CO in OH/IR-Stars - on Excitation and Mass Loss

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Observations of CO in long period variables have been widely used to determine mass loss rates by applying models for CO line formation (e.g. Knapp and Morris, 1985) which use a simple method to take the impact from infrared radiation into account. Recent CO(2-1) and (1-0) observations of some more evolved OH/IR stars yielded much too low mass loss rates using these simple models, thus indicating that they cannot be extrapolated to far evolved AGB stars with optically thick circumstellar envelopes.

In order to investigate this effect in more detail we selected a sample of OH/IR stars with well known distances and IR and OH properties which should cover a wide range in optical depths of the circumstellar dust shells. It was observed in the CO(2-1) and CO(1-0) lines with the 30m-IRAM-telescope at Pico Veleta/Spain.

The following results were obtained:

1 - Mass loss rates determined from the CO(1-0) and CO(2-1) lines give too low values compared to those derived from the infrared continuum.

2 - The line ratio CO(2-1)/CO(1-0) increases with increasing IRAS colors when the 9.7 μm feature turns from emission into absorption.

3 - In some objects the expansion velocities derived from the CO(1-0) lines are larger than those derived from CO(2-1) or OH lines. The latter ones are comparable.

The main conclusion is that CO(1-0) and probably also CO(2-1) line intensities are suppressed if optically thick dust is present, i.e. the excitation temperature drops drastically when the optical depths of the dust in the 9.7 μm silicate feature.

Observations of the CO(3-2) line and comparison with present results should give more insight on excitation temperature and level population of CO.

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