

R&D of CW Normal Conductivity VHF Gun at Tsinghua University (SHINE Injector)

A 217 MHz very-high-frequency gun operating in CW mode is being developed at Tsinghua University, which will be served as the beam source of the high repetition XFEL facilities and high repetition MeV UED. The cavity profile has been optimized to minimize input power, peak surface electric field, and peak wall power density. The profile optimization also takes into account the suppression of multipacting effect. Additionally, thermal analysis has been performed to guide the design of water cooling channels in coordination with gun mechanical design. The fabrication of the gun has been completed, and the frequency and quality factor measured in cold test are in good agreement with simulation expectations. During high power conditioning, 75 kW cw radio frequency power was successfully fed into the gun, corresponding to a cathode gradient of 27 MV/m and a gun voltage of 780 keV. Under this condition, the maximum dark current collected by the Faraday cup at the gun exit was 376 nA when the strength of the gun solenoid was scanned. To measure and optimize the beam quality, a test beamline was constructed. After preliminary optimization, the 95% projected transverse emittance was 0.161 mm mrad for 10 pC bunches with a bunch length of 0.49 mm rms, 0.429 mm mrad for 50 pC bunches with a bunch length of 1.15 mm rms, and 0.853 mm mrad for 100 pC bunches with a bunch length of 1.44 mm rms. Now one of the guns has been delivered to Shanghai and installed in the SHINE tunnel. Recently, it was operated in CW mode with ~75 kW input power and generated the first beam successfully.

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