

Improved confinement and related physics study in Compact Helical System

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Recent experimental results in Compact Helical System (CHS) will be presented focusing on the improved confinement and physics study of electric field and turbulence in helical plasmas. Among various improved confinement modes found in CHS experiments, the edge transport barrier (ETB) formation is an important topic, which we have been studying intensively for these years. The discharges of CHS with ETB have characteristics very similar to H-mode discharges in tokamaks and W7-AS stellarator. We observe a sharp drop of H α emission signal, increase of plasma density together with an increase of local density gradient at the plasma edge, so we call our ETB discharges as H-mode. The power threshold for the transition is clearly observed which is again similar to standard H-mode discharges, i.e., the threshold increases with the density and magnetic field. Unique feature of CHS H-mode is the dependence on the magnetic field configuration. We examined H-mode discharges for the configurations with magnetic axis shift and the magnetic quadrupole control. The transition appeared for a wide range of configurations with the rotational transform at the plasma edge ($i(a)$) below and above unity. There is a general dependence of power threshold: higher power needed for the inward shifted configuration (with lower value of $i(a)$) and lower power for outward shift. The absolute power threshold of CHS H-mode for the outward shifted configuration is very close to the tokamak H-mode with a divertor configuration.

Other topics of confinement studies in CHS will be also presented. We have a unique diagnostic system of two heavy ion beam probes. It is unique in stellarator research and also for all toroidal confinement research including many tokamaks in the world. As well as fruitful result of electric field measurements, that is one of key elements for stellarator physics, this diagnostic measures turbulence in the plasma, which gives essential information for the study of anomalous transport. The zonal flow measurement was one example of experimental observations from this diagnostics.