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H2 clumped isotope measurements at natural isotopic abundances with the MAT-253 ULTRA instrument

Maria Elena Popa (1), Dipayan Paul (1,2), Christof Janssen (3), and Thomas Röckmann (1)

(1) Utrecht University, IMAU, Utrecht, Netherlands (epopa2@yahoo.com), (2) Center for Isotope Research (CIO), University of Groningen, Groningen, The Netherlands, (3) LERMA-IPSL, Sorbonne Universités, UPMC Univ. Paris 6, Observatoire de Paris, PSL Research University, CNRS, Paris, France

Natural molecular hydrogen (H2) has three stable isotopologues: HH, HD and DD. At random distribution, the abundance of the so-called “clumped” molecules (DD) is directly related to the D/H ratio. The clumped anomaly (ΔDD) is a measure of the difference between the actual D distribution among HD and DD molecules, and the random distribution.

The ΔDD anomaly is independent from the classical isotopic signature δD, and it is thus interesting as a potential new tracer for studying processes involving H2. At thermodynamic equilibrium, ΔDD has a strong dependence on temperature with a difference of about 200 ‰ over the 0 – 1000 °C range, and with a sensitivity of about 1‰ per °C at ambient temperatures.

The H2 clumped isotope anomaly ΔDD has never been measured at natural isotopic abundance. We will present a method for ΔDD analysis using the new MAT-253 Ultra instrument at IMAU. The precision obtained for ΔDD of 2- 6 ‰ is sufficient to observe the expected natural variability. H2 equilibrated at different temperatures shows a dependence on temperature as expected from theoretical calculations, which validates our method.