Capabilities of a Diamond Detector matrix for neutron spectroscopy measurements at JET

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INTRODUCTION

• New system based on a 12-pixels single crystal diamond detector (SDD) matrix has been recently realized and has been installed at JET for neutron spectroscopy measurements
• Diamonds feature high radiation hardness, fast response, low sensitivity to magnetic fields and compact size
• n-α reaction 12C(n,α)Be allows direct 14 MeV neutron spectroscopy measurements
• 2.5 MeV neutrons can be detected by nuclear elastic scattering on carbon nuclei in the detector
• Calibration results of the SDD matrix with alpha particles in the laboratory and 14 MeV neutrons performed at the Frascati Neutron Generator will be presented.

ALPHA PARTICLE MEASUREMENTS

• In order to characterize and calibrate each single pixel with its own electronic chain, alpha particle measurements with a 241Am source were performed in laboratory
• Measurements were performed in vacuum and then at atmospheric pressure.
• Each pixel was coupled to the 241Am source thanks to 12 holes placed in front of each pixel which work as pinhole collimators
• The mean value of the energy resolution for the recorded peaks during the measurements in vacuum is 1.74 % with a standard deviation of 0.08

INSTALLATION at JET

CONCLUSIONS

• New system based on a 12-pixel SDD matrix has been realized and proven to be a good neutron diagnostic for fusion plasmas
• Dedicated digital acquisition allows neutron spectroscopy measurements with simultaneously high energy resolution and high count rate capability (MHz)
• Response of the SDD matrix was measured with 14 MeV neutrons and α particles
• Uniform response of each pixel to radiation was observed: Energy resolution of 1.74 % and 1.3 % for 5.485 MeV α and 14 MeV neutrons was observed, respectively
• SDD Matrix has been installed at JET as a Vertical Neutron Spectrometer and it will take data in the next campaigns