CBETA Capabilities

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CBETA, the Cornell-BNL ERL Test Accelerator that is currently being constructed in a collaboration between Cornell and BNL is designed for beam energies and beam currents typical for electron coolers of the EIC designs; it combines several forefront accelerator components to a prototyping facility for the Electron-Ion Collider. CBETA uses a high-brightness photo-emitter DC electron source, an SRF injector linac optimized for high acceleration power, an SRF main ERL linac optimized for recovering the energy of high currents, a Fixed Field Alternating-gradient loop for all 4 recirculating energies, and associated diagnostics for beam preservation, beam protection, and phase space characterization.

This presentation will explain the components of CBETA, their parameter ranges, and their relevance for EIC designs. Findings that are all directly transferable to the EICs are expected from studies in reliability and stability of the source and of SRF components; calibration, optimization, and stabilization procedures for cavities including relativistic velocity changes; beam detection and correction procedures for simultaneous beams; startup scenarios to ramp ERLs to high currents; limits to the current, notably from from HOM heating, HOM driven instabilities, and beam-halo losses, beam manipulation methods pertinent to high-power beams, like halo detection, steering, and collimation, as well as ERL limits on beam scattering and wake fields, to mention only the most pressing. Additionally, CBETA will produce bunches at the energy of EIC coolers and can therefore analyze whether and how beams with sufficient smoothness for electron cooling can be provided, avoiding detrimental instabilities.

Because of its relevance for the EIC, JLAB scientists have already joint the Cornell-BNL collaboration for beam studies, testing ideas for magnetized cooler beams. Researchers from several other, international laboratories have also joint or expressed interest in joining CBETA beam studies, either because of their interest in EIC R&D or because of their interest in the new beam-parameter ranges that ERLs open up, notably for nuclear physics, X-ray science, lithography, and nuclear-isotope production. CBETA is therefore an EIC cooler prototype that provides a collaborative environment for studies of the EIC-ERLs and beyond.