Abstract

The first measurements of turbulent stresses and flows inside the separatrix of a tokamak H-mode plasma are reported, using a reciprocating multi-tip Langmuir probe at the DIII-D tokamak. A strong co-current rotation layer at the separatrix is found to precede intrinsic rotation development in the core. The measured fluid turbulent stresses transport toroidal momentum outward against the velocity gradient and thus try to sustain the edge layer. However, the inward transport of toroidal momentum leading to co-current core plasma rotation can only be explained by postulating the existence of large kinetic stresses, i.e. stresses originating in velocity space. Constraints from the evolution of both intrinsic and driven rotation profiles require the stresses to be independent of the local velocity and its gradient. The importance of such kinetic stresses is corroborated by the success of a simple orbit loss model, representing a purely kinetic mechanism, in the prediction of features of the edge co-rotation layer.