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CBETA: a 4-pass superconducting ERL with combined permanent magnet return arc

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Beam commissioning is currently in progress for the CBETA ERL recently built at Cornell University in collaboration with BNL. This machine has a 6MeV injector and 36MeV main superconducting RF module at ~ 1.3 GHz frequency. The beam passes through the main RF up to four times accelerating and four times decelerating, before being dumped at 6MeV. These four energies (42, 78, 114, 150MeV) are returned to the RF by a racetrack-shaped return loop of fixed-field permanent magnets. These magnets have been designed so that all four energies are stably transported through the same $R=25$ mm good field aperture. Between the RF and return loop on either side, the four energies are split apart for adjustment to tune energy recovery and optics performance. At the date of writing, beam commissioning has made one turn through the permanent magnet loop at 42MeV including orbit correction to <1 mm.

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