Ethics in (natural) sciences

How to recognize (and avoid) scientific misconduct

Björn Kriete

Material compiled by T. Banerjee & B. Noheda (University of Groningen, The Netherlands)
Adapted and edited by B. Kriete (University of Groningen, The Netherlands)

Main Sources:

'Ethical issues in research', Michael Kalichman, U. of California, San Diego

'Introduction to the Responsible Conduct of Research' (ORI-US Federal Office of Research Integrity)

'Plastic Fantastic', Eugenie S. Reich, PALGRAVE MCMILLAN, 2009

The responsible scientist

Responsible conduct of research assumed for all researchers, independently from their own personalities:

HONESTY *— conveying information truthfully and honoring commitments,*

ACCURACY*— reporting findings precisely and taking care to avoid errors,*

EFFICIENCY*— using resources wisely and avoiding waste,*

OBJECTIVITY*— letting the facts speak for themselves and avoiding bias.*

Zero tolerance:

Acting differently, may not necessary lead to crime or fraud, but it is considered irreponsible scientific behaviour and a way of scientific misconduct.

Scientific fraud	**Irresponsible behaviour**	**Scientific integrity**
Clear ✓	*???*	*Clear* ✓

“Excuses” to misbehave

- I already have enough information to know what the results will be, so there is no need to run checks again, even though they did not give me the expected results the first time. → **Accuracy**
- If my bosses read my research papers rather than counting them, I wouldn’t have to publish the same research twice or chop it up into small, insignificant pieces. → **Efficiency**
- Given the competition in my field, I will be damaging myself if I shared my methods and information with colleagues too freely. → **Objectivity**
- They will cut off my funds if I report these results, so for the good of my laboratory and staff I should sit on them for a while longer. → **Efficiency**
- I know my research is not going to harm anyone, so why waste my time getting the safety permission. → **Honesty**

→ Don’t let these situations force (or fool) you into non-ethical behaviour

Example - Jan Hendrik Schön

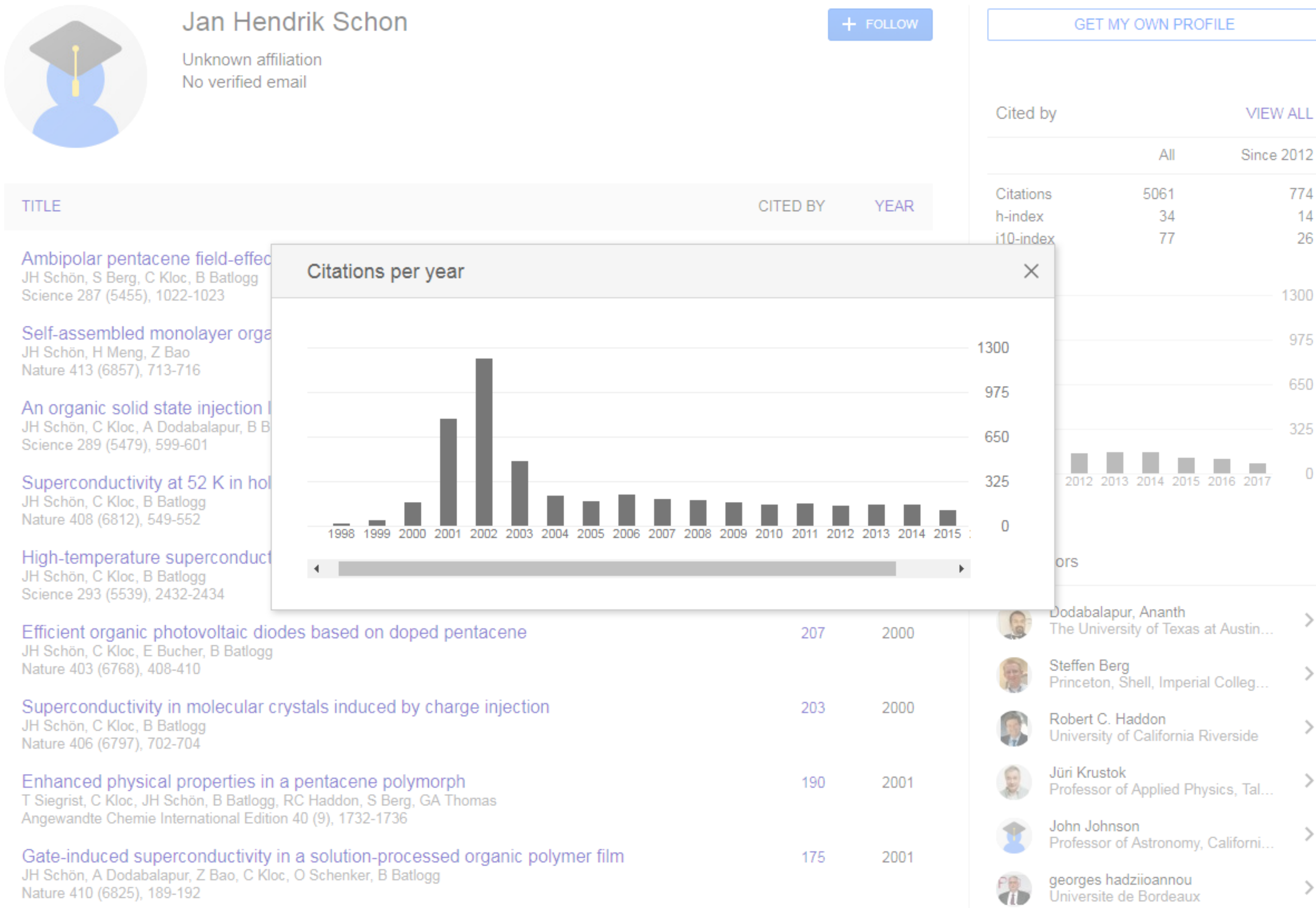
Timeline

1997	Graduation from University of Constance (Germany) Hired by Bell Labs (United States of America)
1998	First results on electrical properties of organic crystals
Early 1999	First *Nature* paper (organic crystal solar cells)
End 1999	Quantum Hall effect in organic crystals
2000-2001	**~90 papers, ~74 lead author**
May 2002	Bell Labs Committee launches internal investigation of scientific fraud by Schön
Sep. 2002	Found guilty for committing scientific misconduct

Images source*: 'Winning Streak Brought Awe, And Then Doubts', Science*, 297, **2002**

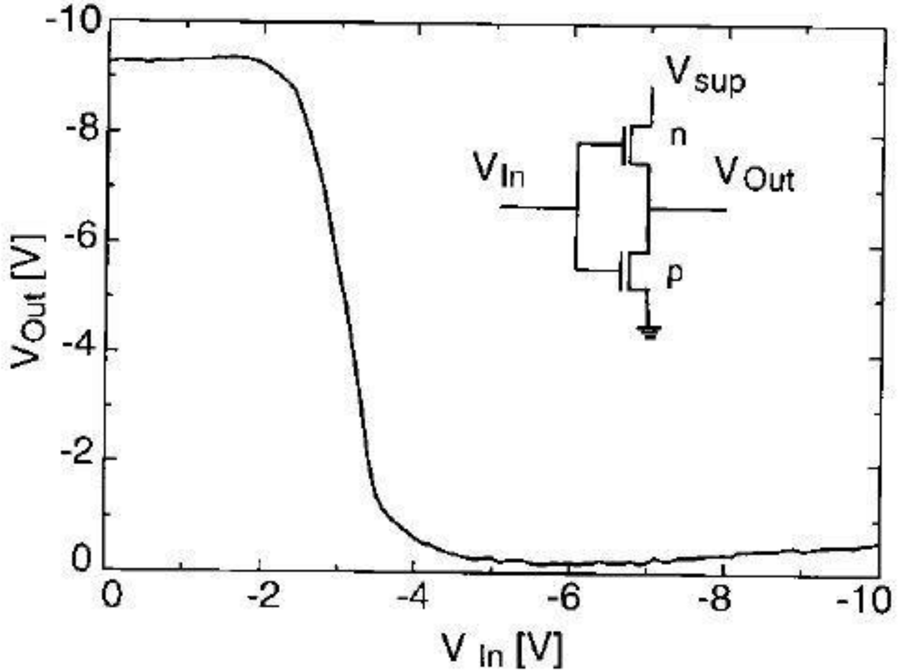
'Plastic Fantastic', Eugenie S. Reich, PALGRAVE MCMILLAN, 2009

Example - Jan Hendrik Schön



Google scholar profile, date accessed: 07/11/2017

Example - Jan Hendrik Schön



→ Schön used identical graphs (with identical noise) in multiple papers

- No labjournals describing Schön's experiments and changing accounts of how data was obtained
- Primary data not available (deleted due to limited hard drive capacity according to Schön)
- Samples destroyed or damaged beyond repair

Graph from: Schön, J. H.; Berg, S.; Kloc Ch.; Batlogg, B. Ambipolar Pentacene Field-Effect Transistors and Inverters, *Science*, **2000**, *287*, 1022

Example - Jan Hendrik Schön

Why?

- Success, fame and respect
- Meeting expectations
- Publishing increasingly competitive
    - Bonus schemes
    - Permanent positions (at Bell Labs as rewards)
- *Other personal reasons (?)*

How?

- Forging results according to expectations
→ „science backwards“
- Experiments at two different locations
- Reputation (and thus credibility) of co-workers
- Reputation of research Institute Bell Labs

'Plastic Fantastic', Eugenie S. Reich, PALGRAVE MCMILLAN, 2009

Example - Jan Hendrik Schön

Lessons learned:

- Self-correcting nature of science works, but can be painfully slow
- What responsibility is taken by the co-authors?

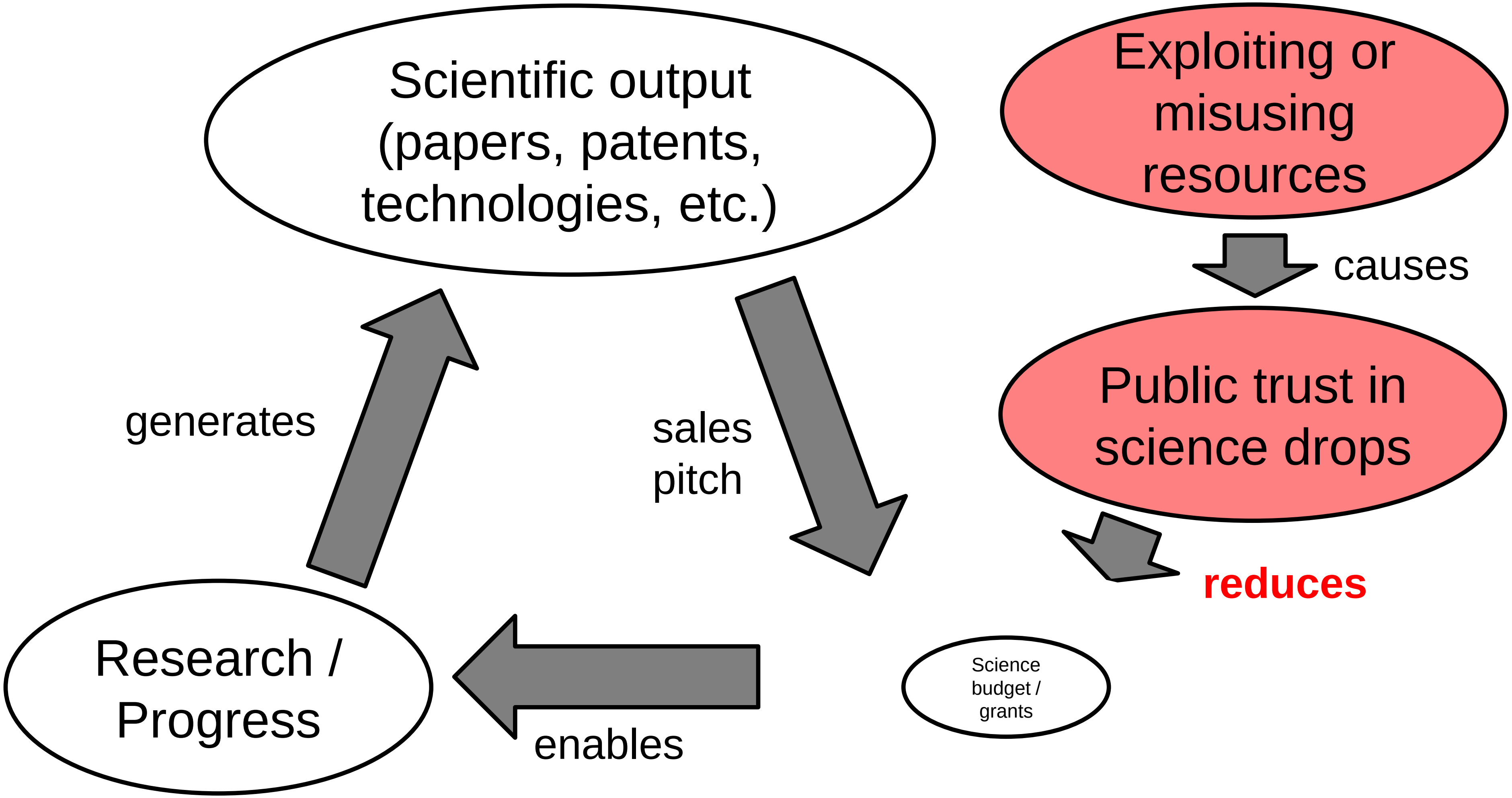
→ Peer review system has been proven not fool-prove

→ How can reoccurrences of such cases be prevented?

→ Avoid waste of public resources on such outrageous scale

'Plastic Fantastic', Eugenie S. Reich, PALGRAVE MCMILLAN, 2009

Trust: Science - Public



→ Vicious circle! **→ Scientific integrity**

Ethics in research

- (1) Planning research
- (2) Conducting research
- (3) Reporting research

1. Planning research

- **(1.1) Safety**

Avoid accidents, proper use and disposal of hazardous materials, etc.

- **(1.2) Laboratory Animals**

Regulations for animals used in research

- **1.3 Conflicts**

What researchers should do when they are faced with conflicting tasks

1.3 Tasks of a scientist that can lead to conflict of interest

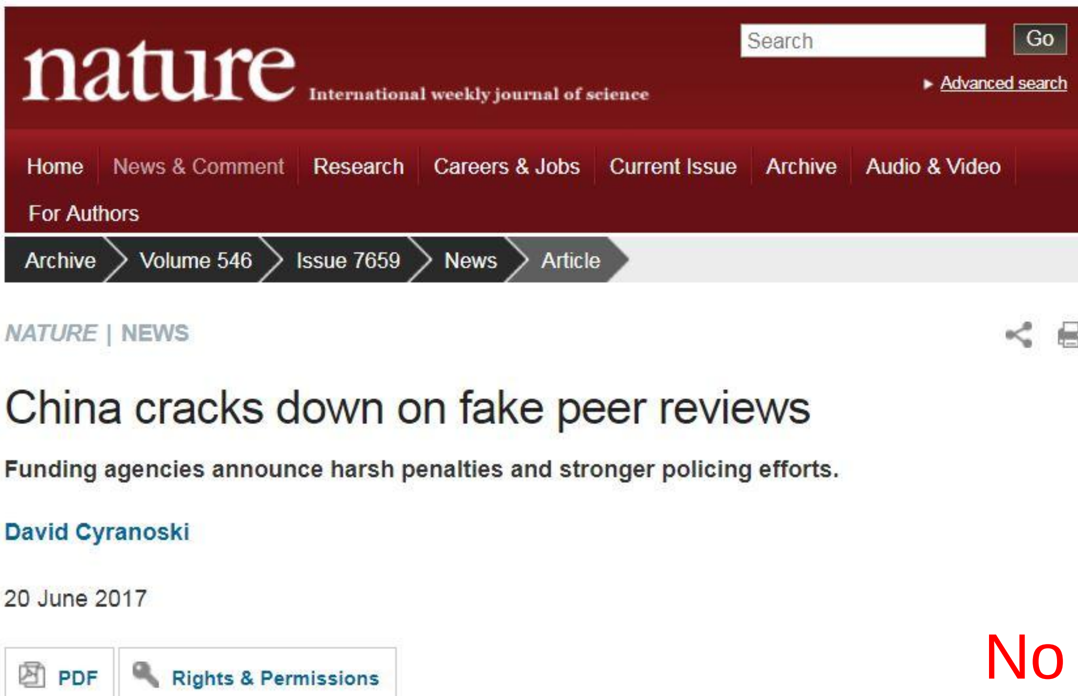
- working on one or more funded projects;
  - allocation of time (teaching vs. research)
  - honor time commitments (TSP, contract)
- applying for grants for a new project;
- teaching and advising students → obligation as mentor vs. own interests;
- attending professional meetings and giving lectures;
- sitting on advisory boards;
- serving as a peer reviewer

Personal or intellectual conflicts

- Researchers are expected to be **objective**. They should avoid making judgments or presenting conclusions not based on scientific evidence, even if in an non-scientific context (e.g. TV).
- Strong personal views on the importance of a particular area of research should be disclosed so that others can take them into consideration when judging the researcher’s statements. → **neutral**
- Researchers should not serve as reviewers for grants and publications submitted by close colleagues and students. → **unbiased**

Example - Peer Reviewing

- Researchers should not serve as reviewers for grants and publications submitted by close colleagues and students. Example: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NATURE | NEWS

China cracks down on fake peer reviews

Funding agencies announce harsh penalties and stronger policing efforts.

David Cyranoski

20 June 2017

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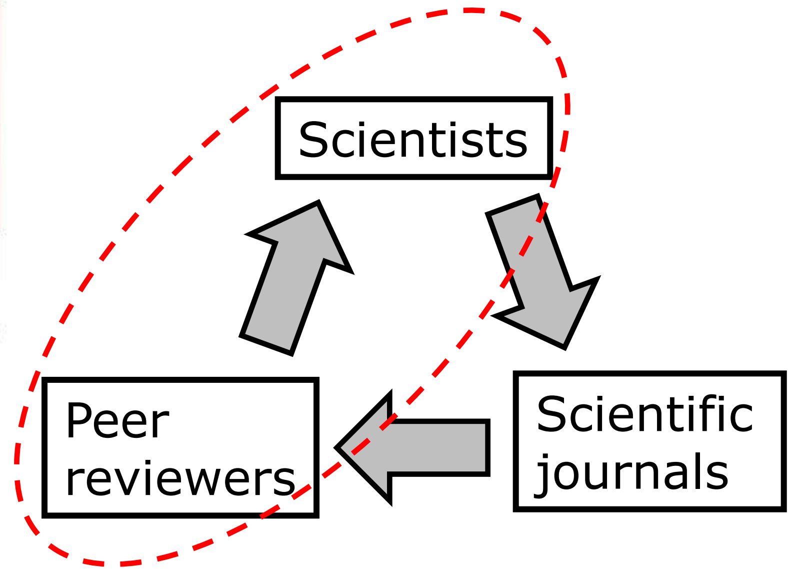


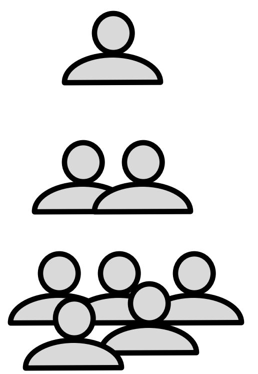
No fair competition for grants → waste of public resources

www.nature.com/news/china-cracks-down-on-fake-peer-reviews-1.22176

Ethics in research

- (1) Planning research
- (2) Conducting research
- (3) Reporting research

- **2.1 Data Management**
- **2.2 Mentor and trainee's responsibilities**
- **2.3 Collaborative Research**



Data ownership

Researchers must be aware of their obligations to the funding agencies before they begin collecting data:

- *Who owns the data I am collecting?*
- *What rights do I have to publish the data?*
- *Does collecting these data impose any obligations on me?*

Support for research is typically awarded to research institutions, not to individual researchers. This means that researchers **do not own** the data they produce.

Data collection

The *Do's* and *Don't's* of data collection

- Hard-copy evidence should be entered into a numbered, bound notebook so that there is no question later about the date and order of the experiment(s) and/or the results achieved. (e.g. Kamerlingh Onnes experiments)

- Do not use loose-leaf notebooks or simply collect pages of evidence in a file. Do not change records in a bound notebook without noting the date and reasons for the change.

- Electronic evidence should be validated in some way to assure that it was actually recorded on a particular date and not changed at some later date. (Lab computers, …)

Kamerlingh Onnes experiments

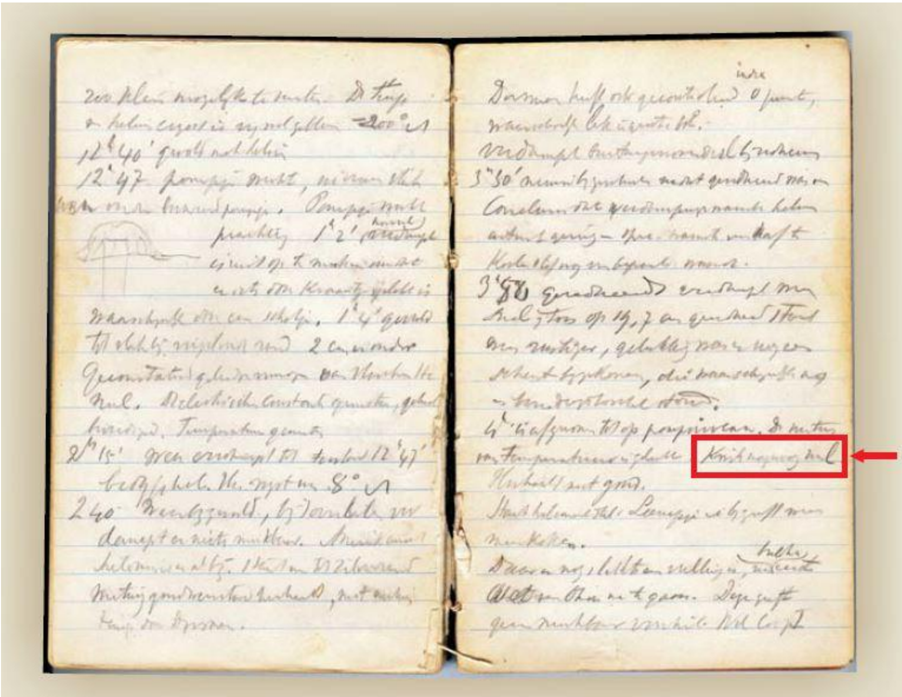


Figure 2. A terse entry for 8 April 1911 in Heike Kamerlingh Onnes's notebook 56 records the first observation of superconductivity. The highlighted Dutch sentence *Kwik nagenoeg nul* means "Mercury['s resistance] practically zero [at 3 K]." The very next sentence, *Herhaald met goud,* means "repeated with gold." (Courtesy of the Boerhaave Museum.)

8 April [YEAR?]
Resistance of mercury and gold practically zero

19 April [1910]
Other experiments

23 May [YEAR?]
Control experiment for superconductivity of mercury

Safe, accurate and tidy data collection is crucial in research

- to confirm (authenticity of) research findings,
- to establish priority, or
- to be reanalyzed by other researchers.

Figure taken from: Van Delft, D. & Kes, P. The discovery of superconductivity, *Physics Today*, **2010**, 38-43

Data storage

The *Do's* and *Don't's* of data storage

- Lab notebooks should be stored in a **safe place** (in the research institutions, and not be taken home)

- Computer files should be backed up and the backup data saved in a secure place far from the original data and **preferably on multiple computers**.

- Samples should be kept so that they will **not degrade**.

- Individual cases (e.g. companies): Special care should be taken if **confidentiality** needs to be preserved.

→ **RDMP should summarize how data is handled**

Research Data Management Plans (RDMPs or DMPs)

Q: *What is an RDMP?*

A data management plan […] is a formal document that outlines how data are to be handled both during a research project, and after the project is completed.

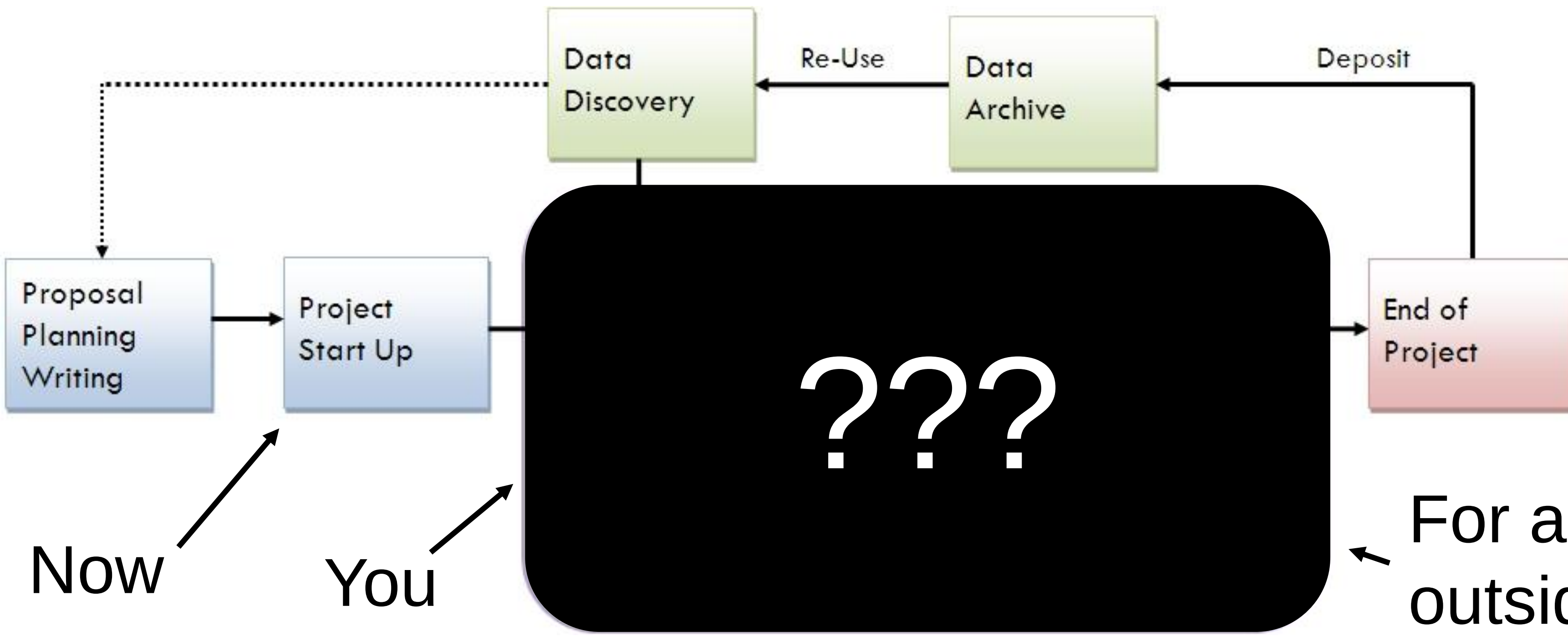


Image source: http://data.library.virginia.edu/data-management/lifecycle/
date accessed: 13/11/2017

Example – Pshenichnikov group

OCMP Optical Condensed Matter Physics

- RDMP form describing responsibilities, data storage locations, etc.
- Daily data backup of all computers to NAS with read only access (primary + secondary data)
- Handwritten (legible!) or digital logbooks in English
- Copies of original data on lab computers
- Description of data (naming, formats, acquisition and processing software, etc.)
- Applies to all postdocs, PhDs & bachelor/master students

Data sharing

The *Do's* and *Don't's* of data sharing

- Do not release data that have not been **carefully validated**
- Do not release data before you have **informed all the people involved** in the research.
- Researchers can withhold data until they have had time to **establish their priority** for their work (through publication).
- Keeping data confidential prior to publication is a commonly accepted practice. Researchers do **not have to release data immediately**, even though this might speed the advance of knowledge (unless it is of immediate public interest).
- Once the results are published, it is expected that all the information about that experiment, including the final data, should be **freely available** for other researchers to check and use.

2.2 Mentor-trainee relationship

The mentor-trainee relationship is complex and could lead to conflicts:

- *How much time should each devote to the other?*
- *Who gets credit for ideas that take shape during the course of a shared experiment or a scientific discussion?*
- *Who owns the results?*
- *When does a trainee become an independent researcher?*

→ Applies to PI – PhD as much as for PhD – bachelor/master student

2.2 Mentor-trainee relationship

Mentoring should begin with:

- understanding of responsibilities
- commitment to maintain a productive research environment
- proper supervision and review
- understanding that the main purpose is to prepare trainees to become successful researchers

→ **Basic idea: Mentors invest time and resources in trainees. Trainees should use time and use resources responsibly.**

Basic responsibilities

Trainees have to know …

- Expected amount of time to spend on research
- Performance assessment criteria
- how responsibilities are shared or divided in the research setting
- standard operating procedures (data handling, data interpretation, etc.)
- how authorship and ownership are established

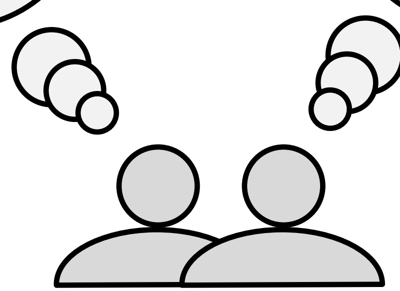
Talk

Mentors have to know that trainees will…

- do assigned work conscientiously and responsibly;
- respect the authority of others working in the research setting,
- follow research regulations and protocols,
- live by agreements established for authorship and ownership

Trainees

Mentors



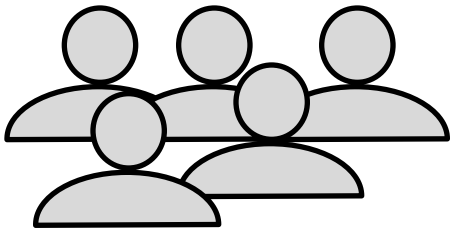
Research environment

Despite the diversity of styles and cultural backgrounds, mentors should provide some minimum conditions:

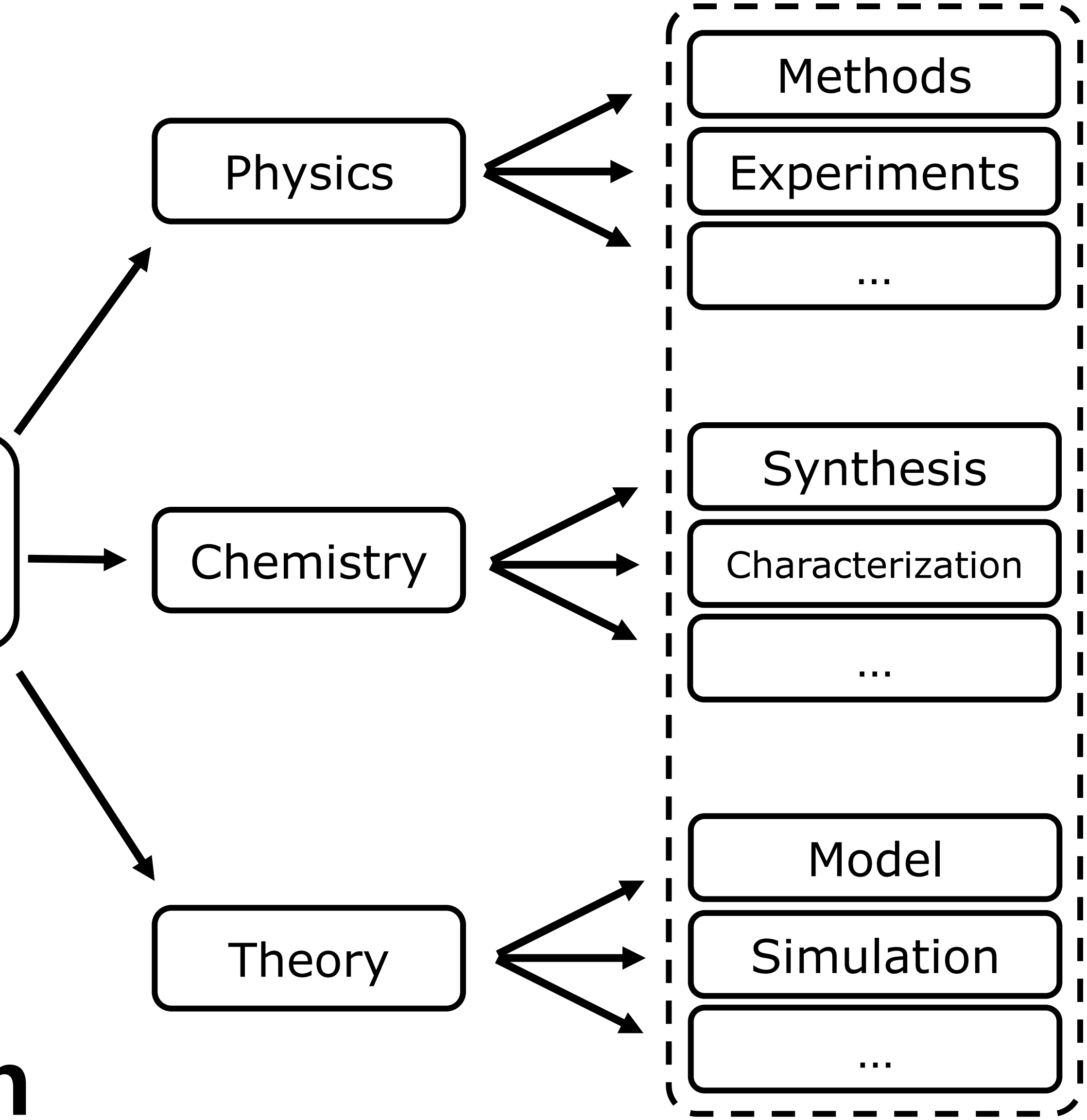
- **Equal treatment**
  - All students should be subject to the same level of supervision
  - Mentors have the obligation to assure equal access to needed resources

- **Professional practice**
  - Trainees learn by example as well as by formal training
  - Mentors have an obligation to maintain research environments that set appropriate examples

2.3 Collaborative research



Cutting edge science
Multidisciplinary approach
State-of-the-art



→ No expert in <u>all fields</u>

→ Collaboration

2.3 Collaborative research

Clear from the very beginning:

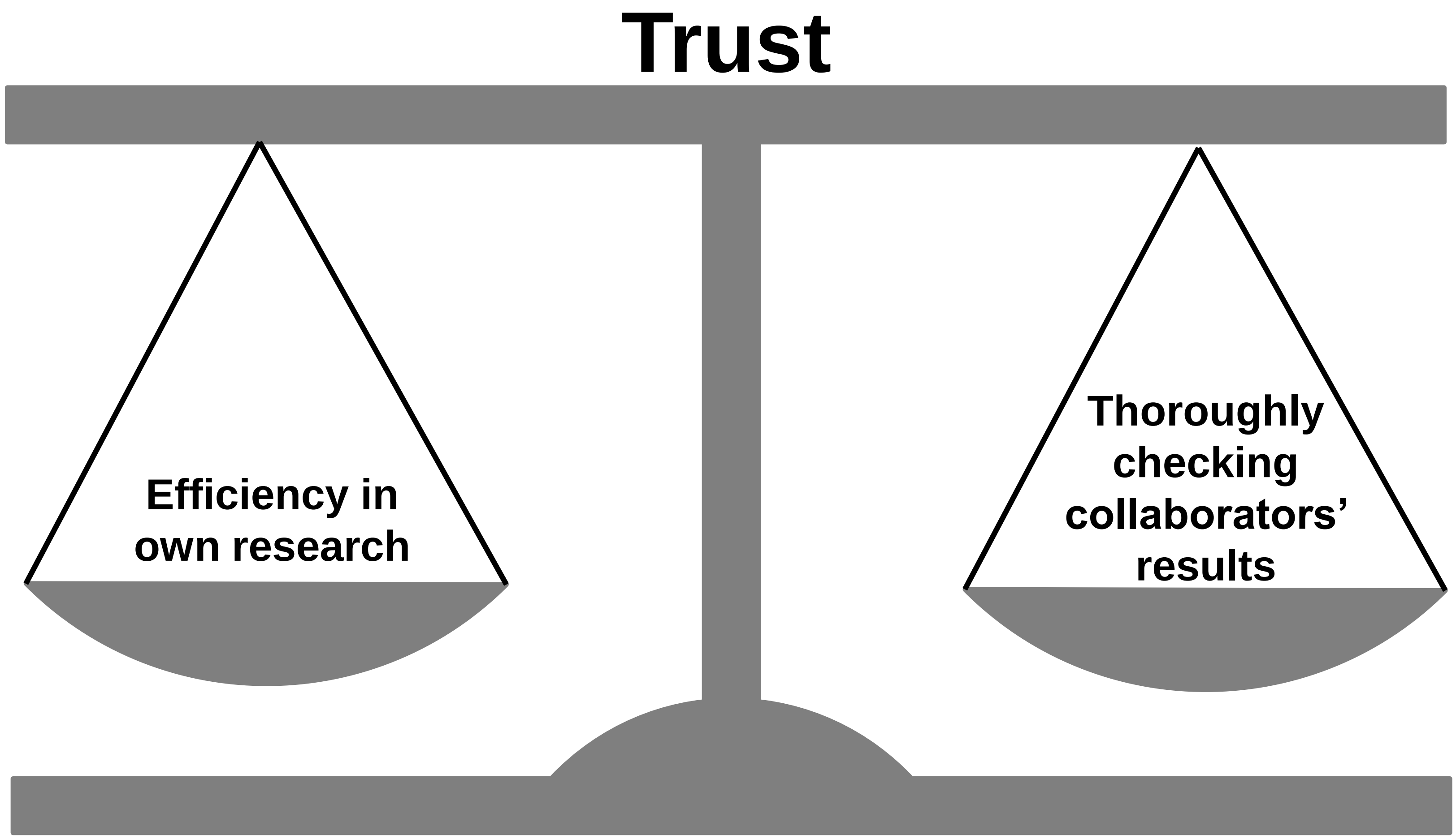
- the goals of the project and anticipated outcomes
- the role each partner in the collaboration
- how data will be collected, stored, and shared
- how changes in the research design will be made
- who will be responsible for writing the papers
- the criteria that will be used to identify and rank contributing authors
- who will be responsible for submitting reports
- who will be responsible for speaking publicly
- how intellectual property rights and ownership issues will be resolved
- When the collaboration will end

2.3 Collaborative research

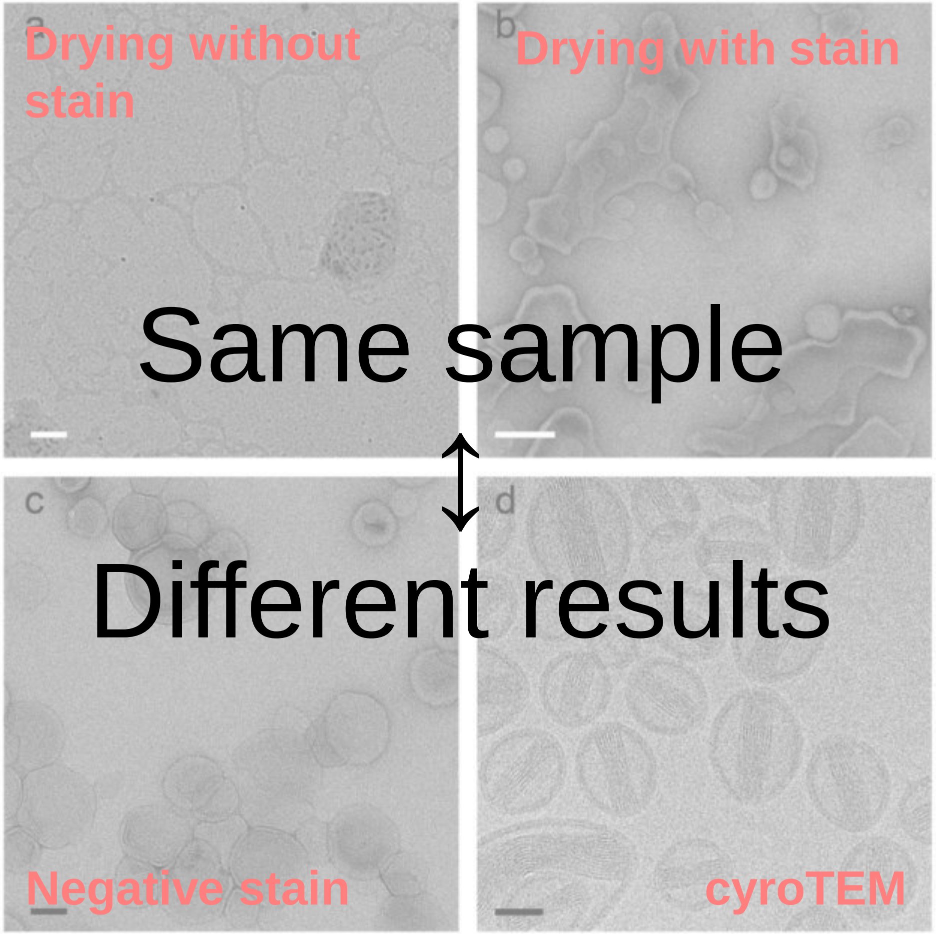
The *Do's* and *Don't's* of collaborating

- share findings with colleagues in the collaboration and **pay attention** to what others are doing
- **report and discuss** problems as well as findings
- make other collaborators **aware of any important changes**, such as changes in key personnel
- **share** related news and developments
- **trust** each other's work and competence

Trust: Among Sciencists



Example – TEM



***HONESTY** — conveying information truthfully and honoring commitments,*
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***EFFICIENCY**— using resources wisely and avoiding waste,*
***OBJECTIVITY**— letting the facts speak for themselves and avoiding bias.*

Franken, L. E.; Boekema, E. J.; Stuart, M. C. A. Transmission Electron Microscopy as a Tool for the Characterization of Soft Materials: Application and Interpretation, *Advanced Science*, **2017**, 1600476

Ethics in research

- (1) Planning research
- (2) Conducting research
- (3) Reporting research

3. Reporting and reviewing research

Why publish results?

- **Main scientific output**: proof of achievements and well invested (public) funds and resources
- Results are shared so they can be tested, applied and used to **advance knowledge**
- Ideas are shared with public agencies to get funding or with other colleagues or companies to find **practical applications**
- **Not** for your personal resume/CV and boosting your career

3. Reporting and reviewing research

3.1 Authorship and Publication

- Researchers have responsibilities when they share results with others through informal communications, oral presentations, publications, …
- Whatever mechanism is used, research results should be shared **honestly** and **without bias**, but also **efficiently**
- Inefficiency (publishing similar results several times or incremental progress) wastes public funds and the valuable time of reviewers and journal editors.
  → **Typical example of non-fraudulent but irresponsible behaviour**

3. Reporting and reviewing research

3.2. Peer Review

- Researchers have responsibilities when they review the work of other researchers.
- Reviews are done by peers. Your colleagues (often your competitors) play a crucial role in many important decisions about the funding, publication, and use of your research.
- Honesty, fairness and the advance of knowledge always priorities.

3.1 Authorship and allocation of credit

Q: Who should be an author?

Not easily answered. Methods vary greatly in academia, even within the same institution it is agreed that authorship is based on ‘substantial’ contribution (but define ‘substantial’).

Q: Are there are specific norms?

Some emphasize: having the work done
Others: on the idea, the experimental design, data interpretation,

It typically depends on discretion of principal investigator.
It tends to be collectively decided within the different fields.

Different types: Some investigators expect authorship for providing access to equipment or samples of unusual kind or assistance with experimental design

→ **If it worries you: do not hesitate to discuss!**

3.1 Authorship

Competition for funding puts pressure on researchers to publish. Ideally, quality should matter more than quantity. → **Publish or perish**

Some publication practices should be avoided:

- **Honorary authorship**. The practice of listing undeserving authors on publications is a form of **research misconduct**. No agreement exist and honorary authorship is a significant problem today

  Some researchers are listed on publications because they:
  - are the chair of the department or program in which the research was conducted,
  - provided funding for the research,
  - are the leading researcher in the area,
  - provided reagents, or
  - served as a mentor to the primary author.

  They deserve recognition but should not be listed if these are the only contributions they made.


ETHICS ON THE EDGE
I see you're the co-author of this paper, Dr. Mauritz, and you came up with some new insights in the field of quantum mechanics, which you will explain further next week.
I Am?
I DID?
I WILL?
S. Harris

3.1. Authorship and Credit

The *Do's* and *Don't's* of allocation of authorship

- Dissemination of research results and appropriate credit for contributions
- Credit can take different forms (authorship, acknowledgement, public forms of recognition…)
- Mentors must exercise great care to neither award authorship to students, whose contribution do not merit it nor deny due credit to the work of students
- Receiving credit for work means that **we are also responsible for the work**. (If a part of the project is later found wrong, then sharing the responsibility)

Example – Victor Ninov

- Scientific misconduct: Ninov fabricated data that claimed creation of elements 116 and 118 (heaviest elements by that time)
- Data analysis software at LBNL could only be operated by Ninov → <u>no checks by co-authors</u>

VOLUME 83, NUMBER 6 PHYSICAL REVIEW LETTERS 9 AUGUST 1999

Observation of Superheavy Nuclei Produced in the Reaction of ^{86}Kr with ^{208}Pb

V. Ninov,[1] K. E. Gregorich,[1] W. Loveland,[2] A. Ghiorso,[1] D. C. Hoffman,[1,3] D. M. Lee,[1] H. Nitsche,[1,3] W. J. Swiatecki,[1] U. W. Kirbach,[1] C. A. Laue,[1] J. L. Adams,[1,3] J. B. Patin,[1,3] D. A. Shaughnessy,[1,3] D. A. Strellis,[1] and P. A. Wilk[1,3]
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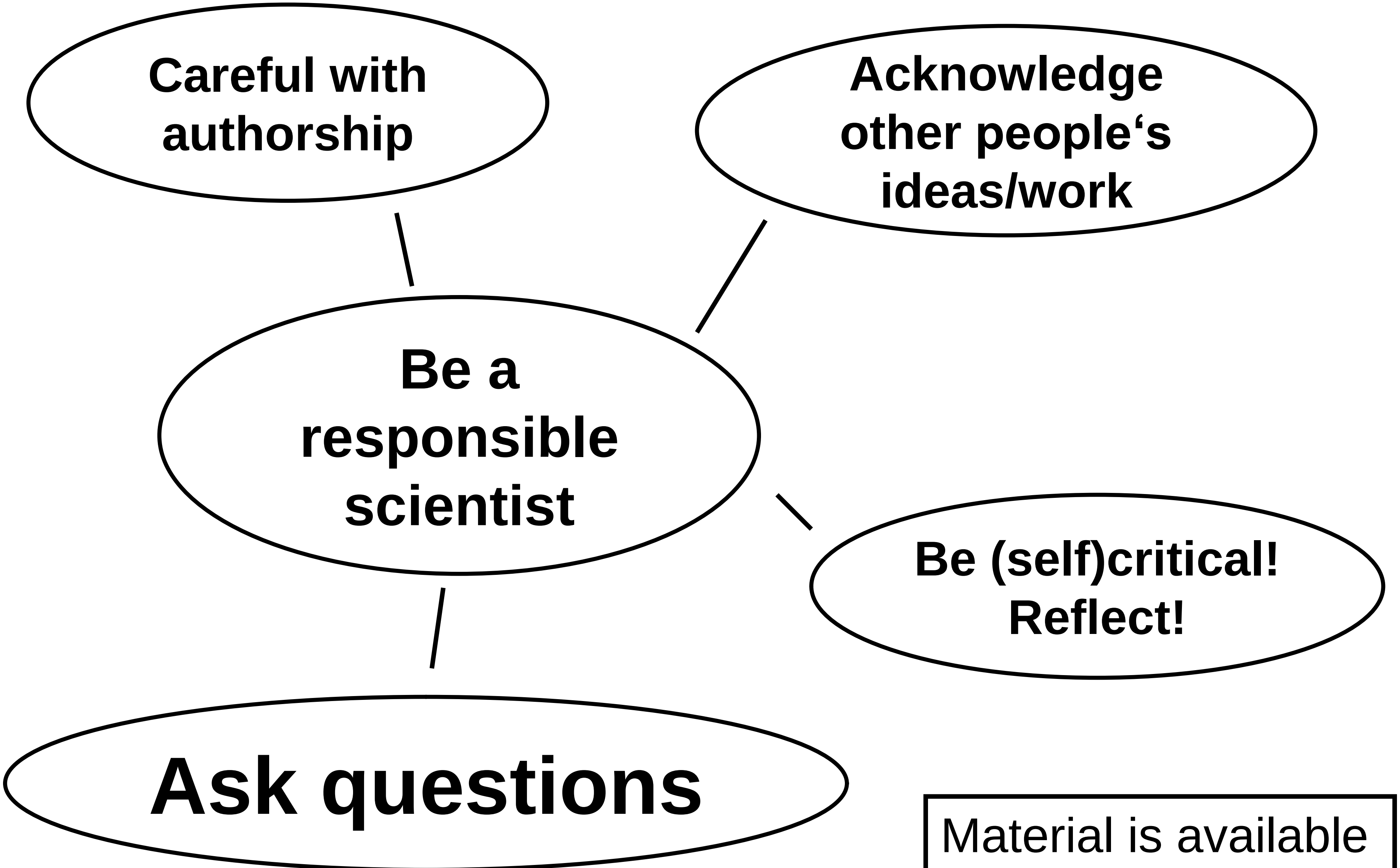
[2]*Department of Chemistry, Oregon State University, Corvallis, Oregon 97331*
[3]*Department of Chemistry, University of California, Berkeley, California 94720*
(Received 27 May 1999)

Following a prediction by Smolańczuk [Phys. Rev. C **59**, 2634 (1999)], we searched for superheavy element formation in the bombardment of ^{208}Pb with 449-MeV ^{86}Kr ions. We have observed three decay chains, each consisting of an implanted heavy atom and six subsequent α decays, correlated in time and position. In these decay chains, a rapid (ms) sequence of high energy α particles ($E_\alpha \geq 10$ MeV) indicates the decay of a new high-Z element. The observed chains are consistent with the formation of $^{293}118$ and its decay by sequential α-particle emission to $^{289}116$, $^{285}114$, $^{281}112$, $^{277}110$, ^{273}Hs ($Z = 108$) and ^{269}Sg ($Z = 106$). The production cross section is $2.2^{+2.6}_{-0.8}$ pb.

PACS numbers: 25.70.Jj, 27.90.+b

Dalton, R. 'Misconduct: The stars who fell to Earth', Nature, 420,728-729, **2002**

Conclusions



Material is available via www.sepomo.eu