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Inertial Electrostatic Confinement (IEC) is a means to produce fusion reactions via electrostatic fields in a converging geometry. Although the long term goal is to generate energy, IEC has near term applications as a neutron generator for Neutron Activation Analysis (NAA), production of medical isotopes, material studies, etc.. Spherical IECs (SIECs) are investigated both theoretical and experimentally. Theoretically, the emphasis is on finding operation regimes for a particularly favorable mode of operation. Given these results, recommendations are made to increase the chance of achieving this favorable operation mode in the laboratory.

Experimentally, a particular mode of operation, known as glow discharge mode, is investigated. Current theories and hypotheses regarding the structure of the discharge and the phenomena of "micro-channeling" are verified and evaluated. In addition, two sub-modes of glow discharge mode; "Jet" mode and "Star" mode, are compared. In addition, the threshold for transition from "Star" mode to "Jet" mode is obtained experimentally.