diagnostics OF PLASMA Effective charge at the Globus-m2 tokamak

Tukhmeneva E.A., Gusev V.K., Kurskiev G.S., Minaev V.B., Petrov Yu.V., Sakharov N.V., Tolstyakov S.Yu., Tukachinsky A.S., Telnova A.Yu., Bakharev N.N., Shegolev P.B.

Ioffe Physical Technical Institute, Russian Academy of Sciences, Saint Petersburg, Russia, tuxmeneva@gmail.com

The traditional method to determine the effective charge Zeff plasma is based on measuring the bremsstrahlung intensity in spectral intervals that are free of line radiation. Despite the well-known approach, the definition of Zeff requires to take into aacount the features of each plasma device – the elemental composition of impurities, the specific features of plasma configuration.

The present work is the first step in designing of a plasma diagnostic for measuring the effective Zeff charge on the Globus-M2 tokamak.

The development took into account the experience of implementation of such diagnostics on MAST [1], ASDEX Upgrade [2], EAST [3], T-10 [4] tokamaks. The calculations of the expected bremsstrahlung intensity were made for various regimes of the Globus-M2 tokamak. The geometry of the experiment was chosen taking into account the intensity estimates, two diagnostic channels were developed and manufactured with two types of detectors – the photodiode FPU100-2 and APD Hamamatsu S11519-30 for operation in the NIR spectral region. In addition, the design provides the installation of a Hamamatsu H10721 photomultiplier for measurements in the visible region. The sensitivity of the measuring channels was absolutely calibrated using the integrating sphere Labsphere USLR-V12F-NMNN.

The measurement channels of the diagnostic were used for test measurements of Zeff (t) on the Globus-M, Globus-M2, and Tuman-3M tokamaks in different observation geometries and spectral intervals. For discharges on the Globus-M tokamak, the Zeff (t) modeling was performed using the ASTRA transport code, which demonstrated good agreement with the experimental results.

This work was carried out with financial support from RSF No. 17‑72‑20076.

References

1. A. Patel, et al., Zeff profile measurements from bremsstrahlung imaging in the MAST spherical tokamak // Review of scientific instruments, V. 75, N. 11, 2004.
2. H. Meister, et al., Zeff from spectroscopic bremsstrahlung measurements at ASDEX Upgrade and JET // 30th EPS Conference on Contr. Fusion and Plasma Phys., 2003 ECA Vol. 27A, P 1.136
3. Yingjie Chen, et al., Zeff first measurements in EAST with a multi-channel visible bremsstrahlung new system // Fus. Eng. and Des., V. 88, I. 11, 2013, P. 2825–2829.
4. V.A. Krupin et al., Complex of Spectroscopic Diagnostics for Measurements of the Absolute Value and Radial Distribution of the Effective Plasma Charge on the T-10 Tokamak // VANT, Nuclear Fusion Series, 2016, vol. 36, no. 1 [in Russian].