Last update February 5, 2024

# The Scientific Publication

Lectures for PhD Students and Young Scientists

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home page http://rubiola.org

# Copyright information

This document

- Is intended for PhD students and guests attending my lectures
- Has no lucrative purpose, teaching is already paid by my monthly salary
- Started as an informal collection of ideas discussed privately with a small number of students
- Evolved in a document for classroom use
- Was later expanded and cleaned up over the years, trying hard to make it suitable for public release
- I am afraid that a small amount of material may have escaped from my attention (appropriate citation or copyright)

Should you spot a problem, please email rather than making a fuss. Fixing immediately is all what I want

# Scientific publication in a nutshell

**Good**

Should be

- Share advances in science
- Submit new ideas to the colleagues' criticism

**Evil**

Also a means to

- Assert supremacy
- Compete for grants
- Take control on open positions
- A lot of time wasted

**… and necessary**

Only a fool *learns* from his own *mistakes*.
The wise man *learns* from the *mistakes* of others
Otto E. L. Fürst "von Bismarck," German Statesman, 1815–1898

# Why worrying that much?

## A wise publication strategy is vital for a researcher

A common ditto says

**Publish or Perish**

- Research costs a lot of money
- Funding depend on your publication record

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- Academic career is highly competitive
- Access and career depend on your publication record

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- Academics obsessed by career and grants
  - Do poor science
  - Have a miserable life

# We will learn about

- All about the peer-review process
- Why articles are published or rejected
- Choice of a journal or of a conference
- Impact factor, and other relevant topics
- Copyright, plagiarism…
- How to communicate scientific ideas in journals, conferences, books…
- Organization of a text
- How to give a talk
- Computer tools
- Academic careers

… and other useful stuff

**We will not learn**
a step-by-step method
to write your article

# Practical information


- Learning material
  - Slides are released as soon as I can
  - Check on my web page http://rubiola.org
- Regularly registered PhD students
  - Obligations (ruled by PhD School, not by me)
  - Attend to all sessions
  - Either, sign the list of attendees (classroom), or show up online
  - Fill the inquiry at the end of the course
- Everybody else is welcome
  - Informal registration to our Doctoral School
  - No obligation to attend all lectures, but you sign on the list of attendee

home page http://rubiola.org

# Other lectures

## A set of 15 lectures on time-and-frequency, instrumentation and metrology

| Part | Lectures | Burden | Content |
|---|---|---|---|
| 1 | 1-5 | 7.5 h | General instruments and experimental methods |
| 2 | 6-10 | 7.5 h | Oscillators, phase noise and frequency stability |
| 4 | 11-15 | 7.5 h | The new International System of Units SI |

**Option A (recommended)**: Part 1-3 (lectures 1-15, 22.5 hours). The secrets of oscillators do not suffice to you without the foundations of the science of measurement. Take both Phase Noise and Frequency Stability in Oscillators from RF/Microwaves to Optics, and Scientific Instruments.

**Option B**: Part 1-2 (lectures 1-10, 15 hours). You want to know the secrets of stable and low-noise oscillators, how they can be measured, and the systems they belong to. Choose Phase Noise and Frequency Stability in Oscillators from RF/Microwaves to Optics.

**Option C**: Part 1 and 3 (lectures 1-5 and 11-15, 15 hours). You are an experimentalist interested in precision measurements, in the subtle meaning of uncertainty, and in the nature of the measurement units we use in all domains of science. Attend Scientific Instruments

# Students of Time-and-Frequency, Optics, and Physics

## European Frequency and Time Seminar

Besançon, July 1-5, 2024

Full week seminar, for PhD students, Engineers and Scientists

Int'l instructors, lectures and labs every day

After approval of your supervisor,
register by e-mailing to frequency-time-seminar@femto-st.fr

http://efts.eu

# Lecture 1

## The Scientific Publication

Lectures for PhD Students and Young Scientists

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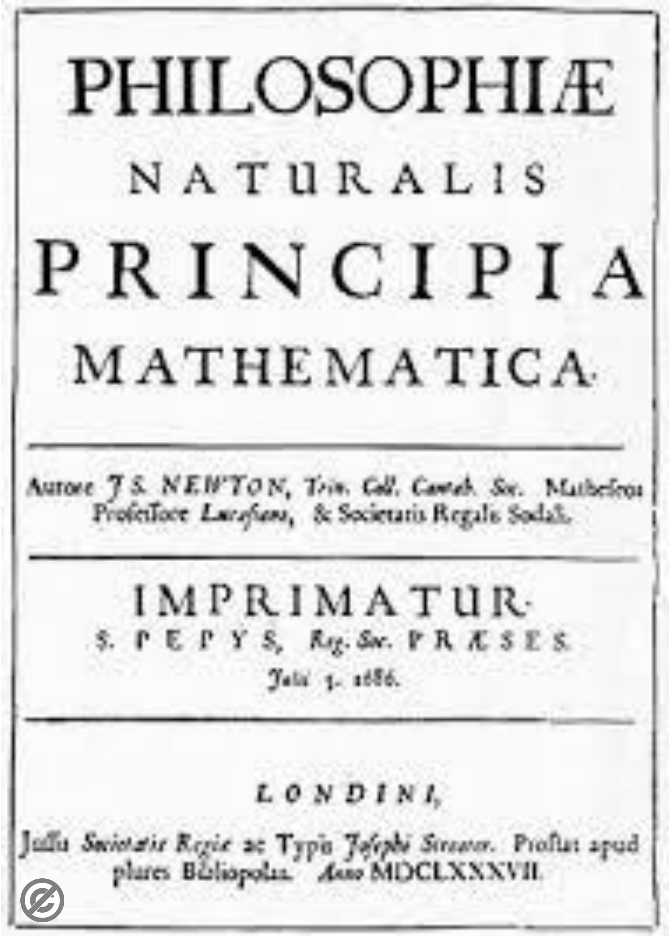
# English Language

This is mainly addressed to French folks

…but the language of scientific disciplines may be a challenge

# A Common language



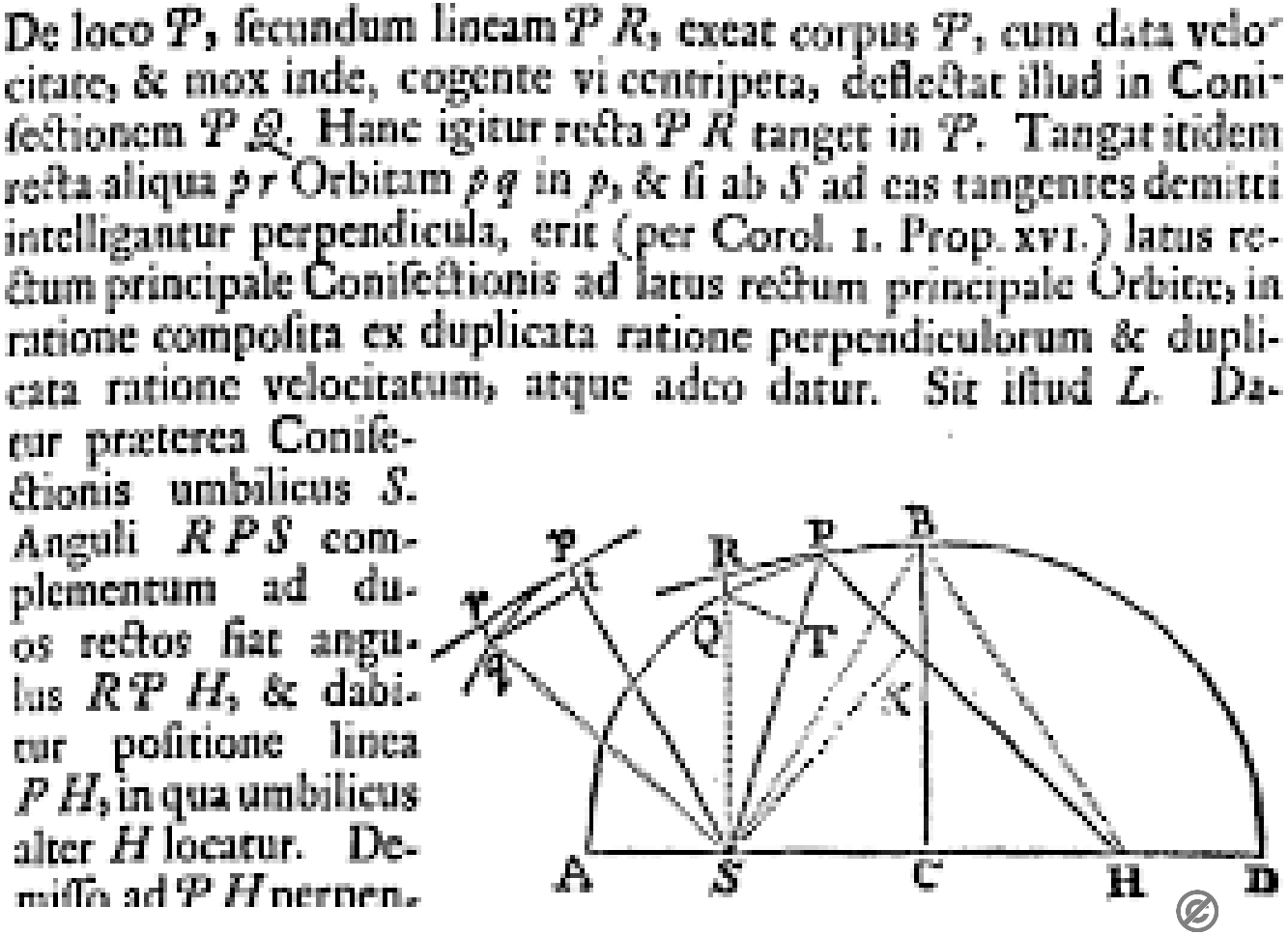


PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA

Autore *J. S. NEWTON*, *Trin. Coll. Cantab. Soc.* Matheseos Professore *Lucasiano*, & Societatis Regalis Sodali.

IMPRIMATUR.
*S. PEPYS*, *Reg. Soc. PRÆSES.*
*Julii 5. 1686.*

*LONDINI*,
*Justu Societatis Regiæ ac Typis Josephi Streater.* Prostat apud plures Bibliopolas. *Anno* MDCLXXXVII.



De loco $P$, secundum lineam $PR$, exeat corpus $P$, cum data velocitate, & mox inde, cogente vi centripeta, deflectat illud in Conisectionem $PQ$. Hanc igitur recta $PR$ tanget in $P$. Tangat itidem recta aliqua $pr$ Orbitam $pq$ in $p$, & si ab $S$ ad eas tangentes demitti intelligantur perpendicula, erit (per Corol. 1. Prop. XVI.) latus rectum principale Conisectionis ad latus rectum principale Orbitæ, in ratione composita ex duplicata ratione perpendiculorum & duplicata ratione velocitatum, atque adeo datur. Sit istud $L$. Datur præterea Conisectionis umbilicus $S$. Anguli $RPS$ complementum ad duos rectos fiat angulus $RPH$, & dabitur positione linea $PH$, in qua umbilicus alter $H$ locatur. Demissa ad $PH$ perpen-

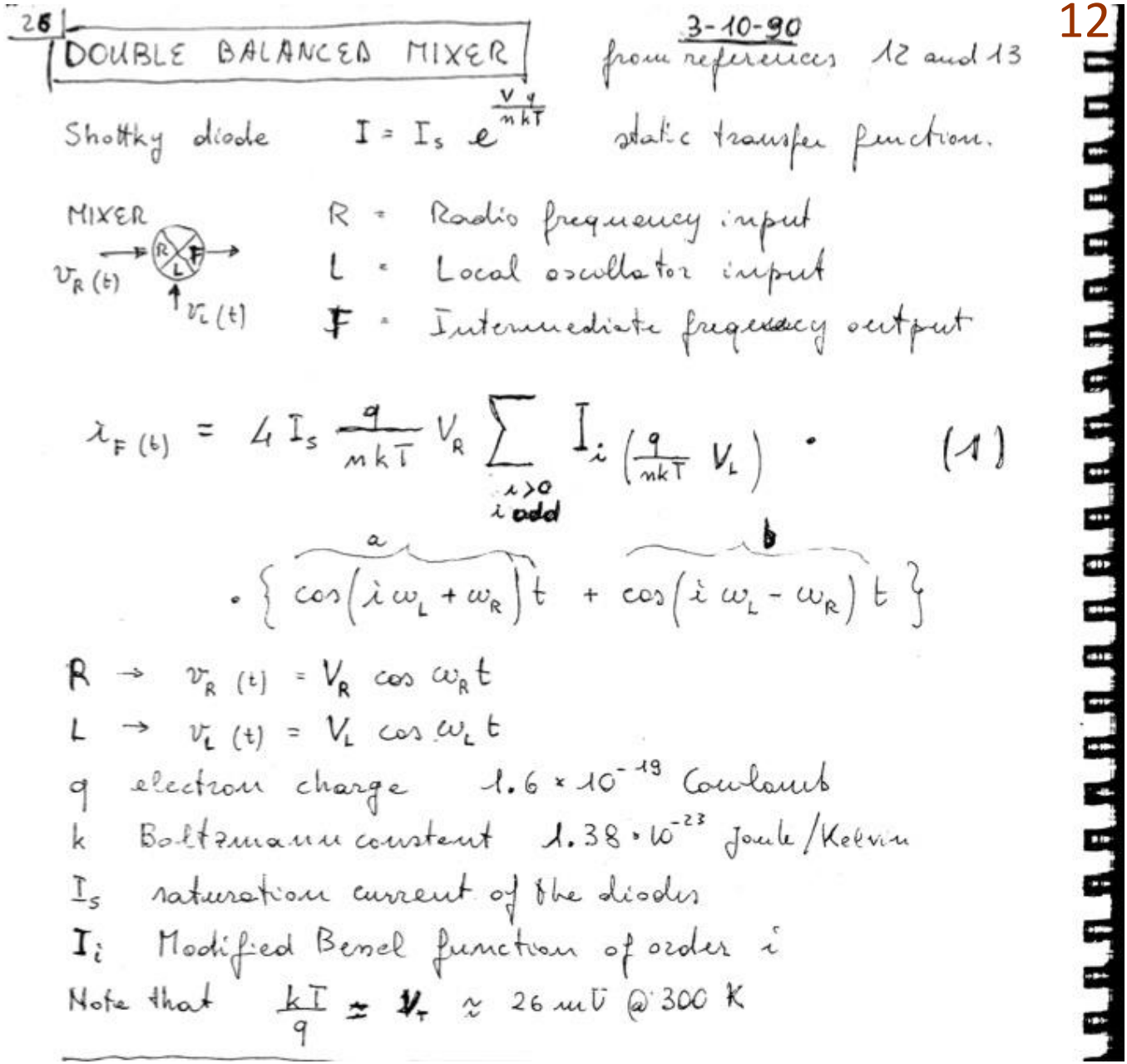


At the time of Newton, Latin was the language generally used for science

Now Latin is gone, and virtually all serious science is in English

# My own standpoint

- Does your idea deserve reading?
  - Yes –> you write it in English
  - Not –> you don't write it at all
    Save your time for better purposes
- We live in the era of globalization
  - Take your notes in English, even when using other languages
  - Write your lab logbook in English
- American English should be preferred to UK English



26 DOUBLE BALANCED MIXER 3-10-90 from references 12 and 13

Shottky diode $I = I_s e^{\frac{V q}{n k T}}$ static transfer function.

MIXER

$v_R(t)$ → R, L, F → $v_L(t)$

R = Radio frequency input
L = Local oscillator input
F = Intermediate frequency output

$$i_F(t) = 4 I_s \frac{q}{nkT} V_R \sum_{\substack{i>0 \\ i\ odd}} I_i\left(\frac{q}{nkT} V_L\right) \cdot \{ \overbrace{\cos(i\omega_L + \omega_R)t}^{a} + \overbrace{\cos(i\omega_L - \omega_R)t}^{b} \} \quad (1)$$

R → $v_R(t) = V_R \cos \omega_R t$

L → $v_L(t) = V_L \cos \omega_L t$

q electron charge $1.6 \times 10^{-19}$ Coulomb

k Boltzmann constant $1.38 \cdot 10^{-23}$ Joule/Kelvin

$I_s$ saturation current of the diodes

$I_i$ Modified Bessel function of order i

Note that $\frac{kT}{q} \simeq V_T \approx 26$ mV @ 300 K

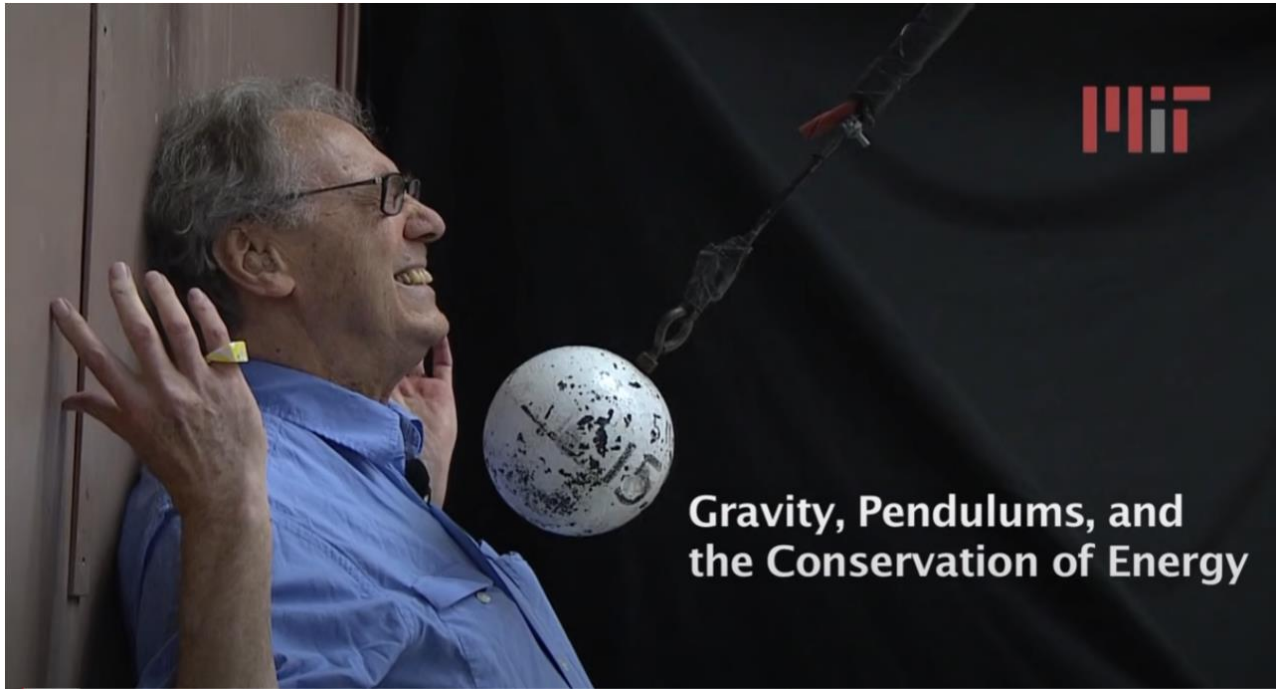
My old notebooks turned out to be useful to some colleagues
This would have been impossible if I wrote in French or in Italian

A page of my lab logbook, October 3, 1990
Italian, spending a sabbatical in France

# Major universities offer free online lectures

However good is your English level,
university lectures may be the best option to learn the vocabulary of a discipline

- Audio recordings and full video
- Different levels, from undergrad to PhD / postdoc
- Different topics
  - Art & Humanities, Biology, Chemistry, Engineering, Genetics, Mathematics, Physics, Psychology,
- Some are really entertaining
- Start MIT and Stanford




Screenshot, Walter Lewin Lecture #1 - Gravity, Pendulums, and the Conservation of Energy
https://www.youtube.com/watch?v=86vsAM1JEkU

My favorite choice is Walter H. G. Lewin
(Formerly on MIT Open Courseware)

Most (all?) of the Walter's lectures are found on YouTube
https://www.youtube.com/channel/UCiEHVhv0SBMpP75JbzJShqw

At the end 2014, Walter was censored by the MIT. I do not know enough to have an independent judgement. But, whatever happened, this sad end does not diminish the value of Walter's lectures

# Improve your English

- Familiar with file-exchange sites and peer-to-peer network? Get e-books related to your domain
  - Physics, mathematics, Chemistry, etc. are available on

    BookFinder, Library Genesis, Sci-Hub, etc.

    …be wary of copyright and DNS
- General literature is available from http://gutenberg.org
  - For fun, take a look the “Visit to the Lagado Academy”, Gulliver’s travels http://www.gutenberg.org/files/829/829-h/829-h.htm
- BBC radio 4 makes available wonderful cultural broadcasts/podcasts

Everybody has a smartphone or a tablet Use it to learn when commuting!

# The Peer-Review Process

# The legacy of Francis Bacon

## Empiricism – or the scientific method

- Early rejection of the medieval Aristotelianism (deductive reasoning)
- Inductive reasoning
- There is no room for hypotheses
- Start from experimental observation
- Gradually generalize a finding based on facts
- Finally, state a physical law

The word “Science” means “Natural Science”

(In a strict sense, mathematics is *not* science)

Francis Bacon, 1561–1626 (painted by Paul van Somer I)
https://commons.wikimedia.org/wiki/File:Somer_Francis_Bacon.jpg


Science –> inventions that give relief to miseries and needs of human life

The Bacon’s empiricism influences the main way in which we communicate scientific results:
the peer-review process

# The peer-review process

## Basic facts

- Unpublished science is useless
- In the era of Internet, we are flooded by untrusted/unverified information
- Academics and scientists build their career on published results
- Vanity and desire of immortality push humans to publish

## Questions

- New?
- Relevant?
- Trusted and correct?

The answer is in the

Peer Review Process

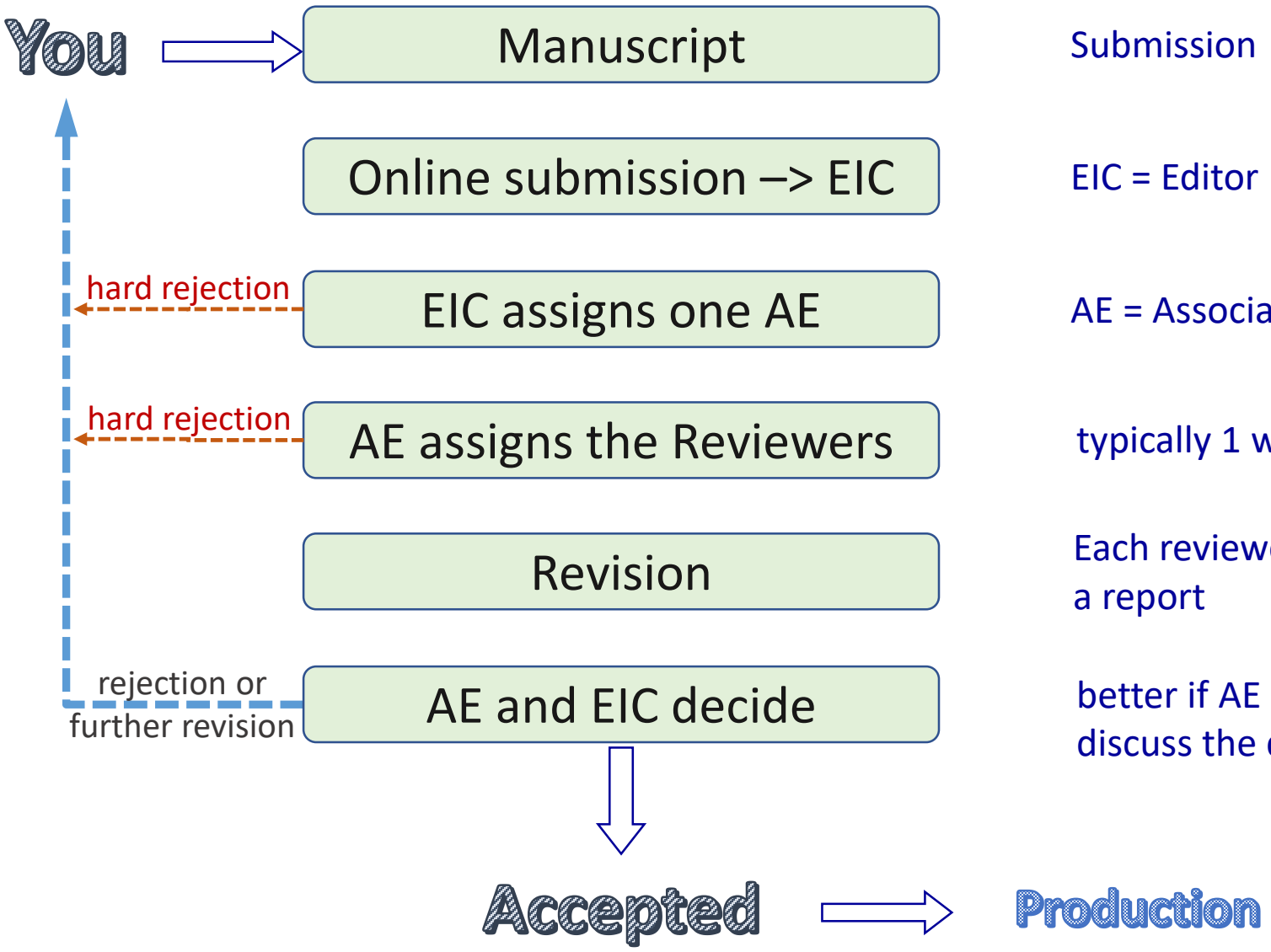
## You

- Submit your work to anonymous evaluators
- Accept the response

## Readers and colleagues

- Trust the peer review process
- And are aware of the rank of the journal
  - Higher rank journals go with tougher review

# Process overview




Submission

EIC = Editor In Chief

Paper submission has gone long ago

AE = Associate Editor

typically 1 week

reviewer, referee, peer are synonymous

Each reviewer sends a report

Blind or double blind?

better if AE and EIC discuss the decision

# How Long Does It Take?

- A general answer is 4–8 months for the full process
  - Strongly dependent on the journal
- The practical minimum is 2–3 months
  1 week for the AE to find the reviewers,
  2 weeks for the reviewer
  1 week for the AE to make the decision
  2 weeks for production
  (and 2 weeks dead time between steps)
- Higher rank journals are generally faster
- A too short time generally goes with a scam
- A too long time may reveal a problem
  - Somebody is trying to steal your work
  - Your work is
    - So boring that nobody wants to take it in charge
    - So difficult that nobody understands it
  - Management problem inside the journal

# ☺ What may happen to a boring text ☺



There can be nothing so gratifying to an author as to arouse the respect and esteem of the reader. Make him laugh and he will think you a trivial fellow, but bore him in the right way and your reputation is assured. There was once a man called Blenkinsop. He had no talent, but he wrote a book in which his earnestness and his sincerity, his thoughtfulness and his integrity were so evident that, although it was quite unreadable, no one could fail to be impressed by it. Reviewers were unable to get through it, but could not but recognise the author's high aim and purity of purpose. They praised it with such an enthusiastic unanimity that all the people who flatter themselves they are in the movement felt bound to have it on their tables. The critic of *The London Mercury* said that he would have liked to have written it himself. This was the highest praise he knew.

W. Somerset Maugham, *The Gentleman in the Parlour*, William Heinmamm, 1930
Excerpt from p.54

# Monte Carlo Average – Empiricism Again!

IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS—I: FUNDAMENTAL THEORY AND APPLICATIONS VOL. 47, NO. 5, MAY 2000 655

## Phase Noise in Oscillators: A Unifying Theory and Numerical Methods for Characterization

Alper Demir, Amit Mehrotra, and Jaijeet Roychowdhury

Manuscript received April 29, 1998; revised August 17, 1999. This paper was recommended by Associate Editor P. Rentrop.

A. Demit and J. Roychowdhury are with the Design Principles Research Department, Bell Laboratories, Lucent Technologies, Murray Hill, NJ 07974 USA.
A. Mehrotra is with the Department of Electrical and Computer Engineering, University of Illinois, Urbana-Champaign, IL 61801 USA.

Publisher Item Identifier S 1057-7122(00)03972-6.



**Slow**

Received: 29 Apr 1998
Revised: 17 Aug 1999
Published: 5 May 2000

**Dazzling fast**

Received: 3 Dec 1986
Accepted: 10 Dec 1986
Published: 2 Mar 1987

Volume 120, number 6 PHYSICS LETTERS A 2 March 1987

## EXPERIMENTAL OBSERVATION OF FUNDAMENTAL MICROWAVE ABSORPTION IN HIGH-QUALITY DIELECTRIC CRYSTALS

V.B. BRAGINSKY, V.S. ILCHENKO
*Department of Physics, Moscow State University, Moscow 119899, USSR*

and

Kh.S. BAGDASSAROV
*Institute of Crystallography, USSR Academy of Sciences, Moscow 117333, USSR*

Received 3 December 1986; accepted for publication 10 December 1986

# Decision Outcomes

- Accept (as it is)
- Further review
  - Minor revision
  - Major
  - Rewrite and resubmit
- Inappropriate journal
- Don’t publish
  - Already known matter
  - Plagiarism
  - Wrong
  - Insufficient
  - Rubbish
  - AI detected

details / do what you are asked is probably the best choice

may be a trick to delay the publication

Sometimes the answer details the reasons

More often, you receive a very polite letter that says nothing

# The Response of the Reviewers

The reviewer is expected to report on the manuscript.
The details vary from journal to journal, around the following issues

## Contents

- Technical / scientific value of the manuscript
- The topic is suitable to the journal
- The general level is sufficient, compared to the journal rank
- The results are trusted / likely to be true
- The results are useful (in a wide sense)
- Bibliography – state of the art, related works, competitors

## Writing

- Quality of English writing
- Clarity of Abstract and Introduction
- Clarity of analysis and conclusion
- Other
- Formulas
- Figures and tables
- Technical terms and symbols

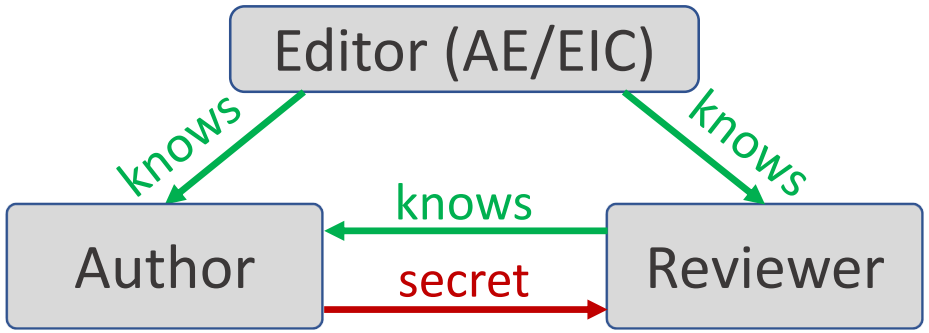
The reviewer is generally allowed/encouraged to join a free-form report on the manuscript.
Not a rule, but if well written it increases the reviewer weight in the decision

# Two-Step Peer Review

- Screening
  - You have to send all your recent articles on the topic
  - Check if the manuscript deserves the long peer review
  - Rapid decision
- In-depth peer review
- Adopted by the most prestigious journals
  - Nature
  - Science
  - …

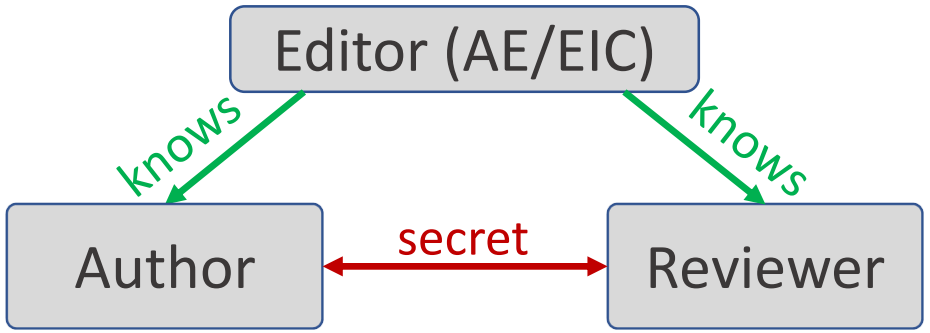
# Blind or double-blind?

## Blind




- Virtually all manuscripts are evaluated in this way

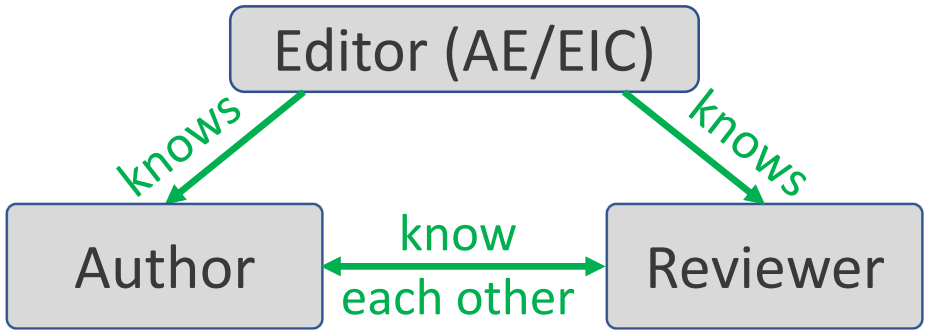
## Double-blind




- Works well in biology/medicine experiments
  - Experimentalist and samples do not now each other
- Unrealistic to evaluate manuscripts
  - Works only with outsiders
  - Otherwise Internet breaks the secret
  - Double-blind is used by some scam journals

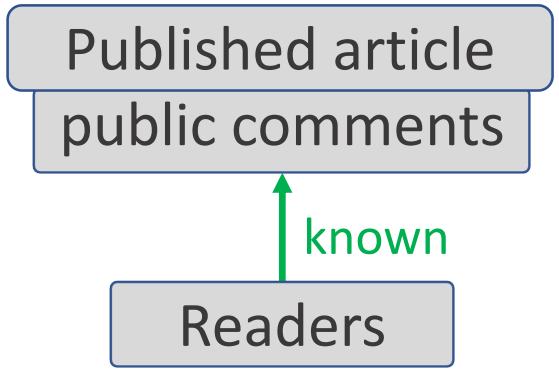
# Alternate models

## No blind




- Collaborative rather than evaluative
- Used long ago by Academies of Science
- Re-proposed by some journals
- My understanding
  - Can only work if preceded by good screening

## Blog-like




- Tool for open criticism

# ORCID

## Open Researcher and Contributor ID

- Unique number that identifies a researcher/author
- Delivered by https://orcid.org,
  - No profit organization
  - Your ORCID is free of charge
- Mandatory for some journals – other just advise do provide
- Can be used to create an account and to sign in
  - Likely, only in science sites
  - Way better than Google andFacebook
- My advice: get yours ASAP

Enrico's ORCID is 0000-0002-5364-1835

# Publons

## What is Publons?

- Track the contribution of reviewers to journals
- Most journals propose to the reviewers
- Commercial website
  - Launched in 2012
  - Acquired by Clarivate in 2017

## Benefits

- Academic recognition
- Career
- Rank

## Problems

- Aggressive commercial approach
- Personal data sharing
- Creates obstacle for young researchers

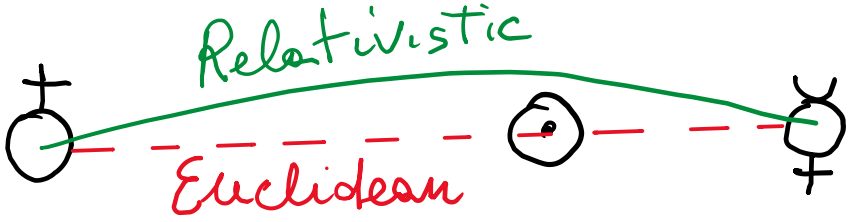
- Now, probably inevitable

# Off-stream Topics

Masterpieces and idiocies are often found here

# Unexplained, well documented facts

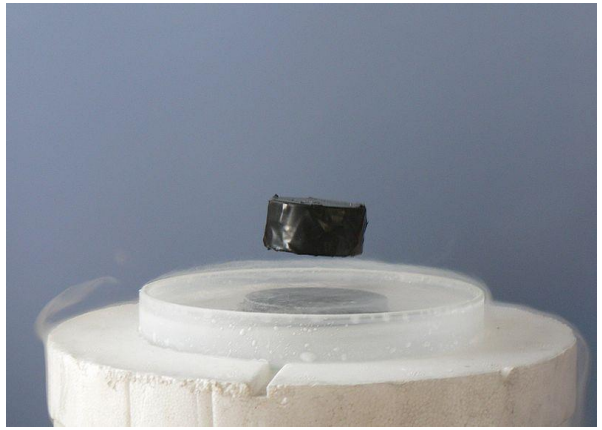
## Astrometry & relativity




- Anomalous precession of Mercury's perihelion discovered by Le Verrier in 1859
- Precursor theory by P. Gerber, 1808
- Explained by the Einstein's General Relativity, 1915

## Superconductivity

- Discovered in 1911 by Heike K. Onnes,
- Complete theory in 1957, Bardeen, Cooper and Schrieffer



Meissner effect



## …the discovery of new laws may follow

# Wrong methods and untrusted results

- Expensive/tough experiment
- Good reason to invest
- …but no or untrusted results!
- What happened?
  - Discover that the method is not applicable
  - Technology not ready
  - Data dispersion
  - Unable to interpret
  - Something goes wrong
- Morally
  - May be quite useful to the community
- In practice
  - Difficult to publish
  - No career reward

Example: gravitational waves. The weber bars, John Weber 1966-67, never worked

B. P. Abbott et al., Observation of Gravitational Waves from a Binary Black Hole Merger, PRL 116(6), 2016

# Fringe research

- The memory of water
- Cold fusion

# A Cultural Provocation


Transgressing the Boundaries: Toward a Transformative Hermeneutics of Quantum Gravity
Author(s): Alan D. Sokal
Source: *Social Text*, No. 46/47, Science Wars (Spring - Summer, 1996), pp. 217-252
Published by: Duke University Press
Stable URL: http://www.jstor.org/stable/466856
Accessed: 31/07/2013 12:40

Later, the author said that this article is a total nonsense, and he did not believe a word of it

# The peer-review process may fail

– The patent review process is similar to the scientific peer review –

## The Howard R. Johnson's *perpetual motor* is awarded 3 patents

Web story on rexresearch.com

United States Patent [19]
Johnson
[11] 4,151,431
[45] Apr. 24, 1979

[54] PERMANENT MAGNET MOTOR

[76] Inventor: Howard R. Johnson, 3300 Mt. Hope Rd., Grass Lake, Mich. 49240

unpaired electron spins in ferro magnetic and other materials as a source of magnetic fields for producing power without any electron flow as occurs in normal

United States Patent [19]
Johnson
[11] Patent Number: 4,877,983
[45] Date of Patent: Oct. 31, 1989

[54] MAGNETIC FORCE GENERATING METHOD AND APPARATUS

[76] Inventor: Howard R. Johnson, Box 199, 314 N. Main, Blacksburg, Va. 24060

[56] References Cited
U.S. PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 4,074,153 | 2/1978 | Baker et al. | 310/12 |
| 4,151,431 | 4/1979 | Johnson | 310/12 |

Primary Examiner—R. Skudy

[21] Appl. No.:

[22] Filed:

[51] Int. Cl.[4] ....
[52] U.S. Cl. ....
[58] Field of Sea

US005402021A

United States Patent [19]
Johnson
[11] Patent Number: 5,402,021
[45] Date of Patent: Mar. 28, 1995

[54] MAGNETIC PROPULSION SYSTEM

[76] Inventor: Howard R. Johnson, 1440 Harding Rd., Blacksburg, Va. 24060

[21] Appl. No.: 64,930

[22] Filed: May 24, 1993

[51] Int. Cl.[6] ..... B65G 35/06; H02K 41/00
[52] U.S. Cl. ..... 310/12; 310/152;

specifically arranged permanent magnets and a magnetic vehicle propelled thereby along a path defined by the permanent magnets. The magnetic vehicle which is to be propelled includes a rigidly attached armature comprising several curved magnets. The propulsion system further includes two parallel walls of permanent magnets arranged so as to define the lateral sides of a vehicle path. Preferably, the walls are identical to one


Science & Mechanics, Spring 1980

# The Peer-Review Process Is not Perfect

Weird examples all around

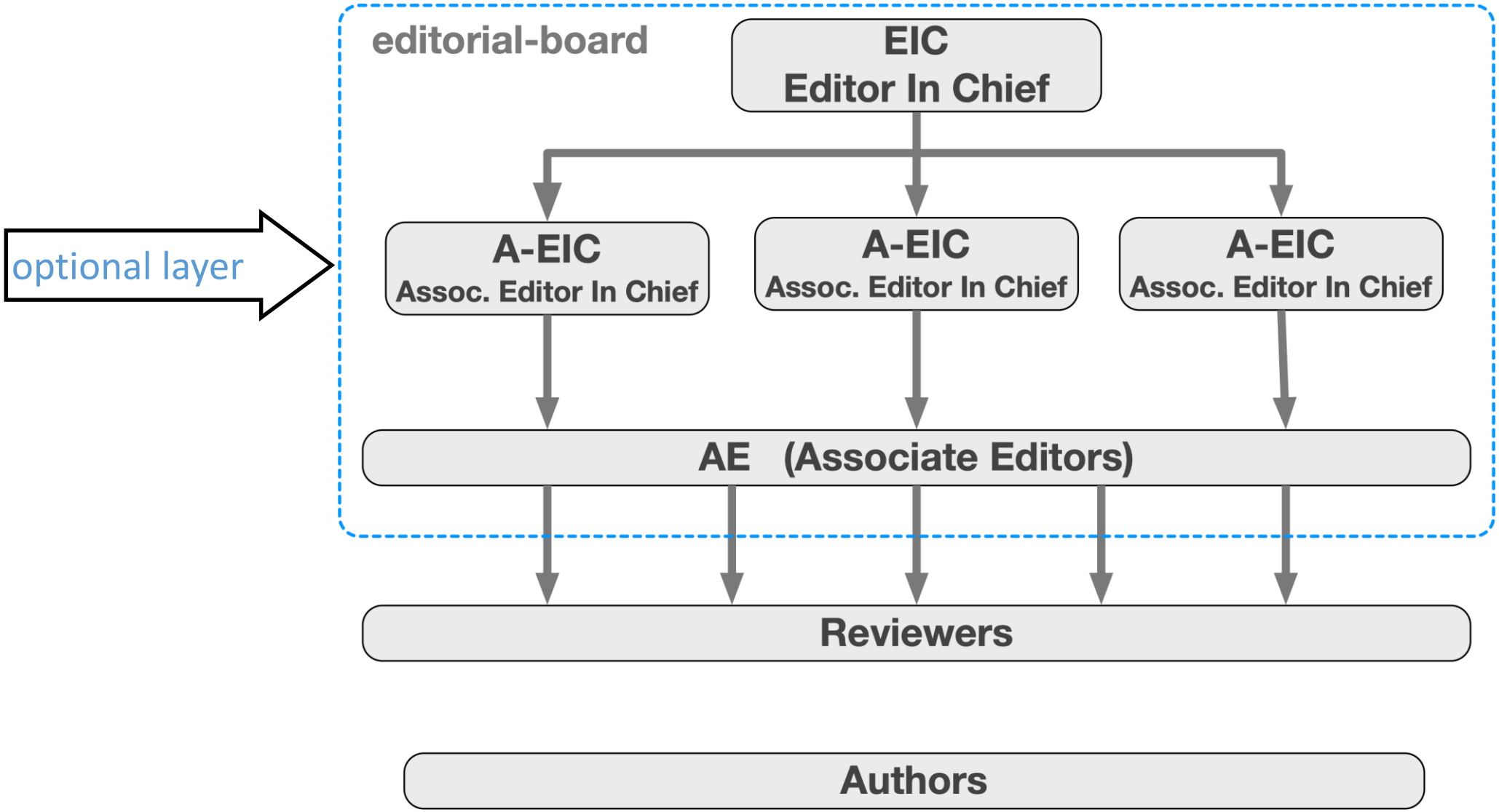
Yet it is the best we have

Just like democracy

# Appendix to
# The Peer-Review Process

You may review this by yourself

# Hierarchic Tree of a Journal (Example)



Inside Front Cover of a Journal

# IEEE ULTRASONICS, FERROELECTRICS, AND FREQUENCY CONTROL SOCIETY

The Ultrasonics, Ferroelectrics, and Frequency Control Society is an organization, within the framework of the IEEE, of members with principal professional interest in ultrasonics, ferroelectrics, and frequency control. The scope of interest of the Society shall include the theory, technology, materials, and applications relating to: (1) the generation, transmission, and detection of mechanical waves and vibrations and their interactions with other phenomena; (2) medical ultrasound, including hyperthermia, bioeffects, tissue characterization and imaging; (3) ferroelectric, piezoelectric, and piezomagnetic materials, including crystals, polycrystalline solids, films, polymers, and composites; (4) frequency control, timing and time distribution, including crystal oscillators and other means of classical frequency control, and atomic, molecular, and laser frequency control standards. Areas of interest range from fundamental studies to the design and/or applications of devices and systems within the general scope defined above. All members of the IEEE are eligible for membership in the Society and will receive this TRANSACTIONS upon payment of the annual Society membership fee of $20.00. Besides receipt of this TRANSACTIONS, an indirect benefit of Society membership stems from the support it provides for the organization and continuance of the Society Symposia. These events are internationally recognized as the foremost forums for the presentation of new research and application results in the field. For information on joining, write to the IEEE at the address below. *Member copies of Transactions/Journals are for personal use only.* Further information about the IEEE and the UFFC Society can be found at http://www.ieee.org and http://www.ieee.org/uffc. The TRANSACTIONS is now available online to all active members via the World Wide Web (WWW). The TRANSACTIONS homepage is located at: http://www.ieee-uffc.org/tr/

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# Vocabulary

- Author
- Manuscript = The draft submitted for publication
- Editor = Big boss, in charge of everything. Has the last words
- Associate Editor = In charge of a manuscript, under the Editor
- Guest Editor → When a journal has a special issue on a topic
- Reviewer / Peer / Referee =
  Anonymous evaluators, for each manuscript

# Du Yourself at Home

## Answer the following

- Who choses
  - Reviewers
  - Editor / AE
- Which are the main qualities of
  - Reviewers
  - Editor / AE
- Are Editor and AE a “better” / “higher-rank” scientists than a reviewer?

## Homework

- Identify at least 3 journals relevant to your PhD (or research) project
- Bring to your mind 2-4 articles you have already read, and you consider important to you.
- Choose one article, and review
  - the organization of the text
  - the typographical layout

  Spend 15-20 minutes

End of Lecture #1

# Lecture 2

## The Scientific Publication

Lectures for PhD Students and Young Scientists

Enrico Rubiola

CNRS FEMTO-ST Institute, Besancon, France

University of (Bourgogne) and Franche Comté, Besancon, France

INRiM, Torino, Italy



ORCID 0000-0002-5364-1835

home page http://rubiola.org

# Advice: Use a To-Do list

- Submission
  - Company clearance?
  - Permissions?
  - Manuscript submission
    - Get info on the  process
    - Check on the typesetting rules
    - Manuscript, Text and Bibliography
    - Figures and Tables
    - Cover letter?
    - At end, sort out the directory
- Revision process
  - Send the revised manuscript
  - Sort out the directory
- Upon acceptance
  - Copyright assignment
  - No-financial-interest form
  - Decide on charges
    - color, over-length, open access…
  - Additional info
- Production
  - Figures/tables artwork
  - Proof editing
  - Pay charges, if any
- Additional burden
  - Everything on your CV now
    - Submitted / Accepted / Printed
  - Company database
    - At FEMTO-ST we have PUBLIWEB
- Get the pdf (and print) ASAP
- Update your home page
- Keep track of everything
  - Be simple and efficient

Nature Vol 613 p. 414, 19 January 2023

nature

You can read the full report (290 p)

M. Nerad et al. (ed), Towards a Global Core Value System in Doctoral Education, ISBN 978-1-80008-018-8, UCL Press 2022

# PhD training is no longer fit for purpose — it needs reform now

**If researchers are to meet society's expectations, their training and mentoring must escape the nineteenth century.**

These days, there's barely a world leader who doesn't talk up science. Prime Minister Narendra Modi was the star turn at the annual Indian Science Congress, held this month in Nagpur, where he exhorted the nation's

**"In most places, a candidate's work is still**

sometimes called a viva voce ('with living voice' in Latin), a nod to its nineteenth-century origins. And in many countries, candidates must publish in a journal before they get a PhD, something that critics say could fuel predatory publishing.

The system's strains have become more obvious because the number of people doing PhD training has been rising sharply. According to the 2022 book *Towards a Global Core Value System in Doctoral Education* – available as an open-access PDF; see go.nature.com/3zihyuk – the number of PhDs awarded in China more than doubled from 23,400 in 2004 to 55,011 in 2016 (and reached around 60,000 in 2019). India's numbers increased from 17,850 in 2004 to 25,095 in 2016; US figures climbed from 48,500 to 69,525 over the same period.

## The doctorate updated

Too often, PhD training is still, at least conceptually, organized as it was after its development in and subsequent export from mid-nineteenth-century Germany. At that time, young scholars were attached to individual

# Types of Articles and Journals

Regular, Short, Letter, Review, Tutorial, etc.

# Types of Journal Article

## Research Report Articles

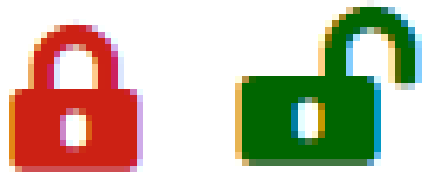
- Article (regular article)
  - Research report, relevant innovation in a domain
- Short (article)
  - Same as regular article, shorter and less important
  - Often at the end of the issue
  - Usual names for short article: Correspondence / Short communication / Note
- Letter
  - Concise research report
  - Claims important results deserving rapid publication
- Review (article)
  - Synthesis / State of the art in a domain
  - Usually long (10–50 pages), often invited
- Tutorial (article)
  - Intended to teach
  - Ideally, simpler and deep content, accessible language
- Invited article
  - Under invitation of the Editor (EIC or AE)
- Editorial
  - Official voice of a journal
- Example: comment on a discovery or an event

# Types of Journals

- Journal (regular journal)
  - Mainly research reports (regular articles)
- Letter Journal
  - Publishes (almost) only letters
  - High rank teams publish almost only in letter journals
- Reviews
  - Publishes (almost) only review articles
- Magazine (not a scientific journal in strict sense)
  - General interest and broad readership
  - Articles decided by the Editorial Board
  - Written by internal staff / freelancers / invited

# Subscription vs Open Access (OA)

Sadly, it is all about money



- Long time ago
  - Readers paid the journals
  - Journals paid the authors
- Subscription journals
  - Charges are paid buy corporate subscribers (universities and labs)
  - Seldom by individuals
- Open Access online journals
  - Article Processing Charges (APC) paid by the authors
  - Potential incomes may bias the peer-review process
  - Publishers put pressure to authors

→ Transformative (publish & read) subscription

- Mixed / My favorite option
  - Open Access option in a subscription journal
  - The OA option is chosen at the end of the peer review process
- OA biases the number of readers

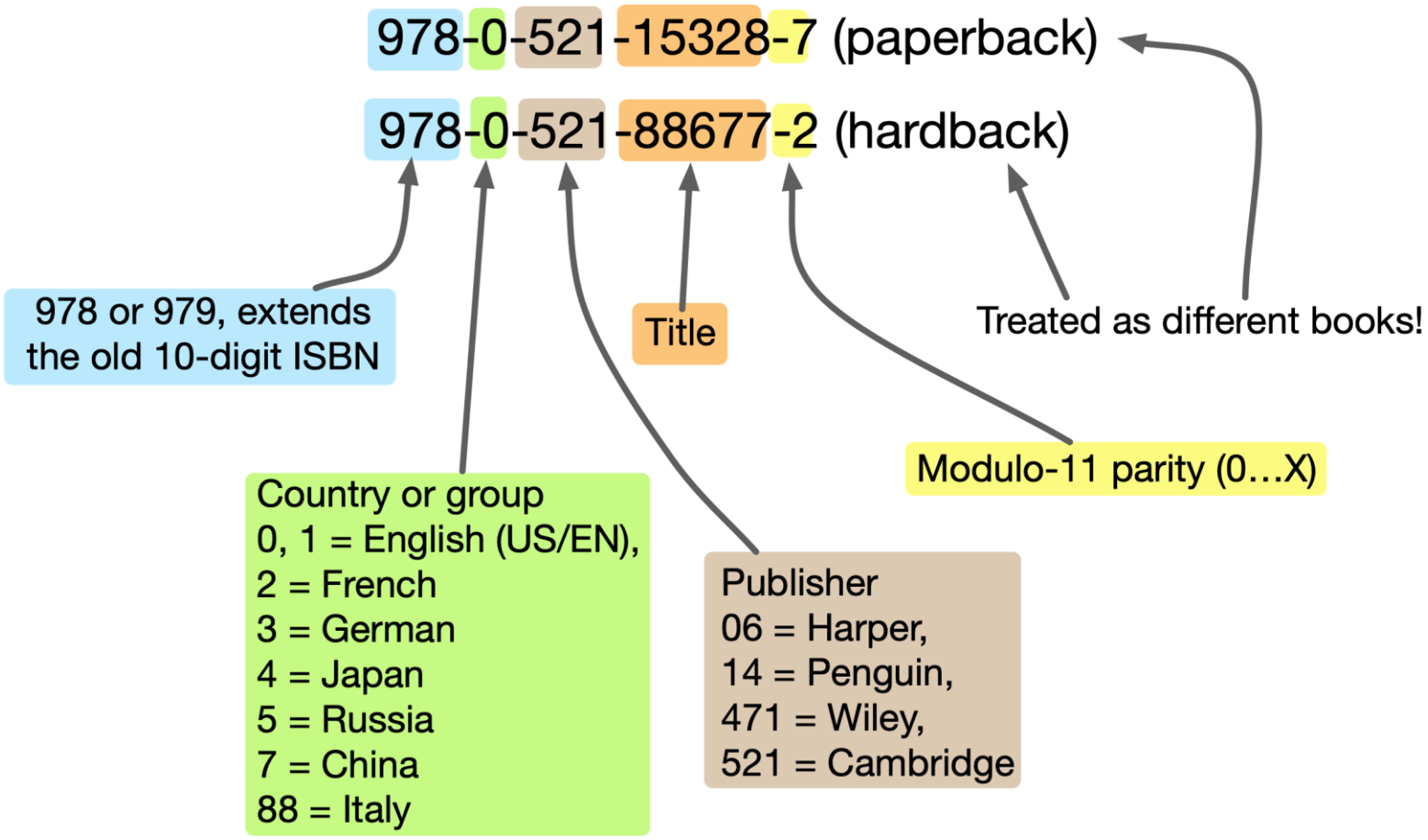
# Publication charges

- For most journals, the cost of publication is payed by the readers
  - Mostly by academic subscriptions
  - Dissuasive cost for single purchases ($ 20–50 per article)
- Open access
  - The cost of publication is payed by the author
  - OA articles in a regular journal
  - OA journal
  - May impact on the peer-review decision
- Generally, no (mandatory) publication charges for the author
  - Volunteer publication charges
    obsolete → open access
- Over-length charges discourage too long articles
  - Some journals opt for a rigid boundary, no exceptions allowed
- Options generating additional charges
  - Color in the printed version (color online is free)
  - Reprints

# Unique “Magic” Numbers

- European Article Number EAN: 13 digit (barcode) numbering system for trading
  - Most commercial items have EAN
  - Great keyword for Internet search
- International Standard Book Number ISBN https://www.isbn-international.org)
  - Unique commercial identifier,
  - 13 digits (10 digits before 2017), for a book
  - Also e-ISBN for ebooks
  - $1 each in bundle of 1000, $100 single
- International Standard Serial Number ISSN (https://issn.org)
  - Unique commercial identifier,
  - 8 digits, for a serial publication (journal, magazine, etc.)
- International Standard Music Number ISMN
- ISBNs, ISSNs etc. should be purchased from the National Agency
  - In France, Agence Francophone pour la Numérotation Internationale du Livre AFNIL
- Library of Congress Card number (USA)
- Digital Object Identifier DOI: persistent unique identifier/handle
  - Most important reference for digital objects
  - https://www.doi.org
- arXiv
- ….

# ISBN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88 = Italy
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14 = Penguin,
471 = Wiley,
521 = Cambridge
Title
Modulo-11 parity (0…X)
Treated as different books!

# Copyright, Licenses, Permissions, etc.

Authorship and Copyright are not the same thing

# Copyright

- Copyright: the exclusive legal right to reproduce, publish, sell, or distribute the matter and form of something (such as a literary, musical, or artistic work) [Merriam Webster Dictionary, https://www.merriam-webster.com, accessed online March 20, 2019].
- Copyright: the exclusive and assignable legal right, given to the originator for a fixed number of years, to print, publish, perform, film, or record literary, artistic, or musical material [Oxford Living Dictionary, https://en.oxforddictionaries.com accessed online March 20, 2019].
- Copyright is quite a technical issue. Meaning and laws depend on Country
- Same applies to research material

Re-using a very small part of a copyrighted object (as I do in this page) for no-profit / education purposes is in most cases ethically sound
Notice the citation: an entry of a dictionary is unambiguous

# Licenses

- All digital objects go with a license (like a computer app)
    - Some electric cars go with a software license too!!!
- A license is a set of permissions and restrictions to the use / reproduction / diffusion / resale of the object
- Most journal/conference articles are copyrighted by the publisher
- In USA and UK, the copyright of the work done by gov employees belongs to the government (Crown copyright, or US Gov copyright)
    - No copyright transfer to a publisher
- Open access is a major trend in research funded by the European Community. Either:
    - The articles are published with open-access license
    - The author/institution retains the license

# The Creative Commons licenses

A major trend in Europe

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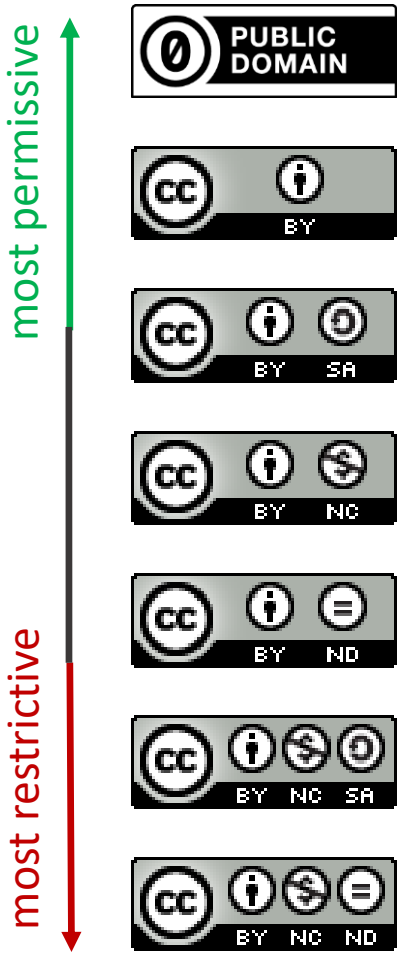


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# More about the ND attribute (simple)

The Book of Paradoxes

S. B. Smart

Be free, under conditions

Henry Jekyll, *Triangles* (p.3.14)

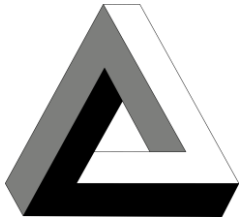

Fig. 2.718: Penrose triangle

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Do not create a new book built upon this

The Book of Nonsenses

Eduard Hyde

Dr Jekill must cite

- At least, the author
- Better, the full book

(read the license)

# More About the ND Attribute (technical)

## Reproducing a small excerpt is no violation of the ND restriction

**Can I reuse an excerpt of a larger work that is licensed with the NoDerivs restriction?**

The NoDerivs licenses (BY-ND and BY-NC-ND) prohibit re-users from creating adaptations. What constitutes an adaptation, otherwise known as a derivative work, varies slightly based on the law of the relevant jurisdiction.

Incorporating an unaltered excerpt from an ND-licensed work into a larger work only creates an adaptation if the larger work can be said to be built upon and derived from the work from which the excerpt was taken. Generally, no derivative work is made of the original from which the excerpt was taken when the excerpt is used to illuminate an idea or provide an example in another larger work. Instead, only the reproduction right of the original copyright holder is being exercised by person reusing the excerpt. All CC licenses grant the right to reproduce a CC-licensed work for noncommercial purposes (at a minimum). For example, a person could make copies of one chapter of an ND-licensed book and not be in violation of the license so long as other conditions of the license are met.

There are exceptions to that general rule, however, when the excerpts are combined with other material in a way that creates some new version of the original from which the excerpt is taken. For example, if a portion of a song was used as part of a new song, that may rise to the level of creating an adaptation of the original song, even though only a portion of it was used and even if that portion was used as-is.

Excerpt from the Creative Commons FAQ, Jan 27, 2021
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Excerpt from Brigitte Vézina, *Why Sharing Academic Publication Under "No Derivatives" licenses is Misguided*, Post on the Creative Commons Blog, April 21, 2020
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Further, our FAQ clarifies that, generally, no derivative work is made of the original from which an excerpt is taken when the portion is used to illustrate an idea or provide an example in another larger work. This is solely an act of *reproduction*, not of *improving* upon the pre-existing work in a way that could create an adaptation in violation of the ND license.

# Copyright transfer

## The author is asked to

- Transfer the copyright to the journal (generally, for free)
- Declare that (s)he has the power of doing it
  (as the copyright owner, or on behalf of his/her employer…)
- Usually, the corresponding author signs on behalf of all authors

## The copyright

- Applies to the form of the article (text and figures)
- Does not apply to the semantic contents

## Exceptions, generally accepted

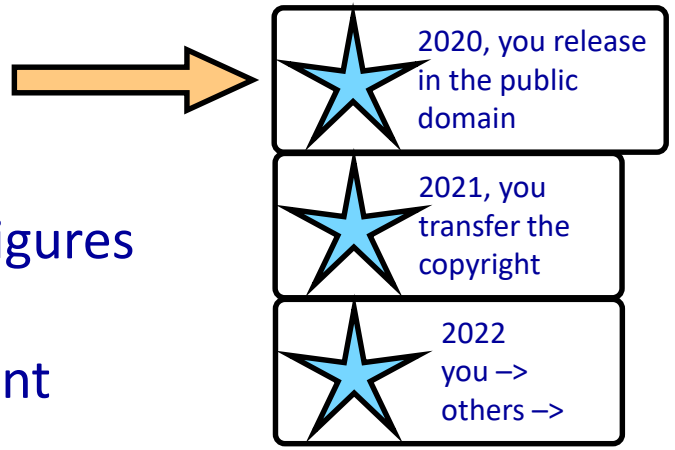
- A work prepared by a US Government officer or employee as part of his/her official duty is US Gov copyright —> free access
- Same for Crown copyright (UK)

Major trend in American style
Every agreement is written and signed by the parties

# Copyright transfer

## Bad news

- Now the journal owns the copyright of your article
- Re-use of your own work is subject to limitations
- Figures may be difficult to manage
- Think about one figure often needed
- Public domain makes the whole thing more confusing




## Policy may mitigate the problem

- For example, you may be allowed to re-use your own figures provided you write “reprinted with permission of…”
- Domains related to art are fussy, science is more tolerant

## Good news

- Managing permissions is simple
- The copyright owner is easy to identify and contact

# Permissions

- Whenever you use copyrighted material, you must have a permission
  - You are in charge of contacting the copyright owner and getting the permission
  - The publisher asks for a written document
- The use copyrighted material occurs
  - Seldom, in (regular) journal articles and conference proceedings
  - Often, in books and review articles
- Sometimes the permission is implied in the copyright policy
  - Your own work
  - Non-profit use
  - Web pages,  etc…
- Often free of charge, except
  - Whenever there is significant money
  - Journals
- The entire process is generally simple and fast
  - Companies: routine, managed quickly and efficiently by pros
  - Publishers
    - Contact the Publisher
    - Online platform, like RightsLink

# RightsLink – Get permissions online

The Copyright Clearance Center (CCC) is a private business that helps with the management of copyright
RightsLink is a subpage of CCC.

- Supports Publishers and Authors to get permissions
- Manly intended for science
- Often the publisher asks the author to get permissions there
- Fast and efficient
- You get permissions for your own material
  (after transferring the copyright to a publisher)
- Small amount, like figures, should be free of charge
- Not sure it is always the case
- The cost depends on item and target project

# Example of permission got via RightLinks

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V1.2

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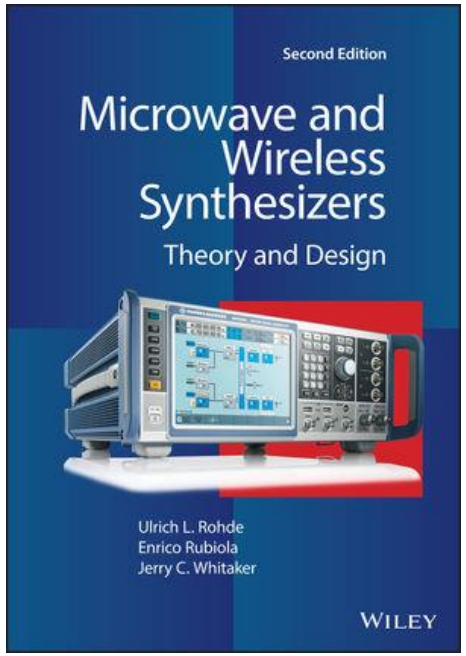
…but I had to pay ≈$35 for a figure published by a close colleague ☹

Target book



# Even old style is smooth and fast

October 4, 2007

I Ask Agilent (now Keysight) the permission to use a figure in my book.

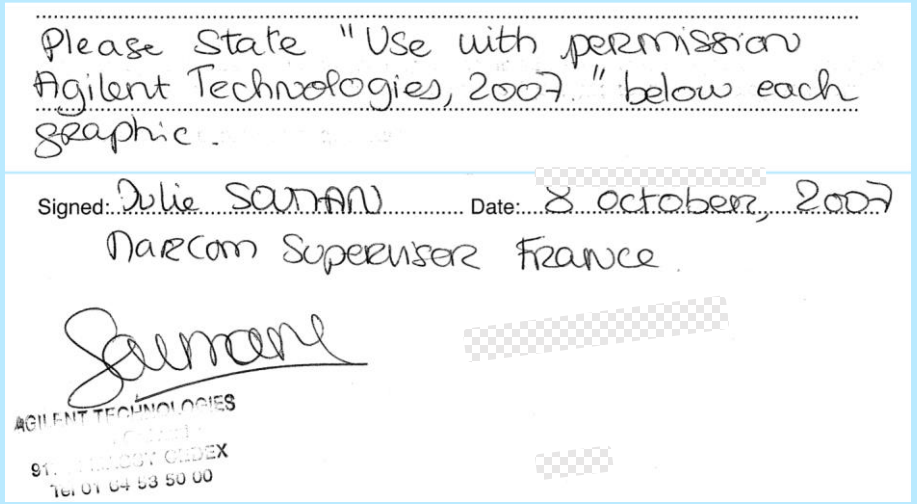
I reverse-engineer a product and print my comments on the figure

My request was processed by the Agilent office in Paris

October 8, 2007

The permission is granted and signed, I receive it next day

For all requests, I used a form proposed by Cambridge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E. Rubiola, Phase noise and frequency stability in oscillators, Cambridge 2008, 2010, 2012, 2014

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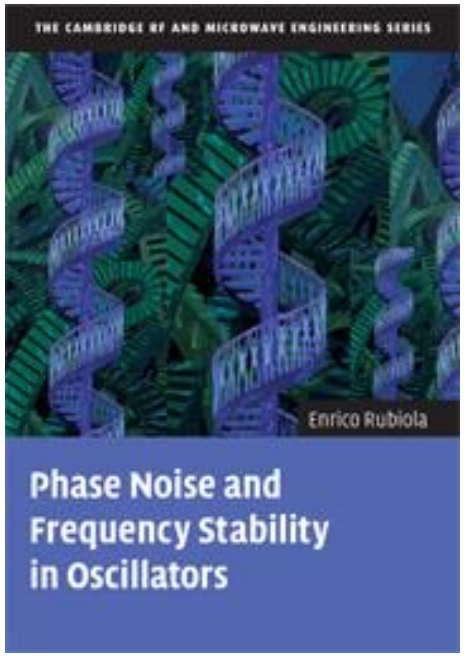

# Copyright advices

- If you got a grant for your research, be aware of the rules
- Read the copyright transfer (carefully, but quickly)
- Keep a copy in your archive
  - Soon or later, you may have to apologize
  - Should this happen, make sure that you know what you are talking about
- Keep all your figures/tables, either
  - Clear directory tree (safest, but cumbersome/difficult)
  - Asset management app (easier but risky)
    - Think 10-20 years ahead
      - Will this app be available?
      - Will you use the same OS?

# "There is no reason for scientists to make an exclusive free copyright transfer of their work to publishers"[66]

## Alain Schuhl

Interview copyed verbatim from https://www.cnrs.fr/en/cnrsinfo/there-no-reason-scientists-make-exclusive-free-copyright-transfer-their-work-publishers

The CNRS encourages its researchers to apply the rights retention strategy when submitting a manuscript to publishers

**What is the rights retention strategy (RRS)?**

**Alain Schuhl**: Scientists own their work, so there is no reason for them to make an exclusive free copyright transfer to a publisher, which denies them the right to reuse their own publications. The rights retention strategy makes it possible for researchers to release the accepted author manuscript (AAM) of their work for immediate open access in an open archive. This also includes AAMs of articles published in subscription journals. This strategy means immediate open access is now possible without paying publication charges—misleadingly known as article processing charges or APCs.

**What is the framework for the application of this strategy?**

**A. S.**: The rights retention strategy is driven and promoted by the members of cOAlition S (including the French National Research Agency - ANR - and Horizon Europe, Europe's research framework program), a consortium of national research agencies and funders that developed Plan S1 . It is mandatory for any project funded as part of the ANR's Action Plan for 2022 and or by Horizon Europe to apply this strategy to all publications in all journals, whether these are subscription, hybrid or full open access journals. The CNRS is calling for the application of this strategy, which goes further than the Law for a Digital Republic on two levels. Firstly, it represents progress in saving time because it removes the embargo period, which can vary from six to twelve months depending on the discipline involved. Secondly, it represents geographical progress, because its international dimension makes it possible to leave behind the purely French framework set by the Law for a Digital Republic.

**How should the rights retention strategy be implemented?**

**A. S.**: It is a simple process. Authors only need to add the 'CC-BY 4.0' reference to their manuscripts along with the URL link describing the CC-BY license they select. When submitting the manuscript, authors should inform the publisher of this and can use model sentences to do so that are provided in the implementation guide published by the Committee for Open Science's Publications College. The last step is to share the manuscript online in an open archive - in this case HAL2 . All these steps need to be repeated for each version of the manuscript right up to the AAM.

**Why is this strategy called 'stratégie de non-cession des droits d'auteur' in French?**

**A. S.**: The English term 'rights retention strategy' was translated into French as 'stratégie de non-cession des droits', literally 'non-transfer of rights strategy'. The exact full wording would need to be: 'strategy of non-exclusive transfer of rights to a publisher'. By putting a CC-BY license on all their manuscripts up to the AAM from the word go, authors can prevent their publication from being completely taken over by a publisher. This is why it is called a 'rights retention' strategy in English because all the rights are not transferred exclusively to a publisher. But putting a CC-BY license on an AAM actually corresponds to a 'strategy to open up the rights' because researchers who do so no longer have to authorise others to translate or disseminate their publications and so on. Moreover, authors will be able to freely re-use their own texts, graphics and other content for teaching purposes or any forms of communication, which is impossible when all the rights are transferred to a publisher.

**What would you say to researchers who are afraid of how their publisher might react?**

**A. S.**: Indeed, publishers' responses to this strategy have been ambiguous. Either they have redirected authors applying this strategy to another journal which has a required publication fee or they have demanded that researchers remove their AAM from the open archive where they deposited it (which is impossible) among other attempts to confuse scientists. If you are faced with this kind of situation, cOAlition S invites you to change journals and at least 'name and shame' those concerned.Que reste-t-il à accomplir pour la science ouverte ?

**What still needs to be achieved in terms of open science?**

**A. S.**: By advocating the implementation of the rights retention strategy, our aim is to facilitate the development of immediate open access to accepted author manuscripts. The next step is to develop immediate open access to 'versions of record' (VoR) or 'publisher-edited PDFs'. Therefore, we still need to continue working on the development of the so-called 'diamond' scientific publishing in all disciplines. This enables immediate open access publishing without requiring the payment of an APC. This form of publishing can only exist on a long-term basis with the support of public institutions. Until it becomes generalized, the CNRS's message is clear: authors should opt for subscription journals, avoid paying APCs, apply the rights retention strategy and above all should deposit their author- accepted manuscripts on HAL.

# Plagiarism

Plagiarism and copyright infringement are not the same thing

# Plagiarism

- Definition:
  the use of somebody else's material (ideas, results, or just text and figures) without mentioning clearly author/source.
- One of the worst sins a researcher may commit
  (the sin of fake results is worse)
- Consequences
  - Ethical —> ban from a community or institution (likely)
  - Legal —> being sued (seldom)
- Accusation *may break a career*, even if innocence is proved

# Self plagiarism

- Self plagiarism is the reuse of one's own material already published (without proper citation)
  - Improper term, applies also to properly cited material
  - Increases the number of publications without producing science
  - Somewhat inevitable under the pressure of modern world
  - There are rules for the amount of reuse
- Reuse often allowed/encouraged
  - Publish parts of your own PhD thesis (may be mandatory)
  - Conference abstracts (Bok of abstracts, only for participants)
  - Invited conference

# Plagiarism detection

- Computers used to detect have
  - No common sense
  - No knowledge of laws
- Humans make decisions
- A recent lucrative service
- Routinely used in universities to check on home assignments
- Spreading in journals and conferences
  - Pressure to spend money
    - On journals, to keep the level high
    - On authors, check your manuscript before submitting

# Phase-Noise and Amplitude-Noise Measurement of DACs and DDSs

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***Abstract*—This article proposes a method for the measurement of Phase Noise (PN) and Amplitude Noise (AN) of Digital-to-Analog Converters and Direct Digital Synthesizers. The main virtues of our method are (1) owing to RF amplification of the noise sidebands, the noise specs of the PN analyzer are relaxed by a factor of at least 20 dB, with respect to the noise of the device under test, and (2) the capability to measure AN using a phase noise analyzer, with no need for the analyzer to feature AN measurements. An obvious variant enables the same measurements using only an AN analyzer (i.e., a power-detector diode followed by a FFT analyzer), with no need for PN measurement capability. Exploiting the device-under-test's internal amplitude and phase control, there is no need for external line stretcher and variable attenuators. In one case (AD9144), we observed a flicker PN on 8 decades of frequency, with a discrepancy within ±1 dB with respect to the exact $1/f$ slope over 7 decades.**

**This summary is an early draft of a larger article that will be submit for the 2019 IFCS Special Issue of the IEEE Transact. on UFFC.**

## I. Introduction

As a matter of fact, in virtually all domains of RF technology there is a major effort to replace traditional RF circuits with digital electronics. Because input and output remain analog, the noise at the interface between analog and digital is a limiting factor. In this context, we focus on the amplitude noise (AN) and on the phase noise (PN) of Digital-to-Analog Converters (DAC) and Direct Digital Synthesizers (DDS). This is crucial in all domains relying on the availability of spectrally pure sinusoidal signals.

Going through numerous data sheets of DACs and DDSs, we see that PN is generally documented only through examples. There is no scaling rule to predict the PN at different amplitude and frequency, and it often difficult to divide the device's PN from the contribution of the reference oscillator and of the phase noise analyzer. Furthermore, we have never seen the AN documented in DAC and DDS data sheets.

Interestingly, modern high-speed telecom-oriented DACs have an internal NCO, which makes them very similar to the DDS. Thus we refer to the DAC, implying that same measurements can be also done on a DDS.

Our method derives from [1], with the addition of a RF amplifier to amplify the noise sidebands after attenuating or suppressing the carrier. However, instead of seeking for the maximum carrier rejection as in [2], [3], we leave a controlled amount of carrier, as proposed in [4]. Depending on the phase relationships between input carrier and residual carrier, there results AN and PN amplification, or AN/PN and PN/AN conversion and amplification. The output signal is suitable to the measurement with all-digital PN analyzers [5], [6], or with a simple amplitude-noise measurement scheme [7].

## II. Method

This article proposes a method to measure AN and PN of DACs using a phase noise analyzer, with no need for the analyzer to feature AN measurement. The method is shown on Fig. 1.

Let $V_1 = V_0 e^{\alpha_1 + j\varphi_1}$ and $V_2 = V_0 e^{\alpha_2 + j\varphi_2}$ the two DAC outputs in complex-vector notation. First, we adjust the phases of the two DACs for the outputs to be equal and opposite, but for a small amplitude factor $\pm\eta/2$. The signals at the output of the coupler are

$$V_\Delta = \frac{1}{\sqrt{2}}\left[V_2\left(1+\frac{\eta}{2}\right) - V_1\left(1-\frac{\eta}{2}\right)\right] \quad (1)$$

$$V_\Sigma = \frac{1}{\sqrt{2}}\left[V_2\left(1+\frac{\eta}{2}\right) + V_1\left(1-\frac{\eta}{2}\right)\right] \quad (2)$$

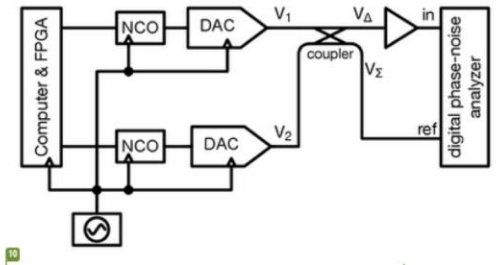


Fig. 1. Block diagram of the method for the measurement of AN and PN of DACs and DDSs.

Manuscript 248 submitted to 2019 Joint Conference of the IEEE International Frequency Control Symposium and European Frequency and Time Forum (IFCS-EFTF 2019). Received December 7, 2018.



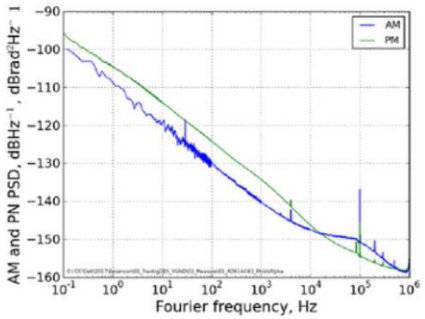


Fig. 2. Example of AM and PM measurement (two sections of a AD9144 at 125 MHz output frequency, 1 GSa/s sampling frequency). Take away 3 dB for the noise of one DAC.

It can be proved that, for small $\alpha_1$, $\alpha_2$, $\varphi_1$, $\varphi_2$ and $\eta$, the power spectral density $S_\psi(f)$ of the phase fluctuation $\psi$ at the $\Delta$ output, versus the $\Sigma$ output taken as the reference, is

$$S_\psi(f) = \frac{1}{\eta^2}\left[S_{\varphi 2}(f) + S_{\varphi 1}(f)\right] \quad (3)$$

Similarly, setting the two signals equal and opposite, but for a small angle $\theta$, so that the residual carrier is in quadrature with the inputs

$$V_\Delta = -\frac{j}{\sqrt{2}}\left(V_2 e^{j\theta/2} - V_1 e^{-j\theta/2}\right) \quad (4)$$

for small $\alpha_1$, $\alpha_2$, $\varphi_1$, $\varphi_2$ and $\theta$, it holds that

$$S_\psi(f) = \frac{1}{\theta^2}\left[S_{\alpha 2}(f) + S_{\alpha 1}(f)\right] \quad (5)$$

PN amplification (AN-to-PN conversion and amplification) is inherent in the method. It relaxes the noise specs of the PN analyzer by a factor of $1/\eta$ (or $1/\theta$), which is of 20–30 dB, with respect to the noise of the device under test.

## III. Experiments and Results

Using the scheme of Figure 1, we compare two sections of an AD9144, each consisting of a NCO and a DAC (two unused DACs remain, one per NCO). To this extent, the experiment is equivalent to comparing two independent DDSs. The 'Computer & FPGA' block is a ZC706 board, which sends data via a JESD204B interface. The speed is needed only for the amplitude, phase and frequency are static and set once. The phase-noise analyzer is a Microsemi 5125A.

The DAC output is +2 dBm at 125 MHz, sampled at 1 GSa/s. Each DAC is followed by a 250 MHz low pass filter. The directional coupler is based on a transformer network, like most off similar devices in the HF-VHF bands.

The amplifier has a gain of 40 dB, a noise figure of about 3 dB, and a bandwidth of 1.5 GHz. We set the two outputs as described, with a carrier suppression of 30 dB. Values between 20 dB and 40 dB give the same results, but require to change the amplifier gain in order to match the 5125A's input range.

Figure 2 shows the results. The flicker phase noise is of $-104$ dBrad$^2$/Hz extrapolated to 1 Hz, fitting the $1/f$ model from 1 Hz to 2 kHz. The flicker amplitude noise is of $-110$ dBrad$^2$/Hz extrapolated to 1 Hz, fitting the $1/f$ model from 1 Hz to 10 kHz. All values are for two converters, thus the noise contribution of each DAC is 3 dB lower. There is a possible interaction between AM and PM noise in the region between 10 kHz and 1 MHz, under investigation. The white noise floor is not clearly visble on Fig. 2, but we can infer a value close to $-160$ dB1/Hz for both AM and PM.

## IV. Acknowledgments

This work is partially funded by the ANR "Programme d'Investissement d'Avenir" (PIA) under the Oscillator IMP project and First-TF network, and by grants from the Région Bourgogne Franche-Comté intended to support the PIA.

## References

[1] K. H. Sann, "The measurement of near-carrier noise in microwave amplifiers," *IEEE Trans. Microw. Theory Tech.*, vol. 9, pp. 761–766, Sep. 1968.
[2] E. N. Ivanov, M. E. Tobar, and R. A. Woode, "Microwave interferometry: Application to precision measurements and noise reduction techniques," *IEEE Trans. Ultras. Ferroelec. Freq. Contr.*, vol. 45, no. 11, pp. 1526–1535, Nov. 1998.
[3] E. Rubiola, V. Giordano, and J. Groslambert, "Very high frequency and microwave interferometric PM and AM noise measurements," *Rev. Sci. Instrum.*, vol. 70, no. 1, pp. 220–225, Jan. 1999.
[4] F. L. Walls, "Suppressed carrier pm and am noise measurement techniques," in *Proc. Int'l Freq. Control Symp.*, 1997, pp. 485–492.
[5] G. Feldhaus and A. Roth, "A 1 MHz to 50 GHz direct down-conversion phase noise analyzer with cross-correlation," in *Proc. Europ. Freq. Time Forum*, 2016.
[6] J. Grove, J. Hein, J. Retta, P. Schweiger, W. Solbrig, and S. R. Stein, "Direct-digital phase-noise measurement," in *Proc. Int'l Freq. Control Symp.*, Montreal, Quebec, Canada, Aug. 23-27, 2004, pp. 287–291.
[7] E. Rubiola, "The measurement of AM noise of oscillators," arXiv:physics/0512082, Dec. 2005.

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- Time wasted in answering
- Kind of “police” keeps the world safe
  - The system is new, and too zealous
  - Computers do well the first part of the job
  - Humans needed
- Ethics/moral is not the same across cultures

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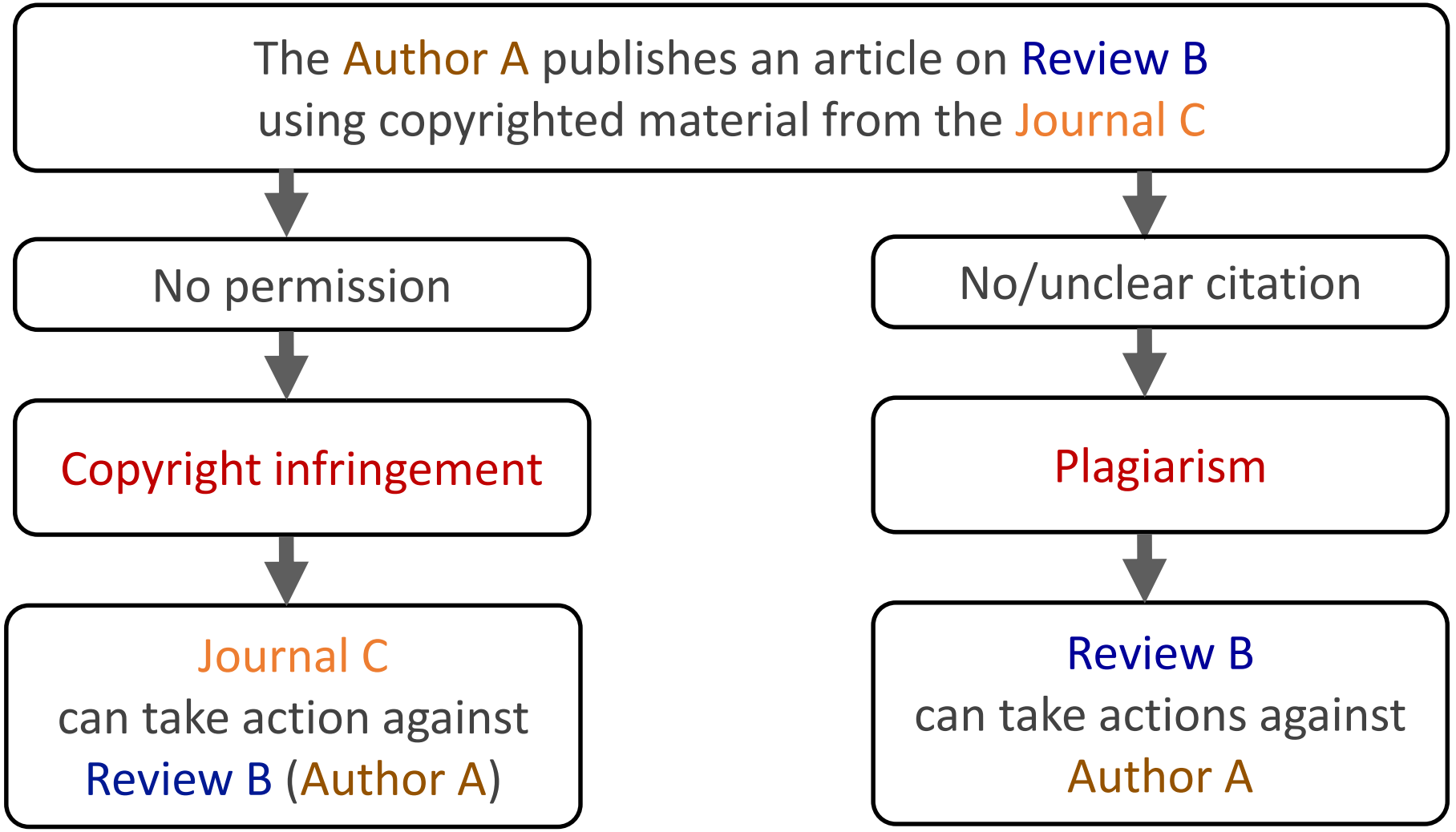
Two totally different immoral/illegal practices



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- Simple-minded people can claim ignorance, not PhD graduates

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# Repositories and Databases

No peer review, free and very fast

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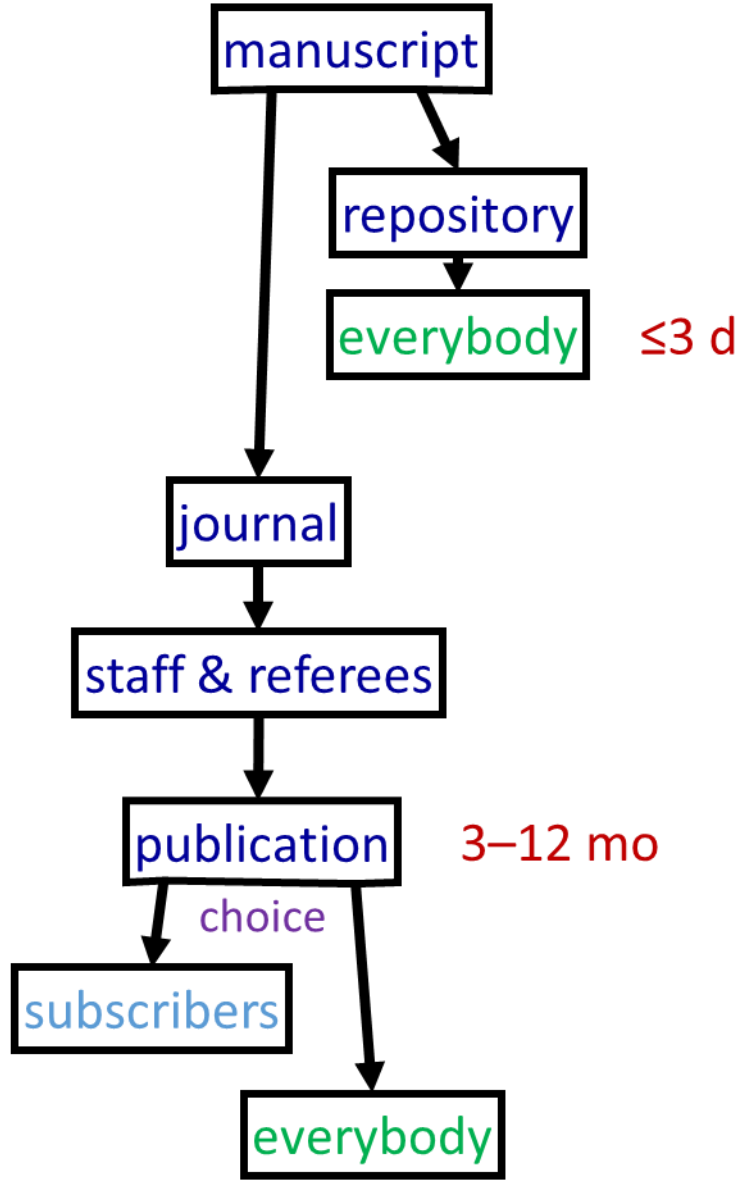

# arXiv.org

The letter X replaces the Greek letter χ

- Started in 1991 by Paul Ginsparg
  - Originally hosted at the Los Alamos National Laboratory (LANL)
  - Moved to Cornell University in 2001 (when Ginsparg moved)
- Scope
  - Originally a repository for preprints in high-energy physics
  - Later, astronomy, mathematics, computer science, nonlinear science, quantitative biology, statistics
- Open-access repository, as opposed to peer-review journal
- Generally used for worldwide access before publication in journals
  - Some very influential articles never published on journals
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  - Some journals accept the arXiv preprint as the manuscript
- Instant public availability
  - Generally, 2 days
  - Additional delay in weekends/holidays, or when endorsement is needed

- Moderators and endorsement process
- After two posts in a domain, you no longer need endorsement
- One author posts, the other claim co-ownership
- Mostly public domain or share alike license

# arXiv, moderation and endorsement

- At the beginning, arXiv had no restrictions
- Moderation was gradually introduced
- Prevent
  - Flooding
  - Inappropriate contents
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    - political/religious propaganda
    - etc.
- Articles need endorsement
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    - 5-10 min check
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    - known in person,
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Physics > Instrumentation and Detectors

[Submitted on 22 Dec 2019 (v1), last revised 25 Mar 2020 (this version, v3)]

# Artifacts and Errors in Cross-Spectrum Phase Noise Measurements

Yannick Gruson, Adrian Rus, Ulrich L. Rohde, Alexander Roth, Enrico Rubiola

This article deals with the erratic and inconsistent phase-noise spectra often seen in low-noise oscillators, whose floor is of the order of $-180$ dBc/Hz or less. Such oscillators are generally measured with two-channel instruments based on averaging two simultaneous and statistically independent measures. Our new method consists of inserting a dissipative attenuator between the oscillator under test and the phase-noise analyzer. The thermal noise of the attenuator introduces a controlled amount of phase noise. We compare the phase noise floor to the theoretical expectation with different values of the attenuation in small steps. The analysis reveals a negative bias (underestimation of phase noise) due to the thermal energy of the internal power splitter at the instrument input, and an uncertainty due to crosstalk between the two channels. In not-so-rare unfortunate cases, the bias results in a negative phase-noise spectrum, which is an obvious nonsense. Similar results are observed separately in three labs with instruments from the two major brands. We give experimental evidence, full theory, and suggestions to mitigate the problem. Our multiple-attenuators method provides quantitative information about the correlation phenomena inside the instrument.

Comments: 24 pages, 10 figures, 1 table, 38 references

Subjects: **Instrumentation and Detectors (physics.ins-det)**

Cite as: arXiv:1912.10449 **[physics.ins-det]**

(or arXiv:1912.10449v3 **[physics.ins-det]** for this version)

https://doi.org/10.48550/arXiv.1912.10449 DOI of the arXiv version

Journal reference: Metrologia 57(5) 055010, August 2020

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# A lot of fundamental science is on arXiv





## Measurement of the neutrino velocity with the OPERA detector in the CNGS beam

T. Adam[a], N. Agafonova[b], A. Aleksandrov[c,1], O. Altinok[d], P. Alvarez Sanchez[e], S. Aoki[f], A. Ariga[g], T. Ariga[g], D. Autiero[h], A. Badertscher[i], A. Ben Dhahbi[g], A. Bertolin[j], C. Bozza[k], T. Brugière[h], F. Brunet[l], G. Brunetti[h,m,2], S. Buontempo[c], F. Cavanna[n], A. Cazes[h], L. Chaussard[h], M. Chernyavskiy[o], V. Chiarella[p], A. Chukanov[q], G. Colosimo[r], M. Crespi[r], N. D'Ambrosio[s], Y. Déclais[h], P. del Amo Sanchez[l], G. De Lellis[t,c], M. De Serio[u], F. Di Capua[c], F. Cavanna[p], A. Di Crescenzo[t,c], D. Di Ferdinando[v], N. Di Marco[s], S. Dmitrievsky[q], M. Dracos[a], D. Duchesneau[l], S. Dusini[j], J. Ebert[w], I. Eftimiopolous[e], O. Egorov[x], A. Ereditato[g], L.S. Esposito[i], J. Favier[l], T. Ferber[w], R.A. Fini[u], T. Fukuda[y], A. Garfagnini[z,j], G. Giacomelli[m,v], C. Girerd[h], M. Giorgini[m,v,3], M. Giovannozzi[e], J. Goldberg[aa], C. Göllnitz[w], L. Goncharova[o], Y. Gornushkin[q], G. Grella[k], F. Grianti[ab,p], E. Gschewentner[e], C. Guerin[h], A.M. Guler[d], C. Gustavino[ac], K. Hamada[ad], T. Hara[f], M. Hierholzer[w], A. Hollnagel[w], M. Ieva[u], H. Ishida[y], K. Ishiguro[ad], K. Jakovcic[ae], C. Jollet[a], M. Jones[e], F. Juget[g], M. Kamiscioglu[d], J. Kawada[g], S.H. Kim[af,4], M. Kimura[y], N. Kitagawa[ad], B. Klicek[ae], J. Knuesel[g], K. Kodama[ag], M. Komatsu[ad], U. Kose[j], I. Kreslo[g], C. Lazzaro[i], J. Lenkeit[w], A. Ljubicic[ae], A. Longhin[p], A. Malgin[b], G. Mandrioli[v], J. Marteau[h], T. Matsuo[y], N. Mauri[p], A. Mazzoni[r], E. Medinaceli[z,j], F. Meisel[g], A. Meregaglia[a], P. Migliozzi[c], S. Mikado[y], D. Missiaen[e], K. Morishima[ad], U. Moser[g], M.T. Muciaccia[ah,u], N. Naganawa[ad], T. Naka[ad], M. Nakamura[ad], T. Nakano[ad], Y. Nakatsuka[ad], D. Naumov[q], V. Nikitina[ai], S. Ogawa[y], N. Okateva[o], A. Olchevsky[s], O. Palamara[s], A. Paoloni[p], B.D. Park[af,5], I.G. Park[af], A. Pastore[ag,u], L. Patrizii[v], E. Pennacchio[h], H. Pessard[l], C. Pistillo[g], N. Polukhina[o], M. Pozzato[m,v], K. Pretzl[g], F. Pupilli[s], R. Rescigno[k], T. Roganova[ai], H. Rokujo[f], G. Rosa[aj,ac], I. Rostovtseva[x], A. Rubbia[i], A. Russo[c], O. Sato[ad], Y. Sato[ak], A. Schembri[s], J. Schuler[a], L. Scotto Lavina[g,6], J. Serrano[e], A. Sheshukov[q], H. Shibuya[y], G. Shoziyoev[ai], S. Simone[ah,u], M. Sioli[m,v], C. Sirignano[s], G. Sirri[v], J.S. Song[af], M. Spinetti[p], N. Starkov[o], M. Stellacci[k], M. Stipcevic[ae], T. Strauss[g], P. Strolin[t,c], S. Takahashi[f], M. Tenti[m,v,h], F. Terranova[p], I. Tezuka[ak], V. Tioukov[c], P. Tolun[d], T. Tran[h], S. Tufanli[g], P. Vilain[al], M. Vladimirov[o], L. Votano[p], J.-L. Vuilleumier[g], G. Wilquet[al], B. Wonsak[w], J. Wurtz[a], C.S. Yoon[af], J. Yoshida[ad], Y. Zaitsev[x], S. Zemskova[q], A. Zghiche[l]

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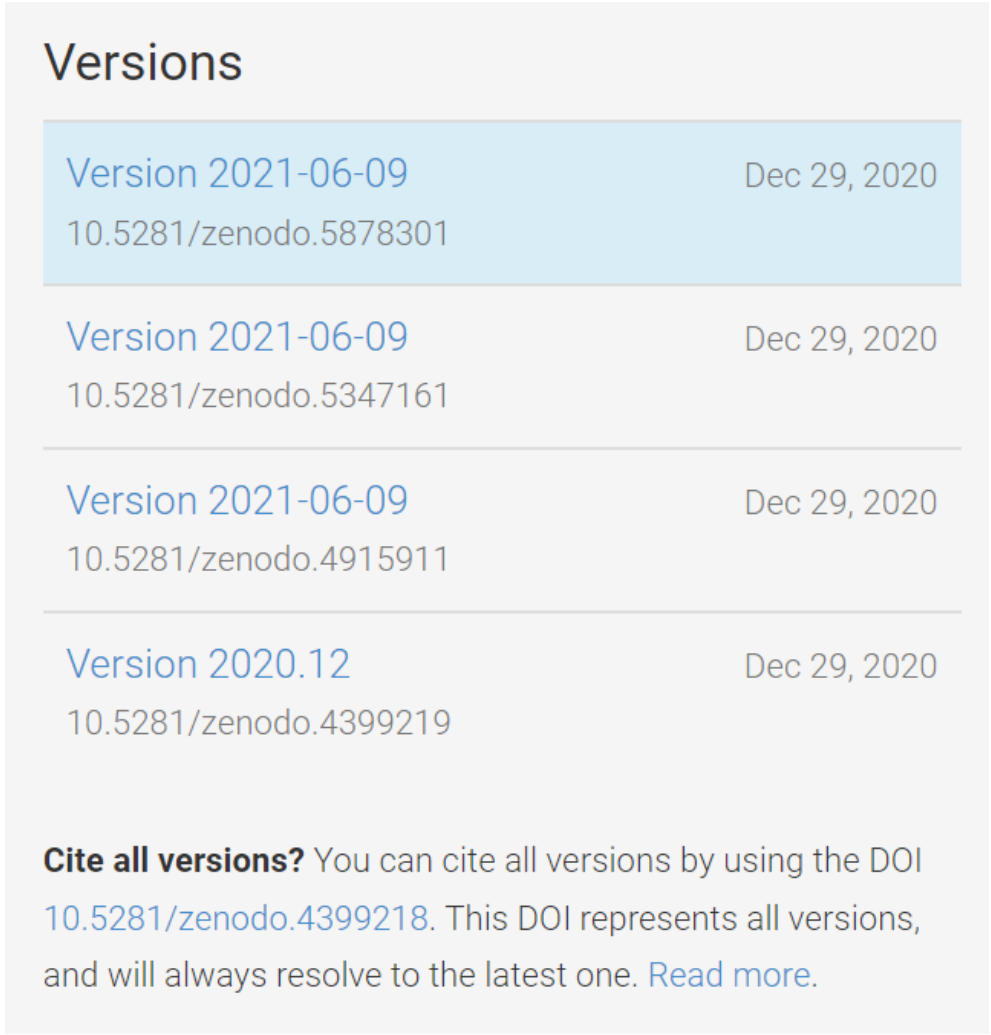
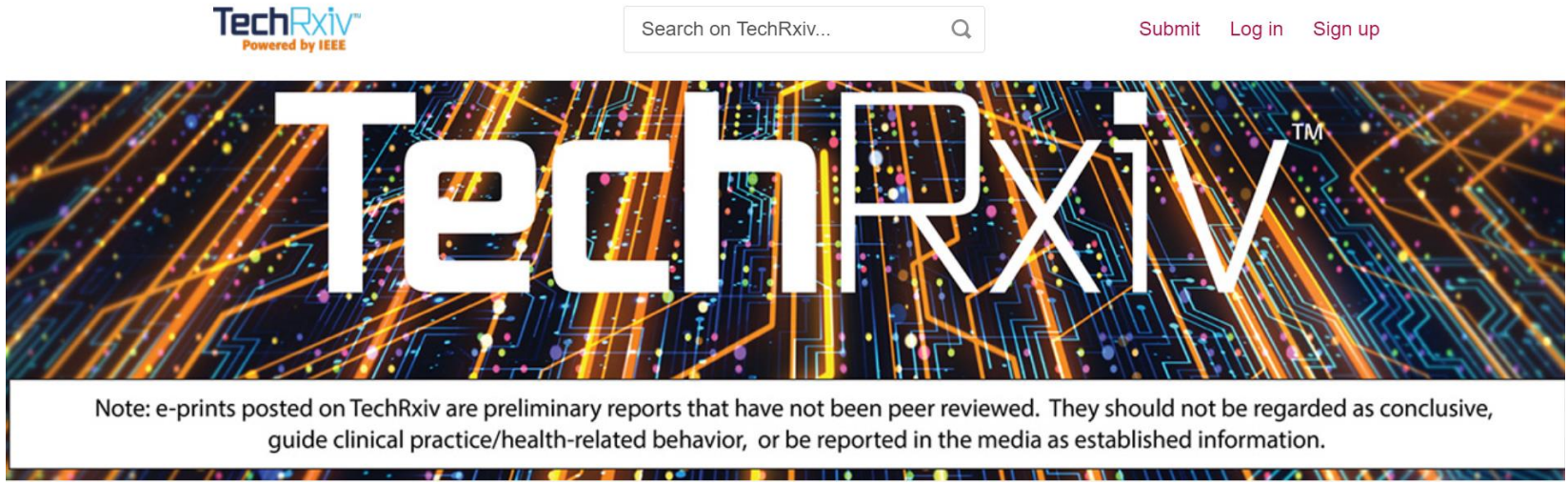
- Concept DOI, represents all versions and always resolves to the latest version

Zenodotus (Ζηνόδοτος) was the first librarian of the Library of Alexandria



# TechRxiv.org – The IEEE Repository

- Founded in 2020
- Similar to arXiv
- A lot fussier
  - Appropriateness
  - Plagiarism
  - 4 busyness days
  - No removal possible
    - Withdrawing keeps the manuscript marked “withdrawn,” with the reason for
- Creative Common license
  - Missing ND attribute




- Provides DOI
- Shows bibliometrics
  - Views
  - Downloads
  - Citations

# Other repositories

- HAL is the French version of arXiv
  - Mandatory (reference only, not text) for administration purposes
  - Buggy cross reference to arXiv
  - My experience, or more general?
  - Improved recently

- BioRxiv
  - Modern biology only
  - Gives a DOI to each document

- There are more repositories than you could believe
  - https://en.wikipedia.org/wiki/List_of_preprint_repositories
  - https://docs.google.com/spreadsheets/d/17RgfuQcGJHKSsSJwZZn0oiXAnimZu2sZsWp8Z6ZaYYo/edit#gid=0

# Databases

- ADS = Astrophysics Data System, Smithsonian Astrophysical Laboratory
- DOAJ = Directory of Open Access Journals
- Google Scholar
- ISI = Institute for Scientific Information (now Thomson Reuters)
  - WoK = Web of Knowledge
  - Web of Science
- JCR = Journal of Citation Reports (survey/census of all citations)
- LANL = Los Alamos National Laboratory
- PubMed
- SciVerse Scopus, aka Scopus, by Elsevier
- SpringerLink, by Springer
- …etc

End of Lecture #2

# Lecture 3

## The Scientific Publication

Lectures for PhD Students and Young Scientists

Enrico Rubiola

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If the audio drops, please text to my private number

+33 680 736703

I am bad at managing the chat during the lecture

Be free to interrupt me

# Bibliometrics
## 1 – Journals and Articles

Express the value, or the influential power of science works as a number

Applies to journals, articles and researchers

# Suggested readings

## AN APOLOGY FROM THE FORMER ASSOCIATE EDITOR

Daniel V. Schroeder

American J Physics 85(6), 2017

## Quotations from the text

*…I just never understood that the criterion for accepting a paper should be not whether other* readers *will* use *it, but whether other* authors *will* cite *it.*

*…AJP should expect its authors to cite as many other AJP papers as possible—relevant or not…*

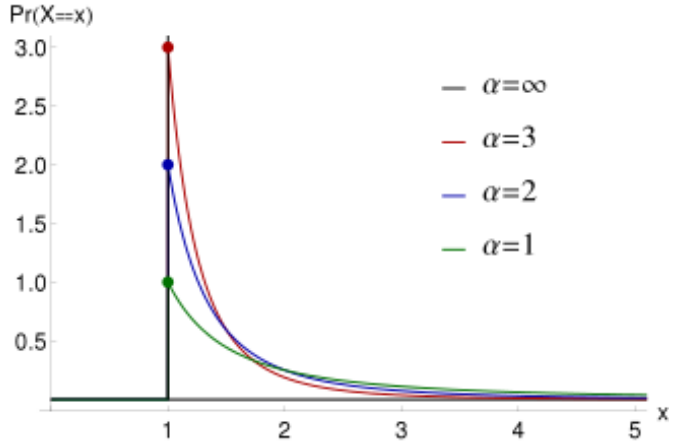
See also
David P. Jackson, Editor, Appropriate journal use in the modern age Am J Phys 84(5), 2016

# The Pareto Distribution

Vilfredo Federico Damaso Pareto, 1848-1923. Italian engineer, sociologist, economist, political scientist, and philosopher
Graduated in 1870 at the Politecnico di Torino

The Pareto principle (also known as the 80–20 rule, the law of the vital few) states that, for many events, roughly 80% of the effects come from 20% of the causes. May be applied recursively

$$f_X(x) = \begin{cases} \frac{\alpha x_{\mathrm{m}}^{\alpha}}{x^{\alpha+1}} & x \geq x_{\mathrm{m}}, \\ 0 & x < x_{\mathrm{m}}. \end{cases}$$




In a Company

80% of profits come from 20% of its customers

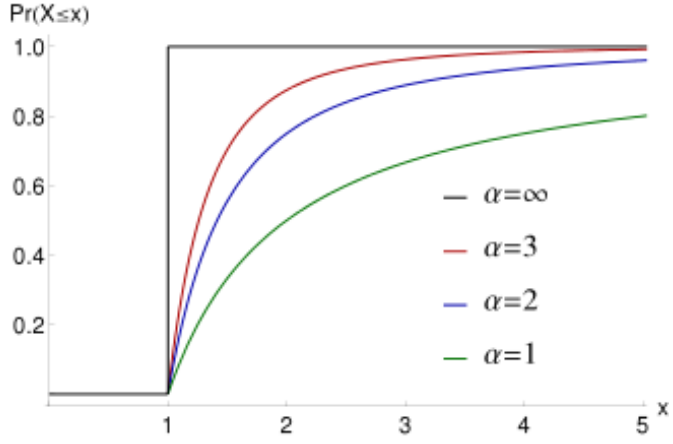
80% of complaints come from 20% of its customers

80% of profits come from 20% of the manpower

80% of a sales come from 20% of its products

80% of a sales are made by 20% of its sales staff

$$F_X(x) = \begin{cases} 1 - \left(\frac{x_{\mathrm{m}}}{x}\right)^{\alpha} & x \geq x_{\mathrm{m}}, \\ 0 & x < x_{\mathrm{m}}. \end{cases}$$



# Motivations, requirements and challenges

- Breakthroughs and major innovations
  - Made by a small number of people
  - Sometimes with small resources (example, STM)
  - Escape from evaluation
  - Detected only if in the appropriate eco-system
- Far more numerous are lower-rank discoveries
  - Bricks of wealth
  - Boost the economy
  - Give relief from the miseries of human life (…Sir F. Bacon)
- Civilization / social aggregation
  - Long term strategy
  - Management of collective resources (brains and money)
- Match social needs, brainpower and financial power
  - Select and manage financial proposals
  - Hire the right people at the right place
  - Career management
- The variety of academia
  - Brilliant people carrying on serious & useful research
  - Smart scientists made useless by the hypertrophic community
  - Folks disconnected from the reality (CF the satiric “Visit to Lagado Academy” by J. Swift)
- Practical need of research evaluation
  - Laboratories
  - Individual researchers
  - Journals and conferences where researchers communicate

# ISI Impact Factor (IF)

$$\mathrm{IF} = \frac{\text{no of articles published in years } [\mathrm{Y}-2, \mathrm{Y}-1], \text{cited in Y}}{\text{no of citable articles published in years } [\mathrm{Y}-2, \mathrm{Y}-1]}$$

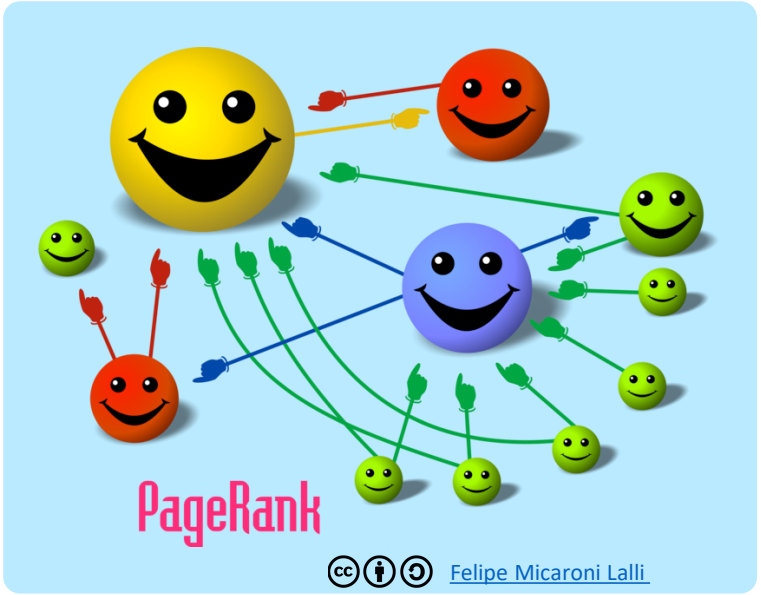
The IF is a rank index for journals

IF = average no. of cited articles in 2 years

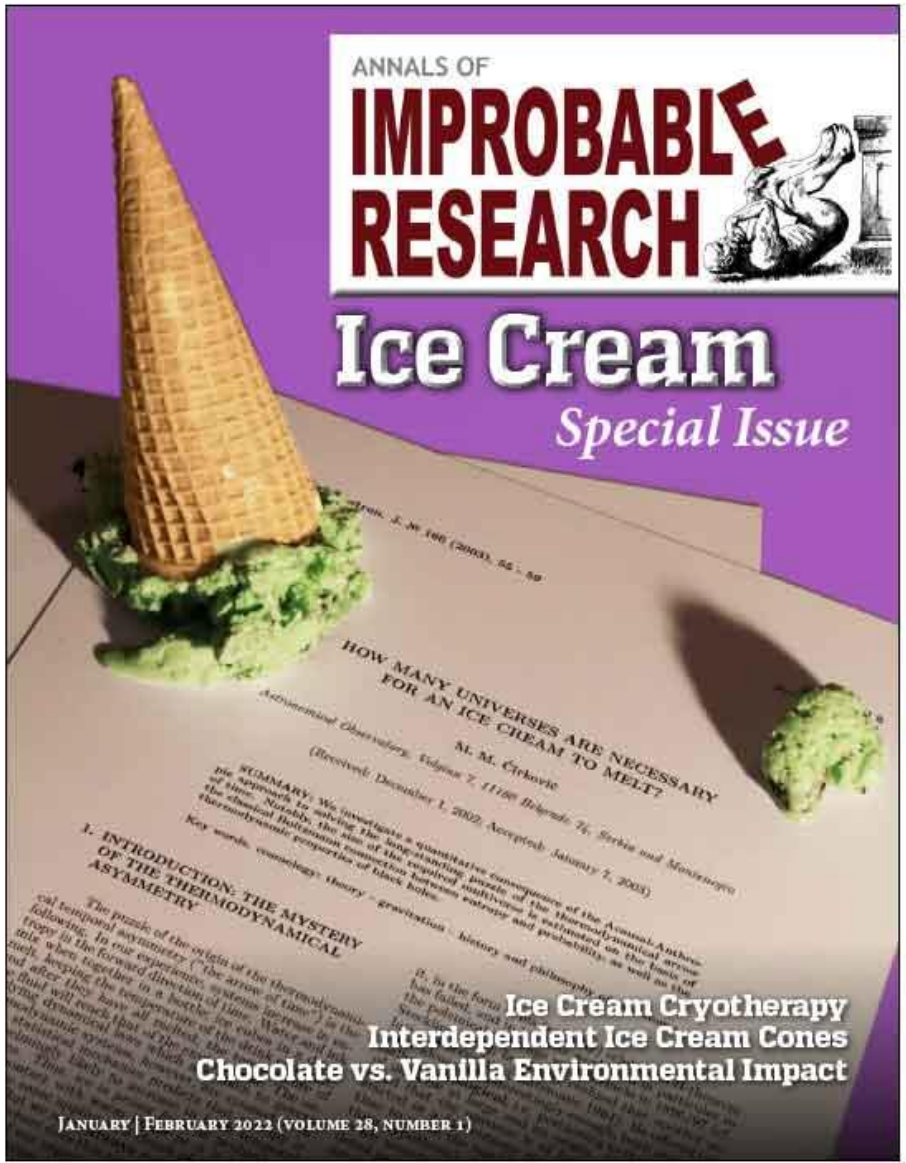
# Google-like PageRank (PR and $PR_w$)

- Google weights the hits with a score associated to the hit origin
- Journals cited many times by prestigious journals increase their prestige
- After iterations from one journal to the other, a stable solution is reached which reflects the prestige of journals.
  PR is calculated in this way
- Weighted algorithm. The transfer of prestige from one journal to the other is modulated by a weight w.
  PRw is calculated in this way
- Another indicator is
  $Y = [ISI\ IF] \times PRw$

There is a serious mathematical approach underneath.
See J. Bollen & al., Journal Status,
Scientometrics 69(3), Dec.2006. Also arXiv:cs.GL/0601030



# Magazines usually don’t have IF




## Example

- Serious magazine
- Ig Nobel prize behind
  - Achievements that make us laugh, than think
- Sadly, the *Journal of Irreproducible Results* jir.com disappeared

# Comparison of major journals

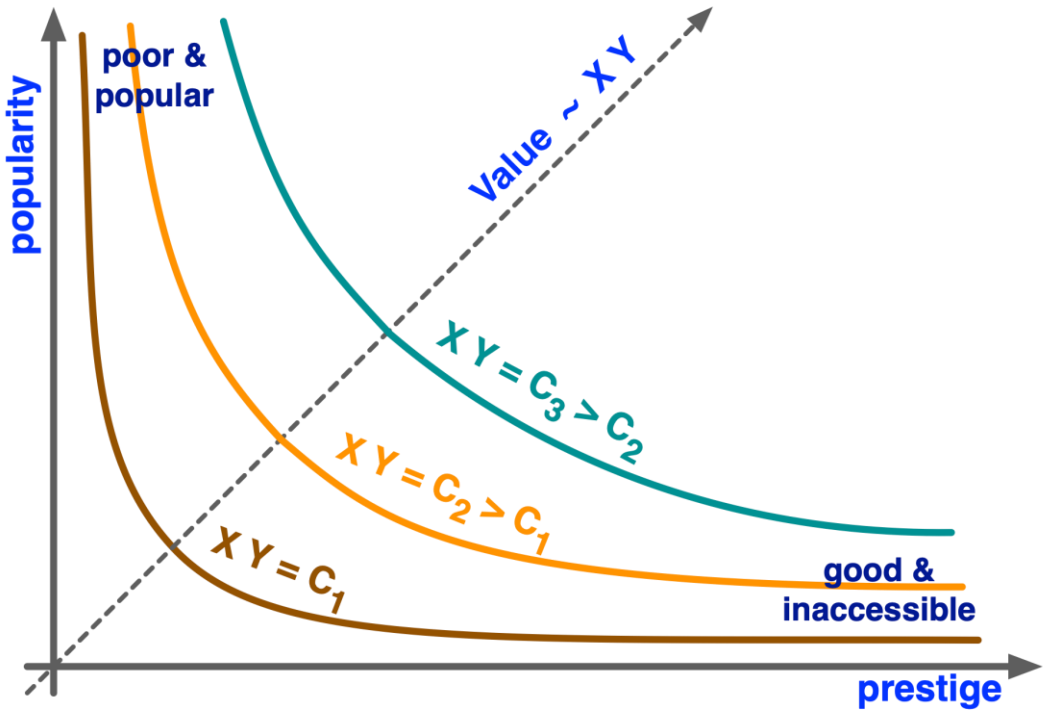
TOP 10 JOURNALS AS RATED BY DIFFERENT METRICS Nature 439(16) p.771, Feb 2006

| Rank | ISI Impact Factor | | PageRank ($\times 10^3$) | | Y-factor ($\times 10^2$) | |
|---|---|---|---|---|---|---|
| | Value | Journal | Value | Journal | Value | Journal |
| 1 | 52.28 | *Annu. Rev. Immunol.* | 16.78 | *Nature* | 51.97 | *Nature* |
| 2 | 37.65 | *Annu. Rev. Biochem.* | 16.39 | *J. Biol. Chem.* | 48.78 | *Science* |
| 3 | 36.83 | *Physiol. Rev.* | 16.38 | *Science* | 19.84 | *N. Engl. J. Med.* |
| 4 | 35.04 | *Nature Rev. Mol. Cell Biol.* | 14.49 | *Proc. Natl Acad. Sci. USA* | 15.34 | *Cell* |
| 5 | 34.83 | *N. Engl. J. Med.* | 8.41 | *Phys. Rev. Lett.* | 14.88 | *Proc. Natl Acad. Sci. USA* |
| 6 | 30.98 | *Nature* | 5.76 | *Cell* | 10.62 | *J. Biol. Chem.* |
| 7 | 30.55 | *Nature Med.* | 5.70 | *N. Engl. J. Med.* | 8.49 | *JAMA* |
| 8 | 29.78 | *Science* | 4.67 | *J. Am. Chem. Soc.* | 7.78 | *Lancet* |
| 9 | 28.18 | *Nature Immunol.* | 4.46 | *J. Immunol.* | 7.56 | *Nature Genet.* |
| 10 | 28.17 | *Rev. Mod. Phys.* | 4.28 | *Appl. Phys. Lett.* | 6.5 | *Nature Med.* |

$Y = IF_{ISI} \times PRw$

Keep IF in our mind

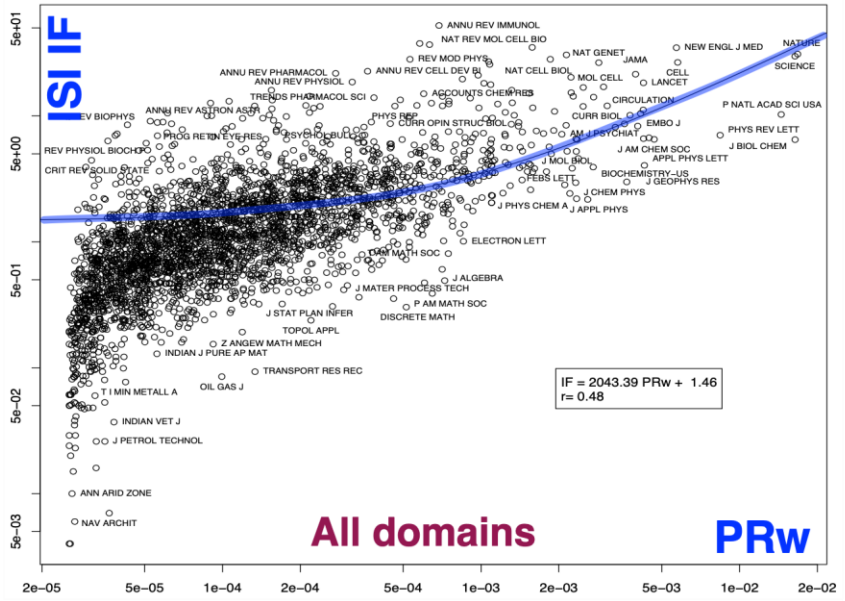
# A possible interpretation of “value”

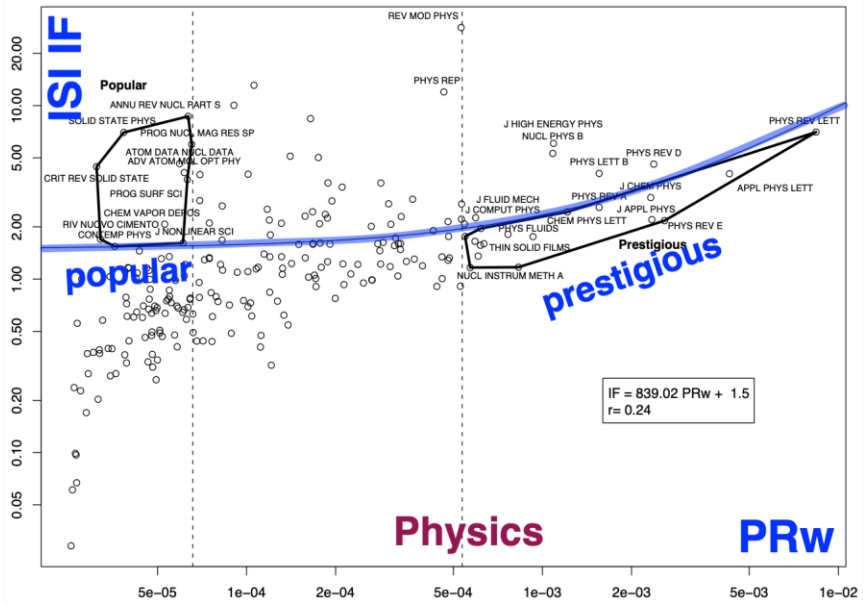


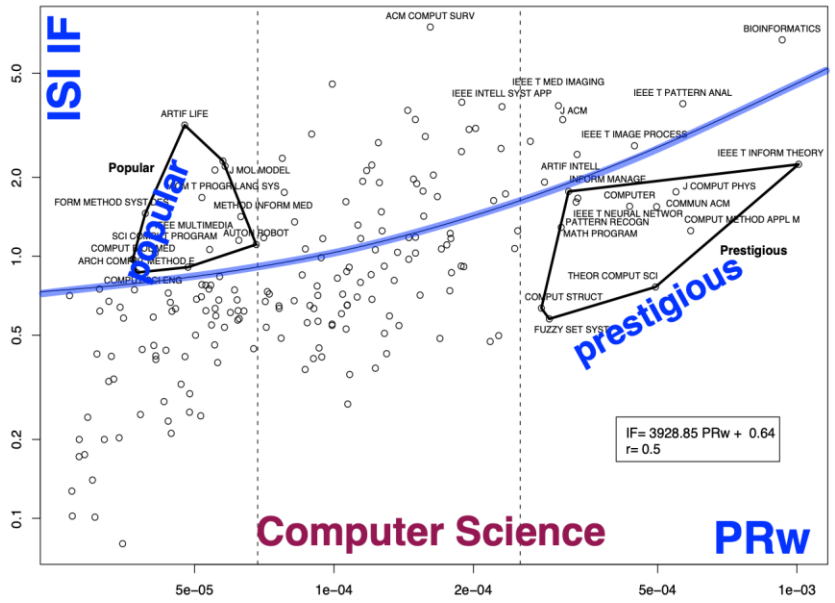

Examples:

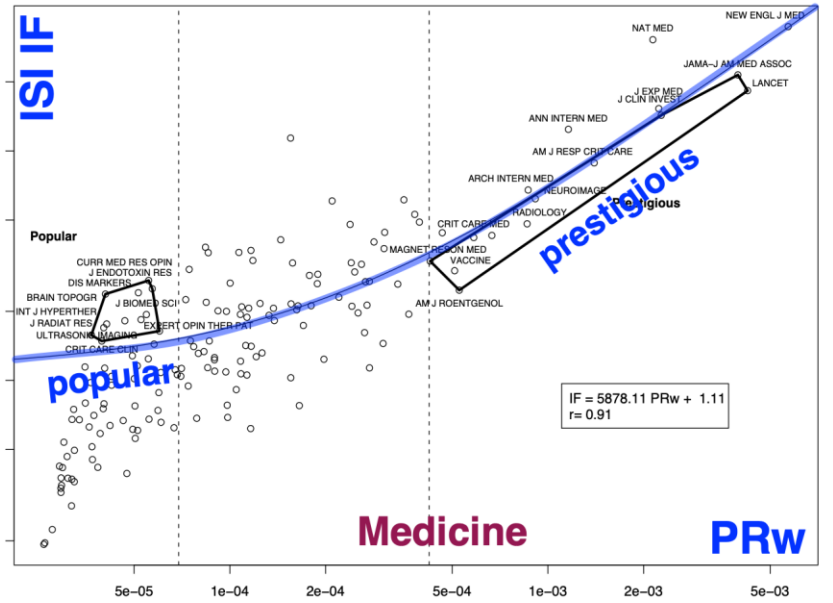
- Telenovelas vs Fermat theorem
- Joanne "Jo" K. Rowling vs James Joyce
  - The Harry Potter series sold ≥600 M copies and translated into ≥88 languages (2024)
  - Joyce “opera omnia” contains the largest number of words, >30 k
- Francoise Bourdin (1952-2022) sold 8 M books (Wikipedia)
  - Tiny impact on the media
  - No English/German/Italian/Spanish translation (checked on Amazon sites, January 2023)
- Suiza, Benedicte Belpois’ first roman, 2019
  - Gallimard *collection blanche* sold 10 k samples
  - *Folio* (pocket) collection followed
  - German, English and Italian translations
  - A few prizes
  - Two more romans followed, both Gallimard *collection blanche*

# Popularity vs Prestige




J. Bollen & al, Journal Status, Scientometrics 69(3), Dec. 2006. Also arXiv:cs.GL/0601030

# Immediacy Index

The II is a rank index for journals based on the citations in the same year

$$\mathrm{II} = \frac{\text{no of cited articles in year Y}}{\text{no of citable articles published in years } [\mathrm{Y}-2, \mathrm{Y}-1]}$$

The definition of “citable” depends partially on Thomas Reuters

- Tends to discount the advantage of large journals over small ones
- Frequently issued journals may have an advantage
  - An article published early in the year has a better chance of being cited than one published later in the year.
- Useful for letter-type journals
  - Fortnightly publications have higher chance
  - Quarterly publications have low II

# Eigenfactor and Article Influence

A rank index for journals available on

http://eigenfactor.org

- Developed by Jevin West and C. Bergstrom at the U of Washington
- Inspired to Google's Page Rank algorithm
- Journals are rated according to the number of citations, with higher weight of citations from highly ranked journals
- Eigenfactor and Article Influence are calculated by eigenfactor.org
- Eigenfactor scores are intended to give a measure of how likely a journal is to be used, and are thought to reflect how frequently an average researcher would access content from that journal
- Eigenfactor is correlated with total citation count for medical journals, yet provides significantly different information

# SCImago Journal Rank

The SJR indicator is an open access journal metric

- A measure of scientific influence of journals that accounts for both the number of citations received by a journal and the importance or prestige of the journals where such citations come from.
- The SJR indicator is a variant of the eigenvector centrality measure used in network theory (difficult to understand).
- In network theory, importance of a node based on the principle that connections to high-scoring nodes contribute more
- Similar to the Google PageRank algorithm
- Size-independent indicator and its values order journals by their "average prestige per article"
- Also available: average citations per document in a 2 year period, computed using the same formula that journal impact factor

# Journal cited half-life

The median age of the articles that were cited in the JCR year

- Half of a journal's cited articles were published more recently than the cited half-life
- Example.  in JCR 2001 the journal CRT has a cited half-life of 7.0.
  The articles published between 1995-2001 (inclusive) account for 50% of all citations to articles from that journal in 2001
- Only journals cited 100 or more times in the JCR year have a cited half-life
- Intended to assist in the management of archives, rather than to evaluate the research
  - A primary research journal might have a longer cited half-life than a journal that provides rapid communication of current information
- 

# Pathologies of the IF

- In 2007, Folia Phoniatrica et Logopaedica (IF = 0.66) published an editorial that cited all its articles from 2005 to 2006
  - Protest against the abuse/misuse of the IF
  - IF stepped from 0.66 to 1.44
  - FPL was excluded from JCR in 2008-2009

- The article "A short history of SHELX" (Acta Crystallographica A, 2008) included a sentence that instructs readers to cite the paper

  "This paper could serve as a general literature citation when one or more of the open-source SHELX programs… are used……"

  - Got viral, > 6,600 citations
    (The second most cited article in 2008 had only 28 citations)
  - IF(ACA) stepped from 2.051 in 2008 to 49.926 in 2009,
    more than Nature (31.434) and Science (28.103)

Schuttea HK, Svec JG (2007). "Reaction of Folia Phoniatrica et Logopaedica on the Current Trend of Impact Factor Measures". Folia Phoniatrica et Logopaedica 59 (6): 281–285

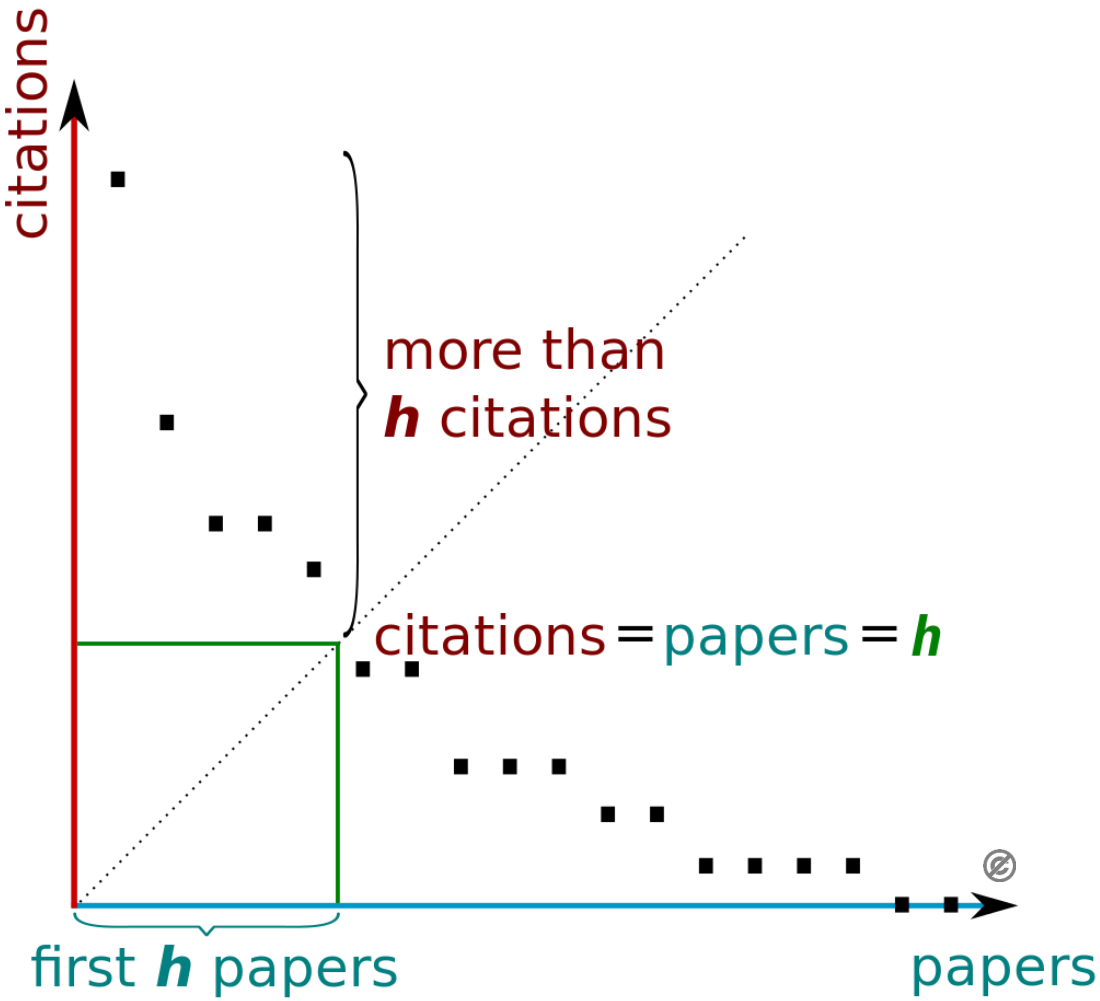
# Bibliometrics
# 2 – Researchers

Express the value, or the influential power of science works as a number

# H index, aka Hirsch Number (1)

H is a rank index for individual scientists

A scientist with an index of H has published H articles each cited ≥ H times



# H index, aka Hirsch Number (2)

## Scientists who published a small number of highly influential articles might have ridiculously low H index

- Example, Evariste Galois (1811-1832) H = 2
  - Two articles
    - Continuous fraction
    - The solution of a polynomial by radicals
  - Books have been written about Galois and his articles
  - Cryptography, secure transaction on the Internet, High Energy Physics, etc.

## Hiring in universities

- The H index is more wisely used as a screening tool, rather than a major parameter

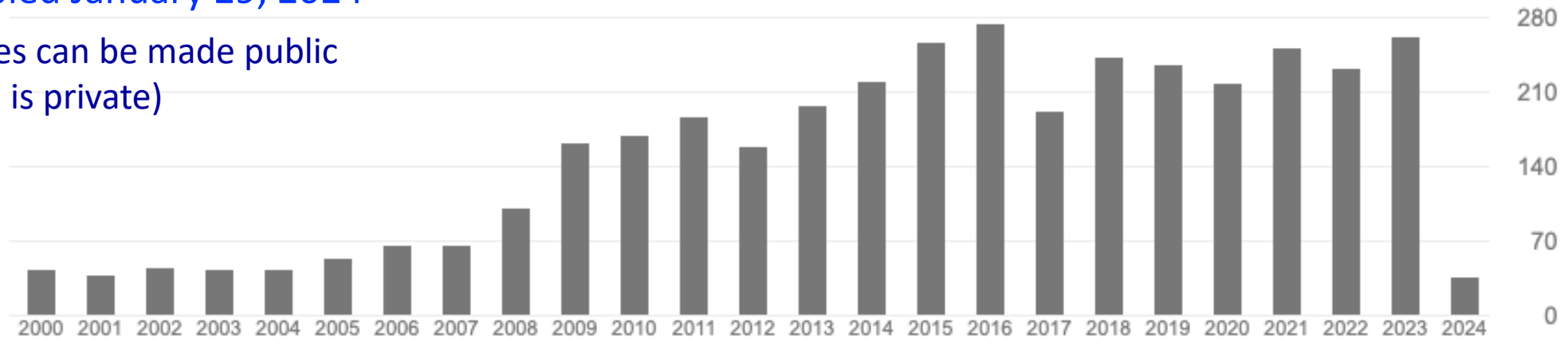
# Enrico on Google Scholar

Google Scholar's estimation is close to that of ISI,

| | All | ≥ 2018 (last 5 years) | Meaning |
|---|---|---|---|
| Citations | 3879 | 1439 | total citations |
| H index | 28 | 17 | Hirsch number |
| i10 index | 75 | 40 | no of items with ≥ i10 citations |

Sampled January 29, 2024

Profiles can be made public (mine is private)



# Science-wide author databases of standardized citation indicators

- Contributor: John P. A. Ioannidis
- Elsevier Data Repository

https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/1

https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.3000384

# G-Index

G is another rank index for individual scientists

- Given a set of articles ranked in decreasing order of citations,
  G is the largest number such that the top G articles received (together) at least $G^2$ citations
- Highly correlated with the H-index
- Differs in that the number of citations per article is not explicit

# The effect of a community

A lesson from Social Sciences and from Game Theory

- Find a community which matches your topics and potential
- Cite systematically their articles
- Inevitably, after a while, they will
  - Know you
  - Cite your articles
- Larger communities generate higher number of citations
  - This has very little to do with good science
- Game theory suggests
  - Cooperative behavior pays well if the total resource is not bounded
  - People are often aware of this

# Inflation

## No rank index accounts for the no of authors

- Inflation strategy, in a team
  - Increase the number of authors per article
  - Lower the threshold for co-authorship
  - Same work –> more publications per member
  - No rank index accounts for the no of authors

- Do the same with colleagues of other labs?
  - May work partially
  - But there is no boss wo watches on the rules

# Read a CV between the lines

There is a wealth of information written in invisible ink

- Very often / or never
  - First author
  - Corresponding author
  - Last author
- Spread of topics
- Number of affiliations, or double affiliations
  - Change job,
  - Visiting scientist
  - Honorary affiliations
- Different authors/teams
  - Same lab
  - In your Country
  - Abroad
- Invitations
  - Just the mention “Invited” at a conference?
  - Also travel & hotel?
- Spread of no of authors
- Single-name publications

# Elderly professor's advices

- Work well, work hard, work on your dreams
- Build your career on a wise long-term strategy
  - A strategy based on index numbers does not pay
  - The rules of the game change
  - In the long run, the weak points of a system are fixed
- Don't look down at bibliometrics
  - Good publication record is necessary
    - Research funds
    - Permanent positions
    - Promotions

Ars longa, vita brevis – ancient Latin proverb

Crafty guys have a short life

# Sponsored Publications, and Vanity Press

Respected business, or not

# Sponsored publication

- A project not suitable to regular for-profit publisher
  - A book intended to promote a Company/Lab (gift to qualified customers/guests)
  - Proceedings of a small workshop, with too few potential readers
  - Catalogue of art exhibits
- Pay a publisher
  - Make sure you have a clear contract,
  - May go with limited advertisement
- Legitimate and respectable “win-win” business
- Serious self-publishing Companies
  - Lulu Press
    - Founded in 2002 by Bob Young, co-founder of Red Hat
  - CreateSpace
    - Trade name of On-Demand Publishing, LLC, owned by Amazon

# Example – lulu.com

- Print on demand
- Additional services
  - ISBN
  - Sell/send to customers
  - Ebooks
  - Royalty collection
  - Royalty-free books

## Example: a book of this course

(royalty-free, I don't want your money ☺)

- Royal format (15.6 x 23.4 $cm^2$)
- 300 p, 90 $g/m^2$ paper
- Pricing (2022)
  - No minimum quantity
  - Hardcover $23.25 (co), $18.75 (bw)
  - Paperback $15.80 (co), $11.40 (bw)
  - Delivers to FR, $30-60 (50 samples)
  - Sold by Lulu €41.2 (H), €30.3 (P)
    - Royalty free,
    - Otherwise, Lulu takes 50% of royalties

# Vanity press

Broadly similar to sponsored books

- Target fiction authors having no access to mainstream publishers
- The author is asked to “participate” to the cost of printing (actually, pay all!)

- The publisher looks legitimate, but
  - Pushes the author to believe what he/she wants to
  - The contract  does not follow
- No advertisements, no side services
  - No samples given to the press
  - Not proposed to book stores
  - No copies are sold
- Later, the author is offered to buy the unsold stock at reduced price
- Before accepting, you may consider
  - A printing company
  - A self-publishing Company

# A funny case of vanity press

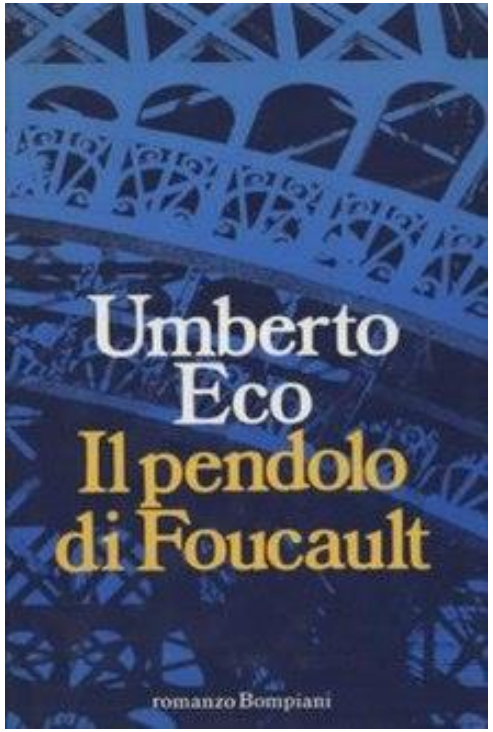
Mr Garamond is a character described in Il pendolo di Foucault, a Umberto Eco's roman (1988)

He owns two publishing Companies

- Garamond (true culture)
- Manuzio (vanity press)

Manuzio takes money from incompetent authors to fuel Garamond, that loses money

Italian edition




Carmina non dant panem – says an ancient Latin proverb
Poetry does pay the bills.  Surprised?

End of Lecture #3

# Lecture 4

## The Scientific Publication

Lectures for PhD Students and Young Scientists

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# Recommended reading

https://arxiv.org/abs/2309.15884

## The strain on scientific publishing

Mark A. Hanson[1], Pablo Gómez Barreiro[2], Paolo Crosetto[3], Dan Brockington[4]

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# Predatory Open-Access Journals

The term “predatory open access publishing” was invented by Jeffrey Beall, who started the celebrated Beall’s list in 2010

# Predatory open-access journals

- Imitate a scientific journal, but are frauds
- No peer review process, they publish whatever submitted
- Publication charges are paid by authors
  - Cheaper than regular OA journals (not always)
- No readership, no impact
- E-mail advertising
  - Aggressive, repeated
  - Target only potential authors, not readers
  - Often offer discounts
  - May target the participants of a conference
- Potentially dangerous for your career

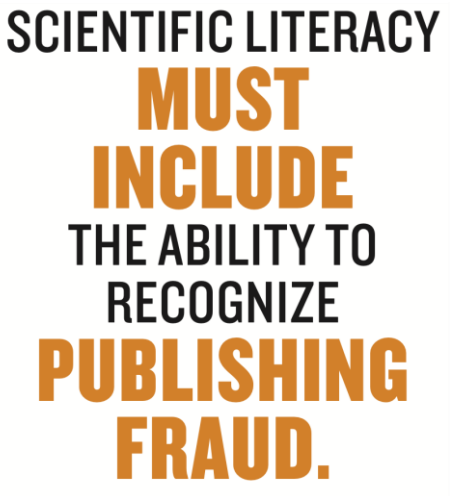
# Suggested Readings



## Predatory publishers are corrupting open access

*Journals that exploit the author-pays model damage scholarly publishing and promote unethical behaviour by scientists, argues* **Jeffrey Beall**.

Nature 489, September 2012
DOI 10.1038/489179a




K. D. Kobey et al., Knowledge and motivations of researchers publishing in presumed predatory journals: a survey
BMJ Open, March 2019
10.1136/bmjopen-2018-026516

## THE TRUE COST OF SCIENCE PUBLISHING

*Cheap open-access journals raise questions about the value publishers add for their money.*

BY RICHARD VAN NOORDEN

Nature 495, 28 March 2013
DOI 10.1038/495426a

# Predatory Open-Access Journals (1/2)

Copied verbatim from Gina Kolata, New York Times, April 7, 2013 – Please visit the New York Times site and read the original

The scientists who were recruited to appear at a conference called Entomology-2013 thought they had been selected to make a presentation to the leading professional association of scientists who study insects.

But they found out the hard way that they were wrong. The prestigious, academically sanctioned conference they had in mind has a slightly different name: Entomology 2013 (without the hyphen). The one they had signed up for featured speakers who were recruited by e-mail, not vetted by leading academics. Those who agreed to appear were later charged a hefty fee for the privilege, and pretty much anyone who paid got a spot on the podium that could be used to pad a résumé.

“I think we were duped,” one of the scientists wrote in an e-mail to the Entomological Society.

Those scientists had stumbled into a parallel world of pseudo-academia, complete with prestigiously titled conferences and journals that sponsor them. Many of the journals and meetings have names that are nearly identical to those of established, well-known publications and events.

Steven Goodman, a dean and professor of medicine at Stanford and the editor of the journal Clinical Trials, which has its own imitators, called this phenomenon “the dark side of open access,” the movement to make scholarly publications freely available.

The number of these journals and conferences has exploded in recent years as scientific publishing has shifted from a traditional business model for professional societies and organizations built almost entirely on subscription revenues to open access, which relies on authors or their backers to pay for the publication of papers online, where anyone can read them.

Open access got its start about a decade ago and quickly won widespread acclaim with the advent of well-regarded, peer-reviewed journals like those published by the Public Library of Science, known as PLoS. Such articles were listed in databases like PubMed, which is maintained by the National Library of Medicine, and selected for their quality.

But some researchers are now raising the alarm about what they see as the proliferation of online journals that will print seemingly anything for a fee. They warn that nonexperts doing online research will have trouble distinguishing credible research from junk. “Most people don’t know the journal universe,” Dr. Goodman said. “They will not know from a journal’s title if it is for real or not.”

Researchers also say that universities are facing new challenges in assessing the résumés of academics. Are the publications they list in highly competitive journals or ones masquerading as such? And some academics themselves say they have found it difficult to disentangle themselves from these journals once they mistakenly agree to serve on their editorial boards.

The phenomenon has caught the attention of Nature, one of the most competitive and well-regarded scientific journals. In a news report published recently, the journal noted “the rise of questionable operators” and explored whether it was better to blacklist them or to create a “white list” of those open-access journals that meet certain standards. Nature included a checklist on “how to perform due diligence before submitting to a journal or a publisher.”

Jeffrey Beall, a research librarian at the University of Colorado in Denver, has developed his own blacklist of what he calls “predatory open-access journals.” There were 20 publishers on his list in 2010, and now there are more than 300. He estimates that there are as many as 4,000 predatory journals today, at least 25 percent of the total number of open-access journals.

“It’s almost like the word is out,” he said. “This is easy money, very little work, a low barrier start-up.”

Journals on what has become known as “Beall’s list” generally do not post the fees they charge on their Web sites and may not even inform authors of them until after an article is submitted. They barrage academics with e-mail invitations to submit articles and to be on editorial boards.

One publisher on Beall’s list, Avens Publishing Group, even sweetened the pot for those who agreed to be on the editorial board of The Journal of Clinical Trails & Patenting, offering 20 percent of its revenues to each editor.

One of the most prolific publishers on Beall’s list, Srinubabu Gedela, the director of the Omics Group, has about 250 journals and charges authors as much as $2,700 per paper. Dr. Gedela, who lists a Ph.D. from Andhra University in India, says on his Web site that he “learnt to devise wonders in biotechnology.”

Open-access publishers say that the papers they publish are reviewed and that their businesses are legitimate and ethical.

“There is no compromise on quality review policy,” Dr. Gedela wrote in an e-mail. “Our team’s hard work and dedicated services to the scientific community will answer all the baseless and defamatory comments that have been made about Omics.”

# Predatory Open-Access Journals (2/2)

Copied verbatim from Gina Kolata, New York Times, April 7, 2013 – Please visit the New York Times site and read the original

But some academics say many of these journals' methods are little different from spam e-mails offering business deals that are too good to be true.

Paulino Martínez, a doctor in Celaya, Mexico, said he was gullible enough to send two articles in response to an e-mail invitation he received last year from The Journal of Clinical Case Reports. They were accepted. Then came a bill saying he owed $2,900. He was shocked, having had no idea there was a fee for publishing. He asked to withdraw the papers, but they were published anyway.

"I am a doctor in a hospital in the province of Mexico, and I don't have the amount they requested," Dr. Martínez said. The journal offered to reduce his bill to $2,600. Finally, after a year and many e-mails and a phone call, the journal forgave the money it claimed he owed.

Some professors listed on the Web sites of journals on Beall's list, and the associated conferences, say they made a big mistake getting involved with the journals and cannot seem to escape them.

Thomas Price, an associate professor of reproductive endocrinology and fertility at the Duke University School of Medicine, agreed to be on the editorial board of The Journal of Gynecology & Obstetrics because he saw the name of a well-respected academic expert on its Web site and wanted to support open-access journals. He was surprised, though, when the journal repeatedly asked him to recruit authors and submit his own papers. Mainstream journals do not do this because researchers ordinarily want to publish their papers in the best journal that will accept them. Dr. Price, appalled by the request, refused and asked repeatedly over three years to be removed from the journal's editorial board. But his name was still there.

"They just don't pay any attention," Dr. Price said.

About two years ago, James White, a plant pathologist at Rutgers, accepted an invitation to serve on the editorial board of a new journal, Plant Pathology & Microbiology, not realizing the nature of the journal. Meanwhile, his name, photograph and résumé were on the journal's Web site. Then he learned that he was listed as an organizer and speaker on a Web site advertising Entomology-2013.

"I am not even an entomologist," he said.

He thinks the publisher of the plant journal, which also sponsored the entomology conference, — just pasted his name, photograph and résumé onto the conference Web site. At this point, he said, outraged that the conference and journal were "using a person's credentials to rip off other unaware scientists," Dr. White asked that his name be removed from the journal and the conference.

Weeks went by and nothing happened, he said. Last Monday, in response to this reporter's e-mail to the conference organizers, Jessica Lincy, who said only that she was a conference member, wrote to explain that the conference had "technical problems" removing Dr. White's name. On Tuesday, his name was gone. But it remained on the Web site of the journal.

Dr. Gedela, the publisher of the journals and sponsor of the conference, said in an e-mail on Thursday that Dr. Price and Dr. White's names remained on the Web sites "because of communication gap between the EB member and the editorial assistant," referring to editorial board members. That day, their names were gone from the journals' Web sites.

"I really should have known better," Dr. White said of his editorial board membership, adding that he did not fully realize how the publishing world had changed. "It seems like the Wild West now."

This article has been revised to reflect the following correction:

Correction: April 9, 2013

An article on Monday about questionable scientific journals and conferences misstated the name of a city in Mexico that is home to a doctor who sent articles to a pseudo-academic journal. It is Celaya, not Ceyala.

This article has been revised to reflect the following correction:

Correction: April 10, 20130

An article on Monday about questionable scientific journals and conferences erroneously included one publishing company among those on a list of "predatory open-access journals," known as Beall's list. Although Dove Press was on the list in 2012, it has since been removed.

email, January 29, 2023

# International Journal of Research in Engineering and Science

**International Journal of Research in Engineering and Science (IJRES)** is an open access peer-reviewed international forum for scientists involved in research to publish quality and refereed papers.
Papers reporting original research or experimentally proved review work are welcome. Papers for publication are selected through peer review to ensure originality, relevance, and readability. The journal ensures a wide indexing policy to make published papers highly visible to the scientific community.

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what the f***

**The Journal has an ISSN No: 2320-9364 with Impact Factor of 5.541(SJIF).**

SJIF

I interpret this as
Scam Journal Impact Factor

**Journal Indexing:**

The journal is indexed with leading International Indexing agencies like Index Medicus, Google Scholar, Pubmed, Open J-Gate, IIFS, Citefactor, DJOF, DRJI, Eyesource etc.

# International Organization of Scientific Research (IOSR)

**Dear Author's,**

We are happy to announce you that International Organization of Scientific Research Journals have come under AQCJ - 2020 Top 10 Journals Ranking.

**IOSR Journals got 9th Ranking by AQCJ (African Quality Center for Journals) - Top 10 Journals Ranking.**

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IOSR Journals provides DOI (Digital Object Identifier) to each article. IOSR Journals DOI is 10.9790.

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| LIST OF JOURNALS | Impact Factor |
|---|---|
| IOSR Journal of Computer Engineering | 3.712 |
| IOSR Journal of Electrical and Electronics Engineering | 3.26 |
| IOSR Journal of Pharmacy and Biological Science | 3.83 |
| IOSR Journal of Nursing and Health Science | 4.59 |
| IOSR Journal of Mechanical and Civil Engineering | 3.781 |
| IOSR Journal of Electronics and Communication Engineering | 3.12 |
| IOSR Journal of Dental and Medical Sciences | 5.164 |
| IOSR Journal of Agriculture and Veterinary Science | 3.26 |
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| IOSR Journal on Mobile Computing & Application | 3.17 |
| IOSR Journal of Sports and Physical Education | 2.97 |
| IOSR Journal of Polymer and Textile Engineering | 2.86 |
| IOSR Journal of Humanities and Social Science | 4.621 |
| IOSR Journal of Research & Method in Education | 3.23 |
| IOSR Journal of Applied Geology and Geophysics | 2.97 |
| IOSR Journal of Environmental Science, Toxicology and Food Technology | 3.462 |
| IOSR Journal of Mathematics | 3.97 |
| IOSR Journal of Business and Management | 3.52 |
| IOSR Journal of Applied Physics | 3.15 |

## Call For Paper: Important Dates

| | |
|---|---|
| Submission last date: | 15th February 2020 |
| Acknowledgment: | Within 24 hrs |
| Acceptance Notification: | After 10 days |
| Publication Date: | 25th February 2020 |

**Engineering and Applied Sciences**

ISSN Online: 2575-1468 ISSN Print: 2575-2022

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Dear Enquebecq, R; Graton, O; Fouvry, S;...,

Hope you're having a good day.

We have learnt about your research paper under the title of "Effect of Fretting Wear of Connectors Regarding Phase Noise of RF Signal: Influence of Sliding Amplitude and Gold Coating Thickness", which has been published in *2017 63RD IEEE HOLM CONFERENCE ON ELECTRICAL CONTACTS*, and the topic of the paper has impressed us a lot.

Due to your rich research experience and excellent academic accomplishments, we will feel honored if you could contribute articles to our journal and join us as one of the Editorial Board Members/Reviewers.

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Dear Scholar,

It is with great pleasure that we welcome you to attend the "**4th International Conference on Photonics Research**" which will be held on April 2**2-28, 2022** in the Convention Centre of the **Liberty Hotels Lykia /Oludeniz** in Muğla, Turkey.

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Specific questions concerning further information can be sent by e-mail to: **chair@interphotonics.org**

We are looking forward to meeting you at **Interphotonics 2022**

With our best regards,

**Chair**

Prof. Dr. Ersin Kayahan (Kocaeli University, Turkey)

**Abstract Submission deadline: January 20, 2022**

Hope you are doing well.

**American Journal of Engineering, Science and Technology** is glad to announce the upcoming Volume 14, 2021. We are thankful to all the previous authors and hope you will continue your support to our journal in the future. We kindly invite you for manuscript submission for the upcoming issue. We would be grateful if you consider the proposal and submit your manuscript to the issue and make it successful.

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I appreciate your attention to this matter and look forward to your response.

Best Regards,
Prof. White
**Editor-in-Chief- AJEST**

# Intentionally addressed only to idiots

English style reveals illiteracy

**From:** **International Journal of Statistical Analysis** editor@ijstatistics.info
**Subject:** [UFC : SPAM BAS]Request to contribute a manuscript to the "International Journal of Statistical Analysis"
**Date:** 25 January 2020 at 18:05
**To:** rubiola@femto-st.fr

Dear. Professor,

Glories wishes from Olive M...!

This mail is to request you to submit a manuscript to the "International Journal of Statistical Analysis", we accept any kind of manuscript.

Therefore, I'm asking for your contribution in order for the better growth of the journal, we'll be grateful if you submit a manuscript.

Thank you for taking the time to look into this matter. I hope to hear from you soon. Have a nice day ahead.

Regards,
Olive Matthew
Editorial Manager
International Journal of Statistical Analysis
USA

If you answer, you reveal that you are simple minded

# Decency please!!!

Browsing, you may find thinks like this

**American Journal of Modern Physics**
2013; 2(5): 255-263
Published online August 20, 2013 (http://www.sciencepublishinggroup.com/j/ajmp)
doi: 10.11648/j.ajmp.20130205.14

SciencePG
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Imitation?

## Modification of Einstein's $E= mc^2$ to $E = \frac{1}{22} mc^2$

**L. Marek-Crnjac**

Technical School Center, Maribor, Slovenia

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Google Chrome

**To cite this article:**

L. Marek-Crnjac. Modification of Einstein's $E= mc^2$ to $E = \frac{1}{22} mc^2$. *American Journal of Modern Physicy.*

Vol. 2, No. 5, 2013, pp. 255-263. doi: 10.11648/j.ajmp.20130205.14

# Still not convinced?

**American Journal of Applied Mathematics**
2014; 2(4): 111-126
Published online August 10, 2014 (http://www.sciencepublishinggroup.com/j/ajam)
doi: 10.11648/j.ajam.20140204.12
ISSN: 2330-0043 (Print); ISSN: 2330-006X (Online)

## Mathematical proof of the Law of Karma

**Jargal Dorj**

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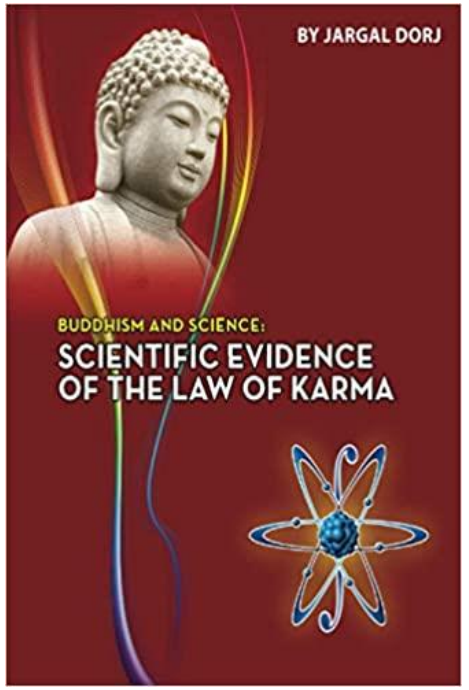
jargaldorj@yahoo.com

**To cite this article:**
Jargal Dorj. Mathematical Proof of the Law of Karma. *American Journal of Applied Mathematics.* Vol. 2, No. 4, 2014, pp. 111-126.
doi: 10.11648/j.ajam.20140204.12

**Abstracts:** The Buddhist teachings assume that all living creatures obey the Law of Karma. Till this day not only ordinary people – but even scientists still do not believe and accept this fact and this is the main reason why some people say the Buddhist religion makes people simpleminded and some religions say the Buddhist religion is misleading. This is related to the absence of a scientific verification for the Law of Karma. The existence of the Law of Karma will be proved and verified in this article using the mathmatical Set Theory. The incomprehension of the "Self" and its emptiness is described in the Buddhist teachings as ignorant. Herewith we shall explain the theory of the "Self" and its emptiness founded on the possession of the body and mind using the mathematical Set Theory. By reading this article the reader will comprehend the "Self" and its emptiness and overcome this ignorance.

Book found on amazon.com
J. Dorj, *Scientific Evidence of the Law of Karma*, 2nd ed, Createspace Independent Publishing Platform 2016, ISBN 978-1540856586



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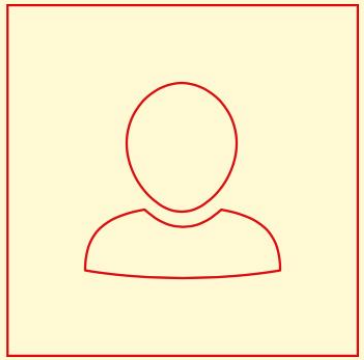

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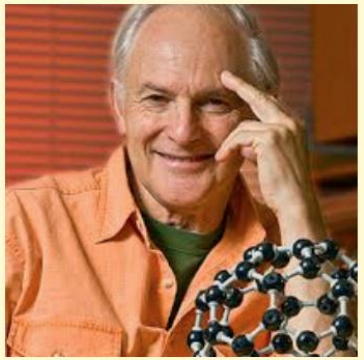

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# Ontology in quantum mechanics

Gerard 't Hooft

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Princetonplein 5, 3584 CC Utrecht,
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e-mail: g.thooft@uu.nl
internet: http://www.staff.science.uu.nl/~hooft101/

## Abstract

It is suspected that the quantum evolution equations describing the micro-world as we know it are of a special kind that allows transformations to a special set of basis states in Hilbert space, such that, in this basis, the evolution is given by elements of the permutation group. This would restore an ontological interpretation. It is shown how, at low energies per particle degree of freedom, almost any quantum system allows for such a transformation. This contradicts Bell's theorem, and we emphasise why some of the assumptions made by Bell to prove his theorem cannot hold for the models studied here. We speculate how an approach of this kind may become helpful in isolating the most likely version of the Standard Model, combined with General Relativity. A link is suggested with black hole physics.

**Keywords:** foundations quantum mechanics, fast variables, cellular automaton, classical/quantum evolution laws, Stern-Gerlach experiment, Bell's theorem, free will, Standard Model, anti-vacuum state.

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OPEN ACCESS PEER-REVIEWED CHAPTER

# Ontology in Quantum Mechanics

WRITTEN BY

**Gerard 't Hooft**

1999 NOBEL WINNER **Gerard't Hooft**
Nobel Prize in Physics in 1999

Only 3 citations! (2024)

Reviewed: August 9th, 2021 , Published: September 1st, 2021

DOI: 10.5772/intechopen.99852

?????

# Jeffrey Beall

- Professor and librarian of the University of Colorado Denver
- Coined the term Predatory Open Access Publishing
- First identified it as a fraud, and a threaten
- Warned the scientific community (articles in major journals)
- Maintained the Beall's List for years (under his true name!)
- Legal threat by OMICS Publishing Group (and others?)
- His web site was removed January 15, 2017
- Fired? Retired? Tired?

# It happened here

1. A PhD student was asked to submit a manuscript to a special issue of a journal for a conference
   - Perfect timeline, and his talk was mentioned correctly
   - His supervisor/co-author received the same email and said yes, we go
   - Looking at the web site, it was an obvious predatory journal
2. IntechOpen published two chapters authored by a permanent employee of CNRS
   - Tiny no of citations (1+2, as Jan 2023)
   - https://www.intechopen.com/chapters/15257 and https://www.intechopen.com/chapters/37716
3. A permanent employee of CNRS proposed an edited book with IntechOpen
   - The book was entitled *Phase Noise and Jitter*, ISBN 978-1-83880-322-3
   - He asked to a few of us to propose a chapter
   - The case was brought to the Director
   - Intech said they had cancelled the project
   - Update: *Oscillators - Recent Developments* (ISBN: 978-1-78985-838-9) was published in June 2019

# Warnings & advices

- Harmful to your career
- Predatory journals either
  - Sink and change name
  - Climb the gray zone towards legitimacy
- If you are asked to submit articles or to take an (Associate) Editor position
  - Do as you didn’t exist
  - Never answer
  - Never show up
  - Never complain

# Web Resources

- Query about which publishing options are supported by funders https://journalcheckertool.org/
- Serious Directory of Open Access Journals https://doaj.org/
- Predatory Publishing https://predatory-publishing.com/
- Scopus
- ISI
- Probably phasing out (not updated)
  - https://beallslist.net/
  - A list of articles about predatory publisher is here https://predatory-publishing.com/the-most-cited-papers-on-predatory-publishing-in-2022/

# Conferences

In some domains, conferences are more important than journals

Warning: I have no first-hand experience of such cases

# Conference

- Gather people interested in a (broad) topic
  - Every year or every other year
  - Some, every 5–8 years
- At the event
  - Several / a few session in parallel
  - Plenary talks by prestigious scientists
  - Exhibitor area, for Companies
  - May be preceded by a Tutorial day
  - Banquet / Social dinner
  - Lab visit / tourist visit
  - Side program for accompanying persons

# Elderly professor's recommendations

- Attending a conference costs big €€€
  - Take the responsibility of spending it well
- Socialize with colleagues
- Don't be shy (even if it costs a lot to you)
- Wise senior scientists like talking to youngsters
- Spend time with people relevant to your research
  - Identify them ASAP
  - Use a checklist
- Do not gather in a ghetto. Don't
  - All French PhD students on a table
  - All people from the same lab sitting together
- Privilege foreigner colleagues
- A network of friends is important for your career

# Lectures, posters and tutorials

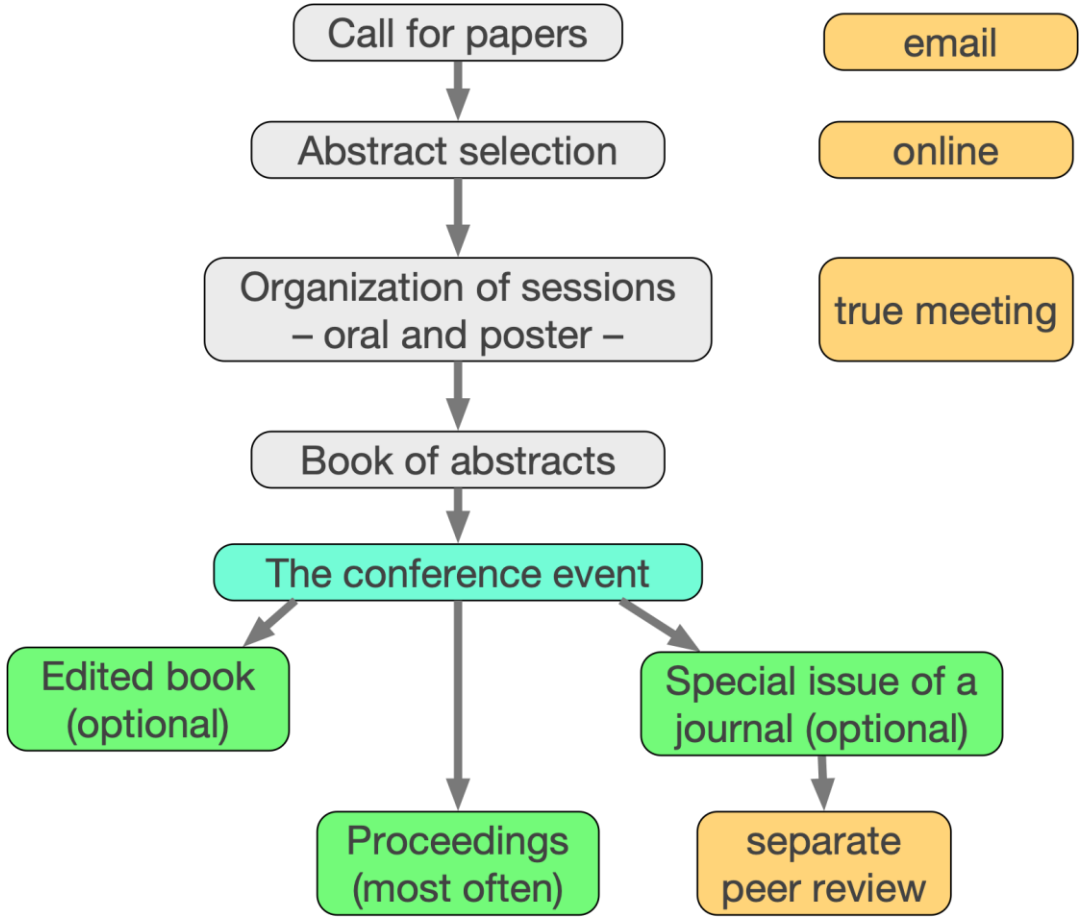
- Regular Lecture
  - 15–20 M
- Plenary (invited) lecture
  - True invited lecture, full audience (no division in sessions)
- Invited lecture
  - Longer time slot, 30–40 M
  - Privileged (begin/end of a session, not last day, …)
  - Often, “invited” at the speaker’s expense
- Poster session
  - Space and time slot for discussion
  - Often in a large room, with coffee, cookies and exhibitors
  - Generally considered lower rank, vs lecture
  - Very few topics are more suitable to poster than to lecture
- Tutorials
  - Intended to teach
  - Lecturers are invited
  - Long (1-2 H)
  - The day before the conference, but it may be a full-week course
  - Sometimes the leturer waives the conference registration fees

# Student competition

- Not all conferences
- Separate registration for the competition (free)
- Examining board
  - The student presents (1+ authors, but only 1 candidate)
  - Usually a poster, but may be a lecture
  - Questions and answer
  - Decision
- Awards given in plenary session / event

# True peer-review conferences

- Extended abstract
  - 2–4 pages, dense 2-column format
- Online peer-review process
- Scientific committee decides the sessions
- Very competitive access to oral sessions
- Tough selection even for poster sessions
- Often the abstract are published in a book
- Full articles
  - A separate (tougher) peer-review process
  - Either a book, or a Special Issue of a journal



# True peer-review conference – example



**Abstract**

Combined magneto-optic and magnetic force microscopy is introduced as a quantitative magnetic characterization technique for nanostructured thin films. Stray field and magnetization values can be imaged over large areas with high spatial resolution as will be shown for patterned hardmagnetic films.

**Introduction**

The ongoing progress in microfabrication of magnetic components calls for advanced magnetic characterization techniques for material defects in patterning and material variations of magnetic properties. Often a quantitative analysis of local magnetic properties on the length scale of these inhomogeneities is required instead of integral magnetometry. A comparative quantitative analysis requires comparable measurement values, i.e. traceable calibration procedure. To understand the underlying physical origins of local properties, an additional micromagnetic analysis is necessary, i.e. high resolution imaging of the underlying domain structure. Microstructured magnetic components such as data storage devices consist of extensive arrays of individual elements. Hence an appropriate technique additionally requires a large imaging area.

We will show that a combination of advanced magneto-optic microscopy using indicator films (MOIF) and magnetic force microscopy (MFM) fulfills requirements stated above.

**Measurement Technique**

i) *Quantitative stray field analysis* is done by MOIF. MOIF was developed as a fully quantitative stray field analysis technique for superconductors [1]. Areas of several millimeters can be imaged. However, stray fields above magnetic microstructures and domains are quite small and have short decay lengths. Hence sensitive and thin indicator films are required. We used rare earth doped Yttrium-Iron-Garnets RE-$Y_{3-x}Bi_xFe_5O_{1}$ with a high Faraday rotation and an in-plane axis of magnetization. They are sensitive to out-of-plane component of the stray field. Advantage of the MOIF-technique is that the response function of the sensors can easily be calibrated by an external field [2, 3], thus yielding traceable quantitative field imaging. Furthermore, the usage of thin RE-YIG indicator films with a thickness below 1 $\mu m$ makes it possible to achieve a high spatial in-plane resolution of about 300 nm. Stray field and magnetization (see below) can be determined with an accuracy of about 10%.

ii) *The magnetization distribution* $\vec{M}(x,y,z)$ has to be calculated from the measured stray field. In general, this inverse problem does not have a unique solution. In the case of thin hard magnetic films it is admissible to neglect the thickness dependence of $\vec{M}$, i.e. $\vec{M}(x,y,z) = \vec{M}(x,y)$. Numerical stray field inversion algorithms have been developed that allow us to calculate local magnetization distribution from measured stray field for strictly in-plane and out-of-plane magnetization, $\vec{M}(x,y) = (M_x, M_y, 0)$ and $\vec{M}(x,y) = (0,0,M_z(x,y))$ respectively.

iii) *High resolution domain imaging* is done by MFM [4, 5]. The measurements are performed with a commercial microscope (Nanoscope IIIa, Veeco) in tapping lift mode at a lift height of 50 nm, where the phase shift of the forced oscillation of the tip cantilever is monitored. The magnetic tips were magnetized along the tip axis and thus are sensitive to the out-of-plane component of the stray field as is the MOIF-technique. The spatial in-plane resolution is 30 nm.

**Experiments**

**Example of Application** To demonstrate the potential of the combined technique, an exemplary characterization of a patterned hard magnetic film has been performed.

An LI of 50 nm thickness with predominant in-plane anisotropy was patterned into arrays of 5 µm squares. Fig. 1 the three steps that are required for a complete analysis are summarized for the example of an array of $5 \times 5\ \mu m^2$ squares. In the left hand part a cutout of an $150 \times 200\ \mu m^2$ stray field image is shown (i). The MOIF signal is calibrated to yield quantitative values for the out-of-plane component of the magnetic stray field $B_z$, shown in the line plots. We then calculate a quantitative magnetization distribution M from the $B_z(x,y)$ pattern taking into account that the magnetization is perpendicular. The result is shown in chart (ii).

Two different magnetization states with different

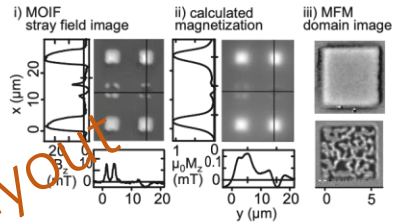



Figure 1: Results of the combined MOIF and MFM characterization of an array of $5 \times 5\ \mu m^2$ squares.

net magnetization values (bright and dark dots) can be observed. Since the magnetic structure with domain widths in the range cannot be resolved by MOIF. Additional MFM investigations have been Fig. (iii) shows the domain structure with different net magnetization direction, while the upper (bright) dot is in a mono domain state, the lower (dark) dot shows a stripe domain pattern which is reflected in the reduced net magnetization value.

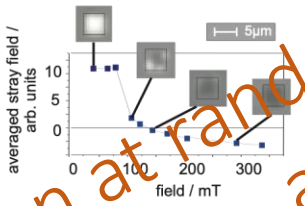



Figure 2: Stray field images and average stray field of a $5 \times 5\ \mu m^2$ square in the course of a remanence curve.

**Remanence Curves.** The combined technique is particularly suitable for the spatially resolved characterization of magnetic switching, as for example for an analysis of the hysteretic behavior of individual patterned elements. To illustrate this specific applications of remanence curves are shown. A patterned CoPt arrays were magnetized in one direction and then remagnetized with increasing reversed external fields $B_{ext}$. After each magnetization step an MOIF and MFM characterization of the remanent state was performed. In Fig. 2 the MOIF stray field image and the average stray field of one $5 \times 5\ \mu m^2$ square are plotted. The values of $B_{ext}$. The average stray field are initially stays constant (stage 1). The external field to 100 mT causes a jump in average stray field followed by a continuous change (stage 2). By means of the stray field inversion, remanent

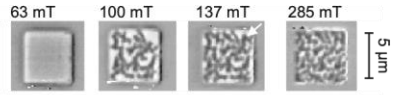



Figure 3: MFM images of $5 \times 5\ \mu m^2$ CoPt squares at different points of a remanence curve (cf. text).

magnetization curves can be determined as well.

The two stages in the remagnetization easily be understood from complementary domain images. Fig. 3 shows MFM images taken in the remagnetization process. The domains remains mono domain up to an of 63 mT. Upon increasing the field domains with reversed magnetization field (dark) nucleate. With increasing field these energetically favorable reversed domains grow. Thus the average magnetization is decreased and, therefore, also the stray field.

Similar experiments also have been performed in patterned films with in-plane anisotropy.

**Summary**

The combined MOIF and MFM technique allows one to measure local magnetic properties and switching behavior. Local stray field and magnetization values can be determined quantitatively. This technique allows one to characterize individual and thus whole arrays of patterned elements in a single shot mode. The MFM measurement is the complementary high resolution domain imaging, which is necessary to relate the MOIF results to the micromagnetic configuration.

**References**

[1] L. A. Dorosinskii, M. Indenbom, V. I. Nikitenko, A. Yu. Ossipyan, A. A. Polyanskii, and V. K. Vlasko-Vlasov, "Studies of HTSC crystal magnetization features using indicator magnetooptic films with in-plane anisotropy," *Physica C*, vol. 203, p. 149, 1992.

[2] Ch. Jooss, A. Forkl, R. Warthmann, H.-U. Habermeier, B. Leibold, H. Kronmller, "Thickness and roughness dependence of magnetic flux penetration and critical current densities in YBaCuO thin films", *Physica C*, vol. 266, p. 233, 1996.

[3] A. A. Polyanskii, D. M. Feldmann, D. Larbalestier in *Handbook of Superconducting Materials*, ed. D. Cardwell and D. Ginley, IOP Publishing, Bristol, 1999.

[4] C. Binnig, C. F. Quate, and Ch. Gerber, "Atomic force microscope", *Phys. Rev. Lett.*, vol. 56, p. 930, 1986.

[5] Y. Martin and K. K. Wickramasinghe, "Magnetic imaging by force microscopy with 1000 Å resolution ", *Appl. Phys. Lett.*, vol. 50, p. 1455, 1987.

# Easy conferences

- Short abstract (half page, one column)
- Fast online check on abstracts
- Scientific committee decides the sessions
- Rather easy access to oral sessions
- Almost all articles admitted to poster sessions
- All full articles published in the Proceedings
  - No peer review process
  - No proofreading
- Sometimes, a “Special Issue” of a journal
  - Regular peer-review process

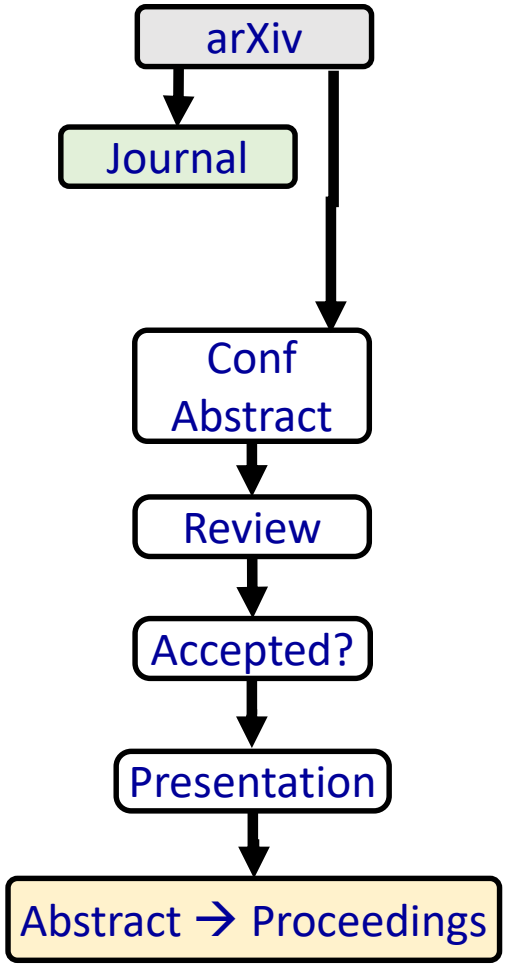
May be serious, especially in small communities

# Recommendations for conference proceedings

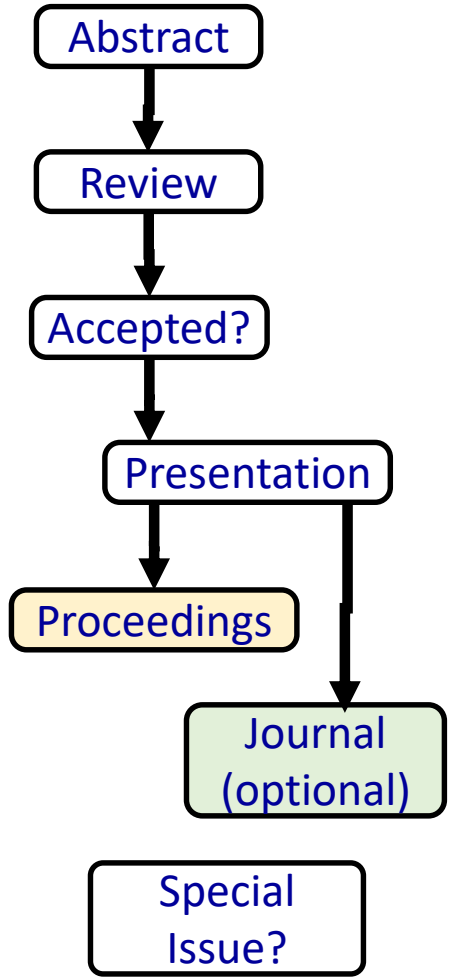
- Target a journal before the conference
- Read carefully the policy
- Journals may not accept the proceedings version, regardless of the value
- Wise choice
  - Do not submit a proceedings article
  - The conference publishes the abstract
  - You have more freedom with journals

- Lecture/poster must be presented
- Authors encouraged to publish in the proceedings
- Usually 4-8 pages
- No peer review for the proceedings
- Special Issue of a journal —> peer review

## Modern




## Old guard



# Predatory conferences

All what we said about Predatory applies to conferences

- Little or no scientific organization
- Time and site appropriate for vacations
- Scope encloses too wide set of topics
- No or poor Scientific Council
- Gifts included in the registration charges
- The session chairman is expected to find the speakers
- Etc…

# The weird case of WMSCI 2005

World Multiconference on Systemics, Cybernetics and Informatics

- Multiple bogus conferences on many different topics organized by Nagib Callaos
- Too many boring "call for papers" spammed
- In 2005, Jeremy Stribling, Daniel Aguayo, and Maxwell Krohn, PhD students at MIT, implemented SCIGEN, a generator of random articles
- Their nonsensical article was accepted
- They rented a room next the WMSCI, and explained their "random article generator" to the WMSCI attendees!!!
- Soon after, Nagib Callaos disappeared (retired, fired, or whatever else)
- Surprisingly, the WMSCI survived for a while, with Callaos back on the stage
  - Update: The WMSCI is alive (July 2022), But Callaos was not there
- MIT kept SCIGEN alive!
  - Try http://pdos.csail.mit.edu/scigen it's real fun
- BBC News talked about the MIT grads http://news.bbc.co.uk/2/hi/americas/4449651.stm

Moral: Don't f*** with world-class PhD students

# Artificial Intelligence boots

- Modern technologies are inevitable
- Help with grammar and syntax
- Suggest contents and citations
- Do most of the job
- Dangerous land
- Be extremely cautious

# Organization of a Short Article

A vital trick

Understand the difference between
fast reading and deep reading

Write for both reading levels

# The IMRaD format for scientific papers

Suitable to short articles and letters

(Titles may not be appear explicitly)

- Title
- Abstract
- Core of the article
- Acknowledgments
- References

Core of the article

- Introduction
  - What was the question?
- Methods
  - How did you try to answer it?
- Results
  - What did you find?
- Discussion
  - What does it mean?

I learned IMRaD from an older edition of Barbara Gastel and Robert A. Day, *How to Write and Publish a Scientific Paper*, 9th ed., Greenwood 2022

# Example of article

arXiv:1702.04669 [physics.ins-det]

Later published on
Phys. Rev. Lett. 118, 263202, 28 June 2017
DOI 10.1103/PhysRevLett.118.263202

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Question:
Albeit the Matei's article is reproduced (almost) in full, this lecture note is not a derivative work.
Why?

The reference to PRL should be here



## 1.5 $\mu$m lasers with sub 10 mHz linewidth

D.G. Matei,[1,*] T. Legero,[1] S. Häfner,[1] C. Grebing,[1,†] R. Weyrich,[1] W. Zhang,[2] L. Sonderhouse,[2] J.M. Robinson,[2] J. Ye,[2] F. Riehle,[1] and U. Sterr[1]

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We report on two ultrastable lasers each stabilized to independent silicon Fabry-Pérot cavities operated at 124 K. The fractional frequency instability of each laser is completely determined by the fundamental thermal Brownian noise of the mirror coatings with a flicker noise floor of $4 \times 10^{-17}$ for integration times between 0.8 s and a few tens of seconds. We rigorously treat the notorious divergencies encountered with the associated flicker frequency noise and derive methods to relate this noise to observable and practically relevant linewidths and coherence times. The individual laser linewidth obtained from the phase noise spectrum or the direct beat note between the two lasers can be as small as 5 mHz at 194 THz. From the measured phase evolution between the two laser fields we derive usable phase coherence times for different applications of 11 s and 60 s.

It is well known that frequency is the physical quantity that can be measured with by far the highest accuracy. "Never measure anything but frequency!" was the advice of Arthur Schawlow [1]. The high accuracy results from the fact that the phase of a purely periodic signal can be measured in the simplest case by counting the zero crossings of the signal within a given time or with even increased accuracy by a phase measurement that interpolates the signal between the zero crossings. Hence, the generation of truly phase coherent signals over long times is the key to precision measurements and enabling technologies. In the most advanced optical atomic clocks [2–5] pre-stabilized lasers serve as oscillators to interrogate ultranarrow optical transitions with linewidths of a few mHz. Oscillators with coherence times of tens to

signed locking electronics, the fractional frequency stability of the laser is given by the fractional stability of the optical length of the cavity. Fundamentally, the cavities' length stability is limited by statistical Brownian noise of the mirror coatings, substrates, and spacer [20]. Due to the inherently low thermal noise of crystalline silicon, the cavities' length fluctuations are dominated by the dielectric mirror coatings, despite their thickness of only a few tens of micrometers. The cryogenic cooling of the cavities further reduces the thermal noise and allows for a fractional length instability of the cavities of $\Delta L/L \approx 10^{-17}$.

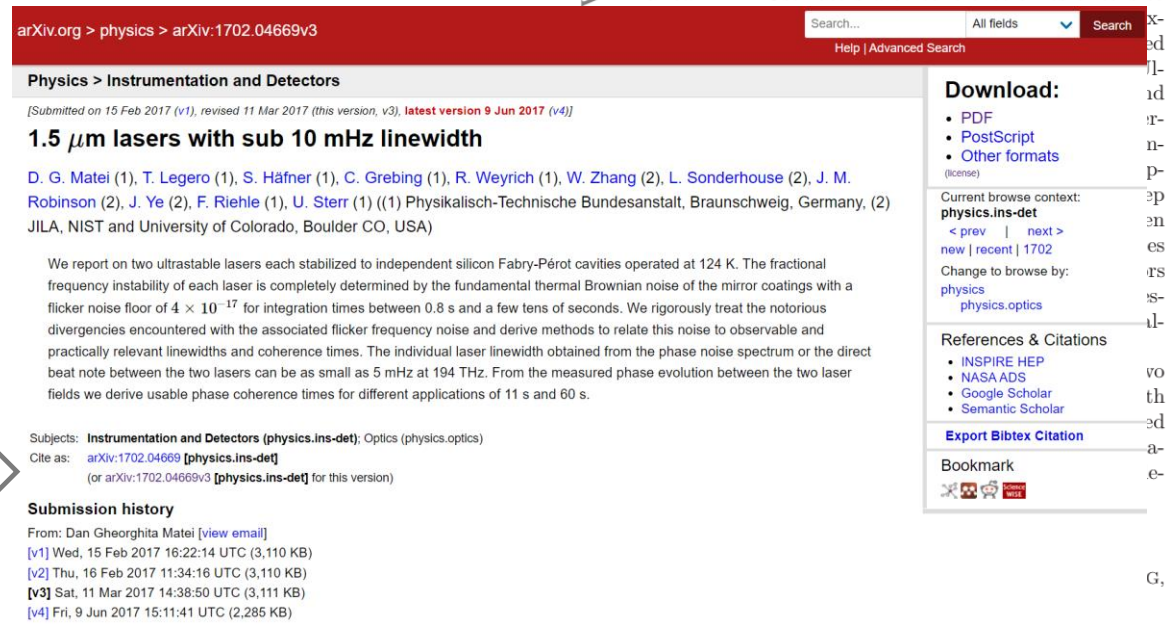
Previously, with such a system (named Si1) we demonstrated a frequency instability of $1 \times 10^{-16}$ [14]. We have now set up two systems (named Si2 and Si3) where we have reduced all additional noise sources [21] to a level well below the thermal noise limit.

In the following we describe briefly the set-up [22] and the analysis of the frequency stability and the phase noise. We subsequently derive methods to relate the dominant flicker frequency noise to observable and practically relevant linewidths and coherence times.

Each cavity consists of a plano-concave mirror pair employing high-reflectivity $Ta_2O_5/SiO_2$ dielectric multilayers. The finesse of the $TEM_{00}$ mode of each cavity is close to 500 000. The 212 mm long spacer and the mirror substrates are machined from single-crystal silicon [14]. The crystal orientation of the optically contacted substrates is aligned to that of the spacer. Both have the silicon ⟨111⟩ axis oriented along the cavity axis.

The cavities are aligned vertically and are supported at three points near the midplane in order to minimize the impact of seismic and acoustic vibrations on their length stability. The anisotropic elasticity of silicon was used to minimize the vertical vibration sensitivity below $10^{-12}/(\mathrm{m\,s^{-2}})$ by adjusting the azimuthal angle between the cavity and its tripod support [21].

The cavities are placed in separate vacuum systems at a residual pressure below $10^{-9}$ mbar. The cavity tem-



Authors

Title

# 1.5 $\mu$m lasers with sub 10 mHz linewidth

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Abstract

We report on two ultrastable lasers each stabilized to independent silicon Fabry-Pérot cavities operated at 124 K. The fractional frequency instability of each laser is completely determined by the fundamental thermal Brownian noise of the mirror coatings with a flicker noise floor of $4 \times 10^{-17}$ for integration times between 0.8 s and a few tens of seconds. We rigorously treat the notorious divergencies encountered with the associated flicker frequency noise and derive methods to relate this noise to observable and practically relevant linewidths and coherence times. The individual laser linewidth obtained from the phase noise spectrum or the direct beat note between the two lasers can be as small as 5 mHz at 194 THz. From the measured phase evolution between the two laser fields we derive usable phase coherence times for different applications of 11 s and 60 s.



## Introduction

It is well known that frequency is the physical quantity that can be measured with by far the highest accuracy. "Never measure anything but frequency!" was the advice of Arthur Schawlow [1]. The high accuracy results from the fact that the phase of a purely periodic signal can be measured in the simplest case by counting the zero crossings of the signal within a given time or with even increased accuracy by a phase measurement that interpolates the signal between the zero crossings. Hence, the generation of truly phase coherent signals over long times is the key to precision measurements and enabling technologies. In the most advanced optical atomic clocks [2–5] pre-stabilized lasers serve as oscillators to interrogate ultranarrow optical transitions with linewidths of a few mHz. Oscillators with coherence times of tens to hundreds of seconds will allow for investigations of extremely small energy shifts in the clock transition, caused by sources such as interactions amongst atoms [6, 7]. Ultrastable oscillators beyond the state of the art will find useful applications in sub-mm very long baseline interferometry (VLBI) [8], atom interferometry and future atom-based gravitational wave detection [9, 10], novel radar applications [11], the search for dark matter [12], and deep space navigation [13]. Consequently, large effort has been put into the development of extremely coherent sources based on highly stable optical Fabry-Pérot resonators [14–17]. Alternative schemes are currently being investigated using cavity-QED systems [16, 18] and spectral-hole burning in cryogenically cooled crystals [19].

Here we report on the coherence properties of two cavity-stabilized laser systems operating at a wavelength of 1542 nm. Our systems are based on well-isolated single-crystal silicon Fabry-Pérot resonators, temperature stabilized at 124 K. For a system that has well designed locking electronics, the fractional frequency stability of the laser is given by the fractional stability of the optical length of the cavity. Fundamentally, the cavities' length stability is limited by statistical Brownian noise of the mirror coatings, substrates, and spacer [20]. Due to the inherently low thermal noise of crystalline silicon, the cavities' length fluctuations are dominated by the dielectric mirror coatings, despite their thickness of only a few tens of micrometers. The cryogenic cooling of the cavities further reduces the thermal noise and allows for a fractional length instability of the cavities of $\Delta L/L \approx 10^{-17}$.

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The cavities are placed in separate vacuum systems at a residual pressure below $10^{-9}$ mbar. The cavity temperature is stabilized to 124 K where a zero crossing of the coefficient of thermal expansion of silicon occurs [14, 21]. Each system is mounted on separate optical tables, about 3 m apart. The systems have their own active vibration isolation platforms and are surrounded by individual acoustic and temperature insulation boxes. They strongly suppress individual and thus also common noise contributions to below the thermal noise level on timescales up to several minutes [21].

Commercial Er-doped distributed feedback (DFB) fiber lasers at 1542 nm are frequency stabilized to the cavities using the Pound-Drever-Hall (PDH) method [23]. Fiber-coupled acousto-optic modulators (AOM) are used for the fast servo allowing locking bandwidths of around 150 kHz. Active residual amplitude modulation (RAM) cancellation [24] is employed to keep the corresponding fractional frequency fluctuations below the thermal noise level of the system [21].

To obtain the individual frequency instabilities of the Si2 and Si3 lasers, we compared them to a third ultrastable laser based on a 48 cm long ultra low expansion glass (ULE) cavity at 698 nm [15]. The frequency gap between the 1.5 $\mu$m Si2 system and the 698 nm ULE-cavity laser was bridged using a fiber-based optical frequency comb as a transfer oscillator [25, 26]. The comb introduces negligible noise that is below the thermal noise floor of the ULE cavity. Additional noise arising from the optical fibers connecting the lasers and the frequency comb is suppressed with active noise cancellation [27].

## Results

We measured the beat frequencies 'Si2 – Si3' and 'Si2 – ULE' using synchronized counters [28]. The third beat frequency 'Si3 – ULE' is calculated as their difference which is justified since our beat measurement system does not introduce appreciable additional noise.

We do not expect correlations between the ULE-cavity system, the optical frequency comb and the Si-systems, since they reside in three different rooms. Thus, the three difference frequencies allowed us to derive the three individual instabilities from a simple three-cornered hat analysis [29] (Fig. 1). The relative linear frequency drift between Si2 and Si3 of about 100 $\mu$Hz/s (comparable with the figure reported in Ref. [30]) and between Si2 and the ULE laser of 15 mHz/s is removed.

The three-cornered hat results (Fig. 1) [32] indicate that for averaging times from 0.8 s up to 10 s the instability of each Si-based laser system is at the expected thermal noise flicker floor of mod $\sigma_y = 4 \times 10^{-17}$. This corresponds to a standard Allan deviation of about $5 \times 10^{-17}$ [33]. For short averaging times the increase in the instability is due to residual vibration and acoustic noise. At long averaging times we see the effect of slow temperature fluctuations affecting the cavity length and of parasitic etalons in the optical setup.

A more complete characterization of the noise processes is given by the power spectral density (PSD) of the phase fluctuations. We have determined the phase of the beat signal from the measured in-phase and quadrature signal components. From more than 37 hours of phase data we determine the phase noise spectrum of a single laser down to Fourier frequencies of 0.1 mHz (Fig. 2), modeled as

$$S_\phi(f) = \nu_0^2 \sum_{k=-2}^{0} h_k f^{k-2}. \qquad (1)$$

From 1 mHz to 1 Hz the noise spectrum closely follows the thermal frequency flicker noise with $h_{-1} = 2.5 \times 10^{-33}$, in agreement with the expected thermal noise. From 1 Hz to 3 kHz the seismic and acoustic perturbations above the thermal noise lead to a number of narrow peaks. The base line of the spectrum can be approximated by white frequency noise with $h_0 = 3.6 \times 10^{-33}$ s consistent with the increase of the instability at short averaging times (Fig. 1). Other possible sources such as photon shot-noise, RAM, laser power fluctuations are well below that level. At higher frequencies, the three broad peaks at 8 kHz, 60 kHz, and 150 kHz result from the servo loops for RAM regulation, fiber noise cancellation and PDH lock to the cavity, respectively. Below 1 mHz slow temperature fluctuations lead to a random walk frequency noise with $h_{-2} = 4 \times 10^{-36}\ \mathrm{s^{-1}}$, corresponding to the Allan deviation values above 100 s.

In the following we use this data to derive values for laser linewidth and coherence time. Usually, linewidth and coherence time are derived from the autocorrelation function of the laser field with amplitude $E_0$ and center

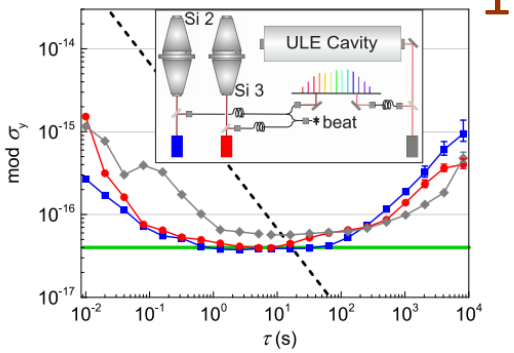


FIG. 1. Modified Allan deviation for Si2 (squares), Si3 (circles) and ULE laser (diamonds) derived from three-cornered hat estimations. We used a 3.4 h dataset for 10 ms $\leq \tau \leq$ 4 s and a 24.2 h dataset for 8 s $\leq \tau \leq$ 8192 s, recorded in the same day. The green line shows the expected thermal noise of the silicon cavities. For a certain evaluation model [31] the dashed line represents the instability where the rms phase fluctuations are $\sqrt{2}$ rad for a given $\tau$. The intersections with the instability curves of the Si-lasers result in coherence times of 16 s. Linear frequency drifts in each dataset were subtracted. The inset shows a schematic of the measurement setup.

## Methods

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† currently with TRUMPF Scientific Lasers GmbH + Co. KG, Feringastr. 10a, 85774 Unterföhring, Germany

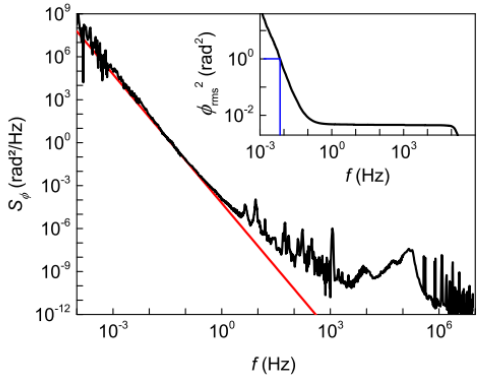


FIG. 2. PSD of phase fluctuations of a Si stabilized laser, obtained as one half of the PSD of the Si3 – Si2 beat. The red line shows the expected flicker frequency noise corresponding to the thermal noise at T = 124 K. The inset shows the rms phase noise integrated down from 10 MHz. A value of 1 rad$^2$ is obtained after integrating down to 6.8 mHz (blue markers) leading to a FWHM linewidth of 13.6 mHz.

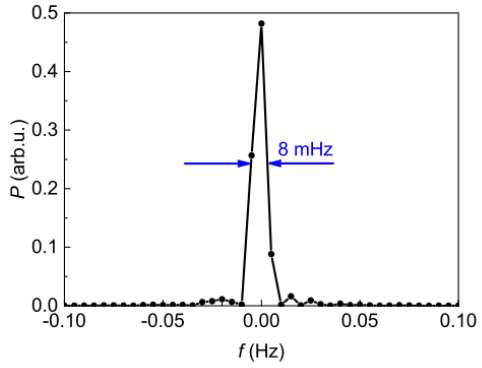


FIG. 3. FFT spectrum of the beat note between lasers Si2 and Si3 (frequency resolution 5 mHz).

frequency $\nu_0$,

$$R_E(\tau) = E_0^2 e^{i2\pi\nu_0\tau} e^{-1/2\left\langle(\phi(t+\tau)-\phi(t))^2\right\rangle}, \quad (2)$$

$$R_E(\tau) = E_0^2 e^{i2\pi\nu_0\tau} e^{-2\int_0^\infty S_\phi(f)\sin^2(\pi f\tau)df}. \quad (3)$$

Flicker frequency noise and random walk frequency noise are the dominant noise processes in our lasers. In this case the laser frequency $\nu(t)$ is nonstationary and $R_E(\tau)$ is divergent so that no unique coherence function can be assigned. This also leads to divergences in the general definition of the field spectrum $S_E(\delta\nu)$ as the Fourier transform of the autocorrelation function $R_E(\tau)$ (Eq. 2) and thus no uniquely defined linewidth exists. Nevertheless we can derive linewidths that are closely related to the experimental observations.

If a spectrum is recorded for a measurement of duration $T_0$ the linewidth is limited by the Fourier width proportional to $1/T_0$ for short measuring times whereas for longer measurement times the nonstationary frequency fluctuations broaden the line. In such a case a practical linewidth can be defined by the minimum.

To elaborate this approach Bishof *et al.* [17] make the assumption that only Fourier components of the phase noise spectrum for frequencies $f > 1/T_0$ contribute during the measurement time $T_0$. From our phase noise model (Eq. 1) we obtain a minimal linewidth of $\Delta\nu_{\mathrm{FWHM}} = 7$ mHz for $T_0 = 170$ s [34].

Experimentally we obtain linewidths from a fast Fourier transform (FFT) of the beat between the two lasers, after the beat is mixed down to a carrier frequency suitable for data acquisition. We choose 200 s measurement time to allow for sufficiently high frequency resolution while keeping the influence of slow frequency fluctuations small enough. Experimentally, in about 25% of the measurements we obtain full-width-half-maximum (FWHM) linewidths $\Delta\nu_{\mathrm{FWHM}}$ of the beat signal between 7 mHz and 10 mHz (see Fig. 3), leading to individual linewidths as small as 5 mHz to 7 mHz, assuming that both lasers contribute equally to the linewidth. This standard approach of measuring the linewidth seems to give a reasonable agreement with the calculated minimal linewidth of 7 mHz according to [17].

To provide a linewidth estimate that includes all fluctuations of the flicker frequency noise, we averaged all FFT spectra obtained from the data set of 37 h after first aligning their centers of mass [35]. This results in an average linewidth for a single laser of about 13 mHz for a measurement time of 150 s. The difference between this longterm averaged value and the calculated minimal linewidth can be explained by the different ways the low-frequency cut-off is introduced. If a FFT spectrum analyzer is used the spectrum is centered at the average frequency during the measurement time $T_0$ which corresponds to a subtraction of the linear phase evolution term. Thus significant quadratic terms still contribute to the phase excursion which correspond to noise at frequencies of approximately $1/2T_0$ that is not included in the approximation of [17]. The narrower linewidths that we have observed (Fig. 3) are cases where the random quadratic term happened to be small.

Many applications are not directly sensitive to the FWHM linewidth but require sufficient spectral power in a narrow bandwidth $\Delta\nu_{\mathrm{P}}$. This bandwidth can be estimated by integrating the phase noise from high-frequencies towards zero [36, 37]. The half bandwidth is obtained as the lower integration limit in

$$\int_{\Delta\nu_{\mathrm{P}}/2}^{\infty} S_\phi(f)\,\mathrm{d}f = 1\,\mathrm{rad}^2\,, \quad (4)$$



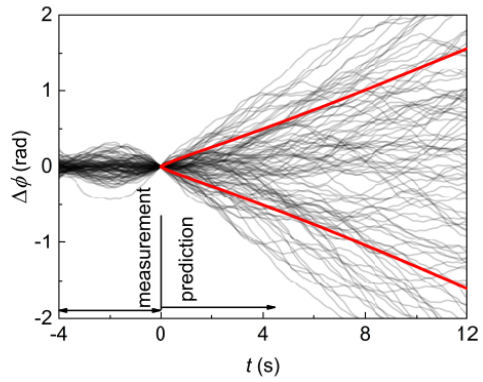


FIG. 4. The evolution of the phase difference between the two Si lasers. The first 4 s segment is used to estimate the average frequency $\overline{\nu}$ at $t = 0$ s. For $t = 0 - 12$ s, the phase deviation from the expected $2\pi\overline{\nu}t$ is calculated. 100 consecutive curves are shown with thin gray lines. The red lines indicate the $\pm\Delta\phi_{\mathrm{rms}}$ range, evaluated statistically from 20 750 curves.

corresponding to the case when one third of the power is contained in the bandwidth $\Delta\nu_{\mathrm{P}}$ [37]. For this definition we find a value of $\Delta\nu_{\mathrm{P}} = 14$ mHz (see inset of Fig. 2).

For many applications it is important to provide effective coherence times of ultrastable oscillators. For this purpose, depending on the particular application, different methods must be employed to adequately consider the nonstationary frequency. One model, widely used in VLBI [31], results in a coherence time of 16 s (Fig. 1).

As an example more adequate for optical clocks we investigate a two-pulse Ramsey interrogation of atoms. There, an average frequency and frequency drift can be estimated from past measurements and considered in the current interrogation in order to keep the phase excursions $\Delta\phi$ between the two pulses sufficiently small.

We simulate such a scenario using the phase evolution of the 'Si2 – Si3' beat recorded for 1 day. We cut this dataset into short samples and fit a linear phase to the first 4 s ($t = -4$ s…0 s) to determine the average frequency $\overline{\nu}$. The phase $2\pi\overline{\nu}t$ is subtracted and the phase at $t = 0$ is set to zero to obtain the phase deviation $\Delta\phi$ for $t \geq 0$. Fig. 4 shows 100 of these samples, which indicate a time-dependent broadening. The root-mean-square deviation $\Delta\phi_{\mathrm{rms}}(t)$ of the normally distributed phase deviation was calculated from 20 750 samples ($\pm1\Delta\phi_{\mathrm{rms}}$ indicated by red lines). The coherence is certainly lost when the phase has acquired an uncertainty of $\Delta\phi_{rms} \approx \pi$ (at $t \approx 30$ s) but depending on the application, more restricting definitions of the coherence time are in use. In a more conservative way we define the coherence time as a duration in which $\Delta\phi_{\mathrm{rms}}$ has increased to 1 rad (i.e., $\sqrt{2}$ rad for the phase difference between the two independent lasers shown in Fig. 4), leading to a coherence time of 11 s. This is equivalent to saying that after 11 s in more than 99% of all cases the actual phase excursions remain below $\pm\pi \approx 3\,\phi_{\mathrm{rms}}$, which ensures unambiguous phase tracing. We find that this value of 11 s represents a broad maximum in the coherence time when the Ramsey interrogation time varies between 4 s and 20 s [38].

Besides situations where the future phase must be predicted there are many applications where the average frequency can be determined in retrospect from the measurement itself. Typical examples are spectral analysis, when the spectrum is centered, or the Rabi interrogation of atoms by single pulses, where the observed excitation provides the information of the average frequency during the measurement time. Analysis of our measured phase data shows that in this case a rms phase deviation of 1 rad occurs at measurement intervals of about 60 s, in agreement with the value estimated from the Allan deviation [38].

In conclusion, we have demonstrated the operation of two cryogenic optical silicon cavities at the thermal noise limit of mod $\sigma_y = 4 \times 10^{-17}$. The light stabilized on these cavities is highly coherent, with a coherence time of about 16 s (Fig. 1) [31]. As seen from the spectral analysis, the linewidth and implicitly the coherence time are mostly determined by the thermal noise level.

Optimizations of the current setup would hardly bring a longer coherence time since we are nearing a fundamental limit. The only way of further improving the current performance is to decrease the thermal noise even further. One approach is to decrease the temperature, thus reducing the thermal motion in the system. For an operating temperature of 4 K the expected thermal noise would be $8 \times 10^{-18}$ in the modified Allan deviation. A comparable noise figure would be achieved by employing AlGaAs-based crystalline coatings, which offer a higher mechanical Q-factor and thus a lower thermal-induced noise [39, 40]. If both methods are implemented, the thermal noise would be reduced to the lower half of the $10^{-18}$ range, roughly an order of magnitude lower than the present level. To ensure that this improvement leads to an increased coherence time it is necessary to reduce the longterm instability for averaging times above 10 s (see intersection of dashed line with the thermal noise level in Fig. 1) while the present short-term instability seems to be sufficiently small. Our rigorous analysis of linewidth and coherence time will be tremendously important when we start using this state-of-the-art laser e.g. for investigations of classical and/or quantum correlated atoms [41]. Achieving enhanced stability from quantum correlation (such as spin squeezing) will need a local oscillator that does not introduce excessive phase noise which can easily remove the benefit of correlation [42].

This silicon cavity work is supported and developed jointly by the Centre for Quantum Engineering and

Discussion

Conclusion

Acknowledgments

Space-Time Research (QUEST), Physikalisch-Technische Bundesanstalt (PTB), the JILA Physics Frontier Center (NSF), the National Institute of Standards and Technology (NIST). We acknowledge support by the European Union through the Horizon 2020 project Q-SENSE and from the project EMPIR 15SIB03 OC18. This project has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme. Support has also been received through the European Metrology Research Programme (EMRP) under QESOCAS. The EMRP is jointly funded by the EMRP participating countries within EURAMET, and the European Union. We wish to thank E. Oelker for helpful comments about the manuscript. J. Ye thanks the Alexander von Humboldt Foundation for support. L. Sonderhouse is supported by the DoD under the NDSEG fellowship.

References


[1] T. W. Hänsch, Rev. Mod. Phys. **78**, 1297 (2006).
[2] A. D. Ludlow, M. M. Boyd, J. Ye, E. Peik, and P. O. Schmidt, Rev. Mod. Phys. **87**, 637 (2015).
[3] T. L. Nicholson, S. L. Campbell, R. B. Hutson, G. E. Marti, B. J. Bloom, R. L. McNally, W. Zhang, M. D. Barrett, M. S. Safronova, G. F. Strouse, W. L. Tew, and J. Ye, Nature Com. **6**, 6896 (2015).
[4] I. Ushijima, M. Takamoto, M. Das, T. Ohkubo, and H. Katori, Nature Photonics **9**, 185 (2015).
[5] N. Huntemann, C. Sanner, B. Lipphardt, C. Tamm, and E. Peik, Phys. Rev. Lett. **116**, 063001 (2016).
[6] A. M. Rey, A. V. Gorshkov, C. V. Kraus, M. J. Martin, M. Bishof, M. D. Swallows, X. Zhang, C. Benko, J. Ye, N. D. Lemke, and A. D. Ludlow, Annals of Physics **340**, 311 (2014).
[7] M. J. Martin, M. Bishof, M. D. Swallows, X. Zhang, C. Benko, J. von Stecher, A. V. Gorshkov, A. M. Rey, and J. Ye, Science **341**, 632 (2013).
[8] S. Doeleman, T. Mai, A. E. E. Rogers, J. G. Hartnett, M. E. Tobar, and N. Nand, Publ. Astron. Soc. Pac. **123**, 582 (2011).
[9] J. M. Hogan and M. A. Kasevich, "Atom interferometric gravitational wave detection using heterodyne laser links," arXiv:1501.06797v1 [physics.atom-ph] (2015).
[10] S. Kolkowitz, I. Pikovski, N. Langellier, M. D. Lukin, R. L. Walsworth, and J. Ye, "Gravitational wave detection with optical lattice atomic clocks," arXiv:1606.01859v2 [physics.atom-ph] (2016).
[11] P. Ghelfi, F. Laghezza, F. Scotti, G. Serafino, A. Capria, S. Pinna, D. Onori, C. Porzi, M. Scaffardi, A. Malacarne, V. Vercesi, E. Lazzeri, F. Berizzi, and A. Bogoni, Nature **507**, 341 (2014).
[12] A. Derevianko and M. Pospelov, Nature Physics **10**, 933 (2014).
[13] S. Grop, P. Y. Bourgeois, N. Bazin, Y. Kersalé, E. Rubiola, C. Langham, M. Oxborrow, D. Clapton, S. Walker, J. De Vicente, and V. Giordano, Rev. Sci. Instrum. **81**, 025102 (2010).
[14] T. Kessler, C. Hagemann, C. Grebing, T. Legero, U. Sterr, F. Riehle, M. J. Martin, L. Chen, and J. Ye, Nature Photonics **6**, 687 (2012).
[15] S. Häfner, S. Falke, C. Grebing, S. Vogt, T. Legero, M. Merimaa, C. Lisdat, and U. Sterr, Opt. Lett. **40**, 2112 (2015).
[16] M. A. Norcia and J. K. Thompson, Phys. Rev. X **6**, 011025 (2016).
[17] M. Bishof, X. Zhang, M. J. Martin, and J. Ye, Phys. Rev. Lett. **111**, 093604 (2013).
[18] B. T. R. Christensen, M. R. Henriksen, S. A. Schäffer, P. G. Westergaard, D. Tieri, J. Ye, M. J. Holland, J. W. Thomsen, Phys. Rev. A **92**, 053820 (2015).
[19] S. Cook, T. Rosenband, and D. R. Leibrandt, Phys. Rev. Lett. **114**, 253902 (2015).
[20] K. Numata, A. Kemery, and J. Camp, Phys. Rev. Lett. **93**, 250602 (2004).
[21] D. G. Matei, T. Legero, C. Grebing, S. Häfner, C. Lisdat, R. Weyrich, W. Zhang, L. Sonderhouse, J. M. Robinson, F. Riehle, J. Ye, and U. Sterr, J. Phys.: Conf. Ser. **723**, 012031 (2016).
[22] See Supplemental Material, 'Set-up: reduction of technical noise'.
[23] R. W. P. Drever, J. L. Hall, F. V. Kowalski, J. Hough, G. M. Ford, A. J. Munley, and H. Ward, Appl. Phys. B **31**, 97 (1983).
[24] W. Zhang, M. J. Martin, C. Benko, J. L. Hall, J. Ye, C. Hagemann, T. Legero, U. Sterr, F. Riehle, G. D. Cole, and M. Aspelmeyer, Opt. Lett. **39**, 1980 (2014).
[25] H. R. Telle, B. Lipphardt, and J. Stenger, Appl. Phys. B **74**, 1 (2002).
[26] J. Stenger, H. Schnatz, C. Tamm, and H. R. Telle, Phys. Rev. Lett. **88**, 073601 (2002).
[27] L.-S. Ma, P. Jungner, J. Ye, and J. L. Hall, Opt. Lett. **19**, 1777 (1994).
[28] G. Kramer and W. Klische, in *Proceedings of the 18th European Frequency and Time Forum, Guildford, UK* (IET, London, UK, 2004) pp. 595–602.
[29] J. E. Gray and D. W. Allan, in *Proceedings of the 28th Annual Symposium on Frequency Control, 29-31 May 1974, Atlantic City, New Jersey, New Jersey* (Electronic Industries Association, 2001 Eye Street, N.W., Washington, D.C. 20006, 1974) pp. 243–246.
[30] C. Hagemann, C. Grebing, C. Lisdat, S. Falke, T. Legero, U. Sterr, F. Riehle, M. J. Martin, and J. Ye, Opt. Lett. **39**, 5102 (2014).
[31] See Supplemental Material, 'Coherence time in radio astronomy'.
[32] See Supplemental Material, 'Allan deviation'.
[33] S. T. Dawkins, J. J. McFerran, and A. N. Luiten, IEEE Trans. Ultrason. Ferroelectr. Freq. Control **54**, 918 (2007).
[34] See Supplemental Material, 'Spectral width calculations'.
[35] See Supplemental Material, 'FFT statistics'.
[36] F. L. Walls and A. E. Wainwright, IEEE Trans. Instrum. Meas. **24**, 15 (1975).
[37] J. L. Hall and M. Zhu, in *Laser Manipulation of Atoms and Ions*, Proceedings Internat. School of Physics "Enrico Fermi", Vol. Course CXVIII (North Holland–Elsevier, Amsterdam, 1992) pp. 671–702.
[38] See Supplemental Material, 'Coherence time'.
[39] G. D. Cole, W. Zhang, M. J. Martin, J. Ye, and M. Aspelmeyer, Nature Photonics **7**, 644 (2013).
[40] G. D. Cole, W. Zhang, B. J. Bjork, D. Follman, P. Heu, C. Deutsch, L. Sonderhouse, J. Robinson, C. Franz, A. Alexandrovski, M. Notcutt, O. H. Heckl, J. Ye, and M. Aspelmeyer, Optica **3**, 647 (2016).
[41] E. Paladino, Y. M. Galperin, G. Falci, and B. L. Altshuler, Rev. Mod. Phys. **86**, 361 (2014).
[42] E. M. Kessler, P. Kómár, M. Bishof, L. Jiang, A. S. Sørensen, J. Ye, and M. D. Lukin, Phys. Rev. Lett. **112**, 190403 (2014).




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Why

# Supplemental Material for 1.5 $\mu m$ lasers with sub 10 mHz linewidth

## SET-UP: REDUCTION OF TECHNICAL NOISE

The fractional frequency stability of the laser is directly related to the fractional stability of the optical length of the cavity. We therefore ensured that the external factors are reduced below the level given by the statistical Brownian noise. We address in the following the influence of temperature, laser power fluctuations, mechanical vibrations, and residual gas pressure fluctuations.

As temperature changes induce length fluctuations through thermal expansion, the operating point of the cryostat is chosen such that the cavity temperature precisely matches the zero-crossing point of the coefficient of thermal expansion (CTE) [S1], thus reducing the impact of temperature fluctuations. These are further reduced by enclosing the cavity in two concentric thermal shields, with the outer one being temperature-stabilized using a flow of nitrogen gas and the inner one serving as a buffer. Care has been taken also to reduce the blackbody radiation of the environment reaching the cavity, by using windows that block most of it and by limiting the solid angle through which the radiation can enter. The coefficients for the heat transfer from the room temperature environment to the inner shield and to the cavity were measured for Si3 to be 8(2) $\mu$W/K and 6(2) $\mu$W/K, respectively. For the same system, the time constants for the heat flow between cavity and inner shield and inner shield and active shield are 1.3 days and 6.5 days, respectively. The temperature fluctuations of the cavity are thus reduced to below one nanokelvin for averaging times of a few seconds and affect the length stability only for times of thousands of seconds or longer [S2].

Fluctuations of the intracavity laser power lead to path length fluctuations due to heating caused by the absorbed power. We measured a value of $1.7(2)\times10^{-15}(\mu\mathrm{W})^{-1}$ for both cavities for the proportionality coefficient between fractional frequency and transmitted power fluctuations. The coefficient is small because the cavity is operated near the zero CTE point of the mirror substrates and due to their high thermal conductivity, and thus no active control of the intensity is needed.

Vibrations transmitted to the cavity can change its dimensions, leading to frequency instability. Thus we minimized the sensitivity to accelerations in all directions by employing a stiff holding frame. In addition, the sensitivity to vertical accelerations was experimentally minimized by changing the angle between the three point support and the crystalline axis [S2]. The acceleration sensitivities are summarized in Table S1.

TABLE S1. Acceleration sensitivities for the Si2 and Si3 cavities.

| | sensitivities ($10^{-12}$ /ms$^{-2}$) | | |
|---|---|---|---|
| System | $k_x$ | $k_y$ | $k_z$ |
| Si2 | 2.5(12) | 0.7(6) | 0.4(5) |
| Si3 | 8.6(7) | 4.0(2) | 0.8(5) |

Combined with the measured seismic vibrational spectrum, this ensures that the vibration-induced frequency noise is below the thermal-noise limit for averaging times above 100 ms [S2].

Fluctuations in the residual gas pressure present in ion pumps [S3] also induce frequency instabilities by changing the refractive index of the residual gas between the mirrors and thus altering the optical length. Using ultra-high-vacuum compatible materials and keeping the ion pumps always in the low pressure range, we achieve a stable base pressure of $10^{-9}$ mbar. From the observed pressure fluctuations we estimate that corresponding frequency fluctuations are below $4\times10^{-17}$ for averaging times shorter than a few thousand seconds.

## ALLAN DEVIATION

The modified Allan deviation (mod ADEV) is used to characterize the frequency stability. It reduces the impact of high frequency phase noise on the stability values at longer averaging times, as our beat signals contain phase noise at high frequencies that arises from the frequency comb [S4] and from laser noise at frequencies above the bandwidth of the PDH locks. The modified Allan deviation also enables to distinguish different types of noise that are typically indistinguishable in the Allan deviation [S5, S6].

The modified Allan deviation requires frequency counters that temporally average the frequency fluctuations with a triangular weighting function (so-called Λ-counters [S7, S8]). As our counters [S9] only approximate the Λ-sensitivity from 1 ms measurements with constant weighting function (Π-counter), we additionally bandpass filter the signals with bandwidths of about 1 kHz to better approximate the correct sensitivity function.

## SPECTRAL WIDTH CALCULATIONS

The Wiener-Khintchine theorem relates the field spectrum $S_\mathrm{E}$ to the Fourier transform of the field autocorrelation function

$$R_\mathrm{E}(\tau) = \langle E(t+\tau)E^*(t)\rangle. \tag{S5}$$

For a field $E(t) = E_0 e^{2\pi i\nu_0 t}e^{i\phi(t)}$ with average frequency $\nu_0$ and random phase $\phi(t)$ this autocorrelation function can be expressed as

$$R_\mathrm{E}(\tau) = E_0^2 e^{2\pi i\nu_0\tau}\exp\left(-\tfrac{1}{2}\Delta\phi^2_\mathrm{rms}(\tau)\right) \tag{S6}$$

where we have used the root-mean-square (rms) phase increment

$$\Delta\phi^2_\mathrm{rms}(\tau) = \langle(\phi(t+\tau)-\phi(t))^2\rangle. \tag{S7}$$

The phase increment can be calculated with a sensitivity function

$$h^{(\tau)}(t) = \delta(t-\tau)-\delta(t) \tag{S8}$$

as

$$\phi(t+\tau)-\phi(t) = \int \phi(t+t')h(t')dt', \tag{S9}$$

using the Dirac delta function $\delta(t)$. With the help of Parseval's theorem, the rms value of this convolution can be expressed through the power spectral density of phase fluctuations $S_\phi(f)$ as

$$\Delta\phi^2_\mathrm{rms}(\tau) = \int_0^\infty S_\phi(f)|H(f)|^2 df \tag{S10}$$

$$= 4\int_0^\infty S_\phi(f)\sin^2(\pi f\tau)df \tag{S11}$$

where the Fourier transform of the sensitivity function $h(t)$

$$H(f) = \int_0^{T_0} h(t)\exp(2\pi i f t)dt \tag{S12}$$

is used.

With the power spectral density of frequency fluctuations $S_\nu(f) = f^2 S_\phi(f)$ the corresponding autorcorrelation function reads

$$R_E(\tau) = E_0^2 e^{2\pi i\nu_0\tau}\exp\left(-2\int_0^\infty S_\nu(f)\frac{\sin^2(\pi f\tau)}{f^2}df\right). \tag{S13}$$

However, for frequency noise processes $S_\nu \propto f^k$ that are diverging towards zero frequency with $k \le -1$ this autocorrelation function is diverging. This is due to the fact that the phase difference, expressed by the average frequency $\overline{\nu}_\tau(t)$ in the interval $[t, t+\tau]$

$$\Delta\phi(t) = \phi(t+\tau)-\phi(t) \tag{S14}$$

$$= 2\pi\tau\overline{\nu}_\tau(t) \tag{S15}$$

is nonstationary, so the expectation values needed for the definition of the autocorrelation function $R_\mathrm{E}$ does not exist.

A similar problem appears when trying to use the classical frequency variance $\langle\overline{\nu}(t)^2\rangle$ to describe the stability of oscillators in time domain [S10]. There the Allan variance $\sigma_\nu^2$ is now widely used instead to describe the stability of such sources, which circumvents the divergence of the classical variance by taking the variance between successive average frequencies:

$$\sigma_\nu^2(\tau) = \tfrac{1}{2}\langle(\overline{\nu}_\tau(t+\tau)-\overline{\nu}_\tau(t))^2\rangle. \tag{S16}$$

### Low-frequency cutoff methods

As only finite observation times $T_0$ are used in any real experiment, it is common to avoid the divergence by introducing low-frequency cutoffs $f_\mathrm{co}$ in Eq. (S13). In the work of Stephan *et al.* [S11] a cutoff at $f_\mathrm{co} = 1/\tau$ is introduced. For pure flicker noise $S_\nu = h_{-1}f^{-1}$ this approach leads to a Gaussian line profile and an effective FWHM linewidth $\Delta\nu = 0.3537\nu_0\sqrt{h_{-1}}$ independent of observation time.

Bishof *et al.* [S12] introduce a cutoff at $f_\mathrm{co} = 1/T_0$, which leads to a linewidth that depends on the observation time $T_0$, and its minimum is used as the effective linewidth. To include also the Fourier width due to the limited observation time, windowing functions $w(t)$ are employed in the finite-length Fourier transform [S13], leading to a spectrum of

$$S_\mathrm{E}(f) = \int_0^\infty W(\tau)R_E(\tau)\cos(2\pi f\tau)d\tau. \tag{S17}$$

Here the weighting function for the autocorrelation function $W(\tau)$ is the convolution of the initial weighting function with itself $W(\tau) = (w * w)(\tau)$. E.g. in the case of a rectangular window function of duration $T_0$ it is

$$W(\tau) = (1-|\tau|/T_0). \tag{S18}$$

### Practical spectral measurements

The above methods do not directly correspond to practically employed spectral measurements. One widely used method to measure an effective linewidth is the spectral analysis of the beat signal between two similar oscillators during a limited measurement duration $T_0$ using spectrum analyzer [S14], often based on a Fast Fourier Transform (FFT) of the signal. Here naturally only the width is recorded, while the average frequency of the beat is manually tracked to keep the signal within the observation bandwidth, which compensates for the nonstationary frequency of flicker noise. E.g. for a spectral measurement of duration $T_0$, the average frequency can be determined from the spectrum itself as the central frequency of the observed spectral feature.

Mathematically, this means that no longer the complete phase evolution $\phi(t)$ is analyzed over infinite durations. Instead the expectation value of finite duration spectra from $\phi^{(\mathrm{cor})}(t)$ are considered, where the phase $\phi^{(\mathrm{av})}(t)$ due to the average frequency $\nu^{\mathrm{av}}$ is subtracted from each individual spectrum. Thus the variance of the phase increments in Eq. (S7) is not taken from the real laser phase but for the phase increments corrected by an average phase increment $2\pi\nu^{(\mathrm{av})}(t_2-t_1)$ during the observation time with an average frequency $\nu^{(\mathrm{av})}$.

Steck [S15] uses a weighted averaging depending on $\tau$ and $T_0$ to obtain a FWHM as function of $T_0$. Its minimum for flicker noise $S_\nu(f) = h_{-1}/f$ is $0.5\nu_0\sqrt{h_{-1}}$ at $T_0 = 14\nu_0/\sqrt{h_{-1}}$.

It should be noted that, due to this subtraction, the corrected phase increment in the observation interval in general is no longer invariant to time translation, but now depends on the two times: $\Delta\phi(t_1,t_2)$. The finite-length spectrum (periodogram) with window function $w(t)$ is given as absolute squared Fourier transform of the signal:

$$S_\mathrm{E}(f) = |\mathcal{F}_E(f)|^2 \tag{S19}$$

$$= \int_0^{T_0}\int_0^{T_0} w(t_1)w(t_2)e^{-\frac{1}{2}\Delta\phi^2(t_1,t_2)} \tag{S20}$$

$$\cdot\ \cos(2\pi f(t_2-t_1))dt_1dt_2. \tag{S21}$$

In the simplest way, the average frequency can be calculated from the phase increment during the interval $[t, t+T_0]$:

$$\phi^{(\mathrm{av})} = 2\pi\tau\overline{\nu}(t) = \phi(t+T_0)-\phi(t). \tag{S22}$$

The sensitivity function that corresponds to this interpolation by the average frequency is

$$h^{(\mathrm{int})}(t_1,t_2) = (t_2-t_1)/T_0(\delta(t-T_0)-\delta(t)), \tag{S23}$$

with the corresponding Fourier transforms

$$H^{(\tau)}(t_1,t_2,f) = e^{2\pi i f t_2}-e^{2\pi i f t_1}, \tag{S24}$$

$$H^{(\mathrm{int})}(t_1,t_2,f) = (t_2-t_1)/T_0(e^{2\pi i f T_0}-1), \tag{S25}$$

$$H^{(\mathrm{diff})}(t_1,t_2,f) = H^{(\tau)}(t_1,t_2,f)-H^{(\mathrm{int})}(t_1,t_2,f) \tag{S26}$$

The rms phase variations $\Delta\phi_\mathrm{rms}(t_1,t_2)$ is thus expressed with the help of Parseval's theorem as:

$$\Delta\phi_\mathrm{rms}(t_1,t_2) = \int_0^\infty S_\phi(f)\left|H^{(\mathrm{diff})}(t_1,t_2,f)\right|^2 df, \tag{S27}$$

and the field autocorrelation with a window function $w(t)$ for $\tau > 0$:

$$R_\mathrm{E}(\tau) = E_0^2\int_0^{T_0-\tau} w(t)\,w(t+\tau)\,e^{-\frac{1}{2}\Delta\phi_\mathrm{rms}(t,t+\tau)}dt. \tag{S28}$$

A better approximation to the average frequency is a least square fit to the laser phase, weighted by the window function $w(t)$ of the FFT. Without loss of generality we consider the interval $[0, T_0]$. For the fit we use a sum of orthogonal polynomials $\Pi_k(t)$ over the interval $[0, T_0]$ with weight $w(t)$. For constant weight $w = 1$ these are the shifted Legendre polynomials. Then in the least-square sense the phase is approximated by

$$\phi^{\mathrm{fit}}(t) = \sum_{k=0}^{N} c_k\Pi_k(t), \tag{S29}$$

with coefficients

$$c_k = \int_0^{T_0} w(t)\Pi_k(t)\phi(t)dt. \tag{S30}$$

Thus these coefficients can be expressed as convolution between the phase $\phi(t)$ and a kernel $w(t)\Pi_k(t)$, thus the variance of the corrected phase can be expressed with the help of Parseval's theorem through the product of $S_\phi$ and the square of the absolute value of the Fourier transform $\mathcal{F}(w(t)\Pi_k(t))$.

The rectangular (constant) weighting window and the Hanning window [S13]

$$w(t) = 1-\cos(2\pi t/T_0) \tag{S31}$$

are widely used in FFT spectral analysis. For both window functions we have calculated the phase variance (Fig. S5) and the linewidth as function of the measurement interval length $T_0$ (Fig. S6 (closed sysbols) and Fig. S7). If only the linear phase is fitted ($N = 1$), we expect to obtain the linewidth of the averaged spectra. If the fit also includes a quadratic term ($N = 2$), we expect to find the minimum observed linewidth, as during these measurements the actual frequency drift (i.e. the quadratic phase) was close to zero.

### FFT statistics

For a complete characterization of the linewidth measurements with FFT we used the 37 h phase record used for calculating the phase noise spectrum. The data was broken up in adjacent equal-length segments and a FFT spectrum was obtained for each of them. The spectra were aligned on the frequency axis such that their center of mass is at 0 Hz. For a finer alignment, the resolution bandwidth of the FFT calculation was increased artificially by zero-padding the segments up to eight times

# Supplemental Material



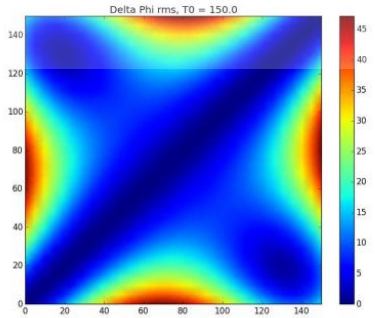


FIG. S5. Phase deviation $\Delta\phi_{\mathrm{rms}}(t_1, t_2)$ for the experimentally observed spectrum of frequency fluctuations, a duration $T_0 = 150$ s and a fit with rectangular weighting function.

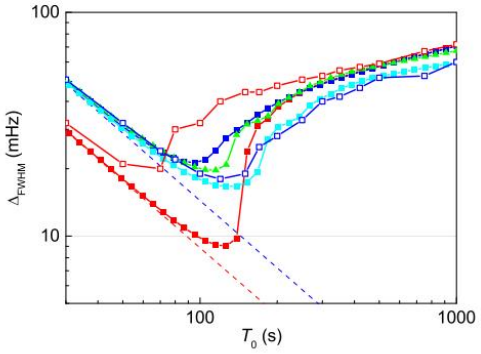


FIG. S6. FWHM beat linewidth $\Delta_{\mathrm{FWHM}}$ as a function of observation time $T_0$. Filled symbols: Calculations using the modeled phase noise spectrum and different methods to deal with the low-frequency divergence: with a cutoff at $f = 1/T_0$ [S12] and rectangular window (red squares) or Hanning window(blue squares), with subtraction of phase frequency from weighted linear fit and Hanning window (green triangles) and with weighted quadratic fit and Hanning window (cyan squares). Open symbols: Linewidths obtained by averaging FFT spectra obtained with different window functions: rectangular (red squares) and Hanning (blue squares). The dashed lines indicate the respective Fourier limits of the rectangular (red) or Hanning window (blue).

their length. For each frequency the mean value from all spectra was calculated, resulting in an averaged spectrum as displayed in Fig. S8. When varying the length of the segments we obtain the data shown in Fig. S6 with open symbols. It results that the optimum interval length for obtaining a minimal linewidth lies between 120 s and 150 s.

Since the individual FFT spectra usually have irregular shapes to which no analytic peak function can be assigned, we use an empirical approach in estimating their linewidths. First the maximum value was determined. Then the maximum was approached from both ends of the spectrum until the half-value was encountered. The difference between the two frequency values was then taken as the FWHM value. Using the data from Fig. S8 we obtain a linewidth of 19 mHz (for a Hanning window) of the beat, which results in a single-laser average linewidth of about 13 mHz.

We also calculate the distribution of linewidths over the time span of 37 h. The result is shown in the upper graph from Fig. S9 for an interval of 200 s. This corresponds to the measurement with a FFT analyzer

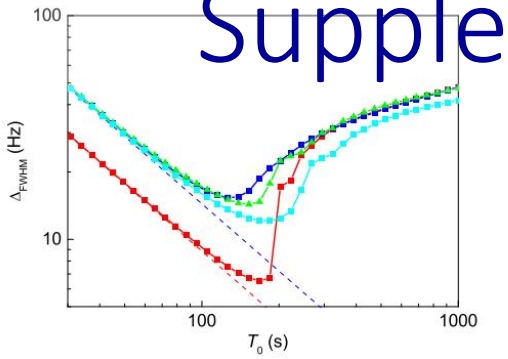


FIG. S7. Single laser FWHM linewidth $\Delta_{\mathrm{FWHM}}$ as a function of observation time $T_0$ calculated from the modeled phase noise spectrum. For plot legend see caption of Fig. S6.

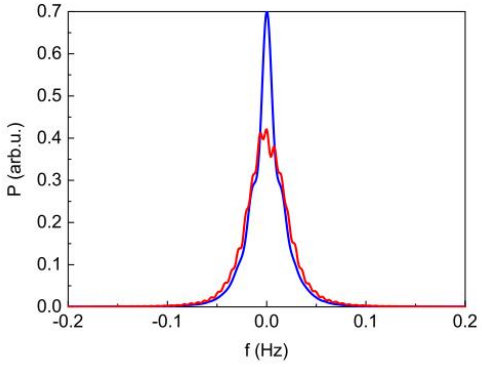


FIG. S8. Averaged FFT spectrum of the beat of the two lasers obtained from a phase measurement of 37 h by averaging all spectra obtained from 150 s intervals with a rectangular window (red line) and Hanning window (blue line). The increased frequency resolution comes from zero-padding the data before the FFT calculation.



shown in the main text. The highlighted part represents the linewidths below 10 mHz which amounts to 25% of all measurements. For comparison, the same analysis for a simulated pure flicker frequency noise is shown in the lower graph. The similarity of the two histograms confirms once again that in this time range the behavior of the lasers is essentially described by a flicker frequency noise and that the broad distribution of linewidths is intrinsic to $1/f$ noise and not due to additional technical perturbations.

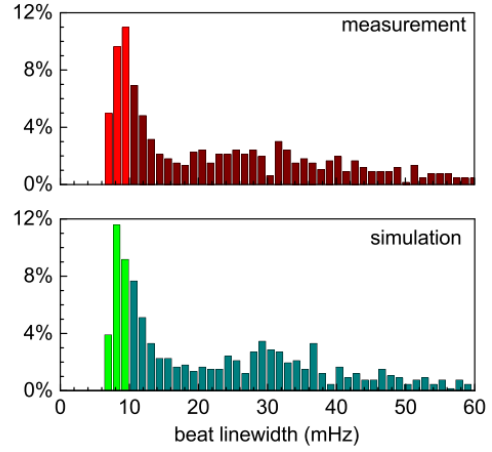


FIG. S9. Histogram of spectral linewidths for measured beat data (upper graph) and simulated flicker frequency noise (lower graph) corresponding to 200 s segments obtained from a 37 h record.

Coherence Time The coherence time $T_{\mathrm{co}}$ can be defined [S16] as the time where the autocorrelation function $R_E(\tau)$ has fallen to a certain fraction (e.g. $1/2$ or $1/e$) of its value at $\tau = 0$. According to Eq. (S6) the definition of coherence time $T_{\mathrm{co}}$ by $R_{\mathrm{E}}(T_{\mathrm{co}}) = 1/e$ corresponds to $\Delta\phi^2(T_{\mathrm{co}}) = 2$ rad$^2$.

A relation between coherence time and FWHM linewidth $\Delta\nu$ can be found in [S16] which gives $T_{\mathrm{co}} = 1/\Delta\nu$ for rectangular, $T_{\mathrm{co}} = 0.32/\Delta\nu$ for Lorentzian and $T_{\mathrm{coh}} = 0.66/\Delta\nu$ for Gaussian spectra.

### Coherence time for Ramsey interogations

For Ramsey spectroscopy, the frequency of the interrogating laser needs to be measured in advance. Depending on this measurement time, the quality of the predicted phase evolution and thus the coherence times may change. Using the measured phase date, we have calculated the corresponding coherence time as a function of the preceding measurement time. As shown in Fig. S10, the coherence time is close to the maximum value of 11 s for measurement times between 4 s and 20 s.

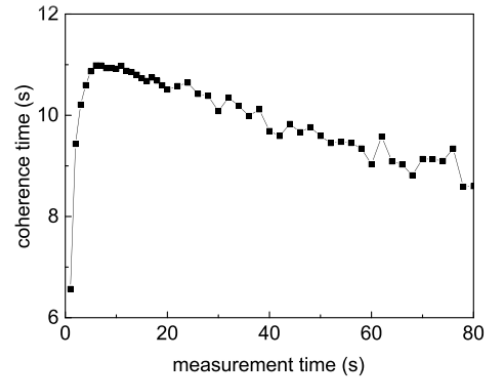


FIG. S10. Coherence time for Ramsey interrogation calculated for different lengths of the preceding measurement interval.

### Coherence time for Rabi interrogations

For a Rabi interrogation the frequency of the laser does not need to be known in advance but can be determined after the measurement from the result of the measurement itself. The coherence time resulting from the phase fluctuations can be measured as indicated in Fig. S11. The same dataset as used above is divided in equal-length intervals and from each interval, the average frequency $\overline{\nu}$ is calculated and its corresponding phase evolution is subtracted from the data. The coherence time is defined as the interval length for which the remaining average phase fluctuations are less than $\sqrt{2}$ rad. From our data we find a value of 60 s.

### Relation between Allan deviation and coherence time

To predict the future phase under the condition of non-stationary frequency fluctuations, as in the case of flicker and random walk frequency noise, the future frequency needs to be estimated using an average frequency from the past values. As a convenient way for extrapolation over a duration $\tau$ in an interval $[t, t + T_0]$, the average frequency from the preceding interval with the same duration $[t - T_0, t]$ can be used. The variance between successive frequencies is used in the definition of the Allan

# Supplemental Material



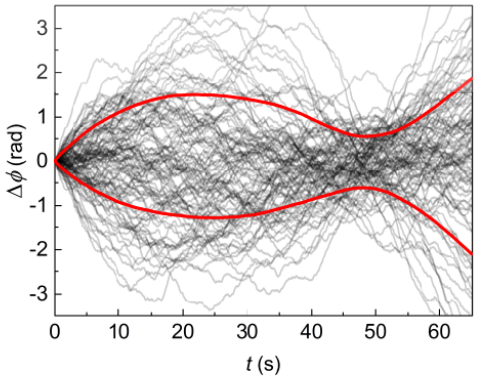


FIG. S11. The evolution of the phase difference between the two Si lasers. The measured phase of 100 consecutive curves is shown with thin gray lines. The average frequency $\overline{\nu}$ calculated for each curve is already subtracted. The remaining rms fluctuations are below $\sqrt{2}$ rad in average for intervals up to 60 s long. The red lines indicate the $\pm\Delta\phi_{\rm rms}$ range, calculated from 1 300 curves.

deviation

$$\sigma_y^2(\tau) = \frac{1}{\nu_0^2}\langle\frac{1}{2}\left(\bar{\nu}_{i-1} - \bar{\nu}_i\right)^2\rangle \tag{S32}$$

$$= \frac{1}{4\pi^2 T_0^2 \nu_0^2}\langle\frac{1}{2}\left(\Delta\phi_{i-1} - \Delta\phi_i\right)^2\rangle, \tag{S33}$$

where $\nu_0$ denotes the average frequency, and $\overline{\nu_i}$ the average frequency over the interval of duration $\tau$, $\langle.\rangle$ the expectation value. If the frequency is adjusted to the frequency of the preceding interval, this corresponds to $\Delta\phi_{i-1} = 0$, and thus

$$\Delta\phi_{\rm rms}^2 = 8\pi^2\nu_0^2 T_0^2 \sigma_y^2(\tau) = \langle\Delta\phi_i^2\rangle. \tag{S34}$$

On the other hand, if the average frequency $\overline{\nu}$ is determined from the measurement itself using $\overline{\nu} = (\phi(t+T_0) - \phi(t))/2\pi T_0$, the maximum phase excursion is expected at the midpoint of the interval $t + T_0/2$ and its variance is given by

$$\Delta\phi_{\rm rms}^2 = \langle\left(\phi(t+T_0/2) - \frac{\phi(t+T_0)-\phi(t)}{2}\right)^2\rangle, \tag{S35}$$

which is

$$\Delta\phi_{\rm rms}^2 = 1/4\cdot(2\pi T_0/2)^2\langle(\overline{\nu_i} - \overline{\nu_{i+1}})^2\rangle, \tag{S36}$$

where $\overline{\nu_i}$ and $\overline{\nu_{i+1}}$ denote the average frequency over the intervals $[t, t+T_0/2]$ and $[t+T_0/2, t+T_0]$.

This can be expressed by the Allan deviation as:

$$\Delta\phi_{\rm rms}^2 = \pi^2 T_0^2 \nu_0^2 \sigma_y(T_0/2)/2. \tag{S37}$$

In the case of flicker noise, the corresponding coherence time $T_0$ is longer by a factor of $\sqrt{8}$ compared to the case where the average frequency is predicted from past values only (Eq. S34).

**Coherence time in radio astronomy**

In radio astronomy the coherence time $\tau_{\rm co}$ of an oscillator with frequency $\nu_0$ is commonly estimated from the standard Allan deviation $\sigma_y$ [S17–S19]:

$$2\pi\nu_0\,\tau_c\,\sigma_y(\tau_c) = 1\,. \tag{S38}$$

Comparing to Eq. (S34), this approach corresponds to a definition of coherence time, where the rms phase excursion is $\sqrt{2}$ radian. It seems the difference of the phase variance by a factor of two from Eq. (S34) is due to a different, not commonly used definition of the Allan deviation without a factor of 1/2 used in [S17–S19].

From the measured flicker floor of mod $\sigma_y = 4\times10^{-17}$ (corresponding to standard Allan deviation $\sigma_y = 5\times10^{-17}$) according to this definition we find a coherence time of about 16 s for the Si-stabilized lasers.

The condition of Eq. (S38) can be illustrated in the stability diagram, shown in Fig. 1 as the intersection between the Allan deviation curve and the $1/\tau$ line corresponding to Eq. (S38). It is clear that for both lasers the coherence time is determined by the flicker floor, given by the thermal noise of the cavities.

Supplemental material may have its own bibliography


[S1] T. Middelmann, A. Walkov, G. Bartl, and R. Schödel, Phys. Rev. B **92**, 174113 (2015).

[S2] D. G. Matei, T. Legero, C. Grebing, S. Häfner, C. Lisdat, R. Weyrich, W. Zhang, L. Sonderhouse, J. M. Robinson, F. Riehle, J. Ye, and U. Sterr, J. Phys.: Conf. Ser. **723**, 012031 (2016).

[S3] G. Rupschus, R. Niepraschk, K. Jousten, and M. Kühne, J. Vacc. Sci. Tech. A **12**, 1686 (1994).

[S4] C. Hagemann, C. Grebing, T. Kessler, S. Falke, N. Lemke, C. Lisdat, H. Schnatz, F. Riehle, and U. Sterr, IEEE Trans. Instrum. Meas. **62**, 1556 (2013).

[S5] D. W. Allan and J. Barnes, in *Proceedings of the 35th Ann. Freq. Control Symposium* (Electronic Industries Association, Ft. Monmouth, NJ 07703, 1981) pp. 470–475, for corrections see [S20].

[S6] E. Benkler, C. Lisdat, and U. Sterr, Metrologia **52**, 565 (2015).

[S7] E. Rubiola, Rev. Sci. Instrum. **76**, 054703 (2005).

[S8] S. T. Dawkins, J. J. McFerran, and A. N. Luiten, IEEE Trans. Ultrason. Ferroelectr. Freq. Control **54**, 918 (2007).

[S9] G. Kramer and W. Klische, in *Proceedings of the 18th European Frequency and Time Forum, Guildford, UK* (IET, London, UK, 2004) pp. 595–602.

[S10] D. W. Allan, IEEE Trans. Instrum. Meas. **IM-36**, 646 (1987).

[S11] G. M. Stephan, T. T. Tam, S. Blin, P. Besnard, and M. Tetu, Phys. Rev. A **71**, 043809 (2005).

[S12] M. Bishof, X. Zhang, M. J. Martin, and J. Ye, Phys. Rev. Lett. **111**, 093604 (2013).

[S13] F. J. Harris, Proc. IEEE **66**, 51 (1978).

[S14] N. VonBandel, M. Akbari, M. Sellahi, T. Souici, R. Dardaillon, and P. Signoret, Opt. Express **24**, 27961 (2016).

[S15] D. A. Steck, *Quantum and Atom Optics* (available online at http://steck.us/teaching (revision 0.11.5, 27 November 2016), 2016).

[S16] B. E. A. Saleh and M. C. Teich, *Fundamentals of Photonics* (John Wiley & Sons, Inc., New York, New York, 1991).

[S17] W. Klemperer, Proc. IEEE **60**, 602 (1972).

[S18] A. E. E. Rogers and J. M. Moran, Jr., IEEE Trans. Instrum. Meas. **30**, 283 (1981).

[S19] A. R. Thompson, J. M. Moran, and G. W. Swenson, *Interferometry and Synthesis in Radio Astronomy* (Wiley, New York, 2007).

[S20] D. Sullivan, D. Allan, D. Howe, and F. Walls, *Characterization of Clocks and Oscillators*, NIST Tech. Note 1337 (NIST, U.S Department of Commerce, National Institute of Standards and Technology, 1990) online available at http://tf.nist.gov/cgi-bin/showpubs.pl.

End of Lecture #4

# Lecture 5

## The Scientific Publication

Lectures for PhD Students and Young Scientists

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University of (Bourgogne) and Franche Comté, Besancon, France

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home page http://rubiola.org

# Title

- The fewest possible words that describe well the contents
- French folks: often too long title
- Important in literature searching
- Should not include extra words (“a study of…”)
- The difficult trade-off between
  - Specific enough but
  - Not too narrow

# Authors

- Only researchers who give a significant contribution
- Some journals publish information about the contributions of each author
- Acknowledgment instead of authorship
  - Technicians –> Acknowledgements
  - Employees of funding/administration agencies
- Context-dependent
  - Reward co-workers at nat'l conferences
  - Be strict in high-impact articles

Order of authors

- Alphabetical (HEP, large list of authors)
- Decreasing importance (Astronomy)
- Logical (3-10 authors)
  - First author: heaviest burden
  - Last author: PI or the most prestigious
  - Reference/Corresponding author, any place in the list
- Reference author
  - Permanent staff or guest?

# Abstract

Same role of the trailer in a film

- Summarizes the paper
- Self-contained –> accessible w/o subscription
- Widely read –> important
- Try the IMRaD format
- Consistent with the paper
- Should not include
  - Figures an tables
    - Most cases: strict rule
    - Some journal have graphical abstract
  - References (exceptions tolerated)

# Introduction

- Background needed to
  - Understand the paper
  - Appreciate its relevance
- Identifies the question the research addressed
- Preferably, fairly short
- Better moving from general to specific
- Most of the references are cited in the introduction

Most difficult part of writing

– Together with References –

# Methods

- Reproducible science
- How you design the experiments, and why
- Consider identifying the following (if applicable)
  - Equipment,
  - Reference materials, organisms, reagents, etc.
  - Statistical methods
  - Ethics approval, if needed (human or animal research
- Include tables and figures
- Think about the level of detail in
  - Well-known methods
  - Methods previously described but not well known
  - Methods that you yourself devised
- Compare your manuscript to articles in the same journal

# Results and Discussion

## Results

- The core of the article
- Often includes tables and figures
- Present without commenting

## Discussion

- You may start with a short summary of the main findings
- Answer the question stated in the introduction
- Other items commonly addressed
  - Limitations
  - Relationship to other research
  - Further research needed
- Move from specific to general (opposite of introduction)

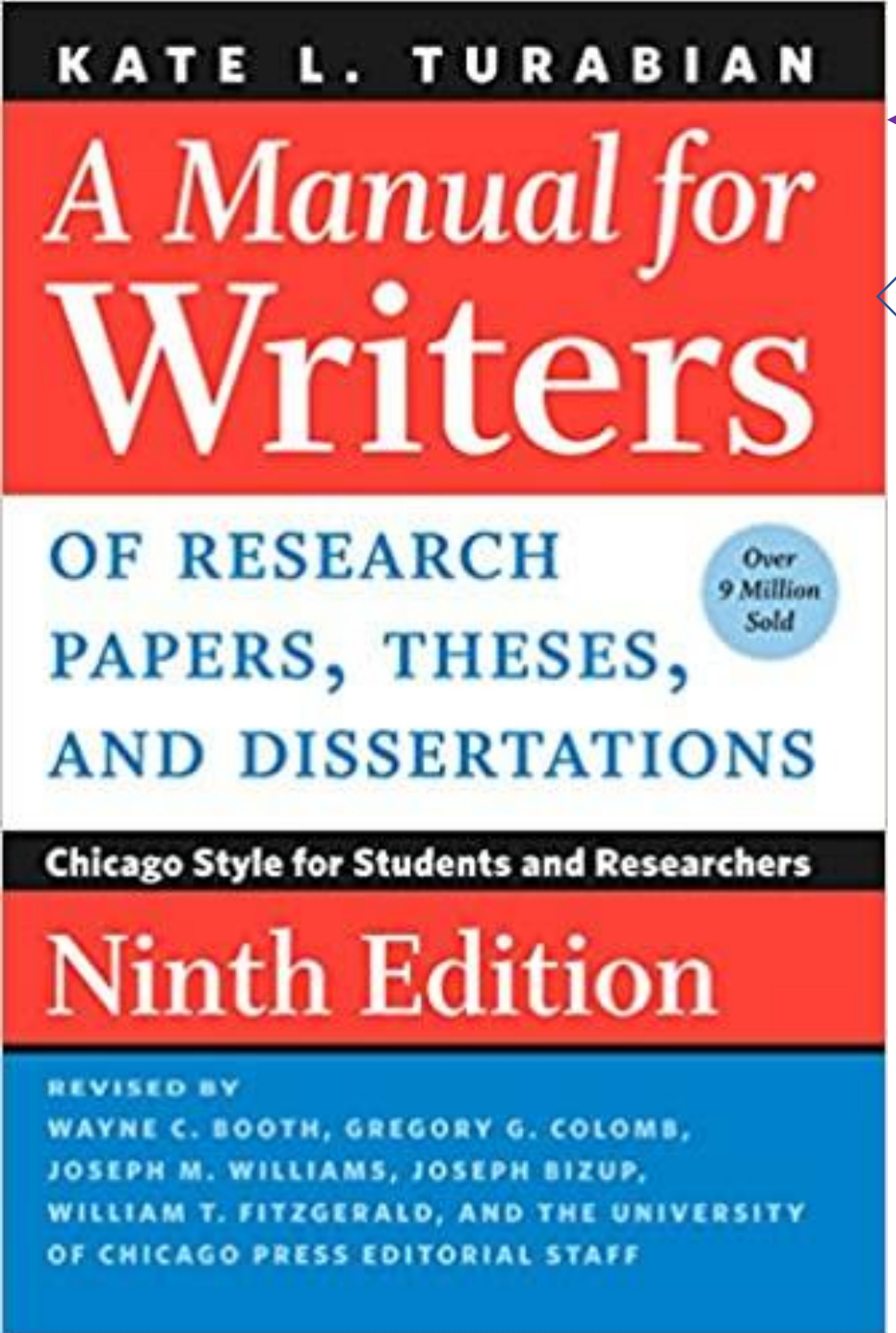
Separating results from interpretation may be difficult to some people

# Thanks and Acknowledgments

- Thank individuals
  - helped but did not make contributions deserving authorship
- Inform / ask to people before listing
  - Implied statement of endorsement
- Acknowledge Agencies, financial support etc.
  - Most agencies require funding acknowledgment

# References

- Purposes
  - Pass the peer review
  - Better chance to be cited
  - Give credit
  - Document/explain your work
  - Help readers to gather further information
- Accuracy
- Format
- Citation management software (EndNote, Reference Manager, Zotero)

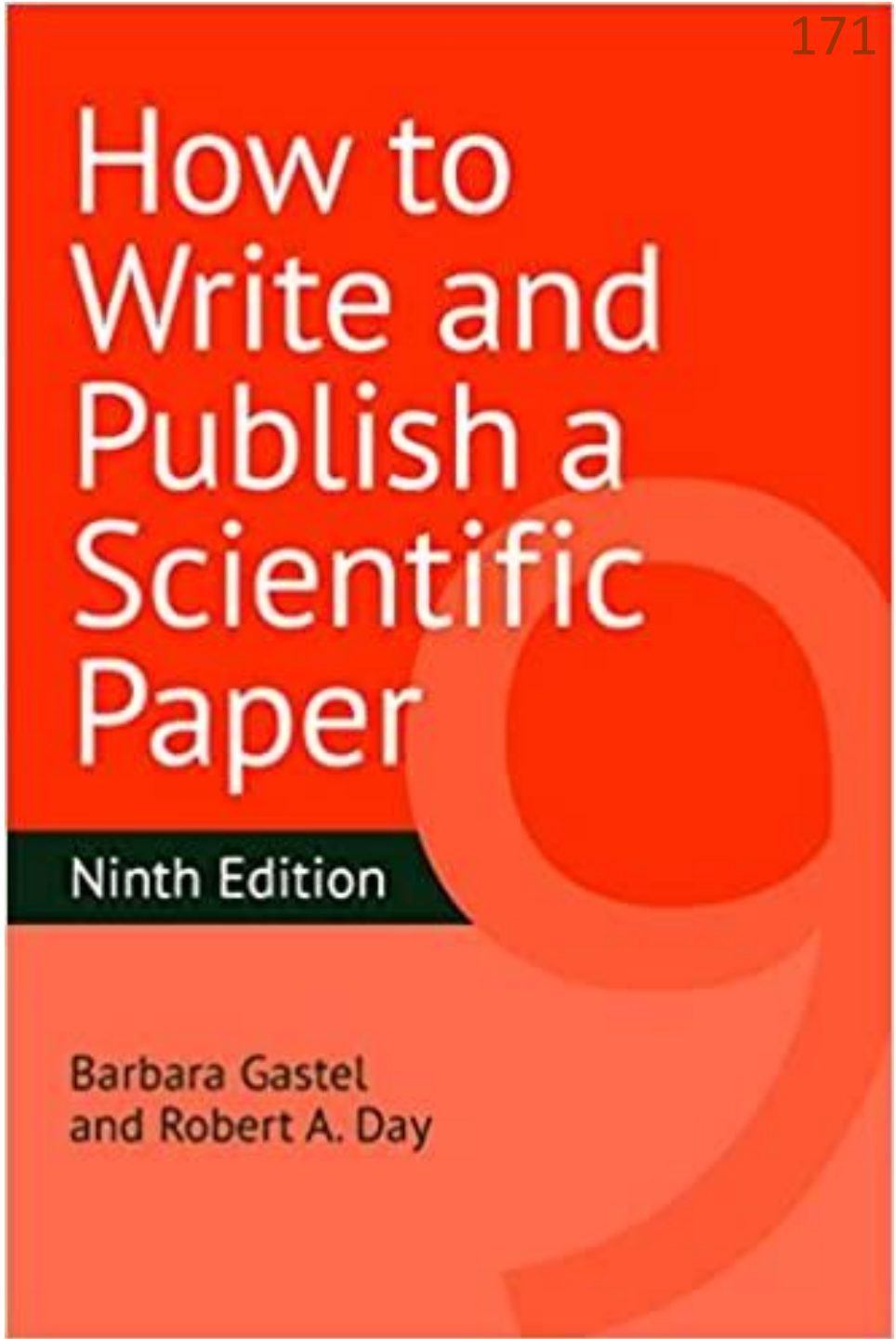



464 p, 17.5 € (Feb 2023)

If I have to choose one, I go for this

How-to guide, plus wisdom

University of Chicago Press, 9th edition, 2018



# Useful readings

## EASE Guidelines for Authors and Translators of Scientific Articles to Be Published in English

June 2011



European Association of Science Editors

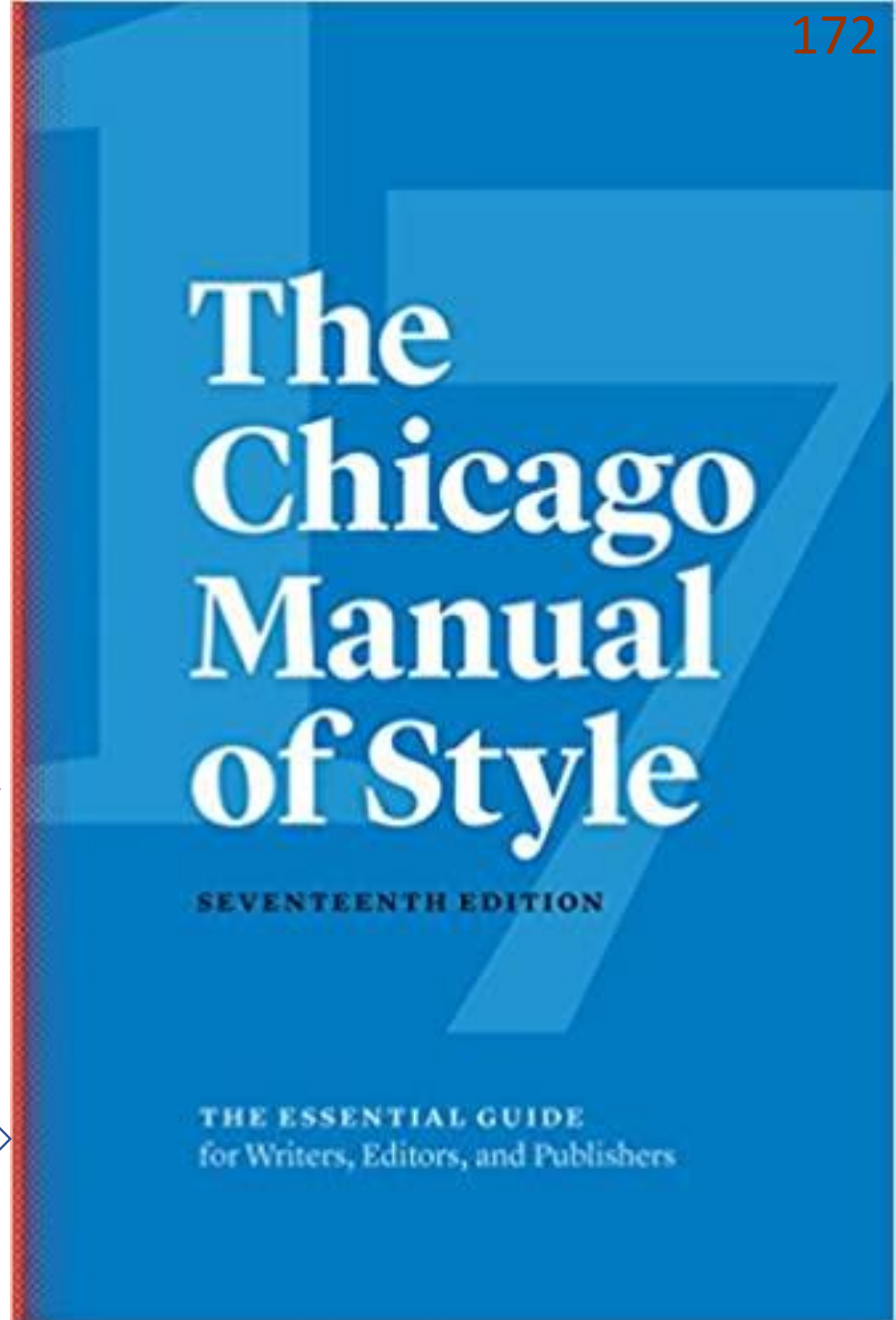
EASE

www.ease.org.uk

1146 p, 63 € (Feb 2023)

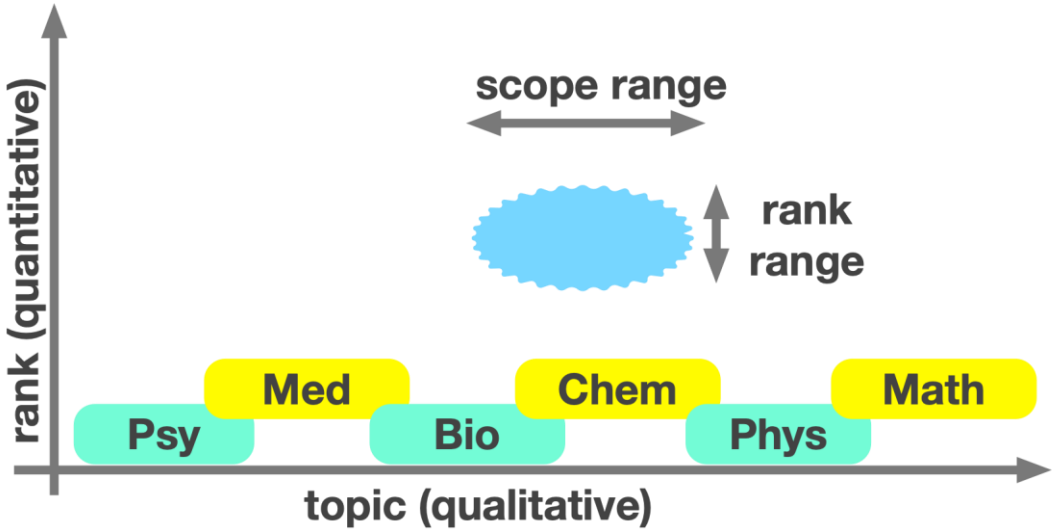
Too technical for most people
Collectible 1st edition, 1906
A must for librarians and typographers

Encyclopedia of typography, & much more



# Choice of a journal

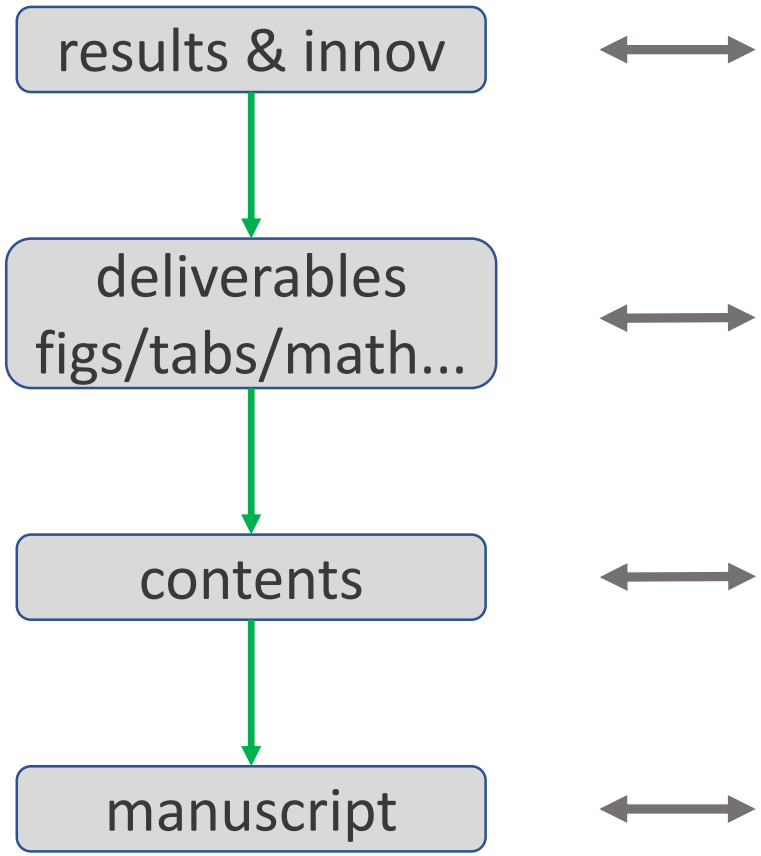
- The skill to target the right journals is vital
- A research result might be appropriate for more than one journal, yet often only after changing writing style
- Why I should *not try the highest rank* in my discipline?
  - High rejection rate is frustrating and time wasting
  - You should not jam the system
  - Respect the reviewers, they are not payed




- Innovation contents
- Breakthrough / major advance / application of known facts / progress report / ……
- Interest, usefulness
- Narrow / broad / very large set of disciplines
- Ultimately, a lot depends on your ability to target the appropriate rank

# Strategy

Top down approach pays well



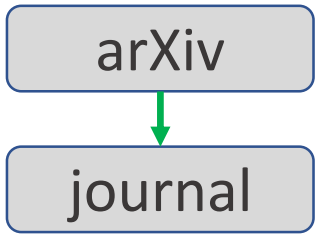

- Start from a few journals fitting your topic
  - Rank your work
  - You end up with 2-4 journals
- For each journal
  - Open recent articles at random
  - Does your manuscript fit?
  - Compare general style & figures
- A special issue is a great opportunity
  - Favorable choice of the reviewers
  - Increased visibility
  - Probability of acceptance
  - Beware of special issue inflation (specific journals)
- Supervisor and colleagues should help
- Why not an AI boot? May help, but don't trust it!

# Practical advices

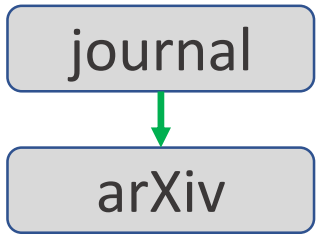
- Read the instructions for the authors
- Read the instructions for the reviewers
  - This is what they are expected to do
- Look for the IF and for other bibliometrics parameters
- Identify the rejection ratio
  - Nature and Science accept of 5% of the manuscripts,
  - However, everybody wants to publish there!

If you have a  bulk of results you may start with a report

# arXiv and other repositories




you inform the editor




you need permission

# Duplicate and redundant submissions

## Duplicate submission

submit (almost) the same article to more than one journal at the same time

## Redundant submission

Generate as many articles as you can from one result, or from a small set of results

## Why should I refrain?

- Journals may ask a declaration on your honor
- Forbidden in all editorial policies
- Un-ethic behavior
  - Easily detected in the Internet
  - Might turn into ban/ostracism

## You are free to re-submit after

- Cancelling the submission
- The manuscript is rejected

# Intentional submission to a partially inappropriate journal

## Case A: Good results which would impact on a community

- Afraid of the judgement
- Want to escape from some highly probable (known) reviewers

## Case B: Poor results, which you may want to be published anyway

- Good or bad reasons (unlucky end of your PhD, too small publication record, pressure from your supervisor, etc.)
- Try to get unnoticed/undetected in the peer-review process

## TIPS

- Avoid whenever possible
- Good results published by an inappropriate journal are wasted
- Use repositories (arXiv) to prevent malicious behavior
- Even if you need a line in your resumé
  - Poor work is poor
  - Time to publish poor work is stolen from next good work
- If you have no choice, just do it efficiently

# Production process

Congratulations, your manuscript has been accepted.

The burden is still not over

# Instructions

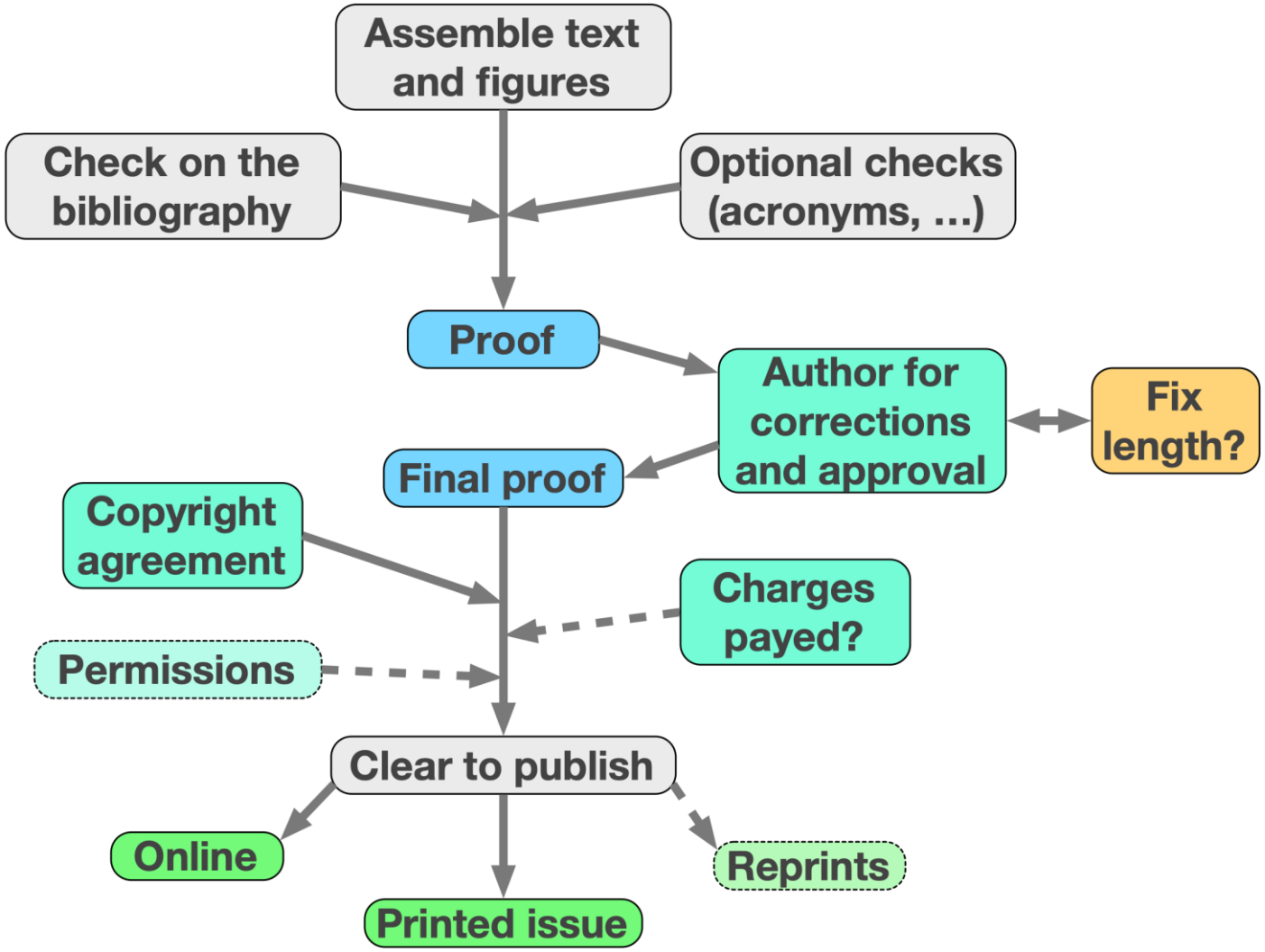
Boring and mandatory stuff
Each journal has its own rules, available online

- Typesetting rules
- Manuscript length
- Formulas and Equations
- Figures
- Bibliography style
- Etc…

- Template on the journal web site
- Latex / Word generally available
- Accurate preview and length estimation
- Common good practice of computers helps a lot
- The template often tells about itself
- Explains in words
- Shows the result

At the time of submission, you should have worked properly in this way

# The production process




- The corresponding author is expected to do the job
- Actual burden share may be different

# Copy Editing — Proofreading

- Generally a simple process for (regular) articles and small documents
- Can be complex for books and large documents
- Complexity depends on the publisher
- Get used to standard marks, they are clear (to all pros) and save your time
- However, standards marks may not be mandatory for small docs
- Logical division between
  - Editor's corrections and notes
  - The changes you make to the text (including answer to queries)
  - Other technical issues

Choose a style and use it through all your PhD training





*sample function*, is a time-domain signal $x_e(t)$. For short, the subscript $e$ is dropped whenever there is no ambiguity, or no need to refer to a specific outcome $e$.

A random process and its associated ensemble are powerful mathematical concepts, but they are not accessible to the experimentalist, who can only measure a finite number of realizations.

**Averages and expectation.** In the measurement of random processes (See 1.3.2) we use simultaneously three types of "averages," the simple mean, the time average, and the mathematical expectation. Hence, for clarity we need different notations.

Given a series of $N$ data $x_i$, the simple ***mean*** of $x$ denoted with the acute brackets, is defined as

$$\langle x \rangle_N = \frac{1}{N} \sum_{i=1}^{N} x_i \quad \text{(simple mean)}. \tag{1.25}$$

The simple mean is often used to average the output stream of an instrument. The quantity $x$ is still unspecified. For example, we can average in this way a series of numbers, a series of spectra, etc.

The ***time average*** of $x$ denoted with the over-lined variable $\overline{x}$, is defined as

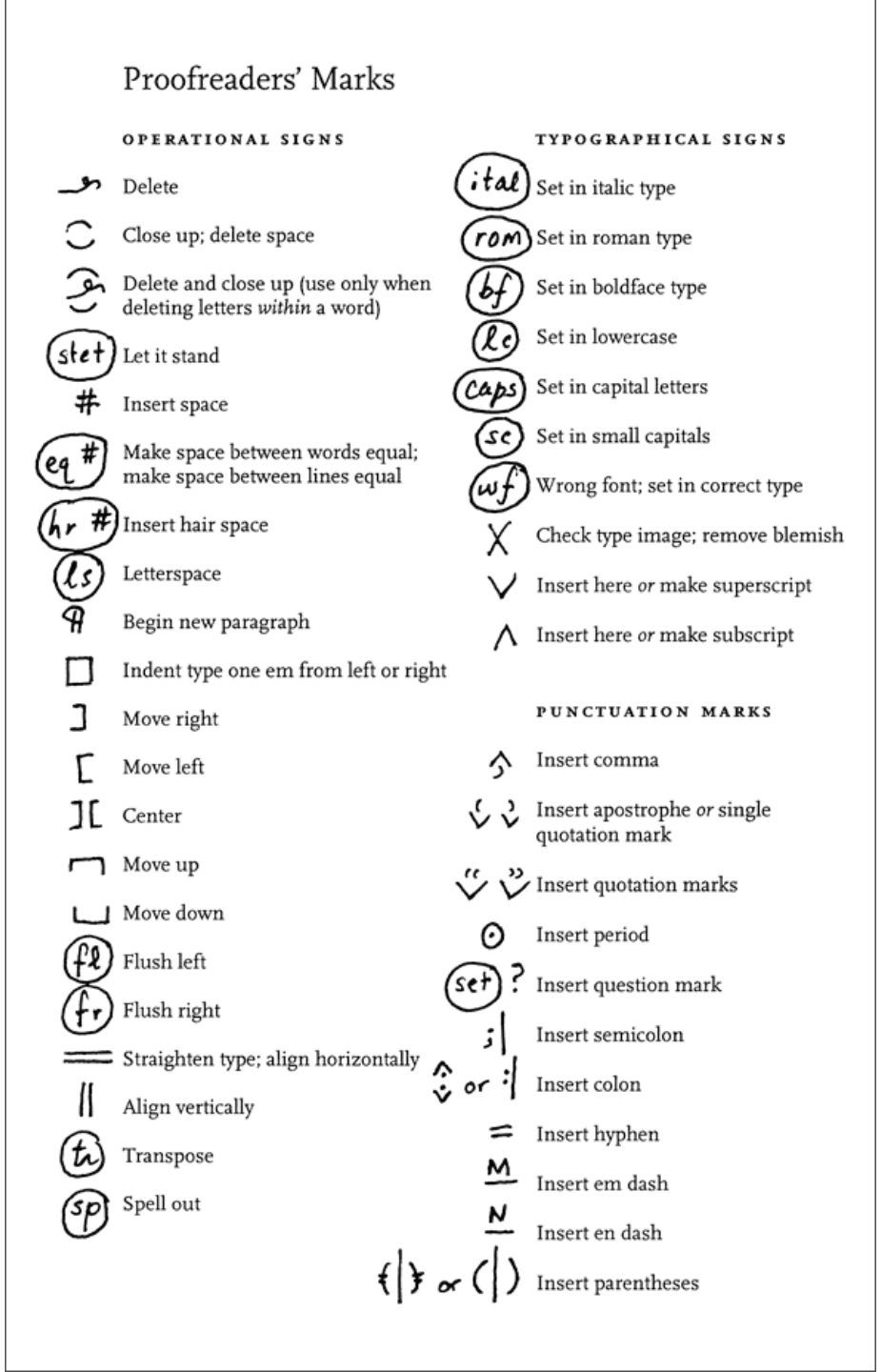
$$\overline{x} = \frac{1}{T} \int_{-T/2}^{T/2} x(t)\, dt \quad \text{(time average)} \tag{1.26}$$

In the case of causal systems, where the response starts at $t = 0$, the integration boundaries are change from $-T/2$, $T/2$ into $0$, $T$. In most cases, the readout of an instrument is of the form (1.26). This means that the input quantity $x$ is averaged uniformly over the time $T$.

A page of Phase noise and frequency stability in oscillators, copy-edited by Susan Parkinson

# Proofreaders' Marks

The Chicago Manual of Style Online, 2.6 of the 17th edition



## Proofreaders' Marks

**OPERATIONAL SIGNS**

- Delete
- Close up; delete space
- Delete and close up (use only when deleting letters *within* a word)
- stet — Let it stand
- # — Insert space
- eq # — Make space between words equal; make space between lines equal
- hr # — Insert hair space
- ls — Letterspace
- ¶ — Begin new paragraph
- Indent type one em from left or right
- Move right
- Move left
- Center
- Move up
- Move down
- fl — Flush left
- fr — Flush right
- Straighten type; align horizontally
- Align vertically
- tr — Transpose
- sp — Spell out

**TYPOGRAPHICAL SIGNS**

- ital — Set in italic type
- rom — Set in roman type
- bf — Set in boldface type
- lc — Set in lowercase
- caps — Set in capital letters
- sc — Set in small capitals
- wf — Wrong font; set in correct type
- Check type image; remove blemish
- Insert here *or* make superscript
- Insert here *or* make subscript

**PUNCTUATION MARKS**

- Insert comma
- Insert apostrophe *or* single quotation mark
- Insert quotation marks
- Insert period
- set ? — Insert question mark
- ; — Insert semicolon
- or : — Insert colon
- Insert hyphen
- M — Insert em dash
- N — Insert en dash
- ( ) or ( ) — Insert parentheses

# Proofreaders' Marks

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unexpectedly (for me) expensive

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## Abstract

Preview

This document specifies symbols for use in copy preparation and proof correction in alphabetic languages and in logographic languages. It is applicable to texts submitted for correction whatever their nature or presentation (manuscripts, typescripts, printer's proofs, etc.) and for marking up copy for all methods of composition.

Symbols for the correction of mathematical texts and colour illustrations are not included.

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**Status** : Published
**Publication date** : 2022-12
**Edition** : 3
**Number of pages** : 44
**Technical Committee** : ISO/TC 130 Graphic technology
**ICS** : 37.100.01 Graphic technology in general

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- Inefficient/slow for large texts (books)



FREQUENCY COMBS

## The purest microwave oscillations

A new femtosecond frequency comb is capable of generating microwave signals at a noise level below the shot noise of light.

Enrico Rubiola and Giorgio Santarelli

Where do these yellow dughnuts come from? Please remove.

Can you remove this grey shadow and let only the rainbow-colored comb?

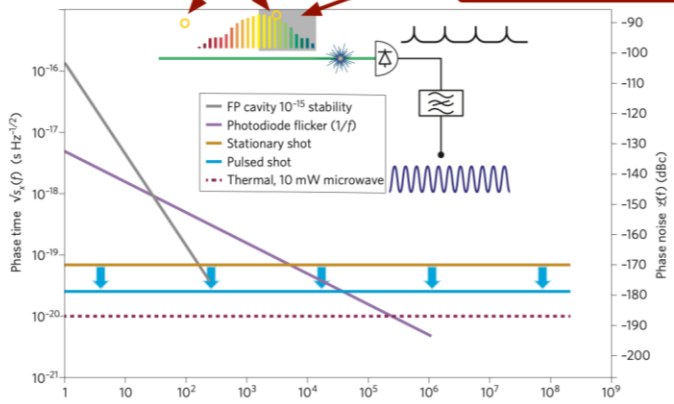



**Figure 1 |** Power spectral density of random phase for a 10-GHz femtosecond frequency comb detected with a high-power photodiode and expressed in terms of different units. The brown and light-blue lines are the shot noise given by Quinlan *et al.*[1] in the stationary and pulsed shot-noise regimes, respectively. By further reducing the shot noise, the pulsed shot-noise floor could reach the thermal noise (dashed line), unless the microwave power increases proportionally. Flicker ($1/f$) noise is inherent in the detectors; the lowest flicker noise is observed at −133 dBc at 1 Hz (solid purple line). Owing to the photodiode flicker, the full advantages of the pulsed-shot regime are attained only at 100 kHz and beyond. At the lowest frequencies, the flicker-of-frequency noise of the Fabry–Pérot cavity (grey line with slope $1/f^3$) may limit the spectral purity. **[Au: Please mention the yellow doughnuts near the spectrum or omit them.]**

Despite the fact that time (and equivalently frequency) is the physical quantity that we can measure most accurately, the demand for more precise and spectrally purer electrical oscillators is continually growing. Although optical techniques have a significant part to play in the race towards the ideal oscillator, they have some particularly challenging problems.

The oscillator we consider here is a mode-locked femtosecond laser whose optical signal is converted to a **[Au: Is this revision correct?]** microwave signal by photodiode detection. The spectral purity of a photonic oscillator is determined by its signal-to-noise ratio, which is the ratio of the thermal and shot noise to the microwave power. **[Au: Is this revision correct?]** This measure is proportional to the optical power $P$ in the thermal region, and to $\sqrt{P}$ at high optical powers for which **[Au: Is this revision correct?]** the shot noise exceeds the thermal noise of the photodiode output load. An important question is whether it is possible to overcome these noise limits.

Reporting in *Nature Photonics*, Franklyn Quinlan and colleagues have now demonstrated that Poisson statistics does not apply to the sharp light pulses generated by a femtosecond frequency comb[1]. Consequently, at high optical powers, the jitter of the photodetected microwave oscillation can be lower than a generally agreed limit due to shot noise. Circumventing the classical shot noise therefore results in a net improvement in the microwave spectral purity. Using this principle, Quinlan *et al.* have realized a noise floor for photodetected pulse train timing of 25 zs Hz$^{-1/2}$, which corresponds to a phase noise of −179 dBc Hz$^{-1}$ for a 10-GHz carrier[1]; this is ~5 dB below that predicted by the accepted time-invariant shot-noise behaviour. **[Au: Could this be replaced by "calculated using the time-invariant shot-noise formula"?]**

It is insightful to consider the origin of the terms 'jitter' and 'spectral purity'. For historical reasons, the oscillator spectral purity is described by $L(f) = S_\varphi(f)/2$ and is expressed in decibels relative to the carrier (dBc). The quantity $S_\varphi(f)$ is the power spectral density of the random phase $\varphi$ as a function of the Fourier (offset) frequency $f$. Alternatively, we can use the phase-time fluctuation **[Au: Could this be replaced by "the temporal fluctuation of the phase"?]** $x = \varphi/2\pi\nu$, where $\nu$ is the carrier frequency. The associated power spectral density is given by $S_x(f) = (1/2\pi\nu)^2 S_\varphi(f)$. For example, −180 dBc at 10 GHz carrier gives $\sqrt{S_x} = 2.25 \times 10^{-20}$ s Hz$^{-1/2}$ (Fig. 1).

High-spectral-purity oscillators have a wealth of potential applications. Among them, modern radar is one of the most demanding. The typical carrier frequency for radar is in the 10-GHz band, and the measurement time is determined by the target range and speed. The ability to detect small targets in cluttered and hostile environments depends on the oscillator phase noise. Some particle accelerators require a very low jitter of a few femtoseconds. High spectral purity increases with increasing carrier frequency because the phase-time fluctuation **[Au: Could this be replaced by "the temporal fluctuation of the phase"?]** $x$ is proportional to $1/\nu$.

A classical rule states that the additive phase noise is given by $S_\varphi(f) = N/P_\mu$, where $P_\mu$ is the microwave carrier power and $N$ is the noise power spectral density, which accounts for shot effect and thermal energy, and includes the noise figure when appropriate. By using high-power photodiodes, Quinlan *et al.* have overcome this limitation by operating their photodiodes in the pulsed shot-noise



OK

OK

I prefer: power [singular]
I'll never make a fuss for details like that

Please keep the term
*phase-time fluctuation*
This is the technical term found in the time/frequency literature. At your discretion, the first occurrence in italic to emphasize that this is a technical/jargon term.

Again, please keep the term
phase-time fluctuation

Please write
stationary (time-invariant)
if you feel that "stationary" sounds mysterious to the readers, or just
stationary

In the proper language of statistics, the word "stationary" is the appropriate replacement for "time invariant"

# Books

…and PhD Thesis

# Book Types

*The PhD thesis is similar to a book, which type?*

## Textbook

- Usually, support for a course
- Written for step-by-step reading
- Exercises, examples, etc.

Formative
No career payback

## Monograph

- Focus on a (more or less broad) topic
- Written for full/partial reading
- The kind of book PhD students and researchers should read

Formative / Informative
Little career payback

## Handbook

- A reference for practitioners/researchers in the domain

Informative / Technical
Lowest career payback

## Edited book

- Each chapter is written separately
- Often very little coordination in the contents
- Quite good books vs Garbage collections

Informative / state-of-the-art
Some career payback,
yet at moderate cost

## Conference proceedings

Informative / state-of-the-art
Rewards the Editor, moderate cost

# Books Go With a Contract

*Which category do you think Enrico belongs?*

## Crackpot writes

- Submit a full book to a publisher
- Often victims of predatory/vanity press

## Intermediate

- Sign a contract with a detailed book project
- A sample chapter might be required
- The CV and position of the author is a part of the decision
- There can be a serious peer review process on the project

## Bestsellers writers

- Sign a contract with just a title or a topic
- Actual manuscript may be written by somebody else
  - Sport champions, explorer, politicians etc.
  - Richard Feynmann

# Book proposal

your

PhD Thesis

is similar to a book (you just don't submit a proposal)

Start here, you can change

- Plan (table of contents, size etc.)
- Intended readership
  - Book type (monograph, handbook etc.)
  - Level
  - Related to a community/conference?
- Competitors

Address this

  - Similar books
  - Originality of your project
- Schedule

Be aware of

  - Murphy's law states that
    It takes twice than expected, even if you account for this principle
- Free comments & special requirements

Size: 2-5% of the book

# Logbook

Team logbook and personal logbook are
different, (still) incompatible objects

“The logbook is the sniper’s deadliest weapon”

said a soldier in a Hollywood film

Same for scientists, but you are killing problems, not people

# Team logbook


- Document an experiment
  - Multiple researchers
  - Inefficient for the individual
- Structured as a database
- Numerous solutions
  - Commercial
  - Open

# Personal logbook

## Reproducible science

- Document all your work
- Avoid flooding, be concise
- Organize for long term readability
- Chrono order more efficient than topics

## Brain keeps the intense moments

- Document in real time as you work
- Decide immediately what to discard
- Mark
  - Ideas deserving further study
  - Results deserving publication
  - Bibliography, as it comes to your mind
- Keep track of what you read
- Interesting stuff on separate sheets?
  - Stick on your logbook
  - Too large? Reduced color copy!
  - Keep valuable restaurant napkins

## Review the relevant results

- Weekly or Monthly
- When planning articles/conferences

## Protect your work

- Use cloud + backup
  - Physically disconnected disk are immune to ransomware
- Proof of invention/discovery
  - Clumsy dedicated servers
    - Digitally signed receipt
  - Email to a dedicated address
    - Nobody can change past emails in your account
    - Also rock solid backup

# Paper or software?

## Paper notebook

- Stick relevant material
- Mark file names (pictures, code, etc.)
- Durable paper and ink
- Light frame for copy/scan
  - Test before adopting
- Scan periodically (CO 300 dpi)
  - Rescan pages after corrections

## Software notebook

- Need tablet/stylet
- Comfortable future-proof app
  - Make sure you can export A4 pdf
  - What if you change OS?
- Difficult to be concise
- PC not always ready
- Small writing area
- Turning pages is slow

More…

- Most colleagues use paper
- I tried hard different technologies over >15 years
- Always went back to paper
- A close friend does well with software

# My logbooks (BW)

date & place

Topic

Page of topic

page 108 | 22.III-2004-L | PHOTODETECTOR NOISE | p.21 | 1x Volume

real life!

After some minor change in the system, technical noise appeared.
I had a LONG AND PAINFUL DEBUGGING.

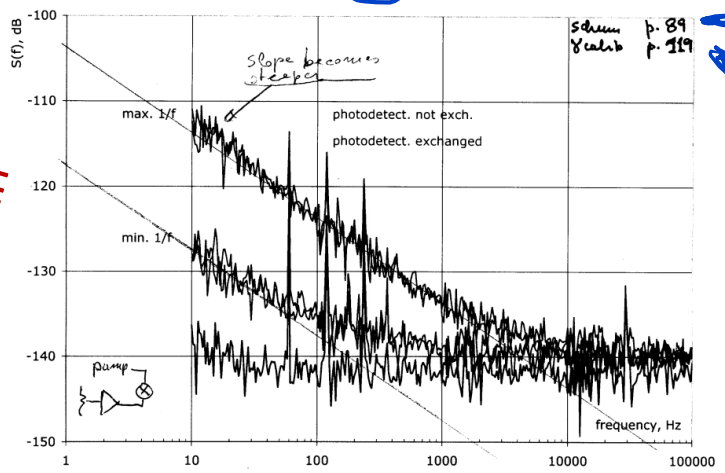
Scheme p.89 - after debugging. I got the same configs.

file name of the plot

photodetector noise - file plot703 - mar 22, 04

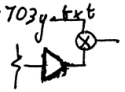
experimental conditions p.89

Calibration validated p.119




MORE EXPERIMENTS, SEE p. 112

6) background noise, file plot703g.txt
I also checked on the noise of the microwave interferometer (phase shifter and attenuator.) - Not shown



1. Search for minimum 1/f → file plot703a.txt
2. search for max. 1/f → file plot703b.txt
3. exchange the photodetectors (the optical connectors are unchanged)
4. min. noise → file plot703c.txt
5. max. noise → file plot703d.txt

Note the background noise is measured only once, with the detectors exchanged.

Ruled paper
The frame is invisible on BW scan

Table of contents always on p. 2

main topics, take many pages

short notes

Started in vol. VIII

started in Vol. VIII continues in Vol X

Starts here, continues in Vol-X

Notes taken at seminars in the lab

Conferences go in a separate notebook

small context-specific topics

2 IX

MAIN SUBJECT

| | | |
|---|---|---|
| ... | 3-30 | COUNTERS |
| ... | 25 | Photonic Osc. II |
| ... | 33- ... | PHOTODETECTOR NOISE |
| | 37-42 | MIXERS (JPL) |
| | 38-44 | AMPLIFIERS (JPL) |
| | 49 | low-power interferom. |
| | 61-70 | FFT ANALYSER / Greenhall |
| | 82-85, 119 | DETECTION ANGLE |
| | 45-192 | PHOTODIODE MODEL |
| .. | 109 | CIRCULATORS |
| ... | 126 | Photonic oscillator (JDick) |
| | 121.. | AM NOISE |
| | 126 | OPTICAL MODULATOR |
| | 174-178 | OPTICAL FIBER (ERTAH) |

STAND-ALONE

| | |
|---|---|
| 3-4 | Nasa oscillator. |
| 21-24 | REPLACE THE FLUKE SYNTHESIZERS |
| 26 | Pound oscillator. |
| 28 | Absolute calibration ⇔ BNM |
| 32 | Laser RIN |
| 54 | OPTICAL LINK / Calhoun |
| 75 | COEO & passive mode locking |
| 141-142 | FIBER SPOOL. |
| 143 | SUMMARY & PLAN |
| 165 | SUMMARY & PLAN |
| 118 | KDI PO42C PHASE MODULATOR |

SEMINARS

| | |
|---|---|
| 34-35 | COEO / Salik |
| 47-48 | Gravity on Vacuum / Maluki |
| 56-58 | μwave Links/opt.fibers Lau |
| 60 | Multistage not / Ramirez |
| 77-78 | Ultra low power PLL / Rabaey |
| 90-91 | Quantum communication / Hayden |
| 99-100 | PPLN Disk resonators / Mohageg |
| 146 | mm Wave imaging / Mizuno |
| 157 | Superfluid clock & gyro / Penanen |
| 162 | cold atom / Loftus |
| 163-164 | Electronics inspired to biology / Sarpeshkar |

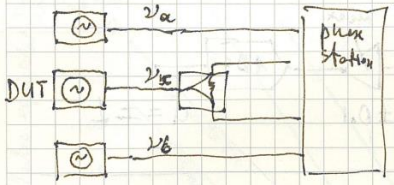
JPL

| | |
|---|---|
| 59 | Shop list (JPL) |
| 72 | ARC-FUSION SPLICER |
| 73 | CONNECTOR POLISHER |
| 137 | HP-8672A & AM |

My logbooks

B.20-V-2020 MISALIGNED OSCILLATORS p.1 XXII

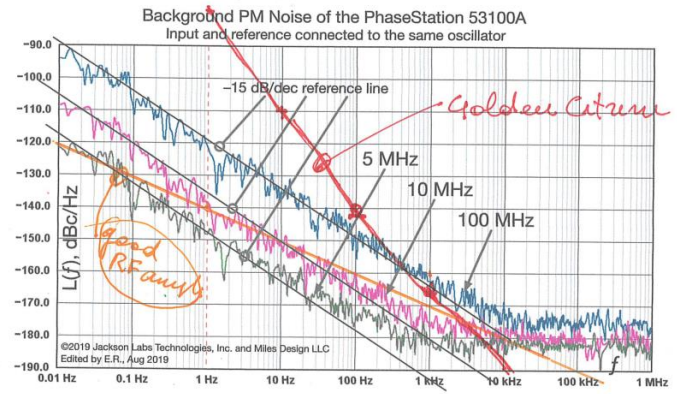
PLANNED → Yannick Gruson




set $\nu_c$ = 100 MHz sharp
$\nu_a$, $\nu_b$ } Just off the nominal value to identify the crosstalk.

$\nu_a - \nu_c = 23$ Hz

$\nu_b - \nu_c = -31$ Hz

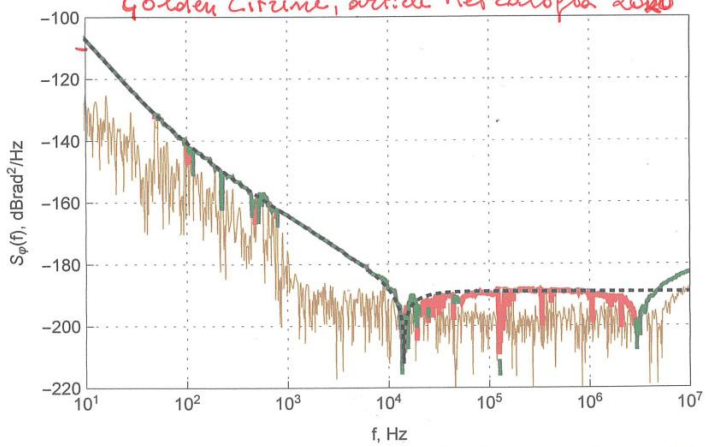



| Trace | Input Freq | Input Amplitude | dBc/Hz at 1 Hz | Elapsed | Instrument |
|---|---|---|---|---|---|
| 100 MHz residual floor | 100.0 MHz | 11 dBm | −121.1 | 58m 49s | PhaseStation 53100A |
| 10 MHz residual floor | 10.0 MHz | 12 dBm | −138.2 | 33m 5s | PhaseStation 53100A |
| 5 MHz residual floor | 5.0 MHz | 12 dBm | −148.2 | 8h | PhaseStation 53100A |

Book
Synthesizers
Wiley 2020

John Miles

Golden Citrine, article Metrologia 2020

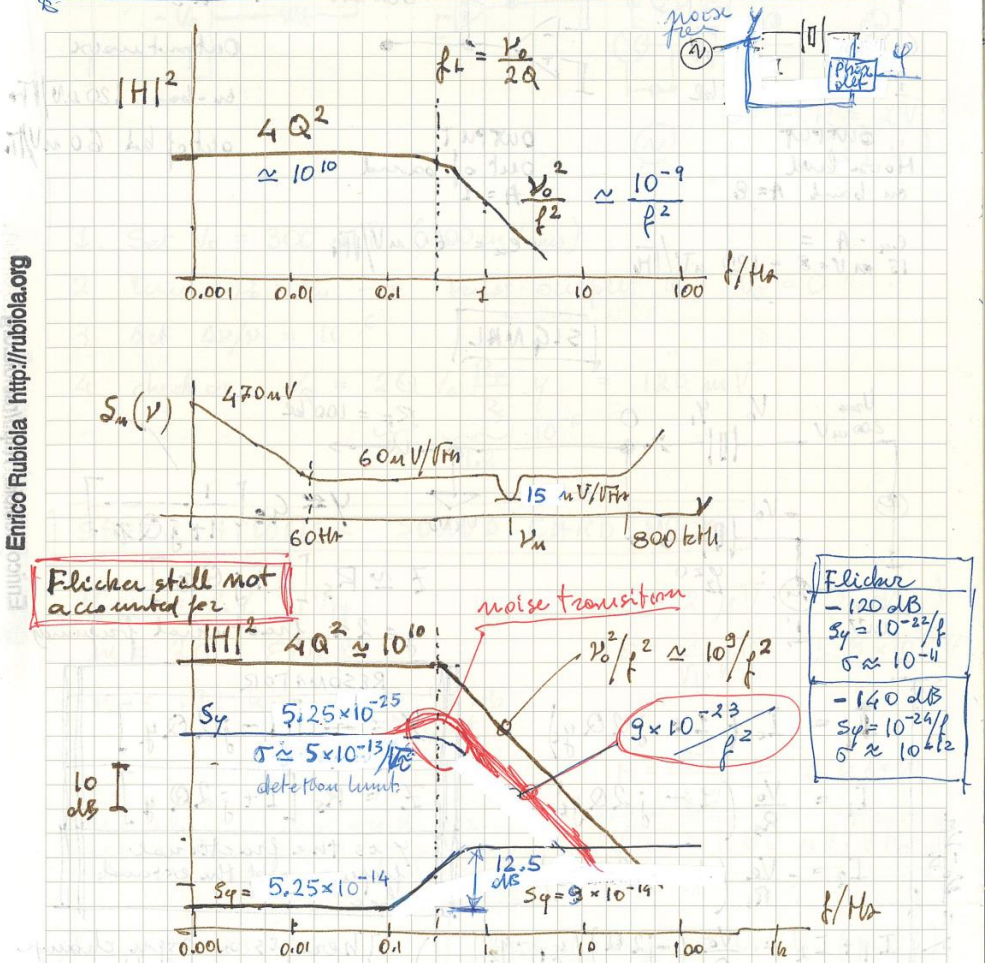



Enrico Rubiola http://rubiola.org

64 FORAY

XXII TUNING FORK p.9 B.20-V-2020

Transfer function $|H|^2 = \frac{S_y(f)}{S_\varphi(f)}$ USE: Measure $S_\varphi$ Calculate $S_y$




Enrico Rubiola http://rubiola.org

Flicker
−120 dB
$S_y = 10^{-22}/f$
$\sigma \simeq 10^{-4}$
−140 dB
$S_y = 10^{-24}/f$
$\sigma \simeq 10^{-12}$

In-band noise
$e_n$ = 3 nV/√Hz } OP27
$R_{in}$ = 4.4 MΩ/√Hz } 14.5 nV/√Hz
$e_{th}$ = 13.5 nV/√Hz
(11kΩ)

Out-of band noise
$e_n$ = 3 nV/√Hz
$R_{in}$ = 40 nV/√Hz } 57 nV/√Hz
$e_{th}$ = 41 nV/√Hz

Signal 200 mV

in-band noise
14.5 nV/√Hz $b_0 = \left(\frac{14.5\,nV}{200\,mV}\right)^2 = 5.25\times10^{-15}$ (−143 dB)

out of band
$b_0 = \left(\frac{60\,nV}{200\,mV}\right)^2 = 9\times10^{-14}$ −130.5 dB

67 FORAY

# CNRS logbooks

- Instruction pages
  - Numbered, at the beginning
  - Mandatory part of the book
    - You have to scan
- No option for
  - Clean room (release particles)
  - Outdoor use (humidity)
  - Other specific/difficult environment
- Porous paper
  - Fountain pen ink diffuses
- Too dark frame for scan/copy
- No area for confidential notes
  - Notes you may not want to share
  - Learn from Moleskine technology
- Witness signature
  - No true proof, can be backdated
  - Ridiculous/obsolete idea
- My feelings
  - bad design
  - do not match my requirements (too poor)

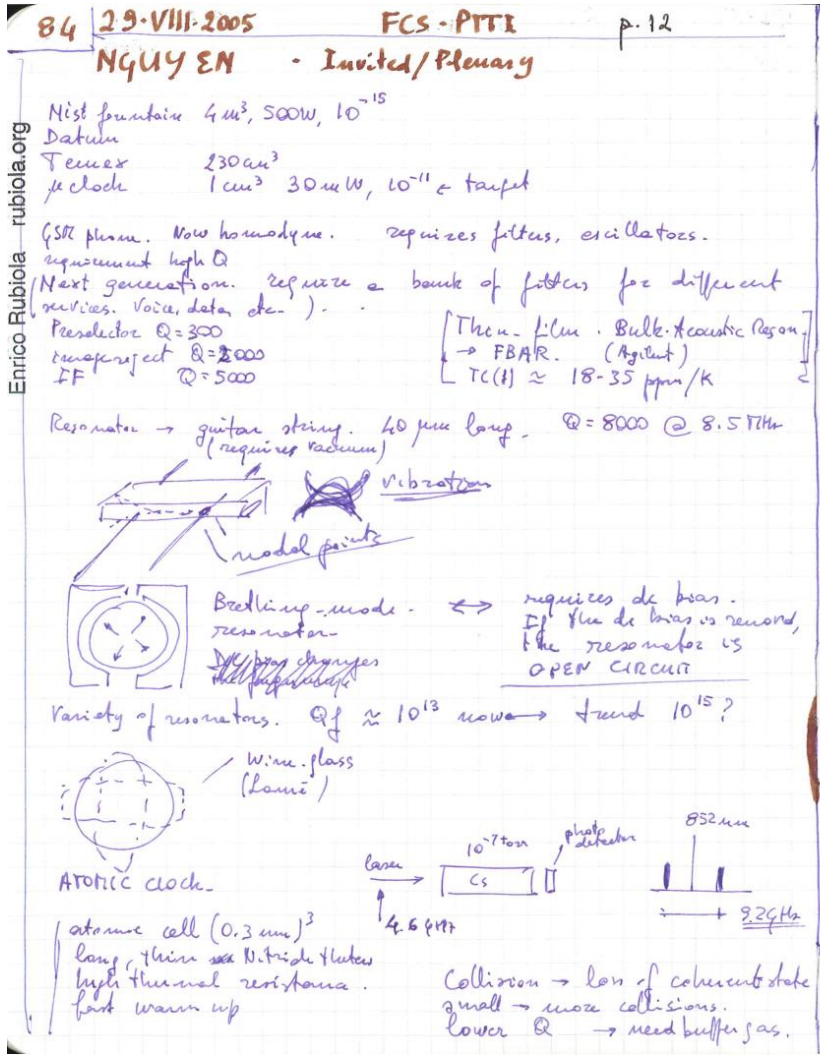
# My logbooks for conferences

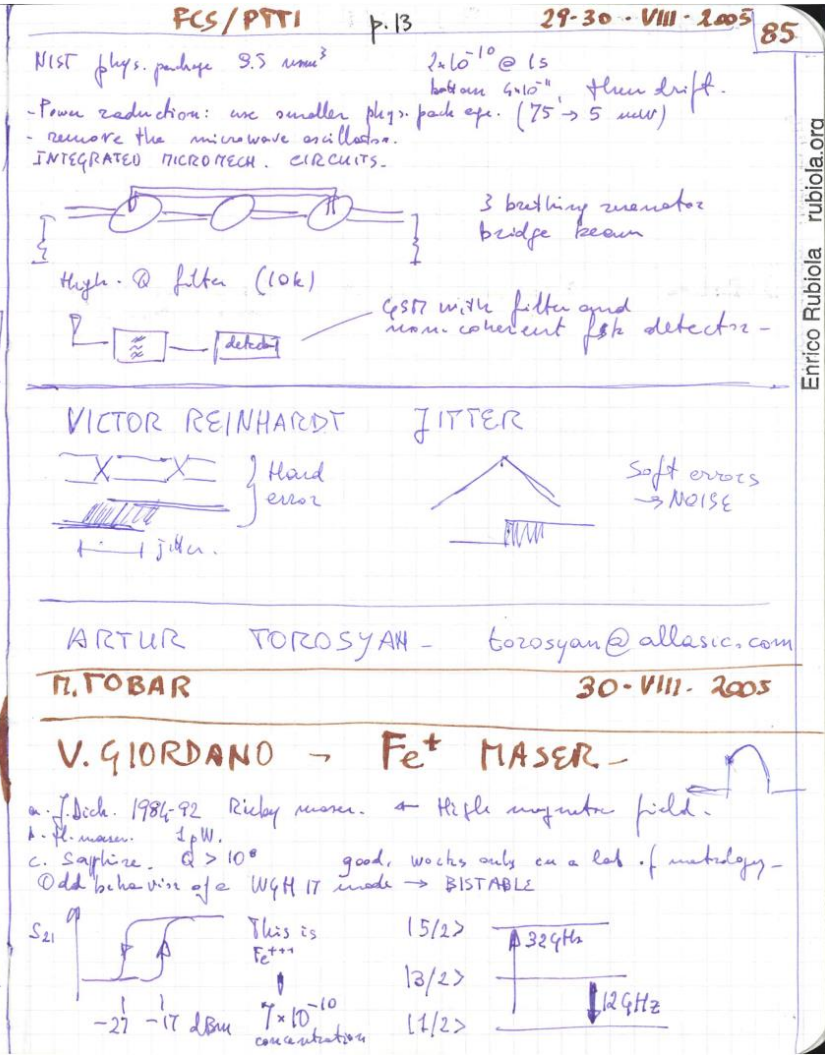
## Table of contents

## Sampled at random

Enrico Rubiola rubiola.org





# My logbooks for conferences

- iPad Pro 10.5”
- GoodNotes app
  - iOS/macOS only
  - Exports pages to pdf

- File can be prepared before
- Copy/paste from the program

Conference | Speaker | Place/Date | Summary of what I learned

CPEM p 10 Martin Milton Paris, 9 VII 2018

7 base units → 3 on fund. const $\nu_{Cs}$, A, cd
3 fund. constants 3 on atoms, s, K, mole

New
6 def on fund const

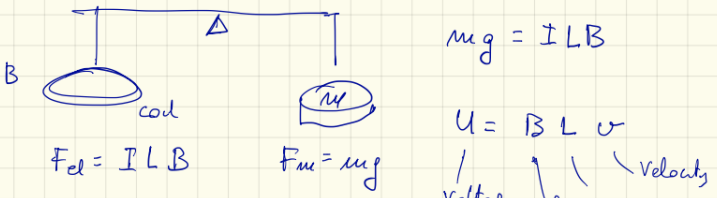
$k_g$, 1880, ratified in 1889

How difficult is it?

kg 1991 → 2014 $\sigma = 3\,\mu g$ Vs copies.

---

kg ⟷ A Kibble balance




$mg = ILB$

$U = BLv$
voltage, flux, velocity

This takes h
It was difficult to agree about h

Si sphere
link from macro to micro gives h

**Impact of new definitions**

A defined in terms of e charge
Quantum Hall → impedance vs $h/e^2$

Nobel 1985 Physics

CPEM p 13 Von Klitzing Paris, 9 VII 2018

FET. The concentration of electrons is defined by the Hall effect


new type of resistance $h/e^2$

First results were ~ 6 kΩ, $h/4e^2$

[the first paper was rejected by PRL !!!]

$R = h/e^2$

realisation of a resistance standard → calibration of $h/e^2$ vs the SI Ω

Thompson Lampard capacitor → most accurate

$h/e^2$ relate to $\alpha$, fine structure constant

1981 CPEM → proposed a new definition of the kg

Reliability ?

Wheatstone bridge
4 resistors give equivalent of $10^{-11}$

CPEM p 28 My Personal Notes Paris, 9 VII 2018

The $^{28}Si$ enriched sphere is a totally different technology -
Oddly, u ~ $10 \times 10^{-9}$ same for the two technologies
Enrichment of u $SiF_4$

Electrical units
The choice h, e has a major impact.
QHR and Josephsson rise to the role of definitions and primary standard

The first consequence is that μ and ε are no longer what they were.
All the electrical unit changes up to 200 ppb
V, A, Ω, C, W, F, H

Kelvin
There are 5 physical phenomena which can be exploited to define the temperature through k:
- Johnson
- Speed of sound in gases — best, 1-7 ppm
- Dielectric constant of gases
- Refractive index of gas
- Doppler broadening

J. Fischer, Metrologia 52, 2015
The TPW is gone

# Still unhappy with technology

- iPad
  - Best stylet technology
  - Too expensive
  - Go for 13” (10.5” is too small)
  - Does not replace a computer
  - iOS dependent apps
- OneNote
  - Windows/macOS (Linux)
  - Great, but
    - Continuous sheet, no page option
    - PDF export breaks pages badly
- Windows tablets
  - Inferior stylet
  - True computer with keyboard
  - Choice between brands
  - I did not test
  - Two friend uses successfully

# Your PhD Thesis

from day one to the defense

# Should I teach during my PhD?

## Rules of the game (France)

- Contract with the university
  - Need the advisor's agreement
- Administrative unit of time H (Hour)
- Max 64 H, paid ~43 €/H
  - Same remuneration of full professors
  - Time for preparation not included
  - Ratio ≈ 4.2/1 (1 day burden for 2 H)
  - Relates to the rule
    - Full time = 1607 h → 384 H
    - Professors teach 192 H (½ time)
- Alternate forms
  - "Mission doctorale" for specific tasks
    - e.g. help a conference or a museum
  - Work 1 day per 2 H

## Why I should

- € € €
- Learn from your supervisor
- A must for future career in universities

## Why I should not

- Time (full 64 H → 6-7 weeks)
- Your supervisor may let you alone
- Not useful for research-only institutions

## When?

- Risky in the 1st year (2nd semester)
- Best done in the 2nd year
- Keep free the 2nd semester of the 3rd year

# The examining board

- 5-7 members, including 2 Referees
- Proposed by your advisor
- Validated/appointed by the Doctoral School
  - Fussy administration criteria
- Plan ≈ 3 month for the review process
  - Time foe PhD School authorization
  - Referees take 2 months
- The manuscript can be unofficially modified between review and defense
- Almost final manuscript before the defense
  - All members of the examining board

# PhD Defense

Examining Board, before

- Lunch or dinner
- Decisions
  - Chairman
  - Order of questions

The defense

- Chairman's welcome
- Presentation: 45 M
- Questions: 1-1.5 H
  - Referees first
    - Start from the most prestigious or longer travel distance
  - Decreasing order of "importance"
  - Advisor is the last
    - Comments rather than questions
    - Does not participate to the evaluation
  - Some chairmen allow questions from the public
  - The chairman has the last word

After the defense

Examining Board, after

- Exam outcome
  - Never seen saying NO
- Thesis outcome
  - Informal changes
  - Written requirement for changes
- Defense report
  - In France, it always goes with the thesis

Happy end

- Public announcement + oath
- Traditional party

# Before the defense

- Get info about the examiners
  - Focus on referees
  - Search engine
  - Discuss with your advisor
- Slideshow
  - Organized as an article
  - Visual aspect
    - Colors and sizes
  - Numbering pages helps Q&A
  - Projectors aspect ratio is 16/9
  - Spare pages at end
- Repeat, repeat, and repeat
  - With your advisor and other grads
  - Watch on talking time
  - Memorize
    - Page order
    - Intermediate times
- Inspect the conference room
  - Podium, projector, microphone, examiners place,
- Videoconference platform
  - You may need
  - Zoom is preferred
    - All employees in CNRS labs eligible for free account
  - Test in the conference room

# Unfiled ideas

- The real value of your PhD
  - Prestige of the advisor(s)
  - Prestige of the examiners
  - In France, the report is always required with the diploma
- Should I give printed slides?
  - Don’t, distracts the examiners
- Over-prepared talk?
  - Safer, but somewhat boring
  - That’s the way French people like it

# Software Tools

Sadly, more about a cult than a rational choice

# Team Working — Simultaneous Editing

- Cloud: Two or more people can edit simultaneously
- Online editing: as Google Docs and Dropbox Papers
- OneDrive merges contributions
  (better not writing the same paragraph at the same time)
- Versioning server (ascii only, mostly used for code)
  - Apache Subversion
  - Git Hub

- Overleaf for Latex users
  - Real-time preview
  - Rich text or ascii editor
  - Subscription
  - But free of charge with limited space and no of files

# Bibliography Management

A critical issue for scientists

# Many Different Bibliography Styles!

---

[2] Cf. W. Schottky, Ann. d. Physik **57**, 541 (1918).

110

Old, APS (American Physical Society)

Footnote on the same page

---

**Van Vugt, M., Hogan, R., & Kaiser, R. B. (2008). Leadership, followership, and evolution: Some lessons from the past. *American Psychologist*, *63*(3), 182-196. doi:10.1037/0003-066X.63.3.182**

APA (American Psychological Association)

Intext reference (Smith, 1992), and bibliography at end

---

[1] K. Vahala, *Optical Microcavities* (World Scientific, Singapore, 2004).

[11] K. Totsuka and M. Tomita, Opt. Lett. **32**, 3197 (2007).

Physical Review,
APS (American Physical Society)

Square brackets in the text [11]

---

1. Gerard, J. M. *et al.* Quantum boxes as active probes for photonic microstructures: The pillar microcavity case. *Appl. Phys. Lett.* 69, 449–451 (1996).

Nature

Superscript, and bibliography at end

---

[1] D. W. Allan, "Statistics of atomic frequency standards," *Proc. IEEE*, vol. 54, pp. 221–230, Feb. 1966.

IEEE

Square brackets in the text [11]

---

…the work of Cormack (1994).
Cormack (1994, pp.32-33) states that…
…professional audience (Cormack, 1994).
Smith (1946) and Jones (1948) have shown…

Harvard

Intext reference (Smith, 1992), and bibliography at end

Cox, C., 2002. What health care assistants know about clean hands. Nursing today, Spring Issue, pp.647-85.
Baron, D. P., 2008. Business and the organization. Chester: Pearson.

---

[KD] Helmut Kopka and Patrick W. Daly, *Guide to LaTeX*, fourth ed., Addison-Wesley, Boston, 2004.

[Kn] Donald E. Knuth, *The TeXbook*, Addison-Wesley, Reading, MA, 1984.

AMS (American Mathematical Society)

Square brackets in the text [Kn]

---

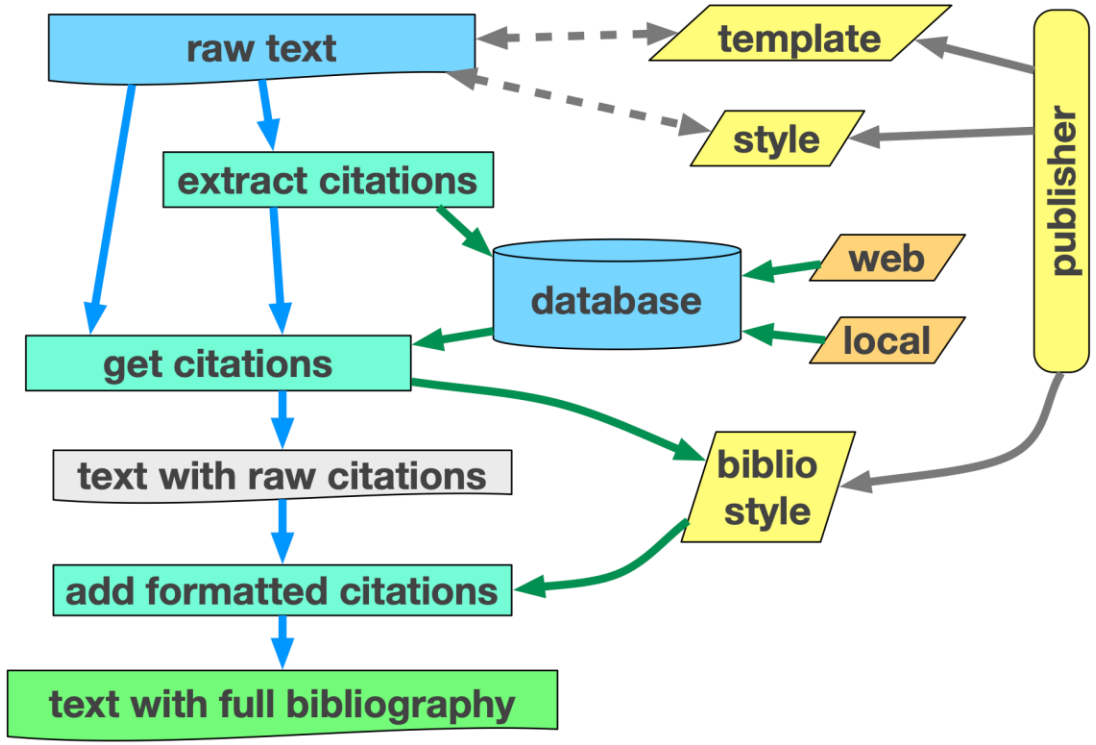
List of abbreviations. Example: PRA / Phys. Rev. A / Physical Review A

# Bibliography Software

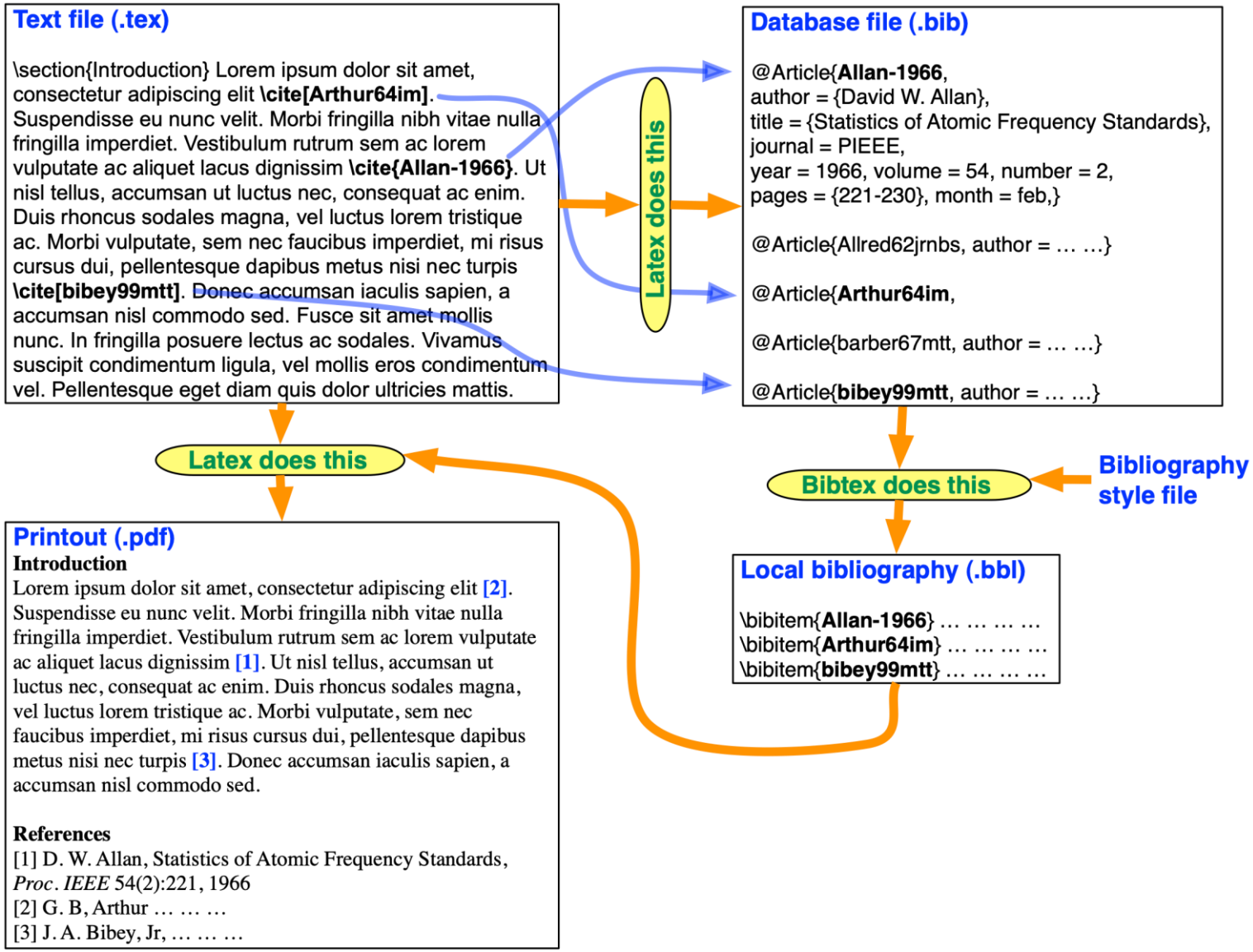
- Ancient time
  - Typeset your bibliography and format it by hand
- Old time
  - Typeset your bibliography database
  - Call “by name” the documents you cite
  - The computer formats the bibliography
- Modern time
  - Build your database when searching on the web
  - PDF files / Saved searches / Database records
  - Compile your bibliography by clicking on the database

# Building the Bibliography

- Start: a bibliographic item is cited by “name” (label)
- Intermediate: the label is replaced by a full database record
- Final: the record is formatted according the publisher rules



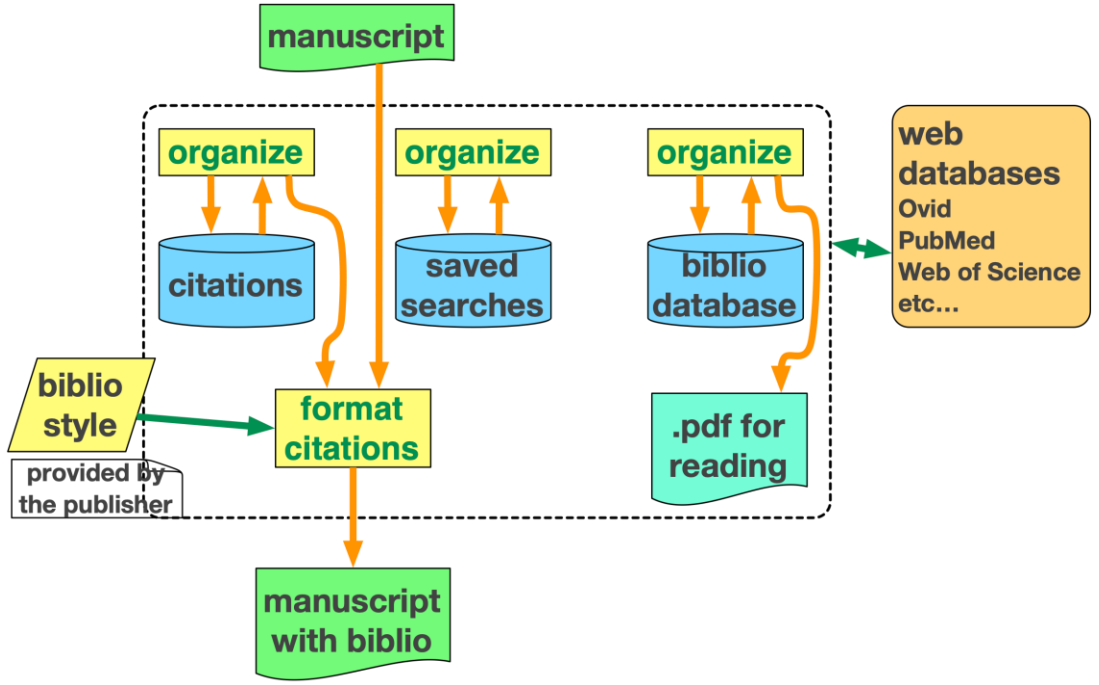
# Example – Latex & Bibtex



# Endnote

Instant bibliography in Microsoft Word, Apple Pages, OpenOffice Writer, Mathematica

- Collect and organize
  - Files for reading
  - Saved searches
  - Citation records
  - Images and figures
  - etc…




Proprietary product, expensive (≈ $300 / €300)

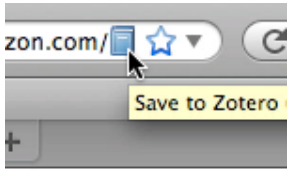
# Mendeley

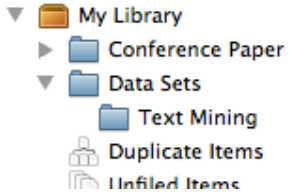
- Broadly similar to Endnote / much simpler
- Proprietary tool
- Elsevier —> Privacy issues?

- Cost
  - 2 GB, free of charge
  - 5 GB, $55/year
  - Unlimited, $165/year

# Zotero

- Choice between standalone and web app
- Linux / macOS / Windows
- Collect all research in a single, searchable interface
  - PDFs, images, audio/video files, screenshots…
- Automatically indexes the full-text library content
- Organizes research into iTunes-playlist-like collections
  - Named collections and sub-collections…
  - Saved searches
- Create footnotes, endnotes, in-text citations, bibliographies
  - Create citations in Word and OpenOffice
- Synchronizes data across many devices
  - Requires registration
    - Subscription charges beyond a small quota
  - General purposes clouds are unsafe




=STANDALONE=

Some notes based on my experience. Most is about how files are organised, in respect of accessing them with the file manager & sync

## BIBDESK

Mac only, fairly good interface

PDF files → goes on the "Bdsk-File-1 = { ..... }" field (or =2, =3 etc) quite easy to keep the file at its own place - (large / distributed field)

.../Article-collection
- subdirectories
- - -
- - -

.../Bibliography
- Bibdesk Database.bib
- links

Notes go on the "annote = { }" field

## JABREF

Linux/Win/Mac Ugly interface

PDF files go on the "file = { }" field, with full path.

be careful, there are two ways to link, with the full path, or putting the PDF in the Jabref database directory

quite small field

Overall, file management structure is similar to BibDesk

Exports to XML → useful to export to Word but not straightforward.

Notes → "comment = { }" field

## ENDNOTE

Win / Mac €250 Too slow on Mac

PDF & File management

- Hashing directory structure
- filenames ≤ 30 chars long

uses its own library

Synch

Cloud: some risk because of the database structure

Online Clarivate cloud
Free for 2 years
Can't say how much it costs later





— STANDALONE —

## MENDELEY

Win / Mac / Linux Elsevier

Files & Sync

- Possible "named directories" like Author, or Author year
- uses its own library
  - local [dropbox, iCloud etc]
  - Mendeley → up to 2GB. Expensive beyond

Unclear if I can put only the links

## ZOTERO

Win / Mac / Linux

- Hash file structure

However, it is possible to link the locally stored files. This

| | Free/open Mac only | Free/open Linux/Mac/Win | €250 Win/Mac | Free/proprd. Linux/Win/Mac | Free/open Linux/Win/Mac |
|---|---|---|---|---|---|
| | BIBDESK | JABREF | ENDNOTE | MENDELEY | ZOTERO |
| File location | local/cloud | local/cloud | local/cloud | local/cloud | local/cloud |
| File structure | my choice | my choice | Hash | hash or name of author | hash |
| Link to my file structure? | yes (default) | yes (be careful) | no way | no way | optional (be careful) |
| Company free space (account) | not avail/required | not required (not offered) | unlimited for 2 (3) years | 2 GB ? | 300 MB |
| Account required | NO (NA) | NO (NA) | NO | YES | NO |
| Account storage type | NA | NA | PDFs and database | database PDF optional? | database (PDF OPTIONAL) |
| Cost, beyond limit | — | — | High? | Med? | LOW |
| Work with only general purpose CLOUD | Y - perfect - | Y - perfect - | Y - risky - | Y - drawbacks! | Y - risky |
| Mixed account + cloud | Y files & database on cloud | Y files and database on cloud | N | ? database → account files → cloud? | Y database → account files → cloud |
| Known problems | clumsy export → Word | clumsy export → Word | Slow on Mac | Elsevier! | |
| Multiple libraries? | Y | Y | Y (better NOT) | N | N |

| | Free/open | Free/open | € 250 | Free/proprid. | Free/open |
|---|---|---|---|---|---|
| | Mac only | Linux/Mac/Win | Win/Mac | Linux/Win/Mac | Linux/Win/Mac |
| | BIBDESK | JABREF | ENDNOTE | MENDELEY | ZOTERO |
| File location | local/cloud | local/cloud | local/cloud | local/cloud | local/cloud |
| File structure | my choice | my choice | Hash | hash or name of author | hash |
| Link to my file structure? | yes (default) | yes (be careful) | no way | no way | optional (be careful) |
| Company free space (Account) | not avail/ required | not required (not avail) | unlimited for 2 (3) years | 2 GB ? | 300 MB |
| Account required | NO (NA) | NO (NA) | NO | YES | NO |
| Account storage type | NA | NA | PDFs and database | database PDF optional? | database PDF OPTIONAL |
| Cost, beyond low | — | — | High ? | Med ? | LOW |
| Work with only general purpose CLOUD | Y - perfect - | Y - perfect - | Y - risky - | Y - drawbacks? | Y - risky |
| Mixed account + cloud | Y files & database on cloud | Y files and data base on cloud | N | ? database → account files → cloud? | Y database → account files → cloud |
| Known problems | clumsy export → Word | clumsy export → Word | Slow on Mac | Elsevier! | |
| Multiple libraries? | Y | Y | Y (better NOT) | N | N |

# Dear students,
# thanks for attending my lectures,
# and best wishes for your career

Yours,
Enrico Rubiola

# End of Lecture #5

# Supplemental Material

## The Scientific Publication

Lectures for PhD Students and Young Scientists

Enrico Rubiola

CNRS FEMTO-ST Institute, Besancon, France

University of (Bourgogne) and Franche Comté, Besancon, France

INRiM, Torino, Italy



ORCID 0000-0002-5364-1835

home page http://rubiola.org

# WYSIWYG Word Processing

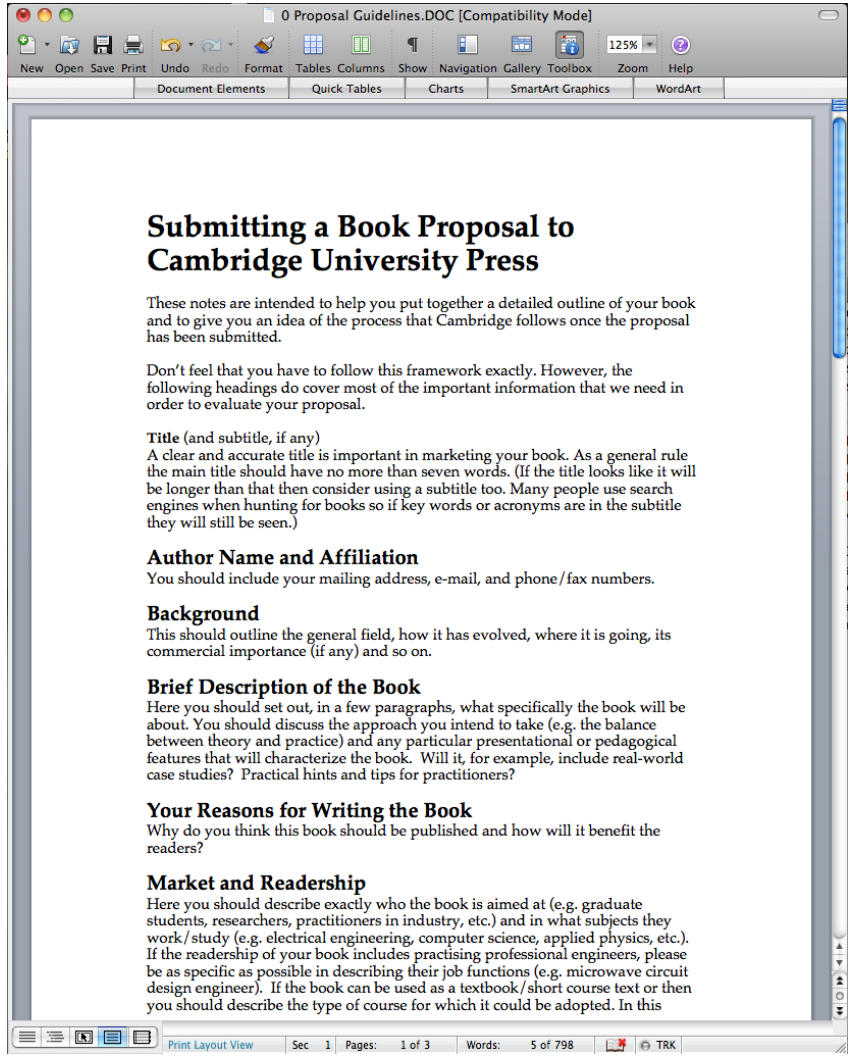
What You See Is What You Get

# Microsoft Office

- The University of Franche Comté subscribes to the Office 365 package (full, not only Word)
- Create an Office 365 account using your email first.last@univ-fcomte.fr, and set a password
- Download Office from the Microsoft web site and install
- Open Word, and choose “School or work account”
- Log in with your email first.last@univ-fcomte.fr and the Office 365 password

# Microsoft Word

## Screenshot




≈

## Printed page

### Submitting a Book Proposal to Cambridge University Press

These notes are intended to help you put together a detailed outline of your book and to give you an idea of the process that Cambridge follows once the proposal has been submitted.

Don't feel that you have to follow this framework exactly. However, the following headings do cover most of the important information that we need in order to evaluate your proposal.

**Title** (and subtitle, if any)
A clear and accurate title is important in marketing your book. As a general rule the main title should have no more than seven words. (If the title looks like it will be longer than that then consider using a subtitle too. Many people use search engines when hunting for books so if key words or acronyms are in the subtitle they will still be seen.)

**Author Name and Affiliation**
You should include your mailing address, e-mail, and phone/fax numbers.

**Background**
This should outline the general field, how it has evolved, where it is going, its commercial importance (if any) and so on.

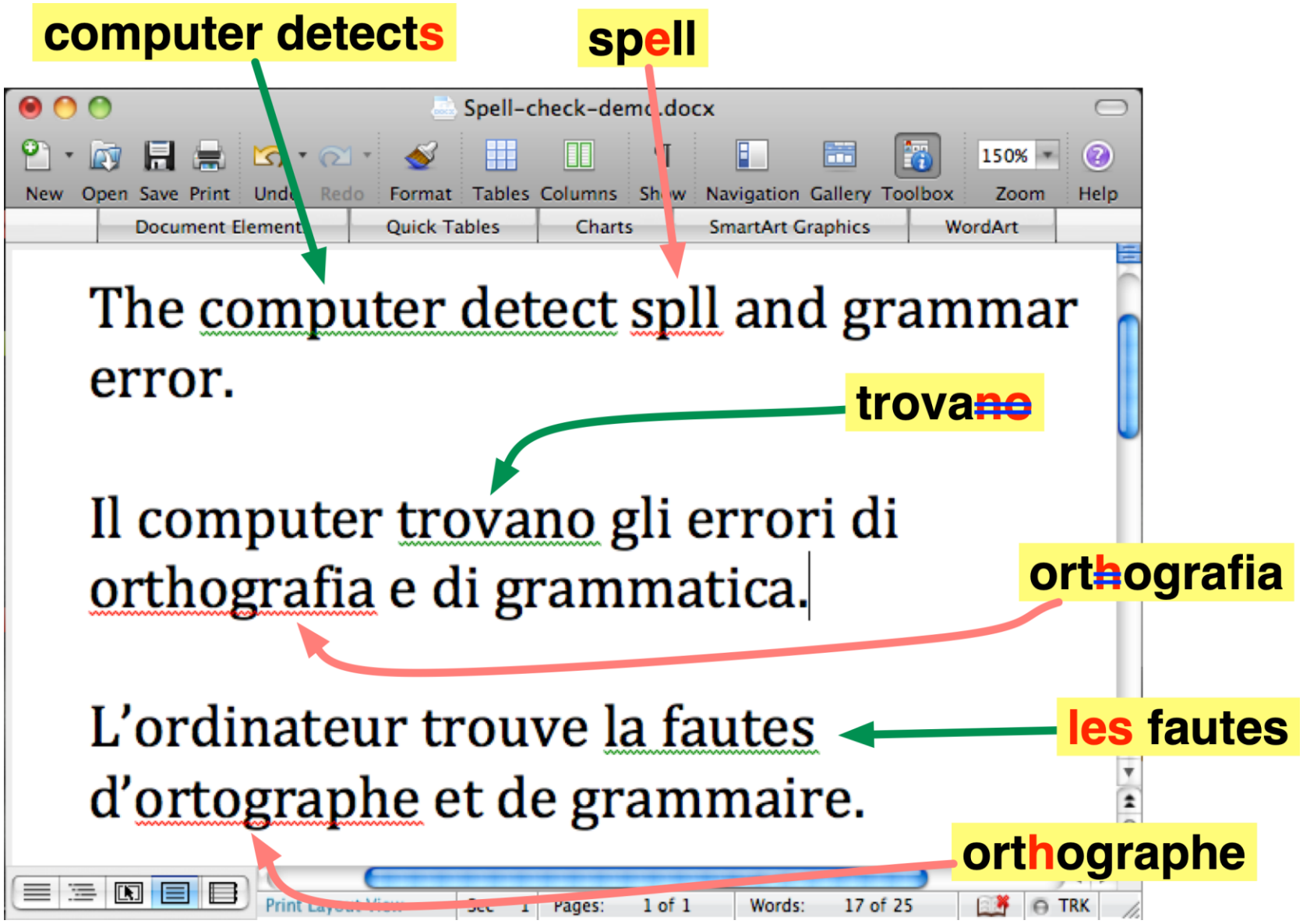
**Brief Description of the Book**
Here you should set out, in a few paragraphs, what specifically the book will be about. You should discuss the approach you intend to take (e.g. the balance between theory and practice) and any particular presentational or pedagogical features that will characterize the book. Will it, for example, include real-world case studies? Practical hints and tips for practitioners?

**Your Reasons for Writing the Book**
Why do you think this book should be published and how will it benefit the readers?

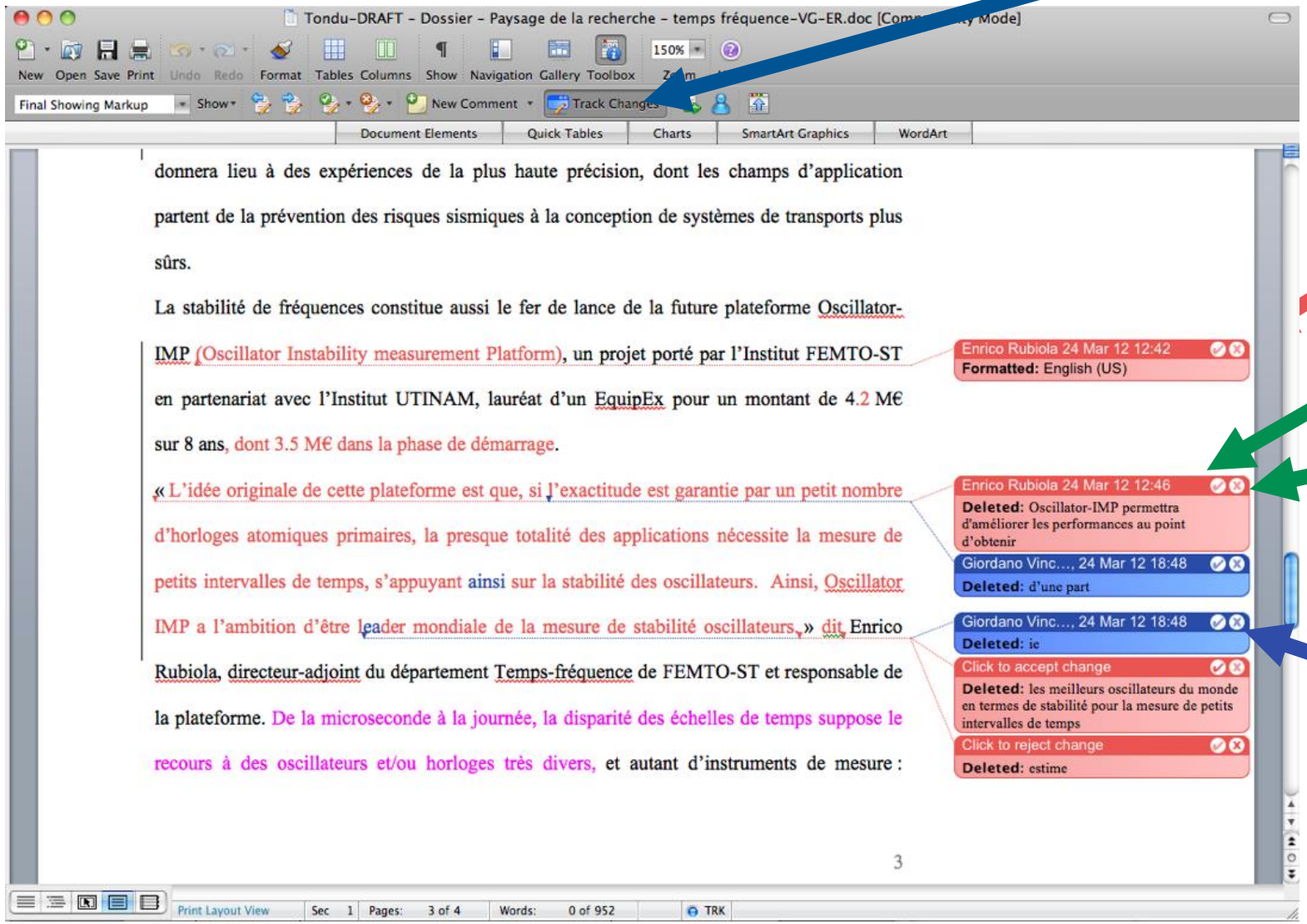
**Market and Readership**
Here you should describe exactly who the book is aimed at (e.g. graduate students, researchers, practitioners in industry, etc.) and in what subjects they work/study (e.g. electrical engineering, computer science, applied physics, etc.). If the readership of your book includes practising professional engineers, please be as specific as possible in describing their job functions (e.g. microwave circuit design engineer). If the book can be used as a textbook/short course text or then you should describe the type of course for which it could be adopted. In this

What You See Is What You Get

# Multilingual Support



# Team Working — Track Changes




Changes made by Enrico Rubiola

Accept or reject changes

Changes made by Vincent Giordano

# Equations

New versions do well

Latex-like typesetting way:  1/2 \sqrt x^2 + y^2

## Microsoft Word 2016

Displayed equation

$$\frac{1}{2}\sqrt{x^2+y^2}$$

Inline equation

$\frac{1}{2}\sqrt{x^2+y^2}$

## Professional typography

displayed formula

$$\frac{1}{2}\sqrt{x^2+y^2} \geq 0$$

inline formula

$\frac{1}{2}\sqrt{x^2+y^2} \geq 0$

# Word – The Bottom Line

My tricks at the URL
http://rubiola.org/pdf-lectures/MS-Word-Tricks.docx

- Pros
  - Basic use extremely simple and quick to learn
  - Spell check and grammar check
  - Sophisticated multilingual support
  - Track changes
- Simultaneous editing
  - Full integration with other programs
  - Generally efficient for small documents
- Industry standard
  - Accepted by all publishers

.doc is proprietary format

.docx is XML, but proprietary

Little-known option for strict open XML

- Cons
- Advanced use is terribly complex and difficult to learn
- Painful search through menus
- Limited set of symbols, difficult to find
- Loss of quality with vector graphics
- Sometimes small documents give a large file
- Print generally inferior  to pro quality
- Large documents are difficult or impossible to manage (split)
- Document damages when changing version

I like Word for drafting, and Latex for professional typesetting (conversion under LibreOffice)

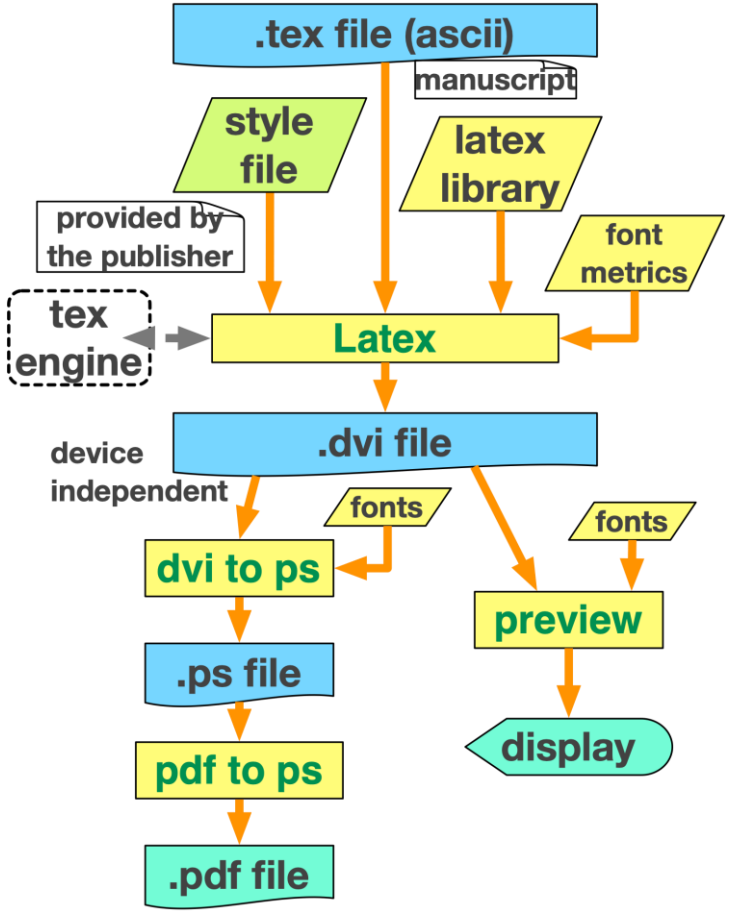
# Other WYSIWYG Programs

- OpenOffice
  - Similar to Office, and free, but less efficient
  - Export in PDF and Latex
- LibreOffice
  - Alternate version of OpenOffice, born when Sun/Oracle tried to limit the freedom with OpenOffice
- Lyx
  - Free, yet small community of users and lacks most pro features
- Pages (Apple)
  - Simple and beautiful results, but lacks most pro features
- Scientific Word
  - Uses Tex/Latex as the typesetting engine
  - Outstanding for technical writing
- TexMacs (free)
  - Free, but small community of users
  - Beautiful prints, but lacks most pro features
  - Designed for integration with some mathematical packages
- Scrivener

# Structured Text Processing

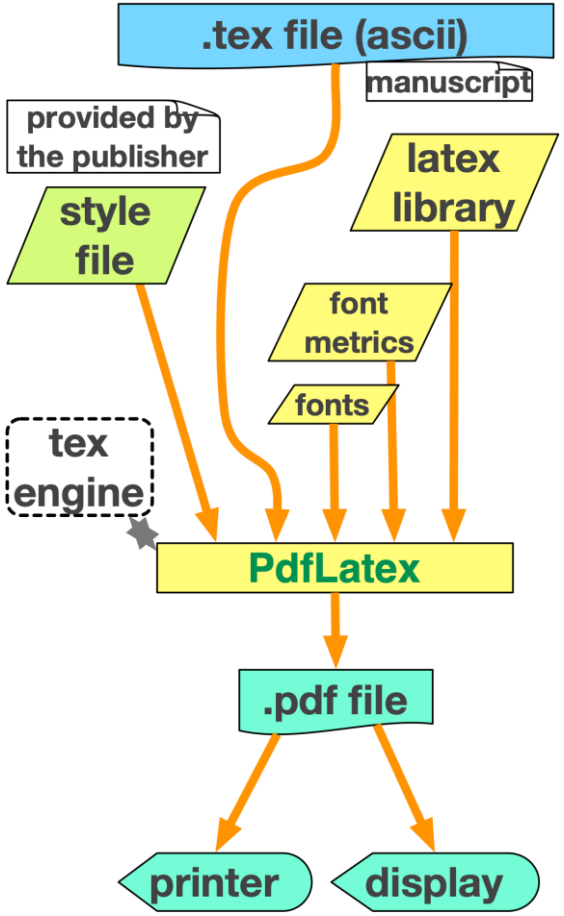
# The Tex / Latex Family

- The .tex is an ASCII file
  - typesetting commands
  - text
- Extremely compact files
- Latex processes boxes (font metrics) instead of graphics
- True fonts are added at preview/print time
- Scalable graphics
- Full professional quality with early computers (1980s: 5 MHz clock, 640 kB RAM, 20 MB hard disk)
- Portability over ≥ 30 years (!!!)
- Free, open source
- Supported by the American Mathematical Society

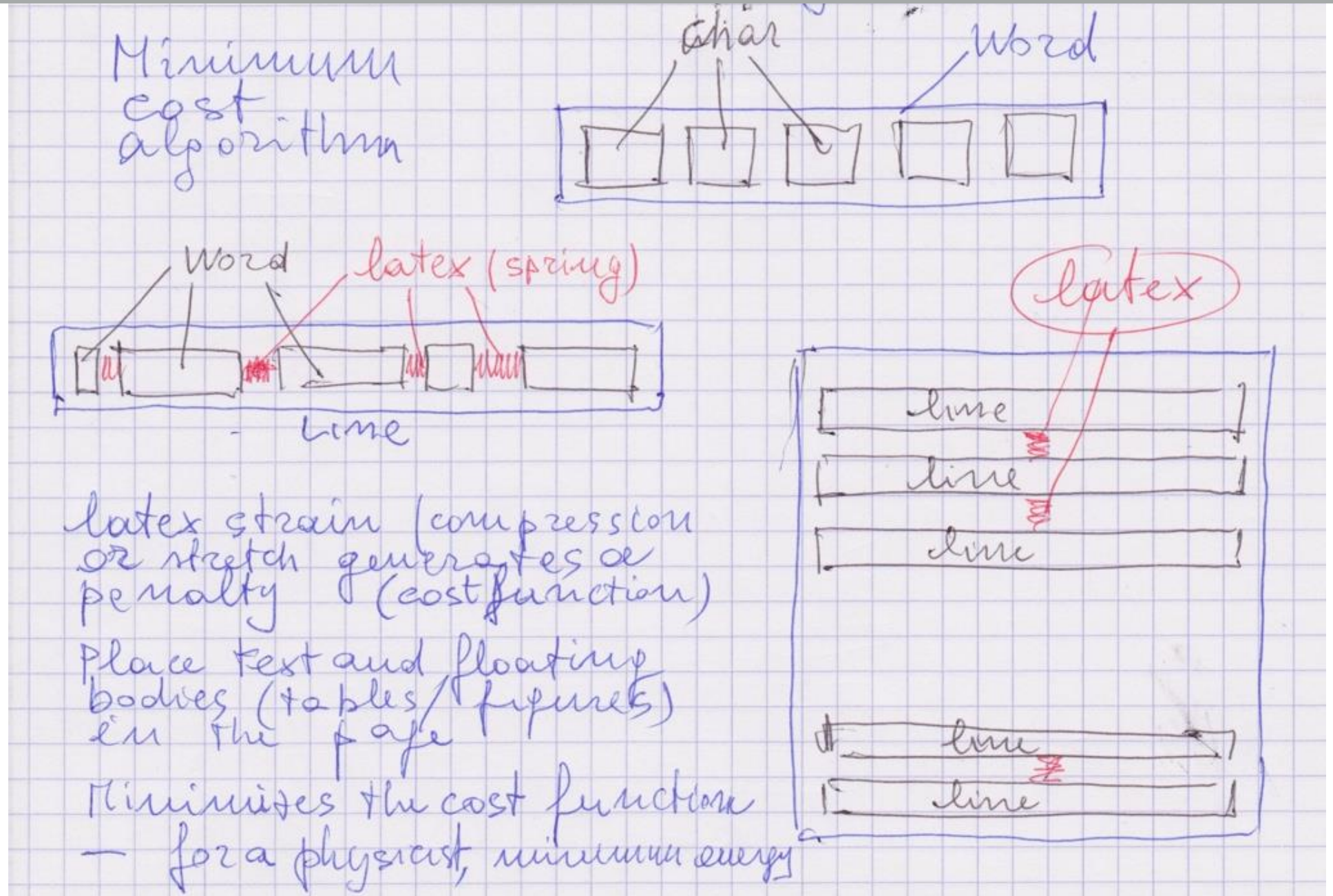


# PdfLatex

- A different flavor of latex which skips dvi and postscript
- Faster and simpler engine
- Default in most installations
- Same results as regular Latex (almost)
- Preferred in most cases
  - Personal use, up to small/mid-size publishing companies
  - Nowadays, very few use true postscript (2400 dpi photo-plotters)



# The Tex Engine



# Pioneering Design, D. Knuth, 1978

- Automated placement of floating bodies (figures, tables)
- Automated numbering of chapters, sections, figures, formulas
- Refer to numbered objects by name (label)
- Table of contents automatically generated and updated
  - Also list of tables, figures, etc.
- Index automatically generated and updated (via Makeindex)
- Bibliography management (via Bibtex)
- Virtually unlimited font set (via Metafont)

# The Source File

I don't remember where this comes from, apologize. I promise I'll replace with something copyright safe

p.246 M. Gossens et al, The Latex Companion, Addison Wesley 1994

## Code

```
daughter-in-law, X-rated\\
pages 13--67\\
yes---or no? \\
$0$, $1$ and $-1$
```

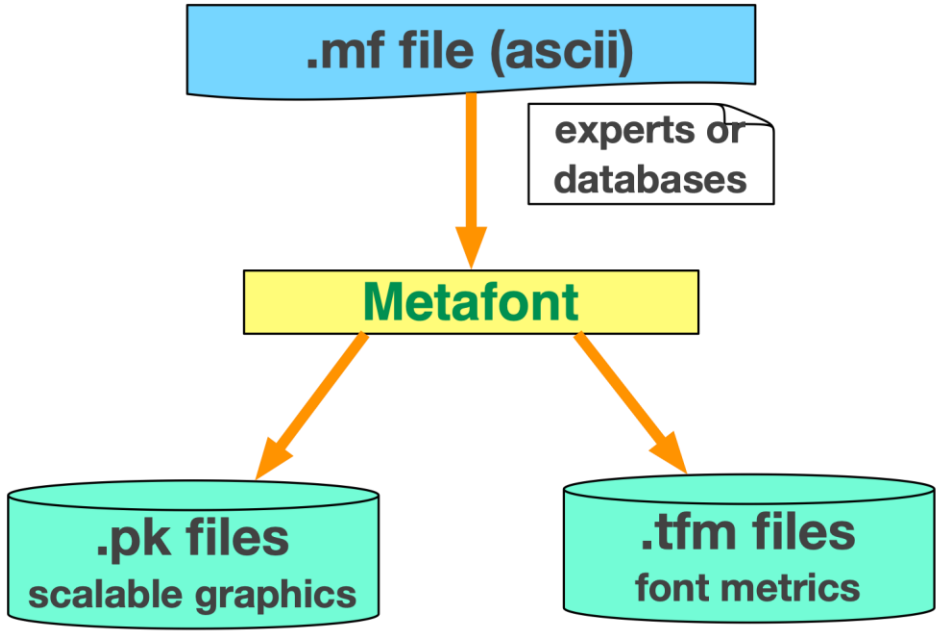
## Printout

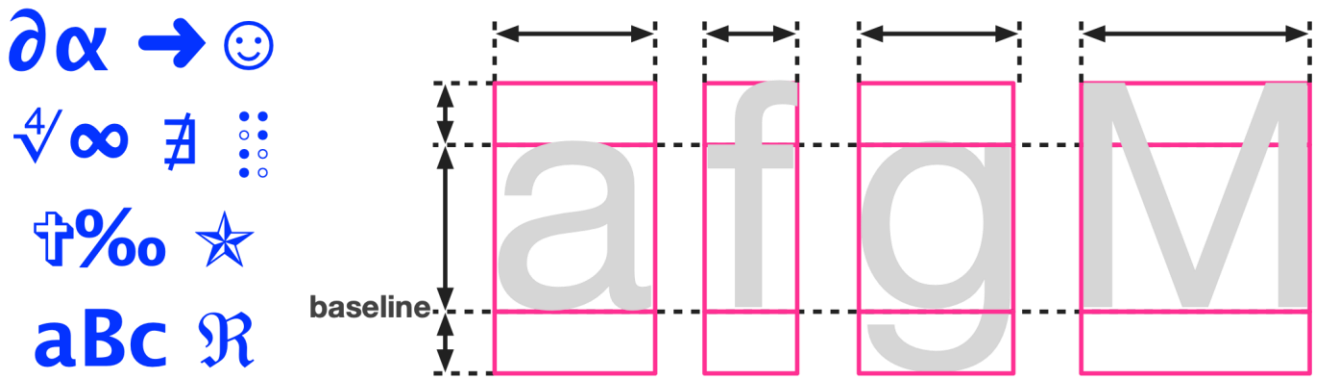
daughter-in-law, X-rated
pages 13–67
yes—or no?
0, 1 and −1

```
\begin{align}
\begin{split}
|I_1| &= \left| \int_\Omega gRu \,d\Omega \right|                    \\
      &\le C_3 \left[ \int_\Omega \left( \int_{a}^x
         g(\xi,t) \,d \xi \right)^2d \Omega \right]^{1/2}           \\
      &\quad\times \left[ \int_\Omega \left\{ u^2_x + \frac{1}{k}
        \left( \int_{a}^x cu_t \, d\xi \right)^2 \right\}
        c \Omega \right]^{1/2}                                      \\
      &\le C_4 \left| \left| f \left| \widetilde{S}^{-1,0}_{a,-}
        W_2(\Omega,\Gamma_l) \right| \right|
        \left| |u| \overset{\circ} \to W_2^{\widetilde{A}}
         (\Omega;\Gamma_r,T) \right| \right|.
\end{split}\label{eq:A}                                             \\
\begin{split}
|I_2| &= \left| \int_{0}^T \psi(t) \left\{ u(a,t)
          -\int_{\gamma(t)}^a \frac{d\theta}{k(\theta,t)}
          \int_{a}^\theta c(\xi) u_t(\xi,t) \,d \xi \right\} dt
        \right|                                                     \\
      &\le C_6 \left| \left| f \int_\Omega
          \left| \widetilde{S}^{-1,0}_{a,-}
             W_2(\Omega,\Gamma_l)  \right| \right|
          \left| |u| \overset{\circ} \to W_2^{\widetilde{A}}
            (\Omega;\Gamma_r,T) \right| \right|.
\end{split}
\end{align}
```

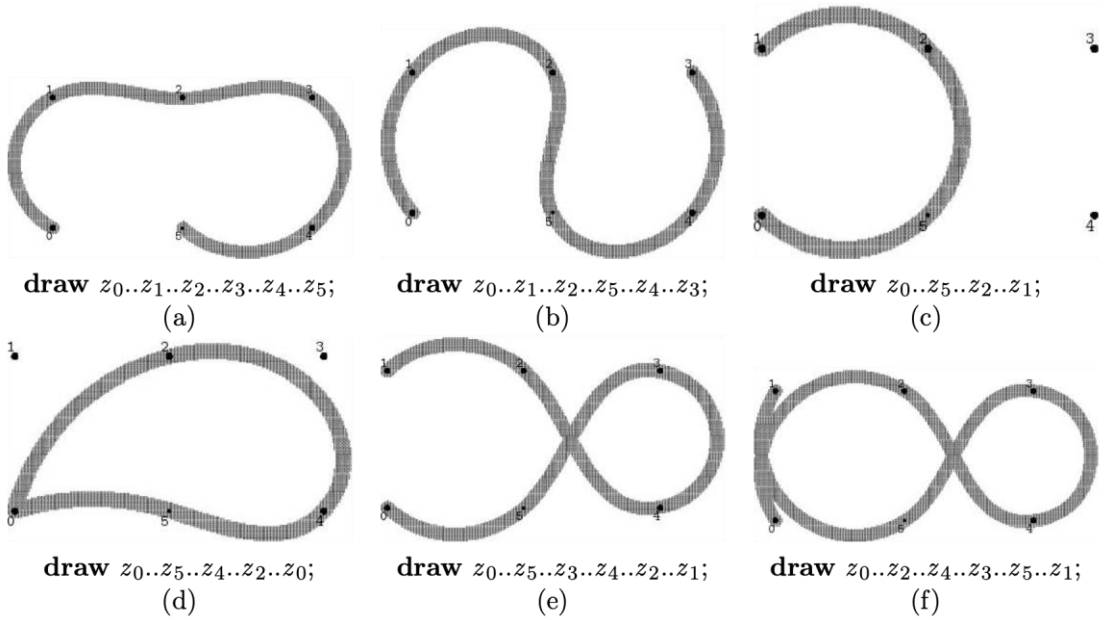
$$
\begin{aligned}
|I_1| &= \left| \int_\Omega gRu \, d\Omega \right| \\
&\le C_3 \left[ \int_\Omega \left( \int_a^x g(\xi,t)\, d\xi \right)^2 d\Omega \right]^{1/2} \\
&\quad \times \left[ \int_\Omega \left\{ u_x^2 + \frac{1}{k} \left( \int_a^x c u_t \, d\xi \right)^2 \right\} c\Omega \right]^{1/2} \\
&\le C_4 \left\| f \left| \widetilde{S}^{-1,0}_{a,-} W_2(\Omega,\Gamma_l) \right| \right\| \left| |u| \overset{\circ}{\to} W_2^{\widetilde{A}}(\Omega;\Gamma_r,T) \right\| . \\
|I_2| &= \left| \int_0^T \psi(t) \left\{ u(a,t) - \int_{\gamma(t)}^a \frac{d\theta}{k(\theta,t)} \int_a^\theta c(\xi) u_t(\xi,t)\, d\xi \right\} dt \right| \\
&\le C_6 \left\| f \int_\Omega \left| \widetilde{S}^{-1,0}_{a,-} W_2(\Omega,\Gamma_l) \right| \right\| \left| |u| \overset{\circ}{\to} W_2^{\widetilde{A}}(\Omega;\Gamma_r,T) \right\| .
\end{aligned}
$$

# The Metafont Concept

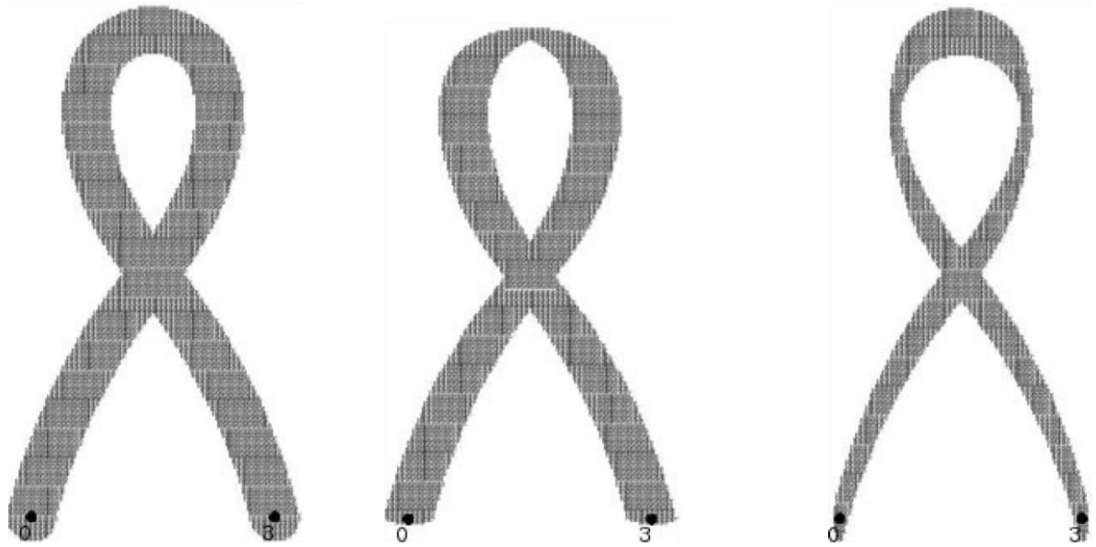


# Metafont and Bezier Lines




Round tip



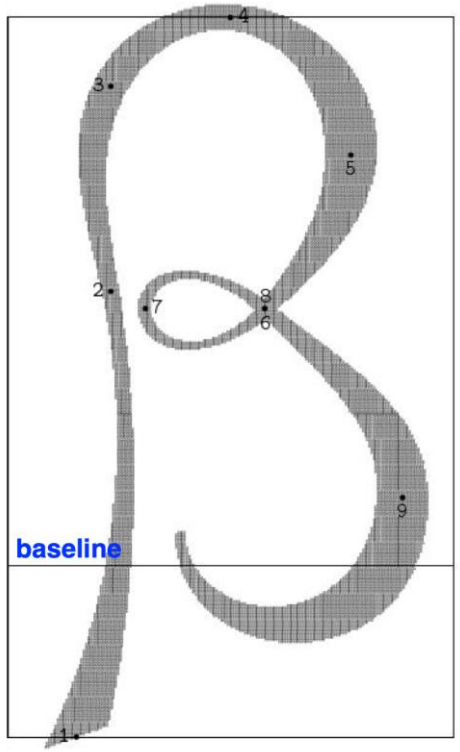
Flat tip

From C. Grandsire

# Metafont Example

```
u#:=4/9pt#;
define_pixels(u);
beginchar(66,13u#,16u#,5u#);"Letter beta";
    x1=2u; x2=x3=3u;
    bot y1=-5u; y2=8u; y3=14u;
    x4=6.5u; top y4=h;
    z5=(10u,12u);
    z6=(7.5u,7.5u); z8=z6;
    z7=(4u,7.5u);
    z9=(11.5u,2u);
    z0=(5u,u);
    penpos1(2u,20);
    penpos2(.5u,0);
    penpos3(u,-45);
    penpos4(.8u,-90);
    penpos5(1.5u,-180);
    penpos6(.4u,150);
    penpos7(.4u,0);
    penpos8(.4u,210);
    penpos9(1.5u,-180);
    penpos0(.3u,20);
    pickup pencircle;
    penstroke z1e..z2e..z3e..z4e..z5e..z6e..{up}z7e..z8e..z9e..{up}z0e;
    labels(range 1 thru 9);
endchar;
end
```

Greek letter “beta”

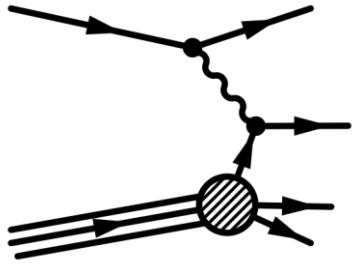


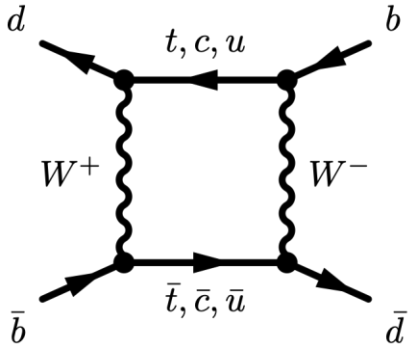

The compressed file takes a few bytes

From C. Grandsire

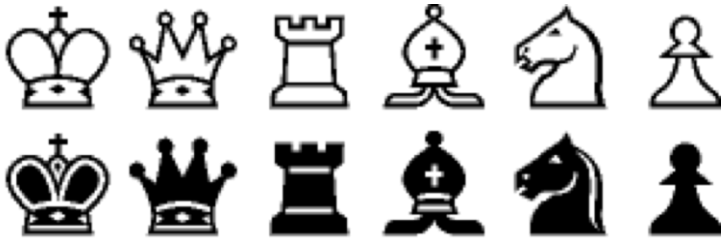
# Unlimited Fancy Graphics

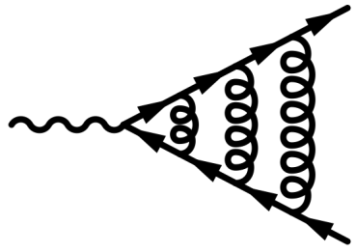


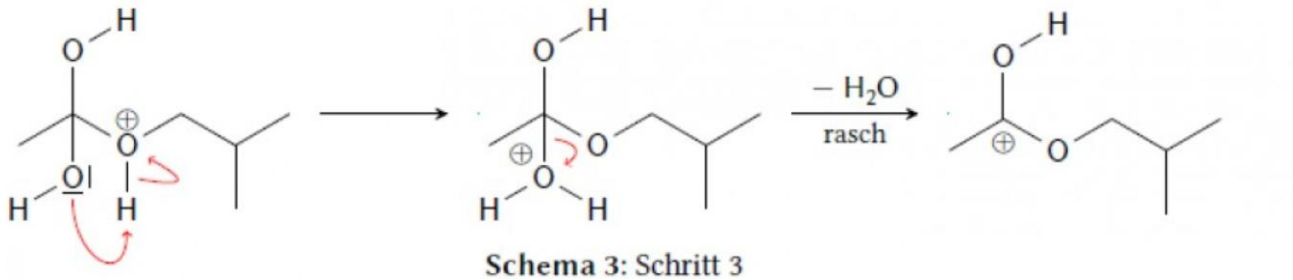





| | |
|---|---|
| ⟼ | \longmapsto |
| ↪ | \hookrightarrow |
| ⇀ | \rightharpoonup |
| ⇁ | \rightharpoondown |
| ⇝ | \leadsto |
| ⇠ | \dashleftarrow |
| ⇐ | \Lleftarrow |
| ↫ | \looparrowleft |
| ↺ | \circlearrowleft |
| ↿ | \upharpoonleft |
| ⇜⇝ | \leftrightsquigarrow |
| ⇉ | \rightrightarrows |
| ⤜ | \rightarrowtail |
| ↷ | \curvearrowright |
| ⇊ | \downdownarrows |
| ⇝ | \rightsquigarrow |








Schema 3: Schritt 3

# Conference Presentation

# General Advices

- Get information about the audience, and design the presentation for them
- Number your slides, helps to aks questions
- Table of contents goes in the first slide (title page)
- Choice of colors –> in the end, you have very little choice
  - Printable at a reasonable cost
  - Visible on screen and print
  - Visible when you don't print the background image/fill
  - Some colors may disturb (bright red, bright light green…)
- Letters and numbers must be visible
  - Avoid too small font in figures and plots
    (appropriate size is bigger than in printed material)
- Choice of the program, and portability of your presentation
- Beware of fancy fonts, they may not be printed/shown correctly
- The last slide should summarize the results you are most proud of
  (don't show a "thank you" slide)

Slides reflect your personality, and shows it in public
Doing some experiments pays back. When you are under pressure is too late

# Other Advices

- Take a look at the conference room
  - Can you use your computer?
  - Is a microphone necessary or mandatory?
  - Is the position comfortable?
  - Is a power outlet available and compatible with your computer?
- Check on laser pointer and battery
- Save a PDF copy of your presentation in a USB key
- Learn by hart the slide order / have a plan for long presentations
- Beginners: practice / record your presentation
- Tradeoff between preparation and improvisation
  - A learned-by-hart presentation is deadly boring (often seen at PhD defenses)
  - Good improvisation catches the attention, at some risk
  - Experience: you know what can be improvised and what cannot

# Planning a Long Presentation

## Example

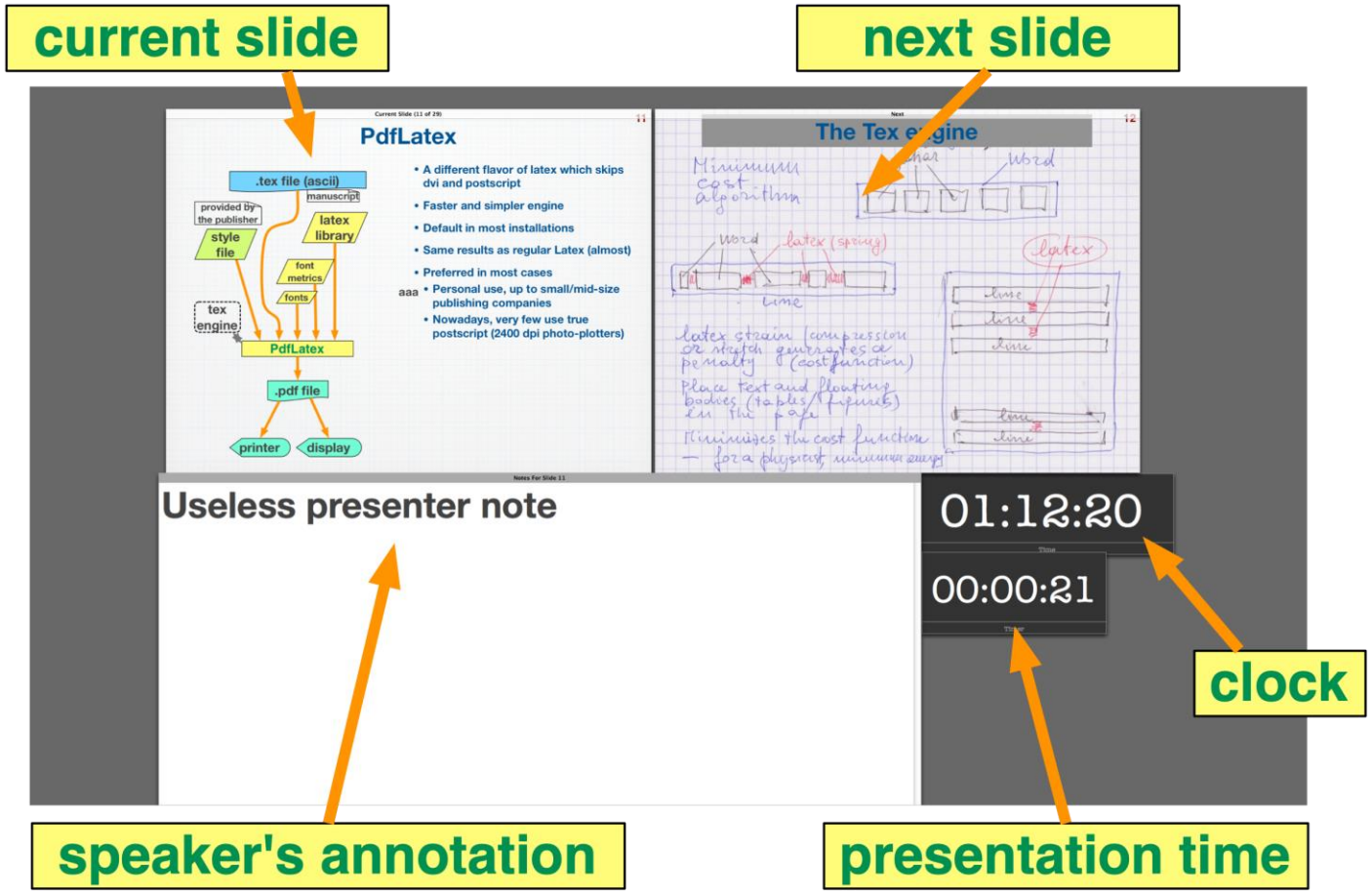
| Enrico Rubiola | | | Fortef 28 March 2012 |
|---|---|---|---|
| | | | |
| | | | **Frequency stability, phase noise etc** |
| **tot** | **dur** | **no.** | **subject** |
| **40** | **40** | **2-26** | **Spectral analysis** |
| | | | 3-6 General |
| | | | 8-15 Fourier |
| | | | 17-26 Nice technical issues |
| **50** | **10** | **28-33** | **Phase noise & friends** |
| **70** | **20** | **34-50** | **Noise in amplifiers and components** |
| | | 36–50 | Flicker and white |
| **100** | **30** | | **Leeson effect** |
| | | 67-74 | Heuristic approach |
| | | 76-95 | Analysis of some oscillators |
| **115** | **15** | **96-105** | **Cross spectrum** |
| **120** | **5** | **107-108** | **Conclusions** |
| | | | |
| | | | **Experimental methods** |
| **tot** | **dur** | **no.** | **subject** |
| **15** | **15** | **4-10** | **Saturated mixer** |
| **25** | **10** | **12-15** | **Correlation measurements** |
| **40** | **15** | **17-27** | **Oscillator phase noise** |
| **55** | **15** | **29-42** | **Photonic techniques** |
| **65** | **10** | **44-48** | **Calibration** |
| **75** | **10** | **50-64** | **Bridge techniques** |
| **85** | **10** | **66-71** | **AM noise** |
| **90** | **5** | **72** | **Conclusion/IMP** |

## Advices

- The plan of a long talk cannot be learned by hart
- Depending on the public, you may need to slow down
- Divide the available time in slots
- Keep the slots on schedule
- Add/skip slides within the slot
- Private next-slide preview helps a lot

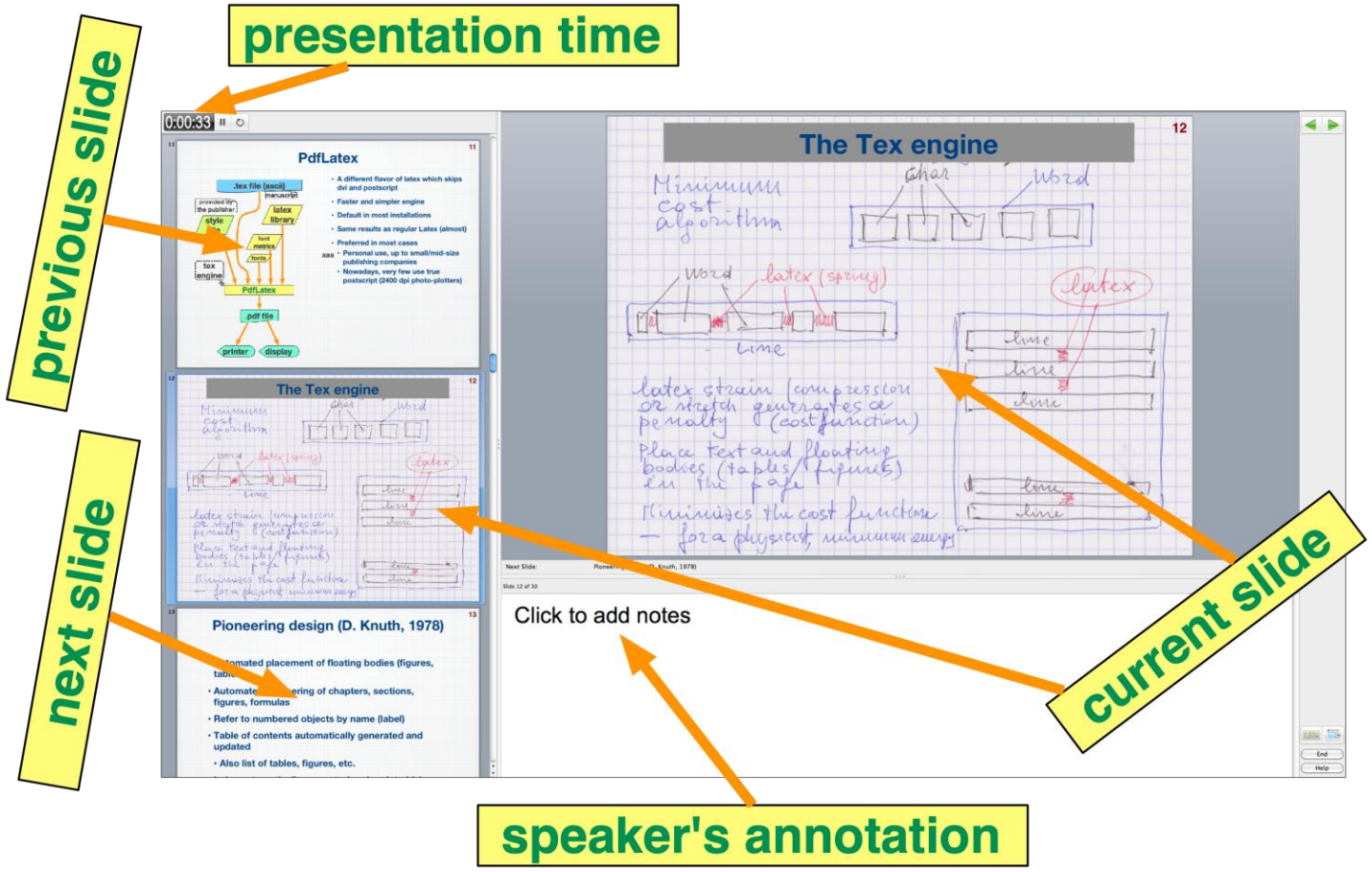
# Speaker's Private Screen

## Apple Keynote app



# Speaker's Private Screen

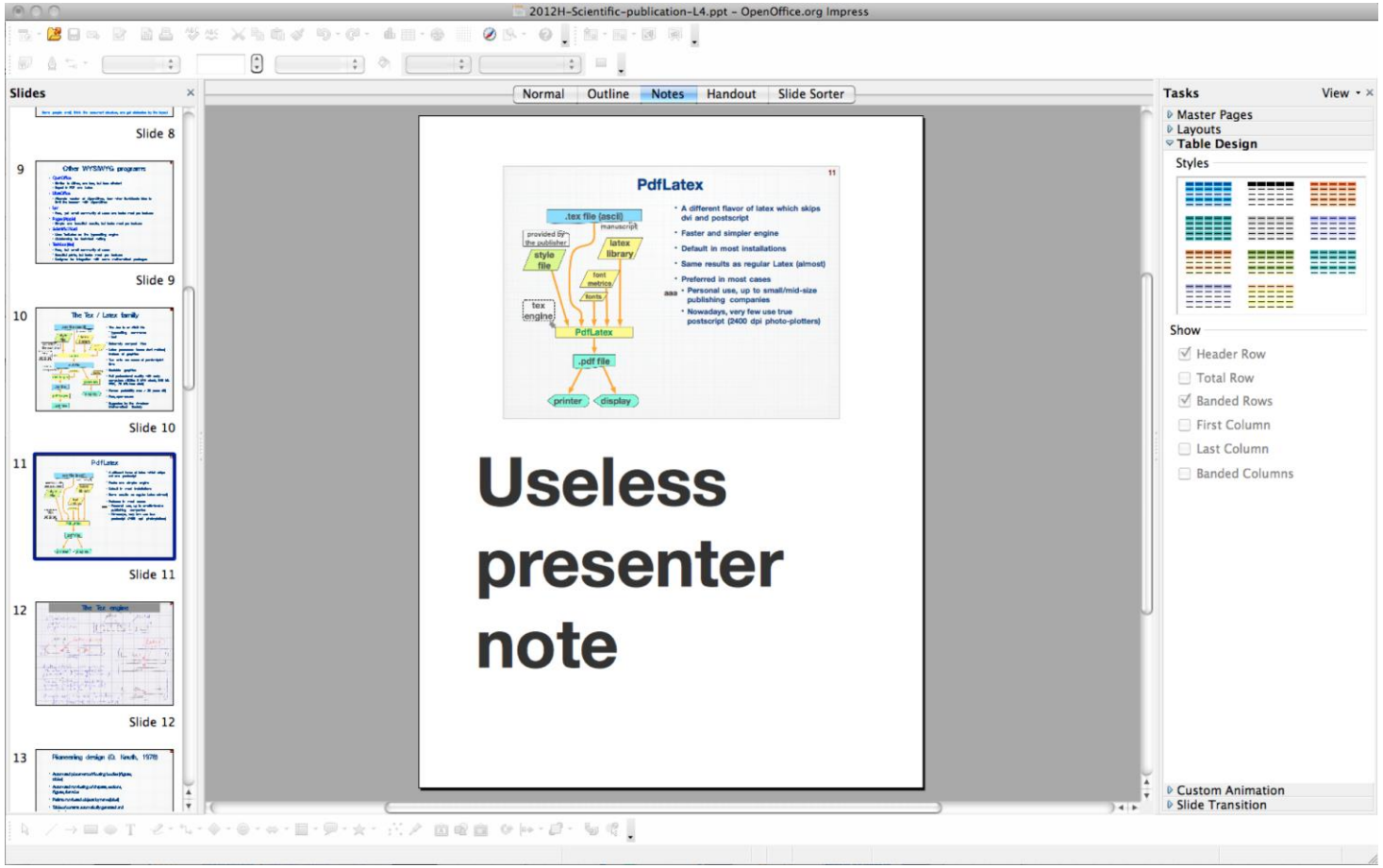
## Microsoft PowerPoint app



# Speaker's Private Scren

## OpenOffice / LibreOffice app

The private screen is totally independent of the presentation



# Latex Presentations

Tex/Latex generate outstanding PDFs.  Why not for a presentation?

- The strength and the weakness of Latex is that it hides the layout
  - Difficult to figure out what the final result look like

- Available packages and styles
  - SliTex is gone
  - Foiltex (IBM) is (one of) the simplest to use
    - Elderly, no longer maintained
  - Beamer is by far the most used

# Beamer – Example



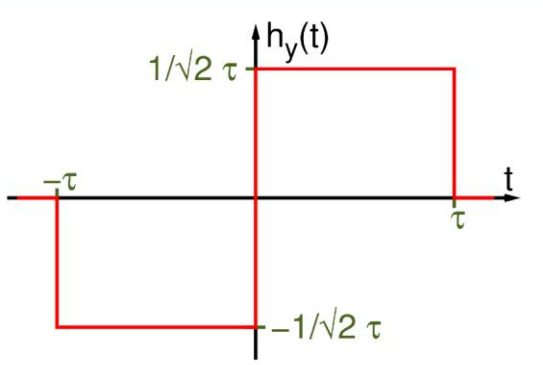
## A spectral analysis tool

as well as a statistical estimator

**Convolution product in the time domain...**

$$\sigma_y^2(\tau) = \left\langle \left[ \int_{-\infty}^{+\infty} y(t) h_y(t_k - t) dt \right]^2 \right\rangle$$

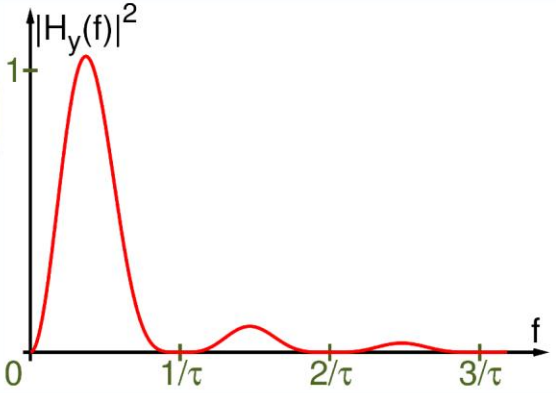
with
$$\begin{cases} h_y(t) = \dfrac{-1}{\sqrt{2}\tau} & \text{if} \quad -\tau \geq t < 0 \\ h_y(t) = \dfrac{+1}{\sqrt{2}\tau} & \text{if} \quad 0 \geq t < \tau \\ h_y(t) = 0 & \text{else} \end{cases}$$




**...filtering in the frequency domain**

$$\sigma_y^2(\tau) = \int_0^{\infty} S_y(f) \, |H_y(f)|^2 \, df$$

with $|H_y(f)|^2 = |\text{F.T.}\,[h_y(t)]|^2 = 2\dfrac{\sin^4(\pi\tau f)}{(\pi\tau f)^2}$



# Academic Career

Beware that for some, academia turns out to be the hell

- Always hunt for grants (means, money)
- Serious and stressful multitasking
- Administration prevails on science

# Administratium

## New Chemical Element Discovered

The heaviest element known to science was recently discovered by investigators at a major U.S. research university. The element, tentatively named administratium, has no protons or electrons and thus has an atomic number of 0. However, it does have one neutron, 125 assistant neutrons, 75 vice neutrons and 111 assistant vice neutrons, which gives it an atomic mass of 312. These 312 particles are held together by a force that involves the continuous exchange of meson-like particles called morons.

Since it has no electrons, administratium is inert. However, it can be detected chemically as it impedes every reaction it comes in contact with. According to the discoverers, a minute amount of administratium causes one reaction to take over four days to complete when it would have normally occurred in less than a second.

Administratium has a normal half-life of approximately three years, at which time it does not decay, but instead undergoes a reorganization in which assistant neutrons, vice neutrons and assistant vice neutrons exchange places. Some studies have shown that the atomic mass actually increases after each reorganization.

Research at other laboratories indicates that administratium occurs naturally in the atmosphere. It tends to concentrate at certain points such as government agencies, large corporations, and universities. It can usually be found in the newest, best appointed, and best maintained buildings.

Scientists point out that administratium is known to be toxic at any level of concentration and can easily destroy any productive reaction where it is allowed to accumulate. Attempts are being made to determine how administratium can be controlled to prevent irreversible damage, but results to date are not promising.

Retrieved Feb 7, 2021 from
https://www.mit.edu/people/dmredish/wwwMLRF/links/Humor/Administratium.html

The Tech 40(11) p.1-2, October 4, 1991 reports on the

Ig Nobel prizes

“Thomas Kyle’s discovery of `the heaviest element in the universe, Administratium’ was rewarded the physics prize”

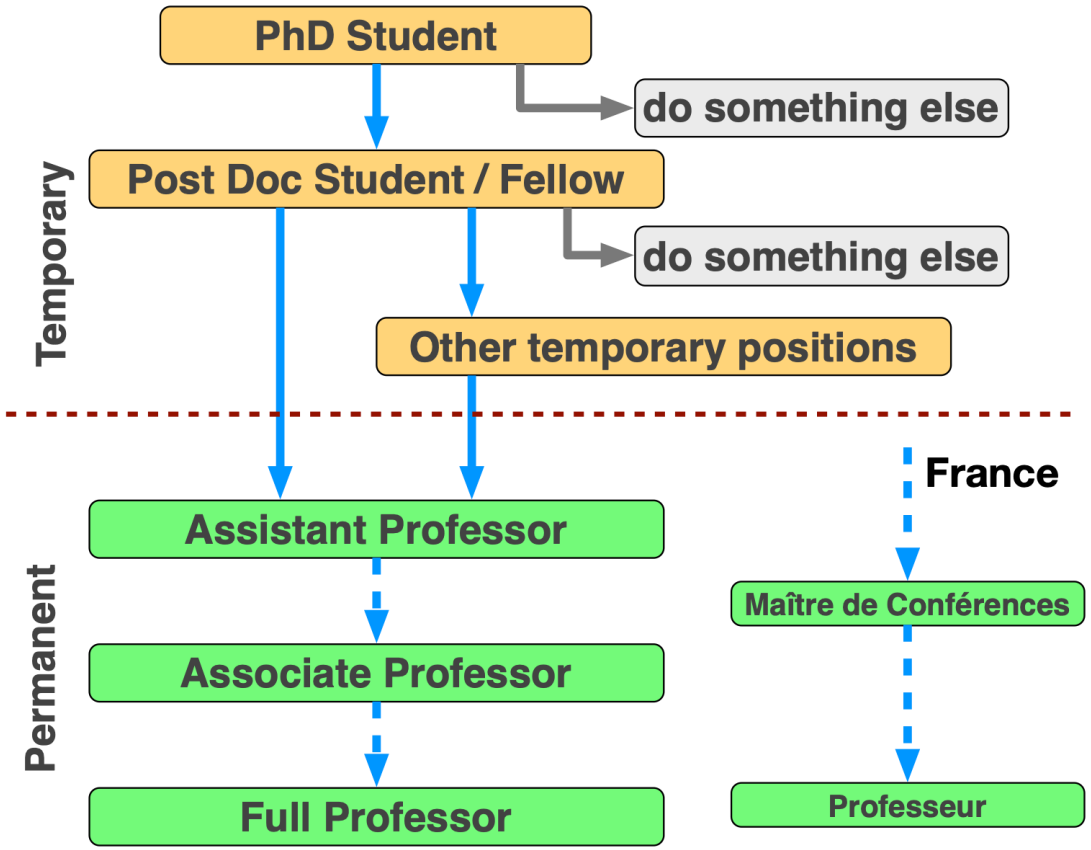
# Career & Life Options

- Tough challenge
- Work hard
- Earn high experience & skills
- Comfortable life for later

- Provide a service
- Temporary (5+5y)
- Few permanents: tech & research management
- Int’l Scientific Council
- Guest researchers

# Academic Career – Oversimplified

- Faculty Member / Academic Career
  - Professor (Full Professor)
  - Associate Professor
  - Assistant Professor
- Others
  - Lecturer
  - Instructor
  - Fellow (UK)



# The Concept of Chair

- Official knowledge/authority in a domain
  - The chair makes the professor above the others
  - Relates to the university, not to the whole Country
- Strongly dependent on Country
  - Professor ordinarius (DE)
  - Cattedra (IT)
  - Named chair (USA/CA), prestigious
  - Lucasian Chair (Cambridge, UK) a few served as a member of Parliament, appointed by the university

# Academic Positions

- PR and MCF have similar tasks
  - PR is expected to manage research and education
  - PR is expected to lecture – as opposed to Classroom work and labs
  - In many practical cases cases the legal difference is not respected
- Grades differ only in salary

| Position | Grade | Access | Equivalent |
|---|---|---|---|
| MCF<br><br>Maître de conférences<br><br>(≈80%) | 2nd class<br>(established after 1 y) | Entry level<br>(local selection) | Assistant professor<br>– or –<br>Associate professor |
| | 1st class | Automatic, after 4 y | |
| | HC<br>(hors classe) | Competition<br>(national & local) | |
| PR<br><br>Professeur des universités<br><br>(≈20%) | 2nd class | Entry level<br>(local selection) | Full professor |
| | 1st class | Competition<br>(national & local) | |
| | EX1, EX2<br>(classe exceptionnelle) | Competition<br>(national & local) | |

# The Selection Process

- The expectations are detailed in a document called Profile (profil)
- Usually mentions two contact persons, research and teaching
- The university appoints the Selection Committee (comité de sélection), an examining board specific for each position open
- Members ≥ 50% from other universities
- Screening (≈VN invited for an interview)
  - Rank (publications, contracts, experience, etc…)
  - Profile / resumé matching

- Interview (virtual meeting is allowed)
- Report on experience / research / contracts / education
- Research project (sometimes required, sometimes not)
- Answer to the Committee's questions
- Decision, by the Selection Committee
- Strongly recommended, before the interview
- Visit university & lab, introduce yourself, and get all possible information
- Give a seminar on your work, or on a subject of broad interest
- If possible, have a correspondent who gives feedback

# Probation Period

- Maître de Conferences
  - One year
  - Report to National Council of University (CNU)
  - Lifetime position confirmed (most cases)
  - One more year probation (seldom)
- Professeur
  - No probation period
  - Lifetime position at the time of hiring

# Problems and Plagues (1)

- Hiring and of promoting local folks
- In some universities and disciplines, up to 95% of PR are former MCF from same institution
- Exception: mathematicians never hire or promote local folks
- Since 2009, the by law targets fixing the problem
- Selection Committee must have ≥50% non-local people
- Too short interview & analysis of the CV
- Short plenary discussion at the selection committee, two referees for each applicant report on the resumé
- In some cases, the interview takes 15 minutes for a lifetime tenure!!!

# Problems and Plagues (2)

- Salaries and career opportunities
- Difficult to hire strongly motivated and ambitious people
- Lower salaries, as compared to some other wealthy Countries
- Unclear hierarchy
- Heading a team is really tough – no control on coworkers
- Heavy teaching duty, 50% of time
- 192 h/year + preparation, assignments, exams, meetings…
- Professors —> No assistants for labs, assignments, schedule, etc.
- Heavy coordination between small modules
- No real link between research and teaching

# CNRS

- Ranks are equivalent to those in universities, different names
- MCF <–> CR = Chargé de Recherche
- PR <–> DR = Directeur de Recherche
- Approximately same salary as in university
- No obligation of teaching
- Teaching is encouraged,
- Paid at standard hour rate, same as PhD student
- Lectures and no of hours negotiated with the university
- Tough competition
- National selection
- Open-research positions and specific positions
- The research project is a relevant point of evaluation
- Slow and tough career
- 5–10% of CR get DR position at t –> oo