Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

Electron Source based on Superconducting RF

By

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High-bunch-charge photoemission electron-sources operating in a continuous wave (CW) mode can provide high peak current as well as high average current which are required for many advanced applications of accelerators facilities, for example electron coolers for hadron beams, electron-ion colliders, and free-electron lasers (FELs), etc.. Superconducting RF (SRF) has many advantages over other electron-injector technologies, especially when it is working in CW mode as it offers higher repetition rate. A 112 MHz SRF electron photo-injector (gun) was developed at Brookhaven National Laboratory (BNL) to produce high-brightness and high-bunch-charge bunches for the Coherent electron Cooling Proof-of-Principle (CeC PoP) experiment. The gun utilizes a quarter-wave resonator (QWR) geometry for assuring beam dynamics. Detailed RF design of the cavity, fundamental coupler and cathode stalk is presented in this work. A GPU accelerated code is written to simulate the multipacting phenomenon, one important hurdle SRF structure has to overcome.

The injector utilizes high quantum efficiency (QE) multi-alkali photocathodes (CsK2Sb) for generating electrons. The cathode fabrication system and procedure is also included in the thesis.

Beam dynamic simulation of the injector is done with ASTRA. To find the optimized parameters of the cavities and beam optics, author wrote a genetic algorithm python script to search for the best solution in this high dimensional parameter space.

The gun is successfully commissioned and produced world record bunch charge and average current in an SRF photo-injector.

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