Studies of the nonthermal electrons in high density plasma in the T-10 tokamak

P.V.Savrukhin, A.V.Sushkov

Russian Research Centre "Kurchatov Institute", 123182, Moscow, Russia

Processes of generation and loss of nonthermal electrons in high density plasma are analysed in the T-10 tokamak. Experiments have indicated that generation of the primary population of the nonthermal electron beams (50-100 keV) can be connected with sawtooth crashes at the quasi-stationary stage of discharge prior to the disruption. The primary beam population can be subsequently amplified during and after the energy quench at the major disruption and can gain energies up to 3MeV. Experiments have indicated that the primary beams are often characterised by narrow localisation around magnetic surfaces with rational values of the safety factor ($q=1,2$). Such localisation of the beams can be connected with strong electric fields induced due to reconnection of the magnetic field lines during growth of the large-scale MHD perturbations. Analysis indicated, that while density of the nonthermal electrons induced during magnetic reconnection is two orders of magnitude smaller than the equilibrium plasma density, they can substitute considerable fraction of the plasma current around the rational q surfaces and can lead to growth of the runaway avalanches during major disruption. Present paper represents detailed analysis of spatial localisation and temporal evolution of x-ray burst connected with the electron beams prior to and during density limit disruption and evaluate role of the primary electron beams in intensive hard x-ray spikes in post-disruptive plasma in the T-10 tokamak. The x-ray intensity is identified using 2D array of CdTe detectors and multi-wire gas detectors with orthogonal view of the plasma column and in-vessel CdTe detectors with tangential view of the plasma column. Results of the experiments are compared with numerical modelling of the nonthermal electron generation during reconnection of the magnetic field lines. Analysis indicated that generation of nonthermal elections depends critically on rate of the reconnection and amplitude of the MHD perturbations. Possible mechanisms of the nonthermal electrons losses during procession of the beams in the toroidal magnetic filed with ripples are considered in the analysis.

E-mail: psavrukhin@nfi.kiae.ru

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