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Field Emission Cathodes on Niobium Conduction-Cooled SRF Cavity

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A high-current electron source capable of generating high charge electron bunches at MHz repetition rates is currently being prototyped. The source is based on a 650-MHz single-cell superconducting cavity modified to include a reentrant cathode holder optimized to significantly enhance the electric field on the cathode surface. The electrons are produced via field emission from a field-emitter-array cathode. The system is cooled using a cryogen-free conduction cooling system to ~5K. Electromagnetic simulations indicate the SRF-cavity configuration supports an average accelerating field of 1.4MV/m with the peak field at the cathode around 8.5MV/m. The average electron beam current is limited to 10 microamps by the RF-power source and the field-emitters enhancement factor. We will discuss the design strategy and planned improvements, along with the status of the experiment.

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