TC-9 Intrinsic plasma rotation

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| **TG priority:** High | **Start date:** 2006 | **Status:**  On-going | **Personnel exchange:**  Yes |
| **IO priority:** | **End date:** Not fixed | **Motivation:** Physics Basis | |

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| **Device /**  **Association** | **Contact**  **Person** | **TG Request** | **Activity (from JEX/JA spreadsheet)** | | | | |
| **2012** | **2013** | **2014** | **2015** | **2016** |
| C-Mod | J. Rice | Desirable | Committed | Analysis | Analysis | Committed |  |
| DIII-D | W. Solomon | Desirable | Analysis | Not doing | Not doing | Analysis |  |
| AUG | R. McDermott | Desirable | Committed | Committed | Committed | Analysis |  |
| NSTX-U | W. Solomon | Desirable | Analysis | Analysis | Analysis |  |  |
| TCV | B. Duval | Desirable | Committed | Committed | Analysis | Considering |  |
| EAST | Y. Shi | Desirable | Committed | Considering | Considering | Committed |  |
| JET | F. Nave | Desirable | Committed | Considering | Considering | Analysis |  |
| JT-60U | M. Yoshida | Desirable | Analysis | Analysis | Analysis | Analysis |  |
| Tore Supra | C. Fenzi | Desirable | Committed | Analysis | Analysis | Analysis |  |
| KSTAR | Y.S. Na | Desirable | Considering | Committed | Committed |  |  |
| MAST | J. Hillesheim | Desirable | Not doing |  | Analysis |  |  |

**Purpose:** The purpose of these experiments is to document the intrinsic or spontaneous plasma rotation with no external momentum input on a range of devices, so as to establish a scaling to ITER, and to lead to an explanation of the phenomenon.

**Results for 2015**

* The major activity was setting up the database by B. Duval, A.Karpushov and R. McDermott. Several discharges from AUG and TCV have been entered, some initial queries have been made, demonstrating the functionality of the system, and were shown at the Garching meeting.
* Rotation changes were observed in Tore Supra plasmas following density ramps. These had all the characteristics of rotation reversals, including concomitant turbulence changes across the LOC/SOC boundary, but there seemed to be an offset, likely due to the dominance of ripple losses.
* Rotation changes in response to variations of the x-point location have been documented in TCV plasmas.
* The \* dependence of intrinsic rotation has been studied in C-Mod plasmas at both high and low magnetic field to augment the large number of observations at 5.4 T in H- and I-mode discharges.
* The dependence of the rotation direction on the q profile has been examined in C-Mod and Tore Supra plasmas with LHCD. In both devices the rotation is directed counter-current at high plasma current and co-current at low plasma current. Results from many devices can be unified by simply looking at q0. If q0 is below 1 the rotation is counter-current, and co-current for q0 above 1.

**Plans for 2016**

* The main activity will be to populate the new profile database with observations from C-Mod, AUG, TCV, JET and Tore Supra. The target date is the spring ITPA meeting.
* Another activity will be to perform modelling, exploring the role of local gradients and collisionality, and to make comparisons with the Barnes/Parra model (M.Barnes et al., 2013 PRL **111** 055005).
* C-Mod will continue to explore the \* scaling at high magnetic field in I-mode.
* AUG will perform modulation experiments for momentum transport, and will continue studies of edge poloidal rotation, with comparisons to neo-classical theory.
* ICRF Mode Conversion Flow Drive experiments will be performed in C-Mod.
* A new XICS system will be operational for rotation measurements in WEST.

**Background:** Momentum input from neutral beam injection on future devices will be low, so alternative methods for driving rotation (and shear) for suppression of RWMs and turbulence are necessary. One candidate is to rely on the universally observed intrinsic rotation. In order to take advantage of this self-generated flow, the underlying mechanism must be understood, and to help guide the theory, an empirical characterization is necessary. The purpose of these experiments is to document, compare and distill scalings of the magnitude of intrinsic rotation, as well as the complete profiles. The H-mode database will be expanded to include rotation velocity profiles, and updates for the scalar database are solicited from all devices, especially at higher normalized pressure. The L-mode (Ohmic) database will be expanded to include all devices. Parameters of interest are the electron density, electron and ion temperatures, plasma current, magnetic field, working gas and magnetic configuration. Two complementary approaches are being used: (1) Similarity experiments. Discharges with matched shape, collisionality, normalized gyroradius and normalized pressure will be produced and Mach numberswill be compared between the devices. (2) Empirical scaling studies, based on a database of rotation measurements from scans of engineering parameters.