

Overview of the CsrTA R&D Program

Saturday, October 9, 2010 3:00 PM (30 minutes)

The Cornell Electron Storage Ring (CESR) is configured as a test accelerator (CsrTA) for investigation of electron cloud phenomena in the regime of low emittance damping rings. The storage ring is equipped with superconducting damping wigglers and focusing optics to reduce horizontal emittance to 2.5 nm at 2.1 GeV. The machine is instrumented with detectors (retarding field analyzers) to measure the growth of the electron cloud in wiggler magnets, dipoles, quadrupoles and field free drifts. Shielded button pickups are used to measure the time development of the cloud. A gated tune receiver is used to measure the cloud induced tune shift along a train of bunches and to identify sidebands associated with a head tail instability. An xray camera with high speed readout provides a single pass measurement of the vertical size of each bunch in a long train of bunches, so that emittance growth due to the electron cloud can be observed. Various mitigations are tested by installation of prepared vacuum chambers in association with retarding field analyzers. The phase shift in the transmission of a TE wave propagated between adjacent beam position monitors provides a measure of the local electron density, obviating the need for specialized detectors. We measure the energy dependence of the secondary emission yield of a variety of sample materials, including the effect of beam processing. We utilize high bandwidth precision beam position monitors to measure and correct transverse coupling and vertical dispersion in order to minimize vertical emittance. Our low emittance tuning procedure typically yields vertical emittance less than 20 pm in one or two iterations, so that measurements of electron cloud effects peculiar to ultra-low emittance can be readily accommodated. Modeling and simulation of RFA detector response, electron cloud growth, electron cloud - beam interaction, cloud as plasma, and nonlinear beam dynamics provide context for interpretation of the experimental data, and motivation to pursue additional measurements and develop new experimental techniques.

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