Recent development of inorganic scintillators for 2.5 MeV neutron spectroscopy of fusion plasma

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Abstract

A new C7LYC based neutron spectrometer has been recently installed at the Experimental Advanced Superconducting Tokamak (EAST). The detector is placed along a dedicated line of sight and it is based on an inorganic scintillator crystal C7LYC (Cs_2LiYCl_6: Ce) enriched with ^{7}Li coupled to a photo multiplier tube. The absence of ^{6}Li makes the C7LYC insensitive to thermal neutrons while the detection of 2.5 MeV neutrons is based on nuclear reaction with $^{35}Cl(n,p)^{35}S$. This reaction has a positive Q-value of 0.617 MeV and, being a two-body reaction, produces a univocal peak in the recorded pulse height spectrum. The C7LYC crystal is very interesting as a fast neutron spectrometer also thanks to its capability to discriminate between neutron and gamma-rays. The discrimination is based on the pulse shape due to the difference of scintillation times between neutron/gammas induced events. In this work we present the first 2.5 MeV neutron spectroscopy measurements on EAST in D plasmas when NBI was applied. A successful comparison with the expected neutron spectra based on GENESIS simulations is also given. The clear response function of the C7LYC detector to 2.5 MeV neutrons together with its good capability in the n/g discrimination, makes this detector an interesting spectrometer for D plasmas diagnostics. In particular, its compactness allows for integration in a multi-line of sight camera where space constraints are present.