IAEA FEC 201

Contribution ID: **53** Type: **Poster**

Formation of impurity transport barrier in LHD plasmas with hollow density profile

Friday, 21 October 2016 14:00 (4h 45m)

In the Large Helical Device (LHD), the n_e profile can exhibit a peaked, flat or hollow shape. For the purpose of heavy impurity control, it is important to investigate the effect of n_e profile on the impurity transport.
Radial emissions profiles of Fe^16+ through Fe^23+ ions have been simultaneously measured in the Fe L_α array. The total iron density (N_Fe(ρ)) profile is then calculated for peaked and hollow n_e profiles with R_ax=3.6 m and B_t=2.75 T. When the n_e profile is peaked (hollow), the N_Fe also exhibits a peaked (hollow) profile. The N_Fe(ρ=0) at the peaked n_e profile is at least one order of magnitude higher than that at the hollow n_e profile over a wide n_e range. The result strongly suggests the iron transport in the plasma core is entirely different between the two cases.
A one-dimensional impurity transport code is employed to simulate the time-dependent iron density profile. Minimization process of the error between measurement and simulation determines the transport coefficients. The convective velocity (V) is assumed to be proportional to the ion charge q. The iron transport is analyzed without assumption on the radial structure of transport coefficients because the Fe L_α transitions are distributed in a wide radial range.
The diffusion coefficient (D) profile is very similar between peaked and hollow n_e profiles, while the D gradually increases toward the plasma edge from the center. On the other hand, the profile of V averaged among Fe^16+ through Fe^23+, is entirely different. In the peaked n_e profile, the V is inward and increases from the center to the edge. This indicates the impurity accumulation easily occurs with a peaked n_e profile. In the hollow n_e profile, an outward V is obviously observed inside ρ=0.8. Near the edge the V changes from outward to inward where the n_e gradient changes the sign from positive to negative. Due to this quick change in the V profile, the iron ions are pushed back outwards and concentrated near the edge. An impurity transport barrier is thus formed. As a result the large difference in the n_Fe(ρ=0) in the two cases can be well explained.
Since hollow n_e profiles are usually observed in high-temperature and low-collision plasmas with high NBI power input, the present result demonstrates that the control of heavy impurities is possible in LHD by controlling the n_e profile.

Paper Number

EX/P8-5

Country or International Organization

Japan

Primary author: Dr HUANG, Xianli (National Institute for Fusion Science)

Co-authors: Mr ZHANG, Hongming (Graduate University for Advanced Studies); Prof. MURAKAMI, Izumi (National Institute for Fusion Science); Dr GOTO, Motoshi (National Institute for Fusion Science); Prof. MORITA, Shigeru (National Institute for Fusion Science); Dr OISHI, Tetsutarou (National Institute for Fusion Science); Mr LIU, Yang (Graduate University for Advanced Studies)

Presenter: Dr HUANG, Xianli (National Institute for Fusion Science)

Session Classification: Poster 8

Track Classification: EXC - Magnetic Confinement Experiments: Confinement