TRANSACTIONSNASTPHL
ISSN 0115-8848 (print)
ISSN 2815-2042 (online)
https://transactions.nast.ph/

Vol. 46 (2024)
doi.org/10.57043/transnastphl.2024.4179

BRIEF REPORT

Diversity and Inclusion Issues in Physics in Asian Countries: A Status Report

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ABSTRACT

The physics profession across Asia, like many other science and technology fields, faces ongoing challenges related to diversity, equity, and inclusivity (DEI). This report presents an overview of the current DEI landscape within the Asian physics community, with a particular focus on the participation and status of women in physics. It highlights the gender disparities prevalent in several Asian countries and reviews various initiatives aimed at addressing these issues, including institutional and government-led programs to support and empower women in the field. The findings underscore the need for sustained and collective action to foster an equitable and inclusive environment for all physicists across Asia.

Keywords: diversity, women in stem, gender disparity, gender equity initiatives

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Citation
Goswami S. 2024. Diversity and inclusion issues in physics in asian countries: a status report. Transactions NAST PHL 46: doi.org/10.57043/transnastphl.2024.4179

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Abbreviations: DEI - Diversity, Equity, and Inclusivity; STEM - Science, Technology, Engineering, and Mathematics; ICWIP - International Conference on Women in Physics; GIPWG - Gender in Physics Working Group; AASSA - Association of Academies and Societies of Sciences in Asia, WISE - Women in Science and Engineering; IAGRG - Indian Association for General Relativity and Gravitation; IAPT - Indian Association for Physics Teachers; GATI - Gender Advancement through Transforming Institutions; JPS - Japanese Physical Society; JSAP - Japan Society of Applied Physics; EPMEWSE - Japan Inter-Society Liaison Association Committee for Promoting Equal Participation of Men and Women in Science and Engineering; UNESCO - United Nations Educational, Scientific and Cultural Organization

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doi.org/10.57043/transnastphl.2024.4179

Introduction

The lack of gender diversity in STEM fields, in general and Physics, in particular, is a global issue. Asia, although a region of remarkable cultural and linguistic variety, is no exception to this. According to the statistics published by the UNESCO Institute for Statistics on the women researchers in STEM fields in different countries, the global average fraction of women in STEM is 28.4% (UNESCO 2018). Many Asian countries have a larger percentage of women researchers than this — with seven Asian countries having more than 50% female researchers in permanent positions. Myanmar, with 84.5%, tops the list. But, surprisingly, for bigger and more developed countries in Asia, such as China, Japan, South Korea, and India, the proportion of women researchers is lower than the global average. This disparity can be attributed to a range of factors — (i) cultural and societal norms: in some countries, traditional gender roles and societal expectations can influence women's participation in certain fields, including research and academia (ii) educational and career pathways: even if women have access to education, they might face barriers in pursuing advanced degrees or research careers due to gender biases or lack of support (iii) work-life balance: in many countries, the challenge of balancing career and family responsibilities can disproportionately affect women, potentially impacting their career progression in research (iv) institutional barriers: gender bias and lack of mentorship opportunities and role models can also contribute to the lower representation of women in research. In the next section, we present gender statistics specifically within the field of physics across a few Asian countries, as well as highlight the steps being taken to improve gender parity.

Status report of gender ratios in physics and measures to improve the scenario

In order to assess the gender ratio in any subject, statistics plays an important role. The statistics presented below are collected from the proceedings and presentations at

the International Conference on Women in Physics (ICWIP) (ICWIP 2023; Foley and Madison 2023; ICWIP 2017) This series of conferences provides a forum for physicists from different countries to disseminate and deliberate on DEI issues and learn from each other's best practices. The latest conference in this series was hosted by India using online mode.

In India

In recent times, India has witnessed a surge in gender awareness and efforts to improve the gender proportion specially in STEM fields. Among the STEM fields, the discipline of physics suffers from severe underrepresentation of women, especially as one climbs up the ladder to higher levels. The efforts to mitigate these issues in physics are spearheaded by two gender working groups: the Working Group of Gender Equity formed in 2015 under the Astronomical Society of India and the Gender in Physics Working Group (GIPWG) set up in 2017 under the Indian Physics Association. GIPWG coordinates the presentation of gender status in the country in physics. Since 2017, there has been an increased awareness of mitigating gender issues. GIPWG organized the first national conference on gender in physics, Pressing for Progress 2019 (GIPWG 2019). The deliberations culminated in the “Hyderabad Charter for Gender Equity in Physics,” a comprehensive charter outlining the root causes and remedies (GIPWG n.d.). The data presented in ICWIP 2021 revealed 30% of women Physics PhD students, which nosedived to 14% at the faculty level.

The data presented in ICWIP 2023 show that the number of permanent women faculty varies between 10% in research institutes to 18% in universities. The numbers of female PhD students in these organizations are 20% and 44%, respectively. This reveals the existence of the "leaky pipeline problem." Women fellows in Indian Science Academies are less than 10% in number, whereas there are 16% of women as Directors, council members, etc. The latter showed an increase from a meager 3%, as presented in ICWIP 2017. The representation of women as invited speakers in national conferences has been around 10 to 20% (ICWIP 2023). Post ICWIP-2021, the gender groups in different disciplines, like high energy physics, condensed matter physics, nuclear and atomic physics, etc., were formed by the GIPWG to look into the relevant issues more closely and to raise awareness at a wider level. Independently, the Indian Association for General Relativity and Gravitation (IAGRG) and the Indian Association for Physics Teachers (IAPT) also organized gender groups demonstrating the widespread

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awareness and commitment to improving gender parity in India.

In 2023, GIPWG co-organized the ICWIP meeting in online mode. This has created renewed enthusiasm all across the country in raising awareness about the issue. There are also a lot of initiatives and support from the Government of India. Various schemes to improve the status of women in science include the women scientist scheme initiated in 2002, which provides fellowships for women with a career break, Power Fellowships and Grants for women researchers (2020), the GATI (Gender Advancement through Transforming Institutions) accreditation program (2020) — inspired by the Athena Swan scheme in UK. Overall, India is making significant strides in addressing the challenges faced by women in STEM, although there is still a long way to go.

In China

Data presented at the 6th International Conference on Women in Physics (ICWIP) in 2017 provided insights into the participation of women researchers in physics across 13 universities in China from 2012 to 2016. According to the report, approximately 30% of women are represented at the PhD level; however, this percentage significantly drops to around 1% at the Full Professor level, highlighting a notable decrease in female representation as one moves up the academic hierarchy. This drop underscores systemic challenges faced by women in advancing to senior academic positions in physics.

To address these issues, the Chinese Physical Society established a working group on women in Physics in 2002 with the aim of improving the status and representation of women in Physics in China. This group has implemented several initiatives, including (i) round table meetings, started in 2003, organized during the society's fall meetings to provide a platform for women in Physics to discuss challenges and opportunities; (ii) lecture tours in remote areas to address regional imbalances and encourage more women to pursue careers in Physics; (iii) Xie-Xiede Prize named after the renowned Chinese semiconductor physicist, awarded to outstanding women physicists to recognize and encourage their contributions to the field (ICWIP 2019). In 2022, the round table meeting was held in a hybrid format and the impact of the pandemic was discussed (ICWIP 2023). Other topics included work-life balance and the physical and mental well-being of female physicists. Overall, China has made significant efforts to boost gender equality in STEM fields, including Physics, but more efforts are needed to address the pipeline problem.

In Japan

The gender disparity in physics is also noticeable in Japan. Women are underrepresented in physics research and academic positions, with lower participation rates in higher academic ranks compared to their male counterparts. However, the percentage of female researchers has shown a modest increase, rising from 13.6% in 2009 to 16.6% in 2016. The Japanese Physical Society (JPS) and the Japan Society of Applied Physics (JSAP) have implemented several initiatives to promote women's participation in Physics, including summer schools targeted at junior high and high school girls to inspire interest in Physics and other STEM fields and Diversity-Related Symposiums organized at annual meetings of both societies to discuss and promote gender diversity. Awards for Women Scientists: established to recognize and encourage the contributions of women in Physics.

Additionally, the Japan Inter-Society Liaison Association Committee for Promoting Equal Participation of Men and Women in Science and Engineering (EPMEWSE) was formed in 2001 [5]. This is a coalition of around 100 academic societies in STEM fields in Japan, actively working towards gender equity. This committee conducts large-scale surveys in five-year interval to assess the state of gender equality in STEM and makes recommendations to the government to improve the gender climate in these fields. They also initiated the Support Programs for High School Girls, which includes summer camps and science workshops aimed at encouraging young women to pursue careers in STEM. These initiatives reflect a comprehensive approach to promoting gender equity in Physics and other STEM fields in Japan. By addressing both the pipeline issue and the retention and advancement of women in academia, these efforts aim to generate a more inclusive atmosphere for women in STEM. In a drastic measure, a quota system for female students and faculty members has been introduced in the science and engineering

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departments of many universities in 2023 with an aim to increase the ratio of women researchers to a 30% level (ICWIP 2023).

In South Korea

South Korea's presentation at the ICWIP 2017 conference highlighted the formation of the women in physics group under the Korean Physical Society in 2002 to address gender disparities and promote the participation of women in Physics. From 2009 to 2018, the percentage of female representation in the society increased from 17.4% to 20.9%. This growth indicates progress, though women remain underrepresented in the field. The Women in Physics Group has initiated various activities to support and encourage women in Physics, including Physics Camps for High School Girls, which aim to spark interest in Physics among young girls and provide them with early exposure to the field. Special Sessions during Annual Meetings and Women in Physics Workshops provide a platform for discussion and networking (ICWIP 2017). These initiatives aim to develop a more nurturing and inclusive environment for women in Physics, encouraging more young women to pursue careers in the field and supporting those already in the profession.

In Iran

Iran has recorded a significant increase in the number of female students from nil in 1990 to 50% in 2015, according to data presented at the ICWIP [2]. This study was updated, and the latest status reported in ICWIP2023 showed 12600 female students (about 56% of the total students) studied in BSc, Master, and PhD levels in Physics in 2021. This growth has also been observed at the faculty level. Data show that in 2019, female faculty at the assistant professor level was 30%, associate professor 20%, and full professor, < 10% compared with the data in 2015: assistant professor, > 20%, associate professor, <10%; full professor, <5%. This reflects a steady rise in teaching faculties, though the number decreases considerably as one moves up the ladder, demonstrating the leaky pipeline problem.

The Women in Physics Group in Iran is actively working to support and promote the networking of women physicists. Their initiatives include (i) networking initiatives, facilitating connections among women physicists to share experiences, providing mentorship, and building professional relationships; (ii) regional and national conferences — organizing events that provide platforms for women to present their research, discuss challenges, and explore opportunities for collaboration; (iii) workshops and seminars: conducting skill-building workshops and seminars aimed at enhancing the professional capabilities of women in Physics; (iv) outreach programs: engaging with younger students to inspire and encourage them to pursue careers in Physics, thereby addressing the pipeline issue from an early stage. Online meetings showcasing talks by famous female scientists are being organised by IPM, Tehran to inspire young researchers. These efforts aim to create a more inclusive and supportive environment for women in Physics, helping to reduce the disparities in representation at senior academic levels and promoting the advancement of women in the field.

The AASSA-WISE

The gender groups in ASIA promoting awareness regarding women in STEM include Women in Physics Working Group under the Association of Asia Pacific Physical Societies. Recently, the AASSA-WISE (Women in Science and Engineering Committee under The Association of Academies and Societies of Sciences in Asia (AASSA) initiated the Prof. Yoo Hang Kim Young Women Scientists Award to provide support to early career female researchers to attend conferences.

Conclusion

In this article, we have summarized the statistics of representation of women in physics in selected countries in Asia and highlighted the various steps undertaken to improve the situation. It is evident that, in general, the representation of women decreases significantly as one advances to higher academic positions. Although these issues are increasingly acknowledged, there is a pressing need for more concerted efforts to identify and address the underlying elements contributing to these disparities. The existing measures, such as targeted scholarships, mentorship programs, diversity policies, and educational outreach, are steps in the right

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direction, but further actions are essential. One effective approach could be fostering countrywide and regional networks to facilitate the exchange of best practices and successful strategies. By learning from each other's experiences and adopting proven measures, countries can collectively enhance efforts to improve gender parity in physics.

In conclusion, while progress has been made in improving the representation of women in physics, significant challenges remain. Continued and collaborative efforts are crucial to addressing these issues and ensuring that women have equal opportunities to advance in the field of physics.

Acknowledgements:

None.

Disclosure of conflict of or competing interest:

The author declares no conflict of or competing interest.

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