# EP-6 Fast-ion losses and associated heat load from edge perturbations (ELMs and RMPs)

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| **TG priority:** High | **Start date:** 2011 | **Status:**  On-going | **Personnel exchange:**  Yes |
| **IO priority:** | **End date:** | **Motivation:** Physics Basis | |

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| **Device/ Code** | **Contact**  **Person** | **2016 TG Request** | **Activity (from JEX/JA spreadsheet)** | | | |
| **2012** | **2013** | **2014** | **2015** |
| AUG | M. Garcia-Munoz | Desirable | Committed | Committed | Committed | Committed |
| DIII-D | M. A. Van Zeeland | Desirable | Committed | Considering | Considering | Analysis |
| JET | V. Kiptily | Desirable | Committed | Committed | Committed | Not doing |
| KSTAR | J. Kim | Desirable | Considering | Committed | Committed |  |
| LHD | K. Toi | Desirable |  | Considering | Considering |  |
| MAST | K. McClements | Desirable | Not doing | Considering | Analysis |  |
| SPIRAL | G. Kramer | Desirable |  |  |  |  |
| ASCOT | T. Kurki-Suonio | Desirable |  |  |  |  |
| F3D-OFMC | K. Shinohara | Desirable |  |  |  |  |
| M3D-C1 | N. Ferraro | Desirable |  |  |  |  |

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

**Results for 2014**

In 2014, several devices have contributed to the ITPA EP-6 Joint Experiments (AUG, DIII-D, JET, KSTAR and MAST).

* In AUG, exploratory experiments with rotating RMPs have been carried out to increase the toroidal resolution of FILD measurements. Measured losses are correlated in frequency and phase with the externally applied rotating RMPs in low collisionality and q95 discharges. As collisionality increases, the RMP impact on fast-ion losses decreases.
* In DIII-D, a βN scan combined with n=1 rotating RMPs have been used to investigate the dependence of fast-ion losses on the plasma response to externally applied RMPs. Measured losses strongly depend on βN indicating that the plasma response has to be included when modelling RMP induced fast-ion losses in present and future devices. In n=3 RMP ELM suppressed plasmas with ITER similar shape, a strong impact on fast-ion profiles at ρN>0.7 is observed. Simulations consistent with infra-red observations indicate that most of the losses (85% of lost particles) end in the divertor and are born in the high field side near the edge on passing orbits.
* In JET, first dedicated experiments have been carried out to study the effect of n=1 RMPs on NBI ions and fusion products. A flattening of the neutron profile is observed when the RMPs are applied. Measured losses do not increase in amplitude but change the dominant pitch-angle indicating that, in agreement with ASCOT simulations, most RMP induced fast-losses end in the divertor as the edge field topology changes.
* KSTAR. It is found that beam-ion loss associated with the resonant edge magnetic perturbations clearly depend on the direction of the perturbed magnetic field. The EP loss change during a q95 scan indicates a plasma response to the RMP, and the FILD signal intensity during ELM suppression phase is slightly higher than the case of normal ELMy H-mode under the same q95. Numerical simulations and benchmarking are on-going by using 3-D Lorentz-orbit code.
* MAST.LOCUST/F3D-OFMC simulations of MAST single-null (SND) plasma heated with off-axis NBI indicate a substantial increase in beam power losses due to RMPs with respect to on-axis NBI heated discharges, from <10% to ~50% for n = 3 perturbations at full RMP coil current. The observation of RMP-induced fast ion losses in MAST is complicated by different properties of ELMs/MHD activity in RMP / non-RMP plasmas thus neutron rates are typically used to infer the impact 3D fields has on the fast-ion population. Indeed, in RMP discharges, neutron rates drop relative to non-RMP shots when the applied Icoil > 4.0 kA·t.

**Plans for 2015**

* New experiments in AUG and DIII-D will focus on the effect that the poloidal structure of the externally applied RMPs have on fast-ions. This will be investigated varying the phase between the upper and lower set of RMP coils in low collisionality and q95 discharges.
* In JET, new experiments are planned to complete the exploratory experiments carried out in 2014 to study the effect the EFCC have on NBI ions and fusion products.
* In MAST, more systematic study, involving further simulations and other fast-ion diagnostic data (neutron camera and FIDA) are planned over next few months. A fast-ion loss detector (FILD) is being developed for MAST-U to provide direct measurements of RMP induced fast-ion losses.