Impurity transport and trapped particle modes

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Impurities can have negative effects on the plasma confinement. First they will contribute to plasma dilution, reducing the fuel present for a given pressure. Second, these impurities are ionized multiple times, and will radiate a significant part of the plasma energy from the core. In addition, other species can be introduced in the plasma edge to decrease the heat and particle fluxes on the walls, and these particles can then propagate into the plasma core.

We investigate the influence of the impurity profile on trapped particle modes, and the transport of these impurities. This is done using the gyrokinetic code TERESA-4D, which simultaneously describes trapped-ion (TIM) and trapped-electron (TEM) driven modes and treats the passing particles adiabatically [1, 2]. Its most interesting property is that it enables the full-f treatment of multiple populations of trapped ions, electrons, and impurities at low numerical cost. However, this code is collisionless, therefore it allows to study turbulent transport, but not neoclassical transport and its interplay with anomalous transport.

In this work, a self consistent treatment of a population of impurities [3, 4] uncovers a strong influence on the dynamics of the turbulence in the plasma. We show that the sign of the impurity gradient can modify the nature of the instability [5], and that the impurity flux depends non-monotonously on the ratio impurity over ion density gradients. Furthermore, we show that the nature of the turbulence can have a strong influence on the zonal flow/drift mode energy ratio.

References

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