

A Fokker-Planck collision model for gyrokinetic simulations in stellarators

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The differential test-particle component of the Fokker-Planck operator is treated exactly; the treatment of the integro-differential field-particle component relies on the spherical harmonic and Laguerre polynomial expansion introduced by Hirshman and Sigmar [S. P. Hirshman, D. J. Sigmar, Phys. Fluids, 19, 1532 (1976)]. The properties of the collision model and its implementation in the δf -gyrokinetic code `stella` [M. Barnes, F. I. Parra, M. Landreman, Journal of Comp. Phys., 391, 365 (2019)] are discussed and benchmarks against the collision model of the gyrokinetic solver `gs2` are performed. The accuracy of the collision model can be increased by retaining successively higher number of terms in the series expansion. We solve the Spitzer problem to demonstrate that the first few terms are sufficient for superior accuracy over frequently used collision operators that reduce the field-particle component to momentum and energy restoring terms.