# TC-27 Inward pinch in opaque edge plasmas

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| **TG priority:** Critical | **Start date:** 2015 | **Status:**  On-going | **Personnel exchange:**   |
| **IO priority:**    | **End date:**   | **Motivation:**  |

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| **Device / Association** | **Contact****Person** | **TGRequest** | **Activity (from JEX/JA spreadsheet)** |
| **2015** | **2016** | **2017** | **2018** | **2019** |
| DIII-D  | S. Mordijck | Desirable | Considering |   |   |   |   |
| AUG  |  | Desirable | Committed |   |   |   |   |
| C-Mod | J. Hughes | Desirable | Considering |   |   |   |   |
| JET | T. Tala | Desirable | Committed |   |   |   |   |

**Purpose:** To determine the size and role of the inward pinch at the plasma edge in plasmas with an opaque edge in the buildup of the density profile.

**Results for 2015**

Although no dedicated experiments with an opaque SOL were performed in 2015, JET did perform experiments in which a gas puff modulation was used to study particle transport in the plasma edge in H-mode. Tomographic inversion of D camera data of the divertor region illustrates a strong poloidal dependence of the fueling sources. Edge modeling analysis is ongoing to compare to experimental observations and to be included in the analysis of the particle pinch at the plasma edge. The work also indicates the existence of an inward particle pinch, both in the core (although a large fraction of the peaking in the core is dominated by NBI fueling) and also in the pedestal region, which is a new result of great importance for ITER fuelling. More work and dedicated experiments will be needed to properly separate the role of the pedestal pinch from the role of the higher energy neutrals. This work was presented at the EPS meeting in Lisbon by A. Salmi et al.

**Plans for 2016**

Experimental time on DIII-D and JET has been allocated for 2016. The 2015 experiment on C-Mod was postponed to 2016, due to critical failures in the heating systems. Execution of this experiment on C-Mod will depend on the run time that will be allocated by DOE. SOLPS5 modeling on previous JET experiments was started to address the role of neutral fueling, but the upgrade to the SOLPS-ITER code has slowed down the modeling component. The main priority in early 2016 will be on preparing experiments on JET, DIII-D and C-Mod and getting an initial dataset in which opacity in the SOL is varied and compared to pedestal density parameters.

**Background:** Peaked edge density profiles indicate that there could be an inward pinch in order to build up the density profile. However, currently core fueling through neutral beam injection (NBI) does add to density build up in the core, whilst neutral penetration in present device is such that the effect of a possible edge pinch is barely detectable. ITER will not be able to rely upon core fueling through NB injection, nor neutral penetration, so the existence of a pinch is key to ITER fuelling.

The buildup of edge as well as core density profiles after the L-H transition depends strongly on the current and NBI penetration in JET plasmas. Especially at higher densities, where NBI penetration is poorer, the core density can be hollow and this can persist for multiple energy confinement time scales. Modeling shows, that the build-up of the density following an H-mode transition can be described without the inclusion of an inward particle pinch. On the other hand, experiments using a modulated gas puff, in L- and H-mode in DIII-D (with and without RMPs) have shown the existence of an inward pinch.

In ITER NBI fueling will be limited and it will have to rely on the density building up from the plasma edge. In opaque SOLs, such as on ITER, the ionization profile will be located outside the separatrix. In order for the density to peak, ITER will have to rely on the existence of a turbulent particle pinch, transporting plasma from the SOL and plasma edge inward. Understanding how the anomalous pinch behaves in different plasma conditions, such as collisionality, density, electron versus ion heating is going to be crucial in order to make confident predictions for ITER.

Another aspect is ITER's ability to achieve H-mode in Helium plasmas. Depending on density build up during the L-mode phase of the Helium discharges, ITER might not have enough heating available to reach the L-H power threshold. Part of TC-27 is to investigate the role of edge fueling versus the inward pinch in Helium L-mode plasmas and how this will affect the L-H transition in ITER's Helium campaign as well as the density build-up after the L-H transition.

Original plans for 2015 were to propose experiments on DIII-D and JET to investigate the role of the inward particle pinch versus the role of neutral fueling in a plasma with an opaque edge, using the perturbative gas puff technique as well as edge fueling pellets. If JET or DIII-D will have Helium campaigns, fueling versus inward pinch experiments will be proposed. Analysis of existing experiments using edge modeling codes will continue to assess the role of neutral fueling in determining the edge density profile.