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H_2O maser polarization of the water fountains IRAS 15445−5449 and IRAS 18043−2116

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Abstract. We present the morphology and linear polarization of the 22-GHz H_2O masers in the high-velocity outflow of two post-AGB sources, d46 (IRAS 15445−5449) and b292 (IRAS 18043−2116). The observations were performed using The Australia Telescope Compact Array. Different levels of saturated maser emission have been detected for both sources. We also present the mid-infrared image of d46 overlaid with the distribution of the maser features that we have observed in the red-shifted lobe of the bipolar structure. The relative position of the observed masers and a previous radio continuum observation suggests that the continnum is produced along the blue-shifted lobe of the jet. It is likely due to synchrontron radiation, implying the presence of a strong magnetic field in the jet. The fractional polarization levels measured for the maser features of d46 indicate that the polarization vectors are tracing the poloidal component of the magnetic field in the emitting region. For the H_2O masers of b292 we have measured low levels of fractional linear polarization. The linear polarization in the H_2O maser region of this source likely indicates a dominant toroidal or poloidal magnetic field component.

Keywords. masers, polarization, stars: AGB and post-AGB, stars: late-type, stars: magnetic fields, stars: circumstellar matter

1. Introduction

Post-Asymtoptic Giant Branch (post-AGB) stars represent a very short phase in the evolution of low and intermediate initial mass stars ($M_\star \leqslant 9\,M_\odot$). During the post-AGB phase, the high mass-loss rate (10^{-7}–$10^{-4}\,M_\odot\,yr^{-1}$) observed at the end of the asymtoptic giant branch (AGB) evolution decreases. Simultaneously, the effective temperature of the central star increases, while the circumstellar envelope (CSE) slowly detaches from the star (see Habing & Olofsson 2003 for a review). A class of post-AGB stars, the so called "Water Fountains", is characterized by the detection of H_2O maser emission over an unusually large velocity range broader than the velocity range defined by the OH maser emission (Likkel & Morris 1988). Sources with H_2O maser velocity spread over a range of $>100\ km\,s^{-1}$ have been detected (e.g. Gomez *et al.* 2011). Those H_2O masers have been observed in regions where the interaction between the high-velocity outflow and the slow AGB wind seems to be active, hence the H_2O masers are probably excited in the post-shock region. Here we report the detection of linear polarization of 22-GHz H_2O maser emission from two water fountains d46 and b292 (IRAS 15445−5449, IRAS 18043−2116).

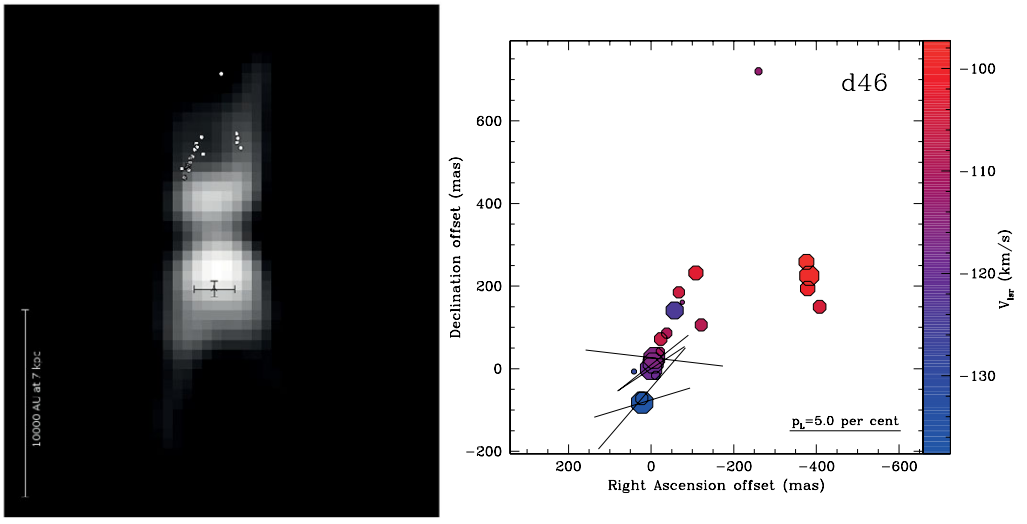

Figure 1. *Left*: H_2O maser and radio continuum position overlaid on the mid-infrared image published by Lagadec *et al.* (2011). For illustration, we have shifted the mid-infrared image, within the 2 arcsec of uncertainty of its position, in order of align the H_2O maser features with the red-shifted side of the high-velocity outflow. *Right*: H_2O maser region of IRAS 15445−5449. The offset positions are with respect to the reference position, which are the brightest maser spots in the region.

2. Results

• IRAS 15445−5449. Most of the maser features were detected to have a high porcentage of linear polarization ($P_L > 5\%$), which likely is a result of maser emission in the saturated regime (Vlemmings *et al.* 2006). The polarization vectors (right panel of Fig. 1) should be perpendicular to the magnetic field lines. The vectors then appear to trace the poloidal field component.

• IRAS 18043-2116. The fractional polarization level detected for the brightest features is low $P_L < 5\%$, corresponding to non-saturated H_2O maser emission. The polarization vectors (see Fig. 2 in Perez-Sanchez *et al.* 2011) could be either perpendicular or parallel to the magnetic field component projected in the sky plane. Considering that the projected jet direction is East-West, the magnetic field is either almost exactly parallel or perpendicular to the high-velocity outflow.

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