Determining the effect of a non-uniform AGB outflow on its chemistry

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Abstract

The chemistry in the outflow of an AGB star is dominated by its C/O abundance ratio. For C-rich stars, no O-rich species are expected in the inner wind since oxygen is locked up in CO, and vice versa for O-rich stars. However, several of these unexpected molecules have been detected. Non-equilibrium chemistry in the inner wind, caused by shocks due to the pulsating AGB star, can in most cases explain their existence and abundance. An alternative mechanism is the penetration of harsh UV photons in a non-uniform outflow. In a non-uniform or "clumpy" outflow, which can be caused by e.g. binary interaction, interstellar UV photons can reach the formerly shielded inner wind and break up CO. Using the porosity description, we take a clumpy density distribution into account by modifying the optical depth of the outflow. The porosity description provides us with a solid mathematical framework. We explore the parameter space characterising clumpiness in our chemical model and describe its effect on the chemistry throughout the outflow. We find that our results can explain the existence of certain species in the inner wind and add to the results of the non-equilibrium models.

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