Doppler backscattering systems on the Globus-M2 tokamak

V.V. Bulanin[1], V.K. Gusev[2], V.B. Minaev[2], A.V. Petrov[1], Yu.V. Petrov[2],
A. M. Ponomarenko[1], V.I. Varfolomeev[2], A.Yu. Yashin[1]
1) Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia
E-mail : V.Bulanin@spbstu.ru
2) Ioffe Institute, St. Petersburg, Russia

The Doppler backscattering (DBS) method was successfully utilised for many years on the Globus-M tokamak. The diagnostics in the form of a single-frequency or four-frequency dual homodyne system was used mainly for the study of zonal flows, filaments and Alfvén modes [1]. These phenomena need to be studied both on the periphery and in the core region of the discharge in a tokamak. That is why two multifrequency DBS systems were installed on the upgraded Globus-M2 tokamak. The first four-frequency system with dual homodyne detection was already used on the Globus-M tokamak and described in detail [2]. The probing frequencies are 20, 29, 39 and 48 GHz. The system is located in the lower hemisphere. The microwave circuit of the second system is similar to the one proposed and successfully used in the DIII-D tokamak [3]. The non-linear transmission line was adapted to generate probing signals at six frequencies 50, 55, 60, 65, 70 and 75 GHz. The new six-frequency DBS system was installed in the equatorial plane of the tokamak. In general, the range of probing frequencies corresponds to the region of critical plasma densities from $5 \cdot 10^{18}$ to $7 \cdot 10^{19}$ m^{-3} at normal incidence.

The pyramidal horn antennas were located inside the vacuum vessel. A special cardan-like rotator outside the camera was applied to tilt antennas in the toroidal and poloidal directions at angles of 0°–8° and 0°–15°. Polarization of the electric field in the antenna mouths corresponded to O-mode propagation.

A previously developed code [4] was applied to simulate 3D raytracing for all frequency channels. Calculations were carried out for different angles of incidence and for different electron density distributions in order to investigate the possibilities of the implementation of radial and poloidal correlation Doppler reflectometry. Some examples of the DBS system application for investigation of plasma fluctuation spectra in the Globus-M2 tokamak are presented.

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References

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