Abstract for an Invited Paper
for the DPP05 Meeting of
The American Physical Society

Thirty Minutes Plasma Sustainment by Real Time Magnetic Axis Swing for Effective Divertor Load Dispersion in the Large Helical Device

TAKASHI MUTOH, National Institute for Fusion Science

Achieving steady-state plasma operation at high plasma temperature is one of the important goals of the world-wide magnetic fusion research. We report here a successful high temperature $\sim$ 2 keV, steady-state plasma sustainment operation on the Large Helical Device (LHD) where the high temperature plasmas were created and maintained for more than 30 minutes with the world record 1.3 GJ of auxiliary heating power injection. By using the magnetic axis swing technique developed on LHD, the heat load to the divertor plates was effectively dispersed. The heat load along the divertor heat exhaust region was largely redistributed and the divertor tile temperatures maintained at acceptable levels by sweeping the magnetic axis position by only 3 cm (R $\sim$ 3.66 - 3.69m) in heliotron configuration and the experimental observation of heat load was well explained by modeling calculation. The LHD steady-stead plasma was mainly heated and sustained by the hydrogen minority heating at Ion cyclotron Range of Frequencies (ICRF) heating while additional Electron Cyclotron (EC) and Neutral Beam Injection (NBI) heating methods were also used. The sustained central ion temperature was around 2 keV or higher, and the line-averaged electron density was around 0.7$\sim$0.8 x 10^{19} m^{-3}. The average input power was 680 kW and the plasma duration was 31 min 45 sec, and the total input energy to the plasma reached 1.3 GJ. An innovative liquid stub tuner was developed enabling the real time antenna coupling control. This successful long operation shows that the heliotron configuration has a high potential as a steady-state fusion reactor.