Disruption prediction based on sawtooth period monitoring by RAPTOR

Disruptions lead to fast plasma termination and consequent high heat and force loads to the device. In present devices, disruptions are tolerated, but it is absolutely necessary to avoid disruptions in future devices. For avoidance, one needs reliable prediction schemes. Present methods are mostly based on neural network trained on database of existing shots. For this purpose, several shots ended by disruption are required and such a neural network is not transferable from one device to another. Therefore this solution is not optimal for future reactors such as ITER or DEMO.

This talk will describe an alternative solution: physics based disruption prediction. For this purpose, we will use the Rapid Plasma Transport simulatOR, a code capable of real time estimation of plasma state (current profile, electron temperature profile and many other quantities). In parallel, some of these quantities can be monitored by real time plasma diagnostics and the state estimated by RAPTOR can be compared to the measured plasma state. If a huge discrepancy is observed, the disruption alarm can be activated and proper actions to safe the plasma/ mitigate disruption consequences can be taken.

The method shortly described within the Phd event talk is focused on disruption prediction based on sawtooth period monitoring. Many disruptions, for example those caused by RWM, LM, high density limit or impurity accumulation are preceded by modified sawtooth behavior. However, as RAPTOR does not have any information about the cause of disruption, it still predicts regular sawtooth behavior. Therefore a huge difference between the sawtooth period predicted by RAPTOR and the experimental sawtooth period is observed before the disruption- monitoring this quantity allows to predict disruptions early enough to take proper actions. The results for RWM disruptions on RFX-mod, LM and density limit disruption on AUG and density limit disruption on TCV will be shown.