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Comparative study of KSTAR and DiPS-2 on the heat flux to the first wall

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Although Type I ELM heat flux mainly reaches the divertor plates, it would cause severe damage to the first wall in advanced tokamaks due to radial convective loss of ELM. Heat loads on the first wall is mostly caused by the fast radial convective propagation of ELM filaments. In this paper, heat fluxes toward the first wall of KSTAR device are investigated as a form of ELM filaments, and they are compared with those of Divertor Plasma Simulator-2 (DiPS-2) installed in Hanyang University.
Plasma parameters are measured by a specially designed electric probe system composed of a set of eight probes, which are fixed on the outboard midplane wall. These are arranged in two, poloidally separated, triple probes and one Mach probe, which allow direct measurements of electron temperatures, particle and heat fluxes, and Mach numbers at the wall with enhanced time resolved acquisition rate of 2 MHz.
During 2015 KSTAR campaign, Type I ELMing H-mode discharges have been performed with a lower single null magnetic geometry, where the outboard separatrix position is slowly scanned over a radial distance of 7 cm, reducing the wall probe–separatrix distance to a minimum of ~9 cm, which enables us to investigate parallel ELM filament energy loss in terms of radial distance. A separate fast reciprocating probe head is held at fixed position toroidally close and 4.7 cm radially in front of the wall probe. An average filament radial propagation speed is extracted as 100 ms-1 or so from those separated probes. Heat flux (q//) is observed to exponentially decay in the radial direction with the following typical range of parameters: q_// = 0.04 −0.5 MWm^-2. The decay length of heat flux has been deduced as 26 ~ 34 mm. Along with the measured radial propagation speed and the calculated radial profile of the magnetic connection lengths across the SOL.
To expand the case of pure plasma in KSTAR to the cased of impure and dusty plasmas, we performed experiments on heat flux to the wall in a linear plasma device, called DiPS-2 which has relevant physical parameters and geometry to simulate both the edge plasmas and ELM phenomena of toroidal devices. Fixed azimuthal probes are installed which are to be simulated the poloidal probes of KSTAR.

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