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**Nonlinear full-$f$ simplified Fokker-Planck multi-species collisions in (gyro)kinetics**[1] MANAURE FRANCISQUEZ, MIT Plasma Science and Fusion Center, JAMES JUNO, University of Maryland, College Park, AMMAR HAKIM, GREGORY HAMMETT, Princeton Plasma Physics Laboratory, DARIN ERNST, MIT Plasma Science and Fusion Center — We present a simplified, nonlinear collision model of like-particle and multi-species collisions for full-$f$ kinetic plasma studies. This Fokker-Planck-like model is a generalization of the popular Dougherty operator, formulated to more rigorously support arbitrary mass ratios, non-quasineutral pairs, and flexible collision frequencies. In particular, this approach can be extended to support velocity-dependent collisionalities. The proposed operator preserves the conservative properties of the Fokker-Planck operator and, in the case of velocity-independent collisionality, can be shown to obey the H-theorem. Non-decreasing entropy can be proved as long as the cross-species temperature remains positive, even in the non-equilibrium case of unequal temperatures. Benchmarks, like Landau damping of Langmuir waves, show the effect of this simplified model to be comparable to that of the full Fokker-Planck operator. These features make it an attractive approach for direct numerical simulation of plasmas where using the full Fokker-Planck operator may be prohibitively expensive. We will present the formulation, discontinuous Galerkin implementation within Gkeyll, and various tests carried out for testing and validation.

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