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HIGH-FREQUENCY MOVABLE MAGNETIC PROBES ON T-15MD TOKAMAK *)

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Magnetic probes are widely used in experiments with high-temperature plasma in tokamaks to study MHD perturbations, analyze non-stationary plasma flows and plasma turbulence. The T-15MD tokamak is equipped with full-scale complex of magnetic probes [1]. Magnetic probes consist of inductive coils made of mineral-insulated cable in thin-walled steel tube. The probes are located under graphite first wall directly on the inner surface of vacuum chamber. This design and location of magnetic probes does not allow reliable measurements of magnetic field perturbations in frequency range above 300 kHz, which limits the possibilities of plasma physics studies. To identify fast-scale electromagnetic field perturbations localized in peripheral plasma regions, it is necessary to use magnetic probes located directly at the plasma discharge boundary and briefly moved to the peripheral plasma regions.

Recent experiments on the T-10 tokamak [2] have shown a possible correlation between fast-scale (0.2-1.5 MHz) electromagnetic field oscillations in peripheral plasma regions and appearance of arc discharges on the in-vessel elements of tokamak. Measurements of spatial localization and temporal evolution of fast-scale electromagnetic oscillations have confirmed the connection between arc discharges formation at the initial stage of disruption instability at high density with the transition from a series of minor (thermal) quenches to major disruption with current collapse. Monitoring of arc discharges at the plasma periphery and associated fast-scale magnetic field oscillations could provide an important trigger for the disruption mitigation systems in future tokamaks.

This report presents a design of high-frequency movable magnetic probes and Langmuir probes for registration of fast-scale electromagnetic field perturbations in peripheral plasma regions in the frequency range up to 2 MHz.

The high-frequency movable magnetic probe on T-15MD tokamak consists of electromagnetic field and current detecting blocks, a positioning system, a vacuum pumping system, a power supply system, a control and data acquisition system. The fast-positioning system based on linear actuator allows short-term (up to 100 ms) movements (up to 100 mm) of detecting block. Magnetic probes consist of a set of three-component coils (3-7 coils) attached inside a shielding housing made of high-vacuum ceramics and graphite plates. The design makes it possible to change the size and location of the coils depending on the experiment requirements. The system of three Langmuir probes measures electric fields and currents on probe. Bunch of needle electrodes with a potential supply of up to 500V are used to initiate arc discharges.

References

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