The interstellar heritage of planetary systems: the case of nitrogen

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Understanding the formation of the solar system is a prerequisite to a comprehensive theory of our origins, while providing essential clues for the birth of planetary systems in general. In particular, the total amount of volatile carbon, oxygen, and nitrogen, and their spatial distributions, in the early protosolar nebula (PSN), and in PSN analogs, is a fascinating issue in our understanding of the primitive chemical composition of exoplanets. A key question from both astrophysical and planetary science perspectives is thus to know to what extent the reservoirs of volatiles (namely, gas and ice) in planetary systems are of interstellar nature or if chemistry was reset in the PSN at the epoch of planet formation. Isotopic ratios are powerful tools to evince the chemical heritage preserved during star and planet formation. Nevertheless, the isotopic ratios of nitrogen in the solar system is an unsolved problem, which is the central question we will adress in this talk.

In this this talk, we present several results obtained with IRAM and ALMA facilities, towards prestellar cores, protostars, and disks. By measuring the $CN/C^{15}N$ isotopic ratio in the TWHya protoplanetary disk, we could demonstrate that fractionated reservoirs of nitrogen are present in PSN analogs [1] and propose a new value, 330+/-30, for the elemental isotopic ratio of nitrogen in the solar neighborhood, which agrees with galactic chemical evolution model predictions. The carbon and nitrogen isotopic ratios in HCN towards the L1498 [2] prestellar core confirm some of the most recent chemical model predictions but challenge others. Meanwhile, new results on the $HC_3N/HC_3{}^{15}N$ in the L1544 core will serve to illustrate the difficulty of isotopic ratios measurements [3]. In parallel, the gas-phase composition of prestellar cores is investigated using our new nuclear spin *University of Grenoble Astrochemical Network* (UGA) which allows us to reproduce the observed ortho-to-para ratios of nitrogen hydrides in prestellar cores [4]. Future works related to the interstellar heritage of planetary systems from theoretical, modelling, and observational perspectives, will be presented.

Références

[1] P. Hily-Blant et al, 603:L6 (2017)
[2] V. Magalhaes et al, A&A in press (2018)
[3] P. Hily-Blant et al. MNRAS submitted (2018)
[4] P. Hily-Blant et al MNRAS in press (2018)