Investigations of isotope effects on fusion experimental plasmas in LHD heliotron

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The Large Helical Device (LHD) is a large-scale superconducting heliotron-type device with a major radius of 3.9 m and a minor radius of 0.65 m, which has been operated since 1998. A pair of l=2 / m=10 continuous helical coils and three pairs of poloidal coils generate the plasma confinement magnetic configuration (Fig. 1). In 2017, deuterium gas was added to working gases in LHD to investigate hydrogen isotope effects on fusion experimental plasmas in LHD. In this presentation, findings and understandings of isotope effects on core and edge plasma properties and plasma-wall interactions obtained in LHD are overviewed.

In many tokamaks, it is well known that a plasma confinement in H-mode is better in deuterium plasmas than that in hydrogen plasmas. On the other hand, no significant effect on plasma confinement was not observed in small scale stellarator/heliotron devices [1]. In the LHD experiment, 10 - 20 % of improvement in the energy confinement time was observed in electron-cyclotron-resonance heated plasmas [2] while no significant improvement of that was observed in neutral beam heated plasmas [3] at present. With regard to the edge and divertor plasmas, a significant increase of carbon from divertor tiles affects plasma properties in deuterium plasmas [4].

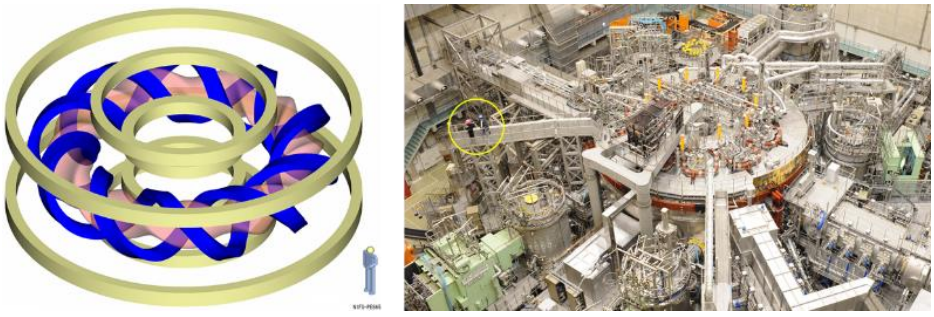

Fig.1. Magnetic coils and plasma in LHD (left), and birds-eye view of LHD

[1] H. Yamada et al. Fusion Sci. Tech. **46** (2004) 82.

[2] H. Yamada et al. IAEA-CN-258/EX/P3-5, IAEA FEC 2018 (2018)

[3] F. Warmer et al. Nucl. Fusion **58** (2018) 106025.

[4] H. Tanaka et al. Nucl. Maters. Energy **19** (2019) 378.