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Experimental and simulated dark current and beam loss studies for a SRF photo-injector of an ERL injector

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The Superconducting RF photo-injector with the prototype 1.4 lambda/2-cell Niobium cavity of the bERLinPro Energy Recovery Linac (ERL), recently renamed to SEALab, *was tested and characterized in a dedicated beam test facility called Gunlab to analyze its performance for the ERL. After dismantling and refurbishing of the cavity, a small surface defect was found close to the cathode opening and by simulated reconstruction of the set-up it was demonstrated to be the main source of the dark current measured at Gunlab. Later, a method was found to remove that defect***, but still the question remains, what amount of dark current is acceptable for an ERL injector, especially for the SRF systems? In this contribution, we show a fully 3D simulation based emulation of the dark current measurements in Gunlab and extrapolate the impact on the complete injector at bERLinPro (SEALab). Here, it can be shown, that besides a small meshed beam loss diagnostics, methods need to be found to determine the amount of field emitted current dumped into the SRF systems.

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Footnotes

- A. Neumann et al., "bERLinPro Becomes SEALab: Status and Perspective of the Energy Recovery Linac at HZB", in Proc. IPAC'22 ** A. Neumann et al., "The BERLinPro SRF Photoinjector System - From First RF Commissioning to First Beam", in Proc. 9th Int. Particle Accelerator Conf. (IPAC'18), ***Y. Tamashevich et al., "Damage Recovery for SRF Photoinjector Cavities", presented at the 20th Int. Conf. on RF Superconductivity (SRF'21)

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