C11 of IUPAP:
Report by the Working Group on Authorship in Large Scientific Collaborations in Experimental High Energy Physics

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I. Introduction

In the past four decades, experiments in particle physics have changed dramatically in scope and so has the number scientists participating. Initially, a large number of relatively simple detectors were built and operated by small university groups over short periods of time. With the introduction of colliding beams, there were fewer experiments, much larger, more complicated and costly. They were designed and built to address a multitude of questions, and were operated over many years. To support these larger experiments particle physicists choose to pool their expertise and manpower and collaborate with colleagues from many different institutions, often from many different countries.

The very significant achievements in experimental high energy physics over the past decades have only been possible because of these enormous collaborative efforts. Particle physicists truly share their resources and responsibility for the experiments and their scientific publications. While in other fields of science the equipment is designed and built by industry, in particle physics the detector design and fabrication is led by physicists who will also carry out the experiment. As the detectors have grown there is more specialization, and individual scientists in these large collaborations tend focus their efforts on specific detector hardware, electronics, or software, and also on specific physics questions. Currently, the larger High Energy Physics (HEP) collaborations have 200 – 600 members, the collaborations supporting the future experiments at the Large Hadron Collider (LHC) will have close to 2000 members.

As high energy physics (HEP) collaborations supporting major experiments have grown there is increasing concern, both inside and outside the HEP community, about authorship of their scientific publications. It is widely recognized that, if collaborations adhere to the current practice of authorship, the expected growth in the

number of authors might become more and more of a problem. Specifically, there is concern that very long author lists

1. do not appropriately credit those who have contributed most to the particular publication,
2. include the names of many scientists who are not very knowledgeable about the published material,
3. do not allow others to identify those most knowledgeable about the contents of the publication, and
4. lead to publication and citation records that no longer reflect the scientific accomplishments of individual scientists.

Members of the Commission of Particles and Fields (C11) of IUPAP have discussed these issues and have agreed that it would be desirable to examine the basis of these concerns and explore ways to improve current practices. C11 has formed an ad-hoc Working Group (WG) made up of representatives of the major HEP collaborations, a few members of C11, and a few wise individuals. The charge to the Working Group is given in Appendix A.

Since the fall of 2004, members of the working group have convened via telephone conferences and communicated in person or via e-mail. The following represents a report of the various points of discussion and findings.

Current Practices of Authorship

Prior to the discussion about practices of defining authorship, the working group reviewed the rules of authorship for scientific papers, as laid out by various physical societies around the world. These guidelines state the responsibility of the authors and of the large collaboration towards potential authors and the process of preparing a publication. The following are excerpts from the Supplementary Guidelines on Responsibilities of Coauthors and Collaborations, APS, adopted on November 10, 2002.

- Authorship should be limited to those who have made significant contributions to the concept, executions, or interpretations of the research. All those who have contributed in this way should be offered the opportunity to be listed as authors.
- Other individuals who have contributed and are not identified as authors should be acknowledged.
- Sources of financial support should be disclosed.
- All authors share responsibility for the paper. Some coauthors have responsibility for the entire paper as an accurate, verifiable report of research, others may make specific limited contributions, are accountable for the integrity of the critical data, carry out the analysis, write the manuscript, present major findings at conferences, or provide scientific leadership for junior colleagues.

- All collaborations should have in place an appropriate process for members to review and ensure the accuracy and validity of the reported results, express critique and pose questions concerning the work, and be able to share the data prior to and after publication.
- All members of the collaboration should be aware of and understand this process.

Being listed as an author not only represents a responsibility towards the published result it also represents recognition and credit for scientific accomplishments and thus is important for

- career development, i.e. hiring and promotions,
- continued support and funding for research by the home institution and funding agencies, and
- scientific discourse, i.e. readers should be able to identify those most knowledgeable about the published material, those who carry most of the responsibility for the results.

Members of the working group started out by reviewing the types of publications and reported current practices for the selection of authorship for scientific papers in large scientific collaborations, both in HEP and other fields of science.

II.1 Common Practices in High Energy Physics

All large HEP collaborations have clearly defined rules for membership and eligibility for authorship for specific publications. They typically distinguish among the following categories of publications and have commonly adopted the following practice:

1. Publications of physics analyses, usually signed by all eligible members of the collaborations: The articles are published in physics journals or submitted as contributions to conferences and/or posted to the electronic archive. The authors are usually listed in alphabetical order, by institution and by name. In the course of a year there are only minor changes to the author lists as new members join and others leave the collaboration. Thus for most collaborations the first author is the same for all publications.
2. Contributions to conference proceedings in the form of write-ups of an invited talk by an individual, usually representing the collaboration: These papers are signed only by the speakers, with reference to the collaboration she/he represents.
3. Scientific Notes: Most collaborations document physics analyses in great detail in internal reports prepared by a small group of scientists. Such reports are signed only by those directly involved in the work. They may relate to analyses techniques or further interpretation of published results or to studies of future extension of the experiment. To the degree this work is of general interest, publication in journals, either physics or technical journals, or as

contributions to conferences and workshops is warranted and should be made possible.

4. Technical publications covering detector design, construction and operation, as well as advances in electronics, data acquisition, computing and software: These publications are usually authored by a subset of the members of the collaboration, often including engineers and technical staff. The articles are published in technical journals or proceedings of conferences and workshops. These publications are more frequent during the design and construction phase, during the steady operation of the detector, only a few papers on detector performance and various upgrades are published

Currently, the larger HEP collaborations have 200 – 600 members. Collaborations have formulated requirements for membership and qualifications for authorship. Authors are generally required to be members and devote most of their research time to the experiment, and to have contributed to the experiment for at least six months or one year. Authors are primarily experimental physicists, including graduate students. In some cases individuals who are not members of the collaboration can sign papers, for instance theorists or engineers who have made important contributions. Members may withdraw their name from a specific paper, but this practice is rare and not encouraged. In fact, collaborations make a significant effort to make sure that the primary authors of a paper address the critique by other members of the collaboration and convince everybody that the result is presented clearly, the uncertainties are correctly assessed and fully covered by the stated errors, and that the conclusions are sound.

Large collaborations publish as many as 50 papers in physics journals per year and typically a larger number of conference contributions on preliminary results. The number of invited talks documented in proceedings exceeds the number of journal publications, typically more than 100 talks per year.

Current policies reflect the high energy physics tradition that detector design, construction, and operation is performed by the same team of physicists that also performs the analysis and jointly brings to publication exciting new results. The drafting and intensive review of the paper is accompanied by strong efforts in guiding students, internal refereeing of analyses and the manuscript, communication of preliminary results, etc.. Publications thus are the outcome of joint efforts by the collaboration, not just the few individual scientists who initiate and perform a specific analysis and arrive at the result. This has been the overriding reason for all HEP collaborations to include all active members of the collaboration as authors for scientific journal publications.

The question that has been raised is whether the current practice which has worked reasonably well for a few hundred authors can also work for much larger collaborations in the future. Can the scientific discourse within the collaboration be carried out in such large international groups, spread out geographically? Can a meaningful review take place in a reasonable time? How will many individual groups within the collaboration working on the same analyses combine their efforts towards a joint publication.

With the size of the LHC detectors and the very large number of scientists and engineers, many of whom have worked for more than a decade to design, build and now commission the detector and associated electronics and software, there is concern that these members of the collaboration will not be credited appropriately as major contributors to the scientific results that are expected from these large collaborations. In fact there is concern that the split between physics analyzers and detector experts will grow, though both of them are important for the success of these very large experiments.

II.2 Common Practices in Other Fields

The WG contacted members of large collaborations in other fields, nuclear physics, astronomy and astrophysics as well as the human genome consortium, to learn about their practices for authorship.

The nuclear physics community is now forming collaborations that are similar in size to those in particle physics, and they have apparently adopted authorship practices that are very similar to those of large HEP collaborations. At BNL the STAR and PHENIX collaboration have 500-600 members from some 50 institutions. The ALICE experiment at LHC has attracted 1000 scientists from 86 institutions.

The LIGO Scientific Collaboration (LSC) consists of about 400 members from 41 universities. They have agreed that the author list for scientific publications will include all members of the LIGO Scientific Collaboration with rights to the data. The authors will be listed in alphabetical order and will include the engineers who contributed in a major way to the design, construction, or operation. Up to now LIGO has published eight physics papers, plus a larger number of technical papers signed only by those involved in the particular work.

The Sloan Digital Sky Survey (SDSS) has about 200 scientists from 14 universities. They distinguish four types of publications with different author lists:

1. scientific publications signed by those directly involved in the data analysis as well as any members of the technical team who built the telescope;
2. data release papers, same as other scientific publications, but a different team of scientists who analyzed the data;
3. technical papers signed by those directly involved in the technical work; and
4. follow-up papers on public data by a few authors with reference to SDSS.

As of now more than 100 scientific publications have appeared in print, the typical number of authors varies between 30 and 50, i.e. typically 20% of the collaborators sign, very few among them are the original builders of the telescope. The authors list recognizes the primary authors by listing them first, with the remaining names following in alphabetical order.

In astronomy, practices are different for the traditional ground-based observations and the relatively recent space-based observations. The large optical telescopes are booked by so-called observers who collect and analyze the data. Publications are typically signed by

less than ten authors, not including the builders of the telescope. The scientists who contributed to the design, construction, and maintenance of the facility publish technical details about the facility separately. In recent years there has been an increase of large surveys by consortia of observers using several ground based telescopes, or combinations of ground- and space-based telescopes. For such consortia, a variety of protocols for authorship have been developed. It has become common practice to have the very first survey results authored by all the consortium members, possibly including the builders.

In many ways, space-based astronomy is similar to high energy physics in that large and expensive facilities need to be designed and constructed with the help of engineers and specialized personnel. However, the difference is that those who proposed, designed, and built the facility are apportioned limited Guaranteed Time of Observation (GTO) during which they have sole access to the device and become authors of the resulting first scientific publications. Following the GTO, the instrument, including the calibration and analysis tools, are made available to all astronomers. Some space-based facilities have dedicated science centers (as in the case of the Hubble telescope) where the staff scientists carry out research and also act as the liaison to the larger astronomical community. The number of authors for research with large space-based experiments ranges between 20 and 40, including some of the science center astronomers.

In the biosciences, practices are varied and battles over authorship and who is listed first are not uncommon. The Human Genome Sequencing Consortium has used a variety of practices and members have reported that the responses have not always been positive. For some of the major publications a few hundred authors were chosen and listed by name in print, the names of the remaining 2000 members were accessible as an online supplement to the paper. The first authors were primarily selected from among the team leaders and the PubMed citation index chose to ignore the authors listed in the supplement. There has been a suggestion that not only the full team should be listed by name, but also the contribution of individuals or their team should be called out. Such a practice would certainly extend the header of the papers by a large margin, and thus can only be handled via web storage. It would also require some review by the collaboration to assure a certain degree of balance.

II.3 Belle Policies for Authorship

The Belle Collaboration which is made up of close to 300 scientists from 56 institutions in 13 countries has introduced a novel procedure to determine authorship of their scientific papers. The stated goal is to reestablish a more meaningful relation between the listed authors and the scientists most responsible and knowledgeable about the work presented. Prior to the publication of a paper by the Belle Collaboration, i.e. while the draft which has already been discussed and critiqued widely is undergoing its final review, the eligible members of the collaboration are asked to confirm their authorship by responding to the following three statements on a webpage protected by a personal pass word:

- I have read this paper and I agree with its contents - please include me in the author list;
- I have read the paper, I do not agree with its contents - please do not include me in the author list;
- I have not made sufficient contributions to this paper - please do not include me in the author list.

Figure 1 and 2 show two plots illustrating the impact of this procedure during the past four years. The number of authors listed is now typically one half of the number of eligible authors.

In addition, the Belle leadership encourages the selection of up to three primary authors who will be listed first, in the order chosen by the analysis group. If there is no agreement in the analysis group on the selection of and listing of the primary authors, all authors will be listed in strict alphabetical order. While 90% of the first 30 publications had an alphabetically ordered author list, only 10% of the most recent 30 papers had authors listed in alphabetical order.

The selection of primary authors has become a great incentive for younger scientists and has not been unnoticed by those who decide on university appointments and special recognition. Specifically, one of the younger members of the Belle Collaboration who was listed as first author on two publications drew the attention of the physical society of her home country and she was honored for her accomplishments by the annual prize of the society.

II. Impact of Current Practice

The WG had several discussions about the impact of the current common practice of authorship defined by membership in the scientific collaboration:

- The long default author lists combined with a thorough collaboration-wide review process respect the responsibility of the whole collaboration for the published result. This practice emphasizes the fact that it takes an enormous effort of large numbers of scientists to build and support the operations of a large detector.
- By giving equal credit to analysts and to scientists providing critical technical support to the experiment, the current practice avoids difficult and sometimes controversial decisions of who is most deserving among the several hundred collaborators.
- Given that promotion of scientists strongly depends on the physics analysis accomplishments and less on technical achievements a record of those accomplishment is very important. For experimental particle physicists current publication lists or citation indices are not usable for this purpose. Instead, more subjective recommendations are used.
- Furthermore, it has become almost impossible for people outside of and even inside the large collaborations to judge the contribution of individuals.

- The long alphabetically-sorted author lists do not allow others to identify those most knowledgeable about the analysis and this hampers scientific discourse. In the past, graduate students were often chosen as first authors for papers on their thesis topic and thereby were identified with this first major research project.
- The current practice is an entitlement to authorship, based on membership and not on a record of contributions by individuals to the experiment in general or the publication in particular.
- The current system has been in place for many years, and despite some misgivings, has been widely accepted. In fact, almost all HEP collaborations currently use it, and all LHC Collaborations have so far agreed to continue this practice, without major revisions. It is easy to implement and largely non-controversial as it maximizes the number of published papers for all members of the collaboration.

It is likely that the publishers will decide at some point that it does not make sense to print identical author lists for every paper. For BABAR publications the PRL text equals the list of authors and their home institutions. For CMS and ATLAS the author list is expected to increase to nine pages or more. It is anticipated that in the future only the names of a few authors will be printed below the title, with the name of the collaboration given with a link/reference to the full list of names, electronically accessible. Publishers may agree to periodically print the full list of authors. On the other hand, more and more of the journals will be publish electronically or at least are accessible electronically via the web and thus links to the full author list will be trivial to implement. So, a limit on the number of printed pages is not an issue.

Discussions in ECFA, the European Committee for Future Accelerators, have lead to a position paper on Physics Notes, a new class of publications by very large future collaborations. Scientific Notes are to contain results of analyses, physics simulations, software algorithms and data handling. The results or methodology described should be unique and of interest to a wider scientific community. The Scientific Notes will be authored by those directly involved in the work, but they will be viewed as part of the official publication record of the Collaboration. The Notes should be of high quality, approved and submitted by the collaboration, and undergo a review process that will involve scientists internal and external to the collaboration. It is expected that these Scientific Notes will be made public in electronic form by scientific publishers, and should be cited as is customary for other publications.

It is expected that the publication of Scientific Notes will become a way of recognizing and honoring contributions and original work by individual scientists, just as technical papers on detector design, construction and operation have done for smaller groups of technical experts. In this way these publications should help in the career advancement of high energy physicists.

III. Alternatives to Current System and Their Potential Impact

The introduction of an alternative to the current system by the Belle Collaboration has had the following consequences:

- Over the past four years, it has led to a continuous reduction in the number of authors, currently less than 50% of the eligible authorship. About 125/271 authors have signed more than 75% of the last 30 publications, 44/271 signed less than 25%.
- The non-alphabetic listing of primary authors has resulted in some cases in special recognition.
- Authorship has become more meaningful, in the sense that those who sign the paper have conscientiously decided to do so at the time the paper was circulated for review. Thus the authors as a whole are more knowledgeable about the contents.
- Different first authors have made it easier to identify a referenced publication, given that large collaborations publish many papers per year.
- Readers have commented that it is beneficial to be able to identify the primary authors of a paper and address questions to them directly.
- There is no evidence that funding agencies or the home institutions of scientists have reduced their support because the researchers have their names on fewer publications.

The Belle system emphasizes the responsibility of individuals for the publication allowing members of the collaboration to "opt-in" and "opt-out". The system avoids decisions or dictate by the collaboration management or others charged with authority. Furthermore, it does not require a long-term affiliation to an analysis working group to establish authorship. It is hoped that members of the collaborations will act with integrity, evaluate their contributions more critically over time and see the benefit of a shorter publication list that truly reflects their intellectual contributions. The fraction of members signing publications has been steadily declining, to some extent due to the increasing acceptance of individual responsibility for the published results.

The potential drawback of such a system is that the sign-up relies on the honor system! In a large group of scientists from different regions of the world there are significant differences in customs and practices. So, the question is: can one rely on self-regulation? The establishment of a special oversight to resolve disputes over unreasonable interpretation of the rules would be very undesirable. Fortunately, it appears that the members of the Belle Collaboration are very satisfied, even proud of their system.

The non-alphabetic listing tends to emphasize the contribution to physics analysis over contributions and innovations in common software or hardware tasks. The limit of only three primary authors listed in non-alphabetical order is probably too restrictive. An extension to about ten or even twenty primary authors would allow for special recognition of those who were not directly involved in the analysis but whose work or

ideas were critical for its outcome. As long as the decision on the primary author list can be dealt with in the analysis working group the need for arbitration can be avoided.

Many particle physicists consider attempts to single out those most responsible for the analysis and the practice of listing only the analysts (in analogy to the "observers" in astronomy) unjust to members of the collaboration who have contributed critically to the design and construction of the detector, electronics and software development and common software tools or who are responsible for operations, including data taking, maintenance for hardware and software, Monte Carlo generations, and the many tasks to which collaborators devote on average 20% to 30% of their time. In practice, there are many scientists who devote almost all their time to tasks that support the physics research of the whole collaboration, while others focus primarily on data analysis. On the other hand, many members of large collaborations are not involved full time and do not actively participate in the whole scientific program. So, a selective authorship might apportion credit in a way that is more balanced in regard to the contributions of individual scientists.

An application of this procedure to a much larger collaboration like ATLAS or CMS would probably not reduce the author list to the extent that individual contributions can be recognized, unless only 10-15% of the collaboration decide to sign a given paper.

A significant reduction of the author lists can only come out of the recognition that with only a few large experiments operating in the world, each attracting many hundreds of scientists, we may need to look at these huge operations differently, not as a single monolithic operation, but as a consortium of scientific enterprises. This is different from the situation of some thirty years ago, when the discovery of the ψ meson by the Mark I Collaboration was signed by 35 authors, including three machine physicists who had critical roles in the design and construction of the SPEAR storage ring, and many others who had been engaged in the design and building of the detector or on-line and off-line software. This experiment resulted in a number of other important discoveries. After a couple of years the collaboration introduced the option to list a few primary authors first.

BABAR and Belle now publish a hundred journal and conference papers per year. Very few of the authors, if any, have read and understood them all. For a given paper, only a very small fraction of the collaboration is fully familiar with all aspects and can take credit for significant specific contributions.

In this situation one may ask whether it makes sense to partition the collaborations into 10-15 consortia, probably along the lines defined by the 10-15 analysis working groups, with individual scientists participating in at least one, in some cases two, and in exceptional cases several working groups. Scientists responsible for technical tasks should also be encouraged to join these working groups, contribute their expertise and actively take part in meetings, review of various analyses, etc.. Analysis working groups specialize in different areas of physics, develop common analysis tools, meet regularly, and report progress and problems. Such groups would by design be smaller, typically less than 50 and rarely more than 100 members, and thus would allow closer interactions

among members. Leaders of various analysis groups need to interact frequently with the central physics coordinator, the computing and software teams as well as the detector operation teams. The federated oversight by the collaboration as a whole through its publication board and analysis coordinators could remain the same.

Among the members of the physics analysis working group one could introduce a sign-up for authorship like Belle, and thus allow individuals in the working groups to decide case-by-case whether their contribution truly justifies authorship. Other members of the collaboration who contributed through review activities or special ideas and tasks critical to the research to be published should be invited to sign up. In these smaller analysis groups, it would become easier to identify the lead authors. A system like this could reduce the author list by a factor of 10 or more.

There is serious concern that by linking the authorship to membership in analysis groups the collaborative effort needed to operate the complex detectors, extract reliable data, calibrate and develop common computing tools could not be sustained. Also, it may not be trivial to define the working group topics, and there could be unhealthy competition between groups over what might be perceived as the more attractive topics of research.

On the other hand, in most collaborations such a partition into analysis groups already exists. In fact, these groups build a significant knowledge base and make it possible for new members to quickly acquire the necessary expertise to perform analyses. Such a partition is also similar to the practice of dividing the detector construction and operations into subsystem activities that are managed with a high degree of autonomy, but are tightly coordinated and share resources wherever appropriate.

Most likely, such a partition and greater independence of the analysis efforts would only be established after the first one or two years of operation, after the most common software and calibration procedures have been established, and after the first results have been published.

IV. Conclusions

In the course of the discussions among members of this working group and with our colleagues who are members of large collaborations it has become clear that it will be very hard, if not impossible, to return to author lists of less than 100 or even 200 scientists for very large collaborations and thereby fully overcome the concerns raised in the beginning of this report. On the other hand, these discussions have led to some insight, and for some members to the acknowledgement that having one's name on more than ten publications per year may not be truly justified

At present, most particle physicists have accepted as appropriate the current common practice of equating authorship with membership in a large collaboration. Many members of the HEP community have never worked on experiments with less than 50 authors, and thus do not see any reason to question the current practice as anything

unusual. On the other hand, very few of particle physicists have given much thought to the extension of the current practice to more than 1,000 authors. Many of us who learned about the Belle practice acknowledged that the voluntary sign up would be a way of reestablishing a more responsible and knowledgeable authorship. The option of selecting prime authors is generally viewed favorably and may have some attractive consequences.

A further extension of the Belle practice and a more drastic departure from the current practice would be to introduce voluntary sign-up for authorship not for the whole collaboration, but for physics analysis working groups, with the understanding that all members of the collaborations should join and participate in at least one of these groups.

The establishment of rules for authorship should remain the responsibility of the collaborations. It is very important that these rules are fully documented and approved by the collaboration. It may well be that for a given experiment the rules develop over the years, from the initial publications acknowledging the whole team that designed and built the detector and software, to later years, when more specialized publications are prepared by a large number of smaller groups.

At this time, all existing collaborations have rules in place – some already for many years – that regulate membership and authorship. Thus a change of a traditional way of dealing with authorship is considered painful, and in the eye of many unnecessary, if not damaging to the spirit of the collaboration. The promotion of Scientific Notes as a means of documenting analysis methods and results, unique algorithms and physics simulation is seen as a way of recognizing the work of individuals and small groups of scientists. These detailed Scientific Notes would be published electronically by journals and would be part of the official publication record of the collaboration and as such could be referred to in other publications and conference reports.

C11 of IUPAP cannot establish rules and expect the community to accept them.
It can at best raise conscientiousness and outline some proposals and guidelines. The working group suggests that C11 distribute a questionnaire together with this report to the large collaborations and major research laboratories. The purpose of such a questionnaire is to sample the community's response to various options for authorship discussed here.

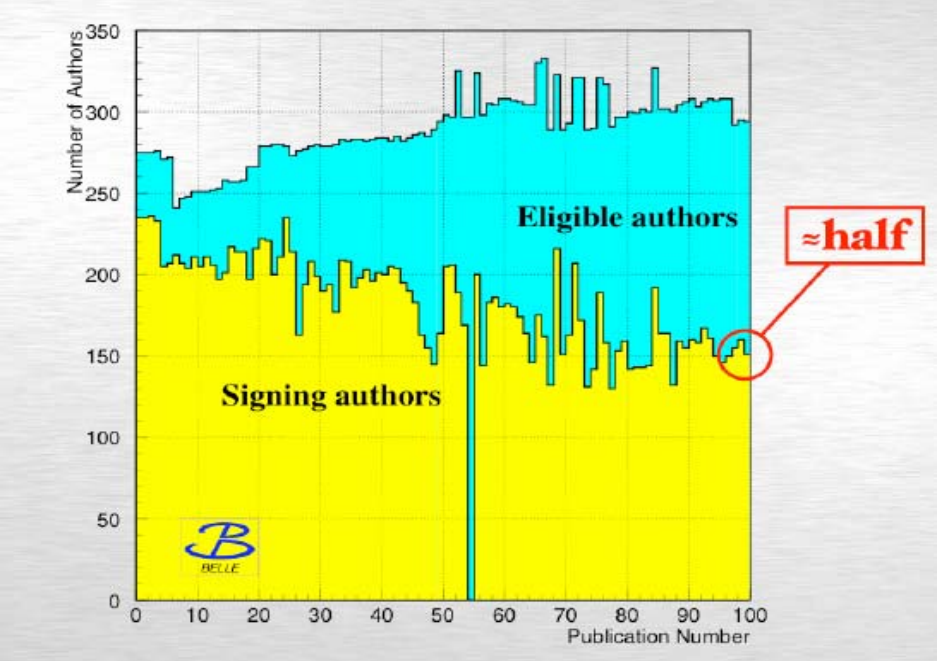

Figure 1: History of Belle Authorship: Number of eligible authors compared to the number of actual authors for the first 100 journal publications.

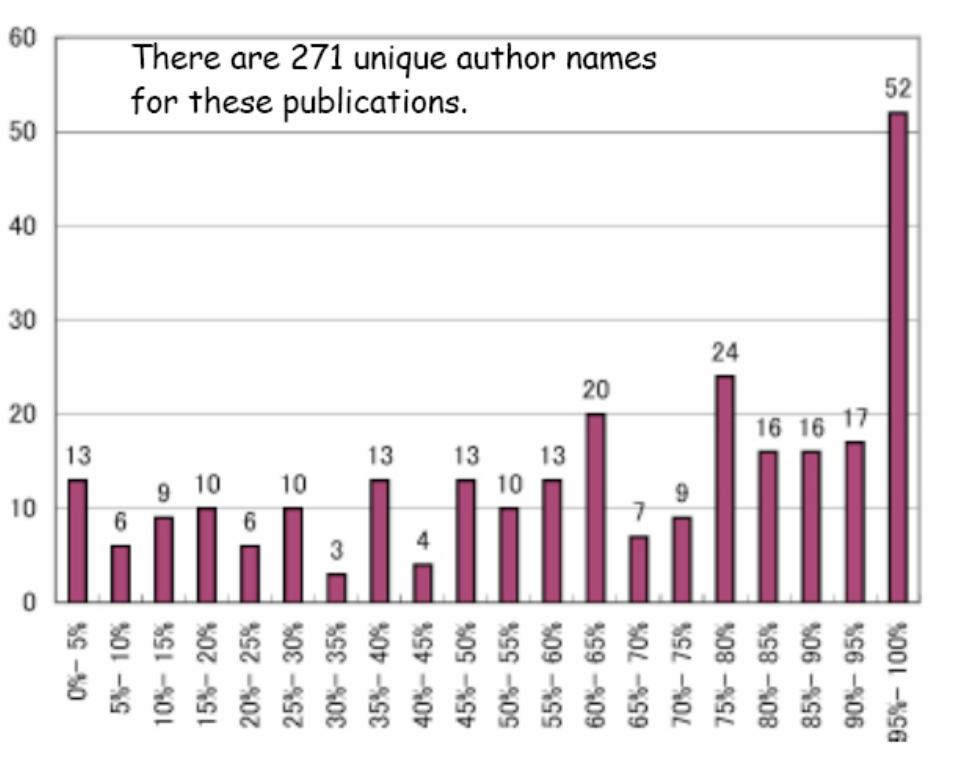

Figure 2: History of Belle Authorship: for the most recent 30 publications, the number of actual authors signing a given fraction of all journal papers.

APPENDIX A:

CHARGE TO C11 WORKING GROUP ON AUHORSHIP

The Working Group on Authorship is charged by C11 of IUPAP to

1. examine the various types of publications, specifically physics analyses in reviewed journals vis-a-vis technical publications with more restricted authorship on analyses techniques, numerical methods, computing, data acquisition, and software development, detector development and operation;
2. survey the current practices for the selection of authors;
3. examine the impact of the current practices and their potential future variants, in particular on the career development of young scientists;
4. examine the potential impact of any reduced authorship on the support of research groups by funding agencies, universities, and laboratories for detector operations and research;
5. examine procedures needed to establish authorship of different types of publications, and develop alternatives to the current practices, in close consultation with the large collaborations;
6. consult with publishers and editors of scientific journals and electronic depositories on various types of publications;
7. prepare a draft report by June 15th 2005, prior to next year's meeting of C11 during LP05 in Uppsala. This report should summarize the findings and outline alternatives to the current practices.

It is expected that the working group will interact mostly via phone conferences and e-mail, though it may be beneficial to arrange for a meeting some time in the spring of 2005. Interaction with IUPAP WG on publications and consultation with publishers may be advised. This report will be made public to the HEP community, should be reviewed by the various national HEP communities and large collaborations, and depending on the overall response could lead to the formulation of guidelines or recommendations.

Beijing, August 2004

APPENDIX B:
Questionnaire on HEP Authorship:

As HEP Collaborations supporting major experiments grow, there is increasing concern about authorship of scientific publications. The Commission of Particles and Fields (C11) of IUPAP has formed an ad-hoc Working Group (WG), made up of representatives of the major HEP collaborations and a few members of C11, to examine current practices and potential alternatives. For obvious reasons C11 of IUPAP will not and cannot establish rules. It can at best raise conscientiousness and outline proposals and possibly guidelines.

The purpose of this questionnaire is to sample the community's assessment of the current practices and some ideas for changes discussed by the Working Group. Individuals are asked to please indicate their response, by marking one of seven possible the ratings:
-3: extremely negative, 0: neutral, +3: extremely positive.

1) Current Practice

Currently publications of physics analyses are signed by all eligible members of the collaborations. The articles are published in physics journals or submitted as contributions to conferences and/or posted to the electronic archive. The authors are usually listed in alphabetical order, by institution and by name. Thus for most collaboration the first author is the same for all publications.

Q1: Do you consider the alphabetic listing of all members of the collaboration the best way to appropriately credit those who contributed to the published research?

NO	o	o	o	o	o	o	o	YES
	-3	-2	-1	0	+1	+2	+3	

Q2: Would you support the proposal to introduce a new class of publications, Scientific Notes, that document analysis methodology, detector and physics simulations, novel algorithms and software developments as a way of acknowledging individual contributions to the experiment and the physics results?

NO	o	o	o	o	o	o	o	YES
	-3	-2	-1	0	+1	+2	+3	

Publishers may in the future stop printing the full author list and provide access to the full list in an electronically accessible file.

Q3: Would you support a proposal by publishers to have, for each collaboration paper, only the names of two contact persons printed above the name of the collaboration, and have the names of the remaining authors recorded in alphabetical order in a file accessible electronically?

NO	o	o	o	o	o	o	o	YES
	-3	-2	-1	0	+1	+2	+3	

2) Current Belle Practice

The Belle Collaboration has introduced a voluntary sign-up for authorship of each individual publication. As a result of this procedure, many individuals only sign a fraction of all publications and the number of authors listed has been decreasing steadily with time. Now only one half of the number of eligible authors sign up.

Q4: Would you consider a sign-up as practiced by Belle as a good way to identify and appropriately credit those who contributed most to the published research.

NO	o	o	o	o	o	o	o	YES
	-3	-2	-1	0	+1	+2	+3	

Q5: Would a reduction in the number of publications in which you are listed as author affect you and/or critically impact the support you and your colleagues receive from your home institution and funding agency?

NO	o	o	o	o	o	o	o	YES
	-3	-2	-1	0	+1	+2	+3	

In addition, the Belle leadership encourages the selection of up to three primary authors who will be listed first, in any order the analysis group agrees to, followed by the other authors in alphabetical order.

Q6: Would you agree that the practice of listing in non-alphabetic order the names of up to ten or even twenty selected scientists who contributed most to the published research and are most knowledgeable about the results, is an effective way to identify the corresponding authors and give credit to those contributing most to the publication?

NO	o	o	o	o	o	o	o	YES
	-3	-2	-1	0	+1	+2	+3	

3) Alternate Scheme

Research in large HEP collaborations is performed by subgroups focusing on specific analyses and supported by technical groups responsible for detector operations, calibrations, computing, data processing and software development. In this situation one may ask whether it makes sense to partition the collaborations into 10-15 consortia, probably along the lines set by the various analysis working groups, with individual scientists participating in at least one, in some cases two and in exceptional cases more working groups. Scientists responsible for technical tasks should be encouraged to join one of these working groups, contribute their expertise and take part in meetings, review of various analyses, etc.. Individual consortia could introduce a sign-up for authorship like Belle, and thus allow members of the working groups to decide case-by-case whether their contribution truly justifies authorship. Other collaborators who contributed through review activities or special tasks to the research to be published should also be encouraged to sign-up. The federated support

by the collaboration as a whole through the development of common techniques and the publication board and analysis coordinators could remain the same. Most likely, such a reduction in authorship would only be established after the first one or two years of operation, following the establishment of the most common software and calibration procedures.

Q7: Would you agree that a partition of the large collaborations into smaller physics research groups focusing on selected topics is an effective way to organize research activities while maintaining the support for common software and hardware?

NO	o	o	o	o	o	o	o	YES
	-3	-2	-1	0	+1	+2	+3	

Q8: Would you agree that the partition of the large collaborations into smaller physics research groups could also be an effective way to establish authorship, i.e. restricting authorship to members of the physics research groups and to others who have contributed directly and are most knowledgeable about the research results presented?

NO	o	o	o	o	o	o	o	YES
	-3	-2	-1	0	+1	+2	+3	

To obtain an assessment of those who responded, you are asked to please provide the following information:

I have been a member of the following HEP collaborations:
_____ Collaboration for ___ years.
_____ Collaboration for ___ years.

In the last ____ years I have been an author of ____ journal publications and also ____ papers submitted to conferences.

Of these papers I was directly involved in the research and writing of ____ papers, In addition, I have carefully read and reviewed ____ papers.

APPENDIX C:

Results from the Survey on Authorship in the HEP Community

The questionnaire prepared by the WG on Authorship was supplied to the major HEP collaborations and then distributed to their members. In total, there were 882 responses to the survey, dominated by contributions from CDF(114), D0(154), CMS(159), ATLAS(207), BABAR(131) and Belle(83).

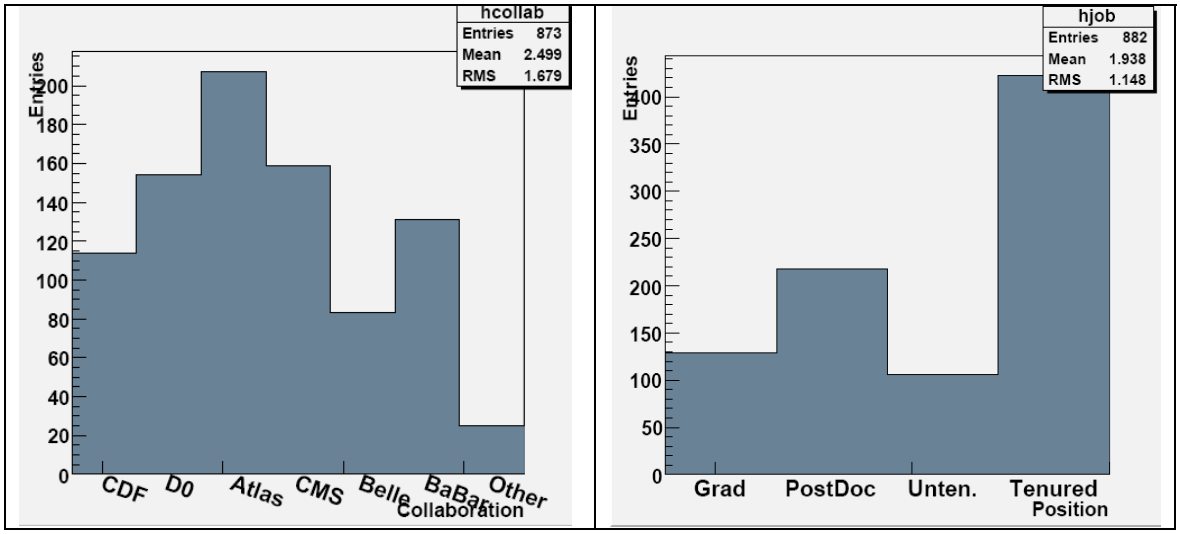

Figure 1: Number of responses to the survey, a) by collaborations, b) by position (graduate students, post doctoral fellows, untenured and tenured staff and faculty).

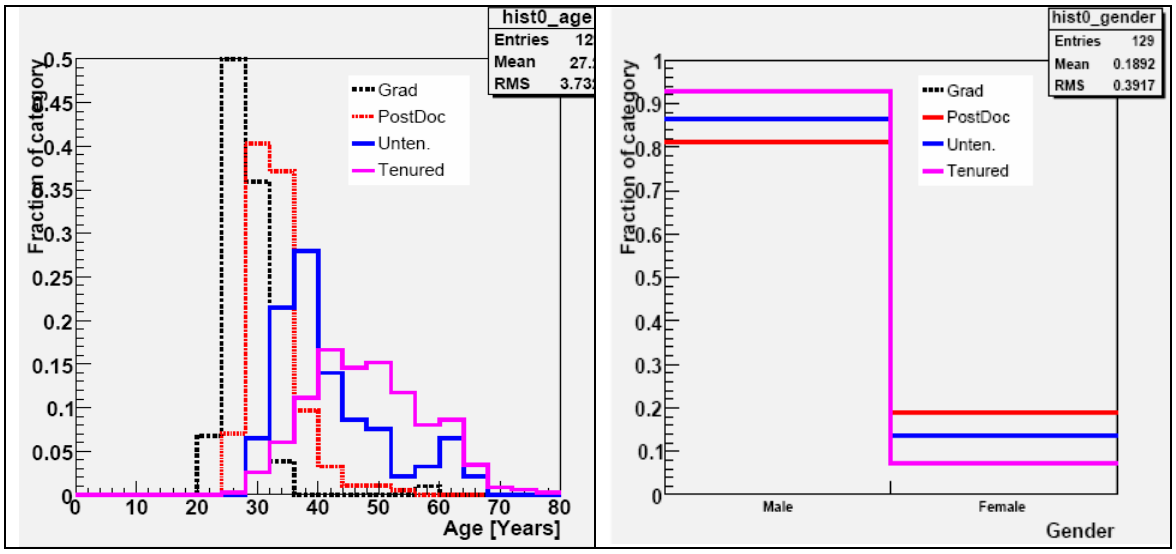

Figure 2: Age and gender distributions of respondents, separate for graduate students, post doctoral fellows, untenured and tenured staff and faculty members.

The largest fraction of responses (48%) were from tenured faculty and staff (422), though there were significant responses from younger scientists: untenured staff and faculty (106), post docs (218), grad students (129). The age and gender distribution is given in Figure 2.

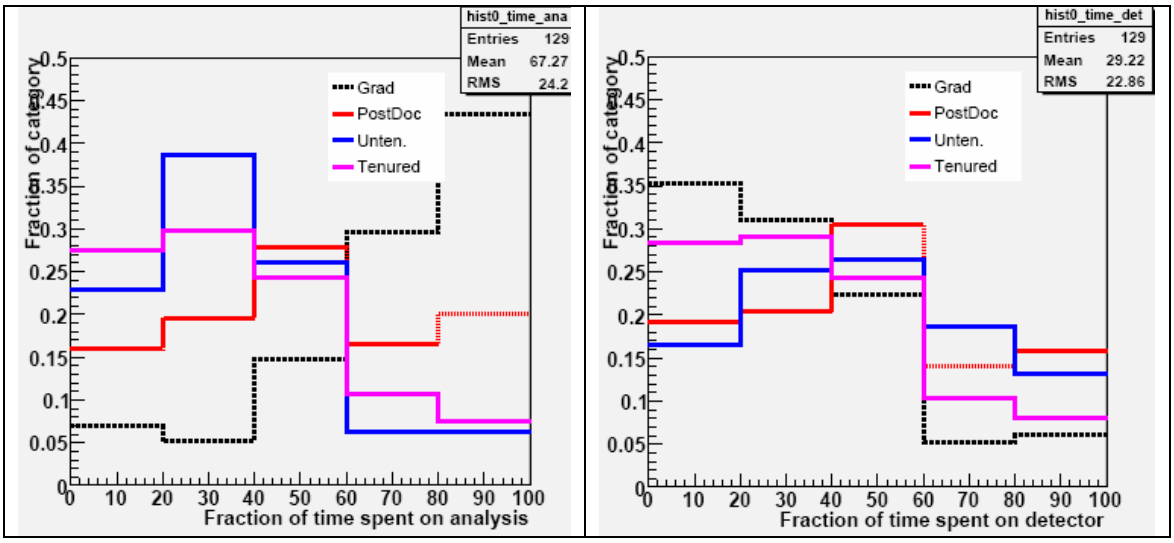

Figure 3: Fraction of time respondents devote to a) data analysis and b) detector maintenance and operation.

The following plots show the responses to the eight questions posed, ranging from -3: extremely negative to +3: extremely positive.

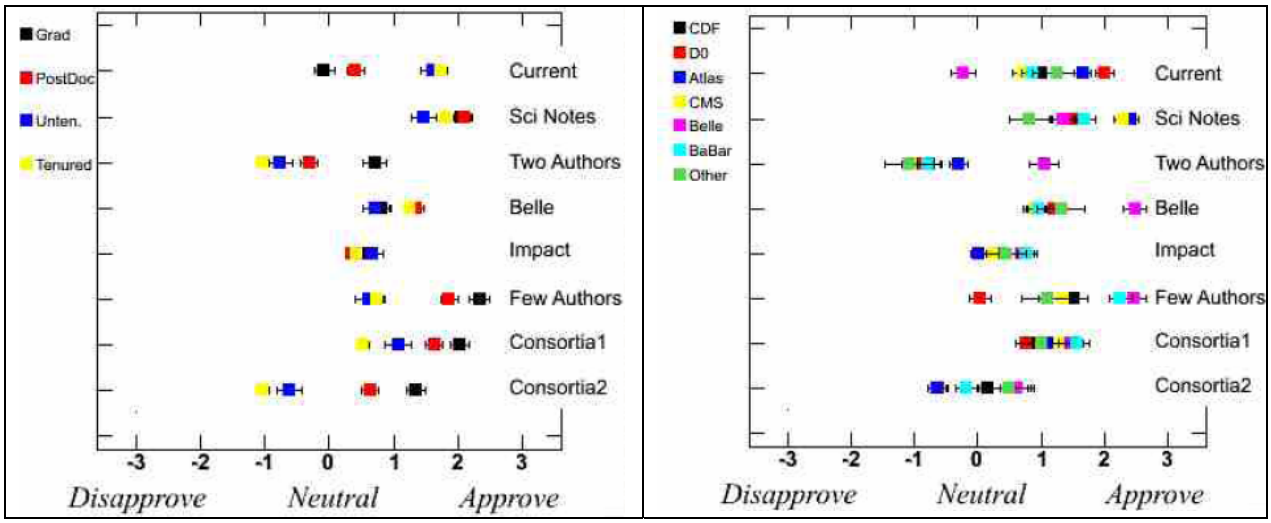

Figure 4: Median of the distributions of responses to the eight questions posed, separately a) for graduate students, post docs, untenured and tenured staff and faculty members, b) for members of the major HEP Collaborations.

There is a clear indication that the younger scientists are less supportive of the current practice and favor recognition of primary authors, and many would support selective authorship, as suggested by the proposal for analysis groups or consortia.

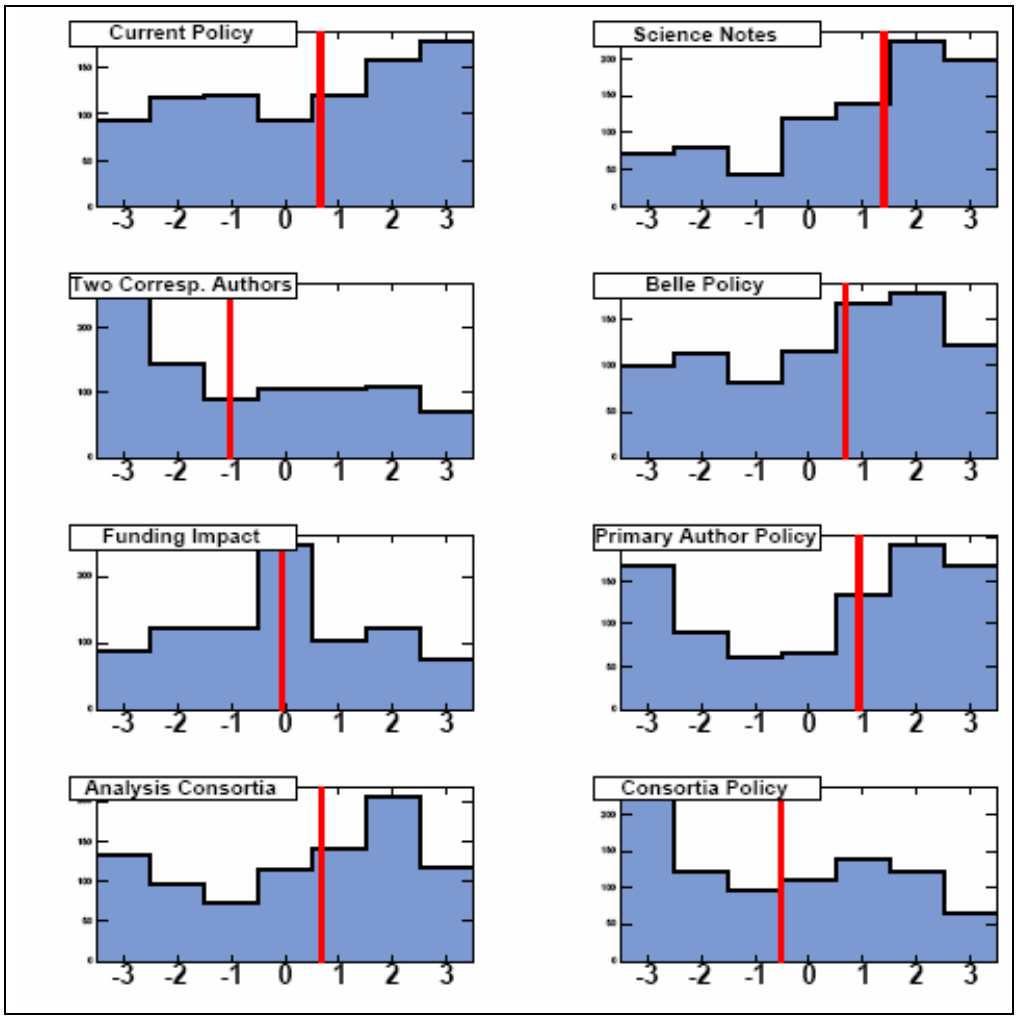

Figure 5. Distribution of responses to the eight questions for all respondents to the survey. The vertical red line marks the median of the distribution.

Summed over all collaborations, most of the distributions are relatively flat, indicating that the responses cover the whole range between the two extremes. Some distributions show a polarization, and there are clear differences between the collaborations, as indicated in Figures 6 and 7. BABAR and Belle members are less supportive of the current practice and show sizable support for primary authors listed first, ATLAS and CMS members are split on this issue. The idea of one or two corresponding authors is objected to by many respondents, likewise the proposal of selective authorship for members of analysis working group members. The proposal to publish detailed science

notes by only a few authors is strongly supported by CMS and ATLAS members, who suggested this form of publication; it is less favored by members of other collaborations.

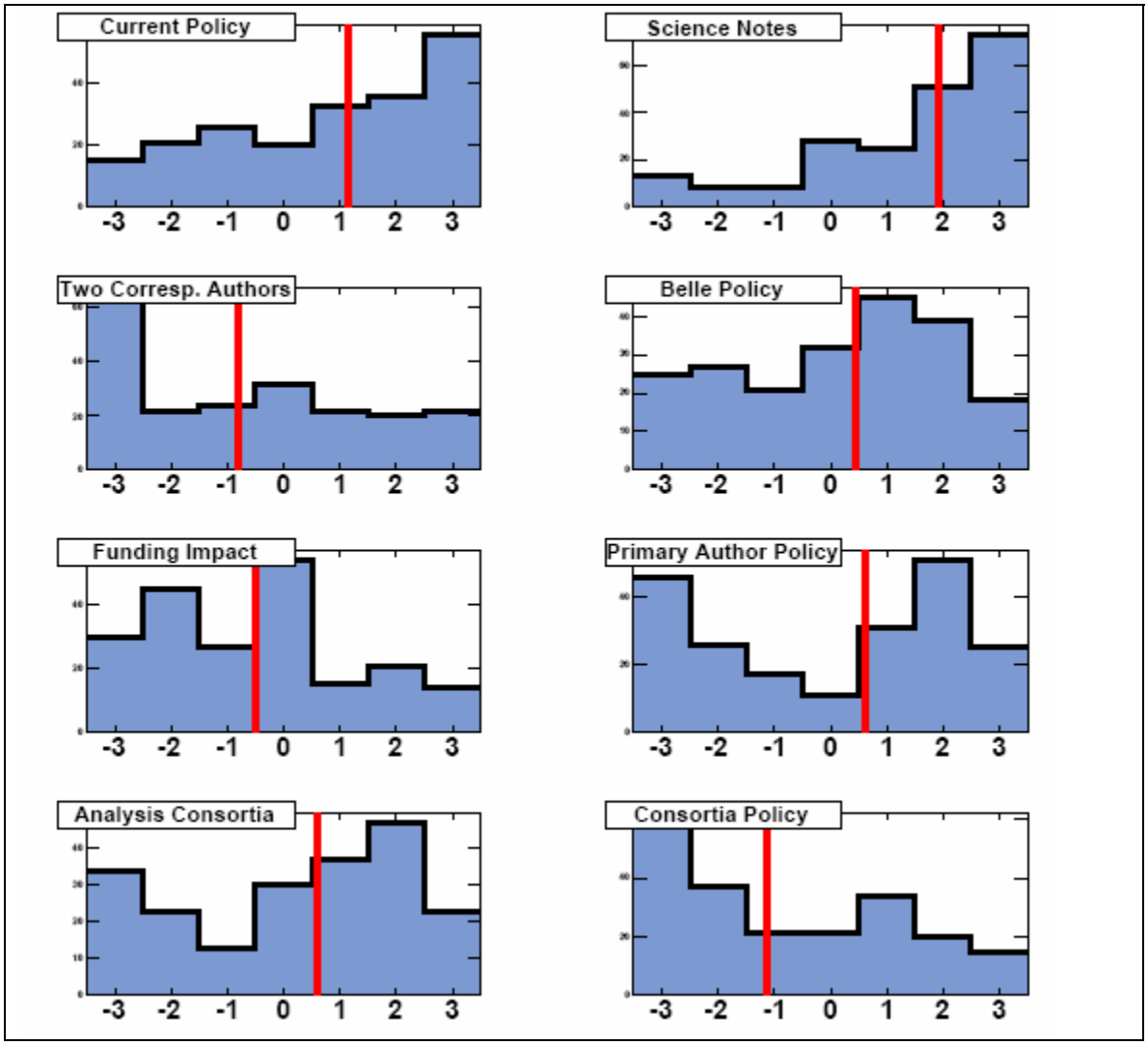

Figure 6: Distribution of responses to the eight questions of the survey by members of the ATLAS Collaboration. The vertical red line marks the median of the distribution.

In summary, the survey provides some interesting information. In follow up discussions it became clear that the more senior members of the collaborations were more concerned that any change in policy could discourage scientists to devote adequate time and effort to technical tasks, necessary to operate and maintain the detector and support the analysis efforts, and could lead to unavoidably to disruption and discontent. In contrast, many younger scientists favor ways to recognize primary authors, and potentially reduce the author lists. It was thought that any changes in policy would have to be spelled out early

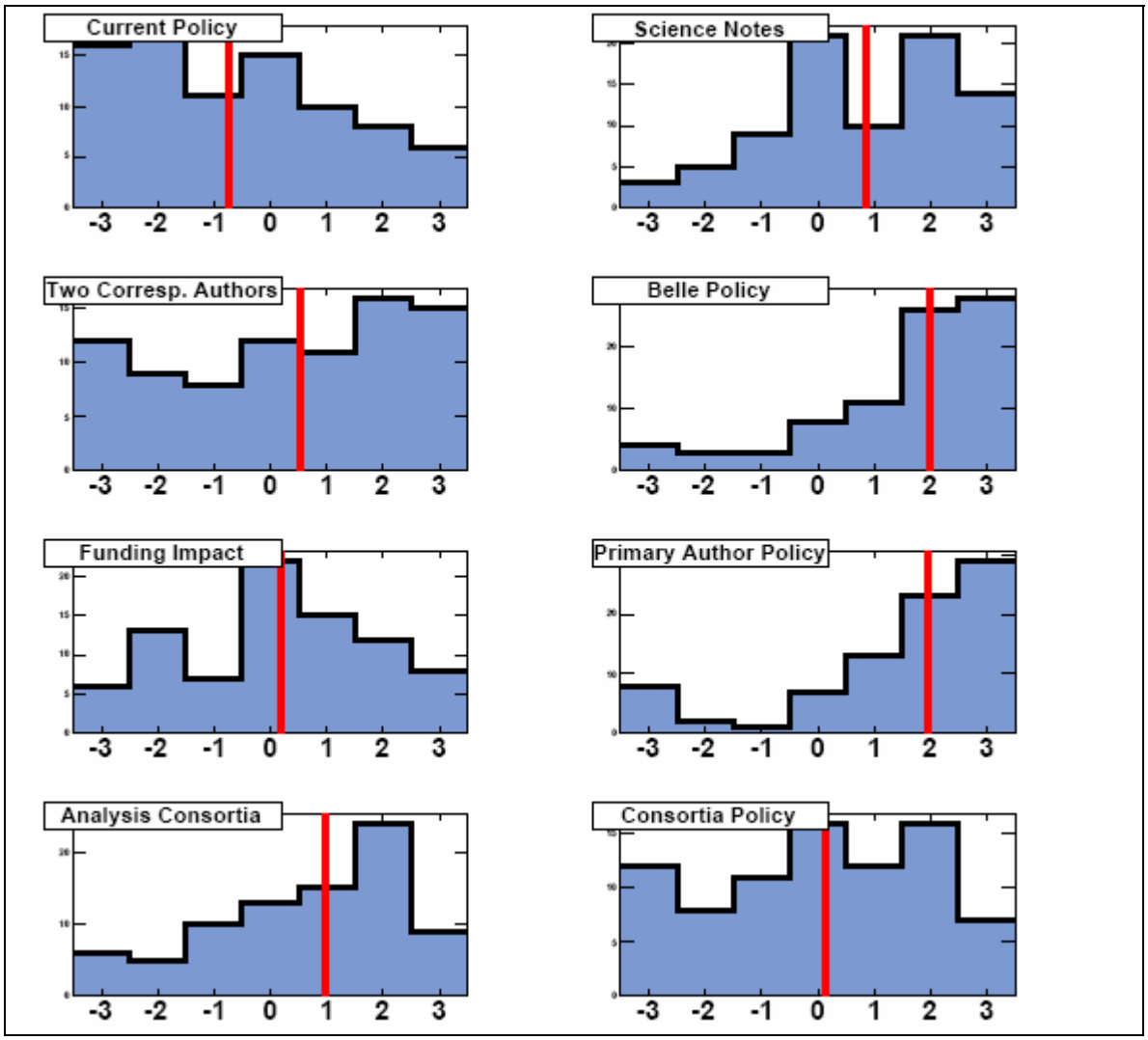

Figure 7: Distribution of responses to the eight questions of the survey by members of the Belle Collaboration. The vertical red line marks the median of the distribution.

in the life of a collaboration, even though the Belle Collaboration, and many years ago the Mark I Collaboration, have introduced such changes with full approval of their members.

The survey website and all these figures were prepared by Daniel Whiteson, a complete set of figures can be found on his webpage: http://www-cdf.fnal.gov/~danielw/authorship/results/. There is also a long list of comments by scientists participating in the survey: http://www-cdf.fnal.gov/~danielw/authorship/results/comments3.html.