Essay: Accelerators, Beams and *Physical Review Special Topics - Accelerators and Beams*

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Accelerator science and technology have evolved as accelerators became larger and important to a broad range of science. *Physical Review Special Topics - Accelerators and Beams* was established to serve the accelerator community as a timely, widely circulated, international journal covering the full breadth of accelerators and beams. The history of the journal and the innovations associated with it are reviewed.

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I. ACCELERATOR SCIENCE AND TECHNOLOGY

Accelerators and the beams they produce are critical for a broad range of sciences. In addition, the study of accelerators and beams is, by itself, an interdisciplinary science with interplay between considerations ranging from basic physics to engineering. It is a discipline that evolved over time as the small accelerators that were commonplace at universities were replaced by the national and international laboratories needed for exploration of the energy frontier of particle physics. Another equally important trend has been the increasing breadth of science enabled by accelerators. These factors have resulted in profound changes in the practitioners of accelerator physics and technology. They evolved from being predominantly university based and engaged with accelerators as part of research in particle physics to being concentrated at laboratories and having accelerators as their central discipline.

There are interconnected consequences of this evolution including a tenuous connection with universities, a service component of accelerator science, and informal ways of disseminating results. Universities are the heart of intellectual and scholarly endeavors with their vibrant atmosphere, breadth of pursuits, and the stimulation that comes from students bringing energy, excitement, and creativity to their studies. The service component of accelerator science was an inevitable development because funding is almost always tied to the science being served rather than to the instruments producing the science. Finally, the standards of universities for promotion and recognition, which include publication of peer reviewed articles, are not as important for a service profession, and accelerator work was often published informally.

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These consequences are natural and there would be little downside if accelerators were not the limiting factor in so many sciences. Operating accelerators are always striving for better performance: higher beam current, higher luminosity, greater beam brightness, etc., and optimizing performance and controlling costs are of major importance in designing new accelerators. Often these will require understanding basic accelerator physics. The electron-cloud effect is an example with critical importance for B-factories, spallation neutron sources, and the Large Hadron Collider, among others. The frontiers of science are often shaped by accelerator physics and technology. As examples, superconducting rf has opened up a world in nuclear physics and neutron production; the short x-ray pulses from free electron lasers will revolutionize atomic and molecular physics, and accelerator science will determine the future of its progenitor, particle physics, where inventions are needed to overcome size and cost limitations.

The accelerator field must have breadth, depth, and creativity to meet the challenges of the future. This can only be accomplished by attracting excellent scientists and engineers and educating the young people so crucial for the long term. While members of the accelerator community are making essential contributions to a range of sciences, their peers are other accelerator scientists and their professional interests are related to accelerators and beams. Therefore, it is essential to value the advancement of knowledge of accelerators and beams as well as contributions to other sciences.

II. THE DIVISION OF PHYSICS OF BEAMS

The Division of Physics of Beams (DPB) of the American Physical Society (APS) was an important step in doing this. The division was established in 1985 with the objective of ''the advancement and diffusion of knowledge regarding the nature and behavior of beams and the instruments for their production and use. . . .In addition, the Division of Physics of Beams: (i) promotes research and development in the science of beams; (ii) encourages scholarly publication; (iii) promotes education in beam science and technology; and (iv) enhances the professional standing of its members'' [1].

Encouraging scholarly publication is one of the DPB objectives. Peer review, which authors and readers benefit from substantially, is an integral part of scholarly publication. A knowledgeable colleague carefully reads a manuscript and gives a frank opinion whether it presents correct, new and important results. In addition, the referee often gives helpful criticism that can improve content and presentation. Acceptance and publication of a manuscript is an indication that the work has been judged to be making a meritorious contribution. For this reason peer reviewed publications are considered a measure of an individual's scholarly accomplishments. This measure is particularly important for universities, and it can play a crucial role in hiring and promotion.

The DPB initiated a study of peer reviewed publications in accelerator and beams in 1997. A conclusion of the study was that while many journals published such articles there was no single, widely circulated journal with this as the focus. As a result the literature was fragmented and not effective as a means of communication within the accelerator community. The division recommended establishing a scholarly, peer reviewed journal devoted to the science and technology of accelerators and beams that would (1) cover the full breadth of accelerators and beams, (2) be timely, (3) be inexpensive to promote wide circulation, and (4) be international with an international editorial board and pool of referees. This recommendation led to the establishment of *Physical Review Special Topics - Accelerators and Beams* (PRST-AB) [2].

III. THE EARLY DAYS

The recommendation reached the American Physical Society at a most opportune time. Marty Blume was the APS Editor-in-Chief. He had previously served as Chair of the National Synchrotron Light Source Department at Brookhaven, and this experience gave him appreciation for accelerator science itself and for the contributions accelerators were making to a wide range of science. In addition, he understood the intimate connection between accelerator science and accelerator technology, and he was willing to champion an editorial policy of

publishing both science and technology. This was critical for covering the full breadth of accelerators and beams.

The other factor that made the timing opportune was that the APS recognized that scholarly publication was moving rapidly from hardcopy to electronic format. A small journal like PRST-AB would be an ideal initial effort where lessons could be learned before embarking on electronic versions of the much larger, established *Physical Review* journals.

Electronic publication satisfied the objectives of timely publication and the potential of wide circulation. However, it had the problem of covering costs, which include, among other things, editorial expenses, composition and production costs, and the costs associated with buying and maintaining servers. Charges to authors or readers would be a significant drawback when establishing a new journal, and it was decided to seek sponsorship from laboratories with large accelerator programs instead. Eight U.S. laboratories agreed to be the initial sponsors, and the APS covered the shortfall in the beginning as a service to the accelerator community and in recognition that PRST-AB was a testing ground for electronic publication. As a result, PRST-AB was available to authors and readers at no cost and without a subscription.

Sponsorship has grown steadily, and PRST-AB now has twenty sponsors: (i) Argonne National Laboratory, (ii) Brookhaven National Laboratory, (iii) The Cockcroft Institute, (iv) Cornell University Laboratory for Elementary-Particle Physics, (v) Deutsches Elektronen-Synchrotron (DESY), (vi) 11th European Particle Accelerator Conference (EPAC '08), (vii) European Organization for Nuclear Research (CERN), (viii) Fermi National Accelerator Laboratory, (ix) Gesellschaft für Schwerionenforschung mbH (GSI), (x) INFN–Laboratori Nazionali di Frascati, (xi) INFN–Laboratori Nazionali di Legnaro, (xii) INFN–Laboratori Nazionali del Sud, Catania, (xiii) Lawrence Berkeley National Laboratory, (xiv) Los Alamos National Laboratory, (xv) National Superconducting Cyclotron Laboratory at Michigan State University, (xvi) Oak Ridge National Laboratory, (xvii) Princeton Plasma Physics Laboratory, (xviii) Stanford Linear Accelerator Center, (xix) Thomas Jefferson National Accelerator Facility, and (xx) TRIUMF–Canada's National Laboratory for Particle and Nuclear Physics. Because of their generous support, PRST-AB continues to be provided without charge to authors or readers.

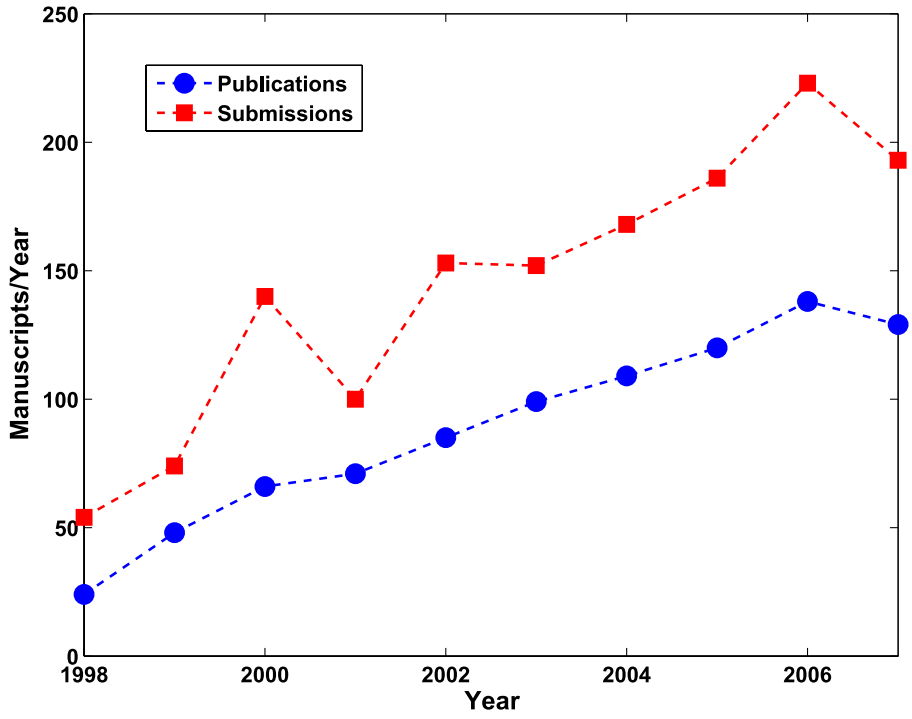

FIG. 1. PRST-AB submissions and publications.

Publication of PRST-AB was approved by the APS Council in November 1997, and I was appointed the Editor shortly afterward. A critical meeting was held at the APS Editorial Office in early 1998. It was decided to move forward on an aggressive schedule with the target of being prepared to accept the first submissions in March. This was accomplished. The first PRST-AB submission [3] was received on March 2 and published on May 12. PRST-AB has grown steadily since that first submission (Fig. 1). In 2007 193 papers were submitted, and 129 papers were published.

IV. INITIATIVES AND INNOVATIONS

PRST-AB is a small, electronic journal in a specialized field with a publisher who is interested in and encouraging of innovation. Sponsorship was one of the most profound and significant ones. As a consequence of sponsorship PRST-AB is freely available, making it one of the first open access journals and a harbinger of the developments at the forefront of scientific publication today.

It was a goal from the beginning to make PRST-AB a truly international journal. Initially this was done informally through the selection of members of the Editorial Board and by using referees from all over the world. These practices have continued to this day. A more formal arrangement was made in 2002 with the European Physical Society Accelerator Group (EPS-AG) [4] when they joined with the APS-DPB to form the Affiliated Professional Groups of PRST-AB. Together they share the responsibility for the health and vitality of the journal by providing advice and encouraging scholarly publication in accelerator science and technology. The EPS-AG has been instrumental in securing sponsorship from laboratories in Europe, and as part of this agreement either the Editor or an Associate Editor is from Europe.

There were a number of innovations related to the electronic only format. These included the following.

All electronic editorial process.—All communications with authors, referees, and editors were electronic and provided the first APS experience with an all electronic editorial process. PRST-AB is now integrated with the ''paperless'' office used for all the APS journals.

Special editions, conference editions, and special collections.—The all-electronic nature allows editions of peer reviewed articles that are associated with conferences or that are about a closely related subject. These articles are published in a regular monthly issue as well as being added to the ''special'' Table of Contents that is updated when the article is published.

''Virtual Journal'' of accelerator related articles published by the APS.—Links to beam physics articles in *Physical Review Letters* and *Physical Review E* are available on the PRST-AB Table of Contents so readers can find links to all of the accelerator related articles published by the APS in one location.

Single column PDF format.—The standard, double-column APS format is not easy to read on a computer screen, and PRST-AB articles are published in single- and double-column formats.

Movies.—Some things can best be visualized with a movie rather than a static figure, and movies can be included in articles. This has not been used by many authors to date, but looking at *Optics Express* [5] gives one an appreciation for the potential of this manner of presentation.

Readers requested other features that have been implemented.

Review articles.—Reviews of topics of particular interest to accelerator scientists and engineers are published.

Monthly Email notification.—The Table of Contents of each monthly issue is Emailed to interested parties. More recently RSS feeds have been made available for all the *Physical Review* journals.

V. PRST-AB, ACCELERATORS AND PUBLISHING

PRST-AB is a timely, widely circulated, freely available, international journal devoted to accelerator science and technology. It has become the premier scholarly, peer reviewed

journal in this field. It is part of what is needed to advance the knowledge of accelerators and to attract excellent scientists and engineers. By doing this it will have a significant impact both within this field and in the broader range of sciences that depend on accelerators.

In addition, PRST-AB had the good fortune of opportune timing combined with a publisher interested in serving the physics community and exploring new methods of publication. As a result PRST-AB was an early, successful experiment in electronic, open access scientific publication.

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[1] Abstracted from the DPB homepage http://units.aps.org/units/dpb/index.cfm.
[2] http://prst-ab.aps.org/
[3] F. Clapier *et al.*, Phys. Rev. ST Accel. Beams **1**, 013501 (1998), http://prst-ab.aps.org/abstract/PRSTAB/v1/i1/e013501.
[4] The EPS-AG homepage is http://epac.web.cern.ch/EPAC/EPS-AG/Welcome.html.
[5] *Optics Express* published by The Optical Society of America and available at http://www.opticsexpress.org.