Gender diversity in the Indian landscape : a personal perspective

Sumathi Rao

ICTS, Bengaluru

SWPNIOE, Shiv Nadar University, New Delhi

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- Have always had a few individual (unsung) women in physics in India (Bibha Chowdhury, Anna Mani, Rajeshwari Chatterjee, ...)
- But for many years, no real recognition that the numbers were skewed and that there were any discriminatory practices
- It was expected to be `natural', not only in India, but even world-wide, that curiosity about science and physics, in particular, is only for men

Plan of the talk - my account of how the personal became the collective

- Personal background
- History of the `working group of women in physics in India',
- Status of GIPWG (Gender in Physics Working Group) in recent years : Positive slope, but .....
- Going forward : What can we do to improve the situation

My journey in physics – opportunity, luck and obstacles

My journey as a scientist

- Basic background - grew up in Hyderabad and Baroda (now Vadodara)
- Always interested in puzzles, detective stories. I was academically good, state-rank holder, interested in science and English literature - but in my school good students went for medicine and engineering and I had got admission in both. Should I take science?
- Eldest daughter with a younger sister and much younger brother (both engineers). Supportive family who encouraged me, grew up with books (often borrowed or from lending libraries!)
- National Science Talent scholarship in class XII gave me the boost to choose science
- Master's, IIT Bombay; PhD, Stonybrook, USA 1983 on neutron-anti-neutron oscillations and B-L violation in grand unified theories


lumni of Science Faculty
Sir Venkataraman Ramakrishnan
Awarded Nobel prize in Chemistry in 2009
Awarded Padma Vibhushan in 2010.
Served as president of the Royal Society from 2015 to 2020.
Graduated in Physics in the year 1960.
Mr. Sam Pitroda
Awarded with the Padma Bhushan in 2009.
Father of India's Computer and IT Revolution.
Post graduation in Physics in the year 1964.
Prof. J J Shah
Fellow of Indian National Science Academy
Fellow of National Academy of Sciences
Received first Doctorate degree from Botany in 1957 .
Prof. Sumati Rao
Fellow of National Academy of Sci
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Graduation from Physics in 1977.
Dr. Arup Kumar Raic
Humboldt Prize Fellow
Received Shanti Swarup Bhatnagar
Graduation in Physics in 1973.
Dr. Dishant Pancho
Received Shanti Swarup Bhatnag
Postgraduation from Mathematics
Dr. A. Surolia
Former Director, National Institu
tion from Biochemist
Dr. Darashaw Nosherwan Wadia
Awarded with the Padma Bhushan in 1956.
Among the first Indian scientists to work in the Geological Survey of India.
Obtained his Bachelor's degree in Botany & Zoology in 1903.
Prof. Vinod K. Singh
Awarded Padma Shri in 2014
Received Shanti Swarup Bhatnagar Prize in 2004
Received Doctorate in Chemistry in 1996.
Dr C S Nautiyal
Fellow of Indian National Science Academy
Former Director of National Botanical Research Institute and Central Institute of Medicinal and Aromatic Plants
Postgraduation from Microbiology in 1992.
Prof S Yadav
ONGC Ltd. Vadodara.


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Kamlesh Lulla

Science Talent summer schools

- Organizing summer schools for women in physics at ICTS now, took me back to 1975 when I attended my first summer school as an NSTS - in BITS Pilani (~50 boys and 8 girls)
- Summer School was a month long, but I was scared and homesick, went home after 2 weeks. Attended the third one in RRI in Bangalore.
- Did not take advantage of this and several other opportunities, due to what I now recognize as `impostor syndrome'.

Early years

- Got married in 1983 (Spouse : Ashoke Sen, who also finished his PhD from Stonybrook in 1982 in QCD - theory of strong interactions - and moved to Fermilab)
- I also got a postdoc at Fermilab (1983-86) (relationship not known to employers prior to getting the job!).
- At Fermilab, I worked on the phenomenology of particle physics, but also worked on topological field theories in 2+1 dimensions - turned out to play an important role in my later career in condensed matter physics, where I worked and continue to work on topological quantum matter!

- Came back to India, to Institute of Physics in Bhubaneswar, in 1987 after a second postdoc at University of Madison-Wisconsin.
- Ashoke, after a second postdoc at Stanford, came back to TIFR, Mumbai
- Difficult years (8 + 2) of commuting marriage and long train journeys between Bhubaneswar and Bombay - 40 hours usually, and 60 hours on one exceptional trip!
- But lucky that there was no pressure either from my family or my husband's family to quit! Many other women do not have this choice

Stability in Allahabad

- In 1995, a new institute started - HRI in Allahabad, with Prof. Mani at the helm and both Ashoke and I got positions there (breaking the unwritten rule that husband and wife cannot get jobs in the same organization!). We stayed there till 2021 (26 years!) after which we moved to ICTS in Bengaluru
- So most of my working years have been spent in HRI

- A brief description of my research interests over the years
- Switched in mid-1990's to condensed matter physics, in order to carve out my own territory
- Initially hard, since my contacts abroad were all in particle physics. Also quite isolated in HRI
- Abdus Salam ICTP (in Italy) and its summer schools on various topics gave many of us an opportunity of learning about new developments. I was an associate of ICTP and in those days, that was important, because the trip was fully paid
- Most faculty in those days had no travel money at all.

- Internet and email also came later, so these trips were really important to be aware of global research
- Got interested in spin systems, and in collaboration with Diptiman Sen, who was also switching from HEP to condensed matter, we wrote many papers together.
- Early 90's, also got interested in fractional quantum Hall effect and composite fermions, introduced by Jainendra Jain, who was a student in Stonybrook, 2-3 years junior to me. Initially looked at the paper because he had written it, and then got fascinated.
- Started my life-long love affair with anyons from then. Wrote a review article `Anyon Primer' in 1992, which is used by students till today!

- Over the years, worked on one-dimensional quantum wires, bosonisation, Luttinger liquids, besides quantum Hall effect and anyons
- But last 10-12 years, have focussed on topological quantum matter, topological insulators, Weyl semimetals, etc and on Majorana modes, which are a special kind of anyon - a non-abelian anyon and on graphene and quantum Hall effect in graphene

Gender-based struggles

- I was the eldest and came from a family where girls were encouraged. My mother had not been allowed to study beyond high school (although she later did her Master's after I finished my Master's), so wanted me and my sister to study as much as we wanted
- Didn't feel gender discrimination through my Bachelor's in MSU, and even in IIT, our class had an exceptionally large number of girls who mostly out-performed the guys.
- While, in retrospect, there was a lot of sexism and gender bias in IIT, perhaps the fact that we were oblivious helped us!

- Did not face overt gender bias during my PhD and postdoc years abroad either
- It was back in India, as a faculty, at IOP and at other places I used to visit, I realised that it was a hard for a young woman physicist to be taken seriously by colleagues, senior students, etc
- Needed several years of hard work. I was married to a `star' and struggled to establish myself independently. Switched my field of study to condensed matter physics (a very good decision, in retrospect, for my taste)
- Life improved as I got older, and started having PhD students

- Always liked working with students. But before 2011, I had only a few students, one at a time (including Sourin Das here)
- After Udit Khanna joined in 2011, and I started having senior collaborators from Israel and USA, I also started having a stream of students and my last student Nirnoy Basak gave his thesis defence in 2025. But 2011 was 28 years after my PhD!

From individual experience to collective recognition of problems

Involvement in women in physics issues

- Started thinking about these issues in early 2000's
- In 1999, IUPAP, International Union of Pure and Applied Physics , formed the working group on women in physics under the leadership of Judy Franz (APS)
- Judy Franz contacted Nandini Trivedi to get data from India.
- First task was to collect data from literacy unto first degree, going all the way upto PhD. Obtained and presented by Nandini, using her parents' IAS contacts to get government data!

From denial to recognition of the problem

- Next was to collect and collate data from 30 working women scientists in India. Since Nandini was leaving for the US, she passed on the responsibility to me. So I ended up doing it and presenting it to an international working group on women in physics
- Surprisingly, at that time, most Indian women (including Rohini, Neelima, and me) said that there was no bias against physics as a subject for women
- Almost no one implied discrimination. However, each and every individual had faced problems, but blamed themselves

- I was in the working group from 2000 to 2008. The first mandate of the group was to plan an international conference on WIP to study the problem of under-representation of women worldwide.

- The first International Conference on Women in Physics was planned by this group, which decided the speakers, the topics, the modalities, the funds, etc and it was held in Paris in 2002.

- Participants included Rohini Godbole as the Asian success story, and 4 others, including myself, Neelima Gupte from IIT Madras, Jyoti Gyanchandani from BARC and Sunita Nair, a young postdoc from Raman Research Institute

- Talks included one by Nancy Hopkins, a molecular biologist who had documented discrimination in MIT, USA

- First time, we realized the commonality of problems and gender discrimination faced by women. Similar in 65 countries ranging from US and the western world to third world countries to individual scientists from places in Africa.

- International Conference on Women in Physics (ICWIP) has been held every 3 years since then. Mandate was to review the situation for women in physics and suggest ways to improve

- Main impact of the first two or three international conferences on women in physics in the Indian context -

RECOGNITION OF THE PROBLEM

Next stage : Impact, increased networking

- IUPAP seeded discussions among working women physicists. We started writing articles, giving talks, highlighting the problem
- Needed to break the `taboo' on mentioning sexual harassment
- Early years, no data available, numbers informally collected

- We also started holding special sessions on women in physics in conferences we attended - Neelima Gupte at Statphys 2004 and Pratibha Jolly, at conference on physics education in 2005

- INSA report on `Science career for Indian Women', committee including Bimla Buti and Rohini Godbole from physics, came in 2004. Before that, only data we had on female participation in science came from some data collected by Nandini Trivedi via her IAS parents

- An important document which included data on women in science for the first time (although not subject-wise (i.e., physics, chemistry, biology, etc)

- Highlighted the fact that in India, difference was not at school level - girls routinely out-performed boys in school board exams even in the sciences
- So problem not to attract girls to sciences, but retain girls in science as they moved up - leaky pipeline
- Could report on this on the second IUPAP conference in Brazil in 2005, although our data on women in physics was sketchy, collected by ourselves

- Attempts were made to start a working group on women in physics in India, but unfortunately, not successful at that time. Very few women were members of the academies, which were then the only organized group of scientists. We were mostly not aware of IPA.

- However, by the third IUPAP women in physics, in 2008 in Korea, our networking had improved. Pratibha was a plenary speaker, and three of us presented at parallel sessions. Participants from India included those from teaching colleges as well as research institutes

- We had many successes to report. Indian Academy of sciences formed the women in science panel in 2005

- IASc Panel brought out `Lilavati's daughters' - 100 essays by working Indian women scientists, edited by Rohini Godbole and Ram Ramaswami
  Highlighted the idea that normal working scientists could be women (not just Marie Curie!)

- By then, I had moved out of the working group, but Shobhana Narasimhan and then Prajval Shastri carried it forward

- And then, in 2017, Prajval Shastri, with a lot of hard work set up the `The Gender in Physics Working Group' of the Indian physics association

- Led to the first Gender in physics conference in Hyderabad - Pressing for progress in 2019, under the leadership of Prajval Shastri, Bindu Bambah and Soma Sanyal.
- Culminated in International Conference on Women in Physics, July 2023 (ICWIP 2023) in India, which was held in an online mode
- Mainly possible due to the hard work of Vandana Nanal and Srubabati Goswami, the co-chairs

Timeline

- 1999-IUPAP working group on women in physics established
- 2002 - First IUPAP meeting on women in physics in Paris
- 2004: INSA report on science careers for Indian women
- 2005: Indian Academy of Sciences Women in Science Panel
- 2007: Lilavati's Daughters
- 2017: IPA Gender in Physics Working Group
- 2019: Pressing for Progress conference, Hyderabad
- 2023: ICWIP hosted from India in online mode

Current status of women in physics in India - many positives but consistent gaps

Shikha has already shown data that shows that inequities and the leaky pipeline problems persist

- In 2007, estimated number of women in physics at master's level - 30%, PhD level 20% and faculty level 10%
- Less than 5% faculty in elite institutes
- Almost no-one in policy making bodies, funding committees, academies, etc, implying exclusion from decision making at the highest level
- 3 percent women in prestigious academies. Not a single Bhatnagar award for a woman physicist
- 2023 gender survey shows 31 percent women PhD students, 29 percent for postdocs and 14 percent for faculty
- ~ 10 percent in elite institutes
- Women directors, VCs, members of governing council increased to about 16 percent.
- 6 percent women in prestigious academies. Women getting IPA award, CV Raman lectureship, etc, increased to around 20 percent

Landmarks in 2019



Rohini Godbole
getting Padmashree



Aditi Sen De
getting Bhatnagar

And 2023



- Urbasi Sinha getting the Bhatnagar award -2023

First response : family based initiatives

- Mainly focused on the idea that it is because of family responsibilities and children that women in science lag behind - true for all working women in any profession
- This also led to various Government policies to provide a more level playing field for women in science
- led to career-break fellowship for women in science to help them get back to work after break (India already has generous child care leave as compared to most countries for all Government employees)

- Many women have utilised these fellowships shows that these policies have helped and there has also been a definite increase in the number of women in science in faculty positions, in the number of women getting projects, and generally in the number of women scientists who are visible now

Other positive responses

- Publication of ` Lilavati's daughters : women in science in India' by Indian Academy of Sciences (2007) - step in the right direction
- Science communication wing of DST has produced video series called `Scientifically yours' by practising women scientists
- Gender in science taken more seriously at higher levels - workshops for women scientists to sensitise them to the problem and prepare them for leadership roles

All women issues of three Indian science publications in March 2017

- All women issue of Physics News (news letter of the Indian Physics association) edited by Prajval Shastri, Bindu Bambah and Vandana Nanal
- All women issue of Current Science with editors Neelima Gupte and Sulabha Kulkarni
- All women issue of Resonance edited by Prajval Shastry and Sudeshna Mazumdar-Leighton

- Later, in March 2019, another issue of Resonance with all women authors was edited by Riddhi Shah and Sudeshna Sinha
- More recently, a special all-women issue of the Physics News was co-edited by Arti Garg, Deepshikha Jaiswal-Nagar and Poonam Mehta.
- But do these success stories mean that we now have gender equity and the struggle is over?

However, no surprise to most of you

Ground reality for many women tells a different story

Gender gap continues to exist

And there are persistent problems!

The way forward

- Earlier responses did not solve the problem of biases in hiring, evaluation, everyday interactions and decision-making
- So what is now needed is making institutions more accountable

Need to accept existence of unconscious bias

- Important to realise that discrimination is not something that is practised by `bad' or `evil-intentioned' people
- All of us practise discrimination at various levels - most times unconsciously
- We both can and will change, if it is brought to our consciousness

Changes that have started and need to be sustained

- Continue to collect statistics for women in science and use them to show that discrimination is real
- Initiatives like all women issues of science magazines need to be followed up by making sure enough women are asked to contribute in regular issues
- Mandatory establishment of creches at workplaces, flexible time, part-time jobs and flexible leave rules, but need to make sure these are not used against the advancement of women
- Mentoring and networking programmes, and conferences like this one

- Special programmes to encourage young women in science have been started - e.g, Vigyan Vidushi programme in TIFR - a 3 week programme for 1st year MSc or 4th year of 5 year integrated BS-MS programmes for exposure to advanced topics and Summer school for women in physics at ICTS - a 2 week programme for 2nd year Bachelor or BS-MS students

- Are these needed? Yes, because India is very diverse country and women from different parts of the country face different problems

But more needs to be done!

Suggestion : A possible solution for two career couples

- Given reality that a large fraction of scientists are married to other scientists, a possible solution will be to allow institutes/IITs/Universities to employ spouses without using up an extra position – i.e., number of positions automatically increases if a spouse is employed

Questions that need to be answered urgently

- How are current policies such as career-break fellowships for women seen in the scientific community? Are these policies really leading to gender equity? Are they contributing to a backlash?
- How to handle and account for gender intersecting with region/class/caste? Should we have affirmative action to account for differences in background among women?
- Important questions which have not yet been addressed!

Need of the hour

- Gender sensitisation programmes for both men and women . We need regular workshops and training to help us first recognise our biases and then learn how to counter them
- Teach us how to conduct interviews for students, faculty, oral exams, etc., without being perceived as aggressive (which can even come from body language)
- Teach us not to ignore voices and ways of speaking that may sound less assertive or confident in meetings

- Teach us to prevent both sexual harassment and gender-based harassment
- Need to differentiate between the two - perhaps there exists no woman who has not experienced gender-based harassment (belittling, stereotyping and differential treatment), but not every gender-based harassment is equivalent to sexual harassment
-

- Many institutes have started lectures and workshops on this, but usually only on women's day or something and not everyone comes for it
- Gender sensitisation training needs to be made COMPULSORY for everyone - faculty, students, administrators, casual workers, etc
- Also, for people working at funding agencies and various hiring, promotion and award -giving committees

General need for diversity

- Science is an international enterprise and much of the progress in science has come because of this – questions have been asked and answered by people all over the world
- Scientists with different perspectives can ask different questions
- Different questions and different ways of answering lead to different insights into the problem

- Diversity implies that we include groups which have been traditionally not included, whether it is women or other marginalised communities due to race, class, caste, etc

- Expect them to ask new questions, fresh ideas, new skills, etc

- Most importantly, need to build a scientifically literate society - many important societal and global issues like education, health, environment require everyone to participate - science cannot remain the bastion of the predominantly male, privileged section of society

Mentorship, students and the next generation

- Back to my story, how do I look back on my years as a physicist? Has been fun. Have worked in many fields and with many collaborators
- Have also served as the Divisional Associate Editor for Physical Review Letters (PRL) for 6 years
- But my major contribution to my field, has been my students.
- Have had many PhD students, many more Master's and visiting students and many postdocs. I have enjoyed mentoring them all, and have learnt as much or more from them as I have taught them
- Many of them are faculty members in IITs and IISERs and so I have many grand-students as well.









- 4 generations


Anjana Devi
Shikha Varma

The change I have witnessed began when individual experiences became collective knowledge.
It will continue only if institutions accept responsibility for making physics inclusive
Your views?