CONTROL ID: 2254693

TITLE: Formation, Excitation and Destruction of CH^+ under the Influence of Water and Irradiation in Star Forming Regions

ABSTRACT BODY:

Abstract Body: Simple ionized hydrides were observed for the first time with Herschel/HIFI towards young star-forming objects of low to high mass. Of particular interest is CH^+, a fundamental precursor molecule for carbon hydrides. Gaseous H_2O reduces the abundance of C and C^+, the starting products of CH^+. The abundances of H_2O and CH^+ cannot be enhanced at the same place. Strong irradiation by FUV or X-rays reduces H_2O, and CH^+ gets more abundant. Thus CH^+ signals high irradiation, but low H_2O abundance.

CH^+ was observed to be enhanced in most objects to an abundance of typically 10^{-10} relative to hydrogen. This suggests an internal source of irradiation. The observed ratio of CH^+/OH^+ is consistent with irradiation by far UV as expected from chemical modelling. For low-mass objects the required FUV flux is between 1 – 200 times the ISRF at the location of the molecules. If the FUV flux originates at the central protostar, an FUV luminosity up to 1.5 L_{sun} is required. The UV flux in two high-mass objects is 30 and 90 times the ISRF using absorption lines, and of the order of 500 ISRF using emission lines. It is smaller than the unattenuated flux expected from the central object(s). The observed CH^+/OH^+ ratio, and other ratios such as OH^+/H_2O^+ and CH^+/C^+, can only be modelled for low molecular hydrogen densities.

The targeted lines of CH^+, OH^+, H_2O^+, and C^+ are detected mostly in blue-shifted absorption. They are proposed to origin in FUV irradiated cavity walls that are shocked by the disk wind. The shock region is turbulent, broadening the lines to some 1 – 12 km/s. It is driven by the outward motion of the wind to blue shifts of 0 to -10 km/s. The blue-shifted H_2O emission line (Kristensen et al. 2013) may be related but not coincident with the CH^+ emitting region.

CONTACT (NAME ONLY): Arnold Benz

CONTACT (E-MAIL ONLY): benz@astro.phys.ethz.ch

AUTHORS/INSTITUTIONS: A.O. Benz, Institute for Astronomy, ETH Zurich, Zurich, SWITZERLAND|B. Simon, E. van Dishoeck, extraterrestrische Physik, Max Planck Institute, Garching, GERMANY|E. van Dishoeck, Leiden University, Leiden, NETHERLANDS|

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