DPP16-2016-001129

Abstract for an Invited Paper
for the DPP16 Meeting of
the American Physical Society

Observation and Calculation of the ECRH Effect on the Tracer Impurity Accumulation in LHD[1]

NAOKI TAMURA, National Institute for Fusion Science, National Institutes of Natural Sciences

In a magnetic confinement fusion reactor various Z impurities will exist inside the plasma. When the amount of the impurities exceeds the acceptable level by an accumulation, this will lead to impermissible plasma performance degradation due to the radiation losses and plasma dilution. Therefore, it is crucially important to develop effective schemes for controlling the impurities in the core plasma and to understand the underlying physical mechanisms of such schemes. Recent LHD experiments show the ability of ECRH to control the impurity accumulation. Experiments on the LHD have used a tracer-encapsulated solid pellet (TESPEL), which is embedded with vanadium, to introduce the extrinsic and non-recycling impurity directly inside the last-closed flux surface (LCFS) region. Therefore, the confinement time of the vanadium impurity can be directly evaluated from the time history of highly ionized vanadium ion. In cases where the collisionality between the impurity ions and the bulk ion is in the Banana-Plateau regime (but close to the collisional Pfirsch-Schlüter (PS) regime), the impurities in the LHD plasma are strongly accumulated into the core plasma. When the 1.5 MW 154 GHz ECRH is applied for such plasma just after the TESPEL injection, the accumulation of the vanadium ions was almost completely suppressed. This result indicates that applying ECRH changes the direction of the radial vanadium particle flux from the inward to the outward. Although the neoclassical ambipolar radial electric field in stellarators has a stronger impact on the transport, particularly on the impurity transport, than in tokamaks, there is no conclusive data regarding a radial electric field measured with a charge exchange spectroscopy diagnostic to support the view that the change in the radial electric field would be attributed to the outward flow of the vanadium ions in the LHD plasma. In this contribution, the results of ongoing evaluations of the neoclassical (e.g., PENTA/DKES that includes the momentum conservation) and turbulent (e.g., GKV-X) transport will be presented to elucidate their respective roles in 3D toroidal plasmas.

[1]This work is mainly supported by a Grant-in-Aid for Scientific Research (B) (No.15H04234) from JSPS Japan and a budgetary Grant-in-Aid No. ULHH012 from NIFS.