THE JWST ICEAGE: UNRAVELLING SOLID STATE CHEMISTRY THROUGH EPOCHS OF STAR AND PLANET FORMATION[a]

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Solid state condensed molecular materials, or ices, are ubiquitous in our galaxy, particularly in regions where star and planet formation dominates. After H_2, molecular ices like H_2O, CO, CO_2 and CH_3OH are the most abundant molecules in star-forming regions. These ices are also the key reservoir of volatile elements (C, H , N, O, S), and the potential origins of so-called complex organic molecules 9COMs), the organic chemicals with more than 6 atoms that represent the increasing chemical complexity that emerges as star-formation progresses.

With the launch of JWST, a space IR telescope, in 2022, astronomers have a new "eye" on the cold icy star-forming regions of our galaxy, particularly the pre-stellar clouds, protostars and protoplanetary discs where ices dominate the IR spectra. In this talk I'll present the first results from the JWST ICEAGE Early Release Science Programme (http://jwst-iceage.org/). The first results show the showcase the exquisite data quality from JWST and reveal the diversity of icy chemistry found in dark regions of molecular clouds. We present a new budget for the C, O, N, and S budgets of ices in the cloud and our understanding of the chemical pathways by which ices form, including evidence for early formation of methanol, the simplest COM, in water rich ice mixtures and a potential detection of ethanol in this cloud.

All of this is only possible by combining observational spectroscopy with modelling and experiments from the laboratory. I'll highlight the work ongoing across the ICEAGE team, in gas-phase sub-mm observations, astrochemical modelling and laboratory spectroscopy, to enable us to extract the maximum understanding and analysis of the ICEAGE spectra. One aspect of this is the potential to map the distribution of ices in space, utilising slit-less spectroscopy techniques. Our ability to exploit JWST to extract and compare 100's of ice spectra concurrently will be briefly shown - with the first "look" ice map data from the ERS ICEAGE programme.

[a]on behalf of the JWST ERS ICEAGE Team