Abstract for an Invited Paper
for the DPP08 Meeting of
The American Physical Society

Observation of an impurity hole in a plasma with an ion internal transport barrier in the Large Helical Device

KATSUMI IDA, National Institute for Fusion Science

Simultaneous achievement of high ion temperature and low impurity concentration is crucial for the high fusion triple product, because impurities cause dilution of the fueling particle. In the Large Helical Device (LHD), the internal transport barrier (ITB) in the ion temperature transport appears after the onset of negative neutral beam injection (160-180keV beam energy) to the relatively low density hydrogen target plasma sustained by positive neutral beam injection (40keV beam energy), where the electron temperature is comparable to the ion temperature. Since the particle diffusion in the plasma with an ITB is relatively low because of the suppression of turbulence, the sign of the convection, which appears as an off-diagonal term in the transport matrix, becomes important in the ITB plasma. The radial profile of carbon becomes hollow during the ITB phase and can be extremely hollow (denoted as 'impurity hole') and the central carbon density drops to 0.3% of plasma density when the ion temperature gradient becomes large. The transport analysis gives a low diffusion of 0.1-0.2 m^2/s and the outward convection velocity of 2 m/s at the half of minor radius, which is in contrast to the tendency in tokamak plasmas for the impurity density to increase due to an inward convection and low diffusion in the ITB region. This experimental result in LHD contradicts to the neoclassical prediction where the negative electric field and an inward convection are predicted because the ion temperature is much larger than the electron temperature by a factor of two in this ITB plasma. The outward convection of the impurity transport in the ITB plasma is considered to be beneficial for future fusion relevant plasmas.