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Towards Gender Equity in Physics in India: Initiatives, Investigations, and Questions

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Abstract. Initiatives towards gender parity in the sciences in India have occurred both at national, governmental levels and at local, institutional levels. A gender gap persists in physics, but data suggest that this gap is due neither to lack of interest in science nor to a lack of career goals in science among girls. We outline investigations that are important to pursue and recommendations that build on the existing science interest and the impact of initiatives so far.

CURRENT TRENDS, POLICY INITIATIVES, AND CULTURAL INITIATIVES TOWARD GENDER PARITY

The fraction of female science faculty in higher education has plateaued at about 43% as of 2012 [1]. About 30% of science research projects funded by the Department of Science and Technology (DST) are by female principal investigators as of 2010 [2]. The numbers in the physical sciences are likely to be lower, however [3].

The female fraction of the DST "INSPIRE" faculty and student fellowship awardees is about 33% and 60%, respectively, laying to rest claims that young girls lack an interest in science or that women lack scientific ability. Indeed, in a sample of 44 female and 25 male scientists, 38% of women were rank-holders and only 9% had low academic rank, compared with 24% and 36%, respectively, for the male scientists [4], suggesting that "fixing the women" by "building their skills" is not the need of the hour. There appears to be a trend for younger women scientists with scientist spouses to consciously choose institutions in smaller towns that may provide an equitable opportunity for both partners [5].

The DST has awarded 223 career-break fellowships for women in the physical sciences to date, has proposed a "mobility scheme" to address constraints of women subjected to family relocations, and continues the CURIE program to substantially support women's universities [6]. A study on women in science sponsored by the Indian Academy of Sciences (IAS) [7] attracted the attention of the Indian Parliament. The Indian National Science Academy (INSA) organized a workshop on women in science (September 2013), and the Astronomical Society of India (ASI) had a session on gender issues in astronomy in its annual meeting for the first time (March 2014); both these sessions strongly foregrounded the debate around gender in formal circles.

Mentoring is clearly extremely important: for example, of the 166 Indian respondents with declared gender in the Global Survey of Physicists, 81% female physicists (26 of 32) reported having a female physics teacher, as opposed to 56% male physicists (69 of 123) [8]. In this direction, *Lilavati's Daughters*, a collection of essays on the lives of Indian women scientists published by the IAS [9, 10] has now been translated into Hindi, Marathi, and Malayalam. *A Girl's Guide to a Life in Science* [10, 11], has sold more than 3000 copies, is available in a Kindle edition, and has been translated into Telugu, with Urdu, Tamil, and Hindi versions forthcoming. The IAS has been running regular career workshops for women. *Vigyan Prasar*, the science communication wing of DST, has produced a TV series,

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Scientifically Yours, featuring 13 practicing Indian women scientists, including two physicists. Local initiatives, such as the network of Women in Physics in Nagpur, undertake gender sensitization and promote physics among young girls (Darisi and Ubale, these proceedings), which also play an important role.

PERSISTING CONCERNS, QUESTIONS TO BE INVESTIGATED, AND RECOMMENDATIONS FOR THE FUTURE

Female scientist fractions in the elite research institutions, which purportedly set the national standards in academic excellence, work culture, and progressive institutional vision, are telling: for example, the astrophysics institutes have a dismal median of about 10% (range 0−20%; from data in ref. 12). Reasons quoted by management, such as lack of female applicants (e.g., ref. 5), are not backed up by evidence. Despite the 40% female fraction of science faculty in higher education, the female fraction in senior governance positions or academy membership remains disproportionately small; for example, women fellows of the IAS are a mere 7% (up from 3% in 1995), the female fraction of the International Astronomical Union is a mere 9% of Indian members, and only 14% of INSA Young Scientists Awardees are women (2008–2014).

There is strong resistance within the community to debate unconscious bias (e.g., ref. 3). Elite institutions, including government and funding agencies, continue to resist gender audits, making it difficult to ascertain the changing nature of representation at different levels (PhD student, postdoc, faculty). Gender-related initiatives are seen as a means for women to get favors for themselves, and the "drumbeat" of discrimination persists (e.g., ref. 13). The social expectation that women can only be scientists if they can manage caregiving *and* science practice, while men *cannot* be the primary caregivers, still weighs heavy; for example, results of the Global Survey of Physicists for India show that while only 46% (16 of 35) of females reported being married/in a long-term relationship, as opposed to 62% of males (79 of 127), and 43% of females reported being a parent or guardian of a child, as opposed to 75% of males, as much as 77% of females reported that their career changed their personal decisions about marriage or children, as opposed to 53% of males (67 of 126) [8].

How has the gender fraction at different levels (PhD student, postdoc, faculty) changed over time in the elite physics institutions? Why is there resistance on the part of elite institutions to publicize employee gender statistics? Are science institutions able to substantiate their claims that they are free of gender bias in hiring, assessment, and recognition with scientific evidence? (For example, can they demonstrate an equal gender distribution between the hired personnel and the applicant pool?) Does higher gender parity in institutions correlate with women-friendly workplaces, reduced sexual harassment, gender-neutral academic recognition, and gender-neutral governance and assignment of responsibilities? Do physicists perceive their institutional processes, such as recruitment, assessment, and governance mechanisms, as transparent, and do men and women—and women physicists not in the main-stream—see these differently? Scientists in research positions see "family pressure" as a more important obstacle to a science career path compared to women scientists without jobs [7]: is this a consequence of social expectations? How do physicists perceive measures towards gender parity (such as the career-break fellowships and gender audits) and gender equity (such as mechanisms to address sexual harassment)? Is there a difference in the perception of men and women regarding these measures? How do women physics graduates from women's universities fare in their careers compared to women and men from co-educational universities? Do policies merely address the short-term goal of gender parity or also the long-term goal of gender equity? The viewpoint of trained women scientists with and without jobs is clearly fractured, with strong implications for policy [7], so there is a clear need to seek the opinion of trained women scientists who are not part of the mainstream, more so because their viewpoints and experiences are not easily available in the public domain.

The recommendations outlined in the previous country report [10] need to be pursued. Clearly the mechanisms that cause gender inequity in science practice in India are not well understood [14]. The gendering of institutional spaces [14] as well as of the perceptions of competence and commitment [4] need investigation. It is essential to move from the traditional framework of family reasons being the overriding cause of the gender gap, to an alternative framework that focuses on formal spaces in institutions. It is time to evaluate policies for impact not only on gender parity, but also on gender equity, and on the long-term goal of gender-healthy workplaces.

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