EX/C3-5Rb · Relationship between Particle and Heat Transport in JT-60U Plasmas with Internal Transport Barrier

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Abstract: Relationship between particle and heat transport in an internal transport barrier (ITB) has been systematically investigated for the first time in reversed shear (RS) and high-β_p ELMy H-mode (weak positive shear) plasmas of JT-60U for understanding of compatibility of improved energy confinement and effective particle control such as exhaust of helium ash and reduction in impurity contamination. In the RS plasma, no helium and carbon accumulation inside the ITB is observed even with highly improved energy confinement. In the high-β_p plasma, both helium and carbon density profiles are flat. As the ion temperature profile changes from parabolic- to box-type, the helium diffusivity decreases by a factor of about 2 as well as the ion thermal diffusivity in the RS plasma. The measured soft X-ray profile is more peaked than that calculated by assuming the same n_{AR} profile as the n_e profile in the Ar injected RS plasma with the box-type profile, suggesting accumulation of Ar inside the ITB. Particle transport is improved with no change of ion temperature in the RS plasma, when density fluctuation is drastically reduced by a pellet injection.

EX/C3-6 · Progress towards Internal Transport Barriers at High Plasma Density Sustained by Pure Electron Heating and Current Drive in the FTU Tokamak

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Abstract: Strong electron Internal Transport Barriers (ITB) are obtained in FTU by the combined injection of Lower Hybrid and Electron Cyclotron RF waves. ITBs occur either during the current plateau or during the ramp up phase, and both in full and partial current drive (CD) regimes. Central electron temperatures $T_{e0} > 11\,\text{keV}$ at central densities close to $0.8 \cdot 10^{20}\text{m}^{-3}$ are sustained for several confinement times. The transport barrier is wider than r/a = 0.4 and slowly expands in time up to r/a = 0.4. It extends over a region where a slightly reversed magnetic shear is established by off-axis LH current drive. The EC power, instead, is used either to benefit from this improved confinement by heating inside the ITB, or to enhance the peripheral LH power deposition and CD with off axis resonance. Despite the fact that the very high T_{e0} reduces the e^- to i^+ energy transfer by 1.4 times during the ITB, the neutron yield is three times larger than in a reference ohmic discharge.

EX/C3-7Ra · Double Transport Barrier Plasmas in Alcator C-Mod

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Abstract: Double transport barrier plasmas comprised of an edge EDA H-mode pedestal and an ITB have been observed in Alcator C-Mod. The ITB can be routinely produced in ICRF heated plasmas by locating the wave resonance off-axis near r/a $\sim$ 0.5, provided the target plasma average density is above $1.4 \times 10^{20}\text{m}^3$, and can develop spontaneously in some Ohmic H-mode discharges. The formation of the barrier appears in conjunction with a decrease or reversal in the central (impurity) toroidal rotation velocity. The ITBs can persist for $\sim$15 energy confinement times, but exhibit a continuous increase of the central electron density, (in the absence of an internal particle source), followed by collapse of the barrier. A significant drop of the core thermal conductivity when the barrier forms is confirmed by modeling. Application of additional on-axis ICRF heating arrests the density and impurity peaking, which occurs along with an increase (co-current) in the core rotation velocity. The density peaking is found to be consistent with an inward neoclassical pinch velocity and a reduced particle diffusivity. Linear growth rate calculations indicate the ITG mode is stabilized in the barrier region.