DYNAMICS OF HIGHLY ENERGETIC ELECTRONS IN NOVEL ACCELERATING DIODES*

Ben Crampsey, Philip MacInnes, Kevin Ronald,
and Alan D. R. Phelps,
SUPA, Physics Department, University of Strathclyde,
Glasgow G4 0NG, UK

We present initial predictions from the investigation of a novel, short-pulse (~200ns), space-charge-limited-emission electron accelerating diode, or electron-gun, that operates purely under the influence of its own self-fields – i.e. without the requirement for externally applied magnetic insulation of the propagating electron beam. The optimised model, developed using CST Studio Suite, predicted a ~500keV, ~1.86kA electron beam, with a mean envelope-radius of 16.8mm propagating into a 18mm radius drift-tube. The beam was very slightly convergent at the entry to the drift-region with a convergence angle of 1.5^0 (0.026rad).

A key consideration, in developing the electron gun, was the potential for vacuum-arcing, due to excessive electric field stresses. The pulsed nature of the gun aids in mitigating some of that risk, however to reduce it further, the maximum field-stress considered "safe" was taken to be ~40MV/m (double the typical Kilpatrick DC limit of 20MV/m). In the optimized model the peak stress was ~35MV/m, falling acceptably within the bounds set.

The electron gun is currently being manufactured for experimental testing, where it will then be used as the particle accelerator driving a novel, self-insulating, high-power microwave source.

---

*Work supported by the Office of Naval Research, Grant No. N62909-18-1-2122– GRANT12538355, N00014-18-S-B001
Ben Crampsey supported by the EPSRC Summer Internship Scheme for undergraduate students.

Crampsey, B., MacInnes, P., Ronald, K., & Phelps, A. D. R. (2020). Dynamics of highly energetic electrons in novel accelerating diodes. Abstract from 47th IEEE International Conference on Plasma Science.