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Superconducting solenoid optimization and fields measurement at ELBE

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In order to reduce the projected transverse beam emittance, a solenoid is usually used at normal conducting as well as superconducting radio frequency (SRF) photoinjectors. At the ELBE SRF Gun-II, a superconducting solenoid is located inside the gun's cryomodule about 0.1 m far from the end of the gun cavity. The solenoid has a longitudinal magnetic field on the axis with a Gaussian-like shape and an effective length of 0.042 m. To determine the beam aberration due to the anomalous, weak quadrupole fields of the solenoid, we measured and analyzed the multipole fields of the solenoid. In this paper, two different multipole magnetic field analysis methods are presented. We also calculated the effect of these fields on the beam emittance. Based on these studies, a group of quadrupole correctors has been installed downstream in the beamline. A comparison of the experimental findings for quadrupole field correction and simulation will be given. For beams with relatively large diameters, the spherical aberrations of the solenoid can increase the emittance significantly. For that reason, an improved solenoid design meets the mechanical and cryogenic demands.

Footnotes

Funding Agency

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Yes

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