

# Upgrading the GS2 collision operator

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## Abstract

Considering that collisions are known to play important role in direct set of physical phenomena in tokamak plasmas, it is essential to develop reliable and robust collisional operator for multiple species when addressing the transport of impurities and momentum transport. Although impurity density is very low in tokamak plasmas, its collision frequency is of same order as the main ions because of  $Z^2$  dependence, where  $Z$  is the charge of impurity. Interaction between impurity species and ions can be very important to understand intrinsic rotation. The linearized gyrokinetic code GS2 [1] currently has test particle and field particle pieces for self-collisions. Adapting the treatment of Sugama et al. [2] in order to facilitate exact numerical properties is currently being implemented in GS2 [1]. The test particle piece consists of pitch angle scattering and energy diffusion terms. It also has finite Larmor effects included in it. The field particle piece is obtained by preserving the particle, momentum, energy, self adjointness relation and H-theorem. This collision operator is the advancement of a previous self-collision operator in [[3] [4]]. It is in gyro- averaged form which can be used in the gyrokinetic equation.

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## References

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