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Revolution in generation of polarized electron beams: the world's first RF electron gun with GaAs photocathode

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Polarized electron beams play critical role in fundamental physics research by providing additional observables and opening new channels of discoveries. T GaAs crystals illuminated by circular polarized IR lasers remain the best choice for generating polarized electrons. All current polarized sources are an electrostatic electron guns providing necessary extreme (XUV) vacuum conditions for survival of GaAs photo-emissivity. But they are limited in accelerating voltage and its gradient limiting both the quality and quantity of available beams. These are the reasons why accelerator community was and is attempting to extend this technology to the radio-frequency electron guns, which are capable of accelerating beams significantly higher accelerating gradients and total accelerating voltage. Unfortunately, all previous attempts of operating GaAs photocathodes in RF guns were unsuccessful. In this paper, we report on successful operation of GaAs photocathode in superconducting RF gun and describe all details of the gun, evolution of the GaAs quantum efficiency, and parameters generated electron beam.

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