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Recent research activities on the SUNIST spherical tokamak

Recent research activities of the SUNIST spherical tokamak focused on MHD activities during ramp-up and ramp-down phase. Besides the TAEs and IREs during the ram-down phase, the tearing modes during the ramp-up of plasma current were studied in these two years. The tearing mode instabilities was carefully measured with the magnetic diagnostic system, which includes a 12-channel toroidal probe array, a 14-channel poloidal probe array at the low field side, and a 30-channel radial probe array with high spatial resolution. The mode structure appears to be typically decreasing from m/n = −6/−1 to m/n = −3/−1, where m and n are the poloidal and toroidal mode numbers. A phase reversal layer in the spatial distribution of the magnetic perturbation extracts the approximate position of the magnetic island chain, which gives insight on the evolution of the internal structure of the MHD activity. The tearing modes caused a significant loss of plasma confinement. Statistical results of the MHD response suggest that the deterioration of the plasma confinement is closely related to the phase inversion position of the poloidal magnetic perturbation.

A new fast magnetic valve has been developed for the gas injection research on the SUNIST. The gas puffing in the high field side showed a higher fueling efficiency. Also, with this fast valve, the gas outflow become supersonic molecular beam injection, which can increase the electron density more rapidly than the usual gas puffing method. The influences of fast valve gas injection in the high field side on the MHD activities and runaway current were also observed in the experiments.

Electron Bernstein wave (EBW) emission on SUNIST spherical tokamak was measured on the SUNIST. The emissions was in the frequency of 3 to 6 GHz, corresponding to the fundamental and second harmonic in low toroidal field (0.1 T) discharge. With emission intensities of different frequencies, an electron temperature profile was obtained. These measurements was also used to evaluate spontaneous conditions for EBW heating on the SUNIST which indicated that the spontaneous edge density profile in SUNIST is suitable for O-X-B heating scheme, and needs to be steeper for the X-B heating scheme.

The diagnostics development with high spatial and temporal resolutions on the SUNIST in recent years will also be introduced in this talk. The proposal and design of a new device SUNIST-2 will be brief mentioned but presented in another talk.

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Primary author: Prof. GAO, Zhe (Tsinghua University)

Presenter: Prof. GAO, Zhe (Tsinghua University)