Letter of Intent, Snowmass 2021

Broad Range of Accelerator R&D: From Basic to Applied Science

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With this LOI we would like to draw attention to the need for continued and enhanced funding of a broad range of Accelerator R&D portfolios across the DOE Office of Science, other DOE Offices and federal agencies, with strong components of long-term R&D, together with directed R&D and project focused activities. Continued successful of accelerator programs requires vigorous funding across all levels of R&D, from high-risk, high-reward studies of novel concepts and technologies for future machines to the construction of new facilities for near-term applications. We suggest a new survey to assess the balance of funding between long-term R&D programs and near-term projects and to inform strategies for continued success of Accelerator R&D in enabling discovery science and applications.

Particle accelerators continue to enable discoveries in high-energy physics and many other areas of science as well as many applications in industry and medicine. The physics of beams and of particle acceleration itself is also of significant scientific depth, and frontiers of beam energy, intensity, quality, control and prediction are being pursued in ongoing community planning and road-mapping activities.

The accelerator R&D landscape has a broad spectrum of diverse, multi-faceted and interconnected disciplines, including superconductivity, rf technology, detectors, advanced computing, as well as beam, plasma, and laser physics. Elements of accelerator R&D include work for current accelerators and construction projects, directed R&D for specific future accelerators and general accelerator R&D that can lay the foundation for future accelerator technologies.

Success in making particle accelerators available to drive future scientific discoveries and completive applications depends on getting the mix right of innovation, optimization and product maturation. The particle accelerator communities inform the broader basic and applied science communities and funding agencies through continuous planning and evaluation activities. Concerns arise with trends in recent years that tend to tip the balance from longer term foundational R&D to shorter term project support.

Strong long-term R&D programs also enable the accelerator community to engage in new initiatives in the DOE Office of Science, such as the recent Exascale and AI/ML initiatives, where there are ample opportunities to benefit accelerator science, design, production and operation. Another example is the Quantum Information Science Initiative, where tools and techniques from Accelerator R&D begin to show high impact on emerging quantum information systems and where emerging quantum information processing techniques might benefit future advances in beam physics and modeling.

Attracting talent into accelerator R&D is essential for continued success, and long-term R&D programs play an important role in inspiring new students and entry level scientists. Teaching through the US Particle Accelerator School (https://uspas.fnal.gov/index.shtml) is one key component in training of the next generation of accelerator scientists, as are University based programs with strong collaborations and connection to the national labs.