

# ALMA spectrum of the extreme OH/IR star OH 26.5+0.6

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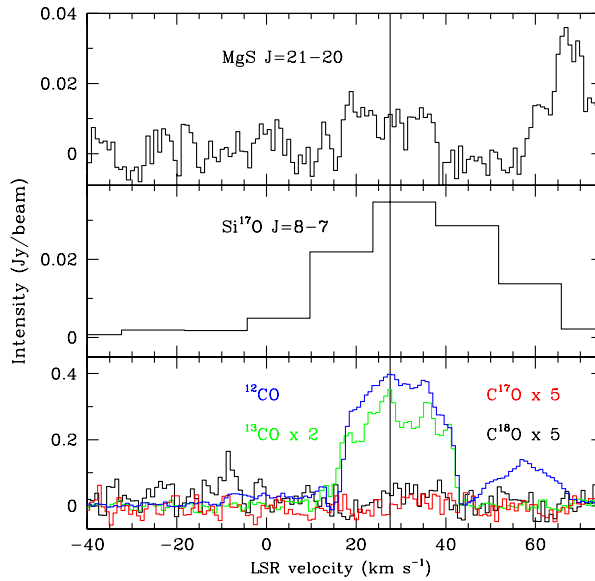
**Abstract.** We present ALMA band 7 data of the extreme OH/IR star, OH 26.5+0.6. In addition to lines of CO and its isotopologues, the circumstellar envelope also exhibits a number of emission lines due to metal-containing molecules, e.g., NaCl and KCl. A lack of C<sup>18</sup>O is expected, but a non-detection of C<sup>17</sup>O is puzzling given the strengths of H<sub>2</sub><sup>17</sup>O in Herschel spectra of the star. However, a line associated with Si<sup>17</sup>O is detected. We also report a tentative detection of a gas-phase emission line of MgS. The ALMA spectrum of this object reveals intriguing features which may be used to investigate chemical processes and dust formation during a high mass-loss phase.

**Keywords.** stars: AGB and post-AGB, circumstellar matter, stars: individual (OH 26.5+0.6), stars: late-type, stars: abundances

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## 1. Introduction

A number of intermediate-mass ( $\sim 4\text{--}8M_{\odot}$ ) that evolve on the AGB are known to be undergoing hot-bottom burning (HBB) from observations of enhancement of <sup>7</sup>Li and other s-process elements (e.g., Garcia *et al.* 2013). The CNO cycle operates during this



**Figure 1.** ALMA spectrum of CO  $J=3-2$  and its isotopologues (bottom),  $\text{Si}^{17}\text{O}$  and a tentative detection of MgS. The vertical line denotes the LSR velocity of OH 26.5+0.6.

evolutionary phase and drives the  $^{12}\text{C}/^{13}\text{C}$  towards the equilibrium value of  $\sim 4$ . The process shuts down when the envelope mass is reduced to  $1 M_{\odot}$  (Karakas & Lattanzio 2014). The Herschel spectrum OH 26.5+0.6 shows a lack of  $\text{H}_2^{18}\text{O}$  while  $\text{H}_2^{16}\text{O}$  and  $\text{H}_2^{17}\text{O}$  are readily detected (Justtanont *et al.* 2013). HBB preferentially destroys  $^{18}\text{O}$  (Karakas & Lattanzio 2014) thereby confirming that the progenitor of OH 26.5+0.6 is an intermediate-mass star. We subsequently observed the object with ALMA in band 7 in 2016 with spectral windows centered on the transition  $J=3-2$  of CO,  $^{13}\text{CO}$ ,  $\text{C}^{17}\text{O}$  and  $\text{C}^{18}\text{O}$  (Justtanont *et al.* 2018, ADS/JAO.ALMA#2015.1.00054.S).

## 2. The ALMA spectrum

A total of about 60 emission lines have been detected in our ALMA observations. Fig. 1 shows the spectrum of CO isotopologues. The  $\text{C}^{17}\text{O}$   $J=3-2$  is not detected above the noise which is unexpected considering that strong  $\text{H}_2^{17}\text{O}$  lines have been detected in the Herschel spectrum of the star. However, we detected a line which can be attributed to  $\text{Si}^{17}\text{O}$   $J=8-7$  at 334.3015 GHz. The resolution of this line is  $14 \text{ km s}^{-1}$  as it falls in a spectral window assigned to a continuum measurement. The ALMA spectrum indicates a possible chemical pathway of molecular formation of oxygen in a high density environment:  $^{17}\text{O}$  is locked up in  $\text{H}_2^{17}\text{O}$  and  $\text{Si}^{17}\text{O}$  rather than  $\text{C}^{17}\text{O}$ .

A line at 335.9845 GHz may be assigned to a new circumstellar molecule. It corresponds to the MgS  $J=21-20$  transition. Previously, a broad dust emission feature at  $30 \mu\text{m}$  has been attributed to MgS dust, but this has been observed only towards C-rich circumstellar environments. A number of lines in the spectrum are due to the lines of SO and metal-containing molecules like NaCl, KCl and their isotopologues. Unlike the low-mass AGB stars, no  $\text{SO}_2$  lines are detected within the spectral range covered by our observations.

## References

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