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EX/P4-34: Fast-scale Magnetic Perturbations and Onset of the Energy Quench during Disruption Instability in the T-10 tokamak

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Avoidance of the plasma disruptions is an ultimate goal of a reliable future thermonuclear reactor. Present studies in the T-10 tokamak are clarifying trigger conditions of the fast transition to energy quench from moderate growth of the MHD perturbations at the initial stage of the disruption. New magnetic probe system is installed on the T-10 tokamak to investigate fast-scale magnetic perturbations (f up to 2 MHz). The system is based on vertical and horizontal magnetic probes made by nickel wire in glass enamel isolation (effective area 20 - 250 cm2) separated from the support structures by ceramic spacers (5-10 mm). The probe system is mounted on the top of movable rode allowing positioning along vertical axis close to the plasma boundary at the low field side of the torus. Additional positioning system allows rotation of the probes around the vertical axis on pulse to pulse basis. The probes are directly connected to the ADC module (acquisition rate 60MHz) through short (˜ 4 m) coaxial cables. The system allowed identification of the fast-scale magnetic oscillations (0.2 –0.5 MHz) during energy quench phase of the disruption instability in plasma with high density. Amplitude of the fast-scale magnetic oscillations decays with distance from the plasma boundary 2-10 times faster than one of the standard magnetohydrodynamic (MHD) modes. The fast-scale magnetic oscillations are observed sometimes simultaneously with bursts of the nonthermal (E ˜ 50 –150 keV) x-ray radiation. This could indicate indirectly connection of the oscillations with nonthermal electrons generated during initial stage of the disruption. Analysis indicated that the oscillations could be connected with spark effect initiated in the plasma core in presence of the large-scale MHD modes. While mechanism of the oscillations is still not clear at the moment they can be used as trigger of the disruption feedback stabilization system. The trigger is used in the T-10 experiments with quasi-stable plasma recovery by ECRH after initial minor disruption.
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