NUMERICAL MODELING OF GAM-INITIATED LH-TRANSITION IN TUMAN-3M TOKAMAK

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Geodesic acoustic mode (GAM) is a specific mode of low-frequency radial electric field and density oscillations in toroidal plasma. GAM do not participate in radial transport directly, although create strong inhomogenity of radial electric field and transverse rotation velocity (so called «shear»), and thus affect anomalous transport through control of turbulence level. Unlike in case of quasi-stationary radial electric field, GAM‑induced shear of Er is not constant in time, therefore possibility of LH-transition initiation in this case is not obvious and is to be studied.

The following situation was observed in TUMAN-3M tokamak: GAM oscillations were detected before LH-transition by means of HIBP [1] and Doppler reflectometry [2]. No oscillations were detected after transition. It is not clear if GAM oscillations are a trigger, which initiates LH-transition, or GAM hinder the transition.

Numerical modeling of density profile evolution (for geometry and basic plasma parameters of TUMAN-3M tokamak) with Er-shear-dependent diffusion coefficent D=k().D0(r) shows possibility of LH-transition, initiated by a space- and time-localized GAM burst. Transition is possible if GAM parameters, such as frequency, amplitude, radial wavelength, are within certain limits. Those limits are related with each other and also depend on plasma parameters, primarily ion temperature. If GAM parameters are outside those limits (e.g. GAM amplitude is below the relevant threshold value), transition to self-sustaining H-mode does not occur, and after decay of GAM burst plasma returns to initial L-mode state.

Comparison of modeling results with experimental observation of GAM before LH-transition in TUMAN-3M tokamak shows that experimental GAM parameters are within range of parameters, in which GAM-initiated LH-transition is possible.

References

1. L.G. Askinazi et al, Evolution of GAM oscillations in a shot with ohmic H-mode in TUMAN-3M tokamak, JTP Letters 38, 6 (2012)
2. V.V. Bulanin et al, GAM observation in the TUMAN-3M tokamak using Doppler Reflectometry, 40th EPS Conf. on Plasma Phys, Helsinki, 2013