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Preliminary results of electromagnetic and beam dynamics simulation for optimizing an SRF gun cavity to maximize the beam brightness

Tuesday 23 September 2025 14:30 (3 hours)

A high beam brightness is an important requirement for an electron linear accelerator, with the electron source setting the lower limit for the achievable brightness. A superconducting radio-frequency photoelectron injector (SRF gun)) stands out as an advanced electron source capable of delivering beams with superior properties compared to other continuous-wave injectors. Currently, SRF guns are being reliably operated at various accelerators. However, the gun cavities are operated below its design gradient due to the field emission. This lower gradient reduces particle energy gain per cell and adversely affects beam quality by deviating from theoretical optima.

To overcome these limitations, a new cavity design is being explored, with the peak surface electric field restricted to 30 MV/m, corresponding to the fields that have typically been achieved so far. In the first step, the first half-cell geometry will be optimized to maximize the ratio of the cathode's electric field to the resonator's surface field (Ecath/Epk) which guarantees the maximum possible acceleration of the electrons from their generation. Following this, additional optimized cells are included to maximize the beam energy gain. Subsequent to the electromagnetic optimization, beam dynamics study will provide the operating point of the SRF gun to maximize the beam brightness. This contribution will discuss the initial findings from the electromagnetic and beam dynamics study.

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Yes

Footnotes

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