Multi-Objective Genetic Optimization of the CEBAF Injector at 200 kV

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The injector for the Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Lab uses four lasers to create four independent electron beams (249.5 MHz or 499 MHz repetition rates). The beam properties at the experimental Halls are determined by the beam properties in the injector. For the same injector beam optics, high and low-charge bunches must be transmitted simultaneously through the injector. Here, we present a multi-objective genetic optimization of a planned injector upgrade using a 200 kV gun using the General Particle Tracer (GPT) simulation code. For the optimizations, there are 30 variables, settings of solenoids and quads, phases, and amplitude settings of RF cavities etc. There are 72 objectives and constraints such as transverse beam size, bunch length, beam transmission, and normalized transverse emittance at different locations along the beamline.

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