Systematic modeling of outflows from O-rich AGB stars

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In order to understand the mass loss from oxygen-rich (O-rich) pulsating late-type stars, we explored the characteristic behaviour of time-dependent hydrodynamic models for their outflows including a proper treatment of dust formation. The models are determined by the fundamental stellar parameters, stellar mass M*, stellar temperature T*, stellar luminosity L*, and the element abundances ϵi and by two pulsation parameters, pulsation period P and velocity amplitude of pulsation Δvp. We built a grid of 75 models by varying these parameters in a range typical for O-rich pulsating Asymptotic Giant Branch (AGB) stars.

Similar to the carbon--rich case, the resulting outflow characteristics define two distinct regions: in region A, the outflows are dominated by radiation pressure on dust and these models are characterized by winds with terminal velocities larger than 8km/s and mass loss rates larger than 8.0 x 10-7 Msun/yr. They show a layered structure of the circumstellar shells. In region B, formation of dust is not efficient enough to dominate the acceleration of the outflow and therefore, these outflows are directly supported by the stellar pulsation. Mass loss rates and terminal velocities of B-type models are lower than the respective values for A-type models.

Based on this grid, we explored the effects of the fundamental stellar parameters and of the pulsation parameters on the outflow characteristics, in particular the mass loss rate and the terminal velocity, and on the resulting spectra. We derive synthetic relations between the mass loss rates and the infrared color indices which are in good agreement with the empirical relations derived from observations based on the grid.

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