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Impact of Self-Gravity on Jet Properties in Collapsar Models

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This study focuses on the analysis of relativistic jets in collapsars with a self-gravitating stellar envelope. In our simulations the initial mass of the black hole is three solar masses, while the stellar envelope mass is twenty-five solar masses. Therefore, self-gravity cannot be neglected in the analysis. We compare two models—with and without self-gravity—under identical initial conditions, with a 5% perturbation to the internal energy of the envelope, which allows us to investigate the influence of small-scale variations on jet dynamics and stability. Our main goal is to determine the effect of the self-gravitating envelope on jet properties, such as the Lorentz factor, opening angle, velocity profile, emitted energy during the process, and jet collimation. Additionally, we study the dynamical evolution of the black hole's spin and mass during jet emission to highlight the impact of self-gravity on these parameters.

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