



Spring 2015 Newsletter

Ernie Malamud, Editor

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Message from the Chair

Edmond L Berger



Dear Colleagues,

With a sense of great honor I write to you as Chair in 2015 of our Forum on International Physics (FIP) of the American Physical Society (APS). As a grass-roots unit within the APS, our mission is to advance the understanding of physics by fostering cooperation and communication among physicists of all nations. Our official membership in 2015 stands at 3712, larger than that of all but one Division of the APS. The membership has held roughly constant since 2011, while declining slightly as a percentage of the total membership of the Society. Encourage more of your friends to join the Forum and to participate actively!

Following the most recent election, the Executive Committee welcomes Cherrill Spencer (SLAC) as Vice-Chair, along with Jason Gardner (Australian Nuclear Science and Technology Organization), and Aldo Romero (West Virginia University) as Members at Large. Maria Spiropulu rises in the Chair line to Chair-Elect in 2015. We thank Ercan Alp (Chair in 2014) and Sergio Ulloa (Past-Chair in 2014) for their years of dedicated leadership of FIP.

The organization of invited paper sessions at APS General Meetings is one of our principal activities. At the 2015 March Meeting in San Antonio, March 2 - 6, the theme of the FIP sessions is “Condensed Matter Phys-

ics in Latin America”, with invited speakers from Argentina, Brazil, Colombia, and Mexico. Executive Committee member Alejandro De Lozanne played a key role in the organization of these March sessions. Please come to the sessions and to the FIP reception on March 3. For the 2015 April Meeting in Baltimore, April 11 – 14, Maria Spiropulu and I have organized two sessions on “Models of International Partnership”, with invited speakers reporting on the organization and management of successful international collaborative efforts in astrophysics, particle physics, nuclear physics, and gravity research. In addition, at the April meeting we are co-sponsors of an invited paper session with the Division of Physics of Beams (DPB) on the topic “International Photon Science Facilities”, as well as a joint session organized by Cherrill Spencer with the Committee on the Status of Women in Physics (CSWP).

Our FIP colleague Per Nordblad, Professor in Solid State Physics, Uppsala University, is the 2015 recipient of the John Wheatley Award of the American Physical Society, for his sustained efforts of nearly three decades in nurturing physics research and education in Bangladesh, Vietnam, Thailand, and Eritrea. The award, to be presented at the April meeting, was established in 1991 with support from FIP to recognize physicists who have made outstanding contributions to the development of physics in countries of the third world, by working with local physicists in research or teaching. The award is presented every two years. Please come to hear Professor Nordblad’s presentation and consider making nominations of appropriate individuals for the 2017 Wheatley award!

Thanks to the personal efforts of Executive Committee member Maria Longobardi funding has been obtained from Authorea (<https://www.authorea.com/>) to award a special travel grant of \$900 to one FIP member attending the 2015 March Meeting 2015. The award is for graduate students and postdocs from Europe and partially covers travel expenses to present their work at the March Meeting. Applications have been solicited.

While on the topic of travel grants, I want to renew attention to the APS International Travel Grant Award Program (ITGAP). This program was a FIP initiative

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that has since drawn sponsors from many APS units. Its purpose is to promote international scientific collaborations between APS members and physicists in developing countries. Up to US\$2,000 per recipient is awarded for travel and lodging expenses for international travel while visiting a collaborator. In her capacity as Vice-Chair of the Executive Committee in 2014, Maria Spiropulu was responsible for the review process, with expert assistance from other sponsoring APS units. For more information and application guidelines, please see <http://www.aps.org/programs/international/programs/travel-grants.cfm>.

Please be pro-active in nominating outstanding FIP members for election to the rank of Fellow of the APS. Candidates should have demonstrated outstanding contributions to physics and, in addition, those advanced by FIP should have identifiable contributions to the development of programs and collaborations between

physicists and their communities from diverse cultural backgrounds. Please see <http://www.aps.org/programs/honors/fellowships/nominations.cfm>

for an outline of the nomination process. The deadline for consideration by the FIP committee is May 15.

Thanks for reading. I look forward to meeting as many as possible at the March and April APS meetings.

Ed Berger is a high energy elementary particle theorist and Distinguished Fellow at Argonne National Laboratory. He is a Fellow of the APS and served previously as Chair of the Division of Particles and Fields (1990); Chair of APS Committee on Constitution and Bylaws (2011); and Chair of the APS Committee on Meetings (1995).

From the Editor

Ernie Malamud

There is no dearth of interesting articles in this issue. Perhaps my complaint in our last issue helped! And there are already several more articles lined up for the next issue this fall.

Fall 2015 newsletter deadline is August 15, 2015

Think about writing a short article and/or sending a couple of pictures with long caption. Or suggest possible topics and/or authors. Please send text in MSword format and graphical material as JPGs.

I thank the authors for the many excellent articles included in this issue. They cover a wide range of international physics activities and events in many different countries.

Sultana Nahar has contributed a trip report on her recent visit to Saudi Arabia. I learn a great deal from her articles about physics research and teaching in parts of the world quite unknown to me. Nahar's tireless dedication in communicating in person with physicists in many countries is exemplary. I also made an interesting trip at the end of last year, to China, not as exotic as Saudi Arabia, but quite new to me. I have written up and include in this issue a short account of the exciting CEPC-SPPC (Circular Electron Positron Collider – Super Proton Collider) project that I worked on in China

Also, I echo Ed Berger's request that you be proactive in nominating worthy candidates for APS Fellow.

Ernie Malamud spent three decades at Fermilab participating in high energy physics experiments and accelerator design and construction. He is a Fermilab Scientist Emeritus and is on the adjunct faculty at the University of Nevada.

Report from the APS International Affairs Office (INTAF)

Amy Flatten



It is a pleasure to begin 2015 by thanking the members of the Forum on International Physics (FIP) for their contributions to the international programs of the APS. The partnership between FIP and the APS International Affairs Office (INTAF) has launched programs that have served our fellow APS members and our physics colleagues worldwide.

As FIP members are well aware, physics is international in nature. Many of you may not realize, however, that 23% of APS members live outside of the United States. To serve our international members, as well as the international physics community, INTAF partnered with FIP and with organizations across the globe to offer exchanges, travel awards, and training programs.

In looking back over the past year, a few opportunities stand out – these are ongoing, sustainable programs to which FIP members and other physicists may wish to apply in the future. For example, in partnership with the Indo-U.S. Science and Technology Forum (IUSSTF) and the Sociedade Brasileira de Física (SBF), APS offered the Brazil & India Physics Ph.D. Student & Professor Exchange Programs. These exchange programs enabled graduate students and post-docs to work overseas with a professor in his/her field of study, and funded senior physicists to teach a short

course or deliver a lecture series in the other country. Watch for our next call for proposals for the Brazil program in the spring. The India program will issue a call for proposals this coming fall. All of these and more are announced on our website: <http://www.aps.org/programs/international/honors/index.cfm>

The Society continues to bring international physicists to speak at APS meetings through both the Marshak and Beller Lectureships, which support distinguished physicists from the developed and developing countries respectively. Here, Chairs of APS Units are invited to submit nominations for international speakers during their sessions at the March and April meetings. I would like to take this opportunity to congratulate the Beller and Marshak Lectureship Recipients for 2015:

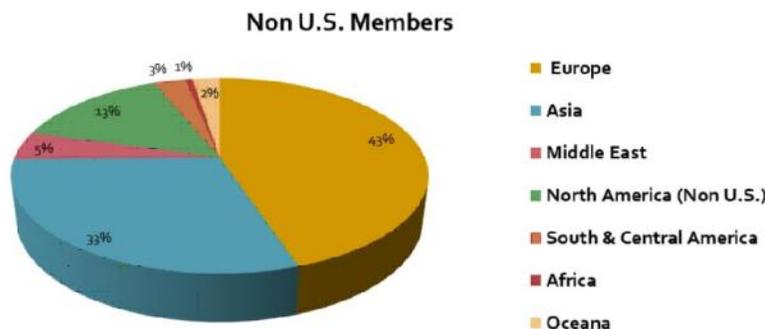
Beller Lectureships:

- **Professor Michael Coey**, Trinity College Dublin
Nominated by the Topical Group on Magnetism and its Applications (GMAG)
- **Professor Balasubramanian Iyer**, International Centre for Theoretical Sciences, India. Nominated by the Topical Group in Gravitation (GGR)
- **Professor Karin Jacobs**, University of Saarland, Germany
Nominated by the Division of Materials Physics (DMP)

Marshak Lectureship

- **Dr. Giorgio Paolucci**, SESAME, Jordan
Nominated by the Forum on Graduate Student Affairs (FGSA)

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~23 % of APS Members Live Outside of United States

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Likewise, the APS also partnered with scientific societies in Europe and the United States toward the SESAME Travel Award Program that supports training opportunities for scientists in the Middle East. The SESAME project -- the synchrotron light source under construction in Amman, Jordan -- brings together physicists from Arab countries & Israel for international scientific collaboration and serves as a wonderful example of science for diplomacy.

In partnership with the UK Institute of Physics (IOP) and the Abdus Salam International Centre for Theoretical Physics (ICTP), the APS continued to co-sponsor the Entrepreneurship Workshops for Physicists and Engineers in Developing Countries. This past year, the partners co-sponsored workshops in Trieste, Ghana and Kenya. The Society also underscored its ongoing commitment to developing country physicists through its International Travel Grant Award Program (ITGAP), which supports developing scientists' travel to visit collaborators in developed countries. As some of you may already know, FIP and INTAF launched ITGAP in 2004, and it has grown over the past decade to include financial contributions from every APS Division and many APS Topical Groups.

Through the AAAS Science and Human Rights Coalition, and the APS Committee on International Freedom of Scientists (CIFS), APS advocated for the human rights of scientists in the US and around the world. The APS also remains vigilant regarding important US Government policies that impact international scientific collaboration and will continue to work with federal leaders to ensure national security concerns do not unduly restrict scientific research with international colleagues.

Along with reflecting upon this past year's activities of INTAF and FIP, I look forward to the upcoming events of this New Year. As some of you may remember from my column in the last issue of the FIP newsletter, the American Physical Society (APS) and the Chinese Physical Society (CPS) have been working to bring together young physi-

cists from our two countries. As many graduate students from the United States and China already plan to attend the 2015 APS March Meeting in San Antonio, Texas, the APS and CPS will hold a "U.S.-China Young Physicists Forum" on February 28 - March 1, 2015 (the weekend before the March Meeting officially begins on Monday, March 2.)

The U.S.-China Young Physicists Forum will combine scientific sessions with career development and networking opportunities for graduate students, with each country sending 30 students (60 total for this meeting). The meeting will span a day and a half, and focus upon Condensed Matter Physics and Materials Physics graduate students. Through special topical and technical sessions, it will provide graduate students from the United States and China with a broader view of physics beyond their own classrooms and laboratories. Moreover, the event will foster an appreciation for international scientific collaboration and networking among young physics researchers, and promote long-term connections among graduate students from our two countries.

In fact, FIP Past-Chair, Ercan Alp, serves on the Advisory Committee for the US-China Young Physicists Forum. We hope that the event will instill in these young physicists an even greater appreciation for the global nature of physics -- an understanding shared by all FIP members. Hopefully, we can host some of the student participants at the FIP reception at this 2015 March Meeting.

Lastly, I want to say thank you again to all of the FIP members that have taken an interest in the APS international programs over this past year, and to those that are helping me to build the programs we will share in the upcoming year. I look forward to seeing some of you at the upcoming APS March and April Meetings.

Dr. Amy Flatten is Director of International Affairs at the American Physical Society

FIP sponsored or co-sponsored sessions at the APS Spring Meetings

March meeting, March 2 – 6, 2015, Henry B. Gonzalez Convention Center, San Antonio, Texas

Session B3, Monday, March 2, 2015, 11:15 AM, Room: 002AB

Condensed Matter Physics in Latin America I

Chair: *Alex de Lozanne, University of Texas at Austin*

- *Pablo Levy*, An overview of Experimental Condensed Matter Physics in Argentina by 2014, and Oxides for Non Volatile Memory Devices: The MeMOSat Project
- *Adalberto Fazzio*, Brazilian Nanotechnology Initiative
- *Marcelino Barboza-Flores*, Development of Micro and Nano Crystalline CVD Diamond TL/OSL Radiation Detectors for Clinical Applications
- *Arturo Ayon*, Influence of Quantum Dots and Surface Nanotexturization on Solar-Cell Performance



FIP RECEPTION, March 3

Session Q3, Wednesday March 4 2015, 2:30 PM, Room: 002AB

Condensed Matter Physics in Latin America II

Chair: *Edmond L Berger, Argonne National Laboratory*

- *Horacio M. Pastawski*, Spin dynamics with Solid State NMR and GPU calculations: Loschmidt Echoes, Intrinsic Decoherence and Quantum Dynamical Phase Transitions
- *Antonio Jose Roque da Silva*, An Upgrade for the Brazilian Synchrotron Light Source: Are you Sirius?
- *Manuel Quevedo-Lopez*, Large area radiation detectors based on II VI thin film
- *Angela Camacho*, Condensed Matter Physics in Colombia is in its forties

April Meeting, April 11 - 14, 2015, Hilton Baltimore Inner Harbor, Baltimore, Maryland

Session J8, Sunday, April 12, 10:45 AM, (co-sponsored with DPB) Room: Key 4

International Photon Science Facilities

Chair: *Stuart Henderson, Argonne National Laboratory*

- *Harald Sinn*, XFEL, Progress and Plans
- *David Schultz*, The LCLS-II Project at SLAC
- *Harald Reichert*, Overview of International 4th Generation Synchrotron Light Sources Plans



Session J12, Sunday, April 12, 10:45 AM, Room: Key 8

Prize Session: Joseph A. Burton, Leo Szilard and John Wheatley Awards co-sponsors: FPS FIP

Chair: *Micah Lowenthal, National Academy of Science*

Session S12, Monday April 13, 2015, 1:30 PM, Room: Key 8

Models of International Partnership – I

Chair: *Edmond L Berger, Argonne National Laboratory*

- *David Gross*, Introduction and Context
- *Sergio Bertolucci*, LHC at CERN – Machine and Detectors
- *Joseph Lykken*, Long Baseline Neutrino Facility at Fermilab – a developing model
- *Thomas Glasmacher*, FRIB – Diverse Partnership Models in Nuclear Physics

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Session U12, Monday April 13, 2015, 3:30 PM, Room: *Key 8*

Models of International Partnership – II

Chair: *Maria Spiropulu, Caltech*

- *Roger Blandford*, Astrophysics and Cosmology International Projects
- *Robert Iotti*, ITER
- *Gabriela Gonzalez*, The LIGO Model
- Panel Discussion

Session Y8, Tuesday, Apr 14 2015, 1:30PM,, Room: *Key 4* (co-sponsored with CSWP)

The 5th International Conference on Women in Physics, Reflections and Going Forward

Chair: *Susan Blessing, Florida State University*

- *Beth Cunningham*, Overview of the 5th ICWIP and ongoing efforts in the US to improve the representation and status of women in physics.
- *Prajval Shastri*, Government policies and other efforts to decrease the gender gap in physics in India
- *Kathryne Sparks Woodle and Herman White*, Experiences at the 5th and 3rd ICWIPs

The Fifth International Conference on Women in Physics, Reflection and Going Forward

from Cherrill Spencer

Every three years women physicists from all over the world (and a few men) convene, in country delegations, for an international conference with these goals:

- Showcase and celebrate scientific work in all areas of physics
- Develop resolutions to address gender issues and promote the participation of women in physics
- Provide networking opportunities to build a strong, diverse and inclusive worldwide physics community

The Fifth International Conference on Women in Physics (ICWIP) was held in August 2014 in Waterloo, Canada. It was attended by 215 (mostly) women physicists from 49 countries and you can hear about what happened during the conference and what attendees learnt about women in physics in all continents from some of the US delegation and the Indian delegation at a session at the APS April 2015 meeting on Tuesday 14th April, 1:30pm.

- Professor Prajval Shastri, Indian Institute of Astrophysics, and leader of the Indian delegation, will speak about government policies and other efforts to decrease the gender gap in physics in India.
- Dr Beth Cunningham, Executive Director of the AAPT and co-leader of the USA delegation, will provide an overview of the 5th ICWIP and ongoing efforts in the US to improve the representation and status of women in physics.
- They will be joined in a panel discussion by Kathryne Sparks Woodle, Penn State University and Herman White, Fermilab, who will report on their experiences at the 5th and 3rd ICWIPs.

This April 2015 APS meeting session, "The 5th International Conference on Women in Physics, Reflection and Going Forward" is co-sponsored by the Committee on the Status of Women in Physics and the Forum on International Physics. It will be co-chaired by Susan Blessing, Florida State University and Cherrill Spencer, retired from SLAC National Accelerator Laboratory, who were both members of the US delegation to the Fifth ICWIP.

Newly elected members of the FIP Executive Committee

Cherrill Spencer

Vice-Chair. 4-year “Chair Line” term 2015-2018
SLAC National Accelerator Laboratory (retired).
APS Member of DPB, FED, FIP, FOEP, FPS, SFW
Spencer was born and educated in England, D.Phil. from Oxford University.

“Physicists and physics educators in the USA can learn a great deal in matters pertaining to physics from colleagues working outside the USA.”



Jason Gardner

Member-at-Large, 2015-2017
Bragg Institute, Australia
APS Member of DCMP, DMP, FIP, GMAG
Born in Liverpool, England, PhD, Warwick University
Fellow of the Institute of Physics, UK and Editor-in-Chief of the Journal of Physics: Condensed Matter

“I believe we can all learn from each other and will encourage the APS to strengthen and broaden its exchange programs. I’ll support endeavors to promote science education, promote the exchange of information and develop personal connections at a global level.”

Aldo Romero

Member-at-Large, 2015-2017
Physics and Astronomy Department, West Virginia University
APS Member of DCMP, DCOMP, DMP, FIP, SMAS
Born in Pamplona, Colombia
PhD at the University of California, San Diego

“One of my goals is to make an effort of involving international graduate and undergraduate students and have a voice of their needs. At the same time, I would like to search for an increase of the number of available exchange programs, additional to the existing ones but focusing on graduate and young researchers. One of the actions that FIP has been involved is to create special grants for international exchange; I think it is important to create those opportunities for third world countries where fewer opportunities are given.”



Mentoring a Generation of Materials Scientists in Africa The African School on Electronic Structure Methods and Applications (ASESMA)

George Amolo and Richard M. Martin

The development of science and technology in Africa is key to the attainment of socio-economic stability within the African society in the long term. However, there is a need to train sufficient manpower and set goals to attain such stability, an endeavor which should best be driven by the citizens of the continent with the support of foreign scientists and well-wishers.

A large number of well-trained materials scientists is likely to have direct or indirect impact in areas such as green energy production, water access and quality as well as food production, which are key to the needs of the African citizens. Materials science holds the possibility to have large impact in areas that take advantage of the rich resources in Africa: solar energy for electricity, new advanced materials processing of the mineral resources. The emergence of new and smart materials, which have wide varying applications from electronics, medical utility and the building industry, is also connected to fundamental studies in materials science. A number of international companies mining the vast mineral resources in Africa have their R&D sections in Europe and America, which is good for business but does not necessarily help to develop local capacity within the continent.

The African School on Electronic Structure Methods and Applications (ASESMA) focuses on materials science bringing to bear fundamental physics and chemistry [1, 2, 3] to address real problems in science and technology. The current knowledge of electronic structure methods and techniques has already contributed to the biological sciences in fields such as drug design and delivery. With the emerging smaller, less costly and powerful computers and computer clusters, electronic structure codes have been developed by experts to simulate real materials from fundamental science. In some cases, the state-of-the-art electronic structure codes are now not only capable of reproducing properties of materials that are close to independently verified experimental data but also have predictive capability. It is expected that the ongoing series of the ASESMA will enhance the capacity of materials scientists and hence turn the tide leading to the establishment of high level

R&D units in Africa.

The first activity related to electronic structure studies was held at the African Institute of Mathematical Sciences (AIMS), Cape Town, South Africa in 2008. There were students from many countries in Africa. The goal of these activities is to grow the area of computational materials science among the younger generation of upcoming graduate students and researchers in the African continent. The next activity, held in 2010 also at AIMS in Cape Town, inaugurated the ASESMA series [4] intended to be held biannually in various African countries until the year 2020. ASESMA is endorsed by the International Union for Pure and Applied Physics (IUPAP) and has received massive support from donors and experts around the world. The second series of the ASESMA was held in Chepkoilel University College, now University of Eldoret, in Eldoret, western Kenya (see Figure 1). The series held in Eldoret, like the first one, also witnessed a large number of experts, tutors and mentors from Europe, America and Asia coming out to support training of African participants in this field.

ASESMA 2015. The ASESMA was held in the University of the Witwatersrand (Wits), Johannesburg, South Africa at the end of January. Wits is a top African university with an excellent research reputation in science and technology. There were 41 participants in ASESMA 2015 from 10 different African countries [see photo in Figure 2] out of more than 250 applications.

This time the ASESMA was reorganized to accommodate both new participants as well as those who have some previous experience on electronic structure calculations, with the aim of taking the latter group to the next level of understanding and capability. These two groups attended common introductory lectures but different hands-on tutorials supported by tutors and mentors from Europe, America, Asia and Africa. Lectures and small groups were designed to give students the basic knowledge to understand what is done in the computations. In the tutorial sessions the participants

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were provided with PCs loaded with several open source codes such as Quantum Espresso [5], YAMBO [6] and Casino [7]. The tutorials on the PC are meant to help prepare input files for further intensive calculations in the supercomputer at the Centre for High Performance Computing (CHPC, Cape Town), which has offered generous support to the previous series of the ASESMA. The CHPC was kind enough to provide 40 dedicated nodes for a whole week for the ASESMA hands-on tutorials.

The ASESMA theme was this time focused on the optical properties of materials with lectures in the morning and hands-on tutorials in the afternoon during the first week. The second week was mainly set aside for projects, allowing the participants an opportunity to put into practice techniques learned the previous week. In the evenings, light lectures on selected topics in the areas of surface science, catalysis, pedagogy of electronic structure calculations were presented to the participants. Other topics covered in the evenings included the areas of women in science, the need for an African network in the field of materials science as well as skills necessary for hunting PhD and postdoctoral opportunities.

Success stories. Several participants, inspired by

the ongoing series of the ASESMA, went ahead to register for graduate studies at the MSc and PhD levels and many are now in permanent positions. These are tangible outputs of the efforts invested in the ASESMA. As examples, Kingsley Obodo from Nigeria, registered for a PhD at the University of Pretoria, graduated in 2014 and is now a Research Officer at Johnson Matthey in South Africa. Mohammed Suleiman from Sudan was a PhD student at Wits and now holds a faculty position in University of Sudan, Khartoum, Sudan. George Manyali from Kenya is a postdoctoral fellow at Wits following his graduation with a PhD.

Sponsors of ASESMA. International Union for Pure and Applied Physics (IUPAP), US Liaison Committee for IUPAP, International Centre for Theoretical Physics (ICTP), The South African National Institute for Theoretical Physics (NITheP), The Thomas Young Centre, and the Centre for Doctoral Training on Theory and Simulation of Materials (TSM) - Imperial College London, Swiss National Center for Computational Design and Discovery of Novel Materials (NCCR MARVEL), Centre for High Performance Computing (CHPC) in Cape Town, DST-NRF (Dept. of Sci. and Tech., Rep. of South Africa, National Research Foundation) Centre of Excellence in Strong Materials (COE-SM), Materials for Energy Research Group (MERG),

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Figure 1: Group photo of the ASESMA in Eldoret, Kenya.

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University of the Witwatersrand, Centre for Research on Adaptive Nanostructures & Nanodevices (CRANN), Trinity College Dublin.

Future Plans. The lectures and tutorials that the participants go through during the ASESMA sessions prepares them for much more than can be accomplished in the two weeks period of the activity. It is important for the participants to continue with the projects and assignments when they get back to their home countries. The participants are encouraged to contact the tutors, mentors and lecturers via email to seek clarification and answers to what do they do not understand. To combat isolation of graduate students and young researchers in this field there have been plans to create an African network on computational materials sciences to complement the efforts of the ASESMA. One of the aims of the network is to keep contact with the current and previous participants of the ASESMA and others in the research community. It is expected that this network will help reach out to many more upcoming graduate students while supporting those currently trying to get experience in this field.

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Figure 2: Group photo of the ASESMA in Wits, South Africa.

Jefferson Science Fellowships at the US Department of State

R. J. (Jerry) Peterson

Because of the importance of science in modern governance, a number of connections have evolved. A recent one, of great prestige and leverage, is the Jefferson Science Fellows (JSF) program at the US Department of State. Members of the Forum may be very well suited and interested in making applications.

The JSF program was announced by Secretary of State Powell in October of 2003, as designed by George Atkinson, then Science Advisor to the Secretary. JSF Fellows work together with the Science Advisor, currently Dr. Frances Colon, through the Office of the Science and Technology Advisor (STAS www.state.gov/e/stas). The stated goal of the JSF program is to serve as an integrative model for engaging the American academic science and engineering communities in US foreign policy.

The JSF program is open to tenured US citizens from eligible US institutions of higher learning. Each Fellow will spend one (academic) year in residence at State or the US Agency for International Development (USAID). After the year in residence, each fellow is expected to remain available for consultation on short-term projects for several years.

The program is administered by the National Academies (www.national-academies.org/jsf), who oversee the selection process. Applications typically close each year in mid January, so this newsletter can allow ample time to plan for the 2016 competition. Criteria include experience and stature in the community, ability to understand new and changing advancements both within and beyond specific expertise, and interest and experience in policy matters. In addition, it is hoped that Fellows returning to their institutions will have a lasting effect on coming generations. Each application requires a well-written Statement of Interest and essays on the impacts, present and anticipated, of science, technology and engineering on U. S. foreign policy. These materials are evaluated with respect to both the scientific attributes of the applicant, and the ability to communicate. Strong letters of recommendation from high levels are expected.

After mail reviews, finalists are invited to DC for panel reviews. The home institutions of the applicants are required to sign a memorandum of understanding, the critical component of which is full salary support for the academic year. Washington is an expensive town, so Fellows also receive significant financial support

beyond their home salary. Fellows must also be able to hold a suitable security clearance.

A valuable orientation begins the year at State, while the Fellows shop around for the best home among the wide range of opportunities at State. The STAS office is very helpful in this search. Duties of the fellow vary widely with position. I worked as a Senior Science Analyst (that's what the sign on my door said) in the Office of Economic Analysis, under the Bureau of Intelligence and Research. I was the first JSF in that Office, but I have been followed by others, mostly physicists. For a full list of Fellows see www.national-academies.org/jsf. You are likely to see names you know.

Work within State is not much like that at your campus—this is no ivory tower. Often, security concerns limit the free discussion of issues. This results in a 'stovepipe' atmosphere, with communication only upwards and only through your Bureau. Feedback from the top is rare, and it may be difficult to see specific effects of your work. When you do see good ideas realized, the downwards causality may be hard to trace. The Department of State is a large and venerable institution, with deeply entrenched habits and traditions.

In spite of this lack of recognition from the top, your efforts will be deeply appreciated at least in the office you find yourself in. You are more than free labor; you bring new ideas and views to the bureaucracy. They are very good at what they do, but new ideas may be scarce, especially in the rapidly changing world of science, technology, and engineering.

My year in State and the five years after, with several briefings or reports per year, were enormously satisfying, and other members of the Forum should examine the opportunity closely and consider applications to the Jefferson Science Fellows program. Feel free to contact me for specific advice—
Jerry.Peterson@colorado.edu.

Professor R. J. (Jerry) Peterson, JSF class of 2007-2008, is in the Department of Physics at the University of Colorado Boulder. Peterson specializes in studying reactions induced by intermediate and high energy protons and pions.

CERIC-ERIC, a new Central European Research Infrastructure

Nicoletta Carboni

CERIC-ERIC is a distributed research facility, set up as a European Research Infrastructure Consortium (ERIC) by *Austria, Czech Republic, Italy, Romania, Serbia, Slovenia* and additionally with the support of Croatia, Hungary and Poland. The CERIC mission is to offer an integrated multi-technique service to researchers from all over the world.

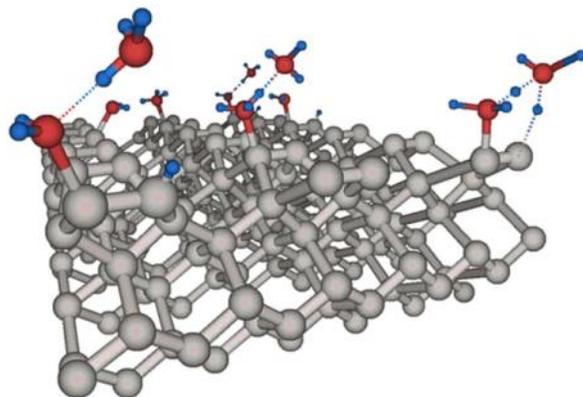


Materials sciences, life sciences and nanotechnology are among the research fields with a large innovative potential. The scientific problems emerging in these fields have become more and more complex in recent years and require access and expertise in an ever increasing number of different analytical and synthesis techniques and a multi-probe and multidisciplinary approach. CERIC responds to these requirements.

CERIC-ERIC entered operation in 2014 through two successful international calls for proposals. It offers to researchers with the best proposals a coordinated and open access to the best facilities in the participating countries. These are facilities already operating in structural investigation and imaging of materials and biomaterials down to the nanoscale, by photon, electron, neutron and ion based techniques. They are complemented by preparation facilities in structural biology, photolithography and materials preparation.

The reason why Research Ministers have approved this single Institution is that they have understood that, by opening access only on the basis of quality, their countries would achieve three main goals: the construction of a Research Infrastructure with unique capabilities and quality at world level, the attraction of international researchers in the area, and the benchmarking of the local researchers and research facilities against the top quality ones at world level. Furthermore, this approach is the best to achieve improvement also in education and in potential industrial returns.

Several facilities for the analysis and synthesis of materials are already present in the world, but they cover a relatively narrow range of techniques and, in the case of Europe, are mostly localized in Western Europe. CERIC, being distributed in Central-Eastern Europe, fosters a greater attraction of researchers in this area. It accelerates excellence and innovation and, last but not least, European integration.



CERIC operates as a Consortium and has set up an open-access, single entry-point to one Partner Facility in each Country. All participating laboratories have been evaluated and approved by an international independent expert committee (the International Evaluation Committee, I-EvCo), and will submit to regular evaluations in the future.

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Currently, the instruments and laboratories available within CERIC-ERIC are:

- The Institute of Inorganic Chemistry (Graz University of Technology, Austria) with expertise in structural characterization and preparation of materials for energy and bio-films for biosensors, offering light scattering laboratories and access to the Austrian SAXS beamline at Elettra.
- The Tandem van de Graaff accelerator facility (Ruđer Bošković Institute, Zagreb, Croatia) entirely dedicated to the development and applications of ion beam techniques for materials modification and characterization, such as PIXE and RBS, as well as heavy ion microprobe, dual beam irradiation chamber with RBS/channeling, and TOF ERDA spectrometer.
- The Surface Physics laboratory (SPL, Charles University in Prague, Czech Republic) with expertise in surface analysis, thin film growth and studies of reaction mechanisms on catalyst surfaces and biosensors. SPL offers 4 ultra-high vacuum systems with XPS, ion scattering spectroscopy and low energy electron diffraction optics, and access to the Czech Materials Science Beamline at Elettra.
- The Centre for Energy Research (Hungarian Academy of Sciences, Budapest Neutron Centre, Hungary) performing R&D in nuclear science and technology, studying the interaction of radiation with matter, and doing isotope and nuclear chemistry, chemical analysis with nuclear methods, radiography, radiation chemistry, radiation protection and nuclear security, renewable energy research, surface chemistry and catalysis.
- Elettra Sincrotrone (Trieste, Italy), a multidisciplinary laboratory generating high quality synchrotron and free-electron laser light for scientific applications.
- The Laboratory of Atomic Structures and Defects in Advanced Materials (National Institute of Material Physics, Bucharest, Romania) with HRTEM and EPR laboratories for research in solid state physics and materials science, including the synthesis and characterization of advanced materials for applications in microelectronics, catalysis, energy industry and ICT.
- The Slovenian NMR Centre (National Institute of

Chemistry in Ljubljana, Slovenia) with NMR spectroscopy for chemical analysis and identification, for determining 3D structures and studying the dynamics of small and larger bio-macro-molecules, for tracking chemical reactions in analytical and bioanalytical procedures, for studying polycrystallinity and identifying metabolites and various amorphous forms.

These facilities, available with open access, are complementary to each other and provide the best possible coverage of the nanoscience and nanotechnology domain, based on high definition probes and techniques.

This multi-technique and interdisciplinary approach spans orders of magnitude in dimension, time resolution and other physicochemical parameters, and gives to users the chance to enter a fertile environment for collaborative projects in a wide range of research areas.

The two international open-access calls for proposals in 2014 have attracted 74 proposals from 15 countries including India and Japan. The next call is expected by the end of February. The deadlines for submitting a proposal and the instruments available for each call will be published on CERIC-ERIC website: www.ceric-eric.eu.



A part of the team working in CERIC-ERIC

Nicoletta Carboni is a Communications Fellow at CERIC-ERIC at the Elettra Sincrotrone in Trieste.

Future Circular Collider (FCC) study

Michael Benedikt and Frank Zimmermann

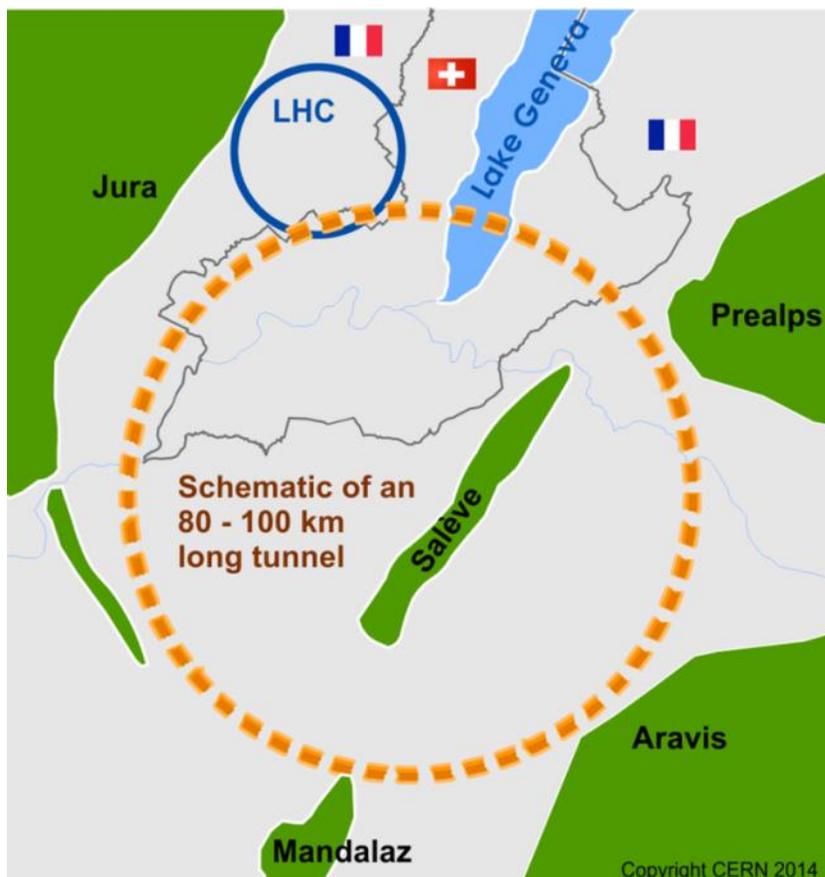
With the discovery of the Higgs boson by two *LHC* experiments in 2012, the Standard Model of particle physics has been experimentally validated, concluding almost 80 years of theoretical and experimental efforts. However, the Standard Model is not a complete theory, since several important outstanding questions remain, e.g. the composition of dark matter, the cause of the universe's accelerated expansion, the origin of the observed matter-antimatter asymmetry, the origin of neutrino masses, the reason for the existence of 3 families of quarks and leptons, the lightness of the Higgs boson, and the weakness of gravity. These questions cannot be explained within the frame of the Standard Model.

Operating at centre-of-mass (c.m.) energies of 7 and 8 TeV in 2011-13, the *LHC* has not uncovered any evidence yet for physics beyond the standard model. Possibly some new information will be provided by *LHC* proton-proton collisions at higher c.m. energy (13 and 14 TeV) in 2015-18. How can one go further?

Recognizing that circular proton-proton colliders are the main, and possibly only, experimental tool available in the coming decades for exploring particle physics in the energy range of tens of TeV, the recent update of the European Strategy for Particle Physics, which was adopted by the CERN Council during an exceptional meeting at Brussels in May 2013, requests CERN to “undertake design studies for accelerator projects in a global context with emphasis on proton-proton and electron-positron high-energy frontier machines ... [which] should be coupled to a vigorous accelerator R&D programme, including high-field magnets and high-gradient accelerating structures, in collaboration with national institutes, laboratories and universities worldwide” in order to be ready “to propose an ambitious post-LHC accelerator project ... by the time of the next Strategy update” [around 2019].

In direct response to this European request, at a special

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Schematic of a 100-km tunnel for a highest-energy circular collider in the Lake Geneva basin.

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FCC kick-off in February 2014 (<http://indico.cern.ch/fcc-kickoff>) CERN has launched the Future Circular Collider (FCC) study (<http://cern.ch/fcc>), the purpose of which is to deliver a Conceptual Design Report and a cost review by 2018. The focus of the FCC study is a 100-TeV c.m. proton-proton collider (FCC-hh), based on 16-T Nb_3Sn magnets in a new 100-km tunnel with a peak luminosity of $5-10 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$. The FCC-hh defines the infrastructure requirements. The FCC study also comprises the design of a high-luminosity e^+e^- collider (FCC-ee, formerly TLEP), serving as Z, W, Higgs and top factory, with luminosities ranging from $\approx 10^{36}$ to $\approx 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ per collision point at the Z pole and t-tbar threshold, respectively, as a potential intermediate step. In addition, the FCC study considers a proton-lepton (FCC-he) option, with a luminosity of up to $10^{35} \text{ cm}^{-2} \text{ s}^{-1}$, reached in collisions of 60-GeV electrons with 50-TeV protons.

Over the last two decades Nb_3Sn high-field magnet technology has made great strides forward, thanks to ITER conductor development, US-LARP and EC co-funded R&D activities and the US DOE core development programme. The High-Luminosity upgrade of the LHC (HL-LHC), which is expected to be completed by 2025, includes a few tens of Nb_3Sn dipole and quadrupole magnets. The HL-LHC, thereby, prepares the technology base for the FCC-hh. Conceptual cost-optimized designs of FCC 15-20 T high field dipole magnets in block-coil geometry shown below. The FCC study of a 100-TeV hadron collider can also draw on the results of several pertinent previous studies, including the Italian 300-km ELOISA TRON project (ongoing since 1979), a little known but far-sighted

“TRISTAN-IP” 94-km tunnel infrastructure study in Japan (1983), the ill-fated 87-km SSC project at Waxahachie, Texas (abandoned in 1993), and the ingenious 233-km VLHC design (culminating in the report “Design Study for a Staged Very Large Hadron Collider,” <http://lss.fnal.gov/archive/test-tm/2000/fermilab-tm-2149.pdf>). In particular, the VLHC design has greatly advanced the development of cost-effective fast cycling transmission line magnets, and of warm photon stops vis-a-vis an unprecedented synchrotron radiation heat load in the cold arcs.

Aside from the development of high-field magnets, the consequences of synchrotron radiation both for the beam and for the cryo beam vacuum system are among the primary design challenges for the FCC-hh. The key element for FCC-ee is a 100-MW RF system at 400 or 800 MHz, for which advanced cavity production techniques and more efficient RF power sources should be developed.

Ongoing discussions with interested partner institutes are presently being formalized through memoranda of understanding. More than 40 institutes from around the world, in particular from Europe, Asia and North America, have already formally joined the FCC study. In parallel, an international collaboration board with representatives from all study participants has been set up. At the preparatory collaboration-board meeting on 9-10 September 2014, Leonid “Lenny” Rivkin from PSI and EPFL (Switzerland) was unanimously elected as interim Collaboration Board Chair. The first annual FCC workshop held at Washington DC in March 2015, jointly organized by CERN and the US DOE’s Office

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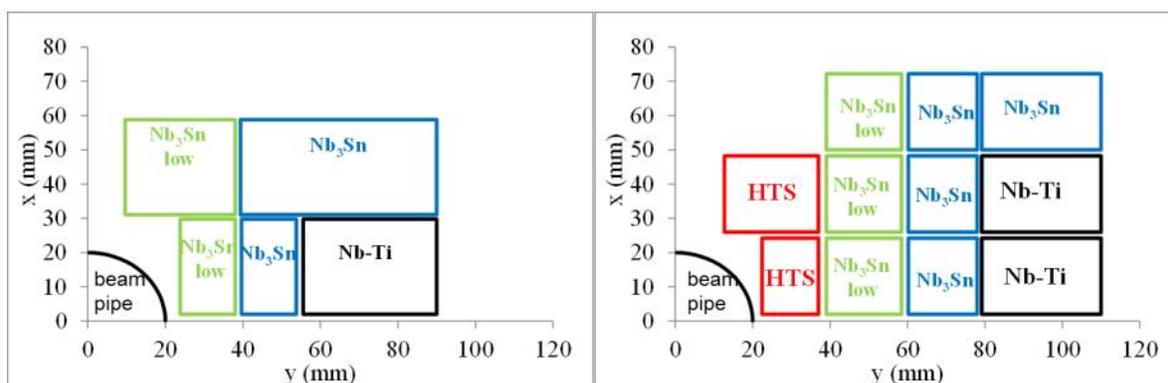


Figure 2: Conceptual designs of 15- or 16-T (left) and 20-T dipole magnets (right). Only a quarter of one magnet is shown. [E. Todesco, L. Rossi, P. McIntyre].

(Continued from page 16)

of Science, marks an important milestone of the FCC study, namely the end of the “weak interaction” phase. The workshop poster of the FCC week 2015 and a sketch of the overall 5-year study time line are shown below.

Michael Benedikt and Frank Zimmermann are senior scientists at CERN. Benedikt is the FCC Study Leader and Zimmermann Deputy FCC Study Leader. Zimmermann, an APS fellow, also serves as the Editor of the APS journal PRST-AB.

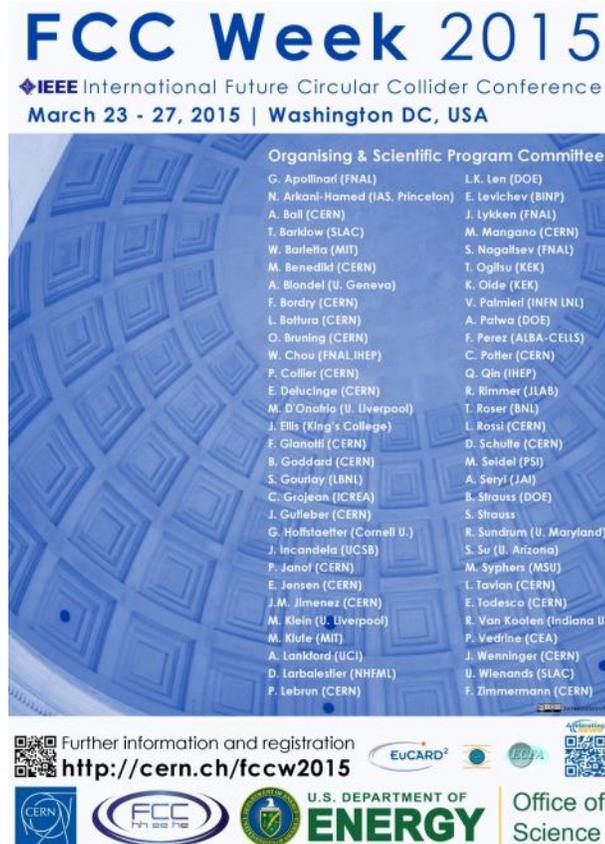


Figure 3: Workshop poster for the “FCC Week 2015” in Washington DC.

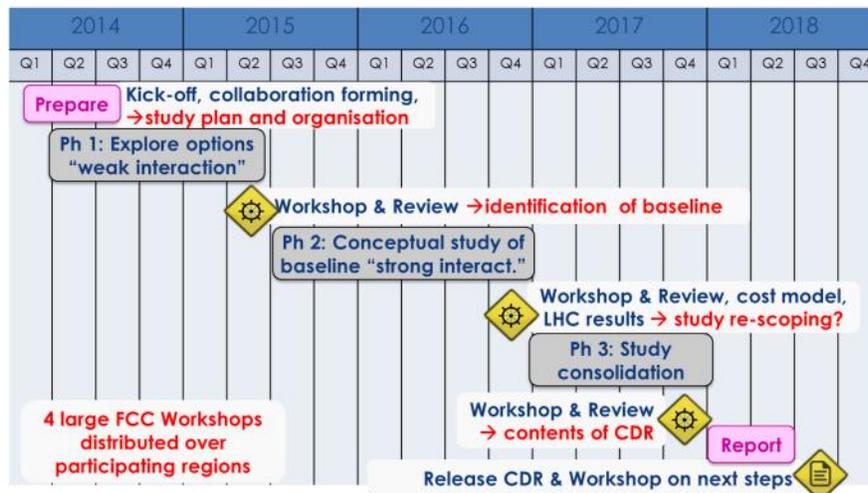


Figure 4: FCC study time line.

The CEPC-SPPC Project, a trip to China

CEPC-SPPC: Circular Electron Positron Collider – Super Proton Proton Collider

Ernie Malamud

In the fall of last year I was “called out of retirement” to assist in the development of a pre-CDR (Conceptual Design Report) for the ambitious Chinese CEPC-SPPC proposal. [1] My role was mainly to smooth out the English, but I was also able to draw on many years of accelerator experience and the preparation of similar large reports [2, 3] to be able to make numerous suggestions on content details. It gave me great satisfaction to be able to do so.

I was invited by Weiren Chou, my Fermilab colleague of many years to join this effort. I spent two weeks at the Institute for High Energy Physics (IHEP) of the Chinese Academy of Sciences. IHEP is a comfortable place to work. It is located in an animated quarter of Beijing; the Guest House is comfortable; the onsite restaurant is excellent and I had a well-equipped office in the IHEP main building.

The pre-CDR has been written by a large group, mostly young hard-working Chinese physicists and engineers. The design study author list currently has 258 names from 44 institutions. Most of the institutions are Chinese with IHEP the lead institution. It is impressive how rapidly the CEPC-SPPC project has evolved. Al-

so it impressed me that these many different Chinese physicists and engineers were able to express themselves in a language that is certainly not native to them and quite different from Chinese. As I worked my way through the text it was apparent that each chapter and in many cases each section of each chapter was written by a different person or group with their own stylistic quirks.

The discovery of the Higgs and its relatively low mass (126 GeV) revived interest in large-circumference circular colliders. (See also the article on the FCC Study [4] in this newsletter.) And once having a large circumference tunnel, it also revives our dream of a super high-energy hadron collider, a dream that died with the demise of the SSC.

The CEPC-SPPC pre-CDR concentrates on the accelerator physics (chapter 4) and the technical systems (chapter 5) required to achieve the performance goals of the e+e- Higgs factory. The pp machine is not yet developed in detail. An important feature of CEPC-SPPC is that the tunnel is large enough so that the pp ring can be put in place without disturbing the lepton

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With Weiren Chou in the comfortable office assigned to me in the IHEP main building. Chou, Chair of the ICFA Beam Dynamics Panel and Co-editor of RAST is leading the preparation of the CEPC-SPPC pre-CDR.



(Continued from page 19)

be underground, 50 - 100 m deep, to accommodate these three ring accelerators: the CEPC collider, the SPPC collider, and a full energy booster for the CEPC. Therefore, the tunnel must be big, about 6 m in width because it is planned to keep the CEPC ring in the tunnel when the SPPC is built and operates. While the two colliders will be mounted on the floor, the booster will hang from the ceiling, similar to the Recycler in the Main Injector tunnel at Fermilab.

The top level parameters for the pp collider are less certain. The energy, of course, depends on the final ring circumference and achievable magnetic fields in production magnets. With the 54.7 km circumference, 70 TeV cm can be realized if the magnets, probably constructed from a combination of Nb₃Sn and High-Temperature SC coils can operate at 20 T. A luminosity goal of 10³⁵ is stated in Chapter 7 (Upgrade to the SPPC) but there is considerable debate in the HEP community of what it needs to be for the physics one is aiming at but also the ability of future detectors to handle these high luminosities. Center of mass energies will depend on the final choice of circumference and what can be achieved in the magnet R&D program. These energies are a factor of 5 to 7 jump from LHC, which itself is a factor of 7 jump from the Tevatron. So this is a logical future step as humanity pushes forward on the energy frontier.

More than 65% of the Booster and Main Ring circumference will consist of dipole magnets. Therefore, the magnet cost becomes an important issue, especially the dipole magnets. Since the field of the dipole magnets is very low, as in LEP's dipole magnets, steel-concrete cores will be used to make the yokes. Advantages for steel-concrete cores are cost reduction since concrete substitutes for 75% of the steel and also by increasing the magnetic induction in the iron, the magnets are less sensitive to variations in iron quality and in particular to the coercive force.

There are numerous possibilities for the site. As was learned from the Fermilab and the SSC site selection processes, choosing a site is complex and many factors are involved. In Chapter 9 of the report a **candidate** site near Qinghuangdao, a city of 2 million, about 300 km east of Beijing, has been chosen. This site has excellent geology and other advantages. Chapter 9 is

interesting reading because the site selection criteria, geology, water, site access, possible construction methods are outlined in detail, and then applied to this "candidate" site.

After considering the details of the technical systems as well as the civil construction it is possible to make a tentative time line for the CEPC for a 5-year R&D phase followed by a 7 year construction period. The most expensive technical systems of the CEPC are: (1) the superconducting RF (SRF) system; (2) the RF power source; and (3) the cryogenic system and a large part of the R&D budget will focus on these systems. The CEPC SRF system will be one of the largest and most powerful SRF accelerator installations in the world. To succeed with designing, fabricating, commissioning and installation of such a system, a significant investment in R&D, infrastructure and personnel development is necessary. The total RF stations provide 12 GeV of RF voltage. The collider will use 384 650-MHz five-cell cavities in 96 cryomodules for the collider and 256 nine-cell 1.3-GHz cavities in 32 cryomodules for the Booster. All the cavities will be cooled in a liquid-helium bath at 2 K. Thus the cryogenic system is a major component of CEPC. The majority of the R&D budget (58%) will be invested in the "big three" systems – SRF, RF power source and cryogenics.

In addition to the capital construction cost, the operations cost is another major issue. It is mainly determined by the power consumption to operate the CEPC. When the Tevatron was running, the average total power usage at Fermilab was 58 MW. When the LHC was running, CERN used 183 MW (average over 2012). The consensus for operating a future circular Higgs factory is that the power should not exceed 300 MW, in which 100 MW is for the synchrotron radiation. In other words, wall plug efficiency of 1/3.

This report only describes a few of the highlights of my trip to China and a few of the major parameters of the CEPC-SPPC facility. The full report [1] will be published soon so the interested reader can learn more details. This is work in progress. Parameters may change but the basic concept is sound. I look forward to another two weeks in Beijing in March as we work to finalize the report after a February review.

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Accelerators in Australia

Mark Boland

Accelerator physics in Australia has been undergoing a renaissance in the past decade, spearheaded by the Australian Synchrotron light source (<http://www.asls.org.au>), a user facility in operation since 2007. The \$200M laboratory located in Melbourne is the latest in a series of research accelerators that have serviced the science community since the pioneering days of particle accelerators [1]. Australians were part of the early development of high energy accelerators led by Mark Oliphant. Oliphant, during his time in Birmingham (1937 – 1945) designed the proton-synchrotron, in which particles could be accelerated to GeV energies. [2, 3, 4] This work was based on the 'phase stability' principle, which he conceived before Vladimir Veksler and Edwin McMillan.

Oliphant's pioneering invention did not lead at that time to the construction of synchrotrons in Australia; however more recent work is putting Australia back on the map. Australia now operates over 200 particle accelerators, from radiation therapy electron linacs and cyclotrons for producing radiopharmaceuticals, to heavy ion accelerators for studying exotic nuclei and Accelerator Mass Spectroscopy. In 2011 the Australian Synchrotron storage ring set a new world record low for vertical emittance coupling [5], research motivated by the requirements for the damping rings for the next generation e⁺-e⁻ linear collider. This achievement of sub-picometer vertical emittance led to the development of a new emittance measurement technique using a vertical undulator [6]. Recent results from Melbourne indicate the quantum limit of vertical emittance has been reached and thus demonstrates the designs for future linear colliders are indeed feasible.

Ernie Malamud (马欧尼), spent three decades at Fermilab participating in high energy physics experiments and accelerator design and construction. He is a Fermilab Scientist Emeritus, is on the adjunct faculty at the University of Nevada, and a member of the CEPC-SPPC Design Study Group.

Kent Wootton, the PhD student responsible for the sub-picometer vertical emittance research, has accepted a postdoc position at SLAC working in the Advanced Accelerator Research Division on the accelerator on the chip project [7]. This new position will build on past collaboration between Australia and SLAC, including the precise beam energy measurements conducted by Kent on both sides of the Pacific Ocean [8]. I am Kent's thesis supervisor and will join him there for six months starting in August 2014 to work on short pulse experiments at SPEAR3 and LCLS.

ACAS, the Australian Collaboration for Accelerator Science (<http://accelerators.org.au>), coordinates activities between the four largest research laboratories in Australia; the Australian Synchrotron, the Australian Nuclear Science and Technology Organisation, the Australian National University and the University of Melbourne. One of the main missions of ACAS is to grow the local accelerator physics community, and it has done so by running summer schools to pique the interest of university students. Four schools have been run since 2008 and provide introductory accelerator physics lectures and laboratory classes. The more advanced students go on to attend international schools like the US Particle Accelerator School (USPAS), the CERN Accelerator School (CAS) and the International School for Linear Colliders. Each school has attracted several students into graduate research projects and they have gone on to work in the field of accelerators at hospitals, in industry, for government agencies for radiation protection and calibration, accelerator operations and accelerator research.

In recognition of the importance of the field of particle accelerators, the Australian Academy of Science as part of a *Future Science* program has commissioned an ex-

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pert panel to write a report on how Australia should continue to develop its accelerator facilities. The world trends suggest these plans will include hadron therapy machines for treating cancer, new light sources such as ultimate storage rings and free electron lasers, participation in international linear collider collaborations and developing the existing user facilities for X-ray and nuclear physics beams. With all the local and worldwide activities in accelerator physics research and development, there are ample reasons for Australia to consolidate its achievements from the past and look forward to a bright future in the field.

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Mark is a Principal Scientist in Accelerator Physics at the Australian Synchrotron and a Principal Fellow at the University of Melbourne where he teaches and supervises student projects. To coordinate the recent developments in accelerator physics in Australia and the international collaborations with labs like SLAC, CERN and KEK, Mark helped found and is a director of ACAS – the Australian Collaboration for Accelerator Science.

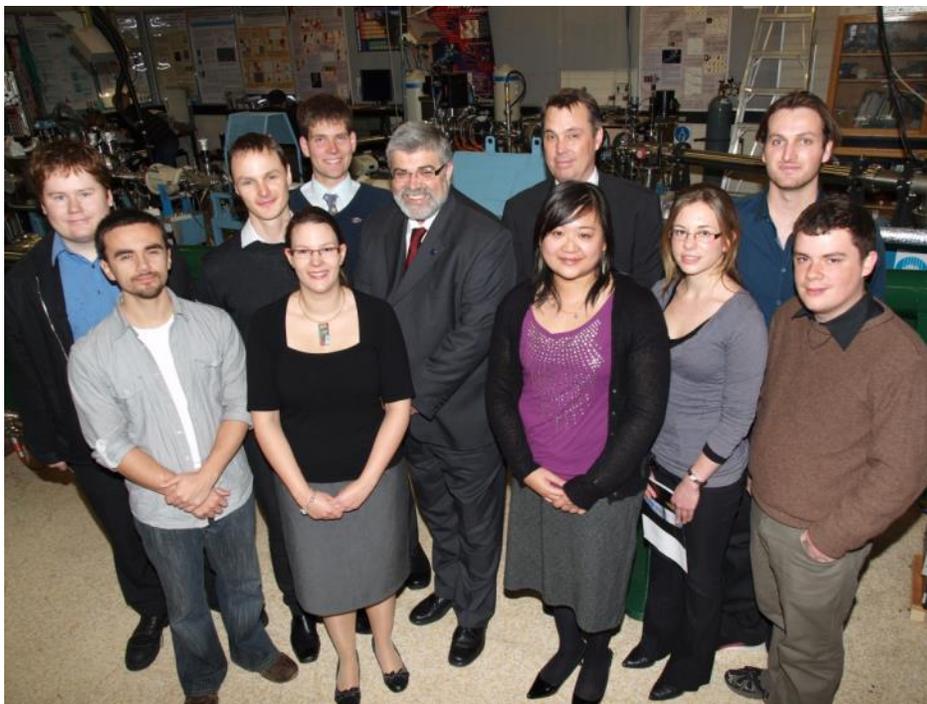
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Mark Boland (R) leads a tour of the Australian Synchrotron for CERN Director General Rolf Heuer (C) and CERN Director of Research and Computing Sergio Bertolucci (L) during ICHEP 2012 in Melbourne after the Higgs particle discovery was announced.



Open Day 2010 at the Australian Synchrotron with a keen interest for the accelerator science displays.



Australian Minister for Science Kim Carr (second from the left) surrounded by accelerator science students at the launch of ACAS in 2010, Kent Wootton is standing behind Kim Carr.

Reflections on the Fifth International Conference on Women in Physics

Chandralekha Singh

Imagine women physicists from every continent on the planet! I made it my mission to talk with as many of them as possible. The countries represented were big and small. I had the opportunity to interact with women physicists not only from the Western countries but also from Burkina Faso, Estonia, Algeria, Tunisia, Iran, Egypt, Zambia, Tanzania, Ghana, Pakistan, Nepal, India, Lithuania, Armenia, Sudan, Japan, China, Uganda, Belarus, Cameroon, Ethiopia, Nigeria, Uruguay, Ecuador, Mexico, El Salvador, Honduras, and Philippines.

In August 2014, I attended the Fifth International Conference on Women in Physics (ICWIP2014) in Waterloo Canada as part of the US delegation. The conference was attended by approximately 215 female physicists and a few male physicists from 49 different countries. There were research talks, panels, workshops, breakout sessions and posters on issues related to women in physics.

Barriers to the advancement of women in physics that were listed in the country reports included societal biases affecting women and accumulating over time from an early age, unconscious gender bias, stereotype threat, family responsibilities, unfriendly and unsupportive environment in physics departments, lack of mentoring, lack of a critical number of women in physics and role models, physics being a competitive field rather than a collaborative field, a perception that physicists do not try to explain to students how physics helps humankind, men in physics in some countries acting “macho” and women physicists feeling marginalized. And, in some countries, e.g., in the Sudan, issues that negatively impact and limit women in physics include religion, economics and politics.

There were workshops in which we learned what social scientists have ascertained about how girls are influenced as they grow up with regard to pursuing science and mathematics. In the workshop, “Equity and education: Examining gendered stigma in science”, we learned that, while most girls are interested in science and math when they are in early grades, in countries

like the US, many tend to step away, often because they unwittingly conform to societal gender stereotypes. Women in some countries like the US are often victims of gender stereotypes from very early on, and some women are impacted so much that they even start questioning their own ability to ever be equal to or better than men in STEM fields. Societal biases related to women not being smart enough to pursue careers in male dominated STEM fields can impact women’s beliefs about their own capability and negatively influence whether women pursue STEM majors and how they perform in STEM courses. In some countries such as the US, when women don’t succeed in a science course, people often attribute it to their poor abilities; but when men do not succeed, people often attribute it to their lack of effort or poor teaching but not to their lack of ability. This dichotomy has a negative impact on whether women who have failed once (“failing” could even be obtaining a B or a C grade in a course for an otherwise high achieving woman) would want to pursue those subjects in the future. Due to these gender stereotypes, many women in male-dominated fields assume that small setbacks, e.g., getting one B or C grade in a physics course, are indicative of their lack of aptitude for physics. They are more likely to interpret such setbacks to imply that they are not cut out to pursue a physics related degree and so they lose confidence. If women underperform, they are often likely to blame themselves and feel that they do not have the talent necessary for excelling in the subject in which their male counterparts seem to have an edge. In several studies, if students did not perform well in a test and were told that learning is about effort, they tried harder and did better later but if they were told that learning is tied to innate ability, they did not try harder after they performed poorly.

The stereotype threat, e.g., directly or indirectly being reminded that women cannot do physics can exacerbate the situation. Women become victims of stereotype threat when their performance is negatively impacted by their negative perception about the group -

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“women”- to which they belong. For example, just asking women to write their gender on the test sheet before they take a test can act as a stereotype threat and can lead to women performing worse than they otherwise would if they were not told to write their gender. Writing her gender can act as a stereotype threat because women are already aware of the societal stereotype that women are not supposed to do as well as men in a math and science.

Such a threat often undermines a woman’s ability to score high on tests or other standard measures of academic achievement. Research in some Western countries such as the US suggests that people often perform much below their level when they conform to a stereotype under the threat.

Discrimination women physicists faced in the work place is overt in some countries and in some cases subtle, the differences are caused by how each culture views women. Women in physics in many countries are still often made to feel that they have chosen a wrong career path. Their success is overlooked. Their opinions are often dismissed even if they are worthy of further discussions. Women physicists from many countries in Africa, Asia and South America reported that they even have to justify why they chose physics despite being a woman because of the macho culture and societal norms.

The “leaky pipeline” prevents women physicists in all countries from reaching the highest levels of our profession. The amount of leakage and at what stage it occurs varies significantly from country to country. In the US, women’s participation in physics decreases precipitously from high school to college level and then again in the top leadership positions in physics. However, unlike the situation in many other countries, in the US, in the last decade, there is no leak from the undergraduate to graduate to assistant professor level in physics --the percentage of women at each of these levels has hovered around 20%.

Regardless of the country, the common theme at the conference was that women are highly underrepresented in leadership positions and decision making roles. The overall proportion of female researchers in Estonia is over 40% and exceeds the European average but the

gender imbalance in the researcher population increases with age. Women physicists from some Asian countries, e.g., China, noted that everything was fine up to graduate school and there was no significant barrier for women in physics until they obtained their Ph.D. After the Ph.D., there is a perception that women do not have the ability to be good physics professors, researchers or scientific leaders or that they should focus on their family rather than pursuing a high-profile career as a physicist. The glass ceiling was cited as a major factor why women fail to reach the top in physics across the world.

Igle Gledhill (South Africa) explored various aspects of our working environment, including intangible ones. Making the distinction between schemas and stereotypes (negative schemas), she introduced the dichotomous pair of schemas: Men are associated with agentic schema (proactive, independent, assertive) and women are associated with nurturative schema (nurturing, helpful, cooperative). She noted that workplaces tend to be agentic and being in the minority in a workplace increases the probability of encountering contradictory schemas. In order to recruit and retain more women in physics and improve the climate for women physicists, she emphasized the need to develop an awareness of our own schemas and challenge them. She noted that it is useful to be aware that prejudice rises during times of threat and, once it is in place, it lingers much longer than the threat does, and is hard to shake off. She also noted that research has shown that a stranger introduced to an environment will assume that a person with advantage is inherently better, whether that is the case or not. Once advantage and disadvantage have been established, the gap tends to widen which can hurt women physicists since they are unlikely to be in an advantageous position.

The other reason discussed for why women fail to rise and sometimes quit midway in physics is a sense of isolation. Women from many countries complained of lack of cooperation and even a condescending attitude displayed by many colleagues.

Casey Tesfaye (American Institute of Physics) presented the results of the International Survey of Physicists analyzed by regions and restricted to 12 countries. In nine of the analyzed countries, women had fewer op-

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opportunities than men and in a different nine country subset they had fewer resources than men. Regarding career progress, women with children progressed more slowly than men in eight of the analyzed countries.

There were several noteworthy differences between the experiences of women physicists in Western versus non-Western countries. The studies from North America suggest that family is not always a major impediment to the professional advancement of women scientists; instead, the major hurdles are the access to resources and implicit bias. However, some women physicists from non-Western countries noted that these findings do not apply to them. In many countries, even today, women are told from a very early age that they should only dream about getting married and having a husband and children, and so most grow up not having high professional aspirations and if they do, they encounter explicit gender bias.

While women in physics in Western countries are striving to be treated as equals without implicit biases and better opportunities for work life balance, in many countries in Africa, South America and Asia, the biases against female physicists are not subtle at all. Women who aspire professionally not only have difficulty fitting in at work; they may also struggle equally hard to win the support of their family members.

Women physicists, especially, from some African countries, noted that taking an interest in physics is also perceived to diminish their feminine attributes. In fact, even in the US, the stereotyped portrayal of female scientists by popular media (e.g., the TV show "The Big Bang Theory") which make them look unattractive does not help in encouraging more young girls to pursue physics. Eileen Pollack, who wrote a New York Times opinion piece (October 13, 2013) about why there are so few women in science, attended this ICWIP2014 conference as a panelist and raised the point that the paucity of women going into physics is exacerbated by the stereotyped portrayal of female scientists.

Women physicists from Iran noted that more than 60% of BS and MS students, 47% of PhD students but only 18% of faculties in the physics departments are currently women. These high percentages of female physics

students are partly because men in Iran are often more interested in engineering since the career prospects are better. Women from Egypt noted that the reason many women do not take comparable jobs to men even after obtaining their Ph.D. is that they want to be closer to home in order to take care of their families and have lower aspirations professionally in order to balance work and family.

What was clear is that in many of these non-Western countries the women physicists have greater difficulty balancing family and work. Not only are they responsible for everything at home, in addition childcare and flexible work hour options are much less common in these countries. Some women physicists from those countries seemed resigned to the fact that they are unlikely to get an opportunity to pursue a career in physics which is as rewarding as the one afforded to their male counterparts because they have to find a job closer to home in order to balance work and life. In some of these countries efforts to provide opportunities to balance work and family and counter biases that exacerbate the difficulties are impossible to even dream of at this time.

Even in western countries female physicists face challenges. The German contingent discussed data suggesting that female physicists' professional competence and accomplishments are less appreciated and that parenthood affects their education and career distinctly stronger than their male counterparts. Physicists from Finland (where the first female professor of physics was hired in 2004 at the University of Helsinki) noted that cultural reasons were central for understanding the gendered career segregation processes. For example, they noted that many major decisions are made in men-only "saunas" which automatically excludes women physicists.

While all ICWIP2014 participants felt that early interventions at the K-12 level were key to the advancement of women in physics, there were large variations in the amount and effectiveness of these interventions implemented so far.

We discussed that many women often set high stand-

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ards for whatever they do and if there are any lapses, they may lose confidence in themselves and feel they have failed. What these women desperately need is more mentoring, encouragement, guidance and support from parents, teachers, counselors, and role models in order to persist and overcome setbacks.

Cathy Foley (Australia) made a presentation, titled “Can you have it all? Making it work for you” and noted that if unconscious societal and workplace biases are removed and climate and support for women physicists at workplace improves, women can succeed both professionally and at home. In another session, Prajval Shastri (India) made a presentation titled “Interventions towards gender equity in physics: seeding or hindering cultural change?” in which she discussed why certain policies for advancement of women in physics are better than others. In the discussions, consequences of Germany’s generous maternity leave policy emerged as an example supporting replacement of maternity leave by family leave. Finland emerged as a counter-example in that the generous gender-neutral parental leave policy is used by less than 10% of fathers. Beth Cunningham, AAPT Executive Officer, asked participants to

engage with the issue of how physics societies can make a difference in the success of women in physics (WIP). She introduced the activities of AAPT and APS related to childcare grants, committees on WIP, workshops on WIP, and inventory of women in leadership roles, awards, plenary speakers, and editorial boards.

Diversity enhances excellence in physics and other STEM fields, especially in an era in which society has become increasingly dependent on science and engineering innovations in every walk of life. Conference participants agreed that we need to provide equal opportunity to everybody regardless of who they are from a very young age to cultivate their interest in these disciplines so that they can live up to their potential.

The good news is that in many countries there is more awareness in the science and engineering departments in which women are underrepresented, that there may be implicit and explicit biases that partly account for the underrepresentation of women and more effort should be devoted to recruit and retain talented women to ensure that everybody has an opportunity to contribute to the vitality of these disciplines.

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The US Delegation at the 5th ICWIP

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At this conference, there were amazing bonds created. The experience was both uplifting and humbling at the same time. I shared many challenges that I have faced but felt lucky that my circumstances were not nearly as difficult as what some of these women physicists have endured.

I think the US can take a leadership role and lead the way with policies and practices that support women physicists, and forge a future by doing the right things to create equality for all physicists. This type of leadership will also enhance excellence in physics.

You can hear interesting and inspiring stories from some of the participants in the conference by watching a 14 minute video: <https://www.youtube.com/watch?v=ofE-mJFJR5w>

This international conference will be the topic of a session at the APS April meeting, at 1:30 pm on Tuesday 14th April, 2015. **The 5th International Conference on**

Women in Physics, Reflection and Going Forward

Jointly sponsored by the Committee on the Status of Women in Physics and the Forum on International Physics, the session will feature two invited speakers and two additional panelists. They will provide an overview of the 5th ICWIP, details of efforts to decrease the gender gap in physics in India and the US and reflections on what they experienced and learned at this invigorating conference.

Chandralekha Singh, is a Professor in the Department of Physics and Astronomy at the University of Pittsburgh and Founding Director of the [Discipline-based Science Education Research Center \(dB-SERC\)](#). The goal of Singh's research is to identify sources of student difficulties in learning physics both at the introductory and advanced levels, and to design, implement, and assess curricula/pedagogies that may significantly reduce these difficulties. Her research also focuses on cognitive issues in learning physics. Singh served in the Chair line of the APS Forum on Education 2009-

Saudi Arabia Connection

Sultana N. Nahar

For the last five years, the Ministry of Higher Education (MOHE) of Saudi Arabia has been holding the International Exhibition and Conference on Higher Education (IECHE) in the Riyadh International Exhibition Center. At the 2014 conference in April 438 universities from 36 countries participated. The US had the most prominent presence with 108 institutions. Universities exhibited their academic programs in booths. They could also buy workshop time to present program details. A number of participating international institutions are MOHE invitees and the Ohio State University (OSU) was one of these. I led the OSU team of 3 members. Being a Muslim, I felt blessed for the opportunity to visit the holy cities of Makkah and Medina before the start of the conference.

Trip objectives:

- Promote OSU programs, particularly the new STEM ER (science, technology, engineering, mathematics research

and education) faculty training program under the Obama-Singh 21st Century Knowledge Initiative award.

- Promote the International Society of Muslim Women in Science (ISMWS) to encourage and help Muslim women in science education and professionally in all areas of science and applied science.
- Promote the American Physical Society (APS) and explain how APS can help physicists become part of the international scientific community.
- Observe status of scientific research and initiate collaborations with interested groups.

At IECHE, I met Dr. Khaled Al Anqari, the Minister of Higher Education and discussed these objectives. He was supportive and assigned Deputy Minister, Dr. Mohammad Al Ohali, for the next step. I also met Deputy Minister Dr. Ahmad Alsaif for discussion. Our STEM faculty training project received the most attention as it

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meets one of their basic needs. Dr. Al Ohali, who has a Ph.D. in physics from Duke University, commented that the program was “super good” and they have put it on their agenda for discussion.

At IECHE the US booths had the largest crowd compared to those from other countries and our OSU booth was one of the most popular ones. There were queries on admission requirements and university ranking for many different departments and fields. We were asked about distance learning, pre- and post-doctoral research exchange programs and teacher training. I met deans, vice presidents, and professors from several universities, including Umm Al-Qura (Makkah), King Khaled (Riyadh), Al Hudud ash Shamaliyah (Arar, Northern Border Province), Jazan (Jizan, Jizan Province), and King Fahd University of Petroleum and Minerals (KFUPM, Dhahran, Eastern Province), Prince Sultan University (Riyadh), American University in Beirut, University of British Columbia, and Universiti Teknologi in Malaysia. All showed interest in the STEM faculty training project and ISMWS, and wanted to have the materials emailed to them. I also spoke with representatives of the Education and Research Committee of the Majlis Alshura Council. One of them, Dr. Elham Hassanain, is a Physics professor. Majlis Alshura, has now a fixed number of educated female members whose positions were introduced a few years ago by King Abdullah. These members are appointed by the government and play an important role by giving their input in making decisions on women as well as educational issues in the government.

I visited four universities: Taibah University (Medina, Medina Province in the west), Dammam University (Dammam, Eastern Province) and King Saud and Princess Norah Universities in Riyadh. It was impressive to observe great progress in education and to meet many scientists, particularly female scientists, who are largely unknown outside the country. In the next decade Saudi Arabia should experience rapid progress in education and research. There are about 32 public and 10 private universities in Saudi Arabia. Most of the public universities are either new or converted to a new university from a branch campus of an older university. While all universities accommodate both men and women, KFUPM has only male students, but expects to be co-ed in the future, and Princess Norah University is solely for females. Almost all universities have large enrollment. Taibah, Dammam, King Saud, and Princess Norah Universities each has over 60,000 students.

Taibah University has over 500 physics majors. The government is building laboratories for both courses and research. Although research is not well advanced in these universities, there are a few exceptions. Taibah University received a \$3M research grant during the last academic year for research initiatives and one pharmacy faculty member, Professor Hosam Gharib, has about \$1M for his research projects. In each place I visited, I met many enthusiastic faculty members and students. There were both non-Saudi and Saudi faculty members, but the students are mostly Saudis. Saudi students study free while non-Saudi students pay full tuition.

I gave multiple seminars at institutions I visited, including a workshop on atomic structure code at King Saud University. People at each university expressed a keen interest in research collaborations. They also appreciated our STEM ER faculty program for Ph.D. students, but unlike MOHE they commented that they are not quite ready for it since the best students, which our project aims at, are sent to developed countries for the Ph.D. degree. Upon return, these students are hired by the major universities. Those who cannot make it outside Saudi Arabia do their Ph.D. in Saudi universities and are hired by smaller universities.

I would like to comment on the black outfit (called abaya) of the two women, Dr. Innas and Dr. Hanadi, in the picture where I am holding the university monogram from President Dr. Almazroa. Black abaya (with some variations in different countries) is the most common traditional outfit for a Muslim woman. She wears it as her choice. She feels it easy to move around without someone's unnecessary attention and keeps her clean from outside dirt. However, inside she always wears something very decent. Inside the four Saudi women's colleges I visited, almost everyone was wearing fashionable western dress and with various hair styles. They wear abaya whenever they step out or have their picture taken. At IECHE, all international female participants wore black abaya given as gifts by Dr. Al Anqari of MOHE. It was pleasant to see that they were wearing the abayas happily and some even went to Riyadh markets to buy extra ones of their choice.

At Taibah University, the head of the Women's college, Dr. Inass, is a physician who works at the hospital for 2 days each week and 3 days at the university. the Vice Dean of the Science faculty, Dr. Hanadi Zahid, has a Ph.D. in mathematics from the University of Manchester. Hanadi was married

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at age 18, but continued her education while raising three children. She told me that was not unusual among educated, married Saudi women.

Dammam University emphasizes engineering for men and biomedical engineering for women. My presentation on X-ray research for cancer treatment was advertised to various deans and departments by the Dean of Engineering, Professor Abdulrahman Hariri. This university has more developed research programs and laboratories. The Dean discussed water research since he learned that OSU has an extensive water research program. The STEM ER program was seen as a further development. I was given the University trophy for making a positive contribution for the university. Research is difficult for the Physics Department in the women college where I gave separate presentations. There is limited access to male colleagues for joint research projects. The physics department chair (with a Ph.D. in molecular spectroscopy) had been trying, so far unsuccessfully, to approach US universities for a research collaboration since it is easy to get a Saudi grant to spend time in the US.

King Saud University is one of the oldest in the country and the recipient of a large research grant. It is active in many research areas. There are two domes for astronomy research, one devoted to solar study. During my 5-day visit, I met people from various science departments, men and women, and deans of the women college. The research group interested in r-matrix calculation that I do has one man, Prof. Nabil Bennessib from Tunisia, and two women, Dr. Norah Alonizan of Saudi Arabia who is also the Chair of Physics Department of the women's college, and Dr. Rabia Qindel of Pakistan. This group has been working very productively. After Rabia Qindel completed her Ph.D. in physics she travelled to South America for a Post Doc and finally obtained a position at King Saud. She struggles in her profession with children and in a country where she cannot drive. Professor Laila Babsail, a Saudi Physics professor with a Ph.D. from Canada, has managed to carry on with a family and a hired male driver from India. She is a member of ISMWS and had been most helpful in introducing me to Princess Nora University. One MOHE official told me that allowing women to drive is under consideration and that the ban will be lifted

I spent one day at Princess Nora University. My visit was advertised and the Dean of faculty of science came to my talk. The laboratory tour showed an emphasis on a strong undergraduate program. There are about 800 physics ma-

jors. Research is being developed, and I have been asked to guide X-ray research in astronomy. MOHE invited delegates, whom it invited to IECHE, for the Desert Picnic one evening. We experienced a camel ride, and Saudi folk songs and participated in simple dances. I may note that there was no problem with the four males helping female delegates to camel ride similar to what they did for the male delegates. This occasion gave me the opportunity to promote the new STEM program and discuss other topics with representatives of universities in Algeria, Lebanon, France, and the US.

The US Embassy organized a reception at Quincy House for US representatives and Saudi education officials. I met several people both from the US and King Fahd University of Petroleum and Minerals. James Smith, the ambassador, presented information on the US university participation in IECHE. He spoke of the continuing strong relationship between the US and Saudi Arabia which began with a meeting between King Abdulaziz and US President Franklin Roosevelt on board the US Navy cruiser Quincy in the Suez Canal on February 14, 1945.

In addition to providing information on studying at OSU, each of our team did considerable networking with MOHE officials, deans or high ranking officials, professors at Saudi universities, and with OSU alumni in Saudi Arabia. The visit to Saudi Arabia also cleared up several misconceptions communicated to us before going to there. I was asked several times to hand over the delegation leadership to male delegate Robert Eckhart because being a female the Saudis would avoid me and might not cooperate or help us. This turned out to be wrong. I was treated very well, like any other male participant. This began with Dr. Salim Al-Malik, the General Director for International Affairs of MOHE, who responded to each of my emails. I also heard that I would be hit on the head if any trace of hair sticks out of the veil, conference helpers would not translate my English to Arabic whenever it would be necessary, we would need to treat any royal member who would stop by the booth with all possible help since they are used to servants doing things for them. We did not encounter any of these, rather were impressed by their generous hospitality.

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At IECHE 2014: Minister of Higher Education, Dr. Khaled Al Anqari gives Sultana a box of MOHE information about current education and research status.



The cone shaped structure in the background, the Al Faisaliah Hotel where the delegates stayed, is called the Jewel of the Middle East.



Recognition with a Monogram of Taibah University and a citation from the President. The Head of women's college, Dr. Inass, and Vice Dean of the Faculty of Science, Dr. Hanadi Zahid, are in the picture



With two faculty members of Princess Nora University.



Discussion with Professor Laila Babsail of King Saud University and Professor Nesreen Ateqad of Prince Sultan University

Dr. Sultana N. Nahar is a research scientist in the Department of Astronomy at [Ohio State University](http://ohio-state.edu). She has published extensively on radiative and collisional atomic processes in astrophysical and laboratory plasmas, and also worked on dielectronic satellite lines, theoretical spectroscopy, and computational nanospectroscopy for biomedical applications. Sultana Nahar is the winner of the APS 2013 John Wheatley Award. Email: nahar.1@osu.edu

Education and Innovation in Global Science

Emanuela Barzi

Entering 2015 for me was like setting foot into a new era. Is it because of an improved economic scenario, at least from what it looks like on this side of the ocean? Is it the sense of renewed scope in our HEP community from the P5 (Particle Physics Project and Prioritization Panel) strategic plan of last year? We had somewhat floated in limbo since our beloved proton/anti-proton collider, the Tevatron, was shut down at Fermilab only a few years ago. We were beaten by our European friends in the race to find the Higgs boson. Gone was the glamour of big discoveries like the top quark. A sunny vision of the future revived a positive atmosphere in my workplace. Or maybe it's just the weather.

Like most professional fields Science and Technology are now global. Globalization is the process of international integration arising from the interchange of world views, products, ideas and other aspects of culture. Advances in transportation and telecommunications, including the rise of the Internet, favored this process by feeding into a generating cycle of further interdependence of economic and cultural activities. Globalization has carried with it a number of negative attributes. For instance, environmental challenges and pollution are linked with globalization. However, the good news is that globalizing processes affect and are affected by business and work organization, economics, socio-cultural resources, and the natural environment. Therefore we can have an impact on this process and make it fruitful for us. While globalization encompasses all under its wings, Science and Technology have become ever more specialized. How can we foster creativity, excellence and innovation into one small specialized slice of science or technology, while at the same time being bombarded by globalization storms? We cannot do without specialization at the core of technological innovation. But perhaps we can use the same tools that made globalization so strong to build and operate an even stronger network of scientific and technological cooperation among different disciplines. Science has no borders and as such has often offered a venue for peace among Nations. This is what many of us are already doing and what our leaders at the DoE support.

At our last Fermilab's Users Meeting in June 2014, Jim Siegrist, Associate Director of the Office of High Ener-

gy Physics, DoE Office of Science, illustrated the potential for HEP Science and Technology Connections. The strength of the US enterprise is a significant advantage for HEP and its relevance strongly depends on taking advantage of the technical opportunities presented by our sister sciences. Community support around those connections, as well as better planning, cooperation and organizing, were encouraged to have the largest impact in HEP or in allied fields. Fermilab has actively worked in this direction by creating bridges between different communities outside and inside HEP.

As an HEP overture to this dialogue with other Science disciplines in the broad field of Instrumentation, our Director Nigel Lockyer will attend the IEEE International Instrumentation and Technology Conference, I2MTC in Pisa, Italy, May 11-14, 2015. Instrumentation was one of the main areas in the P5 recommendations, both for what is related to R&D and for strengthening university-national laboratory partnerships. In his Conference keynote speech, Lockyer will emphasize how the measurement technologies developed for particle physics could be transferred to other sectors of science and technology, including medicine, manufacturing and energy production. Hopefully the audience will realize the great social impact that an effective technology transfer from HEP to other fields of science could have. Also, this year, in addition to standard sessions the I2MTC Conference will include a Special Session on "Superconducting Sensors and Instrumentation" co-chaired by Dr. Marcel Demarteau of Argonne National Laboratory and myself. The first invited speaker of will be CERN Research Director Dr. Sergio Bertolucci.

Below is our Special Session abstract:

Superconducting materials have found a wide range of applications in science and society. Their unique properties and exquisite sensitivity have been exploited in many science disciplines. Superconductivity is used in detectors for dark matter, for the cosmic microwave background radiation, as well as accelerators for medical isotope production and ion therapy treatment. Superconductivity is also being explored for use in biosensors and quantum computing. This special session seeks to understand the state-of-the-art of the technology in the various applications, how the technology can be exploit-

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ed through better instrumentation and how different science disciplines can contribute to advancing and accelerating the use of these sensors.

Technology connections within HEP by enriching the dialogue between experimental particle physicists and scientists in accelerator technology will be discussed at the “Frontier Detectors for Frontier Physics” (FDFP) Pisa Meeting, 24-30 May 2015, at La Biodola, Isola d’Elba (Italy). The 2015 Pisa Meeting on Instrumentation is the thirteenth of a series initiated in Tirrenia in 1980 and continued in Castiglione della Pescaia and in La Biodola. The meeting is sponsored by the Istituto Nazionale di Fisica Nucleare (INFN), the Società Italiana di Fisica (SIF), the European Physical Society (EPS), the University of Pisa and the University of Siena. An aim of the meeting is to review the progress in detector technology with emphasis on applications in future experiments.

For the first time in its history, the FDFP Meeting has included a topic on “Applied Superconductivity in HEP”. The field is fully mature and is receiving increasing interest by HEP researchers. In the last decade there has been strong progress in implementing Nb₃Sn superconductor in high field accelerator magnets. The use of High Temperature Superconductors is also becoming possible. In the process of upgrading the LHC and in conceiving future HEP accelerators and detectors, the HEP community is investing as never before in high field technologies. This creative process involves the US, Europe, Japan and other Asian countries. One dedicated element is the Center for Integrated Engineering Research being created at Fermilab. This Center would promote interdisciplinary collaboration and greater efficiency in designing, developing, building, commissioning and operating accelerator and detector facilities for particle physics. For the FDFP session on Applied Superconductivity, we invite oral and poster abstract contributions by March 15 in the following areas at <http://www.pi.infn.it/pm/>: Detector magnets; High field magnets; Superconducting links; Superconducting Magnet Instrumentation; Superconductors in accelerators and experiments; Superconducting RF cavities.

Italy is productive soil to sow knowledge in scientific disciplines. Since 1984 Fermilab has been hosting a two-month summer training program for selected un-

dergraduate and graduate Italian students in physics and engineering. Building on the traditional close collaboration between the Italian National Institute of Nuclear Physics (INFN) and Fermilab, the program is supported by INFN, by the DoE and by the Scuola Superiore di Sant’Anna of Pisa (SSSA), and is run by the Cultural Association of Italians at Fermilab (CAIF). This year the University of Pisa has qualified it as a “University of Pisa Summer School”, and will grant successful students with European Supplementary Credits. Physics students join the Fermilab HEP research groups, while engineers join the Particle Physics, Accelerator, Technical, or Computing Divisions. Some students have also been sent to other US laboratories and universities for special training. The programs cover topics of great interest for science and for social applications in general, like advanced computing, distributed data analysis, nanoelectronics, particle detectors for earth and space experiments, high precision mechanics, applied superconductivity. Over the years, more than 350 students have been trained and are now employed in the most diverse fields in Italy, Europe, and the US. The call for applications can be found here:

<http://www.pi.infn.it/cdf/ss2015/PisaFermilabSummerSchool.html>.

In addition, the existing Laurea Program in Fermilab’s Technical Division was extended to the whole laboratory, with presently two students in Master’s thesis programs on neutrino physics and detectors in the Neutrino Division. Finally, a joint venture with the Italian Scientists and Scholars North-America Foundation (ISSNAF) provided this year four professional engineers free of charge for Fermilab.

The HEP P5 strategic plan endorses continued US world leadership in superconducting magnet technology for future Energy Frontier Programs. This includes developing 10 to 15 Tesla Nb₃Sn accelerator magnets for the LHC upgrade and for a future 100 TeV-scale pp collider, and as an ultimate goal developing magnet technologies based on combining High Temperature Superconductors (HTS) and Low Temperature Superconductors (LTS) for accelerator magnets above 20 Tesla. This program is performed in close collaboration with US and International laboratories, Universities and Industry, in line with strengthening the global cooperation among laboratories and universities. The

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dual goal for superconducting magnets within the US General Accelerator R&D (GARD) is to increase performance and decrease costs to achieve an affordable technology for a 100 TeV proton-proton collider. This would be best achieved by exploiting the decade-long investment in Nb₃Sn technology. The robust and versatile infrastructure that was developed at FNAL in support of advanced superconductor and accelerator magnet development, together with the expertise acquired by the magnet scientists and engineers in design and analysis tools for superconducting materials, cables and coil technologies, makes FNAL an ideal setting to serve as an example of positive global integration.

The FNAL magnet group, in collaboration with US laboratories and CERN, produced the first in a series of 10 to 12 T accelerator-quality dipoles and quadrupoles made of Nb₃Sn, as well as their scale-up models forming a strong foundation for the HL-LHC project at CERN. In cooperation with Japanese colleagues of the National Institute for Materials Science (NIMS), KEK, Hitachi Cable Ltd., and Hikifune Co. Ltd., developed a Nb₃Al cable and used in magnets for the first time. A Memorandum of Understanding is being renewed between FNAL and NIMS to continue this productive collaboration. This activity plays a key role in the future Energy Frontier programs in the US and worldwide, including the LHC luminosity upgrade, as well as large aperture, high field magnets for the Future Circular Collider (FCC) interaction regions (see also the articles on the FCC Study and on the CEPC-SPPC Project in this newsletter). An assertive conductor R&D program has consistently been carried out at FNAL in parallel to magnet development work. Coordination with industry and universities has been critical to improve performance of superconducting strands and cables.

Recently, in collaboration with a group within the Chemistry, Material and Chemical Engineering Department at the Politecnico di Milano, Italy, led by Prof. Massimiliano Bestetti, we have been working on coating metal surfaces with superconductive Nb₃Sn (Fermi Research Alliance, LLC Business Sensitive). While extending this technique to what we believe is its full potential, our team has been resonating with the DoE renewed emphasis on Technology Transfer and Patenting of promising technologies and has started the pa-

tenting process. I do not want to assess how revolutionary our superconducting coating technique may be, but certainly it is scalable in size and rather inexpensive. With appropriate financial support, it could lead to high performance superconducting magnetic shields for accelerator magnets, MRI, MAGLEV and other applications and/or deliver high performance superconducting RF cavities for much more economical linear and circular accelerators and, yes, also for advanced light sources.

Another exciting endeavor in applied superconductivity is in the Muon g-2 experiment at Fermilab is the capability of superconductive bulk MgB₂ to shield large magnetic fields. It is well known that superconducting materials repel magnetic field, whereas paramagnetic ones concentrate flux lines in their interior. By using concentric tubes of the two materials, the magnetic field inside a cylinder is canceled without modifying the external applied field. Analytical solutions exist, which provide a relation between the thickness of the paramagnetic material and the relative permeability necessary for a complete cloaking. Such a successful hybrid cloak would find immediate application in the Muon g-2 experiment, which presently relies on a superconducting inflector magnet to cancel the 1.5 Tesla storage ring field seen by the muon beam at injection.

Hopefully I have made a convincing enough case that in an integrated global world, new ideas and developments that are based on tangible accomplishments should be supported in any field, and my heartfelt recommendation to our political leaders.

A Fellow of the APS, Dr. Barzi is an active member of the accelerator and HEP communities. The Superconducting R&D lab that she founded is a world leading center in low- and high-temperature superconductor technologies for the next generation of particle accelerators. She is presently also a member of the Muon g-2 Collaboration. She has established a number of high-impact international collaborations, as well as extensive educational programs for undergraduate and graduate students in Physics and Engineering that have benefited hundreds of young professionals. She is serving as a DoE SBIR, Accelerator Stewardship Program, and Lehman reviewer.

Forum on International Physics Committees

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