Low-Power testing of Coherent Electron Cooling Injector

We will conduct the following low-power tests:
1) Beam out of the gun, and
2) Beam through the bunching cavities.

The routine tests will be conducted with 1-2 nC electron bunches with 2 MeV energy (up to 4 mJ) with 1-10 Hz repetition rate, which gives 40 mW beam power into a dump. In all cases beam power will be limited to less then 800 mW, when the beam charge is defined by maximal expected quantum efficiency of 10%, and bunching cavities operating in the accelerating phase boosting beam energy to 3.1 MeV. The control of the beam power will be done through the setting of the photocathode drive laser, pulse energy and repetition rate.

The photocathodes to be used in these tests are cesium potassium antimonide. The maximal charge is defined by 10% photocathode quantum efficiency, 1 kW peak power of the drive laser, and 500 picoseconds pulse duration. The cathode bunch charges will be less than 25 nanoCoulomb (nC) with repetition rate adjusted to maintain the maximum beam power with the given beam energy.
1) The capability of the gun is maximum beam energy of 2.5 MeV (limited by the available heat load on the liquid helium system), and
2) The capability of the each 500 MHz cavity is 300 kV (experimental value).

The pulse repetition rate will be under 10 Hz in all cases. If capabilities of the accelerator cavities will exceed the specified we will reduce the limit on the repetition rate.

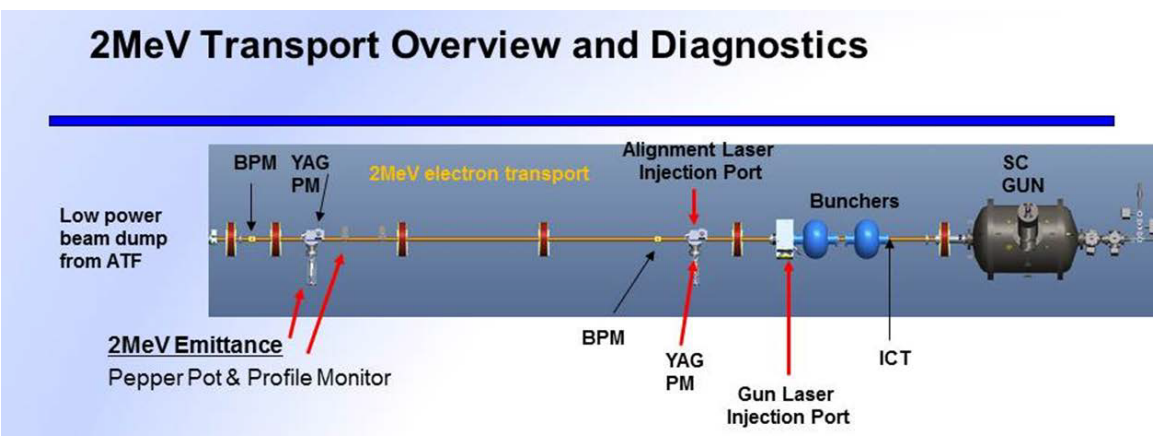

Figure 1: Layout of Coherent Electron Cooling Injector.

The diagnostic equipment available for the beam out of the gun test is an Integrating Current Transformer with Beam Charge Monitor and laser power monitor. For the beam through the bunching cavities additional diagnostics will be beam position

monitors, two beam profile monitors, pepper-pot system for emittance measurement, and Faraday cup (see Figure 1). The absolute limit on the beam power to the dump is set by available RF power of the transmitter for the gun, which is 2 kW. The beam accelerating in the bunching cavities adds extra 25% (0.6 MV vs 2.5 MV) thus setting hardware limit to 2.5 kW.

The CeC injector will be placed in the IP2 hall of RHIC. The experiment area is subject to the sweep search, and equipment will be subject to the PASS interlock.