

LEARNING FROM THE WORLD

--- A REPORT ON THE IUPAP INTERNATIONAL CONFERENCE ON WOMEN IN PHYSICS

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Abstract — Among science and engineering, physics is one of the fields where progress is particularly slow when it comes to women's participation, both in the US and around the world. Women still disproportionately leave physics with each step of career advancement. Why? And how can we change the situation? These questions were the focus of the first International Conference on Women in Physics organized by the International Union of Pure and Applied Physics (IUPAP) in March 2002. The conference brought together more than 300 physicists from 65 countries for three days of energizing and inspirational presentations, discussions, posters, exchanges, and informal interactions. Among many ideas generated at the conference, we discuss what we learned from the experiences brought in from many nations such as a need for transparent decision-making, and family-friendly policies. The ideas are readily generalized to engineering and other fields where women are scarce.

Index Terms — international, women in physics, transparent decision-making, career-family balance

BACKGROUND

It has been no secret that women are severely under-represented in physics, both in the US and globally. In the US, as the percentage of women among Bachelors and PhDs in physics has slowly increased to 20% and 13% respectively (AIP data for 1998), women still disproportionately leave physics at all levels, which has been described as the “leaky pipeline”. While people understand it as an equal opportunity issue--women *do* love physics and deserve a fulfilling career in the field, fewer people realize that the health of the physics field and the greater community demands greater female participation. The best science and engineering requires the best talents from more than just half of humanity; excluding women weakens the science and engineering enterprise. As most other fields, physics can greatly benefit from the diversity of thought and choice of topics that women bring. In addition, exposing more girls and women to science will result in a more scientifically literate public and will lead to more public

support of science. For all these reasons, the low numbers of women in physics is an urgent concern.

THE CONFERENCE SCENE

To understand why, and to develop strategies for increasing women's participation and impact on the field, the International Union of Pure and Applied Physics (IUPAP) established a working group on Women in Physics in 1999 and hosted the first ever International Conference on Women in Physics in the UNESCO headquarter in Paris, France on March 7-9, 2002. The conference was supported by many national and international institutions and organizations and was attended by more than 300 participants from 65 countries and areas. About 15% of the participants were men. Scenes from the conference are presented in Figure 1.



FIG. 1. SCENES FROM THE CONFERENCE. (A) THE PLENARY SESSIONS IN THE MORNING FEATURED INVITED SPEAKERS FROM VARIOUS AREAS OF THE WORLD; (B) THE BREAKOUT SESSIONS IN THE AFTERNOON ALLOWED THE PARTICIPANTS TO SHARE EXPERIENCES, INSIGHTS, AND SOLUTIONS AROUND SIX KEY TOPICS (SEE TEXT).

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Participants were welcomed by Philippe Busquin, Commissioner for Research of the European Union; Walter Erdelen, Assistant Director-General for Natural Sciences at UNESCO; and Burton Richter, President of IUPAP. Ten distinguished speakers—at least one from every major geographic region—provided insights into her own experiences and described the situation, barriers, and actions related to women in physics in her country. Teams of physicists from each participating country presented posters on the situation for women in physics in their countries. Attendees and other women physicists were surveyed by the American Institute of Physics (AIP) in advance and the results of the survey were presented at the conference.

Discussions focused on issues and strategies related to six important topics for increasing women's involvement in physics: attracting girls into physics, launching a successful physics career, getting women into physics leadership, improving the institutional climate, learning from regional differences, and balancing family and career.

At its final session, the Conference unanimously adopted eight resolutions directed at schools, universities, research institutes, industrial laboratories, scientific societies, national governments, granting agencies, and the IUPAP. These resolutions were presented at the 2002 IUPAP General Assembly in Berlin in modified form, and were adopted. In addition, numerous recommendations were compiled that feature specific actions or interventions, many of which have been proven successful in one or more countries. The conference proceedings was published in order to expand the impact of the Conference far beyond the participants. More details about the conference and its resolutions can be found at the web site at <http://www.iupap.org>, under a link to the "International Conference on Women in Physics," and in the conference proceedings.[1]

As the editors of the conference proceedings, we had the chance to interact with many of the highly talented women scientists and learned about their experiences and wisdom first-hand. Here we discuss some of the aspects that may be of value to the women in engineering community.

LEARNING FROM REGIONAL DIFFERENCES

The percentage of women physicists varies greatly from country to country (Fig. 2). Since women earn ~50% of the physics bachelors degrees and nearly 30% of PhDs in some countries, it is clear that there is no intrinsic intellectual barrier to women's participation in physics. In addition, there is little correlation between the women's participation and the economic status or region of the countries. The countries that have high participation of women physicists include France, Poland, Turkey, and India (see Table 1). Portugal, Italy, Argentina, and Brazil are also reported by the conference participants as having large percentages of women physicists. The ones with the lowest female

participation include Netherlands, Japan, Germany, and Switzerland. In other words, economics is not the main factor to prevent women's participation in physics. Yet there is a remarkable consistency in one sobering pattern: the percentage of women decreases markedly with each step up the career ladder. It indicates that women around the world face systematic barriers common in all cultures.

Table 1. Percentages of Physics Degrees Awarded to Women in Selected Countries, 1997 & 1998 (2 year averages). [1]

	PhDs %	First-Level %
France	27	33
Poland	23	36
Norway	23	20
Ukraine	23	--
Australia	22	20
Turkey	21	37
India	20	32
Columbia	--	28
Denmark	17	19
United Kingdom	16	20
Taiwan	13	19
United States	13	18
Sweden	13	17
Canada	12	22
Mexico	10	18
Germany	9	10
Switzerland	9	9
The Netherlands	9	5
South Korea	8	30
Japan	8	13

* Courtesy of R. Ivie, R. Czujko, and K. Stowe[1].

Take France and Germany, for example. Although the two countries are similar in economic status, science and technology stature, and political systems, they differ dramatically when it comes to women's participation in physics. In France, 26% of the assistant professors of physics are women, compared to 2.8% in Germany. Yet the percentage in full professorships still drops to 9% in France. The positive factors in France include that women are expected to work outside the home; there is state-supported free daycare/kindergarten; good science education for girls exists; and parental leave policy and tax break for childcare make it easier for young couples to raise a family while keeping their careers on track. But women still get less chance for promotion and are less represented in the decision-making bodies. Their salaries are also significantly lower than those of their colleagues. In Germany, society's expectations for women are primarily parental. School children need care beginning in early afternoon. And there is a lack of positions for two-career couples. Similar to France, women are disadvantaged in hiring and promotion, whether

or not they have children. Yet it is interesting to note that 70% of female physicists in Germany do not have children as compared to 49% of men [1]!

Around the world, it is common that women have to be more capable to overcome the accumulated disadvantages as the minority in a male-dominated field. A detailed study of publication record in Japan clearly showed that a woman has to be two times more productive to reach the same stature as a man [1].

A KEY WORD: TRANSPARENCY

Outright discrimination, while still existent, especially in some of the developing countries, is becoming a thing of the past. But in a field traditionally dominated by men, people's natural tendency to seek students and coworkers like themselves greatly slows down the process for change. In addition, women receive less mentoring, have fewer role models, and are more likely to be excluded from the informal networks in the community. For these reasons, many practices that are seemingly unrelated to gender, disproportionately damage the woman's career and create hidden barriers for women. Examples include:

- Ambiguity of standards and uneven evaluation;
- Secrecy about decision-making and lack of transparency in hiring/promotions; and
- Narrow view of excellence, which values aggressiveness disproportionately.

These practices make it easier for the "old boys network" to survive and thrive, but in the end they are not fair for any, men and women alike. For career women, these small disadvantages often accumulate to make many women's careers lag behind their full potential, and can sometimes even cause someone's career to end prematurely.

How do we address these issues? While the idea of "quota" was highly controversial and faced opposition from many attendees, a key word that emerged from the conference was "transparency".

"Transparency" means having transparent, gender-blind processes for important decision-making such as recruitment, promotion and salary, resource allocation, peer review, conference programs, etc. The decisions should be reported and explained, which requires remarkably strong and confident leadership. It also encourages written rules and policies to achieve fairness and transparency in policies, practices, and decision making. Such gender-blind policies have been credited for the dramatic increase in female musicians in the Chicago Symphony Orchestra, after blind audition was implemented. In the meantime, such a gain for women is not at the expense of the competent men or the profession. After all, "excellent men have nothing to fear from transparency of process," as one of the attendees pointed out.

FAMILY MATTERS

The reports at the IUPAP conference showed that having a family is not the dominant factor limiting women's participation since (1) women without children are not more successful than the women who have children; and (2) countries with strong family-friendly support systems, such as Switzerland and the Netherlands, can still have few women in physics. In addition, many more women have entered other demanding fields such as law, medicine, and biology, indicating that it is possible for women to handle a "tough" career. Nevertheless, family issues still negatively affect a woman's career more than a man's and have to be addressed. Societal expectations still put the burden of childcare and elder care mainly on women. And the overlap of childbearing years and the years when the career must be established drives many young women out of the field, and makes many others who *do* stay postpone having babies until after their peak fertility period. Can having/raising children co-exist with a successful career? Prof. Bando of Japan reported an interesting study on the impact of motherhood. Using number of papers published in a fixed period of time as the measure of productivity, she showed how such productivity varies as a function of age both macroscopically for the average of the men and women in the Japanese Physical Society, and microscopically for an eminent woman scientist in the US [2]. With both studies, the bad news is that the child-rearing years indeed coincide with relatively lower productivity. The good news is, however, that women's productivity takes an unexpected, dramatic upturn after the child-rearing period and greatly surpasses that of men, which Prof. Bando calls the "recovery phase". While the study is not conclusive since it is based on limited data, it did bring up an interesting point: compared to men's normal linear advancement, women's career paths can be non-linear. The temporary setbacks, however, do not exclude long-term success. This is particularly informative and encouraging for the young women who are struggling to keep the work-life balance. It would also be important for the employers to re-evaluate their employees when it comes to their long-term value to the companies, institutions, and organizations.

How can the institutions be more family-friendly? The recommendations from the conference include:

- Respect and value family obligations;
- Allow flexible career paths;
- Provide funding sources to help people return after a career pause;
- Solve the dual-career couple problem by facilitating geographically co-located job opportunities and creative solutions, such as shared positions.

While it is tough juggling all the responsibilities, many conference attendees showed high spirits when talking about the subject. As Prof. Iya Ipatova of Russia pointed out in her invited talk, *"active occupation in science is compatible with normal family life. She, the family woman, has to be*

perfectly well organized... There are 24 hours in a day - it's a lot of time."

SUMMARY

The first IUPAP International Conference of Women in Physics was highly successful. By bringing together physicists from so many different countries and regions, it became clear that the issue of women in physics is very complex and is deeply rooted in culture and society. Yet there are indeed proven approaches that are not only beneficial for improving women's participation, but also fair for all workers. In this article, benefit from diverse perspectives, transparency in decision-making, and a family-friendly environment were discussed in more detail. We believe these insights would be of particular value to the engineering community. Other ideas included involving men in the process, advancing women into leadership positions, and helping women to learn "the rules of the game"[3].

Despite all the obstacles, a recurring theme at the conference was the women's love of physics and the satisfaction their careers have brought to them. Many were greatly encouraged by the simple sight of so many women physicists at one place, and communicated a positive vision of future: together, we shall overcome.

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