Letter of Interest for Snowmass 2021

Strategy for HEP Accelerator Workforce Training in Coordination with BES, NP, and Industry

Beam Physics and Accelerator Education topical group AF1

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ABSTRACT: A beam of charged/neutral particles or photons consists of small packets of 'focused' and 'directed' energy and information, delivered in an appropriate staccato fashion, to explore and probe matter at the smallest distances and fastest time-scales for fundamental science in various disciplines e.g. high energy particle physics, nuclear physics, basic energy sciences (atomic, molecular, condensed matter and life sciences), and for societal and industrial applications in energy, environment, health and human security . The whole enterprise is enabled by educated and trained experts in the physics and engineering of beams and associated techniques and technologies. The trained work force is a critically relevant national resource, whose stewardship was provided by the high energy physics community for the entire society historically. Today with relevance and demand from significant growth areas beyond high energy physics, the need to establish a nationally coordinated and synergistic education and training program of the HEP work force is a critical need. The HEP community is encouraged to take the strategic lead in establishing an enhanced program in this area in collaboration with NP, BES, FES, and SBIR programs and the industry.

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1 Introduction

Recognizing that Snowmass 2021 is an opportunity for the entire High Energy Physics (HEP) community to come together to identify and document a vision for the future of particle physics in the U.S. and its international partners, it is critical to emphasize that Accelerator Technology and Beam Physics will continue to play a key role in shaping the future of HEP for many decades in this century. Education and outreach in accelerator science and engineering help strengthen the field to drive technological advances for HEP. This LoI is intended to help the HEP community reach a vision for the future of HEP, recognizing the critical role of the enabling accelerator community with demand and competition from other scientific fields and application areas and help prioritize education and training needs of the next generation of accelerator scientists and engineers in the service of HEP. An international survey and articulation of this need was already published for the community in 2012 [1].

1.1 Demand and Competition for Resources

High Energy Physics (HEP) was the center of mass of accelerator physics and technology in the USA though historically HEPAP has run accelerator R&D for the benefit of the broader community. Over the years, the center of mass has shifted to BES, NP and industrial applications have become more significant. From this perspective, HEP accelerator applications compete with other areas for talent to advance technological needs. So, workforce training is also chained to BES, NP, and Industry. Many of the relevant technologies have dual application and advances made for non-HEP applications can impact HEP. In this situation it is best if strategies for workforce training recognize the situation and coordinate to the extent possible for mutual advantage.

1.2 Recognition of Key Differences and Commonalities

In order to have a holistic strategy, it is important to recognize some of the key differences and commonalities in the R&D drivers of various disciplines and applications. We indicate in the table below the critical relevance (with a ***) of beams/systems aspects for various areas in a broad brush.

	HEP *(Colliders, Neutrinos, Fixed Targets etc.)*	NP	BES *(FELs, SRS, Neutron Sources)*	FUSION	INDUSTRY	
Accelerating Gradient	***	***	NO	NO	***	
Radio Frequency	***	***	***	***	***	←←
Lasers	***	***	***	***	***	←←
Magnets	***	***	***	***	***	←←
Beam Brightness	NO	NO	***	NO	***	
Polarization/Cooling	***	***	NO	NO	NO	
Size/duration (ultrafast)	NO	NO	***	NO	***	
Beam Intensity	***	***	***	***	NO	←
Compactness	***	***	***	NO	***	←
Diagnostics/Controls	***	***	***	***	***	←←

As expected, we observe from the above table that while fundamental systems such as radiofrequency, magnets, lasers, diagnostics/controls etc. are universal to all applications (←←), compactness and beam intensity are critical to most (←) while accelerating gradient and beam manipulation techniques (polarization, phase space cooling, emittance and ultrafast time-scales etc.) are tailored to particular applications in HEP, NP, BES and Industry. Future projects will surely generate more commonalities.

2 Strategy

Keeping the above synergies, complementarities and exceptions in mind, the HEP community is encouraged to engage and interact with the Division of Physics of Beams, the US Particle Accelerator School and the leadership of DPF, DNP, DAMOP, DCM, the Offices of HEP, NP, BES, FES and SBIR to establish an all-inclusive education and training program in accelerators. We recommend carrying out a survey of educational opportunities to support identified synergistic topics. Accelerator schools and seminar series should be examined for deficiencies and a long term and sustainable strategy should be developed to fill in any missing compoents and improve training opportunites to grow a new generation of high performers for HEP.

3 References

[1] W. Barletta, S. Chattopadhyay, and A. Seryi, "*Educating and Training Accelerator Scientists and Technologists for Tomorrow*", Reviews of Accelerator Science and Engineering, Vol 05 (2012), World Scientific (Publisher), pp 313-331