Progress in preparing real-time control schemes for Deuterium-Tritium operation in JET

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Operations of a magnetic fusion experiment, such as JET, rely on the presence of real-time (RT) control schemes, which supervise the plasma reaching the expected target performance while maintaining the machine's and sub-systems' integrity. In JET, efforts have been dedicated since [1] in developing and testing RT control schemes in preparation for the upcoming Deuterium and Tritium (DT) campaign. When operating JET in DT, each plasma discharge will be in fact a precious resource, being both T and neutron budget limited. Among the developed control schemes, we will present the fuel mixture controller, which will maintain the required 1:1 DT ratio needed to favour nuclear fusion processes, the dud detector [2], which will terminate a discharge moving toward under-performing states, and a series of improved RT controllers for plasma termination, such as BetaN-control. Moreover, brand-new detectors, based on machine learning approaches, have been implemented for detecting off-normal events or pre-disruptive states and have been included in the PETRA system [3] and new metrics have been employed for flagging alarms, such as the temperature profile hollowness in case of core impurity accumulation [4]. Work is also ongoing to deploy into JET the RAPTOR suite, a RT observer for plasma state monitoring, and to identify control schemes within RAPTOR capabilities, which could contribute to support the development of high performance plasma scenarios [5].

[1] M. Lennholm et al 2017 FED 123, [2] L. Piron et al 2019 FED 146, [3] C.I. Stuart et al 2020 SOFT conference, [4] M. Fontana et al 2020 submitted to FED, [5] C. Piron et al 2020 SOFT conference

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