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An Accelerator R&D Roadmap for Energy Recovery Linacs (ERLs)

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A key ambition expressed in the European Strategy for Particle Physics has been that "the energy efficiency of present and future accelerators [...] is and should remain an area requiring constant attention". Accordingly, "a detailed plan for the […] saving and re-use of energy should be part of the approval process for any major project". The Energy Recovery Linac (ERL) developments directly address this requirement. ERLs are a potentially revolutionary accelerator concept based on recycling or recovering the kinetic energy of a "used" particle beam to accelerate a newly injected particle beam from a high-brightness source. The ERL concept thereby enables high-power beams while greatly reducing the power consumption and avoiding high-power beam dumps with associated radiation protection and activation issues. Conceptual ERL-based designs for future colliders have recently been made for e+e- Higgs factories and for TeV-energy ep/eA colliders. ERL concepts have also been considered for a future muon collider and for reaching the EIC luminosity targets at BNL. Documented in a detailed report [2], the implementation of ERLs for HEP applications promises a luminosity increase by one or more orders of magnitude at a power consumption comparable to classic non-ERL based solutions, a key step for future of high-energy physics and its sustainability. To coordinate the European ERL efforts, an Accelerator R&D Roadmap has been endorsed by CERN Council [1]. It entails three major interrelated elements for advancing the development of ERLs: i) embed the developments in a global collaborative and competitive effort, ii) innovative technology developments, and iii) reach the 100 mA electron current target in new facilities. Two European ERL facilities designed for operation this decade serve as anchors of the Roadmap related activities: bERLinPro (Berlin, Germany) with the goal to operate a singlepass 100 mA, 1.3 GHz facility, and PERLE (hosted by IJCLab Orsay, France) as the first multi-turn, high-power, 802 MHz facility with novel physics applications.

[1] "European Strategy for Particle Physics - Accelerator R&D Roadmap", CERN Yellow Rep. Monogr. 1 (2022)
1-270, arXiv:2201.07895

[2] "The Development of Energy Recovery Linacs", arXiv:2207.02095, to appear in JINST

Collaboration / Activity

ERL R&D Coordination Panel

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