Measured Response of Bubble Neutron Detectors and Prospects for Alpha Knock-On Diagnostics


General Atomics — Measurement of the neutron energy spectrum above ~16 MeV will yield information on the spatial and energy distributions of confined fast alphas in DT tokamaks. The energetic neutrons result from fusion reactions involving the energetic ions created by alpha-fuel ion knock-on collisions. Standard two-gas bubble neutron detectors, designed to only detect neutrons with energies above a selectable threshold determined by the gas mixture, were used in preliminary attempts to measure the knock-on neutrons from DT plasmas in TFTR and JET. Subsequent measurements at accelerator neutron sources showed an unexpected below-threshold detector response that prevented observations of the alpha-induced neutron tails. Spontaneous bubble nucleation measurements show that the majority of this below-threshold response is due to slight variations in the gas mixture, and is not present in single-gas detectors. Single-gas detectors will be tested at UC Berkeley to determine the neutron energy threshold as a function of detector operating temperature and to confirm their suitability for alpha knock-on tail measurements. An array of single-gas detectors operating at different temperatures should allow measurements of the alpha knock-on neutron tail during the proposed DTE2 experiments on JET.

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