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The study of edge-localized modes (ELMs) on the spherical Globus-M2 tokamak

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Edge-localized modes (ELMs) [1] are regularly observed on the spherical tokamakGlobus-M2 [2]. The increased pedestal pressure on the upgraded Globus-M2 after the increase of the toroidal magnetic field up to 0.9 T and plasma current up to 0.4 MA destabilizes the PB mode and leads to the ELM crash [3].

The upgraded Thomson scattering (TS) diagnostic system [4] detected a distortion of the temperature and electron density profiles on the plasma edge during ELMs. A method to synchronize the TS measurements with the emergence of an ELM is being developed. A high-speed CMOS visible camera Phantom Miro M110 with wide-angle speed lens was used for ELM spatial structure study with exposures up to 2 μs. The camera is located on a movable mount, which allows measurements both in the midplane and in the divertor region. The narrow structure of the ELMs was examined in the equatorial low-field side SOL with a movable multi-pin Langmuir probe [5] which measured the ion saturation current, floating potential and electron temperature. Multi-frequency Doppler backscattering (DBS) diagnostics [6,7] measured the poloidal plasma rotation velocity and the radial electric field profiles during and between ELM bursts. The turbulence behaviour was also investigated and correlation analysis determined that ELMs expand radially from the inner plasma regions to the edge at a velocity around 8 km/s. Filaments in the form of quasi coherent bursts in the DBS signals during ELMs were also studied. The effect of linear and non-linear filaments on current drive by the waves of the intermediate range (helicons) in Globus-M2 was studied via modelling using ASTRA&FRTC numerical codes.

The diagram for the Globus-M2 equilibrium shows that ELMs have a tendency to be peeling dominated with low toroidal mode numbers n = 4 – 6. On the other hand, the peeling-ballooning unstable region is marginally close to the experimental pedestal parameters. At the same time, the impurity influx had a stabilizing effect on the Globus-M2 edge plasma, which leads to the assumption that kink-peeling harmonics are the most unstable in the described case. DBS measurements confirm the conclusion that the ELMs in Globus-M2 have traits of type-3 and/or type-5 ELMs.

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