

# **Impurity effect on the ITG nonlinear transport**

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Impurity effect on the anomalous transport is important for understanding transport process in tokamak. To study this topic, the capability of global delta-f gyrokinetic code gKPSP [1] is extended to include impurities and linearized interspecies collision operator [2]. Linear growth rates of ITG and impurity mode are verified with another gyrokinetic code (GYRO). Also, Rosenbluth-Hinton residual potential level is compared with the theoretical formula of impure plasmas [3], which show a reasonable agreement. For verification of implemented interspecies collision operator, neoclassical benchmark results such as heat flux, poloidal flow, temperature equilibration are presented. With this impurity simulation capability, several electrostatic ITG simulations are performed to study nonlinear transport behavior of peaked or inverted impurity density profiles. While the linear stabilizing effect is emphasized in the previous work [4], the role of impurities on intensity and radial structure formation of zonal flow is highlighted in this work. Also, the statistical property of particle and heat flux is discussed in detail.

[1] J.M. Kwon, et al., Nucl. Fusion 52, 013004 (2012).

[2] H. Sugama, et al., Phys. Plasmas 16, 112503 (2009).

[3] W. Guo, et al., Nucl. Fusion 57, 056012 (2017).

[4] K. Kim, et al., Phys. Plasmas 24, 062302 (2017).