

Self-induced transport barrier in the helium plasma on the tokamak

GOLEM

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The edge transport barriers play an important role in plasma particle and energy confinement and stability in tokamaks. Therefore, the investigation of its formation is of high importance for current and future devices. There are, in general, two major ways of transport barrier formation. First, mostly in tokamaks with limiter configuration, is based on the plasma polarization by the external electric field using biasing electrode.

The second one, mostly in tokamaks with divertor configuration, relies on self-induction due to several physical processes occurring in the plasma. These processes are described in many scientific publications, but still not yet fully understood. It plays a crucial role to achieve H-mode in tokamaks with divertor configuration. In this work, we present a unique observation of the spontaneous formation of the transport barrier in helium discharge on the GOLEM tokamak. The tokamak GOLEM is a small fusion facility with limiter configuration, used primarily for plasma edge and RE studies, with remote control system [1]. The transport barrier forms a steep gradient of the electron temperature associated with a gradually increasing of the radial electric field in the narrow region in the edge plasma. The electron temperature and the plasma potential as well as the electric field are obtained using probe system on shot-to-shot basis with 5 mm of radial resolution and microsecond temporal resolution. The measurements are based on the combined ball-pen and Langmuir probe head. The calibration of ball-pen probe in helium plasma is an integral part of the work. The ball-pen probe [2] is commonly used for the plasma potential measurements at different tokamaks. The combination of the ball-pen and Langmuir probe allows us to measure both the electron temperature and plasma potential simultaneously. The additional diagnostic, double Langmuir rake probe, and the ring of Mirnov coils are also used for further fluctuation analysis of both the floating potential and the magnetic oscillations.

The process of the spontaneous formation of the transport barrier is investigated and the impact on turbulent transport is discussed in the paper. The suppression of low frequencies and decoherence of signals is observed.

References

- [1] Tokamak GOLEM, Czech Technical University in Prague, <http://golem.fjfi.cvut.cz/> [online]
- [2] J. Adamek, et. al; Czechoslovak Journal of Physics volume 54, Article number: C95 (2004)