Workforce Diversity in the Field of Accelerators and Beam Physics

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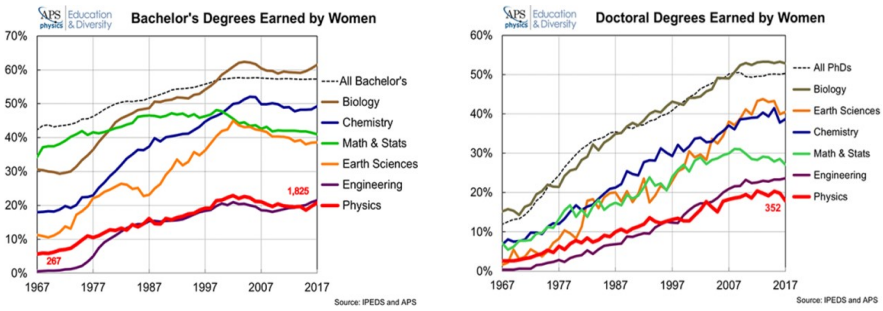
Abstract

This letter discusses the diversity situation in the Accelerator Science and Technology field, as well as trends. The goal is to encourage subsequent discussions in the community and with funding agencies for further improvements.

Today, around 4500 accelerator scientists and engineers work in more than 50 countries [1]. They collaborate with a pool of approximately three times as many technical experts. Several thousand people, including nearly 1400 in Europe and approximately 400 in the US, receive some training in accelerator and beam physics annually [2]. About 40 academic programs at universities worldwide, including a dozen each in the US and Europe, provide that training. However, education for accelerator physicists and engineers also includes on-the-job training supplemented with intensive courses at numerous locations, through programs such as the US Particle Accelerator School and the CERN Accelerator School, and at large accelerator laboratories. Approximately 100 PhDs are awarded each year globally in accelerator and beam physics. In this Letter, we draw community's attention to the situation with diversity in the field of accelerator science and technology (AST).

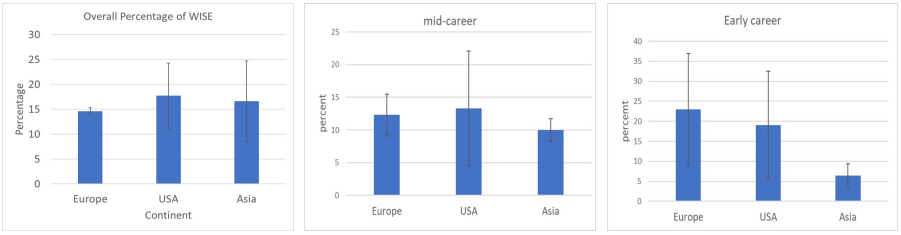
Diversity inequality has been social issues in various situations [3]. While the rigorous definition of diversity is to promote all under-represented groups, whether its gender, race, cultural, religious and geographical backgrounds, etc, the gender inequity has been the most universal topic for a long time. This has also become quite a research topic in social science [4] to figure out the root cause and mitigation measures. There have been numerous studies and surveys from the STEM fields worldwide [5, 6].



Various efforts have been carried out over the past decades. Despite impressive progress, women share in the field of math, physics and engineering is still stuck around 15%, through out all stage of careers. Figures above show the APS survey of the women attendance of colleagues and post-graduate degrees since 1967 [7]. It is evident overall percentage of women earns bachelor and higher degrees has been significant improved through out all fields. The bottom plot of the PhD degrees also clearly show the inequality distribution of women in the disciplinary of the STEM field. This tells us our community needs to figure out to find an effective way to attract the next generation talents, despite of any personnel background to further advance our field.

In preparation for the *Women in Science and Engineering (WISE)* event at the IPAC20, a survey of female researchers across the worldwide major accelerator facilities has been carried out. An inquiry sent out to the accelerator groups in about 17 laboratories to provide for the statistics of female scientists

and engineers as well as the percentage of junior and mid-level career female researchers. Figure below shows results based on the feedback. Due to the variation of definitions in career stage as well as the different methodology of statistics, the data are based on 3 accelerator facilities in each region, ie Europe, USA and Asia. The early career was defined as PhD students plus post-docs and mid-career was defined as staff members whether in management or not. The blue bar is the average of the available data points while the error bar in the three plots shows the spread of data. Due to limited sample, this plot does not reflect the average situation in each region.



These data, as well as the APS DPB unit demography statistics [8], indicate that the AST community can potentially greatly benefit from significant improvement from a more active effort to diversify and ensure the healthy pipeline of talents for answering grand challenges for the next generation accelerator technologies. The very preliminary survey presented in this letter has shown that overall ratio of female researchers in the AST is still around 15% while the female students in the program accounts for higher ratio. In addition, we also realized there are quite different focus as well as the methodology of tracking diversity from continent to continent and from organization to organization. While in the states, the equal opportunity committee consists of representatives from many under represented groups, similar committee in European counties may only reflect gender inequality. Hence, this letter would like to propose the following initiatives

- identify a standard protocol for keep tracking of diversity statistics across all accelerator facilities to properly reflect the ongoing inequality issues during various career stages. Statistics in sub-fields such as physics vs engineering can also be very helpful

- engage the community to identify possible activities with effective measurable outcomes

- Accelerator Frontier, jointly with the Community Engagement Frontier, to organize broad discussion of the discussion of these issues during the *Snowmass'2021* HEP community planning process.

- Explore alterations to career paths that reduce the uncertainty and poverty of early-stage positions so as to enable those with less privileged back-

grounds and greater family obligations to proceed within the field of accelerators.

References

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