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

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A high beam brightness is a crucial 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. This contribution will begin by examining the similarities between accelerator and injector cavity designs, followed by an examination of the specific requirements unique to the injector cavity. Subsequently, the design methodology being followed will be described. A mesh convergence study is then presented in a later section. Various alternative cavity shapes to the TESLA design have been proposed, and the figure of merits (FOM) achieved using these full-cell shapes in conjunction with the existing HZDR injector first cell will be presented. The future plans are outlined in the final section.

Footnotes

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