Contribution ID: **279** Type: **Poster**

Evidence of thermo-diffusive pinch in particle transport

Friday, 21 October 2016 14:00 (4h 45m)

Here is reported the simulation of density evolution in discharges performed at Frascati Tokamak Upgrade (FTU) where a thermo-diffusion term have been used instead of the particle pinch. In these discharges a sensible density peaking is observed at high density, subsequent the formation of a strong MARFE thermal instability at plasma edge. They have been obtained in an experimental campaign dedicated to density limit studies, in which it has been found that, at high q, the Greenwald density limit can be exceeded, as a consequence of the density profile peaking. The presence of a strong MARFE seems to be the key to get density peaking and raise density above the Greenwald limit. Density profiles have been measured using the FTU scanning interferometer, with 32 independent chords of 1 cm separation. The density profile peaking is preceded by a drop of the edge temperature in a wide external region, caused by the thermal collapse at the edge which led to the MARFE formation. A neutral diffusion code has been used to evaluate neutral particle profiles, which has shown that the source term remains negligible in large part of the radius (up to r/a=0.8) and in particular in the region where the change of density gradient is observed. In such region a sensible variation of the diffusion coefficients must occurs, while using a thermo-diffusive term, there is no need to change diffusion coefficients within the simulation. Boundary (at r/a =0.82) and initial conditions have been taken from experimental density profile. The steepening of density gradient in confinement region is well described by the simulation, hence the whole variation of inward particle flux can be described considering the change in temperature characteristics length. The same simulation has been applied successfully to other discharges with similar phenomenology, and will be applied to other discharges where the density peaking is provoked by other effects, as impurity injection.

Paper Number

EX/P8-24

Country or International Organization

Italy

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Session Classification: Poster 8

Track Classification: EXC - Magnetic Confinement Experiments: Confinement