

# **A report on the conference on Women in Physics, Paris, March 7-9, 2002.**

An international conference entitled ‘Women in Physics’ was held at the UNESCO centre in Paris during March 7-9, 2002 under the auspices of the International Union of Pure and Applied Physics (IUPAP). It brought together more than 300 participants - about 15 percent of them men - from 65 countries. India was represented by a five member delegation at this conference consisting of the authors of this report as well as Dr. Jyoti Gyanchandani from the Bhabha Atomic Research Centre, Mumbai and Dr. Sunita Nair from the Raman Research Institute, Bangalore. Prof. Sumathi Rao who is a member of the IUPAP working group on women in physics, was the team leader. We presented a write-up which was a summary of the issues concerning participation of women in physics in India as seen by the women physicists in the country as well as a poster which focused on a few representative women physicists in the country who have successfully tackled the typical problems faced by women with physics careers and made a success of their profession. (This poster can be viewed at the site <http://www.if.ufrgs.br/barbosa/conference.html>). Prof. Rohini Godbole was ‘the Asian success story invitee’ and one of the plenary speakers at this conference, in addition to being part of the Indian delegation.

## **1 The Background**

Women are traditionally under-represented in science in general and physics in particular. Moreover, the fraction of women in these fields decreases markedly with each step of career advancement. A working group was established by IUPAP in 1999 to hold an international conference on ‘women in physics’ to understand the reasons that lead to this under-representation and to identify strategies to increase the participation and impact of women in physics. Such strategies will also lead to the advancement of women in other professions that are essential to progress in a highly technological society. Although the problem of under-representation of women in scientific professions is universal, there are important regional differences in the manifestations of the problem. The working group on women found that there were almost

no data available regarding the participation of women in physics for most countries. Hence, one of the tasks of the working group before the conference, was to collect this data from different countries. Firstly, country-wide data on physics education and employment, starting from literacy levels to first degrees, to Ph. D's and faculty levels, with gender-wise break-up were needed. In India, this was obtained with a lot of effort by Prof. Nandini Trivedi, who was then a member of the working group, through various government channels. Then, more detailed personal data was collected (in India by SR) through questionnaires distributed to working women physicists in each country. The data collected was analysed and presented at the conference and set the stage for the various other talks and discussions at the meeting. The working group decided that it would be useful to have the following six discussion topics at the conference.

1. Attracting Girls into Physics
2. Launching a Successful Physics Career
3. Getting Women into the Physics Leadership Structure Nationally and Internationally
4. Improving the Institutional Climate for Women in Physics
5. Learning from Regional Differences
6. Balancing Family and Career

## **2 The Proceedings**

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 each gave a speech to open the conference and welcome the participants. Eleven invited speakers, from different parts of the world, used their personal experience to describe the situation and barriers faced by women physicists as well as initiatives that have been undertaken to improve the situation in different parts of the world. Small discussion groups met in the afternoons to enable everyone to participate in

discussions on the six topics above, and share information, problems and successful practices from various perspectives. Key elements of the discussions of the subgroups were then conveyed to the rest of the participants through a plenary talk by the discussion group leader.

Prof. Sumathi Rao was asked to take up the responsibility to organise the discussion group on the topic of attracting girls into physics which she shared with other members of the working group, members of the Indian delegation and some participants from Europe, U.S. and Ghana who were interested in the subject. An interesting point that came to the fore was that, when discussing the issue of attracting girls to physics, we in India tend to think of the whole range from high school to research, whereas in the developed countries, they tend to confine the discussion only to the high school level. One of the reasons for this is that unlike in many countries, in India, the study of physics and other sciences are not considered a male prerogative, so there are no barriers to girls taking up the study of science at the high school level. The primary reasons for women dropping out of science in India tend to be marriage and family related, and arise at much later stages in their careers.

The conference venue had a permanent exhibition hall, where all the participating countries had put up informative posters, which were displayed throughout the duration of the conference. There was a great deal of vigorous interaction and information exchange among the participants during the conference which provided much food for thought and avenues for action. The commonality of views of working women physicists coming from 65 countries as well as that of the problems faced by them in their careers came as a surprise to many of us. An important benefit of the conference for many of us was the access to the painstaking and careful statistics that had been collected and which exposed the under-representation of women and the inequitable treatment meted out to them at all stages in their careers. The most significant observation from the statistics was the phenomenon of the 'leaky pipe-line' by which the numbers of women physicists drop off at each stage of education and advancement. Although the figures vary slightly across countries and disciplines, the over-all picture remains the same and is rather bleak.

Here are some actual figures to support the sad conclusion above. The fraction of B.Sc. degrees in Physics obtained by women ranges from a low of 6% in the Netherlands to a high of 36% in Poland, with India at the

upper end of the spectrum at 32%. The fraction of Ph.D. degrees awarded to women again ranges from 8% for Japan to 23% for Poland, again with India doing quite well at 20%. While detailed data on the fraction of permanent positions available to women were not available across countries, about 10% of the faculty positions in physics in Indian universities are held by women. At senior levels the numbers fall to barely 3% at the full professor or equivalent level in practically all countries. When the numbers are so small, statistics do not convey the full enormity of the situation, even when all the natural sciences and engineering are included in the statistics. For this, one needs to realise that there were only 3 women professors of Chemistry in the United Kingdom when the data were compiled. The situation in industry was similar, although developing countries possess very few opportunities for the employment of scientists compared to developed countries. In countries like the U.S., where pay is negotiated, there was a pay gap between men and women that got wider with increasing levels of seniority; with the pay differential being 5.7% at the instructor level and increasing to 9.4% at the professor's level. Another way in which women are discriminated against, is by slowing down their promotions. Detailed statistics from Japan showed that it takes women on an average 10 years longer than their male colleagues to advance professionally to the rank of professor despite comparable or far better performance levels as measured by statistical indicators. A report from the United States on a study at the Massachusetts Institute of Technology showed that women professors consistently had less laboratory and office space and were paid less than their male colleagues.

These facts came as eye-openers and strengthened the determination of the delegates to take action which could balance out such inequities, and prevent their recurrence in the future. While there are common factors in the situations faced by woman physicists the world over, the discussion also brought out important regional differences. The issue of sexual harassment came up as a common problem, although the degree of its extent varied significantly in different countries. While the necessity of a supportive family structure, especially that of encouragement and support from the spouse, clearly emerged as a common, and important requirement for all women, women physicists from developing countries felt that the need for change in social attitudes was a more pressing issue than those from developed countries who focused more on changes in institutional conventions and practices. The action plan to remedy the situation will therefore need to have signif-

icant regional variation. The U.S. and European Community initiatives in this direction have underlined the utility of involving social scientists and physicists towards this end. Another important lesson drawn from the experience of our North American and European colleagues is that pro-active measures do pay dividends in terms of the increase in the participation of women physicists at all levels.

### **3 Resolutions and Recommendations**

The Conference adopted eight Resolutions directed at schools, universities, research institutes, industrial laboratories, scientific societies, national governments, granting agencies and at the organiser IUPAP. The discussions at the Conference also resulted in a set of recommendations which could help in increasing the participation of women in technology and science. Some key elements of these resolutions and recommendations are summarised below. Further details of these resolutions as well as a great deal of other material about the conference can be found at the site <http://www.if.ufrgs.br/barbosa/conference.html>.

Girls should be given the same opportunities and encouragement as boys to learn physics in schools. Methods and textbooks used in teaching physics should include those that have been shown to interest girls in physics and foster their success. One way is to provide young girls and their parents with opportunities to see ways in which physics has a positive impact on society. Parents should be educated about opportunities for daughters and how to encourage them, and also be requested to educate boys to share family responsibilities and to expect women to have professions.

Undergraduate physics education should be made more welcoming to students, boys as well as girls, by using a broad interdisciplinary approach to physics; providing flexible entry criteria to the physics major; and allowing early participation in research. Young women often feel isolated and unwelcome in physics. This can be overcome by making special efforts to provide enlightened and supportive mentors and supervisors for women physicists who will help them overcome the visible and invisible barriers to their success as scientists.

Since studies have shown that women scientists have not been treated fairly even at top universities and research institutes, institutions must ex-

amine and communicate their policies and practices to make sure that they promote equity. It is of key importance that universities guarantee transparent and fair mechanisms of recruitment and promotion. Transparency can be aided by having a requirement for decisions to be reported and explained and by having written rules and policies. Similar policies should be followed by agencies which grant research funding. Limits on age of eligibility or grant structure and duration that seriously disadvantage applicants taking family leave should be reconsidered.

Having a family should not be allowed to impede women's participation in scientific careers. A family-friendly environment that provides such things as child-care facilities, flexible working schedules and employment opportunities for dual career families will enable career success.

Institutional governance has been found to be dominated by men. Women need to be included in institutional governance, particularly on key policy committees. Women must have input into those policies that control their own destinies.

It is important for the development of young women physicists to see successful women active in research, teaching and leadership. Scientific and professional societies can and should play a major role in increasing the number and success of women in physics. Each society should have a committee or working group that is responsible for such issues and that makes recommendations to the society as a whole. At a minimum societies should do the following things: work with other organisations to collect and make available statistical data on the participation of women in physics at all levels; identify women physicists and publicise them as role models; include women on program committees and as invited speakers for society-sponsored meetings and conferences; and include women on editorial boards of society journals. Additionally, national planning and review committees should include women, and awards of government funds should only be made to organisations and institutions that make gender equity a part of their policies.

## 4 The Follow-up

Finally, it has been recommended to the organisers of the conference, viz. IUPAP as an international organisation of physicists which exerts considerable influence on the physics community through its statements and activities,

to communicate the results of this conference to international scientific organisations in other fields, and also to continue its working group on women in physics and empower it to establish an international advisory committee with a member from every participating country. It is hoped that this group will form the basis of a network that can continue the work of increasing the number and success of women in physics.

It is expected that these recommendations will be discussed at the IUPAP general body meeting taking place in Berlin in October this year. Meanwhile, it is heartening to note that a few of the measures suggested at the meeting are already in place in India. Administrative initiatives have led to increased age limits for women post doctoral CSIR fellowships as well as for the DST young Scientist program. The Department of Science and Technology has also formed a thematic sub-group on technology transfer and capacity building for local level planning' which is discussing steps to be taken to provide support for women to have physics and technology as a career. Some measures have already been taken up to deal with the issue of sexual harassment, not for women scientists alone, but for all women at their work-places. The government of India has strong guide-lines about harassment and the Supreme Court has legislated that Women's cells which deal with such cases should exist in all State and Centrally funded institutions. However, more needs to be done before such cells become functioning and effective in academic institutions. Other issues also need to be tackled at administrative and institutional levels. These include measures to help women overcome the crucial barrier between the post-doctoral and faculty positions, and also to increase their representation in decision making bodies to levels which more truly reflect the high degree of achievement reached by many women. Institutional infrastructure needs to be improved to make it women and family-friendly. Thus, much further action needs to be taken before women can participate in advancing the frontiers of science and technology on an equal footing with men. We hope the coming years will bring further initiatives in this direction.

**Rohini Godbole**<sup>1</sup>, **Neelima Gupte**<sup>2</sup>, and **Sumathi Rao**<sup>3</sup>,

<sup>1</sup> CERN, Theory Division, CH-1211, Geneva, Switzerland and Center for Theoretical Studies, Indian Institute of Science, Bangalore, 560012,  
E-mail: rohini@cts.iisc.ernet.in, Rohini.Godbole@cern.ch

<sup>2</sup> Dept. of Physics, Indian Institute of Technology, Madras, Chennai, 600036,  
E-mail: gupte@acer.iitm.ac.in.

<sup>3</sup> 104, Davey Lab, Penn State University, State College, PA 16802 and Harish-  
Chandra Research Institute, Allahabad, 211019,  
E-mail: sumathi@phys.psu.edu, sumathi@mri.ernet.in.