THE AUTHORSHIP LIST IN SCIENCE: JUNIOR PHYSICISTS' PERCEPTIONS OF WHO APPEARS AND WHY

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ABSTRACT

A questionnaire probing the distribution of authorship credit was given to postdoctoral associates ("postdocs") in order to determine their awareness of the professional society's ethical statement on authorship, the extent of communication with their supervisors about authorship criteria, and the appropriateness of authorship assignments on submitted papers.

Results indicate a low awareness of the professional society's ethical statement and that little communication takes place between postdocs and supervisors about authorship criteria. A substantial amount of authorship credit given to supervisors and other workers is perceived by the postdocs to violate the professional society's ethical statement.

INTRODUCTION

Research scientists attempt to discover, describe, and understand phenomena of nature. The information that results is published in books and journals. These books and journals are continuously appended with new information that slowly replaces or enhances what was there before. It is one of the most successful endeavors of humanity.

One of the reasons for the success may be the immediate feedback given in the publication process: scientists are rewarded by being listed as authors on the publications. Authorship credit is an important motivator for scientists. Friedman writes that it is "the principal means of demonstrating intellectual achievement for the purpose of academic advancement or recognition".[1] Courtiss writes that without significant authorship, grant money is hard to get, citations and prizes are few. Authorship is also desired for reasons of ego, referrals, politics, education credits, and to have a technique or other entity named after oneself.[2] Authorship is also important to the funders of the scientific endeavor. It gives a basis for decisions about which scientists should be given resources to perform future research.

This paper is one of the first inquiries into how authorship is distributed in every-day research collaborations. It will focus on the perhaps most important class of all research collaborations: junior scientists in non-permanent positions (postdoctoral associates or “postdocs”) supervised by senior scientists. A short summary of some of the present results was previously published[3].

It might be helpful to describe the circumstances under which a postdoc performs and reports her research. Let us say she investigates a particular property of a particular substance in the laboratory, and discovers something that is original about that substance. Typically, the postdoc did

not perform this research independently. Minimally she needed funding for her salary, a laboratory in which to work and a library in which to learn about previous findings. The first two likely came from a government grant awarded to her supervisor by a government agency. The postdoc may also have collaborated more or less closely with other scientists including her supervisor. The project scope itself is defined by the government agency, the supervisor, and the postdoc.

After the research project is finished, the postdoc usually writes a paper. This paper is reviewed by the supervisor before it is submitted for consideration for publication in a journal. Several people are designated authors. One of them is the postdoc, another is usually the supervisor, and, likely, a few (even many) more scientists are credited as well. The funding agency does not receive authorship, but it does receive an acknowledgement at the end of the paper.

Several questions can be asked about the designation of authorship: Is there an agreed upon standard for this process? Is this standard complied with? How much communication about the authorship assignment takes place?

The scientific work on the designation of authorship is limited to four statistical studies[4-7]. Ross Vasta[4] investigated authorship among junior and senior scientists who were members of the American Psychological Association. He found that 28% of respondents answered yes to the question "have you personally ever been involved in a situation where you believe your authorship was not commensurate with your input?". He also found that although ethical guidelines existed at the time, they were not specific and not used by the scientists. Honorary authorship (authorship given to colleagues who did not contribute substantially to the research) was considered reasonable by 21% of respondents, and Vasta found this to be uncorrelated with professional age. Further, he

found an interesting division of the respondents: some had been hurt by authorship issues and displayed hostility and bitterness, while others were not convinced that the topic deserved attention.

Swazey, Anderson and Lewis[5], studied self-reported exposure to a variety of types of misconduct within the preceeding five years among university professors and graduate students in four academic fields. The authors found that the rates of plagiarism and inappropriate authorship were reported to be similar by both faculty and students, that is, student reports of faculty violations were similar to faculty reports of faculty violations and vice versa. They further found that inappropriate authorship was slightly more frequent than plagiarism with one interesting twist: while plagiarism was about three times more likely to be committed by students than by faculty, inappropriate authorship was about three times more likely to be committed by faculty than by students.

Kalichman and Friedman[6] carried out a study further refined by Eastwood, Derish, Leash and Ordway[7]. The latter authors surveyed the overall perception of postdocs regarding inappropriate authorship of others and self, their training in ethics, and their opinions with regard to appropriate criteria for authorship. They surveyed one thousand postdocs at the University of California, San Francisco, an institution primarily devoted to biomedical research. Among the postdocs, 66% held PhDs; those with MDs and PharmDs were included as well. The authors found that fewer than half of the respondents were familiar with any university, school, laboratory or departmental guidelines for research and publication. (Such guidelines may or may not exist.) When asked to check off whether a particular contribution warrants authorship, nearly half believed that being head of the lab warrants authorship, and slightly fewer believed that obtaining funding warrants authorship. Both

views are in opposition to the "Uniform Requirement for Manuscripts Submitted to Biomedical Journals"[8].

Formal training in ethics was rare—only a small minority (18%) had had a course specifically dedicated to ethics in research. The training correlated with an individual's belief that it influenced conduct of scientific research and publishing, and that it heightened his sensitivity to misconduct. However, these authors found that training in ethics is actually uncorrelated with willingness to commit unethical or questionable research practices in the future, and is positively correlated with a tendency to award honorary authorship. The intention to award honorary authorship also increases dramatically for those who have first-hand experience with inappropriate authorship (either by having been asked to list an undeserving author, named as an author together with an undeserving author, or unfairly denied authorship). The authors concluded that "despite the respondents' own standards in this matter, their perception of the actual practice of authorship assignment in the research environment has fostered a willingness to compromise their principles." They also pointed out that their study provided "no insight into the actual prevalence of … misconduct." The present contribution will address the latter in the field of physics by counting the number of papers with inappropriate authorship, where "inappropriate" is defined by postdocs' interpretation of authorship violating the existing ethical statement of the American Physical Society (APS).

Since authorship is of such great importance to careers in science, one can argue that four statistical investigations is not very many. INSPEC, an online database covering physics and engineering since 1/1/90 shows not one article about the ethics of authorship under the keyword "authorship" out of a total of 1.2 million articles. MEDLINE, covering the health sciences,

includes about one hundred opinion articles by journal editors and journal letter writers corresponding to 0.006 % of all articles. There is also a relative absence of discussions of authorship in community-wide efforts with regard to science ethics. The recent report from the Commission on Scientific Integrity (www.faseb.org/opar/cri.html), perhaps the largest attempt by the government to deal with ethics in science, did not touch upon designation of authorship. It is also noteworthy that a common standard of scientific misconduct promoted by the National Academy of Sciences - fabrication, falsification, and plagiarism - does not include the bulk of possible misconduct relevant to the designation of authorship.

The current investigation examines postdoc awareness of the APS ethical statement on authorship, communication with the supervisor about authorship criteria, and appropriateness of authorship assignments on submitted papers.

METHOD

The questionnaire (see Appendix A) examined the process leading up to authorship assignment as perceived by physics postdocs. It consisted of respondent background information, information about the immediate research group (including, for example, the postdocs' perception of the importance of recommendation letters from the research supervisor, and of published papers) and whether the postdoc had seen the APS ethical statement regarding authorship. Using this ethical statement as a reference, the postdocs were asked about the appropriateness of the authorship assignment on the last five papers the postdoc authored in her or his present position. They were also asked how much authorship decisions were discussed with the supervisor.

Two groups of postdoctoral associates were sampled: 99 randomly picked from a mailing list of all postdocs at a very large national laboratory, and 92 randomly picked from an APS mailing list of all university postdocs. For the first sample non-respondents were asked a second and third time to return the questionnaire. For the second sample permission to follow up was not given. The respective return rates were 59% and 47%. Included among the returns were incomplete questionnaires, for example, questions eliciting authorship details were answered the least (by 65-70% of the returned surveys giving an effective return rate of 34-37%). To compare, the return rate for Vasta's investigation was 66%,[4] for the one by Swazey, Anderson, and Lewis the rates were 72% and 59%, for faculty and graduate students, respectively;[5] and for the one by Eastwood, Derish, Leash and Ordway, it was 33%.[7] In the present study, all results below are averaged over both groups sampled. Finally, in the interest of confidentiality, respondents' genders have been changed.

RESULTS

The APS ethics guidelines give "minimal standards of ethical behavior" that are important for the creation of an environment of "mutual trust" in which physics is "best advanced" (APS Guidelines for Professional Conduct as published on the APS Web page at `www.aps.org/statements/91.8.html`). The sentence relating to requirements for authorship reads:

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

The results will be based on the postdocs' interpretation of this ethics statement. Supervisors' interpretations may be similar to the postdocs' since Swazey, Anderson and Lewis[5] found that both faculty and graduate students reported a similar rate of faculty authorship misappropriation.

The survey results indicate that 26% of r

espondents have seen the ethical statement above, the majority have not. Moreover, there is sometimes little agreement among respondents as to what the APS ethical statement means as revealed by the answer to the question:

> "Do you consider, according to the ethical statement above, that obtaining grants and other funding for a project qualifies as a "significant contribution" that warrants authorship?"

Forty-nine percent of the respondents answer affirmatively, while the rest are of the opposite opinion.

Respondents reported publishing an average of two papers per year. Guided by the APS ethical guidelines, in 14 % of papers with the supervisor as an author, respondents indicated that the supervisor should not have been listed as an author. The supervisor was an author on 92% of all papers the survey respondents authored. Similarly, in 33% of papers with authors in addition to the supervisor or the postdoc, one or more authors, other than the postdoc or the supervisor, should not have been listed as authors. Forty-six percent of all postdocs answering the question reported that at least one paper on which he or she was an author had at least one inappropriate author; twenty-two

percent of postdocs answering the question reported that at least one paper had the supervisor as an inappropriate author. Respondents reported that in one percent of all papers, they were themselves inappropriate authors. The distribution of relative inappropriate authorship could be simulated with a single 17% probability of inappropriate authorship of authors other than the postdoc.

In 75% of postdoc-supervisor relationships, authorship criteria had never been discussed: in 61% of relationships the criteria for the postdoc's authorship were not "clearly agreed upon" and in 70% of the relationships the criteria for designating others as authors were not "clearly agreed upon." Discussions were somewhat correlated with agreement on postdoc authorship criteria (12% of the variance) and with agreement on criteria for others' authorship (17% of the variance). There is no correlation between postdocs who reported supervisors discussing authorship criteria and postdocs who reported inappropriate attribution of authorship by their supervisors.

Reasons reported for the inappropriate attribution of authorship are listed in Appendix B. The responses were divided into four categories: relationship building (11 entries); minor contributions (11 entries); previous or expected contributions (7 entries); and crediting staff that are close in a social sense, for example, part of the same research group (6 entries). Two entries remained unclassified.

The importance of the supervisor-postdoc relationship was investigated by asking about the factors a postdoc perceives as influencing career advancement. A question read as follows:

> "Rate, on a scale of 1-5 (where 5 is essential and 1 is unimportant), the importance of the following items to your career (for example, in obtaining a permanent position):

learning from supervisor	3.4
prestige and influence of your supervisor	3.5
supervisor recommendation letters	4.1
your publications	4.2

Numbers after the question show the results. We see that, from the combined average of factors related to the postdoc's objective achievements (learning from supervisor and publications) versus factors related to more subjective measures (prestige and influence of your supervisor and supervisor recommendation letters) that the former are perceived to be no more important than the latter.

DISCUSSION

Main Conclusions

From this study two main conclusions stand out:

First, *the distribution of authorship is a relatively undefined undertaking.* It is typically not something that postdocs and supervisors have discussed or agreed upon. The single ethical statement available to the community, the APS Guidelines for Professional Conduct, has not been seen by a majority of postdoc authors. Furthermore, these Guidelines allow broad interpretation--for example, the statement on authorship does not clearly indicate whether obtaining funding for a research project qualifies a person for attribution as author since half of survey respondents believe that it does while the other half do not. The Guidelines also do not require the "significant contribution" to be intellectual nor original.

Second, using the existing APS Guidelines for Professional Conduct as a standard, *postdocs perceive there to be a substantial amount of inappropriate authorship*. The supervisor, a joint author in 92% of all papers, is inappropriately given authorship in 14% of those papers. In 33 % of the papers with additional authors other than the supervisor, one or more authors were perceived as inappropriately listed. In contrast, the postdoc was an inappropriate author on only one percent of all papers.

Lack of Criteria for Authorship Assignment

The physics community is not alone in its lack of a consistently applied, well-defined public procedure for assignment of authorship. A similar situation in psychology was found by Vasta[4] and in biomedical sciences by Eastwood, Derish, Leash, and Ordway[7]. There are considerable forces acting against addressing the issue of assignment of authorship among postdocs as well as among senior scientits. Two anecdotal examples illustrate the point: a statement was made to me by a postdoc who had an elected position with the APS. He told me that the present study was "offensive," a "hot issue" and that he feared "isolating himself" should he bring it up in an APS committee meeting. Second, a committee that was to create the authorship guidelines for the APS some years ago worked in an "atmosphere of hostility" according to one committee member. The guidelines brought difficult issues to the table including due process, defamation of character, deprivation of rights, whether an individual accused would have a right to face his or her accuser(s), and other legal ramifications. The proposed guidelines were difficult to pass and had to be "watered down" until they became the guidelines quoted above.

Although legal issues influence the scientific community with regard to procedures for assignment of authorship, they are not the only relevant factors (a). There are at least three other factors that may be involved. First is the desire to avoid a process that could involve conflict:

> Interest in attributing varying degrees of credit to individual members of groups is a principal source of strain for collaborators. It forces their attention to delicate matters of credit that they prefer to keep undefined (p.401). [9]

A second factor is that postdocs generally believe their supervisors' recommendation letters are very important for future job prospects. Accordingly, fear of obtaining bad recommendations may prevent the postdocs from raising the topic of authorship with their supervisors. The role of fear of penalization and retaliation in preventing reports of faculty ethical misconduct by graduate students was previously reported[10].

A third factor that may explain the lack of a well understood and agreed upon contract for authorship is that the power to legislate the rules of authorship is in the hands of more senior scientists (a finding of powerlessness among postdocs to address ethical issues has been reported[7]). At this stage in their career, senior scientists may not perceive the issue as important--for example no supervisor exists who can easily appropriate authorship from them--or, they may see authorship as an entitlement of their senior status[11].

Two well established senior physicists with high elected APS positions made statements to me that were consistent with this third possibility. One told me that allocation of authorship was not a problem: he guessed that only a minority of perhaps ten percent of supervisors would

misappropriate authorship. He stated that a study of authorship issues was "nobody's highest priority with the exception of postdocs" who he said "tend sometimes to be an underclass" and therefore would not have the political clout needed to bring up the issue. The second told me that once you obtain a high level position it becomes easy to just go with the flow.

CONCLUSION

As we have seen, assignment of authorship is a relatively undefined undertaking in the physics community. Since authorship is such an important part of the scientific endeavor, one must ask the question - are there useful ways to standardize the procedure of authorship assignment? There seems to be at least two options. One is to follow the patent authorship model and have an attorney, or another disinterested party, inquire into the research work and, according to existing legal standards for patent authorship, write down the list of authors. A second choice would be to more accurately assign authorship by adding an authorship section at the end of each paper explaining what each author contributed[12] (a non-committal endorsement of this latter option is described in the "Uniform Requirement for Manuscripts Submitted to Biomedical Journals"[8]: "Editors may ask authors to describe what each contributed; this information may be published."). Both approaches would counteract major reasons that underlie honorary authorship found in this paper: relationship-building, social closeness, previous and expected work; in the first model because the authorship list is written down by a disinterested third party and in the second model because of the public disclosure of what the person actually accomplished. The latter procedure may also respond to concerns about minor contributions

resulting in authorship credit since the extent of all contributions would be stated. A sample "manuscript authorship form" appears in Appendix C.

However, it is likely that the scientific community will not adopt any new procedures. Therefore authorship assignment needs to be studied further given its fundamental importance for the scientific endeavor. Several topics are worthy of further research.

For example, while this paper has made some progress in elucidating the current procedure for assigning authorship, more details are needed. Who writes or types the list of authors the first time? Who reviews the list? Is the list changed in the review process? If so, by whom, when, how and why?

A second topic of interest is the perceptions of supervisors. Vasta's observation that the tendency of awarding honorary authorship is not related to professional age, and the finding of Swazey, Anderson and Lewis[5] that both faculty and graduate students report a similar rate of faculty authorship misappropriation both suggest that supervisors would not tell a different story. However, a longitudinal study of authorship assignment across the graduate student-faculty transition would shed further light on this question.

A third topic for further investigation is the value of authorship, that is, what is authorship worth in terms of money, career and prestige? Assuming it is the postdoc who types the list of authors, how much can a postdoc gain or lose by giving authorship to others more or less generously? Is the partial loss of intellectual ownership more than compensated by the positive promotion of the postdoc by the additional staff listed as authors? What should a mentor give as career advice?

In addition, the relationship between authorship credit and intellectual property needs to be clarified among all members of the scientific community. Should authorship credit be treated like other intellectual property such as patents and copyrights? Or, as journal editors might rather have it, is authorship a way to establish responsibility for the research content, a "certification" of the results? (For example, as the "Uniform Requirement for Manuscripts Submitted to Biomedical Journals"[8] states: "Each author should have participated sufficiently in the work to take public responsibility for the content".) If so, what is the purpose of the referee process?

A fifth topic for further investigation is the statistical distribution of opinions as to the importance of clarifying authorship practices. Many postdocs believed that authorship credit distribution was not "a problem," but many other would agree with what one of the postdocs said when given an authorship questionnaire at a conference (a pilot study was conducted with questionnaires handed out in person[3)]: "Usually authorship is a sham, right?" Similarly, Vasta[4] had some respondents ask him why he cared, and others thanked him for his study. These two positions seem common with little in between, suggesting a statistically non-normal distribution of responses. If this would be born out in a statistical study it would support stage models for ethical judgement. A numerical simulation, however, seems to suggest that this is a false impression: the distribution of relative inappropriate authorship from the survey could be simulated with a single 17% probability of inappropriate authorship of authors other than the postdoc. It was not necessary to introduce different "ethical types."

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FOOTNOTES

(a) Indeed, the legal issues were resolved in the related case of patent authorship. Authorship on patents is a much more well defined and consistently carried out task than authorship on research papers. Typically a patent attorney meets with all parties, inquires as to how the invention was conceived, calls other parties to investigate the content of discussions, brain storming sessions, etc., and thereafter the attorney writes down the authorship list. The attorney functions as an objective third party who ensures that the legal criteria for authorship are met.

APPENDIX A: QUESTIONNAIRE

POSTDOC AUTHORSHIP STUDY

BACKGROUND INFORMATION

1.1. For the purpose of this questionnaire, postdoctoral appointments are defined as "temporary positions in academia, industry or government that provide for continued education or experience in research." Do you have a postdoctoral appointment at this time?

_____yes

_____no (If no, please return this questionnaire anyway so it can be counted and so that you will not continue to receive follow-up questionnaires.)

.2. Your postdoc appointment is at:

_____a university
_____a government laboratory
_____a private industry laboratory
_____elsewhere (please explain)

3. How many years, in total, have you been a postdoc?

_____years

4. Which one of the following subfields are you currently working in?

_____astronomy and astrophysics
_____atomic, molecular and optical physics
_____biophysics
_____chemical physics
_____complex systems
_____condensed matter
_____elementary particle physics
_____geophysics
_____low temperature physics
_____medical/health physics
_____nuclear physics
_____plasma physics and fluid dynamics
_____other (please explain)

5. To which of the following categories do you primarily belong?

_____experimental physicist
_____theoretical physicist
_____computational physicist

6. Citizenship status.
_____US
_____non-US, permanent visa
_____non-US, temporary visa

7. Sex.
_____male
_____female

8. Year of birth.
19_____

9. Marital status and children.
_____married
_____single, divorced, widowed
_____number of children

YOU AND YOUR IMMEDIATE RESEARCH GROUP

10. How many members of your current research group are in each of the following categories?
_____research supervisors (usually one)
_____postdocs (include yourself)
_____graduate students
_____others (please explain)

11. Rate, on a scale of 1-5 (where 5 is essential and 1 is unimportant), the importance of the following items to your career (for example, in obtaining a permanent position):
_____learning from supervisor
_____prestige and influence of your supervisor
_____supervisor recommendation letters
_____your publications

12. Pick one of your current projects. Who decided to pursue the particular research question you are working on? (Indicate the answer on a scale of 1-5, where 1 means that you did it independently of your supervisor, 5 means that your supervishor did it independently of you, 3 means that you did it together.
_____(rank)

13. Have you had research ideas that your supervisor told you not to pursue?
_____yes (please explain)
_____no

AUTHORSHIP

For the purpose of this questionnaire, both an "author" and a "coauthor" are considered "authors."

14. In your present postdoctoral employment, how many papers were completed with you as an author?
_____papers

In the American Physical Society (APS) *Guidelines for Professional Conduct* there is a requirement relevant to authorship that reads:

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

15. Have you seen this statement before?
_____yes (where)
_____no

16. Do you consider, according to the APS statement above, that obtaining grants and other funding for a project qualifies as a "significant contribution" that warrants authorship?
_____yes (please explain)
_____no (please explain)

17. Please fill out the table below with information regarding the papers you authored in your present postdoc position. The information includes whether - according to the APS statement above - the authors of the papers made a "significant contribution." (If you have authored more than five papers in your present position, please list the most recent five.)

Paper # -->:	1	2	3	4	5
(i.) Number of authors on paper.					
(ii.) Check if "significant contribution" was made by you.					
(iii.) Check if your research supervisor was an author.					
(iv.) Check if "significant contribution" was made by your research supervisor.					
(v.) Choose (a) or (b): (a) If there are ≤ five authors on the paper: Excluding yourself and your research supervisor, how many of the other authors made a "significant contribution?"					

(b) If there are > five authors on the paper: Excluding yourself and your research supervisor, did all the other authors make a "significant contribution"? (yes or no)					

18. If, in the papers you listed in the above table, some author(s) did not make a "significant contribution," please indicate in each case what occurred. (For example, who put that/those author's(s') name(s) on the paper, and what was the motivation for this action.)

19. Have you, in your current postdoc position, ever made a "significant contribution" to a research paper without being asked to be an author?
_____yes (please explain)
_____no

20. Have you ever made the main contribution and not been credited as the principal author?
_____yes (please explain)
_____no

21. Has your supervisor ever discussed the criteria for authorship with you?
_____yes (briefly explain the extent of the conversation)
_____no

22a. Are the criteria for your authorship clearly agreed upon between you and your supervisor?
_____yes (please explain)
_____no

22b. Are the criteria for others' authorship clearly agreed upon between you and your supervisor?
_____yes (please explain)
_____no

23. What are your personal three most frequently used criteria for authorship (brief description)?

ADDITIONAL COMMENTS

24. Is there anything you would like to add? (For example, what was your reaction to this questionnaire when you got it, and if you discussed it with others, what was the topic of discussion?)

PERMISSION TO USE YOUR COMMENTS

25. Do you give me permission to publish the comments you made in this questionnaire (anonymously, of course)?

_____yes

_____no

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE!

APPENDIX B: REASONS FOR INAPPROPRIATE AUTHORSHIP AS REPORTED BY THE POSTDOCS (EDITED FOR GRAMMAR)

1. Relationship building (11 entries):

No one wants to have a bad relationship with your supervisor. Your future can be in his hands.

Two of the authors I listed for political reasons. I had generated data using computer codes developed by them some years ago. It was widely known that not doing this would cause trouble.

1. Supervisors do not read your papers unless they are co-authors. 2. Supervisors cannot say anything about your work in letters or references unless they read the paper. 3. Thus they have to be co-authors!

Another professor in the department, a close friend of my boss, helped evaluate some theoretical work which was ultimately cut out of the paper.

Friends of supervisor.

The author was listed because he, unlike my research advisor and myself, was a distinguished researcher in the field in which we wanted to publish the paper. His name would help it get

published. He probably spent three hours on the paper and suggested terminology that was appropriate to the field.

The author was the head of the group, had generated the funds and his name would add prestige.

My research supervisor listed a technician on the paper so that he would continue to do work for the supervisor.

The primary author had some discussions with researchers who had made significant prior contributions and, in addition, one of these researchers was well-known. The primary author thought he had to "honor" these researchers by offering them co-authorship.

Primary / secondary person requesting or authorizing work to be done, results used for programmatic decisions at facility.

One author was a supervisor of a graduate student who worked on the project. His name was listed by tradition and because he authors in the field.

2. Minor contributions (10 entries)

The author had previously worked for my advisor. He was consulted periodically over the phone for opinions but didn't do calculations. Consultations became less frequent as time passed.

I had valuable discussions with my supervisor but he did not do any direct work.

Small theoretical guidance was offered by author.

I used the author's equipment.

The author did some sample preparation.

The third co-author initiated idea without contributing to develop or apply it. I added him myself.

Sample originated from the author.

One author only showed me how apparatus worked.

I was myself an inappropriate author since I only showed a visiting scientist how to operate the system.

The additional authors were students who were there briefly but did not "work" on the project to any significant degree, and accelerator operations people who had beam delivery responsibilities for the experiment.

Obtained a sample from the boss of the other person.

3. Previous or expected contributions (8 entries):

The authors were listed on the project from the beginning and were expected to make significant contributions. In the end, their contribution did not come through, but their names were left listed anyway.

Usually the motivation is that the author is involved in some paper previous to the one submitted by us.

The other authors were involved in the development and construction of experimental detectors, but did not contribute specifically to the analysis presented in the papers.

The co-authors were part of a bigger picture--they contributed to writing the grant proposal.

Existing computer programs of the author were used in the research.

One author had comments which could not be included because of a missed deadline.

An author was involved in an earlier stage of a project, but did not contribute significantly to the results in the paper.

4. Staff being socially close to the collaboration (6 entries):

One author was a contact person for the collaboration.

My research supervisor “coordinated” interactions between myself and the other co-author, a junior faculty member.

The author did not make a “significant” contribution for this project, but he has been an active member of our research group in general.

Our papers are signed by all members of the collaboration.

Standard practice is to list as authors all students who collected data. I considered this to be too much.

I joined a pre-existing collaboration, whose third member contributed little to the project being done.

5. Other reason (2 entries):

I am not certain of the reasons.

One author was listed by the first author and I don’t know why.

APPENDIX C: MANUSCRIPT AUTHORSHIP FORM

NAME OF JOURNAL:

TITLE OF MANUSCRIPT:

AUTHORSHIP DETERMINATION METHOD (PLEASE CHOOSE "1" or "2"):

1. THIRD-PARTY CERTIFICATION: Disinterested third party compiled authorship list limited to and including all individuals who made original contributions or discoveries and has described each party's particular contribution to the manuscript below:

AUTHORSHIP LIST (in order of decreasing contribution to manuscript)

Name	Original contribution or discovery	Telephone

DISINTERESTED THIRD PARTY

Name	Title	Signature	Date	Telephone

2.SELF CERTIFICATION: All parties involved in the work of the manuscript, no matter the extent, have been offered authorship of the manuscript. Each author has described her or his particular contribution to the manuscript below (these descriptions will be published with the manuscript):

AUTHORS (in no particular order)

Name	Original contribution or discovery	Signature	Date	Telephone