Transonic accretion flows in Kerr black hole geometry

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Astrophysical black holes, though among the most extreme objects in the universe, are remarkably simple objects — defined only by their mass and spin. While the mass can be determined through the far-field gravitational influence, determining the spin requires probing the strong gravity region near the event horizon, where the general relativistic effects are prominent. However, studying physical processes in the strong gravity limit using the exact Kerr metric is a formidable task, most certainly by theoretical means. There are numerical simulations which may have an uncertain amount of dissipation in the numerical codes. To address this, we formulate an accurate pseudo-Kerr formalism that can be incorporated into Newtonian equations, making it accessible even to those less familiar with general relativity. Using this framework, we investigate the transonic behaviour of accretion flows around spinning black holes and concentrate on accretion solutions featuring centrifugal pressure-supported shock waves. Our approach makes it easier to compute spectra from an accretion flow with viscous dissipation and radiative cooling, offering valuable insights into the observational signatures of Kerr black holes.