## §1. Summary of High-ion-temperature Plasma Experiment in the Large Helical Device

Nagaoka, K., Takahashi, H., Murakami, S. (Kyoto Univ.),
Nakano, H., Takeiri, Y., Osakabe, M.,
Ida, K., Yoshinuma, M.,
Yokoyama, M., Tanaka, K., Fujii, K. (Kyoto Univ.),
Morita, S., Goto, M., Oishi, T., Kubo, S., Seki, R., Ii, T.

Extension of temperature regime of helical plasmas is a key issue for magnetically confined fusion research and has been progressed in the Large Helical Device (LHD). In the 17th LHD experimental campaign (2013), the integration of ion internal transport barrier (ion ITB) and electron ITB have been demonstrated, and the central ion temperature of 6keV and the central electron temperature of 6keV have been achieved, which is a new regime of helical plasmas. In the 18th campaign (2014), we have tried to extend high-temperature regime toward high-$T_i$ regime over our record of $T_{i0}$=8.1keV and toward high-$T_i$ and high-$T_e$ regime over $T_{i0}$=6keV and $T_{e0}$=7keV. In addition, we also perform experiments to investigate isotope/mass effects and impurity effects on ion heat transport.

[High-$T_i$ plasma] The new record of high-$T_i$ regime could not be obtained in the 18th campaign, because of some troubles in NBIs and the total heating power was lower than that in the previous campaign.

[High-Ti and high-Te plasma] New gyrotron with the frequency of 154GHz was installed. The total power of 5.4MW was applicable to the heating power. In addition, the ray tracing code, LHDGauss, was mounted on the TASK-3Da, then the power deposition profile was calculated within half hour after the discharge. These upgrade of ECH system leaded to the extension of parameter of high-$T_i$ and high-$T_e$ plasma toward high-$T_e$ regime, which is shown in Fig. 1.

[Transport dependence on H/He ratio] For the pre-study of isotope effect planed in the D-D experiment, ion and electron heat transport was investigated in high-$T_i$ discharges. Fig. 2 shows the decrease of ion temperature with increase of hydrogen ratio, while electron temperature remains unchanged. The numerical modeling is developing with the upgrade of numerical codes, such as GNET, TASK-3Da.

[Transport dependence on impurity] Nitrogen gas puff was utilized to investigate the ion heat transport on impurity. The high-$T_i$ plasma was produced with nitrogen gas puff. The quantitative measurement of nitrogen was also performed. The quantitative discussion of ion heat transport dependence on impurity will be possible in near future.

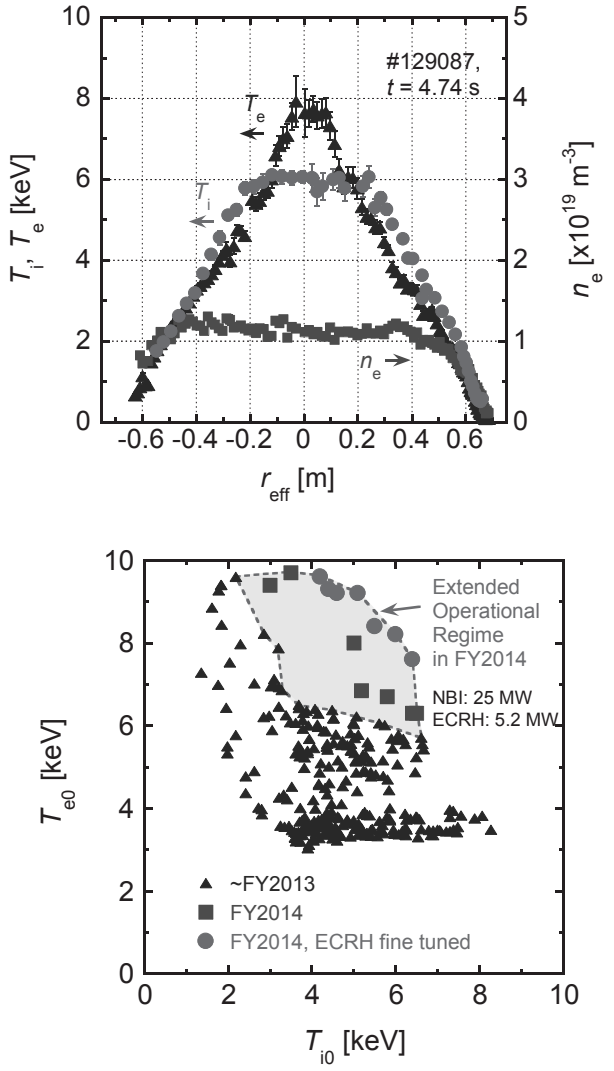


Fig. 1 (upper) Profiles of typical high-$T_i$ and high-$T_e$ plasma. (bottom) The extended parameter regime in the 18th campaign.

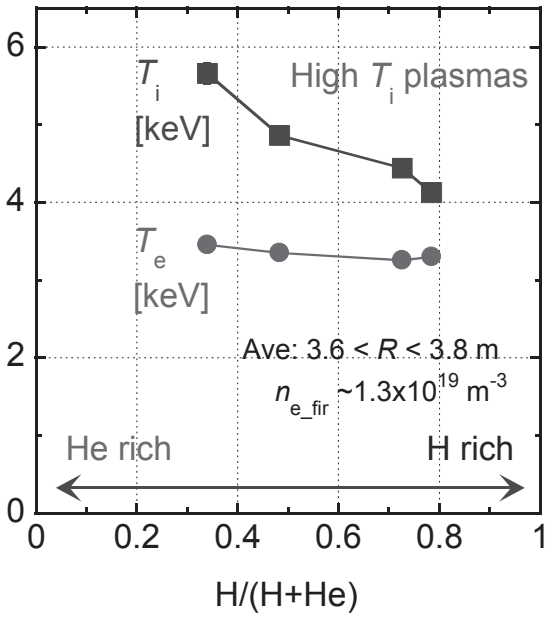


Fig. 2 Ion and electron temperature dependence on hydrogen ion density ratio.