TC-19 Characteristics of I-mode plasmas

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| **TG priority:** High | **Start date:** 2011 | **Status:**  On-going | **Personnel exchange:**  Yes |
| **IO priority:** | **End date:** Not fixed | **Motivation:** Physics Basis | |

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| **Device /**  **Association** | **Contact**  **Person** | **2016 TG Request** | **Activity (from JEX/JA spreadsheet)** | | | | |
| **2012** | **2013** | **2014** | **2015** | **2016** |
| C-Mod | J. Rice | Desirable | Committed | Analysis | Analysis | Committed |  |
| DIII-D | P. Gohil | Desirable | Considering | Considering | Analysis | Analysis |  |
| AUG | F. Ryter | Desirable | Committed | Committed | Committed | Committed |  |
| NSTX-U | R. Maingi | Desirable | Considering | Not doing | Not doing |  |  |
| TCV | B. Duval | Desirable | Considering | Considering | Analysis | Analysis |  |
| EAST | X. Gao | Desirable |  |  |  |  |  |
| JET | H. Weisen | Desirable | Not doing | Not doing | Not doing | Not doing |  |
| KSTAR | Y. Shi | Desirable |  | Considering | Considering |  |  |

**Purpose:** The purpose of these experiments is to document the access conditions, power scaling and general characteristics of I-mode plasmas. In particular, the access power and scaling with target density, plasma current and shape are to be determined and compared with H-mode. Also of interest are the details of the transition dynamics, including turbulence characteristics, of for example the relative phase between density and temperature fluctuations. The edge profile shapes of density, velocity and temperature should be verified.

**Results for 2015**

* Extensive experiments have been performed on C-Mod, with particular emphasis on 8 T operation; this requires D(3He) minority heating. The power threshold for entering I-mode seems to be independent of magnetic field. Coupled with the nearly linear dependence for entering H-mode, this may explain why the operating window is so small on AUG and DIII-D, where operation is around 2 T. In fact the operational window between I- and H-mode is very small on C-Mod at 2.8 T. At 8 T, it was not possible to enter H-mode with the available 5 MW of ICRF power. A regression analysis has been performed on C-Mod data for the energy confinement time in I-mode, and it is found to scale as I.7 B.8 n.0 P-.3. Depending on the major radius scaling (either R1.5 or R2), projections to ITER look promising, with predicted confinement times in the range of 2.5-8 s. A favorable attribute of I-mode is that there isn’t a strong degradation of energy confinement with loss power as is observed H-mode. I-mode has been maintained in the double null configuration, and impurity seeding/detachment studies are being analyzed.
* New results of fluctuation studies in AUG I-modes reveal a weakly coherent mode near 100 kHz, and a low frequency GAM. The WCM has an n=0, m=1 structure, while the turbulence in general exhibits a bursty structure.
* Detailed studies of impurity transport have been undertaken on C-Mod. The impurity transport coefficients are nearly identical to those found in L-mode, that is, anomalously large diffusivity ~0.3 m2/s with no evidence for inward convection. This latter property is due to the lack of an edge density pedestal which is present in H-mode. There seems to be no dependence of impurity confinement on impurity mass as Ca and Mo have identical confinement times.
* Very new I-mode experiments have been performed at KSTAR and analysis is underway.

**Plans for 2016**

* I-mode run time is scheduled for C-Mod, EAST, TCV, NSTX-U and KSTAR.

**Background:** I-mode is an enhanced confinement regime which features H-mode energy confinement (with an edge temperature pedestal) and L-mode particle and impurity confinement (no edge density pedestal). It is primarily obtained with the unfavorable drift direction (X-point away from the ion BxgradB drift direction) and has been demonstrated on ASDEX Upgrade, Alcator C-Mod and DIII-D. I-modes operate in a collisionality regime characteristic of Type I ELMy H-mode, but because they have reduced edge pressure gradient, they are mostly free of ELM activity. Given these favorable confinement properties, and operational access at low collisionality, it is desirable to develop an understanding of this regime and a parametric scaling which can be applied to ITER conditions. On C-Mod, excitation of the WCM (which is associated with I-mode) using a shoelace antenna will be attempted.