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Radiation driven dust hydrodynamics in late-phase AGB stars
HANIF ZARGARNEZHAD, JACOB MCFARLAND, Texas A and M university, ANGELA SPECK, FINIS STRIBLING, university of Texas at San antonio — Over the years, scientists have sought to understand the formation of small- and large-scale hydrodynamic features in planetary nebulae. These visually striking features involve both ionized gas and dust and are formed from the end of Asymptotic Giant Branch (AGB) stars. Much remains unknown about how this dust is formed and processed by these late phase stars. At the end of the evolutionary stage of AGB stars, shock waves formed by stellar pulsations and radiation pressure push the gas and particles in layers, shells, out from the star. In our work we aim to study the role of dust in the formation of small-scale hydrodynamic features known as cometary knots. In contrast to previous research, which addressed to the mixture of dust and gas as a single mixed fluid, we investigate these flows using an Eulerian-Lagrangian method to track the phases separately. Simulations are performed using the FLASH CODE developed at the FLASH Center at the University of Chicago. The particle-in-cell method was used with the two-dimensional Euler equations and solved using directionally split piecewise-parabolic method. This method was then adapted for the astrophysics regime by implementing radiation and non-continuum drag models for the particle phase. Further, the gas phase was modified to enable a hydrostatic equilibrium to exist over stellar length scales. The effects of a perturbed radiation field and perturbed particle spatial distribution were investigated to determine if these could be responsible for the formation of cometary knots observed in planetary nebulae.

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