CONTROL ID: 2249617

TITLE: Water in the warm inner regions of Class 0 protostars

ABSTRACT BODY:

Abstract Body: Water plays a key role in many astrophysical environments (star-forming regions, outflows, prestellar cores, comets, asteroids, …) as well as for the emergence of life as we know it. Its detection in the inner regions of low-mass protostars raises the question whether this is similar to the water that is incorporated into comets and asteroids that may deliver it to Earth-like planets. The water deuterium fractionation is very helpful to understand how it forms and evolves. For example, Cleeves et al. (2014) showed that a contribution of water formed in the primordial cloud is necessary to explain the HDO/H_2O ratio of the terrestrial oceans. Observations of the deuterated and non-deuterated forms of water at an early stage of star formation may therefore potentially be an important tool to describe the origin of water on Earth.

We here present recent interferometric measurements of the distribution and deuteration of water on Solar System scales. During the last few years, a few HDO and $H_2{}^{18}O$ lines were observed in the inner regions of Class 0 protostars with interferometers (Jørgensen & van Dishoeck 2010, Codella+2010, Persson+ 2012, 2013, 2014, Taquet+ 2013), which enables estimates of the HDO/H_2O ratios. Our recent detection of D_2O with the Plateau de Bure interferometer towards the low-mass protostar NGC1333 IRAS2A leads to a surprisingly high D_2O/HDO ratio compared with the HDO/H_2O ratio (Coutens+ 2014). These results contradict the predictions of current grain surface chemical models and indicate that either an ingredient is missing in our understanding of the surface deuteration process or that both sublimation of grain mantles and water formation at high temperature (T > 230K) take place in the inner regions of protostars. We also present the first results of an ALMA Cycle 2 program (PI: A. Coutens) to target several HDO, $H_2{}^{18}O$ and D_2O lines at a spatial resolution of ~0.3" (40 AU) toward the nearby protostellar binary IRAS16293-2422. These observations will reveal the dynamics of water in the warm inner regions of protostars and determine if the high D_2O/HDO ratio derived in NGC1333 IRAS2A is specific to this source or common among low-mass protostars.

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