GYRO Simulations of Turbulently Driven Density Peaking in C-Mod Plasmas

D.R. Mikkelsen, M. Bitter, K.W. Hill, Princeton Plasma Physics Laboratory
M. Greenwald, Y. Podpaly, J.E. Rice, J W. Hughes, Y. Ma, MIT
J. Candy, R.E. Waltz, General Atomics

Experimental results from Alcator C-Mod have confirmed earlier AUG and JET findings that spontaneous peaking of the density profile in H-mode plasmas depends on collisionality. Previously reported nonlinear, 'full-radius' GYRO simulations [1] of low-collisionality, peaked-density H-mode plasmas in C-Mod generated a particle pinch that was produced exclusively by higher-k modes. Nonlinear simulations of AUG low-collisionality, peaked-density H-mode plasmas have a similar character [2], and detailed linear analyses [2,3] suggest that density peaking may be common in low collisionality plasmas. Here we increase the number of ion species in the simulations to determine whether the degree of hydrogenic density peaking has an isotope dependence or is influenced by the presence of impurity ions. The simulations include experimentally relevant levels of boron, and a 50/50 H/D mix. We find that the deuterium density profile is modestly more peaked than hydrogen, the overall density peaking is very similar to pure deuterium simulations, and the impurity has no effect on hydrogenic density peaking. The ion temperature profile is varied in an attempt to align the predicted heat flux to the experimental transport analysis, and we find that the predicted density peaking is very weakly dependent on the total power flow. The novel simulation procedure is very successful in producing robust predictions that are remarkably insensitive to temporal variations in the turbulent heat and particle fluxes. Each hydrogenic species is represented by two ions in each simulation (e.g. two D *and* two H); they differ only by having different density gradients, these offset each other so the total density for each species has the same shape as the electron density. Linear interpolation between the calculated particle fluxes (with R/L_{ni} as the independent variable) is used to estimate the density gradient that would produce no particle flux for each hydrogenic species (as required in steady state C-Mod plasmas), and the resulting R/L_{ni} is integrated to find the predicted density peaking. Studies of the density peaking of impurities are planned.

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