Large Scale Deuteration in the Heart of the Swan, Cygnus-X

Christensen, I. B.[1], Wyrowski, F.[1], and Menten, K. M.[1], Beuther, H. [2] and Bouscasse, L.[1,3]

[1] *Max-Planck-Institut for Radioastronomy, Auf dem Hügel 69, D-53121, Bonn, Germany*

[2] *Max Planck Institute for Astronomy, Königstuhl 17, 69117 Heidelberg, Germany*

[3] *Institut de Radioastronomie Millimétrique (IRAM), 300 Rue de la Piscine, 38400 Saint-Martin-d'Hères, Frances*

Probing the initial conditions and early stages of high-mass clumps is key for our understanding of the formation of high-mass star clusters. During this early stage of star formation, deuterated molecules are efficiently formed. Deuteration is mainly driven by the reaction $H_3^+ + HD \rightarrow H_2D^+ + H_2 + 230$ K, an exothermic reaction at low temperature (below 25 K) [1], where a high degree of deuteration has been found towards clumps hosting young stellar objects in the early stages of high- mass star-formation. Observing the ground state transitions of deuterated molecules provides a unique view into the conditions of the cold-phases, hence gives an insight of the early-stages of high-mass star formation [2,3].

In the frame of the MIOP Cygnus-X project, we aim to explore the large-scale structure of deuterated molecules in the cloud complex Cygnus X at 3-mm wavelength, an ideal hunting ground for massive clumps.

The large-scale structure of deuterated molecules towards high density regions in Cygnus X are mapped. The integrated intensity maps of 12 sub-regions within Cygnus-X are measured in lines from NH_2D, DCO^+, DCN and DNC, the deuterated molecules that show the most extended emission. There are clear differences in the morphology of these molecules' distributions that allow us to constrain the chemical and physical conditions in the star-forming clumps and their cloud environments.

Motte et al. [4] detected 129 dense cores using the IRAM-30m telescope at 1.2-mm wavelength, and Cao et al. [5] used Spitzer, Herschel, the JCMT, and the IRAM 30 m telescope and detected 151 massive dense clumps. Of these, 66 clumps of the Motte et al. catalogue and 60 clumps of the Cao et al. catalogue are covered in the MIOP Cygnus-X. With a 5σ confidence, NH_2D is observed in 45.0%, DCO^+ in 48.3%, DCN in 26.7% and DNC in 53.3% of the covered clumps of the Cao catalogue and NH_2D observed in 54.5%, DCO^+ in 53.0% DCN in 40.9% and DNC in 65.2% in the Motte catalogue.

References

[1] Roberts, H. & Millar, T. J. 2000, A&A, 364, 780

[2] Aikawa, Y., Wakelam, V., Hersant, F., Garrod, R. T., & Herbst, E. 2012, ApJ, 760, 40

[3] Taquet, V., Ceccarelli, C., & Kahane, C. 2012, Apj, 748, L3

[4] Motte, F., Bontemps, S., SChilke, P., et al. 2007, A&A, 476, 1243

[5] Cao, Y., Qiu, K., Zhang, Q., et al. 2019, ApJS, 241, 1