Application of Doppler backscattering for Alfvén mode investigation on the Globus-M tokamak

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The Doppler backscattering method (DBS) was first employed as a tool for the investigation of Alfvén modes in the inner regions of a tokamak. The experiments were carried out on the spherical tokamak Globus-M in conditions where previously the toroidal Alfvén eigenmodes (TAE) were recorded using a Mirnov probe array [1]. The version of multifrequency DBS diagnostics was used to record simultaneously microwave backscattering on four major radii. Quadrature detection multifrequency scheme and the specifics of the use of the DBS method on the spherical tokamak under a large pitch angle and magnetic shear are described in detail in Ref. [2]. The cut-off positions of incident microwave radiation covered a range of normalized small radius from $\rho = 0.5$ to 0.75. The experiments were carried out in the deuterium plasma on Globus-M with NBI heating under the following discharge parameters: $I_p = 250$ kA, $n_e < 5\times10^{19}$ m^{-3}, and $B_T = 0.5$ T. The Alfvén modes were manifested as oscillations of the poloidal plasma velocity, which was determined by the DBS diagnostics. The spectra of the velocity oscillations reproduce the magnetic-field fluctuation's spectra with great accuracy. The most probable reason for the occurrence of the velocity oscillations is the ExB drift in the alternating electric field of the Alfvén wave. Based on this assumption, the absolute amplitudes of the radial electric field and the magnetic field of the Alfvén modes were estimated in the region of their existence. The multi-frequency DBS approach has made it possible to determine the areas of the development of Alfvén oscillations with different mode numbers. The data obtained in the experiment were used to identify the Alfvén modes in the Globus-M tokamak [3].

References:

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