Why Galaxies Care About AGB Stars: A Continuing Challenge through Cosmic Time
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Looking for new water-fountain stars

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Abstract. We carried out simultaneous observations of H_2O and OH masers, and radio continuum at 1.3 cm with the Karl G. Jansky Very Large Array (VLA) towards 4 water-fountain candidates. Water fountains (WFs) are evolved stars, in the AGB and post-AGB phase, with collimated jets traced by high-velocity H_2O masers. Up to now, only 15 sources have been confirmed as WFs through interferometric observations. We are interested in the discovery and study of new WFs. A higher number of these sources is important to understand their properties as a group, because they may represent one of the first manifestations of collimated mass-loss in evolved stars. These observations will provide information about the role of magnetic fields in the launching of jets in WFs. Our aim is to ascertain the WF nature of these candidates, and investigate the spatial distribution of the H_2O and OH masers.

Keywords. masers –stars: AGB and post-AGB

1. Introduction

The H_2O maser emission in WFs traces motions that are significantly faster than the typical expansion velocities of circumstellar envelopes during the AGB phase ($10-30\,\mathrm{km\,s^{-1}}$; Sevenster *et al.* 1997). These expansion velocities are traced by the double-peaked OH spectra typically seen in AGB and post-AGB stars, and thus, WF candidates are identified by H_2O maser spectra whose velocity spread is larger than that of the OH (te Lintel Hekkert *et al.* 1989; Imai *et al.* 2008).

With our recent confirmation of IRAS 17291−2147 and IRAS 18596+0315 as WFs (Gómez *et al.* 2017), there is a total of 15 WFs. Interferometric observations (with angular resolutions better than a few arcsec) are necessary, given the relatively low angular resolution of the single-dish observations (around 1 arcmin).

There remain several sources that are considered to be WF candidates based on single-dish observations (Yung *et al.* 2013, 2014, Gómez *et al.* 2015). Despite showing larger velocities in their H_2O maser spectrum than in OH, the velocity spread of some of these candidates is relatively low ($\simeq 40\,\mathrm{km\ s^{-1}}$), compared with the case of some WFs ($>100\,\mathrm{km\,s^{-1}}$). This may be a projection effect, if jets are moving close to the plane of the sky, but they might also represent a different kind of source (e.g., with less massive progenitors, or being relatively younger sources).

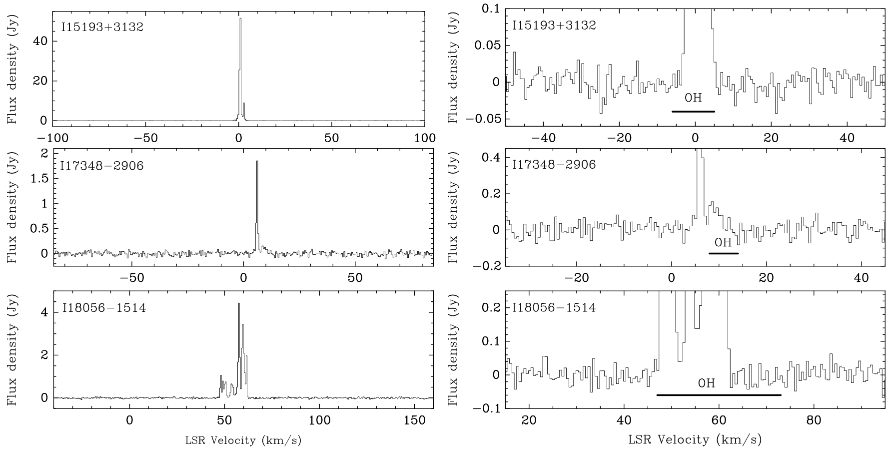

Figure 1. H_2O maser spectra toward the WF candidates, shown with different velocity and flux density ranges. The velocity range between the two OH maser peaks are shown by the thick lines.

2. Observations and Results

Our observations were carried out with the VLA of the National Radio Astronomy Observatory (NRAO), in its C configuration, on July and August 2017. We calibrated and processed the data using the CASA package. H_2O maser spectra was smoothed to a velocity resolution of 0.5 km s^{-1}.

Our main targets were IRAS 15193+3132, IRAS 17021−3109, IRAS 17348−2906 and IRAS 18056−1514. We confirm through interferometric observations that H_2O maser emission is associated with all sources, except in IRAS 17021−3109. Here, we present preliminary results of the H_2O maser spectra (Fig. 1). From these new data, more maser features are identified, showing variability in the flux density compared with the previous data. Unfortunately, some H_2O features with the higher velocity difference respect to the OH features, detected in the previous single-dish observations are absent in the new interferometric observations, so it is not possible to confirm whether they were associated with the target sources. Therefore, with the current data, we cannot confirm the nature of these candidates as WFs.

3. Summary

These WF candidates presented relatively high-velocity features in previous single-dish observations that have disappeared in the new interferometric observations. These sources could be different from the classical WFs, whose high-velocity emission is more stable over the time. Monitoring these candidates is crucial to ascertain their nature as WFs, and determine whether WF characteristics occur during a very limited time in stellar evolution, or whether they are recurrent episodes during longer periods of time.

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