Overview of the results from the divertor experiments at Wendelstein 7-X and their implications for steady-state operation


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Introduction

W7-X wants to demonstrate high power, high performance at steady-state 10 separate divertor units, adapted to the shape of the flux surfaces.

Neutral compression provided by neutrals recycling near the divertor target.

Attached plasmas

Large wetted areas allow for efficient heat flux spreading.

Overloading leading edges showed that W7-X has good impurity screening.

Detached plasmas

Neutral pressure sufficient for steady-state density control at W7-X.

Two effects increase neutral pressure:

1. Longer penetration length mainly due to lower plasma temperature (5 eV) in the islands
2. CRS processes between fast ions coming from upstream and slow neutrals downstream. [Y. Feng, et al., submitted to NF]

Detached plasmas

Complete, stable detachment for 26 seconds.

Neutral density with (left) and w/o (right) CRS processes.

Good separation of counter-streaming flows enables higher recycling regime.

The flow measurement is performed by coherence image spectroscopy. [2] It measures the Doppler shift of carbon ions, which serves as a proxy for the bulk plasma flow. [5] The flows are well separated due to sufficient island size. They do not contribute to the momentum dissipation in the scrape-off layer. This enables high-recycling regime, important for particle exhaust. [F. Reimold, this conference]