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Shaping of AGB outflows by wind-companion interactions in eccentric binary and hierarchical triple systems

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At the end of their lives, low and intermediate mass stars scatter their envelope throughout the interstellar medium via a stellar wind. For decades, modelling endeavours of these outflows have assumed that these winds are spherically symmetric. However, recent high-spatial resolution observations reveal that the winds of evolved stars typically possess a high degree of complexity, from spirals, disks, clumps, and bi-conical outflows in the winds of AGB stars, to highly bi- or multi- polar structures around post-AGB stars and planetary nebulae. Sophisticated 3-dimensional hydro-dynamical modelling tools indicate that such structures can be formed by the gravitational interaction of a stellar or planetary companion with the AGB outflow, and the induced orbital motion of both components.
Nevertheless, a number of observed targets posses complex-structured nebulae of which the morphological shape can still not be understood on the basis of the current set of theoretical models for such systems. To advance our insights on the origins of these complex nebulae, I present a comprehensive set of high-resolution models of (i) a stellar wind perturbed by a solar-mass companion in orbits of varying eccentricity, and (ii) a mass-loosing star in various hierarchical triple configurations. These models are constructed with the Smoothed-Particle-Hydrodynamics solver PHANTOM *(Price et al. 2018)*.
The ultimate goal of these sophisticated models is to compare them to high-resolution observations, to unravel how and by which binary/triple configuration the observed wind structures can be created. Therefore, we post-process our hydrodynamical models with the radiative transfer code MAGRITTE *(De Ceuster et al. 2019, 2020)* to create synthetic observations. Subsequently, we apply the primary ALMA data processing software CASA *(McMullin et al. 2007)* on the synthetic observations with various telescope configurations, and reveal the similarities with actual ALMA observations. These new simulations hence offer us a novel gateway for understanding the complex wind structures of evolved stars, and thus for constraining the fundamental stellar and wind parameters, key ingredients for predicting their further evolution.

Session

Stellar evolution

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