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Runaway Electrons Studies with Hard X-Ray and Microwave Diagnostics in the FT-2 Low-Hybrid Current Drive Discharges

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Analysis of the super-thermal and runaway electrons behavior in ohmic and low-hybrid current drive FT-2 tokamak ($R = 0.55m, a = 0.08m, B_T\ 3T, I_pl = 32kA, \langle n \rangle = 1.9 \times 10^{19} m^{-3}, f_0 = 920Hz$) plasmas has been carried out using information obtained from measurements of hard X-ray spectra and non-thermal microwave synchrotron radiation intensity in the frequency range (53 ÷ 78) GHz [1]. A gamma-ray spectrometer developed for gamma-ray diagnostics of ITER (Nuclear Facility INB-174) and based on LaBr_3(Ce) scintillator has been used in measurements of hard X-ray emission (E > 0.1MeV) generated by runaway electrons. An advanced digital processing algorithm of the detector signal recorded with high sampling rate has provided a pulse height analysis at rates exceeding 10ˆ7 1/s. A spectrum deconvolution code DeGaSum has been used for reconstruction of the energy distribution of runaway electrons escaping from the plasma and interacting with materials of the FT-2 limiter in the vacuum vessel [2]. The developed digital signal processing technique for LaBr_3(Ce) spectrometer has allowed studying the evolution of runaways energy distribution in the FT-2 plasma discharges with time resolution of 1ms. Super-thermal electrons accelerated up to 2 MeV by the LH waves at the high-frequency pumping of the plasma with low density $\langle n_e \rangle \sim 2 \times 10^{13} cm^{-3}$ and then up to 6 MeV by vortex electric field have been found. A correlation between the hard X-ray and synchrotron radiations as well as a role of MHD activity is discussed. Analysis of the runaway electron beam generation and evolution of their energy distribution in FT-2 plasmas has been presented in the report.
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1. V.V. Rozhdestvensky, et al., Energy Environ. Eng. 3(3): 42-49, (2015)
2. A.E. Shevelev, et al., Nucl. Fusion 53 (2013) 123004

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