# **MDC-22 Disruption prediction for ITER**

|  |  |  |  |
| --- | --- | --- | --- |
| **TG priority:** Critical | **Start date:** 2014 | **Status:**  On-going | **Personnel exchange:**  Yes |
| **IO priority:** | **End date:**  N/A | **Motivation:** Disruption avoidance, mitigation | |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Device /**  **Association** | **Contact**  **Person** | **2016 TG Request** | **Activity (from JEX/JA spreadsheet)** | | | | |
| **2014** | **2015** | **2016** | **2017** | **2018** |
| AUG | G. Pautasso | Desirable | Committed | Committed |  |  |  |
| Aditya | J. Ghosh | Desirable |  |  |  |  |  |
| C-Mod | R. Granetz | Desirable |  | Committed |  |  |  |
| DIII-D | N. Eidietis | Desirable | Considering | Analysis |  |  |  |
| EAST | Y. Zhang | Desirable |  |  |  |  |  |
| JET | J. Vega | Desirable | Committed | Committed |  |  |  |
| JT-60U | A. Isayama | Desirable | Analysis | Analysis |  |  |  |
| KSTAR | I. Kim | Desirable | Considering |  |  |  |  |
| NSTX-U | S. Gerhardt | Desirable |  | Committed |  |  |  |
| TCV | O. Sauter | Desirable |  | Considering |  |  |  |
| FTU | C. Sozzi | Desirable |  |  |  |  |  |
| RFX-Mod | tentative | Desirable |  |  |  |  |  |

**This template is based on the 2014 report.**

**Purpose:** The goal of this joint experiment is the formulation of disruption prediction (DP) criteria for ITER.  
The DP criteria must be based on physical and technical understanding. Data from existing tokamaks will be used for the formulation of these criteria and the DP will be tested on more than one machine.

A plausible approach to the derivation of the DP criteria consists of the following steps:

* Analyze and classify disruptions on a given device.
* Derive for each disruption class a DP algorithm and identify the relevant plasma parameters/measurements, likely with statistical methods.
* Search for a confirmation of the algorithm in physical model and experimental data. (This step may require dedicated experiments.)
* Test the algorithm on more than one device.

The whole work must be done in parallel by more than one device, possibly beginning with comparisons within several smaller clusters of devices. Interaction will occur at the ITPA level between the clusters and with IO expectations/requests. Interaction between ITPA groups and with the developers of the ITER control system is also likely to be required.

**Background:** Empirical methods of real-time disruption prediction have had some success on tokamaks including ASDEX-Upgrade, NSTX, and JET. This joint experiment aims to develop algorithms for disruption prediction that can be transferred between devices, in order to learn how they might be transferred to ITER with maximum reliability and minimum learning period.

**Results for 2014**

* A JET-AUG joint analysis of the LM amplitude before the thermal quench has been carried out. A parametric scaling of the LM amplitude has been derived and supports the hypothesis of a “critical” island triggering the disruption.
* A sub-set of AUG disruptions was analyzed and classified “a la” de Vries (JET classification). Most classes are found in both devices; the likelihood of each class is different, reflecting diverse heating systems, competences and experimental program.
* The amplitude of the poloidal magnetic field measured by one Mirnow coil (rotating modes), along with a “critical” threshold function of the safety factor, is used in FTU as disruption predictor.

**Plans for 2015**

* Continue the assessment of the locked and still-rotating mode amplitude as disruption predictors.
* Continue the analysis of pre-disruption phases and the identification of plasma parameters useful for disruption prediction.
* Collect experience from different devices in predicting a VDE, i.e. a vertically unstable equilibrium.
* Discuss algorithms (diagnostics and criteria) for real time detection of the thermal quench, of minor and major disruptions.