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Modeling and experimental characterization of the plasma produced by velvet cathode in a linear induction accelerator

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At the EPURE facility, in France, a high power electron diode is used to generate an intense high quality pulsed electron beam in order to produce a bremsstrahlung radiation pulse for flash radiography. For this purpose, a cold cathode is driven by a 75 Ω graded transmission line, which delivers a 3.8 MV, 95 ns (FWHM) high power electrical pulse across a diode gap of 17.2 cm. The cathode is composed of a dielectric material (cloth velvet) on a metal substrate. The application of the strong electric field results in plasma formation induced by a surface flashover [1-3]. A space charge limited electron flow is, then, extracted from this plasma. Therefore, to optimize the design of diodes and to have a better understanding of plasma dynamics, we have developed a 0D Collisional-Radiative Model (CRM) which describes the time-dependent evolution of the density of the plasma species. The non-equilibrium electron energy distribution function (EEDF) is pre-calculated for a large range of reduced electric field E/n [4]. EEDF versus E/n are then used to determine the electron rate coefficients needed to calculate time-dependent plasma species densities. We have performed visible spectroscopy measurements in order to investigate the plasma composition and temperature. The emission spectroscopy results are compared to the CRM and plasma characteristics.

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Primary author: PLEWA, J.M. (CEA, DAM, GRAMAT)

Co-authors: Dr BERNIGAUD, V. (CEA, DAM VALDUC, F-21120 Is sur Tille, France); Mr CARTIER, F. (CEA, DAM VALDUC, F-21120 Is sur Tille, France); Mrs CARTIER, S. (CEA, DAM VALDUC, F-21120 Is sur Tille, France); Dr D'ALMEIDA, T. (CEA, DAM, GRAMAT, F-46500 Gramat, France); Prof. EICHWALD, O. (LAPLACE, CNRS, University of Toulouse, 118 Route de Narbonne, Toulouse, FRANCE); Dr MAISONNY, R. (CEA, DAM, GRAMAT, F-46500 Gramat, France); Mr POULET, F. (CEA, DAM VALDUC, F-21120 Is sur Tille, France); Dr RIBIÈRE, M. (CEA, DAM, GRAMAT, F-46500 Gramat, France); Dr WATTIEAUX, G. (LAPLACE, CNRS, University of Toulouse, 118 Route de Narbonne, Toulouse, FRANCE); Prof. YOUSFI, M. (LAPLACE, CNRS, University of Toulouse, 118 Route de Narbonne, Toulouse, FRANCE)

Presenter: PLEWA, J.M. (CEA, DAM, GRAMAT)

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