Scientific Ethics: Issues and Case Studies

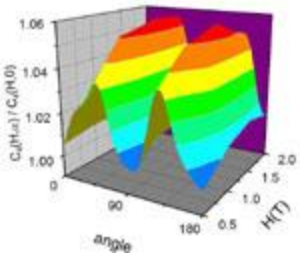
Lance Cooper

Each physicist is a citizen of the community of science. Each shares responsibility for the welfare of this community.

- APS Ethics Standards

https://www.aps.org/about/governance/policies-procedures/ethics

Ethical considerations usually fall into five major categories:



Integrity of research results

Publication and authorship issues

Integrity of peer review

Conflicts of interest

Responsible conduct in the workplace

Highly Recommended Ethics Training

CITI Responsible Conduct of Research (RCR) Module for the Physical Sciences

1. Go to **http://www.citiprogram.org/**
2. Set up new account by clicking on 'Register Here'
3. Click on 'Add a course' and go to Question 3 for RCR
4. Select ***Physical Science RCR Course***
5. Go back to "Main Menu"
6. Complete the Physical Science RCR Course

Ethics Training/Ion Page on Grad Blog

https://physics.illinois.edu/academics/graduates/ethics-training-and-information

Responsible Conduct of Research Document

https://ws.engr.illinois.edu/sitemanager/getfile.asp?id=3103

Ethics Resources on the Grad Blog

Grad Program Overview

Degree Requirements

Graduate Student Blog

Qualifying Examination

Preliminary Examination

Final Defense

Thesis templates

Student Organizations (Grad)

Travel Fund Application

Recent posts

APS Careers Workshop: Women in the Physics Industry

October 7, 2023 Lance Cooper

The APS Activating Industry Physics Careers webinar series is proud to present its second offering: **Women in the Physics Industry**, on **Tuesday, October 17**, 12:00 p.m. ET. **Register Now**.

Apply by Oct. 13 to attend Lindau Nobel Laureate Meeting

October 5, 2023 Lance Cooper

The **Lindau Nobel Laureate meeting** is one of the most prestigious STEM meetings in the world for students and early career scientists. **Applications** to participate are due by **Friday, October 13, 2023**.

IQUIST Has Staff Openings in Research Program Management and Program Coordination

October 5, 2023 Lance Cooper

IQUIST is recruiting a research program manager and research program coordinator.

Current Grad Info

- Physics Grad Student Handbook
- Curriculum Requirements
- Prelim Exam Info
- Thesis Info
- MS Degree Requirements
- MEng Program
- Useful Non-Physics Courses
- CSE Graduate Concentration
- Data Science & Engineering Concentration
- PHYS 596
- PGSA
- Illinois GPS
- Qual Exam Info
- New Student Info
- Ethics Resources
- Responsible Conduct of Research
- Research Safety Training/Info
- Grad Expertise Database
- Grad Travel Award
- Grad Student Evaluations
- Grad College Calendar
- COE Grad Handbook

American Physical Society Ethics Statement

https://www.aps.org/about/governance/policies-procedures/ethics

19.1 Guidelines on Ethics (Full Statement)

Summary

As citizens of the global community of science, physicists share responsibility for its welfare. The success of the scientific enterprise rests upon two ethical pillars. The first of them is the obligation to tell the truth, which includes avoiding fabrication, falsification, and plagiarism. The second is the obligation to treat people well, which prohibits abuse of power, encourages fair and respectful relationships with colleagues, subordinates, and students, and eschews bias, whether implicit or explicit. Professional integrity in the conception, conduct, and communication of physics activities reflects not only on the reputations of individual physicists and their organizations, but also on the image and credibility of the physics profession in the eyes of scientific colleagues, government, and the public. Physicists must adopt high standards of ethical behavior, and transmit improving practices with enthusiasm to future generations.

Adopted by the Council on April 10, 2019
Category: Ethics and Values

Ethics Guidelines

INTRODUCTION AND RATIONALE

The Constitution of the American Physical Society states that the objective of the Society shall be the advancement and diffusion of the knowledge of physics. It is the purpose of this document to advance that objective by presenting ethical guidelines for Society members that address many aspects of the practice of physics. Physicists must always tell the truth in scientific communication. Data fabrication, falsification, and plagiarism (FFP) corrupt the scientific literature and the research proposal process, thereby diminishing the value of science and damaging public trust. Physicists must treat others well. Abuse of colleagues, students, or

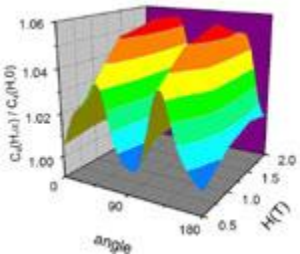
Ethics associated with research results*:

The results of research should be recorded and maintained in a form that allows analysis and review, both by collaborators before publication and by other scientists for a reasonable period after publication.

'Egregious' departures from the expected norms of scientific conduct:

- Fabrication of data
- Selective reporting of data with the intent to deceive
- Theft of others' data

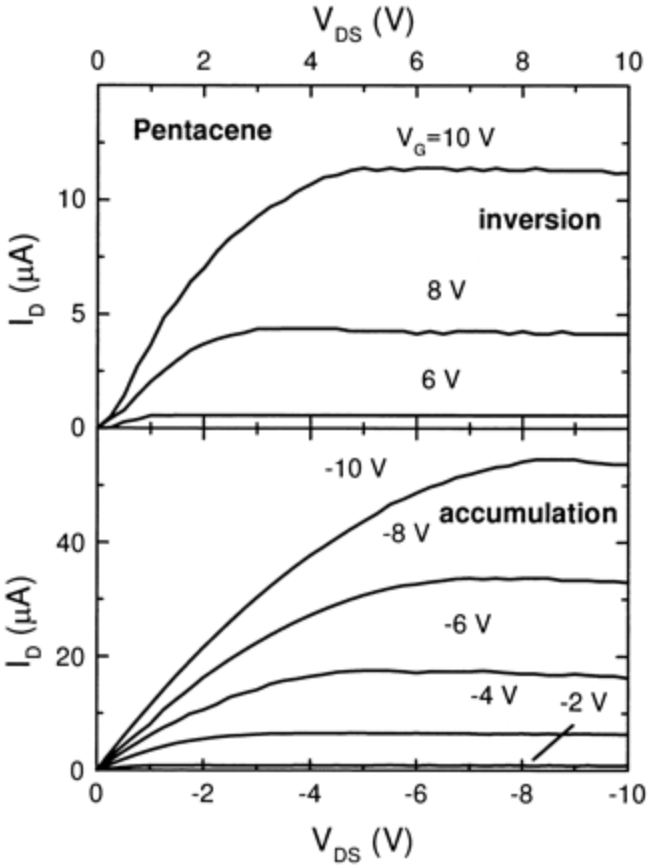
***From AIP statement of ethics and responsibilities of authors:**
http://www.aps.org/policy/statements/02_2.cfm



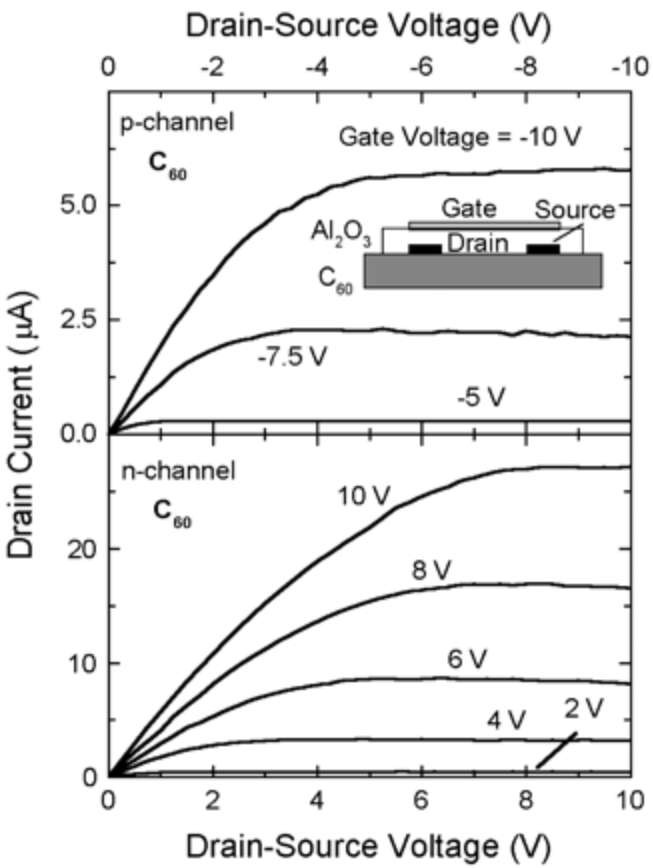
Obviously, data fabrication is a serious breach of scientific ethics*

Forged or fabricated data

Falsified or invented results



J. H. Schön, et al., Ambipolar Pentacene Field-Effect Transistors and Inverters," *Science* **287**, 1022 (2000).



J. H. Schön, et al., "A Superconducting Field Effect Switch," *Science* **288**, 656 (2000).

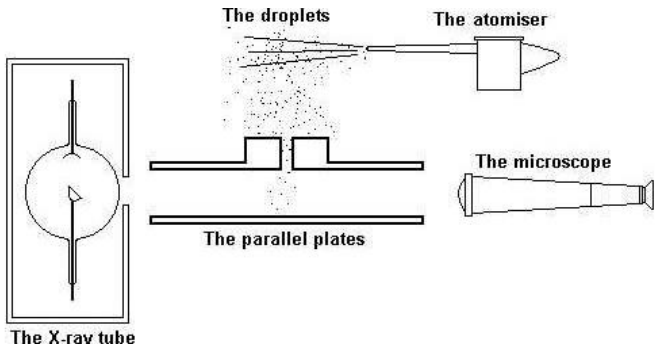
*The Hendrick Schön case: https://en.wikipedia.org/wiki/Sch%C3%B6n_scandal

Data fabrication is clearly wrong; what about more-subtle data "selection"?

In 1910, R.A. Millikan measured the charge *e* of the electron in his famous "oil drop" experiment and published his results in a number of papers. In 1923, he won the Nobel Prize in physics for this work.

In his 1913 paper‡, the most complete account of his measurements of *e*, Millikan stated,
"It is to be remarked, too, that this is not a selected group of drops *but represents all of the drops experimented upon during 60 consecutive days.*"
[emphasis added]

Millikan's own notebook appears to contradict this statement. Of 175 observations during the period in question, only 58 are reported in the paper.



‡"On the Elementary Electrical Charge and the Avogadro Constant," *Phys. Rev.* **2**, 109 (1913).

Marginalia from Millikan's notebooks:

"Good one. Keep this!"
"Publish. Fine for showing two methods…"
"Won't work"

In science, it is generally accepted that certain data may be rejected, but under what conditions?

Reality of the experimental method: Things go wrong; equipment malfunctions; people make mistakes.

Was Millikan's data selection blatantly unethical data manipulation or the application of good scientific intuition?

Data may be excluded for several reasons, but the reasons must be sound!

- Use accepted statistical tests, but *data exclusion must be disclosed* in reported results, for example
  - Chauvenet's criterion[§]: the outlier is more than $t\sigma$ from the mean of N measurements
  - Kolmogorov-Smirnov tests, designed to compare runs against a standard data set in a result-independent manner
- Decide *before* the *experiment* what your criteria are for accepting or excluding data. Make sure all collaborators know and are in agreement with these criteria
  - "Result-unbiased" algorithm
- More difficult … after the experiment you discover biases based on something you monitored but you did not "pre-reject" data. Now what?
  - Ideally, cast the analysis in a result-blind manner. Then, make cuts without physics implications.

[§] J.R. Taylor, *An Introduction to Error Analysis* (Mill Valley CA, Univ Science Books, 1982).

Record *everything*!

Make a permanent record—in a bound log book, in ink, as the data are being taken

Record everything that could affect the measurement (temperature, humidity, ambient light, exhaust hood open or closed, power surges, diagnostic “drift”)

Record data electronically if at all possible to minimize bias or human error

Keep raw data intact; you may have to reanalyze it or refer to it later

Clearly describe your data analysis procedures in the Methods section of any publications

Make sure all your co-authors are aware of and comfortable with your data analysis procedures

Ethics of publication and authorship*:

A paper should contain sufficient detail and references to public sources of information to permit others to repeat the work.

Proper acknowledgment of the work of others used in a research project must always be given. Authors should cite publications that have been influential in determining the nature of the reported work.

Authorship should be limited to those who have made a significant contribution to the concept, design, execution, or interpretation of the research study.

***From AIP statement of ethics and responsibilities of authors:**
http://www.aps.org/policy/statements/02_2.cfm

Ethics of publication and authorship*:

All those who have made significant contributions should be offered the opportunity to be listed as authors. Other individuals who have contributed to the study should be acknowledged, but not identified as authors.

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Ethics of publication and authorship*:

All those who have made *significant* contributions should be offered the opportunity to be listed as authors. Other individuals who have contributed to the study should be acknowledged, but not identified as authors.

The sources of financial support for the project should be disclosed.

Plagiarism constitutes unethical scientific behavior and is never acceptable.

***From AIP statement of ethics and responsibilities of authors:**
http://www.aps.org/policy/statements/02_2.cfm

Plagiarism:

Submitting another's published or unpublished work, in whole, in part, *or in paraphrase*, as one's own without properly crediting the author by footnotes, citations, or bibliographical reference

Submitting material obtained from an individual or agency as one's own original work without reference to the person or agency as the source of the material

Submitting material that has been produced through unacknowledged collaboration with others as one's own original work without written release from collaborators

Tips for avoiding plagiarism when referring to other's work:

(1). Study the original text you want to summarize until you *fully* understand its meaning

(2). Set aside the original and write a summary of the text in your own words

(3). Check your version with the original to ensure that the meaning has been retained

(4). Enclose any text or phrase that you have borrowed exactly in quotation marks

Cite the source!

Ethics of publication and authorship*:

It is unethical for an author to publish manuscripts describing essentially the same research in more than one journal of primary publication.

"self-plagiarism"

Submitting the same manuscript to more than one journal concurrently is unethical and unacceptable.

When an error is discovered in a published work, it is the obligation of all authors to promptly retract the paper or correct the results.

***From AIP statement of ethics and responsibilities of authors:**
http://www.aps.org/policy/statements/02_2.cfm

What about the use of AI (e.g., ChatGPT) and plagiarism?

This is an ongoing discussion, with evolving guidance (e.g., see: "Tools such as ChatGPT threaten transparent science" (Nature article))

The evolving consensus is that the use of ChatGPT and other AI writing tools should be acknowledged in the publication if used to help write a paper or dissertation:

"*Researchers using LLM tools should document this use in the methods or acknowledgments sections. If a paper does not include these sections, the introduction or another appropriate section can be used to document the use of the LLM*." (from: "Tools such as ChatGPT threaten transparent science" (Nature article))

See also OpenAI's statement on the acknowledgment of ChatGPT in publications and other writing: "In which cases can ChatGPT be used as an aid for thesis or scientific paper writing?"

So, failure to acknowledge the use of ChatGPT as a source could be viewed as plagiarism!

Ethics in collaborations*:

All collaborators share some degree of responsibility for any paper they coauthor.

The author who submits the paper for publication should ensure that all coauthors have seen the final version of the paper and have agreed to its submission for publication.

All coauthors have an obligation to provide prompt retractions or correction of errors in published works. Any individual unwilling or unable to accept appropriate responsibility for a paper should not be a coauthor.

***From AIP statement of ethics and responsibilities of authors:**
http://www.aps.org/policy/statements/02_2.cfm

Ethics in peer review*:

Review by independent scientists provides advice to editors of scientific journals concerning the publication of research results. It is an essential component of the scientific enterprise, and all scientists have an obligation to participate in the process.

Privileged information or ideas obtained through peer review must be kept confidential and not used for competitive gain.

Reviewers must disclose conflicts of interest…and avoid cases in which such conflicts preclude an objective evaluation.

***From AIP statement of ethics and responsibilities of authors:**
http://www.aps.org/policy/statements/02_2.cfm

Ethics in peer review*:

Reviewers should judge objectively the quality of the research reported and respect the intellectual independence of the authors.

***From AIP statement of ethics and responsibilities of authors:**
http://www.aps.org/policy/statements/02_2.cfm

Ethics in the Workplace

- Treatment of Subordinates
- Harassment Issues

Workplace Ethics: Treatment of Subordinates*

Subordinates should be treated with respect and with concern for their well-being. Supervisors have the responsibility to facilitate the research, educational, and professional development of subordinates, to provide a safe, supportive working environment and fair compensation, and to promote the timely advance of graduate students and young researchers to the next stage of career development. In addition, supervisors should ensure that subordinates know how to appeal decisions without fear of retribution.

Contributions of subordinates should be properly acknowledged in publications, presentations, and performance appraisals. In particular, subordinates who have made significant contributions to the concept, design, execution, or interpretation of a research study should be afforded the opportunity of authorship of resulting publications, consistent with APS Guidelines for Professional Conduct.

Mentoring of students, postdoctoral researchers, and employees with respect to intellectual development, professional and ethical standards, and career guidance, is a core responsibility for supervisors. Periodic communication of constructive performance appraisals is essential.

*https://www.aps.org/about/governance/policies-procedures/ethics

Workplace Ethics: Harassment Issues*

The Council of The American Physical Society has long been concerned with the serious under-representation of women and minorities in the profession of physics and, over the years, has established a number of programs that attempt to counter this trend. The Council now urges each member of the Society to help in this effort by being sensitive to all matters that affect the atmosphere of the physics workplace.

In particular, actions that create a hostile, intimidating, or offensive work environment for any group undermine the affirmative action efforts of the Society and should be eliminated. These actions include the public posting of materials that are insulting, derogatory, or exclusionary to a particular group.

We call upon all members of the Society to help ensure that persons of every race, gender, and ethnic origin may feel a welcome part of the physics community.

*Statement 88.1 from American Physical Society

Think about how what you wear, say, or do will affect the people around you!

Rosetta scientist Matt Taylor giving interview before Philae spacecraft comet landing

http://www.huffingtonpost.co.uk/2014/11/14/matt-taylor-sexist-shirt-comet-apology_n_6157736.html

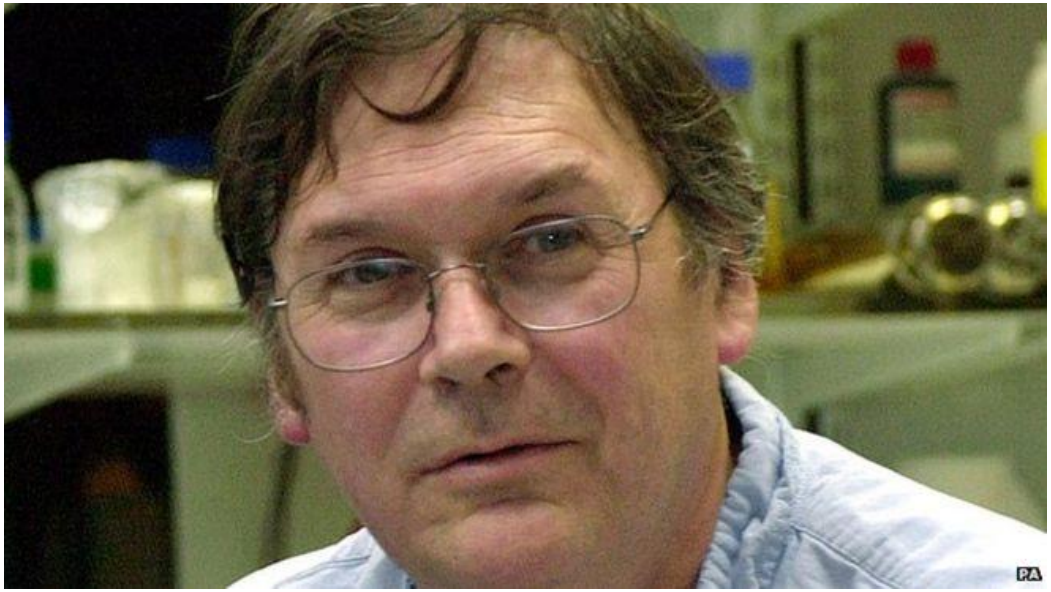
Think about how what you wear, say, or do will affect the people around you!

Twitter responded:

http://www.huffingtonpost.co.uk/2014/11/14/matt-taylor-sexist-shirt-comet-apology_n_6157736.html

Think about how what you wear, say, or do will affect the people around you!

Nobel laureate Tim Hunt resigned from his faculty position after making offensive comments about women in science



http://www.bbc.com/news/uk-33090022

Sexual Harassment:

Berkeley Astronomer Geoff Marcy was found to have violated sexual harassment policies over many years:

http://www.buzzfeed.com/azeenghorayshi/famous-astronomer-allegedly-sexually-harassed-students

Sexual Harassment Resources:

Campus Office of Access and Equity (OAE)
main page: http://oae.illinois.edu/index.html

discrimination and harassment prevention: http://oae.illinois.edu/discrimination-and-harrassment-prevention.html

online form with anonymous option here: https://uillinois-gme-advocate.symplicity.com/public_report
or directly email M.T. Hudson, the relevant OAE officer: mthdsn@illinois.edu

University Ethics and Compliance Office:
https://www.ethics.uillinois.edu/ethics_line

AAS Anti-Harassment Policy, and information about reporting incidents at society activities including AAS conferences: http://aas.org/policies/anti-harassment-policy

CSWA Chair's Message to the Greater Astronomical Community on Harassment:
http://womeninastronomy.blogspot.com/2015/10/cswa-chairs-message-to-greater.html

The new campus WeCare site for Sexual Misconduct Support, Response, and Prevention, where one can seek information as well as report, including anonymously:
http://wecare.illinois.edu/

Illinois Physics Diversity, Equity, and Inclusion Webpage:
https://physics.illinois.edu/people/diversity_equity_inclusion

Many other ethics resources are available

APS Ethics Guidelines

https://www.aps.org/about/governance/policies-procedures/ethics

APS "Ask the Ethicist"

https://www.aps.org/archives/publications/apsnews/200404/ethics.cfm

Online Ethics Center for Engineering and Science

http://onlineethics.org/

Applied Ethics "Case of the Month" Club

https://www.niee.org/resources/ethics-cases/

***Fundamentals of Ethics for Scientists and Engineers*,**
E.G. Seebauer and R.L. Barry (Oxford, Oxford University Press, 2000).

***On Being a Scientist: Responsible Conduct in Research*,**
2nd ed., NAS Press

https://nap.nationalacademies.org/read/12192/chapter/1