THE EFFECT OF MAGNETIC FIELD CONFIGURATION ON PUMPING IN THE JOINT EUROPEAN TORUS (JET)

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The current most promising pathway to commercial fusion is the tokamak reactor. In tokamaks a plasma is heated to extremely high temperatures within in a doughnut-shaped vacuum vessel for the hydrogen fuel ions to fuse and release energy. The plasma must be well confined, to avoid damage to the components of the reactor: this is done via powerful and precise magnetic fields.

However, even with the most precise and power magnetic fields, particles still escape confinement. In addition the build-up of impurities, as fuel ions fuse to heavier elements, requires an in-situ filter system. In divertor tokamaks the plasma is magnetically 'diverted' to specially designed physical targets, made to withstand the extreme heat and particle fluxes, with the heavier elements being pumped out beneath the targets. At JET, various target locations are achievable, and different magnetic configurations can be implemented to direct the plasma flow towards them [1].

The JET divertor is equipped with a cryogenic pump. This pump is liquid nitrogen or helium cooled and uses cryo-condensation to archive pumping of neutral hydrogen gas. Once the plasma is heated in the vessel, the cryopump removes impurities from the plasma and allows for a constant throughput of fuel gas via external gas injection and pumping effectively controlling the plasma density [2].

The magnetic configuration in the divertor with respect to the physical targets plays a role in the efficiency of the pumping. Experimental data shows that a two to eight-fold increase in pressure was achieved within the sub-divertor in certain magnetic configurations. Understanding the gas dynamics within the divertor and sub-divertor is thus of utmost importance to optimise pumped divertor configurations.

To simulate the experiments, the plasma-edge simulation code EDGE2D-EIRENE [3-4] is employed. Due to a recent addition to the code, the sub-divertor region will be simulated fully, allowing for the neutral particles to be tracked and the cryopump pressures to be determined [5]. This contribution gives the comparison of the experimental and computational pumping data, and provides physics explanations of the observed configuration dependence.

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