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Steps in Validating Scrape-off Layer Simulations of Detached Plasmas in the JET ITER-like Wall Configuration

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Further steps have been taken in validating predictions of detached divertor simulations with the edge fluid code EDGE2D coupled to the neutral Monte-Carlo code EIRENE for JET low confinement mode plasmas in the ITER-like wall configuration. Fully detached and strongly recombining divertor plasmas close to the density limit were characterized experimentally by bolometry, spectroscopy, and plasma imaging. The absence of carbon as a primary radiator and carbon chemistry in the sputtering processes greatly simplified the assessment of the role of deuterium in removing momentum and power from the plasma to achieve detachment.
Predictions of the line-integrated bolometer signals confirmed the previous observation and consistently show a factor of 2 to 3 lower power levels than measured, consistent with the previously reported power deficit. Inclusion of cross-field drifts due to ExB and Bxgrad(B) raises the power from the high field side divertor by 50%. Assuming full coverage of the tungsten divertor with beryllium further raises the total power by another 50%. However, assessment
of the components of power radiated from the divertor in these plasmas showed that deuterium atomic and molecular line radiation accounts for more than 90% of the radiation, with radiative recombination becoming important (~30%) at high density. Emission from beryllium, tungsten, oxygen and carbon are measured to be insignificant in these plasmas, while BeD molecules may produce significant radiation. While predictions of the Balmer-alpha line intensities across the low field side divertor leg fall short by factors of 2 to 4 when the divertor plasma is detached, the simulations reproduce line emission from high-n Balmer transitions (10-2, 11-2), which indicate that recombination is a significant process in the low field side divertor plasma at plasma temperatures of or below 1 eV in front of the target plate.
The predicted two-dimensional profiles of Balmer-alpha line emission in the divertor show the emission being extended into the divertor plasma both on the high field and low field side, while the measurements reveal more localised emission at the strike points.
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