Radially Scanning Magnetic Probes to Study Local Helicity Injection Dynamics

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To study Local Helicity Injection (LHI) dynamics and current drive, a new insertable $\dot{B}$ magnetic probe was deployed on the Pegasus spherical tokamak. The Magnetic Radial Array (MrA) probe consists of an array of 15 pickup coils ($\sim 5 \times 8$ mm each) that measure $B\dot{}\_z(R)$ over a 15 cm linear extent. The coils consist of traces embedded in a printed circuit board (PCB), with twisted-pair wires bringing the signal off the PCB to reduce noise. Three different coil designs are utilized to balance frequency response and coil sensitivity. Helmholtz coil measurements confirm bandwidth of $\lesssim$3.5 MHz and sensitives of $0.18/0.35/0.96$ mV T^(-1) s. The probe uses the carbon armor and vacuum assembly from an existing probe. MrA probe measurements during LHI show significant magnetic activity at ~600 kHz that is localized to the plasma edge. To complement this high-speed $B\dot{}$ array, a lower-bandwidth (≤ 40 kHz) $\boldsymbol{B}(R)$ probe array is being developed. It utilizes ratiometric Hall effect sensors (with built-in amplifiers and compensators) that are mounted in a 3D printed form. This probe will provide measurements of field strength ($|\boldsymbol{B}| \leq 120$ mT) and direction at 10 spatial points ($\Delta R = 1.5$ cm), to support studies of equilibrium field structure and current dynamics.

Work supported by US DOE grant DE-FG02-96ER54375.