

Edge Current Density Profile Measurement Using an Array of Miniature Magnetic Probes in ADITYA-U Tokamak

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Current distribution inside the tokamak needs to be known for understanding of magnetohydrodynamic (MHD) stability and transport. However, the measurement of radial profile of current density is not easy. The external magnetic measurements yield only the plasma shape and global current profile parameters such as β_p and I_p in tokamaks. The radial current density profile is reconstructed using simulations codes such as EFIT incorporating the external magnetic measurements and kinetic profile measurements.

The radial profile of current density in the edge and scrape-off-layer (SOL) is measured for ADITYA-U tokamak using a set of miniature magnetic probes which are inserted inside the last closed flux surface (LCFS). These magnetic probes are designed, fabricated, calibrated and installed in ADITYA-U tokamak, a medium sized air core tokamak with a major radius of 0.75 m and a minor radius of 0.25 m. These coils can be translated along the radial direction and rotated along the axis using a multi-motion feedthrough. The linear motion provides the radial profile whereas the rotational motion provides the angular profile of the current density. These miniature coils are housed inside a ceramic assembly for thermal and electrical insulation from the plasma. The coils are adequately calibrated for the frequency response using a test setup before inserting into the tokamak. The current density profile in the edge and SOL region of ADITYA-U tokamak has been successfully measured. The results obtained from the probes will be corroborated by those obtained from an array of miniature Rogowski coils planned to be inserted inside the LCFS. Further, the results are justified by comparison with the measurement of plasma position using a pair of Sine-Cosine Rogowski coils installed in tokamak. The measured profile matches reasonably well with that reconstructed using EFIT code. After thoroughly establishing the measurements, the changes in current density profile in the edge and SOL region due to externally applied radial electric field with biased electrode and during multiple periodic gas puffing have been studied. The details of probe installation and operation along with current density profile modification due to radial electric field application and multiple periodic gas puff application will be presented in this paper.

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