IAEA FEC 2014

Contribution ID: **112** Type: **Poster**

Multi-Diagnostic Study of Core Turbulence and Geodesic Acoustic Modes in the TCV Tokamak

Wednesday 15 October 2014 08:30 (4 hours)

TCV is equipped with a suite of diagnostics capable of making fluctuation measurements of several plasma parameters. The suite has been used in a large variety of TCV discharges. Emphasis has been placed on the study of turbulence as a function of plasma shape and in particular of edge triangularity. Correlation ECE (CECE) measurements have shown that the relative electron temperature fluctuation amplitude decreases as edge triangularity goes from positive to negative (+/- 0.34). At the same time tangential phase contrast imaging (TPCI) measurements show an analogous reduction in the density fluctuation component deep into the plasma core (rho ~ 0.3). Local, non-linear, flux tube, gyrokinetic simulations have reproduced the fluctuation reduction in the plasma edge but not in the core (rho < 0.7). The geodesic acoustic mode (GAM) has been identified in TCV discharges through its toroidal symmetry and the linear scaling of its frequency with sound speed. It has been simultaneously detected in radiative temperature, electron density, magnetic field and plasma flow velocity measurements, appearing as a coherent mode in the 20-30kHz range close to the plasma edge. The multiple diagnostic identification of the GAM has allowed its radial location and poloidal distribution and its propagation direction to be determined. The poloidal mode number of its magnetic component is predominantly 2 as predicted by theory. In some cases the GAM no longer appears as a single coherent mode but as a continuum with radially varying frequency. The transition from coherent to continuum nature has been observed in a discharge during the course of a current ramp. Global simulations with the PIC gyrokinetic code ORB5 have been performed to study the GAM characteristics. Results are in good, semi-quantitative agreement with experimental findings. Synthetic diagnostics are being developed to allow comparison of numerical simulations with experimental results. Prototype CECE and TPCI synthetic diagnostics have been developed as post processing modules for use with the GENE code and are planned for the ORB5 code. First comparisons with experimental data will be presented.

Paper Number

EX/P3-57

Country or International Organisation

Switzerland

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Session Classification: Poster 3