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PERLE : A High Power Energy Recovery Facility for Europe

The efficient recovery of power, to re-excite cavities from the used beam, was proposed in 1965. Major advances in superconducting RF technology, as quantified by cavity quality factors Q0 in excess of 1010, and the consideration of multi-turn recirculator passages, have opened the door to the green generation of high energy, high brightness, high current electron beams. The facility PERLE, here presented to the formation of the European Strategy for Particle Physics, is being designed as a new generation facility reaching for the first time into the 10MW power regime of beam current and energy. The PERLE Collaboration comprises currently ten institutions. With Daresbury (UK), Darmstadt (D), Jlab (US) and Novosibirsk (Ru) there are four laboratories, which have been pioneering the development of ERL technology, together with three leading laboratories on superconducting RF (SRF) technology, CERN, Orsay (LAL and IPN) and Saclay CEA, and others. PERLE has been designed in support of the LHeC development, which defines its configuration (3 turn recirculator), its frequency (802 MHz, synergetic with FCC requirements) and electron current (20mA or 500pC in the LHC, 40MHz time structure). This contribution, based on the 2017 PERLE CDR [1] and recent progress, describes the purpose, the parameters and configuration as well as the main components, including the successfully built first 802MHz SC Niobium cavity with a large dynamic range and a Q0 exceeding 3·1010. Based on in-kind contributions including re-use of existing components, especially the source (Daresbury, ALICE) and cryomodule (CERN, SPL), PERLE is expected to be operational at Orsay in the early twenties in an initial configuration subsequently upgradeable to full energy. The facility has the main goal of developing ERL technology, especially SRF, for application in high energy colliders, especially LHeC and FCC, as well as to develop techniques for multi-turn, high current ERL operation, complementary to and collaborating with the upcoming 1.3 GHz facilities CBETA at Cornell and bERLinPro and others. As such it represents a major contribution to the development of energy and intensity frontier accelerators, the innovation through technology of which compares well with plasma wakefield R&D for high gradient acceleration. The uniquely demanding parameters of PERLE make it a most powerful facility for lower energy precision electron beam physics in the areas of electroweak interactions, proton radius, search for dark bosons, or for the investigation of the unknown charge density of heavy nuclei such as the magic 132Sn as a striking example for a PERLE nuclear physics programme. From PERLE a 5 MeV energy photon beam can be derived of an intensity more than a factor of 100 higher than at ELI, which is a base for novel photo-nuclear physics or the production of medical radio-isotopes. As this paper is being submitted, the leading laboratories are signing Memoranda of Understanding for the foundation of the PERLE Collaboration. Being hosted at Orsay, in one of Europe' s larger national laboratories, PERLE is ideally suited to support our joint particle physics future at CERN and to also maintain more than one of our larger associated research infrastructures at the highest level, for Europe and beyond.

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