SKA for astrochemical characterization of Solar System precursors

Eleonora Bianchi*[1]

[1]Univ. Grenoble Alpes, CNRS, Institut de Planétologie et d'Astrophysique de Grenoble (IPAG) – IPAG Grenoble – France

Abstract

In the last years a striking chemical diversity has been identified around Sun-like protostars. In particular, major differences have been observed in the chemistry of hot corinos (enriched in complex organic molecules, e.g. Ceccarelli et al. 2007) and the WCCC (*Warm Carbon Chain Chemistry*) sources (enriched of unsaturated small carbon chains, with less than about five C-atoms: e.g. Sakai & Yamamoto 2013). The origin of this diversity is unclear and it may be related to environmental conditions at the epoch of dust icy mantles formation, as it is unclear which impact this has on the chemical composition of forming planetary systems. Moreover, very few is known so far about the presence and the evolution of large carbon species (e.g. chains with more than seven C-atoms) which cannot be properly investigated at mm wavelengths. Yet, heavy C-species might have a crucial role in the heritage of organic material from the pre- and proto- stellar phase to the objects of the newly formed planetary system, like asteroids and comets (e.g. Mumma & Charnley 2011). Recent pilot surveys have been performed with the Green Bank Telescope to unveil the large carbon chains reservoir in few Solar precursors, discovering a plethora of complex C-chains species (C4H, C6H, HC7N, HC9N, C3S, Bianchi et al. in prep.; see also McGuire et al. 2020, Cernicharo et al. 2021). A fundamental step ahead in astrochemistry is to use SKA to unveil the C-chains reservoir at a Solar System scales, where planetary systems are forming. I will present a dedicated user case for SKA (Band 5), developed in the context of the Cradle Of Life working group activities. The project will shed light on the origin of the chemical diversity observed in Solar-System precursors and on how it affects the composition of the forming planetary systems. These observations will be possible only thanks to the combination of high angular resolution and sensitivity provided by SKA, in which France is strongly implicated through the Maison SKA (https://ska-france.oca.eu/fr/accueil-ska). This project will be highly complementary to several astrochemical surveys at mm- and submm- wavelengths, performed with IRAM-30m (e.g., ASAI survey; Lefloch et al. 2018), IRAM-NOEMA (e.g., SOLIS; Ceccarelli et al. 2017) and ALMA (e.g., FAUST; Bianchi et al. 2020), which obtained the chemical census of complex organic molecules in Solar System precursors. In this respect, the SKA project represents a major step ahead. On the one hand, it will overcome several limitations related to mm-observations, such as dust opacity and line confusion, providing new insights on the envelope/disk protostellar structure. On the other hand, it will unveil a new chemistry of complex C-chain species, which are expected to play a major role in the emergency of life, acting as the backbone of relevant biological molecules, such as proteins.

*Speaker