Studying the OH emission from low- and intermediate-mass protostars

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Motivation

OH is a key molecule in the water chemistry of protostars. It is linked to both the formation and destruction of H_2O through $OH + H_2 \leftrightarrow H_2O + H$. OH is also an important molecular coolant.

Goals

We would like to determine

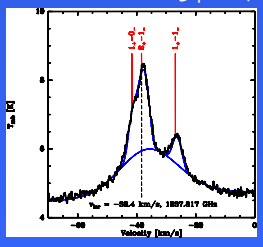
- the origin of the OH emission
- how the OH molecules are excited (collisions vs. radiative pumping)
- the fractional abundance of OH
- the OH/H2O abundance ratio
- the relative importance of the various water formation and destruction routes

Herschel observations

"Water in Star-Forming Regions with Herschel" (**WISH**, PI: E. F. van Dishoeck) key program:

Spatially resolved **PACS** spectroscopy of 13 low-mass class 0 and I YSOs and 5 intermediate-mass protostars in at least four OH transitions (79, 84, 119, 163 μm) .

HIFI high-resolution spectroscopy of 5 sources to resolve the hyperfine structure of the 163 μm (1834 and 1837 GHz) triplets.



HIFI spectrum of the OH triplet at 1837 GHz from the high-mass protostar W3~IRS 5

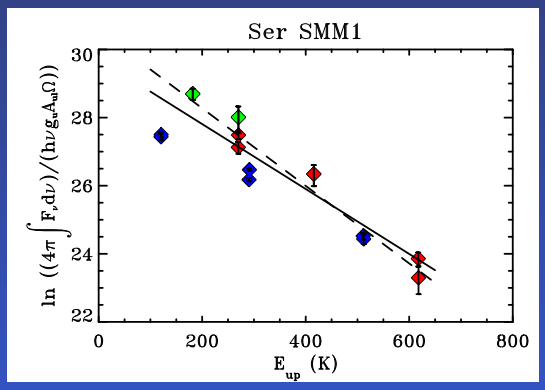
OH excitation study (radiative transfer models)

„Slab" model including dust continuum with density, OH and dust column densities, gas and dust temperatures as free parameters.

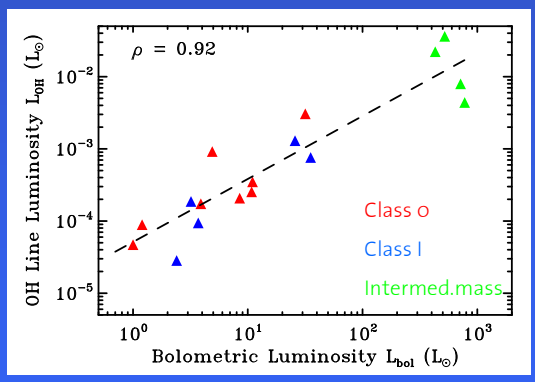
Main result: radiative pumping dominates at low densities, collisions at higher densities.

Observational results

• OH level populations can be approximated by a Boltzmann distribution of T ~ 100 K



• OH luminosity is strongly correlated to the bolometric luminosity, potential correlation with outflow force.



• An origin in the outflow is the most likely scenario for the bulk OH emission, as the HIFI spectra are dominated by a broad component. A significant envelope contribution is only observed in high-mass sources.

References

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S.F. Wampfler et al., 2011, A&A, 531, L16
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