Contribution ID: **407** Type: **Poster**

Integrated Heat Transport Simulation of High Ion Temperature Plasma of LHD

Thursday, October 16, 2014 2:00 PM (4h 45m)

High ion temperature, T_i, experiments have been performed applying the tangential and perpendicular NBI heating systems in LHD. The high T_i plasma up to 7.3keV has been obtained during the decay phase of the density after rapid increase due to a carbon pellet injection. Simple heat transport analysis of these high T_i plasma has been done but the rapid change of density effect on the NBI heat deposition and the multi-ion species effects on the heat transport is not treated accurately. In order to analyze the transport property of the time evolving plasma, we have to use NBI heat deposition analysis code including the effect of plasma time evolution. Also the plasma contains sufficient impurities due to the He gas puff and C pellet injection and the heat transport simulation should take care the multi-ion species.
In this paper we study the high T_i plasma with C pellet injection of LHD applying the integrated simulation code, TASK3D+GNET-TD. The NBI heat deposition profile of time evolving plasma is evaluated by GNET-TD extending the 5D drift kinetic equation solver GNET. The heat transport of multi-ion species plasma (e, H, He, C) is studied by the integrated transport simulation code, TASK3D. It is found that an achievement of high ion temperature plasma is attributed to the 1) increase of heating power per ion due to the temporal increase of effective charge, 2) reduction of effective neoclassical transport with impurities, 3) reduction of turbulence transport. The reduction of turbulence transport is most significant contribution to achieve the high ion temperature and the reduction of the turbulent transport from the L-mode plasma (normal hydrogen plasma) is evaluated to be a factor aboutfive by using integrated heat transport simulation code.

Paper Number

TH/P6-38

Country or International Organisation

Japan

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Session Classification: Poster 6