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From the astrochemistry of Sun-like stars to the origin of life with SKA

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To understand the origin of life in the Universe is one of the most outstanding questions in Astrophysics. Complex organic molecules (COMs; molecules containing carbon with more than 6 atoms) are believed to be the building blocks of prebiotic molecules and have been observed at several stages of the star and planet formation process: in cold and dense prestellar cores, in the hot-corinos around Sun-like protostars, and, recently, also in protoplanetary disks and comets. Key questions still to be addressed are: How chemical complexity is built up along the star formation process and finally delivered to planets? Are COMs passed unaltered from the large-scale envelope to the disk where planets, comets, and asteroids form? Or is there a chemical reset at the protoplanetary disk stage? These are key questions in the context of the SKA WG Cradle of Life.
In the last years millimetre interferometers such as ALMA and IRAM-NOEMA brought a huge advancement in our comprehension of the chemical evolution along the Sun-like star formation process, as they allowed the detection of molecules which are important precursors of amino acids, sugars, and ribonucleotides, as well as the first detections of COMs in planet-forming disks. However, the observations of the innermost regions of protostars and protoplanetary discs (<10 au, i.e. 0.1”at 100 pc), where the formation of terrestrial planets occur is strongly limited by the high optical depth of continuum dust emission at millimetre wavelengths. This prevents measurements of the dust mass in these regions, hence the determination of the raw material available for planet formation, and can also obscure line emission. I will discuss how observations at centimetre wavelengths with the unprecedented combination of spatial resolution and high sensitivity offered by SKA has the potential to provide breakthrough results in terms of detecting biologically-relevant molecules of the planet formation regions around Sun-like stars.

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