# Snowmass 2020 Letter of Interest: Plasma Accelerator Science Community Organization

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September 1, 2020

Plasma accelerators are a promising advanced acceleration concept, able to support accelerating gradients many orders of magnitude higher than those in conventional structures. They are at an early stage of development, with many possibilities for how accelerator components may emerge from plasma-based elements. Much progress has been made in important technical readiness demonstrations needed for a plasma-based accelerator. Work is still needed, however, to meet the *ABP grand challenges* of beam intensity, beam quality, beam control and beam prediction relevant to plasma accelerators, which requires a community effort.

In Europe, there are a number of community organizations in plasma accelerators, such as EuPRAXIA, which aids interactions between Universities and National Laboratories, and provide integration and coordination of research efforts within an overall framework of plasma accelerator development. ALEGRO is an international organization to promote Advanced and Novel Accelerators for High Energy Physics applications and supports the international community. There have been increased planning efforts over the last decade in the US, with the publication of the 2016 Advanced Accelerator Development Strategy Report [1]. Community planning activities for plasma physics and high intensity laser facilities include the Plasma 2020 study [2], APS Division of Plasma Physics Community Planning Process [3], the Brightest Light Initiative

[4] and the Workshop on Opportunities, Challenges, and Best Practices for Basic Plasma Science User Facilities [5]. Nevertheless, in the US, research in plasma accelerators is fragmented, with little collaboration or coordination between different institutions. The formation of the Accelerator Test Facilities Council among the National Laboratories is a start in this process, but needs expansion and coordination with University programs.

Moreover, there is a need for education and training of scientist for the emerging large scale efforts in plasma acceleration. Experimental methods and diagnostics, and advances in theory and modeling are both essential to the field and such activities should also be well supported. Nurturing a growing workforce will be essential as the field expands. Many postdocs working at plasma accelerator research centers are, anecdotally, foreign trained due to a lack of appropriately trained graduate students from the US. HEP would like development of technology that will be fielded decades from now, so several generations of scientists will be needed, which requires a well developed pipeline of graduate students.

The interdisciplinary nature of the endeavor also makes this training a challenge. Plasma accelerators require knowledge of traditional accelerator physics subjects, but also topics including high intensity / ultrashort laser technology and physics, relativistic (and low temperature) plasma physics, etc., which is not fully served by education opportunities in individual institutions or summer/winter schools etc. 1-2 week USPAS courses that exist on plasma based accelerators are extremely useful but limited in scope at present, compared to the CERN Accelerator School equivalent. Several summer schools on laser-plasma related topics exist, but these do not meet the needs of this community fully. More comprehensive summer schools are needed.

A plasma accelerator science community organization could provide a resource to start to address these issues. Because of the interdisciplinary nature of the field (plasma physics, accelerator technology, laser science, etc.), no single professional society fills this role right now. Potential ways that it could support the community could be by supporting

- *graduate education programs in plasma accelerators.* This could include initiating and leading summer schools in plasma accelerator theory, computation and experiments. For example, expanding the scope of the existing USPAS course on accelerators to be similar to the comprehensive CERN Accelerator School on plasma based accelerators. It could involve organization of specialized workshops for graduate students from the US who do not have access to the range of course material needed. These could include hands on training at laboratories and simulation workshops involving large scale codes supported by HEP. It could provide information resources for potential students interested in graduate studies, details of programs, etc.

- *research programs in plasma accelerators.* This could involve developing a coordinated plasma accelerator research program. by providing a forum to bring researchers together to identify open problems in plasma accelerator research that need working on, showcasing research highlights, connecting researchers with shared interests to initiate collaborations, as well as assisting in the development of multi-institution funding initiatives such as graduate student training networks. Lobby for national scale multi-institutional University-Lab collaborations to tackle research problems. Provide a forum in which government agencies can communicate to the community, by providing webinar hosting or coordinating satellite events at APS meetings.

- *the general plasma accelerator community* by developing an infrastructure for cross cutting communications between various plasma physics communities. This can be accomplished by providing research and facility news to a broader audience, as well as sharing job and career information to plasma physics faculty and centers. Inclusion of plasma physics conference information can promote broader engagement, as well as participation in general plasma physics seminar series.

There is a strong need in the plasma accelerator community to progress towards an integrated design study for a plasma based collider. This will require integrating techniques from different research groups over the next 10 years, which requires more community organization.

# References


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