Use Of Intermittent Burst Temporal Characteristics For Investigation Of Plasma Turbulent Transport In Tokamaks

Irakli S. Nanobashvili[1,2]
[1]*Andronikashvili Institute of Physics of the Ivane Javakhishvili Tbilisi State University, Tamarashvili str. 6, 0177 Tbilisi, Georgia*
[2]*Institute of Theoretical Physics, Ilia State University, Kakutsa Cholokashvili ave. 3/5, 0162 Tbilisi, Georgia*

Investigation of tokamak plasma turbulent transport is crucial issue of fusion research. Plasma transport is bursty and intermittent. For determination of its physical nature investigation of plasma density fluctuations recorded by Langmuir probes is important. We proposed new method for fluctuation analysis. Initially large amplitude positive fluctuations – bursts – of plasma density are selected using threshold method. Then burst temporal characteristics – burst rate, inter-burst time and burst duration are calculated. Study of their radial dependence allows deeper understanding of turbulent transport and coherent structure dynamics in fusion plasma.

We observed increase of burst rate and decrease of burst duration during biasing on the CASTOR tokamak [1]. During biasing non-uniform radial electric field is generated, which causes sheared poloidal rotation of plasma. Sheared poloidal rotation splits coherent turbulent structures (which are responsible for appearance of density bursts) into smaller ones and moves them faster poloidally (compared to poloidal rotation speed in ohmic regime). As a result Langmuir probe detects more bursts and burst rate increases. Since we have smaller structures during biasing which move faster, they need less time to cross the probe and burst duration decreases. Thus, the new method allowed direct experimental demonstration that electrode biasing splits coherent structures into smaller ones thereby reducing plasma turbulent transport [1].

The new method allowed to find on the TEXTOR tokamak that modifications caused by electrode biasing and some regimes of dynamic ergodic divertor (DED) are quite close – burst rate increases and burst duration decreases [2,3]. The reason is that during DED open stochastic magnetic field lines appear and radial magnetic connection between edge plasma and wall is created. Electrons move faster than ions along radial field lines and radial electric field is modified. In some DED regimes the modified radial electric field affects coherent structures in the same way as during biasing. Thus, after detailed investigations certain regimes of DED can be used as "contactless biasing" in next generation tokamaks.

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