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$[^{17}O]/[^{18}O]$ ratio in post-AGB sources: canonical and non-canonical populations

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Abstract

Stellar nucleosynthesis models are fundamental tools to derive parameters of stars from elemental atomic and isotopic abundance ratios. For evolved stars, the [C]/[O]/[N] elemental ratios and the $[^{12}C]/[^{13}C]$ and $[^{16}O/][^{17}O]/[^{18}O]$ isotopic ratios provide constraints to the initial mass of the stars. In post-AGB sources, their chemical composition can be derived from observations of rotational lines of molecular species in the mm and sub-mm radio domains. The initial mass of post-AGB sources is a fundamental parameter to establish correlations with the main properties of their nebulae (mass, momentum, kinetic energy, shape) and progress in our knowledge of their formation and evolution. In these sources, the C/O ratio is derived from the detection of C- and O-bearing molecules, while the $[^{17}O]/[^{18}O]$ ratio is determined from the relative strength of optically thin lines of $C^{17}O$ and $C^{18}O$. However, the results obtained up to date are far from being clear.

We review the status of the question, including new accurate $[^{17}O]/[^{18}O]$ ratio measurements for 13 targets, totalling 30 studied post-AGB envelopes. Comparing the $[^{17}O]/[^{18}O]$ ratios and the C-rich/O-rich chemical composition with models for sources that have completed the AGB evolution, we find that 50% of the cases are canonical: observational data agree with model predictions. For the non-canonical sources, the remaining 50%, the O-rich ones present $[^{17}O]/[^{18}O]$ ratios above predictions. This can be explained by a premature interruption of the AGB evolution as a consequence of the ejection of a large fraction of the initial mass. This hypothesis agrees with the suggestion that these envelopes form in the merging of common envelope-like events. The non-canonical C-rich sources, on the contrary, display $[^{17}O]/[^{18}O]$ ratios below the predictions. We discuss explanations for this enigmatic behaviour, including the possibility that these are extrinsic C-rich stars, whose C abundances result from previous mass accretion from a donor companion.

My poster in zenodo.org can be found here