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High Frequency Magnetic Oscillations in the TUMAN-3M Ohmically Heated Plasmas

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Bursts of high frequency oscillations have been found in Ohmically heated plasmas in the TUMAN-3M using magnetic probes sited inside vacuum vessel. Typical frequencies of the oscillations are within 0.8-1.8 MHz range. It was found that the frequency of the oscillations followed the dependence of Alfven velocity on toroidal magnetic field and density. This dependence allowed identifying the oscillations as Alfven waves (AW). The observation is of interest since AWs are usually driven by energetic ions produced by strong auxiliary heating and thus are unexpected in Ohmic regime.
In the recent experiments isotope dependence of frequency measured in H and D plasmas has proved the Alfven nature of the oscillations. Ratio of the oscillation frequency to Alfven velocity is approximately constant in both working gases and at all velocities.
In many cases bursts of AW oscillations are strongly linked to moments of magnetic reconnections arising due to sawtooth crashes or strong MHD events. Duration of bursts is typically in the range of 0.1-0.2 ms. The oscillations are quenched shortly after reconnection phases. Excitation of these AWs in Ohmic plasma without energetic ions could be understood in frames of the model of percussive magnetic perturbations arising due to reconnection events.
Besides the bursting modes, the patches of quasi-continuous oscillations were detected. The oscillations start 0.1-0.2 ms after reconnection event and persist 0.3-0.8 ms until next reconnection. Their spectra are by an order of magnitude narrower than in bursting cases: 20-40 kHz compared to 200-400 kHz. Coexistence of two quasi-continuous modes with different frequencies should be noticed. Frequency difference of these modes is up to 350 kHz. Trigger mechanism of quasi-continuous mode excitation is not evident and should be further analyzed. Energetic ions accelerated up to Alfven velocity by electric field produced during reconnection process are candidate driver. Besides the energetic ions, runaway or subthermal electrons could be considered as a driver of the oscillations. Possible driving mechanism is the resonance interaction with precessional drift frequency of energetic particles or with diamagnetic drift frequency. Observation of correlation between quasi-continuous mode amplitude and amount of runaway electrons in TUMAN-3M plasma supports the hypothesis.

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