DIVISION OF ATOMIC, MOLECULAR AND OPTICAL PHYSICS NEWSLETTER

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INSIDE...

1998 AMO DOCTORAL THESIS AWARD WINNER ANNOUNCED!

The 1998 award for Outstanding Doctoral Thesis Research in Atomic, Molecular and Optical Physics was awarded to Chris Wood who will receive a check for $1000 and a certificate from the American Physical Society. Dr. Wood is presently at the National Institute of Standards and Technology in Boulder. His thesis was entitled **"Improved Measurement of Parity Non-Conservation in Atomic Cesium and First Measurement of the Nuclear Anapole Moment."**

This work was undertaken at the Joint Institute for Laboratory Astrophysics under the direction of Carl Wieman. The prizewinner was selected following a special invited session at the Santa Fe meeting. All of the finalists presented excellent talks to a large, receptive audience. This session is now one of the highlights of the DAMOP meeting. We are grateful to this year's selection committee consisting of Carol Tanner (Chair), Wendell Hill, Mike Morrison, Hossein Sadeghpour and

William van Wijngaarden

UNDERGRADUATE RESEARCH PRESENTATIONS

The fourth annual competition to select the best research being performed in AMO Physics by undergraduates was held prior to the Santa Fe meeting. Candidates were asked to submit an abstract of their work and a brief description of their involvement and contribution to the research project. Five winners were selected to present talks at the Santa Fe meeting. The talks covered a wide variety of topics.

Dan Chitwood (University of Missouri-Rolla) discussed quantum mechanical interference effects that can occur in atomic ionization when the ionized electron energy coincides with the energy of an autoionizing state of the atom. David Griggs (Georgia Southern University) talked about the dynamical behavior of cold-atom Bose-Einstein condensates driven by an oscillating magnetic trap. Brooks Hitt (University of Nebraska) presented a novel method for creating polarized electrons through collisions with optically pumped rubidium. Robert Komara (Youngstown State University) discussed ion-core parameters for argon that have been determined by analyzing thirteen transitions between high- Rydberg states. Finally, Chris Maloney (University of Missouri-Rolla) presented theoretical calculations for electrons colliding with argon atoms that have been laser excited to a metastable state.

We are grateful to Don Madison who organized the competition and to the selection committee: Klaus Bartschat, Jim McGuire, Michael Schulz and Charles Su.

DAMOP ELECTION RESULTS!

We congratulate the 1998 DAMOP election winners:

Vice-Chair:
Daniel Larson

Executive Committee:
Randy Hulet
Carol Tanner

The nominating committee consisted of Keith MacAdam (Chair), Gordon Berry, Paul Julienne, Ron Phaneuf and Janine Shertzer.

Message From the Chair

Carl Wieman

My My term as chair began with the DAMOP meeting in Santa Fe, which was an excellent way to start. The meeting was a marvelous success, and we all owe thanks to Jim Cohen and the rest of the local organizing committee. Although I am not sure that we can give them credit for the nice weather, all of the other outstanding arrangements were their doing, including providing what must be considered the "Rolls Royce" of conference bags! Of course, the diligence and hard work of our Past Chair, Kate Kirby, was also important, as it has been in ensuring the smooth operation of all aspects of DAMOP for the past year.

During this meeting it was striking how exciting and dynamic AMO physics is at present. A very large part of the meeting was devoted to

areas that were almost nonexistent just a few years ago. For example, newer technologies such as ultrashort intense laser pulses and laser cooling and trapping have opened up new regimes of atomic and molecular physics that are being eagerly explored. The large number of well attended sessions devoted to these and other new areas was indicative of the rapid growth and evolution of the field. Along with the growth in subfields is a corresponding growth in people. The annual meeting continues to regularly set records both for overall attendance, and the number of students attending.

There are some drawbacks to this growth, of course. The meetings are becoming longer and less intimate, and it becomes increasingly difficult to find ideal facilities. The demands on the meeting organizers are also growing. However, I hope that the community will recognize that this is the price of success, and we should do our best to adapt gracefully to the growth.

Another mixed-blessing to growth is the addition of hungry new mouths to feed (with money for research). This is one of several evolving aspects of funding that all of us need to recognize. Most of these were conveyed in excellent discussions at Santa Fe by Pat Dehmer of DOE and Denise Caldwell and Barry Schneider of the NSF on the funding situations in their respective agencies. Pat generously agreed to write an article for this newsletter based on her remarks. As discussed there, these two agencies and the work funded by them are different in many respects. However, I was struck by an important similarity in what we heard about both NSF and DOE. It is unlikely that there will be a major increase in the base programs for AMO physics at either agency (although AMO has done rather well at NSF in the past few years). Essentially all of the new money that will be available is going to be in new initiatives or programs. This is almost the only source of additional money to fill all those hungry young (and possibly old) mouths. The implication is clear. To achieve long-term success, our growing AMO community will have to be entrepreneurial in looking beyond the base programs at these, and other, funding agencies. We must search out the new initiatives and find how AMO science can play a part in them, particularly in the early stages while the specifics of the initiatives are still being formulated.

SPECIAL APPRECIATION

DAMOP owes special thanks to our outgoing chair Kate Kirby who has served us with dedication and provided very effective leadership during the past year. Thanks Kate!

Thanks also to Nora Berrah and Steve Manson who have just completed three year terms on the DAMOP Executive Committee.

Special thanks are also due to the organizers of the Santa Fe meeting whose hard work and attention to detail resulted in a most successful conference. The Local Organizing Committee included James Cohen (Chair), Roger Bartlett, Howard Bryant, David Cartwright, Lee Collins, Ivan Deutsch, Jean-Claude Diels, Christopher Fontes, A. Gavrielides, Richard Hughes, George Kyrala, Kenneth LaGuttata, Richard Martin, Peter Milonni, Gottfried Schappert, Arlee Smith, Antoinette Taylor, Dale Tupa and David Vieira.

DAMOP MEMBERSHIP

The official APS membership statistics show that as of January 1, 1998 DAMOP had 2702 members, 6.63% of total APS membership. This figure is slightly up from the previous year and maintains two representatives from the division on the APS council (APS bylaws grant division, forums and topical groups one representative for each 3% of total APS membership).

DAMOP MEETINGS

Santa Fe 1998

The meeting was an outstanding success, with exciting new physics complemented by perfect weather and excellent food and drink. A total of 800 scientists registered, including 239 students, both new records for DAMOP. The names and coordinates of the registrants are available on the web at http://t4.lanl.gov/DAMOP/ registrants.cfm. There were a total of 674 papers submitted, including 67 invited talks, 230 contributed talks and 377 posters. Two outreaches extended the scope of the usual meeting. An NSF/DOE-sponsored Conference Experience for Undergraduates, which lasted two weeks and encompassed the DAMOP meeting, mentored 17 students. On Saturday morning about 850 attended the multimedia presentations of Nobel Laureates Bill Phillips and Steve Chu, including an estimated 225 local high-school students and guests.

Atlanta 1999: APS Centennial Meeting

DAMOP will meet in conjunction with the special APS Centennial Meeting to be held in Atlanta from Saturday March 20 to Friday March 26 in the Atlanta Convention Center and the Westin Hotel. The DAMOP program will run March 22-25. Paul Neill is the DAMOP liaison person for this meeting.

2000 and Beyond

The DAMOP Executive Committee in Santa Fe voted to accept a bid from the University of Connecticut to hold the DAMOP 2000 meeting in Storrs, CT from Wednesday, June 14 to Saturday, June 17. The joint DAMOP/DAMP 2001 meeting will be held in London, Ontario from Wednesday May 15 to Saturday May 19.

AMOP AT NSF GOES FASTLANE

The experimental Atomic, Molecular, Optical, and Plasma Physics Program (AMOP) at the National Science Foundation is converting fully to the use of FASTLANE for proposal submission. This implies that the program expects ALL proposals submitted by the September 16, 1998, target date to be submitted via FASTLANE. Information about FASTLANE can be found on the NSF web page at **http://www.nsf.gov**.

NOMINATIONS FOR DAMOP OFFICES

The DAMOP Nominating Committee welcomes suggestions of candidates for Vice-Chair, Secretary/ Treasurer, APS Divisional Councilor and for Executive Committee Membership. Please contact the Chair (Tom Gallagher) or other members of the committee with your suggestions of candidates who are willing to serve, along with a brief supporting statement. Because the DAMOP meetning next year

will be held in March, the slate must be finalized in October. The list of committee members is included later in this Newsletter.

NOMINATIONS FOR APS FELLOWSHIP

The The deadline for nominations for APS Fellowship is February 15, 1999. Information and nomination forms can be found on the APS website.

CALL FOR PAPERS - SPECIAL SESSION ON UNDERGRADUATE RESEARCH AT THE APS CENTENNIAL MEETING

Don Madison

There will be a special session featuring research performed by undergraduate students at the 1999 DAMOP meeting which is being held in conjunction with the APS Centennial Meeting in Atlanta, Georgia 20-26 March 1999. The papers will be 20 minutes long including discussion. Interested students should submit an electronic abstract for their talk in standard APS format and a one page summary of their contribution to the project by November 20, 1998. From the submitted materials, a committee will select four students to be invited to give talks in the special session. Participation is limited to currently enrolled undergraduate students. The participation of women and minority undergraduate students is especially encouraged.

PLEASE NOTE EARLY ABSTRACT DEADLINE. The deadline for regular abstracts for the DAMOP meeting is December 4. The deadline for abstracts for the undergraduate session is **November 20**. Abstracts should be sent to Don Madison at madison@umr.edu

DAMOP COMMITTEES FOR 1998-99

We are grateful to these **members** for their willingness to serve and for their efforts on our behalf. Committee members will be happy to receive input or provide information.

Physical Review and Physical Review Letters

announce the appointment or reappointment of the following as members of their Editorial Boards:

- **Physical Review A**
  Keith Burnett (University of Oxford)
  Howard Carmichael (University of Oregon)
  Gordon W. F. Drake (University of Windsor)
  M. Yu. Ivanov (National Research Council of Canada)
  Eugen Merzbacher (University of North Carolina)
  Robert F. O'Connell (Louisiana State University)
  Jean-Michel Raimond (Laboratoire Kastler Brossel)
  Janine Shertzer (College of the Holy Cross)
- **Physical Review E**
  Martin C. Gutzwiller (IBM T. J. Watson Research Center)
- **Physical Review Letters**
  Ennio Arimondo (Universita di Pisa)
  Alexander Fetter (Stanford University)

NIST PRECISION MEASUREMENT GRANTS

Applications are being solicited for two new Precision Measurement

Grants, sponsored by the National Institute of Standards and Technology, to be awarded beginning 1 October 1999 (Fiscal Year 2000). Each grant is in the amount of $50,000 per year, renewable for up to two additional years, for a total of $150,000. NIST sponsors these grants to encourage research by U. S. university and college faculty members in the field of precision measurement and fundamental constants and to foster contacts between NIST scientists and faculty members actively engaged in such work. Candidates' pre-proposal summaries and biographical information must reach NIST by 1 February 1999 to be considered for the FY 2000 awards. For more information, contact Barry N. Taylor, Chairman, NIST Precision Measurement Grants Committee, National Institute of Standards and Technology, Building 225, Room B161, Gaithersburg, MD 20899-0001, (301) 975-4220, barry.taylor@nist.gov.

RELATED FUTURE MEETINGS

- The **XXI International Conference on the Physics of Electronic and Atomic Collisions** will be held in Sendai, Japan, July 21-27, 1999. For further information contact Michio Matsuzawa, Department of Applied Physics and Chemistry, University of Electro-Communications, Chofu-shi, Tokyo 182, Japan. e-mail: michio@ pc.uec.ac.jp or visit the conference homepage at http://power1.pc.uec. ac.jp/Sendai.
- The **International Conference on Atomic Collisions in Solids** will be held in Odense, Denmark, August 3-8, 1999. For further information contact the conference secretary at ICACS, Physics Department, Odense University, DK-5230, Odense M, Denmark. e- mail: icacs@fysik.ou.dk.
- The **Fifteenth International Conference on the Application of Accelerators in Research and Industry** will be held November 5-7, 1998 at the University of North Texas, Denton, TX. The purpose of the conference is to review research and the wealth of industrial applications that are in progress with accelerators throughout the world. For further information contact Dr. Jerome L. Duggan (Co-Chairman) or Barbie Stippec (Administrative Assistant), University of North Texas, Department of Physics, P. O. Box 305370, Denton, TX 76203-5730; Phone: (940) 565-3252, Fax (940) 565-2227, e-mail: stippec@unt. edu.

The Role of Atomic, Molecular and Optical Physics in the Basic Energy Sciences Program

Pat Dehmer

(This report is based on a talk at the 1998 DAMOP meeting given by Patricia M. Dehmer, Associate Director for Energy Research for Basic Energy Sciences, U. S. Department of Energy.)

The 1994 National Research Council report on the Future of Atomic, Molecular, and Optical Sciences (colloquially known as the FAMOS Report) describes AMO science as "a basic and enabling science." Those familiar with the field would readily agree. Yet that alone is neither a necessary nor a sufficient justification for the support of AMO science by a mission agency of the federal government.

Why, then, is AMO science supported by Basic Energy Sciences

(BES)? What has been its past justification? What do we see as its current and future justifications? How does this impact the AMO science community? What should you do? What should BES do?

In order to understand the answers to these questions, it is first necessary to understand the BES Program and its philosophy and a little bit about DOE as well. With an FY 1998 appropriation of approximately $668 million and an FY 1999 Congressional Request of $836 million, the BES Program within the DOE's Office of Energy Research (ER) is one of the Nation's primary sponsors of fundamental research in materials sciences, chemical sciences, geosciences, plant and microbial sciences, and engineering sciences. The program funds more than 2,400 researchers at 200 institutions nationwide and supports 17 major national user facilities. Included among these facilities are the Nation's four major synchrotron radiation light sources, four neutron sources, and a number of specialized facilities for electron- beam microcharacterization, materials synthesis and processing, combustion research, pulsed radiolysis, and ion beam studies. Over 4,500 users, including hundreds of industrial scientists from about 100 U. S. companies, are accommodated at the major BES scientific user facilities each year. [Detailed descriptions of the BES programs and the facilities as well as links to other related sites can be found on the BES homepage at **http://www.er.doe.gov/production/bes/**.]

The BES program is thus prototypical of a large, diverse, and robust fundamental research program that exists within a mission agency. Because of its size, it is perhaps the quintessential example of such a program. Part of its value derives from this special role, which is neither that of pure curiosity-driven research programs supported, for example, by the National Science Foundation nor that of applied research and development programs supported by industry. Rather, the BES program supports fundamental research with a long-term objective.

The characteristics of individual basic research projects supported by BES are often indistinguishable from those of projects supported by the NSF. For both organizations, achieving scientific quality is the primary goal, and merit review based on peer evaluation is the predominant vehicle for assessing excellence. However, to understand the differences between the two science programs, one needs to compare the groupings of research projects within the broad scientific disciplines. A large part of BES' value is derived from the explicit goal to integrate the basic research supported by BES with applied research and development activities supported by other parts of DOE or by industry. As a result, BES supports fundamental research in a large number of areas that are expected to impact energy. For many of these areas, the link to energy-related activities is obvious. For AMO science, the link is less obvious; for this discipline to thrive in BES, it is necessary for us all to understand the reasons that it is supported here.

A Basic and Enabling Science

The FAMOS report describes AMO science as "simultaneously a basic and enabling science that answers questions about the behavior of matter and energy in atomic and molecular systems that we can precisely probe, control, and manipulate. It focuses on the common building blocks of the world around us, that is, atoms, molecules, and light, and on phenomena that occur in the ranges of temperatures and

energy that are characteristic of daily human activities."

While correct, this is perhaps not as precise or rigorous as is necessary to justify a program of fundamental research within a mission agency. In particular, "Enabling" is not unique to AMO science. Much of the fundamental science supported by BES can be characterized as enabling.

"Enabling" suggests a linear model of research and development in which fundamental research enables applied research, which in turn spurs technology development. Few science policy experts or practicing scientists believe that the linear model accurately describes modern research, which is often multi-disciplinary in nature and has both fundamental and applied drivers.

Finally, at its worst, the word "enabling" can have pejorative connotations if it is assumed that the burden for "enablement" falls to others, i.e., others must to seek out and use the discoveries of AMO science.

Enablement as a Goal

One of the tenets of the BES program is that it strives for excellence in basic research. Our definition of "excellent" basic research is work that produces new knowledge and ideas that endure, that change the way people think, and that are widely used by others. We would like the hallmark of the BES program to be that research supported by the program is widely used by other scientific disciplines, by the DOE technology offices, and by industry. For this to happen, scientists must interact with their counterparts in other disciplines and sectors. It suggests then that "enabling" is active rather than passive, and that scientists who do the fundamental research seek out partnerships.

Many in our own community have supported and championed this philosophy. For example, in 1996, Richard Freeman, then Chair of the DAMOP, sent every DAMOP member a copy of the FAMOS report and urged them to use the report in their home institution to further the awareness of AMO science, especially its close connection between pure and applied science.

As a second example, in September of 1997, BES held an AMO workshop in lieu of our normal contractors' meeting. The theme of the workshop was "directions and connections." Lloyd Armstrong chaired the workshop, and we invited a very large number of people who were not contractors - perhaps 50% of the workshop were such invitees. We looked to scientific directions, and to connections with other scientific disciplines and with applications. Some of the breakout groups were mainstream in the contractors' group; some were on topics that overlapped with other BES- supported work. They were:

- Interactions of Atoms and Molecules with Photons - Low Field
- Interactions of Atoms and Molecules with Photons - High Field
- Surface Interactions with Photons, Electrons, Ions, Atoms, and Molecules
- Theory of Structure and Dynamics
- Nano- and Mesoscopic Structures

In summarizing the workshop, Lloyd ended his remarks by talking about the connections part of the charge:

"I heard from the panels on surfaces and nanothings calls for help in transferring some existing AMO technologies to those fields, and descriptions of problems for which there seems to be no technological solution available at present. I heard statements of theoretical problems where one might reasonably expect that AMO theorists could bring useful insight. I heard of complementary techniques being developed in other fields, primarily in light production, with minimal input from our own most creative experts in the area.

These statements were clear expressions of need from other communities for the enabling function that AMO can provide. This enabling function is one of tech transfer, and there the most effective form of tech transfer is the exchange of real not virtual scientists. I believe that the AMO community could greatly strengthen its critically important enabling function by a greater emphasis on collaborative efforts. Such efforts would almost certainly result in two-way transmission of insights and understanding, and this would serve to further stimulate and advance AMO science at the same time as we are providing stimulation and help to another field."

Developing a Vision of AMO Science within BES

In developing a vision for AMO science within BES, we must be faithful to the BES mission and philosophy; we must consider input from a variety of sources such as the AMO workshop just described; and we must remain cognizant of the recommendations from the broad scientific community for AMO science as put forth in the FAMOS report.

Finally, the "What and Why" of AMO Science within BES. Considering the above, we believe that the AMO science portfolio should contain work in the following areas:

1. Interactions of photons, electrons, and heavy particles (including ions) with matter

In service to its mission and to the broader national research community, BES annually invests nearly 40% of its budget in the operation of synchrotron radiation light sources, neutron sources, and electron beam microcharacterization centers. Historically, it has been the AMO community that has driven (1) advances in the fundamental understanding of the interactions of these primary particles with matter, (2) advances in instrumentation, (3) revolutionary new discoveries. Witness the Nobel prizes listed in the FAMOS report.

Many things are grouped in this category, for example:

- Fundamental understanding of the interactions. Recently, the interaction of optical EM fields with matter in the non-perturbative (high field) regime is emerging as important.
- Probing matter
- Production of novel states of matter by such interactions - BEC, extremes of temperature and pressure
- Controlling matter - atomic and molecular trapping and cooling,

atom lasers, coherent control of atoms and molecules with light fields.

2. Novel materials

There are ways in which AMO science can contribute to the most fundamental understanding of novel, nanostructured materials, some of which display and/or rely on quantum mechanical effects for their uniqueness. Examples include quantum dots, artificial atoms, etc. Some of this type of work is already supported (clusters in Chemical Physics and Materials, nanostructures in Materials, etc.), but we don't have anyone approaching these things from the AMO perspective. This may be an area where AMO theory can have some impact.

3. Heavy and highly charged ion collisions/Plasma science

Here we have a stewardship responsibility to provide data and understanding for high temperature fusion plasmas, and there is an extension of historical charter to include low temperature plasmas for industrial processing.

Next Steps for PIs

- Remember our AMO program is only $9-10M
- Discover BES interests both within and outside of AMO
- Talk to program managers
- Submit pre-proposals
- Surf the web
- Be cognizant of special opportunities such as: PNGV (Program for Next Generation Vehicles); ETP (Environmental Technology Program); PAIR (Program for Academic-Industrial Relations); Complex & Collective Phenomena; CCTI (Climate Change Technology Initiative); SSI (Strategic Simulation Initiative)

Next Steps for BES

BES will continue to hold AMO contractors' meetings with a connections/directions theme. BES will invite representatives from the AMO community to other related contractors' meetings and workshops of all kinds.

Newsletter Input

If you have any information, ideas, announcements, etc. that are of general interest to DAMOP members, please send them to me at any time.

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