runaway ELECTRONS GENERATION during INITIAL STAGE OF THE DISCHARGE IN THE T-10 TOKAMAK

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The formation of runaway electron beams is one of the features of the operation of plasma magnetic confinement devices such as tokamak and is associated with the presence of strong electric fields. The studies carried out on the T-10 tokamak show that the electron energy in the beam can reach 10 MeV, and the heat flux density is 3 GW / m2 [1]. The evolution of runaway electrons during breakdown can determine the behavior of the initial stage of discharge [2]. The runaway electrons formed during the breakdown continue to exist also in the quasi-stationary stage of the discharge. At the same time, their interaction with the limiter can cause erosion of its surface. Runaway electrons at a quasi-stationary stage can be initiators of the onset of plasma oscillations and instabilities [3].

In this paper we study the formation of high-energy electrons in a strong longitudinal magnetic field at the initial stage of a plasma discharge in a tokamak. The investigations are primarily connected with the need to explain the influence of accelerated electrons formed at the initial stage of the discharge in a tokamak on the plasma parameters during the entire discharge pulse. The formation of high-energy electrons in the initial stage of discharge in a tokamak, as a rule, is registered by traditional monitor diagnostic systems (hard x-ray radiation monitor). However, such monitor diagnostics do not allow detailed studies of the parameters of accelerated electrons. During the research, detectors of superthermal (50 keV-1 MeV) and hard x-ray (500 keV - 10 MeV) radiation are used, operating both in the current and in the photon counting mode. Measurements in the photon counting mode make it possible to determine the energy spectrum of X-ray radiation and on its basis to estimate the electron energy in the beam. According to measurements in the current mode, with the help of a movable invessel detector with a high spatial resolution (up to 15 mm), the origin and trajectory of the beam are determined. Joint measurements of X-ray radiation using a standard NaI hard X-ray spectrometer and an invessel CdTe detector made it possible to clarify the factors affecting the formation of accelerated electrons in the T-10 tokamak.

The report gives the results of measurements of X-ray spectra in a T10 tokamak in plasma discharges with various parameters (plasma density, impurity concentration, plasma temperature, longitudinal electric fields). On the basis of these measurements, the energy of runaway electrons and their localization at the initial stage of the discharge was determined. The effect of external resonant magnetic fields and microwave heating on the beams of accelerated electrons at the initial stage of the discharge

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