# TC-24 Impact of resonant magnetic perturbations on transport and confinement

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| **TG priority:** High | **Start date:** 2014 | **Status:**  On-going | **Personnel exchange:**  No |
| **IO priority:**   | **End date:** 2016 | **Motivation:** Physics Basis for resolving ITER issues |
| **Overall coordination:** | T. Evans, M. Jakubowski | **Modeling:** Y. Liu, ITER: A. Loarte |

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| **Device /****Association** | **Contact****Person** | **2016 TGRequest** | **Activity (from JEX/JA spreadsheet)** |
| **2014** | **2015** | **2016** |
| DIII-D | G. McKee | High priority | Committed  | Analysis |  |
| COMPASS | P. Cahyna | High priority | Inactive | Inactive |  |
| EAST | Y. Sun | High priority | Inactive | Inactive |  |
| HL-2A | Y. Liu | High priority | Inactive | Inactive |  |
| LHD | K. Tanaka | High priority | Analysis  | Analysis |  |
| TJ-II | C. Hidalgo | High priority |  Analysis  | Analysis  |  |
| W7-X | M. Jakubowski | High priority | Inactive | Inactive |  |
| MAST | A. Kirk | Analysis | Committed  | Analysis |  |
| AUG  | W. Suttrop | Desirable | Committed  | Committed |  |
| JET | Y. F. Liang | Desirable | Inactive  | Analysis |  |
| KSTAR | G.-Y. Park | Desirable | Committed  | Committed |  |
| NSTX-U | S. Kaye | Desirable | Analysis  | Analysis |  |

**Purpose:** Develop a predictive understanding of the impact of 3D fields on transport and confinement. The devices proposed for the experiments offer a wide range of plasma types and conditions, i.e. collisionalities, shapes of magnetic equilibrium, spectrum of the perturbation. Common findings will provide insight into generic mechanisms responsible for modifying the transport by external perturbation or 3D topology.

**Results for 2015**

* Dedicated RMP particle transport experiments were carried out on ASDEX-Upgrade and MAST and are planned to be reported in a forthcoming PPCF special issue article.
* Results from joint experiments between DIII-D and LHD on spontaneous bifurcations of the thermal transport across an m,n=2,1 island have recently appeared in Scientific Reports, an open access journal (http://www.nature.com/articles/srep16165).

**Plans for 2016**: Planning for 2016 experiments, along with targeted modeling, to address several high-priority ITER issues is underway. These issues include: 1) Effect of resonant (RMP) and non-resonant (nRMP) perturbations on pedestal and core plasma transport for given torque input for two triangularities, 2) Effect of torque input and electron to ion heating on pedestal and core plasma transport for RMP and nRMP for two triangularities, 3) Effect of edge island formation and RMP versus nRMP on the plasma parameters and/or power required for H-mode access/exit and sustainment (one triangularity) and 4) Demonstrate potential of 3D field perturbations to improve energy confinement in L-mode. A TC-24 subgroup has been formed to address topics 3 and 4, which includes a strong modelling effort. Coordinated experiments within this subgroup will be carried out on EAST, HL-2A, LHD, TJ-II and COMPASS in 2016 and possibly W7-X. The goal is to establish a coherent theoretical, numerical and experimental framework, in combination with the ITPA PEP group activities, in order to resolve these issues. It is desirable to combine topic 1) with PEP-38 as similar experiments in this group are planned on ASDEX-Upgrade and DIII-D.

**Background:** Theory and experiments indicate that changes in the plasma potential and radial electric fields are key ingredient for understanding 3D transport and confinement physics. An increase in the pedestal particle transport in RMP suppressed discharges [Evans, et al., Nature Phys. **2** (2006) 419] is known to be a necessary but not a sufficient condition to stabilize ELMs. This may be an undesirable effect during ELM suppression in ITER. A better understanding of this physics is needed to minimize this effect in ITER.