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P1.1098 Prospects for fuel ion ratio measurements in DT plasmas with compact neutron spectrometers

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In a DT plasma the T/D fuel ion ratio represents an important parameter which is difficult to measure. In principle, it is possible to infer the T/D ratio from a direct simultaneous measurement of the neutron spectra of 2.5 MeV neutrons from D+D->He3+n and 14 MeV neutrons from the D+T->He4+n reactions, respectively. However, the main challenges in this measurement arise from the background contribution in the 2.5 MeV neutron energy range produced by backscattered 14 MeV neutrons and from the experimental difficulties in measuring 2.5 MeV neutron spectra in a high 14 MeV neutron field. For ITER the method proposed is instead based on high-resolution spectroscopy of the 14 MeV neutrons whereby the D/T ratio is inferred from an accurate separation of suprathermal beam component from thermal emission. This requires a dedicated suite of high-resolution neutron spectrometers to cover the T/D range from 0.001 up to 0.9. CVD diamond is a high-resolution neutron spectrometer capable of measuring 14 MeV neutrons by exploiting the peak due to the 12C(n,)9Be reaction, and 2.5 MeV neutrons via elastic scattering with carbon atoms. Further, the recently developed CLYC inorganic scintillator detector is a capable of a direct spectroscopic measurement of 2.5 MeV neutron on the basis of 35Cl(n,p)35S nuclear reactions, while on the other hand 14 MeV neutron spectroscopy is prevented by the opening of other inelastic reactions. The synthetic data presented in this work shows the methodology identified to determine the T/D ratio from measurements obtained with a system combining CVD diamond and CLYC spectrometers, either by measuring 2.5 and 14 MeV neutron spectra (T/D ratio <0.1), or by high-resolution 14 MeV neutron spectroscopy (T/D>0.1). The work consists in Monte Carlo simulations of the neutron emission spectra for different DT plasma scenarios in order to predict the measured spectra along a specific line of sight. From the analysis of the synthetic data it is possible to evaluate the capability to infer back the T/D ratio.

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