

# A Letter of Interest for Snowmass'21

## Increasing the Pipeline of Graduate Students in Accelerator Physics\*

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(August 22, 2020)

### Introduction

US career opportunities in Accelerator Science and Engineering require a pipeline of highly-trained and broadly skilled scientists and engineers at all levels of education. There are several US universities with graduate programs in Accelerator and Beam Physics [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14], and opportunities to do Ph.D. research at US National Labs affiliated with US research universities. There are formal graduate courses in Accelerator Physics at US universities as well as through the US Particle Accelerator School [15]. However, there remains a workforce shortage in the field [16, 17, 18]. This topic has been the focus in the Office of Science and the High Energy Physics Advisory Panel (HEPAP) commissioned a sub-panel to study the issues [19] and DOE has started awards for Traineeships in Accelerator Science to support master's programs [20, 21, 22] in an attempt to grow the workforce.

One problem is that undergraduates in US college and university science and engineering programs know very little about the field and opportunities, and very few faculty at undergraduate science and engineering departments are well-versed in accelerator physics and graduate education opportunities.

The student pipeline to advanced degrees in accelerator-related areas really starts in the advanced undergraduate years, where students start to think about graduate school and possible fields of study. Very few undergrads know much of the accelerator field or the opportunities. Very few faculty at undergrad institutions who advise advanced undergraduates have detailed or up to date experience with the University programs in accelerator science and technology. Similarly, not many undergraduate faculty have close ties with a national lab where students might go to do summer research or school year projects.

Our experience at Stanford and SLAC suggest that the majority of incoming graduate students arrive with a well-formed idea for an area of advanced study, often have arranged a research assistantship the summer before their arrival on campus. And if Accelerator Science isn't visible at the undergraduate stage, the possible numbers of new young researchers and engineers interested in accelerators is going to be very small.

An example of this visibility is in the comment from Manolis Kargiantoulakis 8/21/20 on SLACK: "From my perspective, again as someone who's had more connections with beam and accelerator physics than most, I would note that I have never been offered a vision for a career in accelerator physics. If the accelerator field will rely significantly in experimentalists like me making the transition, then people like me need to see that path earlier on. So I would suggest the planned undergrad lecture/seminar series to emphasize that aspect, showing undergrads that they are welcome in this field and that there are opportunities for them."

### Proposed Actions

We propose that a small committee develop high quality exciting undergraduate seminar talks on accelerators and send

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\* This work has been supported in part by DOE contract DE-AC02-76-SF00515.

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speakers out each year to undergrad physics and engineering institutions. These speakers are not “recruiting” for a particular university program, the role is to present broad scientific themes which highlight accelerators, and make sure many programs in the US are mentioned as examples. The goal is to bring graduate education and research opportunities to visibility among rising Juniors and Seniors at diverse undergrad institutions, and to bring visibility of the field to the faculty at selective undergraduate institutions who are advising students on graduate education and opportunities.

These talks should be true undergraduate colloquia, which a high-quality department would see as adding to their undergraduate education. They should have real scientific content appropriate for advanced undergraduates. They can excite an undergrad to see how the field combines many sub-disciplines, show the new ideas and new facilities that might be something a young person could work on in graduate school. The purpose is to bring visibility of the science and opportunities for graduate study to an audience that might not even consider applying to the few dedicated programs, and to bring awareness of the field and opportunities to the faculty at schools that have excellent science and engineering programs, but very little contact with the national lab and accelerator community.

- Develop presentation materials and support materials for advanced undergraduates aimed to Increase awareness of opportunities and scientific challenges in the US and international accelerator science area
- Recruit and motivate a small committee of accelerator scientists/engineers who are enthusiastic speakers and interested in speaking with undergraduates
- Develop contacts with undergraduate Physics and Engineering departments, specifically smaller high-quality departments where students and faculty have limited contact with national labs and accelerator science

## References

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  - <sup>3</sup> Illinois Institute of Technology: <http://www.capp.iit.edu/>
  - <sup>4</sup> Massachusetts Institute of Technology: <https://www.psf.mit.edu/research/topics/accelerators-detectors>
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  - <sup>6</sup> Northern Illinois University: <https://www.niu.edu/clas/nicadd/research/beam.shtml>
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