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OH masers as probes: How does the variability fade away during the AGB - post-AGB transition?

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Abstract. We are currently performing a monitoring program of the 1612 MHz OH maser emission of several dozen Galactic disk OH/IR stars with the Nancay Radio Telescope (NRT). They are complemented by several OH/IR stars toward the Galactic center, which were monitored with the Hartebeesthoek radio telescope. We use the maser variations to probe the underlying stellar variability. As early monitoring programs already have shown, some stars are large amplitude variables with periods up to 7 years, others show small or even no amplitude variations. This dichotomy in the variability behaviour is assumed to mark the border between the AGB and the post-AGB stages. With the current program, we wish to find objects in transition and to describe their variability properties. We consider the fading out of pulsations with steadily declining amplitudes as a viable process. Promising candidates in the disk are the small-amplitude variables OH 138.0+7.2 and OH 51.8−0.2. 'Non-variable' OH/IR stars in the Galactic center region may be as frequent as in the disk.

Keywords. stars: AGB and post-AGB, masers, stars: evolution

During the AGB – post-AGB evolutionary transition stars stop pulsating. While they are observed as large-amplitude variables on the AGB (L-AGB) they are almost non-variable (S-pAGB or 'non-variable' OH/IR stars) at the onset of the post-AGB phase. In both phases the stars are still deeply embedded in their dusty circumstellar shell. H_2O and OH maser emission are present in both phases. In particular the "water fountains", post-AGB stars with jets traced by high-velocity H_2O masers, have attracted much attention in recent years (e.g., Orosz *et al.*, Perez-Sanchez *et al.*, Tafoya *et al.*, in this volume). However, high-velocity H_2O masers are present only in few post-AGB stars, indicating that they document a brief phase at the beginning of post-AGB evolution and may possibly not be representative for the AGB – post-AGB transition.

To obtain a less biased view on the transition process, we are studying a sample of bright OH/IR stars with a flux limit of ~ 4 Jy compiled by Baud *et al.* (1979). In this sample the L-AGB and S-pAGB stars are almost of equal number (Herman & Habing 1985). Assuming similar bolometric luminosities, this implies that the "pulsating" phase connected to relatively high mass-loss rates ($\dot{M} > 10^{-5}$ $M_\odot$/yr) is of similar duration to the early post-AGB phase (Engels 2002). The absence of stars known to be currently in transition, indicate a rather fast transition time ($\leqslant 2000$ yr). To find transition objects we started a monitoring program of OH 1612 MHz masers, in 2013 with the NRT, to probe

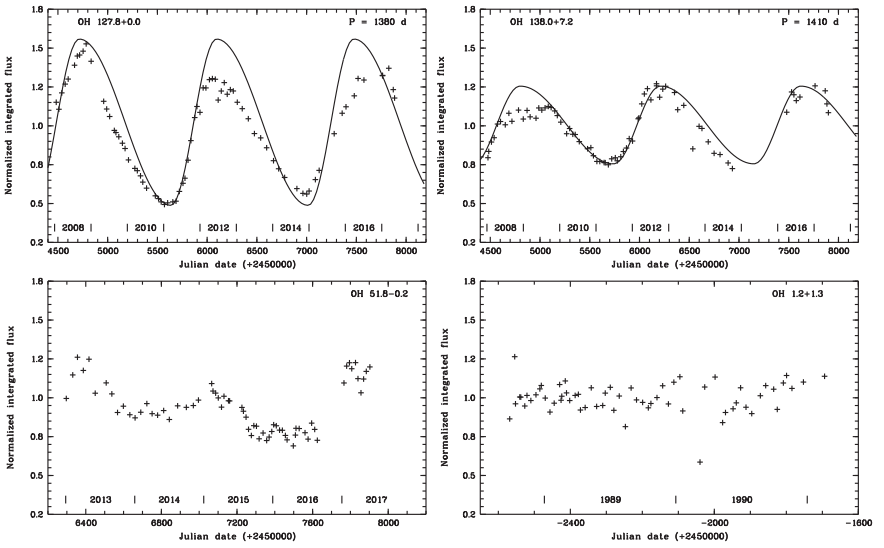

Figure 1. Lightcurves of the 1612 OH maser emission of OH/IR stars monitored at the NRT since 2013 and Hartebeesthoek (1985–1996). NRT lightcurves extending back to 2008 are from a legacy program (Etoka *et al.*, this volume). OH 127.8+0.0 (upper left) is a L-AGB star, and OH 1.2+1.3 (lower right) is a 'non-variable' post-AGB star. The other two OH/IR stars might be objects in transition. The lightcurves give the summed integrated flux of the blue and red emission peaks divided by the mean integrated flux. The stars with periodic variability were fitted by an asymmetric sine-curve.

the underlying stellar variability. A similar monitoring program of OH/IR stars toward the Galactic bulge was made at Hartebeesthoek 1985–1996 (Gaylard & West 1995).

We present here a few examples of OH maser lightcurves obtained so far (Fig. 1). A classical large-amplitude variable AGB star is OH 127.8+0.0 (P$\sim$ 3.8 years). OH 138.0+7.2 still shows periodic variability (P$\sim$ 3.9 years) albeit with significantly smaller amplitude. The type of variability (i.e. periodic or not) of OH 51.8−0.2 is uncertain. OH 1.2+1.3 is a S-pAGB star in the Galactic center region. OH 138.0+7.2 and OH 51.8−0.2 are possible examples for objects in transition between large-amplitude variability and absence of variations. OH 1.2+1.3 shows, that 'non-variable' OH/IR stars are present in the Galactic center region. Summing up all infrared non-variable and non-detected OH/IR stars among the sample monitored in the infrared by Wood *et al.* (1998), the fraction of 'non-variable' OH/IR stars toward the Galactic center is 27%. This is of the same order as found in the disk. Up to now no evidence of stars with short-period, small amplitude pulsations have been found, as assumed to exist as transition objects by Blöcker (1995). While an instantaneous cessation of the pulsation (Vassiliadis & Wood, 1993) cannot be ruled out yet, we consider the fading out of pulsations with steadily declining amplitudes (damped oscillator) as a viable process.

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