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Beam breakup instability: theory, simulation, and consequences for CBETA

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The Cornell Brookhaven Energy-Recovery-Linac (ERL) Test Accelerator (CBETA) is currently under construction at the Cornell University's Wilson Laboratory. The primary structures in CBETA for beam recirculation include the Main Linac Cryomodule (MLC) and the FFAG beamline. As the electron bunches pass through the MLC cavities, Higher Order Modes (HOMs) are excited. The recirculating bunches return to further excite HOMs, and this feedback loop can give rise to beam breakup instability (BBU). We will first explain how BBU effect is simulated using the tracking software Bmad, and check the agreement with the developed BBU theory. We then present the simulation results on how BBU limits the maximum achievable current of CBETA with different HOM spectra in the cavities. Lastly we investigate the potential ways to improve the threshold current of CBETA.

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