DPP15-2015-000071

Abstract for an Invited Paper
for the DPP15 Meeting of
the American Physical Society

Divertor detachment[1]

SERGEI KRASHENINNIKOV, UCSD

The heat exhaust is one of the main conceptual issues of magnetic fusion reactor. In a standard operational regime the large heat flux onto divertor target reaches unacceptable level in any foreseeable reactor design. However, about two decades ago so-called "detached divertor" regimes were found. They are characterized by reduced power and plasma flux on divertor targets and look as a promising solution for heat exhaust in future reactors. In particular, it is envisioned that ITER will operate in a partly detached divertor regime. However, even though divertor detachment was studied extensively for two decades, still there are some issues requiring a new look. Among them is the compatibility of detached divertor regime with a good core confinement. For example, ELMy H-mode exhibits a very good core confinement, but large ELMs can "burn through" detached divertor and release large amounts of energy on the targets. In addition, detached divertor regimes can be subject to thermal instabilities resulting in the MARFE formation, which, potentially, can cause disruption of the discharge. Finally, often inner and outer divertors detach at different plasma conditions, which can lead to core confinement degradation. Here we discuss basic physics of divertor detachment including different mechanisms of power and momentum loss (ionization, impurity and hydrogen radiation loss, ion-neutral collisions, recombination, and their synergistic effects) and evaluate the roles of different plasma processes in the reduction of the plasma flux; detachment stability; and an impact of ELMs on detachment. We also evaluate an impact of different magnetic and divertor geometries on detachment onset, stability, in- out- asymmetry, and tolerance to the ELMs.

[1]Supported by the U.S. Department of Energy Office of Science, Office of Fusion Energy Sciences under Award Number DE-DE-FG02-04ER54739 at UCSD.