A Model of the Radiatively Improved (RI) Confinement Mode in Tokamaks

P. K. Kaw[*], R Singh[*], A. Rogister[+] and V. Tangri[*]

[*]Institute for Plasma Research , Gandhinagar – 382 428, India

[+]Institute for Plasma Physics Forschungszentrum Juelich, D-52425 Juelich, Germany

Abstract

It is well known from impurity seeding experiments in several limiter tokamaks that the plasma may bifurcate into an improved confinement mode, the so called RI mode. In this mode, the confinement improvement is associated with density and temperature peaking and stronger velocity shear. In this paper we propose a novel model for the RI mode. It is demonstrated that radiative effects from impurities distributed in a poloidally asymmetric manner lead to significant density and temperature perturbations on magnetic surfaces. These, in turn, interact with theta dependent toroidal field variations to produce a mean divergence of the stress tensor driving strong toroidal flows. The resulting enhanced toroidal velocity shear on the outer radiative layers produces a stabilizing effect on the instabilities like the drift resistive ballooning mode, drift trapped electron mode and the ion temperature gradient mode. By an investigation of the turbulent particle flux as a function of the density gradient for various values of the radiation asymmetry parameter, it is shown that the plasma can undergo a bifurcation into a better confined peaked density state.