Contribution ID: **729** Type: **Poster**

Direct Measurement of ELM related Momentum Transport in the Edge of HL-2A H-mode Plasmas

Friday, 21 October 2016 08:30 (4 hours)

Turbulent momentum flux, including the Reynolds stress, convective flux, and the flux driven by nonlinear interactions, was experimentally measured in ELMy H-mode. And it was found that net momentum in the electron diamagnetic direction was injected from the edge into the plasma during ELMs. This is a direct evidence that plasma is able to serve as a heat engine to convert heat into poloidal momentum and drive flows.
The experiments was conducted in ELMy H-mode deuterium discharges on the HL-2A tokamak. A special Langmiur probe array was positioned within millimeters around the separatrix and made the measurement. It was found that during ELM eruptions electron density and temperature fluctuated violently, and their mean values indicated by their fluctuations envelopes increased dramatically. This is consistent with the idea that ELM bursts a pack of heat and particles from the pedestal into the SOL region. One pronounced feature is that the velocity measured by Mach probe increased towards the electron diamagnetic direction during the ELM eruption. This means that additional momentum in the electron diamagnetic direction was locally generated or transported and deposited into the region.
The measured total turbulent momentum flux is negative, which indicates that either momentum in the electron diamagnetic direction was transported towards the pedestal or momentum in the ion diamagnetic direction was transported towards the chamber wall. This immediately implies that net momentum in the electron diamagnetic direction was injected into the separatrix, and possibly drove the edge poloidal shear flow. It is worth noting that although the Reynolds stress term is the leading term, the other two terms including the nonlinear term are of the same order of magnitude and cannot be neglected. Particularly, the nonlinear term during the second ELM burst is significantly large, contrary to what people usually expect.

Paper Number

EX/P7-25

Country or International Organization

China

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Session Classification: Poster 7

Track Classification: EXC - Magnetic Confinement Experiments: Confinement