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Conceptual design of the low dark charge photocathode RF gun for Relativistic Ultrafast Electron Diffraction and Imaging (RUEDI) facility

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The electron source is a critical component of the RUEDI (Relativistic Ultrafast Electron Diffraction & Imaging) facility, which needs to provide beam to match the requirements for performing both electron microscopy and ultrafast electron diffraction. To meet these demands, different operational modes are needed, to deliver ultra-short, ultra-bright and highly temporally and energy stable electron pulses with a charge varying from 0.2 pC to 20 pC and a kinetic energy of 4 MeV, with a repetition rate with 100 Hz (and higher). The dark charge produced by the electron source should be minimised to avoid significant noise in the image. Analysis of existing electron sources suggested that the optimal solution is a normal-conducting S-band RF photocathode gun operating with a metal photocathode, illuminated by an ultraviolet laser. A number of critical design decisions were identified to reduce gun dark charge which are discussed in this paper. These include the gun RF design (number of cells and type of coupling), beam generation scheme (that includes the type of the photocathode), reducing duration of RF drive pulse and methods of maintaining good RF field stability.

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Footnotes

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Yes

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