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VLBA H_2O and SiO maser observations in the pPN OH 231.8+4.2

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Abstract. We report high-resolution observations of H_2O, $6_{1,6}$–$5_{2,3}$ and ^{28}SiO v=2, J=1-0 maser emissions obtained with the Very Long Baseline Array in the bipolar pre-planetary nebulae OH 231.8+4.2 (see Desmurs *et al.*, 2007). A phase referencing technique was used to recover the absolute position of both emissions. We detected two groups of water vapour emission oriented nearly north-south. SiO masers are tentatively found to be placed between the two H_2O maser emitting regions.

Keywords. Maser, stars: AGB and post-AGB, radio lines: stars

1. Introduction

OH 231.8+4.2 is a well studied bipolar pre-planetary nebula (pPN) at a distance of ∼1500 pc. The central source is a binary system formed by an M9-10 III Mira variable (i.e. an AGB star) and a A0 main sequence companion (Sánchez Contreras *et al.*, 2004). The nebula shows all the signs of post-AGB evolution: fast bipolar outflows with velocities ∼200–400 km/s, shock-excited gas and shock-induced chemistry. The presence of a late-type star in the core of a bipolar post-AGB nebula like OH 231.8 is very unusual since the central stars of pPNe are typically hotter, with spectral types from B to K. This enables the survival of SiO and H_2O masers in the Mira's vicinity, where the agents governing non-spherical mass ejections are expected to operate.

2. Results and discussion

We performed VLBA observations of the H_2O $6_{1,6}$–$5_{2,3}$ and SiO v=1 and v=2, J=1–0 maser emission in the pPN OH 231.8 using the phase referencing technique to measure the relative position of the H_2O and SiO maser spots (see Desmurs *et al.* 2007).

H_2O maser emission arises in two groups of compact spots separated by ∼ 60 mas (80 AU) along the north-south direction, i.e. roughly along the nebular symmetry axis. A clear velocity gradient is observed indicating an expansive kinematics in this region (Fig. 1). The deprojected expansion velocity of the spots of 10-15 km/s for an inclination of the nebular axis with respect of the plane of the sky of i∼36°(Shure *et al.* 1995) is in good agreement with the usual velocities found in AGB stars (e.g. Loup *et al.*, 1993). However, the total velocity dispersion in OH 231.8 of ∼20 km/s is larger than values obtained from H_2O maser profile in most AGB stars (e.g. Colomer *et al.*, 2000). The SiO masers arise in a torus like structure around the Mira placed approximately in the middle of both H_2O maser-emitting areas.

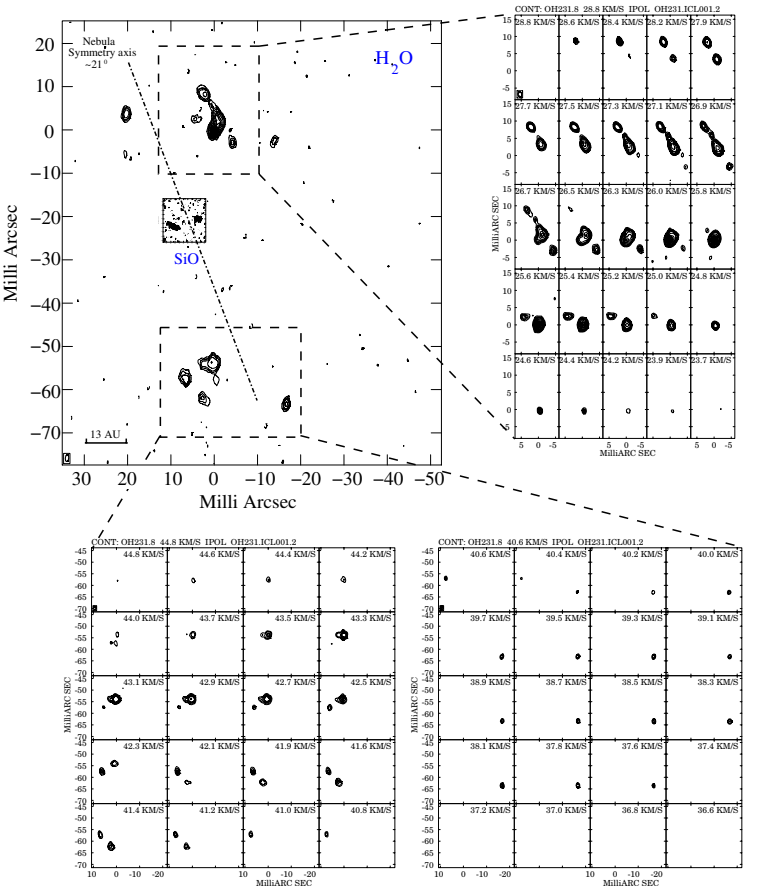

Figure 1. Integrated and velocity H_2O map (SiO map from Sánchez Contreras *et al.*, 2002).

The distribution of the H_2O and SiO masers in OH 231.8 is different from the ring-like chain of spots typically found in AGB stars. The distribution of the H_2O and SiO masers suggests that the equatorial regions of the inner circumstellar envelope of OH 231.8 have been strongly modified. In particular, an equatorial density enhancement, e.g. induced by the presence of the companion, could have quenched and intensified the H_2O and SiO masers respectively in these equatorial regions. Alternatively, the H_2O masers could trace the base of a relatively slow bipolar outflow.

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