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The Scrape-off Layer plasma transport physics simulation activity for Indian tokamaks Aditya and SST-1

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The computational modelling activity of plasma transport in the Scrape-off Layer (SOL) region of Indian tokamaks Aditya and SST-1 has explored a range of aspects of SOL plasma transport in both the devices. While 2-dimensional computations using SOLPS have predictively addressed aspects of the phase-I of divertor plasma operation of the tokamak SST-1, complete 3-dimensional EMC3-EIRENE computer simulations are applied to the 3D SOL plasma transport in tokamak Aditya operating for over last three decades. The Aditya studies are extended to predict operation scenario of its upgrade version and draw conclusions with respect to experience of SOL physics in its original setup.

The phase-I divertor operation scenario of the tokamak SST-1 examined by SOLPS suit of codes recovers access to sheath- and conduction-limited divertor regimes where a transition could be achieved in the edge density scan, affected by the gas puff intensity, beyond 1.5×10^{19} m^{-3}. A need is indicated to optimize the operating scenario with tolerable target heat loads and low enough density for an effective LHCD operation. The analysis provided estimates of the relative power loading of the inboard and outboard targets for cases with and without control by a localized gas-puff.
The Aditya SOL simulations explored the inherently 3D SOL generated by a toroidally localized ring-like limiter in its circular plasma, complementing the localized probe measurements on device SOL. Since the radial diamagnetic drift enters flow continuity with the $E \times B$ and PS flows, it generates a finite flow vorticity, influencing degree of SOL turbulence, cross field diffusivity and the key pedestal parameter $D_{edge} = D_{SOL}$. More recent Aditya Upgrade relevant setups indicate strongly changed connection length distribution, impacting the total recycling flux and modifying parallel and perpendicular plasma fluxes indicating smaller total recycling flux in upgrade for equivalent edge densities in the original setup. A mechanism identified causing excess main chamber recycling relates to observations in ALCATOR C where despite a regular density variation, a radially diverging main chamber plasma flux causes loss of neutral particle control, even for ITER like conditions. The presentation will highlight the characterization of results from the activity for both Aditya and SST-1 tokamaks.

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