PARAXIAL DIODE OPERATION ON RITS-6*

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The paraxial diode is a relativistic electron-beam-driven diode that is being investigated as a potential x-ray source for flash radiography. The diode typically employs a gas-filled transport cell (~1 torr air) to focus the beam onto a high-atomic-number target to generate x-rays. Two key objectives are to produce a small x-ray spot size (< 5 mm) and high forward-directed dose (> 600 Rads@1m). Ultimately, it appears the limitation in the diode is its large spot size (> 5 mm). Previous particle-in-cell (PIC) simulations have shown that the primary limitation in spot size is due to beam sweep in which the finite decay of the plasma return current inside the gas cell causes the beam focal location to sweep axially away from the target during the timescale of the pulse. This leads to an increased time-integrated spot size [1]. Paraxial diode experiments have been performed on the RITS-6 pulsed power accelerator at Sandia National Laboratories at voltages 4.5 – 10.5 MV and with different rise-times 5 - 30 ns. Measurements of dose, dose rate, time-integrated (and time-resolved) spot size, and current are reported. These results are compared with the previous and newer models developed using the hybrid PIC/fluid code LSP [2]. Simulations consider temporal cathode emission evolution, anode ion emission, and kinetic and fluid gas-breakdown models for the range of operating parameters on RITS-6.

1. B.V. Oliver, D. Short, G. Cooper, J. McLean and J. O'Malley, "Paraxial gas-cell focusing of relativistic electron beams for radiography", IEEE Trans. Plasma Sci., 33, 704 (2005).

2. LSP is a software product developed by ATK Mission Research.

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