Ion-Induced Secondary Electron Emission and Surface Flashover Breakdown for High-Gradient Ion-Beam Accelerators

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LABORATORY DIRECTED RESEARCH & DEVELOPMENT

Early Career R&D Program

Sandia National Laboratories

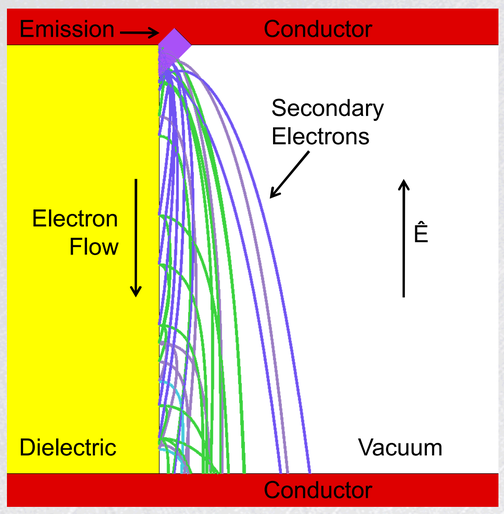
Joseph Howard (02735), PI
Juan Elizondo (02735), Mentor
Clifford Renschler (02730), PM
Mike Eatough (02730), DM

Problem

Background: Secondary Electron Emission (SEE), initiated from both electrons and ions, is an underlying mechanism of several failure modes observed for particle accelerators.

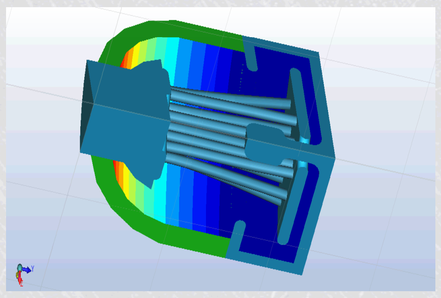
Problem: Ion-induced SEE is relatively complex, and no data exist for ion-induced SEE and vacuum flashover that directly correlate to the materials and beam chemistries used in practical accelerators.

Challenge: A variable perveance ion accelerator, operating with constant current and beam chemistry, is required to obtain relevant SEE data.

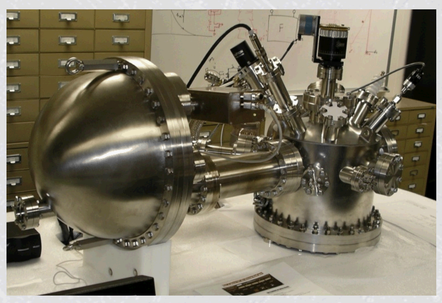


Approach

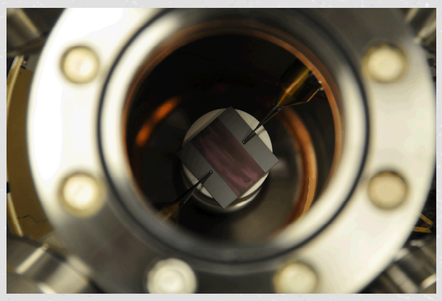
Modify typical tube to create ion accelerator with representative beam chemistry



Perform SEE measurements on ceramics and target materials

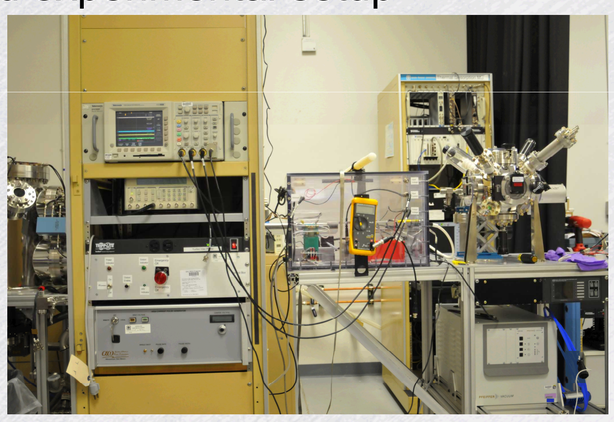


Perform flashover experiments on tube materials and geometries under influence of ion beam

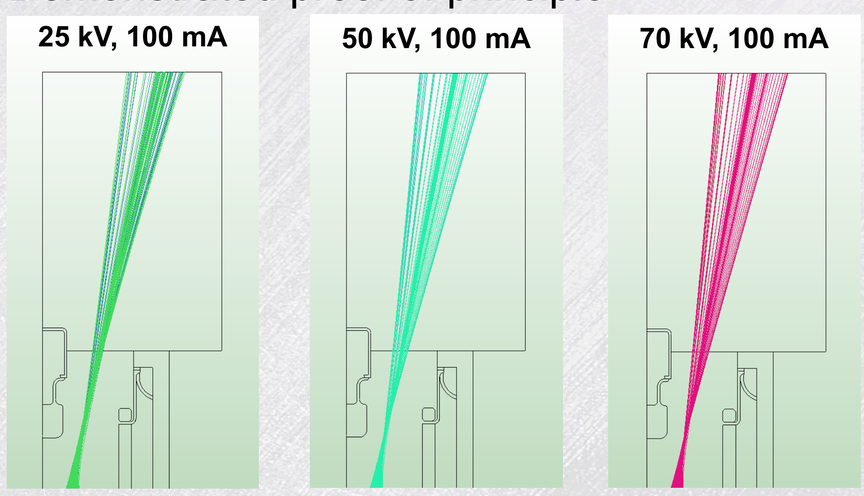


Results

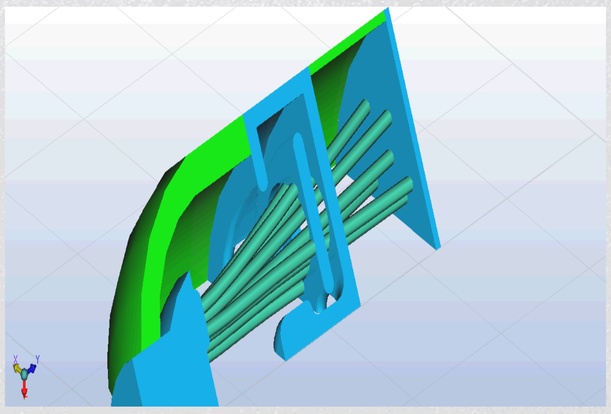
Developed experimental setup



Demonstrated proof of principle



Modeled options for variable-perveance accelerator



Significance

Design advancement for compact, portable, high-gradient particle accelerators:

- More reliable with less catastrophic failures
- Improved power efficiency
- Higher output for neutron generators

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