STATUS ON NUMERICAL MHD TOOLS USED TO ANALYSE WIRE ARRAY EXPERIMENTS AT CEA-GRAMAT FOR RADIATION EFFECTS AND HEDP STUDIES*

J. Grunenwald, H. Calamy, F. Lassalle, P. Maury, T. Maillard, F. Zucchini
CEA, DAM, GRAMAT, F-46500, Gramat, France

J. Chittenden, N. Niasse, A. Marocchino
Blackett Laboratory,Imperial College,London,SW7 2BW,UK

The SPHINX machine[1] is a 6 MA, 1 µs driver based on the LTD technology, used for Z-pinch experiments. The main loads are cylindrical wire arrays which appear to be, despite the long implosion time of Sphinx driver, efficient plasma radiation sources especially with the use of multi-microsecond prepulse technique[2]. Recently, new configurations have been studied : radial wire arrays to investigate the potential of more compact radiation sources for HEDP purposes and conical wire arrays for laboratory astrophysics experiments on jet propagation. The behaviour of these new configurations with long current rise time have been first investigated on the OEDIPE test bed (730 kA, 1,2 µs) then the scaling up to Sphinx have been done by means of numerical simulations. These MHD codes used to design new configurations and to provide basic physics understandings are MARPLE 2D and GORGON 3D.
MARPLE is a 2D(r,z) MHD code developed under CEG contract by the IMM[3] and is used mainly for benchmarks and parametric studies on cylindrical wire arrays. GORGON is a 3D MHD code developed by the Imperial College[4] and is used mainly for studying 3D aspects of wire arrays implosion, instabilities developments and wire ablation systems.
We present here recent numerical results obtained on wire array experiments. The link inferred by Marple2D simulations between the ablation velocity and load parameters for single wire array is shown. The effect of plasma expanding from electrodes during cylindrical Z-pinch implosion is analysed thanks to Gorgon. 3D simulations of radial and conical wire arrays are also presented showing their dynamics and characteristics. Then, 3D results of a typical Al single wire array load is discussed as far as the dynamics of the implosion and the spectral radiation of the final column are concerned. Finally, the current development by the IMM of a 3D version of Marple using unstructured meshes will be presented.

1. F. Lassalle et al., IEEE Trans. On Plasma Sciences, Volume 36, Issue 2, Part 1, pages 370-377, April 2008
2. H. Calamy et al., Phys. Plasmas 15, 012701 (2008)
3. V. Gasilov et al., Marple 2D & 3D developments at Institute of Mathematical Modelling, Moscow, Russia. Work supported by DGA/UM/NBC under CEG contract n°200725061000500000
4. J. Chittenden et al., Phys. Plasmas 8, 2305 (2001)

* Work supported by French Ministry of Defense – DGA/UM NBC