Revealing GHz Range Plasma Waves Driven by Kinetic Instabilities in Relativistic Electrons Scenarios

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During the last years a significant fraction of the experiments carried out at the Frascati Tokamak Upgrade (FTU) device has been dedicated to study the generation and control of electrons [1] that, under certain conditions, can be accelerated becoming relativistic (runaway) particles with high energies, tipically 6-30 MeV in FTU. Due to their high energy density, runaways beams formed during a disruption can cause deep melting of the vessel in case of beam impacts: this is one of the major concern for new generation tokamaks as ITER [2]. In this scenario, runaway driven modes, as whistler waves recently measured on DIII-D [3], are being considered as a new possible approach to influence the generation of runaway electrons and also to partially mitigate them promptly acting on the generation phase. In 2019 an experimental campaign has been performed at FTU, aimed at investigating the spectral content of radiation originating from plasma oscillation modes in a resolved frequency band between ~300 MHz and 3 GHz. The measurement system consists of two kinds of antennas, alternately installed, and a digitizer for signal acquisition and direct Fourier transformation. A variety of emissions, diversified for spectral features and trends over time, have been measured during different phases of discharges dominated by runaway electrons. Time behaviour is typically intermittent, with intense and rapid bursts on top of a slowly varying background level. Additionally, dramatic changes are found after pellet injection: burst of emission disappear and the background amplitude reduces to the noise level as measured in absence of plasma, which may be suggesting of two different regimes of RE dynamics characterized by different levels of plasma collisionality. A detailed analysis of the dynamics of these observations will be reported soon in a dedicate work [4]. In this paper, a first survey of the different observations attained in FTU during the start-up, post-disruption and quiescent phase scenarios is presented.

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