CODED APERTURE IMAGING TECHNIQUE FOR INVESTIGATION OF FUSION SOURCE SPATIAL DISTRIBUTION IN PLASMA FOCUS DEVICE

A.R. Talebitaher, S.V. Springham, P. M. E. Shutler, M. V. Roshan, R. S. Rawat, P. Lee
National Institute of Education, Nanyang Technological University, 1Nanyang Walk, Singapore 637616

The Coded Aperture Imaging (CAI) technique, which originally was developed for x-ray and γ-ray astronomy, has been applied to investigate the spatial distribution of DD fusion in a 1.7 kJ Plasma Focus device with deuterium filling gas operated in its neutron-optimized regime. The mask has been fabricated with 20×20 pixels and 57 square holes (14% open area) using a Singer-set Cyclic Difference pattern. Four CAI cameras were placed at 45° to plasma focus axis and one at 0°. The nuclear track detector material PM-355 (CR-39) was used to register proton tracks from D(d,p)T reactions. The detectors have been covered by 75 μm Kapton film to stop all energetic charged particles (mostly deuterons) other than the 3 MeV fusion protons. A de-convolution algorithm was applied to the measured proton tracks coordinates to obtain images of the fusion source image from the five directions. The number of proton tracks registered by each detector per shot was typically $(2–8)\times10^4$. Two beryllium fast-neutron detectors were employed simultaneously to measure the associated neutron yield and anisotropy for each shot. The results clearly show the advantages of the CAI technique in comparison to conventional pinhole imaging, particularly in terms of a significantly improved signal-to-noise ratio in the obtained images.