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P2.031 The dud detector: an empirically-based real-time algorithm to save neutrons and tritium during JET DTE2

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Operations using deuterium-tritium mixtures are envisaged on JET in 2019-2020 (DTE2). Each plasma discharge will be a precious resource during this campaign, being both tritium and neutron budget limited. During DTE2 it will be mandatory to promptly detect and safely terminate those plasma discharges which do not achieve the expected target parameters, due to unsatisfactory plasma performances (i.e. low beta, low fusion power, non-stationarity) or unhealthy conditions that compromise the experiment goals (i.e. inadequate heating power, deleterious MHD, incorrect fuel mixture). A real-time detector of underperforming discharges (dud) algorithm has been developed for this purpose. The algorithm will calculate and monitor the time evolution of plasma performance indicators, which are then used to trigger alarms. Among these, the confinement scaling H98y,2 and the reactivity normalized to the plasma stored energy are the most promising indicators, since they can be easily, yet robustly, estimated based on the available real-time signals on JET. Alarm thresholds for such indicators have been empirically tuned over a wide database of advanced tokamak, baseline and hybrid plasmas. Notably, the robustness of such alarm thresholds will be tested in high heating power regimes and in presence of different isotope mixtures in upcoming JET campaigns. The performance of both detection and alarm generation has been characterized and documented. Coupling the dud detector to other real-time controllers (i.e. radiation peaking detector, isotope mixture and mode locking control) and to proper plasma termination strategies has been investigated in this work. Furthermore, a possible synergy with the real-time state observer RAPTOR code, which will provide a model-based expectation of the plasma state, is also discussed.
*See the author list of "X. Litaudon et al 2017 Nucl. Fusion 57 102001″

Presenter: PIRON, Lidia (CCFE)

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