A Second-Order Asymptotic-Preserving and Positivity-Preserving Discontinuous Galerkin Scheme for the Kerr–Debye Model

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In this talk, we present a second-order asymptotic-preserving and positivity-preserving discontinuous Galerkin (DG) scheme for the Kerr–Debye model. By using the approach first introduced by Zhang and Shu in [Q. Zhang and C.-W. Shu, Error estimates to smooth solutions of Runge–Kutta discontinuous Galerkin methods for scalar conservation laws, SIAM J. Numer. Anal. 42 (2004) 641–666.] with an energy estimate and Taylor expansion, the asymptotic-preserving property of the semi-discrete DG methods is proved rigorously. In addition, we propose a class of unconditional positivity-preserving implicit–explicit (IMEX) Runge–Kutta methods for the system of ordinary differential equations arising from the semi-discretization of the Kerr–Debye model. The new IMEX Runge–Kutta methods are based on the modification of the strong-stability-preserving (SSP) implicit Runge–Kutta method and have second-order accuracy. The numerical results validate our analysis. This is joint work with Chi-Wang Shu at Brown Univerisity.