

Unravelling the chemical characteristics of YSOs

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The formation of stars is accompanied by orders of magnitude changes in the physical conditions, with densities in the envelopes and disks increasing from 10^4 cm^{-3} to $> 10^{13} \text{ cm}^{-3}$ and temperatures from $\sim 10 \text{ K}$ in the cold quiescent gas to 10,000 K in shocked regions. The abundances and excitation of the various molecules respond to these changes, and are therefore excellent probes of the physical evolution of YSOs. Moreover, a comprehensive inventory of the chemical composition of envelopes and disks at different evolutionary stages is essential to study the chemistry of matter as it is incorporated into new solar systems. Recent observations of the envelopes of YSOs using single-dish telescopes and millimeter interferometers clearly reveal the potential of submillimeter lines to probe these physical and chemical changes. However, the existing data generally lack the spatial resolution to separate the different physical components, such as the warm inner envelope or 'hot core', the region of interaction of the outflow with the envelope and any possible circumstellar disk. ALMA will be essential to provide an 'unblurred' view of the YSO environment and unravel the chemical evolution during star formation.

In this talk, an overview will be given of recent single-dish and interferometer results of the chemistry in the envelopes and disks around low- and high-mass young stellar objects. Together with ISO data on solid-state material, these observations lead to a chemical scenario in which both gas-phase and gas-grain chemistry (in particular freeze-out and evaporation) play an important role. The evaporated molecules drive a rich chemistry in the warm gas, which can result in complex organic molecules. The potential of ALMA to test chemical theories and determine the composition of gas and dust as it enters forming planetary systems will be illustrated.

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