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High current measurements at TWINEBIS

The TWINEBIS is a replica of REXEBIS used for off-line research and development. REXEBIS is designed to provide a stable 500 mA electron beam at an electron energy of approximately 6.5 keV. During long term operation the REXEBIS is typically run only at 200 mA for reliability purposes. The full design value operation was never used in practice.

Recently the first 500 mA electron beam was achieved at TWINEBIS under quasi-stable operation conditions. For the first time active focusing of the electron gun was used and demonstrated a major influence on the loss current and related non-thermal outgassing. The 500 mA current was achieved at higher than normal cathode temperature providing sufficient thermionic emission and stay close to space-charge limited operation. Such high cathode temperatures shorten the cathode life-time significantly, but also allow first experiments of optimizing the TWINEBIS for high-current electron beams.

The increased current affects the EBIS performance in several ways. First, owing to the increased current the EBIS acceptance and capacity will grow proportional to the current, however the same is true for the emittance. Furthermore the current density will increase linearly with the current, which means reduced breeding time by a factor of 2.5.

The experiments were backed up by 2D and initial 3D simulations. The simulations provide better understanding of several operational aspects of the EBIS, such as the influence of radial symmetry-breaking misalignment on the loss current. The experiments will be continued with an IrCe cathode having a lower work function and longer life-time than the presently used LaB6 cathode.

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