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TH/P3-05: Impurity Transport due to Electromagnetic Drift Wave Turbulence

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In the view of an increasing interest in high beta operation scenarios, such as hybrid scenarios for ITER the question of finite beta effects on the impurity transport is a critical issue due to possible fuel dilution and radiative cooling in the core. Here, electromagnetic effects at finite beta on impurity transport are studied through local linear gyrokinetic simulations with GYRO [J. Candy and E. Belli, General Atomics Report GA-A26818 (2011)]; in particular we investigate the parametric dependences of the impurity peaking factor (zero-flux density gradient) and the onset of the kinetic ballooning modes (KBM). Our results show that for the considered plasma parameters two possible modes can be unstable depending on the normalized electron pressure; ion temperature gradient (ITG) modes dominate in the region beta_e less than 0.015, while KBM dominate for beta_e greater than 0.015. The KBM instability threshold depends on the plasma parameters, particularly strongly on plasma shape. We have shown that magnetic geometry significantly influences the results, and the commonly used s-alpha model overestimates the KBM growth rates and ITG stabilization at high beta. The beta_e scaling of the impurity peaking factor shows two branches in connection with the two branches of the unstable modes present. We find that electromagnetic effects even at low beta can have significant impact on the impurity transport. In the ITG branch the peaking factor increases with beta_e with strong charge dependence and this dependence increases as beta_e increases, however, for heavy impurities with lower charge to mass ratio such as tungsten, lower peaking factors with very little beta_e dependence is observed. In the beta range where the KBM is the dominant instability the impurity peaking factor is strongly reduced, with very little dependence on beta and the impurity charge.

Country or International Organization of Primary Author

Sweden

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International Tokamak Physics Activities

Primary author: Ms MORADI, Sara (Sweden)

Co-authors: Mr MOLLÉN, Albert (Chalmers University of Technology and Euratom-VR Association); Dr PUSZTAI, Istvan (Chalmers University of Technology and Euratom-VR Association); Prof. FÜLÖP, Tünde (Chalmers University of Technology and Euratom-VR Association)

Presenter: Ms MORADI, Sara (Sweden)

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