

Overview of the CEBAF Accelerator Upgrade

Friday, 13 December 2024 09:25 (20 minutes)

Extending the energy reach of CEBAF up to 22 GeV within the existing tunnel is being explored. Proposed energy upgrade can be achieved by increasing the number of recirculations, while using the existing CEBAF SRF cavity system. Presented scheme is based on an exciting new approach to accelerate electrons efficiently with multiple passes in a single FFA (Fixed Field Alternating Gradient) beam line. Encouraged by recent success of the CBETA Test Accelerator, a proposal was formulated to raise CEBAF energy by replacing the highest-energy arcs with Fixed Field Alternating Gradient (FFA) arcs. The new pair of arcs configured with FFA lattice would support simultaneous transport of additional 6 passes with energies spanning a factor of two, using the non-scaling FFA principle implemented with Halbach-derived permanent magnets - a novel magnet technology that significantly saves energy and lowers operating costs. One of the challenges of the multi-pass (11) linac optics is to provide uniform focusing in a vast range of energies, using fixed field lattice. Here, we propose a triplet lattice scaled up with increasing momentum along the linac. This would provide a stable periodic solution covering energy ratio of 1:33. The current CEBAF configured with a 123 MeV injector, makes optical matching in the first linac virtually impossible due to extremely high energy span ratio (1:175). Therefore, we envision replacement of the current injector with a 650 MeV 3-pass recirculating injector based on the existing LERF facility. Finally, the 22 GeV CEBAF would promise to deliver in 10-passes a beam with normalized emittance of 80 mm·mrad and with a relative energy spread of 1.5×10^{-3} . Further recirculation beyond 22 GeV is limited by large, 974 MeV per electron, energy loss due to synchrotron radiation.

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Session Classification: Summaries and Path Forward