Status Update and Grand Challenges in Education and Outreach for accelerator science and technology

On behalf of APS DPB Education, Outreach and Diversity Committee

Abstract

The purpose of this letter is to outline the status and the opportunities in education and outreach for accelerator science and technology on behalf of the APS Division of Physics of Beams Education, Outreach and Diversity Committee. In particular we review the ongoing efforts to recruit student talent to Accelerator Science & Engineering and the related APS Division of Physics of Beams education and outreach activities in support of HEAP.

Workforce needs and opportunities in accelerator science and technology

There continues to be a strong need for accelerator science and technology workforce development due to steady demands from National Laboratories and increased demands from industry. Despite acknowledging the importance of accelerators, the U.S. educates few students to understand beam physics and accelerator science and technology. Approximately a dozen U.S. universities offer doctoral degrees in accelerator science [1], together producing 15–20 doctoral accelerator scientists per year; but the estimated need at labs and in industry is four times that number [2]. The continuous evolution of the set of skills and techniques required in modern particle accelerators (nowadays ranging from photonics, low-temperature physics, material sciences and computational methods) adds to the challenges associated with the formation of the future workforce in this field. Leveraging the nation-wide increased attention (concurrently driven by student-demand) for interdisciplinary and applied science programs in academia, it is essential to continue to explore and foster such opportunities. In this sense, the new DOE traineeship program [3] is a welcome addition to the available support for these programs.

National laboratories are the core of the development of accelerator-based technology and their facilities serve as resources for universities, private industry, and other centers for science and technology R&D [4]. The Department of Energy's Office of Science funds and operates a number of these accelerator-based user facilities. Thus, facilitating connections between the National Laboratories and the academia across the United States (joint appointments and internships at all levels, faculty, postdocs, graduate and undergraduate students) can be an important way to help this process. Industry has an important role to play in the career pipeline and should also be engaged with regard to equity, diversity and inclusion. Industry partnerships with academia and national labs need to be encouraged and supported in the future.

Existing undergraduate and graduate student programs

The USPAS is the primary resource for specialized accelerator science and engineering training in the USA[5]. It offers two, two-week duration intensive-format sessions a year with university credit and rigor with topics linked to basic training (e.g., Accelerator Fundamentals, Accelerator Physics, Microwave Measurements) and speciality topics (e.g., Spin Dynamics, Beam Cooling, SRF Technology, Cryo Engineering, Alignment). These courses enroll ~300 students/year with typically 50% enrolled at universities. The USPAS offers limited financial aid covering the course fee, room, and board, but not travel. About 100 students (approx 30%) are supported per year out of the USPAS budget at a rough

average cost of $1.7 K/student. Students report trouble funding USPAS training out of grants linked to academic advisors. This results in sub-optimal use of available training resources. Students would benefit if DOE expected all students meeting eligibility threshold to be supported for a few sessions and budgeted accordingly. This need will become more acute with the DOE traineeships boosting student numbers and not having USPAS study budgeted.

The DOE Office of Science grants for Traineeship in Accelerator Science and Engineering have been available since 2017, and 3 awards (five year) have been made so far. Funds are reserved for U.S. citizens and permanent residents. These grants provide two years of full funding per student with the expectation that awarded institutions will take on 4-10 new students per year. So far the 3 awards are supporting 31 PhD students and 17 MS students, and have supported 2 students who have completed their degrees. The thesis projects are often linked with research at the national laboratories, and may also be linked with DOE sponsored private sector organizations. After two years of support, students continuing for a PhD must find a new source of funding.

Undergraduate student summer internships support recruitment by exposing students to accelerator science and technology before they reach the graduate level. An example of such a program is the Lee Teng undergraduate summer research internship run jointly by the USPAS, Fermilab, and Argonne Laboratory. It has been operating successfully since 2008, and has now served 132 students. This is an important avenue of recruitment since most colleges and universities do not provide exposure to this area of research. Recruitment is across the U.S., allowing selection from a broad range of students (physics majors as well as engineering and computer science), including those from minority serving institutions. Such internships provide a path forward into the field for the widest range of potential students. Continuation, and possibly extension, of this and similar programs is recommended.

Diversity and inclusion of underrepresented minorities

Emphasis has long been placed on increasing underrepresented minorities and improving gender balance in our field which is traditionally lagging behind national averages in terms of diversity. Progress has been stubbornly slow, in large part due to insufficient pools of prospective students. We propose enhanced outreach to primary school students to advertise opportunities in accelerator science and technology. Schools with higher underrepresented minority percentages could be targeted for greater impact. Funding requirements to enable this might be minimal since efforts could be mostly local to those carrying out outreach activities. These efforts should be highlighted/acknowledged by the wider accelerator community.

In addition, impactful opportunities could be provided for underrepresented minorities with just a small amount of earmarked funding. For example, a complete scholarship including travel funds to USPAS could be reserved for each session for an underrepresented minority student. Full funding for undergraduate summer internship positions at a national laboratory could be similarly made available. These research/academic opportunities would have to be advertised by reaching out to (for example) traditionally minority serving universities with a pool of qualified potential applicants. In order to have significant impact we envision the need to engage in long term collaboration and relationship building with faculty at these institutions.

References:

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[4] http://www.acceleratorsamerica.org/working-with-labs/index.html

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