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Editorial: 40th Anniversary of Physical Review A (July 1, 2010)

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The year 2010 marks the 40th anniversary of the founding of *Physical Review A* as an autonomous member of the APS family of journals, along with the other members B, C, and D. Today, *Physical Review A* stands as the journal of choice for papers in atomic, molecular, and optical physics. The story of the remarkable growth and impact of *Physical Review A* begins with its more humble title in 1970 as a journal for "General Physics." The duties of Editor were initially shared by C. L. Snead and R. H. Tucker. Back then, the journal's pages were filled with papers that could not be easily classified under some more specific title, such as condensed matter physics, nuclear physics, or elementary particles and fields. To the uninitiated, the field seemed to "lack focus," and with this, there was often a parallel lack of funding for the researchers.

The situation has changed dramatically since then. By chance, this year is also the 50th anniversary of the building of the first laser in 1960 by Theodore Maiman at Hughes Research Laboratory. To celebrate the occasion, the Optical Society of America, the American Physical Society, SPIE, and IEEE Photonics Society have jointly declared a *LaserFest* for 2010 (see http://www.laserfest.org). This new laboratory tool initially seemed like a solution in search of a problem. Since then, it has turned out to be one of the most important inventions of the 20th century. As pointed out by past APS President Arthur Bienenstock in an APS press release (see http://www.laserfest.org/news/092808.cfm), "Many people realized the laser was an important development when the early papers were published half a century ago, but no one could have imagined the tremendous impact it's had on our lives ever since. In celebrating the laser, we are also celebrating the value of pure research, and all the unpredictable and revolutionary advances that only basic research can produce."

The ongoing development of the power and versatility of lasers for laboratory, industrial, and commercial applications is well documented in the pages of *Physical Review A*. In fact, lasers and their many varied applications have been a major driving force for a dramatic rebirth of activity in basic atomic and molecular physics. Figure 1 shows a graph of the number of papers submitted and published each year in *Physical Review A* since its founding in 1970, and also the number of papers containing the word "laser" in the title (before 1991) or title plus abstract and key words (1991 and after), scaled up by a factor of four.

This graph and its interpretation reveal much of the history of *Physical Review A*. The sharp downward spike in January 1993 marks the end of a process begun in January 1990 to split the journal into *Physical Review A: Atomic, Molecular, and Optical Physics* and *Physical Review E: Statistical Physics, Plasmas, Fluids, and Related Interdisciplinary Topics*. As is evident from the graph, it took only 12 years for the newly reconstituted *Physical Review A* to recover the 37% reduction in its size. Benjamin Bederson as Editor played a major role in the development of the journal during this period. In fact, his appointment as Editor in 1978 closely corresponds to the upturn in the size of the journal that began at about the same time. His personal influence was responsible for attracting many papers of key importance during this period, and establishing the reputation of the journal. The importance of early work on laser spectroscopy published by a great many authors in *Physical Review A* was recognized by the awarding of Nobel Prizes to Arthur L. Schawlow and Nicolaas Bloembergen in 1981. The prize was shared that year with Kai M. Siegbahn for equally influential work on electron spectroscopy.

Bederson's term extended up to January 1992, when he was succeeded by Bernd Crasemann as Editor. Under Crasemann's very able leadership, the journal continued on its trajectory of steady, sometimes called relentless, growth. Increasing numbers of papers began to appear containing the word "high" in the title or abstract, along with "laser," such as "high-intensity," "high-harmonic," "high-precision," etc. This marked the beginning of a new era for the applications of lasers to study a wide range of new phenomena that emerge with the high intensities and short pulses that could be achieved. By this time, the use of lasers for the cooling and trapping of atoms was already under active development, leading to Nobel Prizes for Steven Chu, Claude Cohen-Tannoudji, and William D. Phillips in 1997. Many of their most important papers were published in *Physical Review A*.

The techniques for cooling and trapping led in at least three different directions. One is the production of Bose-Einstein condensates—a phenomenon that heretofore had only been possible under the high density conditions of condensed matter systems. This work led to a second set of Nobel Prizes in this area, for Eric A. Cornell, Wolfgang Ketterle, and Carl E. Wieman in 2001. As a result of the large volume of ongoing work represented by these two sets of Nobel Prizes, the sections titled "Atomic and molecular processes in external fields, including interactions with strong fields and short pulses" and "Matter waves and collective properties of cold atoms and molecules" continue to be the fastest growing sections of *Physical Review A*.

The second direction involves dramatic advances in the accuracy that can be achieved in high precision measurements, especially when the techniques of cooling and trapping are combined with the frequency comb developed by John L. Hall and Theodor W. Hänsch, leading to a third set of Nobel Prizes in 2005, including also Roy J. Glauber for developing the quantum theory of optical coherence. This work is particularly important in making possible improved measurements of the fundamental constants and comparisons with high precision theory. In fact, these comparisons provide the motivation for considerable activity among theorists to improve the accuracy of basic atomic theory and apply it to fundamental tests of quantum electrodynamics, the electroweak interaction, and the standard model. The grand challenges for the future are the detection of gravity waves and precision measurements of the properties of antimatter as tests of *CPT* symmetry.

The third direction involves new possibilities for the realization of a quantum computer, and other associated work on the technology of quantum information and encryption. The practical realization of a quantum computer may still be far off, but a

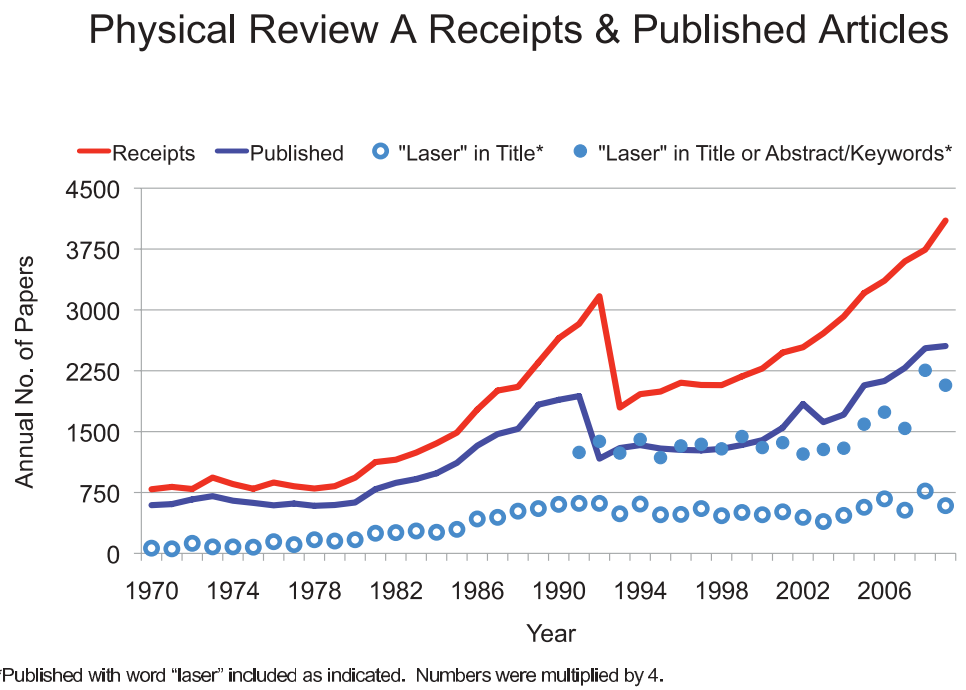

FIG. 1. (Color online) Graph showing the growth of the numbers of papers submitted (upper curve) and published (lower curve) per year by *Physical Review A* from 1970 to the present. Also shown are the numbers of papers containing the word "laser" in the title (open circles) or in the title plus abstract and key words (solid circles), scaled up by a factor of four.

great deal of fascinating new physics has already appeared in the pages of *Physical Review A*, making the section titled "Quantum information" one of the largest and fastest growing over the past several years.

Even without quantum computers, the advent of the microchip in the 1970s and its continuing exponential growth in both speed and storage capacity (according to Moore's Law) have vastly expanded the scope of what can be achieved on the theoretical side. Sophisticated simulations and high precision solutions to the many-body problem can now be carried out on laptop computers. The pages of *Physical Review A* are filled with a wide variety of applications to all areas of atomic and molecular physics, and quantum chemistry. In fact, the most cited paper in *Physical Review A* by a wide margin is a paper on density functional theory by A. D. Becke, Phys. Rev. A **38**, 3098 (1988), dealing with the asymptotic form of the exchange-correlation potential. Large numbers of other papers on the fundamental properties and applications of density functional theory continue to be published in *Physical Review A*.

There are of course other important areas of the atomic, molecular, and optical physics community that are not so directly influenced by lasers, such as the study of atomic and molecular collisions. This also has undergone dramatic changes over the past 40 years in both what can be measured, such as detailed angular correlations and so-called "complete" scattering experiments, and what can be calculated, thanks again to the advances in computing power. Traditional time-independent methods have been augmented by very detailed time-dependent simulations of collision events. Such studies have helped to resolve long-standing questions, even for such basic processes as the impact ionization of atomic hydrogen. Our interpretations of astrophysical observations, and industrial applications such as plasma diagnostics and controlled thermonuclear fusion devices of all types, rest on the foundations provided by a vast wealth of basic atomic and molecular data on collision cross sections and radiative processes.

My own term as Editor began in March 2006. Since then, a further significant change has occurred to the subject matter covered by *Physical Review A*. As of January 1, 2007, the section for papers on classical optics was transferred from *Physical Review E* to *Physical Review A* (see the Editorial of January 2, 2007), thereby unifying the classical and quantum parts of optics in a single journal. The change represented approximately 10% of both journals. The intent of the move was to build a single journal that would better serve all three components of the atomic, molecular, and optical physics community. This change may account for some of the fine structure visible at the right-hand end of the curves in Fig. 1.

A long-term trend that is evident in Fig. 1 is the increasingly large fraction of papers that is rejected. The rejection rate currently stands at around 35%. The rising rejection rate represents at least in part an attempt to control the rate of growth of the journal. However, there are other advantages to be gained if a larger fraction of papers is rejected on the basis of an editorial decision without external review. The advantages are (1) the load on our referees is reduced, and (2) authors receive an immediate notification that their paper is unlikely to receive a positive review, and so they can promptly submit the paper elsewhere. This policy is further discussed in the Editorial of September 12, 2007, together with suitable appeal procedures. The fraction of papers

rejected in this way has been slowly increasing and now stands at about 18%. A recent survey (see the Editorial of December 1, 2009) showed that there is strong support from the readers, authors, and referees of *Physical Review A* for this policy.

In summary, this 40th anniversary provides an opportunity to look back at past accomplishments with pride and to make projections for the future. At the time of writing, the journal continues to grow at the rate of about 5% per year, and there is no sign that this will change any time soon. The field of atomic, molecular, and optical physics continues to expand, as measured by the size of the annual meeting of the Division of Atomic, Molecular, and Optical Physics (DAMOP) of the American Physical Society, the Division of Laser Science, and the Division of Chemical Physics. The proportion of papers that originate from outside of North America has leveled off at around 80%, so the growth is a worldwide phenomenon, with a very important international component.

The success of the journal has been made possible by the dedicated work of the Editors, Associate Editors, and journal staff over many years. Their contributions are much appreciated. I have personally benefited greatly from the very able advice and support of our Managing Editor, Margaret Malloy.

A special debt of gratitude is owed to our referees and members of the Editorial Board. Their entirely voluntary work not only maintains the scientific standards of the journal, but also their referee reports provide authors with the opportunity to improve the quality of their papers and ensure that the work of others is appropriately cited. In an age of rapid electronic publication, it is the work of the referees that differentiates scientific journals from e-print archives.

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