The new GETART method for measurement of the fusion power in DT magnetic confinement fusion based on absolute detection of 17 MeV gamma rays

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In DT fusion experiments the measurement of the fusion power is an important issue related both to the licensing of the site and to the performance achieved. Today the standard method employed in magnetic confinement experiments is based on 14 MeV neutron counting by a few detectors placed around the reactor. It is required to have time consuming in vessel neutron calibration to benchmark neutron transport simulations from the extended plasma source to the flux monitor detectors which typically are fission chambers cross calibrated with activation foils. The in vessel neutron calibration needs to be repeated whenever the machine and the environment around the detectors change.

In this talk the results from an alternative novel method called GETART (Gamma ray Emission in Tokamaks: Assessment of Reaction rate Throughput) will be presented. GETART is based on the absolute detection of gamma rays from the reaction $T(D,\gamma)^5He$, which are emitted with a weak branching ratio ($\sim 10^{-5}$) with respect to neutrons. By using a self-calibrated diagnostic installed on a dedicated line of sight it will be shown that GETART can be used in principle to infer the DT fusion power independently on the main neutron based method and without the need of in vessel calibrations.

The presentation will describe the method developed and the experimental results achieved in the DT experiments at JET. JET has an absolute calibration of the 14 MeV neutron emissions of about 10% which has given a unique opportunity to benchmark the GETART method. Fundamental nuclear science information on the $T(D,\gamma)^5He$ reaction nucleus have been achieved including the first measurement of the ^5He decay gamma ray spectrum and of the gamma to neutron branching ratio in a magnetic confinement experiment. The talk will conclude by addressing the implementation prospect on the upcoming DT reactors such as ITER and SPARC.

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