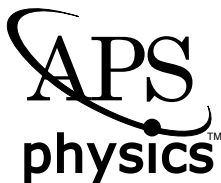


Edited by David Pine



A Division of the American Physical Society

DCMP Newsletter

The Division of Condensed Matter Physics Summer 2009

IMPORTANT DEADLINES & DATES

- DCMP Invited Symposia Nominations | Friday, September 4, 2009
- Vote: DCMP Officers & Executive Committee | September 15, 2009
- Portland Contributed Abstracts | Friday, November 20, 2009
- Contributed Abstracts, Post Deadline | Thursday, December 31, 2009
- APS Fellow Nominations | Friday, January 29, 2010
- Portland APS Meeting | March 15-19, 2010

A Note From the DCMP Chair

A great deal has changed over the past year. Our nation and the world continue to experience the impact of a worldwide economic crisis and a new administration has taken over in Washington DC. Both events have refocused attention on funding for science and technology as the nation struggles to meet both short and long-term needs in critical areas. Congress passed an economic stimulus package that has injected new money into federally funded research programs.

Harriet Kung, the Associate Director of the Office of Science at the Office of Basic Energy Sciences in the Department of Energy (DOE) has contributed a piece to this year's Newsletter summarizing new and promised funding for energy-related research coming from the DOE. More than a simple update of the piece she contributed last year concerning DOE's vision of the role of fundamental research in energy issues, she reports on the how the DOE is allocating funds provided by Congress to address basic research needs identified by the Basic Energy Sciences Advisory Committee. Harold Weinstock, Program Manager for research on superconductivity for the Air Force Office of Scientific Research (AFOSR), has contributed a piece summarizing the Air Force's efforts, past, present, and future to develop high-temperature superconductors. The AFOSR has committed over \$5M *per year* over the next several years in a program

to develop more "user-friendly" superconductors.

The injection of new funds from the Federal Government into the research effort highlights past and ongoing efforts of the APS and its membership to educate the public, Congress, and the Executive Branch about the importance of steady long-term investments in science. Each year for most of the past decade, the DCMP has worked with the APS Office of Public Affairs to communicate with Congress about funding for science by organizing a letter-writing campaign at the March Meeting. DCMP has also worked with the APS Office of Public Affairs to organize trips by APS members to Capitol Hill, usually in February, for face-to-face meetings with Congressional staffers, primarily from the home states and districts of the participating APS members. If you haven't already, I encourage you to become involved in one or more of these important activities. I would also like to take this opportunity to express our collective debt of gratitude to those who have worked to inform the Government about the importance of supporting physics research, and especially to Michael Lubell, who has served as the APS Director of Public Affairs (and who is also a member of the Physics Department at CCNY).

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The 2010 March Meeting

The March Meeting will be held in Portland, Oregon, March 15-19, 2010. This year DCMP will organize 35 of the 108 Invited Sessions. There will be more than 40 parallel sessions and the complete bulletin will be available only in electronic form. This is the first time the March Meeting has been held in Portland. Situated just west of Mount Hood at the confluence of the Willamette and Columbia Rivers, Portland is home to the Oregon Museum of Science and Industry as well as the largest number of breweries of any city in America, which will no doubt stimulate and perhaps even improve our scientific discussions.

Invited Symposia Nominations

The deadline for Invited Symposia nominations is Friday, September 4, 2009. In order to submit a nomination of an Invited Symposium for the March Meeting go to: <http://www.aps.org/meetings/invitation/dcmp.cfm>. The site opens on August 3, 2009.

NEW POLICY: When an Invited Symposium is formally submitted, e-mails will go out to all the proposed speakers and to the proposed session chair to verify that they are (a) aware that they are being nominated and (b) that we have their correct e-mail addresses. The proposed speakers and session chairs will have 2 weeks to respond. If they do not, that speaker either will be dropped from the symposium or will be replaced by a backup speaker. Appropriate notifications will be sent to those who propose a session if their speakers and chairs do not respond in a timely fashion. This new procedure is intended to streamline the notification of invited speakers and session chairs by ensuring the DCMP Executive Committee has correct up-to-date e-mail addresses. Our hope is that it will also promote serious high-quality proposals by making sure that all parties proposed for a symposium are interested and available.

Please note that the Executive Committee as a whole selects invited talks only from those proposed by the community. It cannot substitute speakers of its own choosing. This procedure is unique among APS units. You are encouraged to submit joint nominations for invited sessions with other APS units when submitting to DCMP. In putting together proposals for invited symposia, please consider minority and female candidates, who historically have been underrepresented among invited speakers at the March Meeting.

Suggestions for Creating a Successful Proposal

1. **Propose a symposium on a timely topic with five strong talks.** Generally the Executive Committee favors symposia (preferably with five talks, rather than fewer) over individual invited talks. There are very few of the latter.
2. **Choose an appropriate title and provide a clear justification.** This will aid the committee in making its decision.
3. **Choose titles of individual talks carefully.**
4. **Provide an informative abstract for each talk.** This will underpin the central theme of the symposium and aid the committee in reaching a decision. Speakers who are invited will be asked to submit their own abstracts later.
5. **Provide references to published work in refereed journals.** This will aid the committee in determining whether the work is current and whether it has some level of acceptance by the scientific community.
6. **Include an alternate speaker** in the abstract to provide a substitute in the event the first choice is unavailable. Please **ask individuals who you plan to propose as speakers if they plan to participate** in the meeting.
7. **Enter the proposed symposium under a relevant sorting category** (given at side). This will ensure that the correct subcommittee examines the proposal. **Multiple submissions of a proposal are counterproductive and ineffective.**

The deadline for the receipt of abstracts of contributed papers is Friday, November 20, 2009, 5:00 PM EST. Submission instructions can be found at www.aps.org/meetings/march/categories.cfm.

List of Invited Symposia Sorting Categories

1. Metals
2. Semiconductors
3. Insulators and Dielectrics
4. Polymeric and Organic Materials
5. Superconductors
6. Magnetism
7. Complex Structured Materials
8. Fluids and Soft Matter
9. Phase Transitions and Strongly Correlated Systems
10. Biological Physics
11. Chemical Physics
12. Statistics and Nonlinear Physics
13. Artificially Structured Materials
14. Surfaces, Interfaces & Thin Films
15. Instrumentation and Measurements
16. Applications
17. General Theory (Methods)
18. General
19. High Pressure Physics
20. Quantum Fluids and Solids
21. Atomic, Molecular & Optical (AMO)
22. Physics Education
23. Quantum Information, Concepts and Computation
25. Energy Research & Applications

Investing in Science to Achieve Transformational Discoveries

By Harriet Kung, Associate Director of the Office of Science for the Office of Basic Energy Sciences

The Office of Basic Energy Sciences (BES) program within the Department of Energy's Office of Science will shoulder important responsibilities as the Administration has renewed the emphasis on transformational discoveries and innovative technologies to power the economy through clean and reliable energy sources. President Obama has committed to double the Federal investment in basic research over ten years and the Department of Energy has supported this commitment by investing in research that will transform our understanding of energy and matter and advance the national, economic, and energy security of the United States. The condensed matter physics research community will continue to play a pivotal role in addressing these challenges.

In 2001, BES initiated its series of "Basic Research Needs" workshops aimed at establishing a long-term basic research strategy for a secure and clean energy future. The eleven workshops engaged thousands of scientists from around the world to study the status, limiting factors, and specific fundamental scientific roadblocks limiting the widespread implementation of advanced energy technologies. Since the goals and objectives of this process were last reported in the DCMF Summer 2008 Newsletter, the workshop reports were studied by the Basic Energy Sciences Advisory Committee (BESAC) to assimilate the scientific research directions into a comprehensive set of science themes and to identify the new implementation strategies and tools required to accomplish the scientific challenges identified. This effort was completed by BESAC in their report *New Science for a Secure and Sustainable Energy Future* (December 2008). The complete report series is available at <http://www.sc.doe.gov/bes/reports/list.html>.

Funding to support the transformational research identified in the series of Basic Research Needs Workshop reports significantly increased in 2009 as a result of the Omnibus Appropriations Act of 2009. The Fiscal Year (FY) 2009 appropriation for the BES program is \$1,572 million, an increase of \$319.2 million over FY 2008. This permitted significant growth of the BES research program in selected areas. Thirty new, multi-investigator Energy Frontier Research Center awards were funded at \$2–5 million per year each for five years (\$100 million annually; for details, see <http://www.sc.doe.gov/bes/EFRC.html>). The appropriation included \$55 million for single investigator and small-group research awards within the BES core research program. Together, these new awards will help advance the BES strategic vision for grand challenge science and for use-inspired energy science in combustion, catalysis, hydrogen and fuel cells, superconductivity, solid state lighting, solar energy utilization, electrical energy storage, materials under extreme environments, advanced nuclear energy systems, and geosciences

for carbon sequestration. The FY 2009 appropriation also provided \$17 million for EPSCoR, \$10 million for facility-related research, full funding for the scientific user facilities (\$719 million), and full funding for BES construction and instrumentation activities (\$145.5 million).

The American Recovery and Reinvestment Act of 2009 (Recovery Act) provided BES with an additional one-time appropriation of \$555.4 million. These funds are being used to support seven key BES scientific investments in research, early career fellowships, scientific user facilities, instrumentation and construction that will create jobs today and enable discoveries and breakthroughs that will spur U.S. innovation and economic growth in the years ahead.

In a major effort to accelerate the scientific breakthroughs needed to build a new 21st-century energy economy, BES has invested \$277 million of Recovery Act funding to support an additional sixteen Energy Frontier Research Centers for five years. Altogether, the 46 Energy Frontier Research Centers will assemble the skills and talents of a critical mass of investigators to enable energy relevant, basic research of a scope and complexity that would not be possible with the standard single-investigator or small-group award. In a complementary activity, \$31.1 million of BES Recovery Act funding is being used for newly announced Early Career Fellowships under an Office of Science-wide solicitation announced on July 2, 2009. For details, see <http://www.sc.doe.gov/grants/FAPN09-26.html> and http://www.sc.doe.gov/grants/LAB09_26.html.

Recovery Act funds are also being used for the one-time augmentation of operations and equipment at BES major scientific user facilities that are used annually by over 10,000 researchers. BES user facilities supported by Recovery Act funding include the five Nanoscale Science Research Centers (\$25 million) and the four synchrotron radiation light sources (\$24 million), which will obtain capital equipment to optimize existing and procure novel equipment in order to ensure the availability of state-of-the-art facilities for users and staff. The Linac Coherent Light Source, currently under construction at the SLAC National Accelerator Laboratory will receive \$33.6 million to complete funding of a critical instrumentation project and will make the capabilities of the world's first x-ray free electron laser available earlier than previously planned and enable scientists for the first time to observe chemical reactions at the molecular level in real time. In addition, \$14.7 million will be used to complete the User Support Building at the Advanced Light Source at Lawrence Berkeley National Laboratory in order to enhance the ability of scientists to effectively utilize the facility in achieving important discoveries in a wide variety of scientific disciplines.

The construction of the Brookhaven National Laboratory's National Synchrotron Light Source-II (NSLS-II) will provide one of the key new scientific facilities for maintaining the U.S. leadership in energy-related science, and it received

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Search for More Practical, User-Friendly Superconductors

Harold Weinstock, AFOSR Program Manager for Superconductivity

The Air Force Office of Scientific Research (AFOSR) is the basic research funding arm of the Air Force Research Laboratory (AFRL). AFOSR has a long history of supporting basic research in superconductivity, going back to 1960 when Bernd Matthias and John Hulm convinced my predecessor, Max Swerdlow, that support of superconductivity was in the best interests of the Air Force and of the country. In almost 50 years that support has been maintained and been responsible for many notable achievements. Not the least of these achievements has been the training of grad students and post docs who have picked up the torch once held by Matthias and Hulm. One of those students was Paul Chu. Swerdlow also provided support to Phil Anderson to facilitate his acceptance of a visiting faculty position at the University of Cambridge, where he was able to help mentor Brian Josephson. Later, it was AFOSR support to John Gavaler at the Westinghouse R&D Center in Pittsburgh that enabled him in 1973 to find a (then) record $T_c = 23.2\text{K}$ in Nb_3Ge , a record that stood for 13 years.

Just prior to accepting my current position, there was a meeting held at the NSF in February 1986 of government program managers who supported superconductivity research. While I don't remember the details, there was a general air of doom and gloom, as one PM after another bemoaned the rapidly declining budget for superconductivity research. I was the only person in the room that spoke of a stable budget.

The field of superconductivity changed dramatically from late 1986 to 1988 thanks to the pioneering work on cuprates by first Georg Bednorz and Alex Mueller, and then by a team led by Paul Chu and Maw-Kuen Wu. We were blessed with a class of superconductors whose T_c values were well above the normal boiling point of liquid nitrogen. Suddenly physicists were being treated like rock stars. By 1993, a mercury-based cuprate reached a record T_c of 134K at ambient pressure and 164K at greatly elevated pressure. While these record temperatures still stand after 16 years, it was breakthroughs in thin-film deposition in the mid 1990s at Los Alamos and Oak Ridge National Labs that led to production of long lengths of YBCO tapes, so far up to 2 to 3 hundred meters, on a flexible nickel-alloy substrate, with numerous thin-film buffer layers, and an awesome critical current density. It is noteworthy that the IBCO process developed by the Los Alamos group was first developed in 1990 by Bob Hammond at Stanford under AFOSR funding.

To the casual observer it might appear that cuprate superconductivity is ready to make a major impact on our lives, given how it could lead to many low-loss electric power applications. This includes power transmission, motors,

generators and high-field magnets. One can only be in awe of the achievements in materials engineering, mainly in the US and Japan, but also in China and Europe. Starting with a nominally brittle ceramic, it is now possible to convert YBCO into a flexible tape that can support hundreds of amps without destroying superconductivity. This achievement has come as a result of a considerable financial investment over the past 2 decades. The major contributor to funding power-related superconductivity R&D in the US has been the DoE's Office of Electricity Delivery and Energy Reliability. Other support, mostly for basic research has come from AFOSR, AFRL, DoE's Office of Science and the NSF. However, it is unlikely that these "second generation" (2G) tapes will be applied to most of the cited power applications. Part of the problem is that despite improved critical current, these values are marginal for many of the desired power applications, and yet the critical current density is approaching the depairing limit, particularly above 77K. Another major issue relates to economics. The goal in making superconducting tapes or wires viable as a commodity has been to reach a manufacturing cost of \$10/kAm, approximately the value for copper. Although it is difficult to obtain a precise value for the cost of manufacturing 2G tapes, reliable estimates are between 1 to 2 orders of magnitude above the targeted value.

It was with this assessment of the future for cuprate superconductors, that I joined with Paul Chu, wearing his University of Houston hat, and Horst Rogalla of the University of Twente in The Netherlands to fund and organize a 1-week workshop titled "The Road to Room Temperature Superconductivity (RTS)," which was held at Loen, Norway in June 2007, with local support from Kristian Fossheim of the Norwegian University of Science and Technology. Invited speakers, both theorists and experimentalists, were from the US, Europe and Japan. We discussed a number of possible "routes" to reach higher T_c values. While the title of the workshop was somewhat facetious, we did discuss the need for either a cuprate-like material with a much higher T_c or an A15-like material, i.e., relatively isotropic and less expensive to manufacture in a useful form. At the conclusion of this workshop there was guarded optimism among almost all attendees that it should be possible to raise the known T_c to over 200K within the next 10 years, although I don't know anyone who rushed back to his lab to begin this quest. In the interim, a search for new (non-superconducting) materials by Professor Hosono's group at the Tokyo Institute of Technology found superconductivity at a T_c of 28K in $\text{LaFeAs}(\text{O}_{1-x}\text{F}_x)$, a rather surprising result because of the presence of iron. This discovery was first published in January 2008. In the months that followed, due mainly to research in China and Japan, the record T_c for this new (pnictide) class was raised to 56K, where it now appears to remain, at least for a while.

Thanks to enlightened and bold leadership at AFOSR that backed and encouraged my decision to abandon the

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Vote for DCMP Officers and Executive Committee Members

Please participate in the election of DCMP officers and members of the executive committee. You will be asked to elect a new Vice Chair (who will become in successive years, Chair Elect, Chair and Past Chair), and three members-at-large. The election will occur during August and early September. Members will receive detailed instructions about voting from the APS. Candidate biographies and statements will be available on both the APS and DCMP web sites before and during the election. You can go to the DCMP website: <http://dcmp.bc.edu> and click the link which will appear there shortly, or go to the link in an email that you receive from APS once the elections site opens. Paper ballots will be mailed to those who cannot be reached by email.

The DCMP Executive Committee performs several functions. One of its most important responsibilities is to lead the organization of the APS March Meeting. It is the body that selects the division's Invited Symposia from those nominated by the community, and thus a proper balance of expertise on the Committee is essential for a successful meeting. The Executive Committee helps to lobby Congress on science policy issues. Finally, the DCMP Members-at-Large nominate new Fellows to be forwarded for consideration by the APS Fellowship Committee and Council. The current membership of the Executive Committee can be found at <http://dcmp.bc.edu/page.php?name=exec>. The outgoing committee members are Members-at-Large, Paul Goldbart (Illinois, UIUC), Karin Dahmen (Illinois, UIUC), Aharon Kapitulnik (Stanford) and past chair, Allen Goldman (Minnesota).

The DCMP Web Site

The DCMP web site at <http://dcmp.bc.edu> provides general information and announcements of potential interest to members. The site also informs the general public of the role and value of condensed matter physics in their lives. There is an impressive collection of images in the gallery at <http://dcmp.bc.edu/page.php?name=gallery>.

We welcome contributions to the site from the DCMP membership involving any subject matter that may help achieve these goals. Please send your comments, suggestions, and contributions to Dr. Irina Bariakhtar, at the DCMP Webmaster, at dcmp@bc.edu.

Nominations for APS Fellowship

Members are encouraged to nominate individuals for Fellowship in the APS. The Division is able to elect each year one-half of one percent of its current membership. Nominations for the next cycle open November 1, 2009 and must be received by January 29, 2010 to be considered for action in 2010. Nomination instructions and advice for preparing a strong nomination are available at <http://www.aps.org/>

[programs/honors/fellowships/nominations.cfm](#). Unsuccessful nominees are automatically reconsidered in the second year after nomination. Updated information from sponsors is recommended. In March the DCMP Fellowship Committee, made up of the Members-at-Large and the DCMP member of the APS Council, reviews the nominations referred to the DCMP by the APS and makes recommendations to the APS Fellowship Committee.

Tips for Successful Nominations

The selection process is very competitive; when preparing nominations, the sponsor should ensure that the achievements of the candidate are genuinely reflected in the material submitted. The Fellowship Committee looks for sustained contributions to the field, and successful nominees generally have over ten years of professional experience beyond the Ph.D. The eight representative publications and ten other contributions should be chosen with care. The supporting letters, which evaluate the candidate's work and discuss which of the candidate's achievements are "exceptional," aid the committee considerably.

Join DCMP

Most people reading this newsletter are already DCMP members. However, there may be other APS members whose research is in the area of condensed matter physics who are not yet members of the division. The size of the membership of the division determines both the number of invited symposia that we can organize at the March Meeting, and the number of Fellows that we can recommend to the Society. As a consequence, any increase in these numbers benefits our community. Please ask your condensed matter colleagues and graduate students if they are members of the DCMP. The reality is that many are not. It costs only \$7 to join, and a person can join at any time. Student membership in DCMP is free. See <http://dcmp.bc.edu/page.php?name=unitappl> for details.

Investing in Science continued from page 3

one of the largest Office of Science Recovery Act allotments of \$150 million to accelerate civil construction. In assessing ongoing construction projects for Recovery Act purposes, particular emphasis was placed on the capacity to create jobs in the near term and provide economic prosperity by spurring technological advances. During the construction phase, the NSLS-II Project will employ project engineers, structural engineers, accelerator physicists, instrument designers, research associates and more to build the discovery-class machine that ultimately will push the frontiers of science and enhance national and energy security. When completed in 2015, NSLS-II will provide American scientists with world-leading capability in advanced light sources, which have become the state-of-the-art instruments for effecting major advances in materials science, energy, pharmaceuticals and health, and a range of other fields.

funding of “conventional” YBCO materials research, a program is now being initiated to seek new more user-friendly superconductors. This program is anchored by 3 recently-announced Multidisciplinary University Research Initiative (MURI) awards of between \$1.0M/yr to \$1.4M/yr for 5 years to Stanford, UC-San Diego, and the University of Maryland, headed respectively by Mac Beasley, Ivan Schuller and Rick Greene. There are many distinguished co-PIs at the host institutions and at other universities including Princeton, UC-Irvine, Iowa State, the University of Wisconsin at Milwaukee, and Rutgers. However, heeding my advice to have at least one co-PI at a junior faculty level, there are assistant professor co-PIs at Maryland, Rice, UC-San Diego and Florida State. There also will be a link, and in some cases, funding to scientists at Brookhaven National Lab, Oak Ridge National Lab, the Air Force Research Lab, the University of Madrid and the Naval Research Lab. Grants involving 2 other multi-PI awards will be made shortly to the University of Houston under Paul Chu, and to the University of Texas at Dallas under Anvar Zakhidov, with co-PIs at Yale and Clemson. This last-named award is focused solely on nanotube-based superconductivity. While it is anticipated that each of these 5 large projects will not divulge all of their plans publicly, there already is an informal agreement to share results, and where practical, to cooperate in char-

acterization of materials and in the use of unique fabrication facilities. Within one year there will be an open website to document results. The total investment in these 5 large awards and related smaller ones will be about \$5.4M/yr.

It is hoped that this search will go beyond the coordination of these 5 major projects and the few smaller ones. We anticipate there will be cooperation with a major DoE project of comparable size, the Energy Frontier Research Center (EFRC) titled “Center for Emergent Superconductivity,” that is led by Seamus Davis at Brookhaven National Lab. It has many of the same goals as the AFOSR program, and it features special facilities at both Brookhaven and Argonne National Lab, with primarily materials support from Laura Greene at the University of Illinois. Finally, we anticipate making this a worldwide effort and already have interest from and involvement with scientists in Taiwan, Israel and The Netherlands, with other possibilities pending.

At a pre-award “kick-off” meeting on May 27 in Arlington, VA I stated there could be no guarantee that after 5 years this group effort would result in a great new discovery of a practical higher temperature superconductor or of an isotropic, inexpensive superconductor that works well at 77K, but I did state my faith that important new materials would be found as a result of this ambitious program. The PIs in attendance agreed unanimously with this assessment.

“Let the games begin!”