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 C18O is expected, but a non-detection of C17O is puzzling given the strengths of H217O in Herschel spectra of the star. However, a line associated with Si17O 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

1. Introduction

A number of intermediate-mass (∼ 4-8 M⊙) that evolve on the AGB are known to be undergoing hot-bottom burning (HBB) from observations of enhancement of 7Li 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), Si\textsuperscript{17}O and a tentative detection of MgS. The vertical line denotes the LSR velocity of OH 26.5+0.6.

An evolutionary phase and drives the \textsuperscript{12}C/\textsuperscript{13}C towards the equilibrium value of ∼4. The process shuts down when the envelope mass is reduced to 1 M\textsubscript{☉} (Karakas & Lattanzio 2014). The Herschel spectrum OH 26.5+0.6 shows a lack of H\textsuperscript{18}O while H\textsuperscript{16}O and H\textsuperscript{17}O are readily detected (Justtanont et al. 2013). HBB preferentially destroys \textsuperscript{18}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, \textsuperscript{13}CO, C\textsuperscript{17}O and C\textsuperscript{18}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 C\textsuperscript{17}O J=3-2 is not detected above the noise which is unexpected considering that strong H\textsuperscript{17}O lines have been detected in the Herschel spectrum of the star. However, we detected a line which can be attributed to Si\textsuperscript{17}O J=8-7 at 334.3015 GHz. The resolution of this line is 14 km s\textsuperscript{-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: \textsuperscript{17}O is locked up in H\textsuperscript{17}O and Si\textsuperscript{17}O rather than C\textsuperscript{17}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 μm 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 SO\textsubscript{2} lines are detected within the spectral range covered by our observations.

References
Karakas, A. I. & Lattanzio, J. C. 2014, PASA, 31, 30

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