DAIMoND: **D**evelopment of an **AI**-**Mo**nitored **N**eutron **D**iagnostic

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The fuel ion ratio is an essential parameter to be measured in magnetic fusion devices featuring deuterium-tritium operation. One way of obtaining it is to compare the competing 14.06 MeV deuterium-tritium (DT) and the 2.45 MeV deuterium-deuterium (DD) neutron fluxes by measuring them using a detector with spectroscopic capability. Diamond detectors (which are already scheduled to be installed on ITER as part of the HRNS diagnostic) could fulfill this role. Previous experiences on JET demonstrated that the interpretation of measurements through analytic means alone is challenging for plasmas with more than 5% tritium.

The talk will present the work performed with a machine learning algorithm, proving that its employment can expand the fuel ion ratio assessment with diamond detectors above the 5% tritium limit. The machine learning algorithm was trained and evaluated on Geant4 synthetic data over the entire 0%-50% tritium fraction. Results are shown and are compared to the ITER requirements in terms of accuracy and time resolution, assuming either a well-known or an entirely unknown fusion power. Other considerations regarding model selection, explainable AI (XAI) methods, dependance on the sample size, and scattered spectral components are also presented.

In general, the work serves as proof-of-concept for the method, demonstrating the potential results achievable by combining neutron spectrometry with diamond detectors and AI.