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New Simulations for Ion Production and Back-Bombardment in GaAs Photo-guns

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GaAs-based DC high voltage photo-guns used at accelerators with extensive user programs must exhibit long photocathode operating lifetime. Achieving this goal represents a significant challenge for proposed high average current facilities that must operate at tens of milliamperes or more. Specifically, the operating lifetime is dominated by ion back-bombardment of the photocathode from ionized residual gas. While numerous experiments have been performed to characterize the operating lifetime under various conditions [1], detailed simulations of the ion back-bombardment mechanism that explains these experiments are lacking.
Recently, a new user routine was implemented using the code General Particle Tracer (GPT) to simulate electron impact ionization of residual beamline gas and simultaneously track the incident electron, secondary electron, and the newly formed ion. This new routine was benchmarked against analytical calculations and then applied to experiments performed at the CEBAF injector at the Thomas Jefferson National Accelerator Facility. These simulations were performed using detailed 3D field maps produced with CST Microwave Studio describing the photo-gun electrostatics.
In the first experiment, the electrically isolated anode of the CEBAF photo-gun was attached to a positive voltage power supply and biased to different voltages to study the effectiveness of limiting ions from entering the cathode-anode gap. In the second experiment, the size of the drive laser was varied in order to distribute the deleterious ions over a larger area of the photocathode (experimental results reported at PSTP17 in Daejeon, South Korea [2]). Discussion of these experiments and the application of this new GPT routine to model the experiments will be reported at the workshop.

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References

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Summary

Authors: YOSKOWITZ, Joshua (Old Dominion University); GRAMES, Joe (Jefferson Lab)

Co-authors: POELKER, Matthew (Jefferson Lab); HANSKNECHT, John (Jefferson Lab); HERNANDEZ-GARCIA, Carlos (Jefferson Lab); KRAFFT, Geoffrey (Old Dominion Univerisity/Jefferson Lab); VAN DER GEER, Se-

bastian (Pulsar Physics); PALACIOS-SERRANO, Gabriel (Old Dominion University); SULEIMAN, Riad (Jefferson Lab); WIJETHUNGA, Sajini (Old Dominion University)

Presenter: YOSKOWITZ, Joshua (Old Dominion University)

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