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CEBAF 22 GeV FFA energy upgrade

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Extending the energy reach of CEBAF by increasing the number of recirculations, while using the existing linacs is explored. This energy upgrade is based on the multi-pass acceleration of electrons in a single non-scaling Fixed Field Alternating Gradient (FFA) beam line, using Halbach-style permanent magnets. Encouraged by the recent successful demonstration of CBETA, a proposal was formulated to nearly double the energy of CEBAF from 12 to 22˜GeV by replacing the highest energy arcs with FFA transport. The new FFA arcs would support simultaneous transport of an additional 6 passes spanning roughly a factor of two in energy. One of the challenges of the multi-pass (11) linac optics is to assure uniform focusing over a wide range of energies. Here, we propose a triplet lattice that provides a stable periodic solution covering an energy ratio of 1:33. The current CEBAF injection at 123 MeV, makes optical matching in the first linac impossible due to the extremely high energy ratio (1:175). Replacement of the current injector with a 650 MeV recirculating injector will alleviate this issue. Orbital and optical matching from the FFA arcs to the linacs is implemented as a compact non-adiabatic insert. The design presented here is anticipated to deliver a 22 GeV beam with normalized emittance of 76 mm·mrad and a relative energy spread of 1×10ˆ{-3}. Further recirculation beyond 22 GeV is limited by the large (974 MeV per electron) energy loss due to synchrotron radiation.

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Footnotes

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