Contribution ID: **81** Type: **Invited talk**

Studies of Electrical Breakdown Processes across Vacuum Gaps

Tuesday 14 August 2012 10:55 (20 minutes)

L. R. Grisham, A. von Halle, A. F. Carpe, Guy Rossi, K. R. Gilton, E. D. Macbride, E. P. Gilson, A. Stepanov, T. N. Stevenson

Princeton University Plasma Physics Laboratory
P. O. Box 451, Princeton, New Jersey, 08543, USA

The voltage which can be sustained across any given distance in a vacuum without engendering electrical breakdown forms the principle constraint upon the performance of electrostatic accelerators, determining the length, the electric field gradients, and the electrostatic lens strength which can be obtained. Despite its practical importance, the physical mechanisms governing spontaneous electrical breakdown across vacuum gaps remain somewhat obscure, consisting more of hypotheses than consistent theoretical descriptions. These fall into two main categories: electron emission and the clump hypothesis (that charged clumps detached from the electrode accelerate across the gap and vaporize the other electrode). The first of these fails to reproduce the conventionally observed scaling of voltage holding with distance for gaps larger than a cm when only the electric fields are considered, while the latter does, but seems physically improbable in its original form. We discuss our recent preliminary experiment to investigate whether electron field emission can be circumvented by using a large electric current to envelope the electrode at cathode potential with a magnetic field which is everywhere parallel to the surface planes of the electrode. This experiment did not find evidence of increased voltage holding with the magnetic field present, but it suffered from some limitations, which will also be mentioned. While this experiment was designed as a practicality test, since it used a magnetic field which would be tenable for some accelerator applications, a future test will be intended to test the physical principal of whether field emission is the governing mechanism in vacuum electrical breakdown by using an order of magnitude higher magnetic field. We describe how the second experiment can be implemented, and we also discuss possible implications of the null result from the first experiment, namely, the clump hypothesis might be closer to the correct description of the genesis of vacuum electrical breakdown than electron field emission. To this end, we discuss our suggestion that bacteria spores and husks might be the "clumps"in the clump hypothesis, and how this might be tested. It is hoped that better understanding of electrical breakdown phenomena might lead to more reliable operation of electrostatic accelerators, and perhaps also higher electric field gradients.

Supported by USDOE contract no. DE-AC02-09CH11466

Author: GRISHAM, L. R. (Princeton University Plasma Physics Laboratory)

Presenter: GRISHAM, L. R. (Princeton University Plasma Physics Laboratory)

Session Classification: Accelerator physics and technology I - Chairs: J. Kwan and A. Faltens - Featured Posters: R. Burke, K. Fukushima, T. Yoshimoto, R. Cassel