

NEGATIVE POLARITY ROD PINCH DIODE EXPERIMENTS ON THE ASTERIX GENERATOR

Bertrand Etchessahar, Rodolphe Rosol, Michel Caron, Martial
Toury, Frédéric Cartier, Yaël Tailleur, Virgile Bernigaud,
Rémi Nicolas, David Pierre, Michel Wuattier
CEA / PEM - 51490 Ponfaverger-Moronvilliers, France

Bruno Cassany, Luc Voisin, Thierry Desanlis, Béatrice Bicrel,
David Hébert, Alain Galtié
CEA / CESTA - 33114 Le Barp, France

Alain Garrigues, Christophe Delbos, Isabelle Soleilhavoup
CEA / CEG - 46500 Gramat, France

Frédéric Bayol
ITHPP - 46500 Thégra, France

ASTERIX is a 6MV Marx+Blumlein X-ray generator¹, dedicated to the testing of electrical components. For our experiments, the vacuum diode has been modified in order to set up a flash radiographic diode. The negative polarity rod pinch diode (NPRPD) has been tested on this generator since 2004. The polarity has been reversed from previous experiments², in order to take advantage from the maximal X-ray emission toward the anode holder at such a voltage.

The main goals of these new experiments are a better understanding of the physical phenomena, by the use of new diagnostics as a 4 images high speed camera, a streak camera and vacuum voltage probes.

The NPRPD consists of a small diameter (few mm) cylindrical anode extending from the front end of the vacuum cell through a thin annular cathode, hold by the central conductor. The dependence of the radiographic performances and the impedance with the cathode radius has been observed and an optimum identified. A stable, but not yet fully optimized, configuration has been found and provides 45 rads@1m (in Al) with a 1.9 mm spot size (FWMH from LSF) at a 4 MV gap voltage. The visible images of the diode show the anode and cathode plasmas and the electronic pinch during the pulse. The streak camera gives the speed of the expansion of the rod plasma and it is compared to hydrodynamic calculations.

The comparison of the electrical data to PIC simulations shows good agreement but proves that the diode behavior is not optimal because of electronic emission from the cathode face at larger radii than expected. Further work will focus on this problem, trying to drive, earlier in time, more current from the smaller radii of the cathode.

1. G. Raboisson, P. Eyl, M. Roche, C. Malaval and A. Johan, "ASTERIX, a high intensity X-ray generator", 7th Pulsed Power Conference, 1989, pp. 567-570.

2. S.B. Swanekamp, C. Vermare, F. Bayol, B.V. Oliver et al., "Angular dose variations from 4 to 6 MV rod-pinch diode experiments on the ASTERIX pulsed-power generator", 14th Pulsed Power Conference, 2003.