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#03-134 Fusion fuel ion ratio measurements at JET using neutron spectroscopy

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The fuel ion ratio, n_T/n_D, is an important plasma parameter in magnetically confined fusion, especially for future fusion devices (ITER, DEMO), which plan to achieve fusion through deuterium-tritium (DT) plasmas. In order to maximize the fusion power output, it is necessary to ensure equal number densities of tritium and deuterium (i.e. $n_T/n_D = 1$). Neutron spectroscopy offers the possibility to measure the fuel ion ratio by comparing the contribution to the neutron spectrum from 14 MeV neutrons generated by the T(D, n)$^4_2$He reaction, and 2.5 MeV neutrons from the D(D, n)$^3_2$He reaction. Consequently, neutron spectroscopy has been identified as one of the primary diagnostics for measuring n_T/n_D at ITER. Measurements of the fuel ion ratio is required at ITER over a range of $0.01 < n_T/n_D < 10$ with a precision of 20% and time resolution of 100 ms. In future fusion power plants, the ion ratio will likely be a continuously monitored parameter to ensure the reactor is running at maximum capacity. In this paper we describe a method for measuring the fuel ion ratio for low concentrations of tritium ($n_T/n_D < 1$) at the Joint European Torus (JET) using the time-of-flight (TOF) neutron spectrometer TOFOR. TOFOR has a vertical sight-line of the JET plasma and consists of 37 plastic scintillation detectors which when used in coincidence provide TOF spectra from which information on the energy spectrum of the different neutron components can be inferred. Measurements of the fuel ion temperature are commonly performed using TOFOR data. In this paper, the fuel ion ratio is determined by comparing the TOF peaks corresponding to the two different neutron energies (2.5 MeV & 14 MeV) after removing background and scattered components. Finally, an estimate of the upper limit of n_T/n_D at which the ratio can be accurately determined using a forward scattering TOFOR-like spectrometer is presented.

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