

Swinging Reciprocating Mach Probes for the High Field Side Scrape-Off Layer in DIII-D

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A new set of in-situ reciprocating Mach probes are being deployed on the DIII-D centerpost for the 2012 experimental campaign. The swing probes give extensive coverage and detailed parallel flow measurements of the scrape-off layer on the high-field side of DIII-D even though the entire assembly is confined to a 4 cm space underneath the centerpost tiles. This design is unique in that the probe swings vertically through the edge plasma, taking measurements along a 180 degree arc with a 20 cm radius. The motion is powered by actuator coils that interact with the internal magnetic field. The position and velocity of the probes are determined from the back-EMF on the actuator coils as they rotate with respect to the magnetic field. Two electrodes maintain a Mach-pair orientation throughout the swing and provide measurements of saturation current, electron temperature, and parallel flow speeds up to the separatrix. The vertical sweep necessitates the use of a specialized gearbox to transmit the torque from a pair of counter-rotating actuator coils. The probe arm is armored with a stack of pyrolytic graphite washers that are insulated from one another and from the interior support tube with alumina coatings. This insulation prevents currents from flowing along the probe arms which protects them from disruptions. The swing probes should provide invaluable measurements on the critically under-diagnosed high-field side of the DIII-D scrape-off layer.

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