Forum on
International Physics

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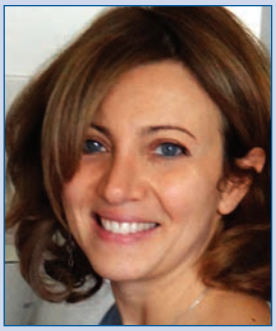
Letter from the Editor



Dear FIP Members,

In this FIP newsletter issue, you will find an overview of our recent efforts in serving the international physics community and articles from some of our speakers at the APS March and April meetings.

I want to thank all the authors of this newsletter, in particular to the speakers at the APS meetings 2019, who wrote articles for this issue. A special thanks also to Prof. Prajaval Sashri from India. She reported on "Pressing for Progress 2019", the first national conference, organized by the Gender in Physics Working Group (GIPWG) of the Indian Physics Association (IPA) and partially supported by the APS, to debate about "gender parity violation" in the physics community in India.

At the end of these years, we want to congratulate again with all the new APS fellows nominated by FIP: *Ming-Chung Chu* (The Chinese University of Hong Kong), *Amy K. Flatten* (American Physical Society), *Jason S. Gardner* (National Synchrotron Radiation Research Center), *Ernesto A. Medina* (School of Physics and Nanotechnology, YachayTech, Ecuador) and *Alexander Valishev* (Fermi National Accelerator Laboratory) and awarded at the APS meetings 2019.

A special congratulations also to the Distinguished Students (DS) awarded in 2019, with the hope that the DS program will continue to grow and serve the community of students for many years.

The FIP is always interested in all the issues related to the global physics community and we would love to hear from you if you have any idea or suggestion for supporting and advocating this community.

I hope you enjoy this issue and do let us know if there are any topics you'd like to see covered in the future.

And I also hope to see you all at our next APS meetings!

Best wishes,

Maria

Maria Longobardi
FIP Newsletter editor
FECS Past Chair
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Inside this Issue

Views and opinions expressed in articles are those of the author and are not necessarily shared by the editor or the APS/FIP.

Letter from the FIP Chair 2019, Elena Aprile

As the 2019 Chair of the APS Forum on International Physics (FIP) it is my pleasure to present some highlights of the FIP activities this year. FIP promotes and supports International Physics in many ways.

Through the International Research Travel Award Program (IRTAP) we support international research collaborations between physicists in developed and developing countries.

Through the Distinguished Student Program (DSP) we support the participation in physics of undergraduate and graduate students from developing air under-developed countries. In 2019 we offered 11 awards to students from several countries who presented their research in a poster or a contributed talk to either the March or April APS meetings.

The Forum also has a voice, through the Past-Chair, Chair and Chair-Elect, in the APS Committee on International Affairs (CISA), which advises the APS Board of Directors on all international matters affecting physics.

Our 2019 Program Committee, which I led in 2018 as Chair-Elect, organized multiple invited speakers sessions at the 2019 APS March and April Meetings in Boston and Denver, respectively.

Most of these speakers flew from other countries to speak on a variety of topics of interest to FIP. I was particularly proud to chair the session on the Underground Physics Laboratories around the world and to help organize a session on Women in Gravitational Wave Astronomy. Marica Branchesi was one of the speakers and was honored with the award Beller Lectureship from the APS.

The FIP Reception was held at the March meeting in Boston and as always, it was very well attended. Next year, we look forward to hosting a Reception for the April meeting as well.

Another way FIP encourages international collaborations is through our selection FIP Fellows. APS Fellowship is an honor signifying recognition by one's professional peers. To qualify to become a FIP Fellow, our Fellowship committee, which I chaired this year, also demands demonstrated activities in fostering scientific collaborations and international programs. In 2019 we nominated 5 outstanding physicists for FIP Fellowship. Physicists like these newly nominated Fellows, who work together across borders and nationalities to answer the deepest scientific questions of our time, are a leading example of the power of science to unify humanity. I am honored to lead the international XENON collaboration (xenon1t.org), a team of more than 170 scientists from 23 institutions around the world, united by the goal of searching for DM with the most sensitive liquid xenon detector built to-date. The question of the nature of DM remains one of the most outstanding open questions in physics today, a question which is at the heart of cosmology, particle physics and astrophysics. It is a privilege to be part of this family of people from different cultures and nations, a family that nurtures the true spirit of international collaboration without boundaries. My experience and leadership role in XENON has made me appreciate the goals of FIP.

I look forward to continuing my participation as a past-chair in 2020, which will put me in charge of the FIP Nominating Committee. With your help, FIP will maintain an excellent team of committee members who are passionate about physics from an international point of view. With Luisa Cifarelli as a new FIP Chair in 2020 and Alan Hurd as Chair-Elect, we will be in great hands.

Reaching Consensus

Richard Davis

The FIP organized a timely session at the APS meeting in April 2019. The focus was on the International System of Units (SI), including changes that had received final approval in November 2018 and which were to come into force on May 20, 2019. There were three speakers, of which I was the second. My own task was to talk about "Reaching international consensus on fundamental changes to the SI." The following is a highly condensed version of my talk.

Who has the authority to make changes to the SI? The short answer is the General Conference on Weights and Measures (CGPM), an intergovernmental conference created by a treaty signed in 1875. The CGPM meets about every four years. There are now 61 Member States who can send a voting delegate to the Conference. On scientific matters, the Conference is guided by the International Committee for Weights and Measures (CIPM), which meets once or twice yearly at the International Bureau of Weights and Measures (BIPM), located in a suburb of Paris. The BIPM assists the CIPM in organizing the work of its Consultative Committees. One task of these committees is "to advise the CIPM on all scientific matters that influence metrology."

The SI has historically been defined by 7 base units, the meter (m), kilogram (kg), second (s), ampere (A), kelvin (K), mole (mol), and candela (cd). Over the years, the fixed numerical values of a ragtag bunch of quantities have defined these units. Most notoriously, one of these quantities was the mass of an object known as the IPK, which was put into service in 1889. Its mass was defined to be 1 kg exactly, making the kg unit only as stable as the mass of the IPK. The CGPM was reminded of this in 1960. Yet there was no workable alternative—until now. The revised SI is based on 7 constants. Although there is no one-to-one correspondence between these constants and the 7 base units, all base units—and therefore all possible SI units—are defined by unique combinations of the 7 constants.

7 base units of the SI (unchanged)

7 defining constants (*h*, *e*, *k*, and N_A are new)

The SI has four new defining constants: Planck (*h*), Boltzmann (*k*), Avogadro (N_A), and the elementary charge (*e*).

To achieve international consensus, it was necessary to demonstrate that: the public would not be inconvenienced by changes that reflect 21st century science (including quantum physics); the accuracies of experiments that would become realizations of the new definitions were established; and interested stakeholders had been widely consulted.

All this preparation payed off: The November vote to adopt the revised SI was unanimous, which is unusual for intergovernmental decisions. Much more information on all of the above can be found on bipm.org.

Richard Davis joined the BIPM in 1990 after having been at NIST for 18 years, starting as a post-doc and ending with responsibility for dissemination of the unit of mass from the national prototype of the kilogram maintained at NIST. He retired from the BIPM in 2010, and is now an emeritus physicist. He is an APS Fellow and a recent member of FIP.

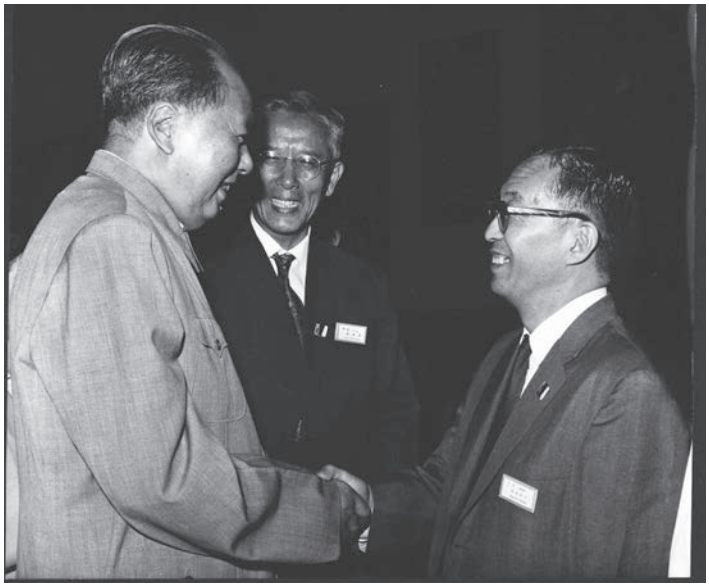
The Genesis of Mao-Particle (Straton): the Chinese Search for Hadron's Structure in the 1960s

LIU Jinyan, Institute for the History of Natural Sciences, Chinese Academy of Sciences

The invited session entitled "History of Contemporary Chinese Physics," was successfully completed at the APS annual meeting in Boston on March 5, 2019. One of the presenters was LIU Jinyan from the Chinese Academy of Sciences. She examines the genesis of Mao-particle or "straton" in China in the 1960s.

In the mid-twentieth century, particle physics was broken away from nuclear physics and entered a stage of rapid development. The rate at which new particles were discovered, left particle physicists with an urgent need to classify more than one hundred kinds of particles, to figure out their underlying relations as well as why such relations exist, and to put forward new conceptual and theoretical models. They successively proposed the Fermi-Yang model, Sakata model, Eightfold way and Quark (or Ace) model from 1949 to 1964. The introduction of quark drew the focus of physicists to the inside of hadrons in their research on the microstructure of matter. Experimental physicists tried their best to search for free quarks but failed to find anything, which led the majority of physicists to dismiss the existence of quarks. In fact, Gell-Mann detoured when he first proposed the concept of quarks, regarding it as a mathematical symbol only.

In the newborn socialist country, Chairman Mao Zedong pushed to develop an atomic bomb in China and took special attention to the philosophical problems in physics. His belief in the infinite divisibility of matter was resonant with Japanese physicist S. Sakata's work that elementary particles have inner structure. Mao's high praise of Sakata caused a nationwide study of Sakata's work in China from1964 to 1965. This directly stimulated a group of Chinese particle physicists to investigate the inner structure of hadron and construct the Straton model. They use the word "straton" to emphasize that the straton is not the most fundamental constituent of matter. Instead, it is only one of the potentially infinite strata of the inner structure of matter; the "straton" itself has an inner structure.



Mao Zedong (left) receiving S. Sakata(right) in Peking Symposium on 31 Aug. 1964

Straton model was an important development at that time. Unfortunately, the main results of straton model have published in Chinese and later the Cultural Revolution interrupted most of the scientific work in China. Though having little international impact, this development promoted domestic physics research.

Jinyan Liu is an Associate Professor at the Institute for the History of Natural Sciences, Chinese Academy of Sciences (CAS). She received her PhD in theoretical physics from the Institute of Theoretical Physics, CAS in 2013. Then she moved into the history of modern physics. Up to now, she has accomplished a systematic examination of the construction of the Straton Model. She is currently undertaking a project on the history of Yang-Mills gauge theory and its acceptance and dissemination in China. This study will fill a significant gap in the recent history of theoretical physics, shedding light on its general progress as well as characteristic development in China.

The New SI System and the Definition of Frequency

Judah Levine, JILA and Department of Physics, University of Colorado, Boulder

I described the definitions of the fundamental constants in the new SI system, which was adopted in May, 2019. The definitions in this new system are based on fixing the values of a number of fundamental parameters such as Planck's constant and Avogadro's number. I compared these definitions with the previous ones, which were based on the values of various physical quantities such as the volt, the ohm, and the ampere. Thus, for example, the value of Planck's constant is fixed in the new system whereas it had to be experimentally determined in terms of the fundamental observables in the old system.

Another important difference in the new SI system is the change in the definition of the kilogram from an artifact standard maintained at the BIPM (with various official copies maintained at other locations) to a quantity experimentally determined in terms of Planck's constant or Avogadro's number. The realization in terms of Planck's constant makes use of the Watt Balance, whereas the realization in terms of Avogadro's number makes use of a silicon sphere. In principle, any laboratory can realize the new definition of the kilogram without reference to the primary artifact at the BIPM. This redefinition is not without difficulty. In order to realize it, it was necessary to determine the best current estimate for Planck's constant, which would then be treated as fixed in the new system. However, the determinations of some laboratories differ significantly from the value that was finally adopted, and the result of this is to push this difference into the realization of the kilogram at these laboratories. Therefore, practical mass metrology at the highest accuracy, will require artifact standards at least for the near-term.

Although it was not part of the change in the definition of the SI base units, I also discussed the ongoing issue with respect to the radian. For example, angular frequencies must be expressed in radians/second when the parameter is used in a trigonometric expression, but frequency is also expressed in Hz. Both of these representations have the same SI unit: s^{-1}, but the numerical values of both are different by a factor of 2π. This factor is considered dimensionless in the current system, but some have argued that it should have units of radians per cycle, or something similar. The confusion that arises from the different numerical values for the same quantity is also used to argue that the radian should be elevated to a base unit. There will be continuing discussions on this possibility.

Judah Levine is a Fellow of the National Institute of Standards and Technology and is the leader of the Network Synchronization Project in the Time and Frequency Division, which is located in the NIST laboratories in Boulder, Colorado. This project operates twenty-five time- servers at four locations and received approximately 600,000 requests per second for time in various formats over the public Internet. He also designed and implemented the time scales that define and realize UTC(NIST), which is computed based on data from an ensemble of cesium standards and hydrogen masers. This time scale is the reference for all NIST time services and is the civilian time reference in the US. The frequency of UTC(NIST) is adjusted periodically to track UTC as computed by the BIPM. The difference UTC(NIST)-UTC is a slowly varying function of time with an amplitude of a few nanoseconds RMS. He received his Ph.D. in Physics from New York University in 1966. Dr. Levine is a senior member of the IEEE and a Fellow of the American Physical Society.

Distinguished Student Program

In 2018, the Distinguished Student Program, sponsored by the FIP and FECS Units, selected 11 students for attending and presenting their research at the March and April Meetings 2019. On behalf of the FECS and FIP, we want to congratulate all the students on the award!

(Left to right): Neeranjan Nepal, Jiahao Xu, Xin Lin, Hira Farooq, Maria Longobardi, Alicia Lima, Shanyang Niu, and Surajit Sen at the 2019 March Meeting

Below there are the name of the DS students, their countries and whether they are to attend the APS March or April meetings 2019.

USA

- **Shanyang Niu**, China, Univ. of Southern California, March
- **Jiahao Xu**, China, Univ. of Georgia, March
- **Xin Lin**, China, Georgia Tech, March
- **Hira Farooq**, Pakistan, Texas Tech Univ., April
- **Neeranjan Nepal**, Nepal, Central Michigan Univ., April
- **Alicia Lima**, Cape Verde, Bowdoin College, April

FOREIGN

- **Krishnakanta Bhattacharya**, India, IIT Guwahati, April
- **Ana Gallego Ros**, Spain, CIEMAT, April
- **Tejal Agarwal**, India, IISER-Pune, March
- **Santanu Kumar Parida**, India, Homi Bhabha National Center, March
- **Denis Torres Munoz**, Colombia, March

A First-of-its-Kind National Conference Towards Gender Equity by the Indian Physics Association: Pressing for Progress 2019

Prajval Shastri, Bindu Bambah, Srubabati Goswami, Vandana Nanal

Pressing for Progress 2019, a first-of-its-kind national conference was organized by the Gender in Physics Working Group (GIPWG) of the Indian Physics Association (IPA) during 19-21 September. 240 physicists, social scientists and educationists gathered for three days to bridge disciplinary divides and debate the long-standing question as to why there is a persistent "gender parity violation" in the physics profession.

The GIPWG chaired by Professor Prajval Shastri was launched in 2017 (cf. *AAPPS Bulletin* vol 27, p51), and this conference was its first major activity. The conference was hosted by the University of Hyderabad, which is one of the first universities to have an inter-disciplinary women studies centre with the involvement of physics faculty since its founding, and the TIFR Center for Interdisciplinary Sciences, Hyderabad was an organizational partner. The conference was partially supported by the American Physical Society which enabled the participation of Professor Megan Urry, astrophysicist and Director of the Yale Center for Astronomy and Astrophysics, as one of the three physics keynote speakers.

Of the 240 participants, 200 were physicists and 40 were from the social sciences, education and other disciplines. All the invited physics speakers were women. Over a third of the participants were men, about half were from the younger generation and about half were faculty and students from Indian universities and colleges.

At the ice-breaker on the evening prior, Megan Urry spoke on *What I Love (and Don't) About Physics*. She then launched the book *31 Fantastic Adventures in Science*, written by science journalists Nandita Jayaraj and Aashima Dogra – a book for ages 10 and up with stories of the questions that fascinate 31 Indian women scientists of whom seven are physicists and two (Prajval Shastri and Shikha Varma) were at the conference.

Welcoming the gathering at the formal inaugural of the conference,

At the ice-breaker event of the conference, Professor Megan Urry (left) launched the book *31 Fantastic Adventures in Science*, written by Nandita Jayaraj and Aashima Dogra.

Professor Prajval Shastri (left), Chair of the Gender in Physics Working Group of the IPA, and member of the APS, giving an overview of the conference.

Professor Bindu Bambah, who led the local organizing committee of the conference, and is also one of the first practicing Indian physicists to collaborate with social scientists in investigating the gender gap question noted, that women intellectuals in India have been "pressing for progress" since ancient times as encapsulated by the dialogue between the two ancient Indian philosophers Gargi and Yajnavalkya. Gargi's persistent questioning on the nature of the universe resulted in Yajnavalkya reprimanding her to stop. Professor Bambah urged the younger generation to "unleash the Gargi" in them.

Professor Prajval Shastri, Co-Chair of the conference, pointed out that the fraction of women among PhDs in physics employed in higher education in India is about 20% which is already skewed. But the fraction in elite institutions, leadership positions and in honour lists, or even in the authorship of physics articles in the not-so-prestigious bulletin of the IPA, plummets much further. Furthermore, the gender gap in physics is among the largest in any scientific discipline, which points to physics being a flawed meritocracy, highly gendered in its practice, despite professing to be an objective science. Which is why this conference was needed.

Professor K Vijayraghavan, the Principal Scientific Adviser to the Government of India, gave the inaugural keynote address over internet video link. He urged moving beyond the common but erroneous explanations for the gender gap in scientific leadership, viz., the innate-biological and entrenched socio-cultural conventions, and instead harnessing the flexibility of science and using structural and economic interventions to mitigate the gap.

The conference had three keynote physics talks. The first one on quantum information was by Aditi De, the first woman Shanti Swarup Bhatnagar awardee in physics, which is the highest Indian award for scientific research. Megan Urry, astrophysicist from Yale University, and Shikha Varma, condensed matter physicist from the Institute of Physics, Bhubaneshwar, gave the keynote talks on the second and third days, on the evolution of the central black holes of galaxies and on DNA as a nano-sensor respectively.

A panel consisting of both mid-career and senior physicists, and those in leadership roles, discussed the question 'The Gender Gap in

Physics: Whose Problem is It?' Anchor Pratibha Jolly, brought to the fore the importance of physicists across the profession, i.e., research scientists to high school teachers, engaging together by crossing hierarchical barriers, in order to improve the profession, citing the example of the American Physical Society and the American Association of Physics Teachers. Arguments for rigorous sensitization programmes for the leaders of institutions as well as extensive training of scientists in sexual harassment procedures were made. The acknowledgement that mitigating the gender gap requires everyone to take responsibility came across strongly, including the argument that all members of the profession need to see the intermingling of work and life of individual colleagues as a collective concern; that the toxic masculinity that significantly pervades the physics culture must go, and physics must be made to be seen as a welcoming discipline and not as a place that is only for geniuses.

About thirty women physicists from all over the country presented talks on their research in four parallel physics sessions ranging from planetary physics to biophysics. A large and wide range of talent was apparent, although this is only a sliver of what is available country-wide. Posters and poster-sparklers at the conference were by participants of all genders.

For the first time, physicists, social scientists, educationists and diversity experts shared a common space to deliberate in a plenary session on *Different Angles on Promoting Gender Equity*. There was range of talks, both by physicists and social scientists, on hiring practices, early seeding among boys of the idea that girls are not competent in science, a framework for physics identity. gendering of the classroom, the politics of gender in physics, and the construction of the idea of scientific genius. Rosalind Dubs from the Australian Academy of Technology & Engineering gave the keynote talk that described the lessons from the interventional policies in Australia.

An innovative component of the conference was the opportunity to participate in interactive, immersive, process-based 3-hour long experimental workshops to understand gender inequity, in which about 90 participants took part each day. They were designed to build our capacities to understand inequity, agency and sexual harassment dynamics, and foster leadership in both the personal and professional spheres of our lives. In parallel with the workshops, there was a film screening each day related to the theme of the conference, viz., *Hidden Figures*, *Agora* and *Marie Curie*.

The panelists airing their views on 'The Gender Gap in Physics: Whose Problem is it?' and discussing with the audience.

Strengthening the interdisciplinary framework of the conference was a classical dance drama *Avidhrta* (= The Unstoppable), composed and choreographed especially for the conference encapsulating its theme by Lalitha Sindhuri, PhD student of dance in the Sarojini Naidu School of performing arts of the university. The astoundingly innovative composition rooted in the classical *Kuchipudi* style of dance and accompaniment, wove the stories of physicist Marie Curie, youth activist Malala Yusufzai, writer J K Rowling and Indian boxing champion Mary Kom into the composition. The mesmerizing performance was accompanied by the live classical music ensemble from the Sarojini Naidu School.

The conference concluded with a plenary session that deliberated on recommendations for the profession, several of which emerged from the panel discussion, the workshops and the comments throughout the conference.

The highlights:

- W*ork-life balance policies and "mobility schemes" for professionals should be gender neutral*
- *Hiring should be based purely on academic merit, with criteria formulated before the process/advertisement*
- *Specifically, the age-bar for hiring should be removed; Status/position of a life-partner should not be a criterion*

The three keynote physics talks (left to right) by Aditi De (HRI), Megan Urry (Yale University) and Shikha Varma (IoP).

- *Gender sensitization training should be mandatory, especially for senior management such as directors and deans*
- *Current and potential members of sexual harassment ICCs should undergo training in the process and the law*
- *Self-declaration of sexual harassment indictments should be mandatory for staff applications and academy fellows*
- *Institutions should involve diversity experts as observers on selection, hiring and promotion committees, editorial boards and funding agency committees.*
- *A course by sociologists on the impact of social processes in the practice of science should be part of the graduate physics curriculum*

Other previous and long-standing recommendations were strongly reiterated:

- *Mandatory gender audit of staff to be published on the organizational webpage*
- *Concerted effort to gender-balance role models in physics text books and educational multi-media material*
- *Mentoring mechanisms for young faculty to be made available*
- *Child-care facilities to be mandatory in institutions as well as conferences*
- *Action-taken report in sexual harassment cases should be mandatory*
- *Funding for conferences should follow the IUPAP guidelines*

The inter-disciplinary conference was primarily supported by the Department of Science and Technology, Government of India, with additional funding from the American Physical Society, Science in Australian Gender Equity (SAGE) and the Australia India Strategic Research Fund (AISRF), Harish Chandra Research Institute, the Institute of Mathematical Sciences, Microsoft, Fujitsu Pvt. Ltd and Horizon, Pvt. Ltd, Hyderabad.

For correspondence: Prajval Shastri prajval.shastri@gmail.com

Prajval Shastri is an astrophysicist who investigates the physics of giant black holes in distant galaxies. She was faculty at the Indian Institute of Astrophysics until 2018, is chair of the Gender in Physics Working Group (GIPWG) of the Indian Physics Association (IPA) and Co-Chair of the Scientific Organizing Committee of the conference.

Top: Avidhrta (= The Unstoppable) in the classical Kuchipudi style, composed and choreographed especially for the conference encapsulating its theme, by Lalitha Sindhuri: (bottom)scenes from the Marie Curie story.

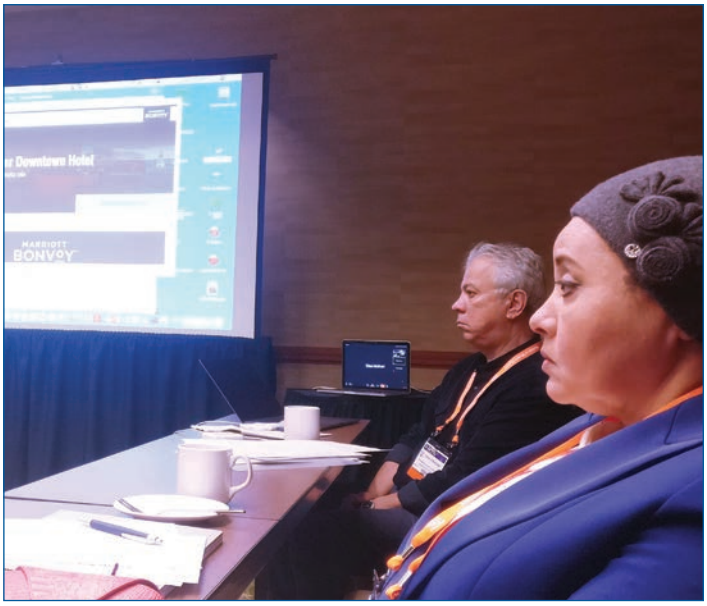
Glimpses of the interactive workshops

FIP Executive Committee Meeting at the 2019 April Meeting

Elena Aprile with the DS student Krishnakanta Bhattacharya

Jason Gardner and Elena Aprile: Jason was a 2018 APS Fellow.

Jerry Peterson and Luisa Cifarelli



Carlos Bertulani (left) and Ilham Al-Qaradawi

Several members of the 2019 FIP Board: (front row/ left to right)–Dmitri Denisov, Ilham Al-Qaradawi, Toyoko Orimoto, Maria Longobardi, Elena Aprile and Luisa Cifarelli; (back row/ left to right)–Jerry Peterson, Emanuela Barzi, Carlos Bertulani, and Alan Hurd

FIP Executive Committee members at a meeting

Left to right: Luisa Cifarelli, Jerry Peterson, Amy Flatten (a 2018 Fellow), Elena Aprile and Alan Hurd

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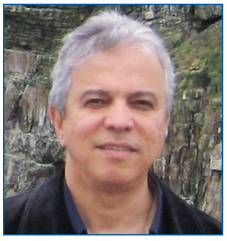

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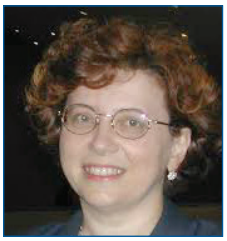

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