

Langmuir Probe Measurements of SOL Conditions in LHW Driven Plasma on TST-2

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At the University of Tokyo's TST-2 group, research is focused on non-inductive methods of plasma start-up, mainly using Lower Hybrid Waves (LHW). Non-inductive current drive is critical to removing the central solenoid and improving the aspect ratio of future spherical tokamak devices. It has previously been shown that LHW can propagate in Scrape-off Layer (SOL) plasma for significant periods of time^[1]. Further research on SOL propagation may lead to insight on possible sources of heating power loss.

To better understand LHW behaviour in SOL plasma, a more comprehensive density profile of SOL plasma is needed. Langmuir probes are a well-developed method of direct measurement of plasma conditions and make an attractive option for use in the SOL. Langmuir probes have previously been used on TST-2 to measure plasma conditions near its Capacitively Coupled Combine (CCC) antennae limiters^[2]. Measurements from currently installed Langmuir probes were used to inform the design of a new set of Langmuir probes which will be used to gain a full density profile of SOL plasma in TST-2.

The newly designed Langmuir probes for TST-2 have a Mach probe-like geometry, and are expected to allow for analysis of electron motion in the SOL^[3]. By measuring the difference in density between each side of the limiter, the flow velocity of plasma is expected to be obtained.

In future work, this new design will be refined and installed in multiple locations to gain a full density profile of SOL plasma. In addition, measurements of plasma flow in the SOL may give more information on unintended heating occurring in SOL plasma.

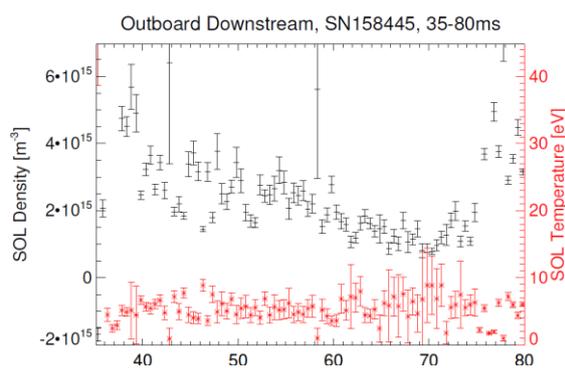


Figure 1: Measurement of SOL density and temperature using a Langmuir Probe previously installed on the Downstream limiter of the Outboard CCC antenna in TST-2.

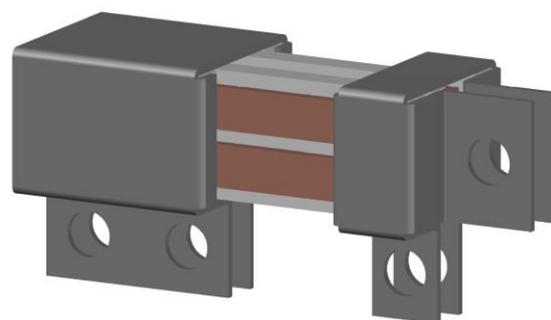


Figure 2: Conceptual rendering of new Langmuir Probe design.

[1] N. Tsujii, *et al.*, *Nucl. Fusion* **57**, 126032 (2017)

[2] T. Shinya, *et al.*, *Nucl. Fusion* **57**, 036006 (2017)

[3] I. H. Hutchinson, *Principles of Plasma Diagnostics*, Cambridge University Press (2002)