Bridging the gap between ice observations and modelling: laboratory data holds the key

Helen Fraser*[1], Martin Mccoustra[2], Serena Viti[3], and Wendy Brown

[1]The Open University (OU) – walton hall milton keynes UK Mk7 6AA, Royaume-Uni
[2]Heriot-Watt University – Royaume-Uni
[3]UCL – Royaume-Uni

Résumé

As part of the UK commitment to ASTRONET, two projects have currently been funded at the national level (by STFC) to address the need for laboratory data in astronomy. Ours is one of these projects, and is focused on solid-state astrochemistry - interstellar ices in particular.
Interstellar ices form during a rich surface chemistry in the pre-stellar phases of molecular cloud evolution. Although models predict that this chemistry provides the "starting block" for the complex chemistry that occurs in the solid-state and gas phases in subsequent cloud collapse and star-formation phases, we still do not have a full understanding of the ice formation process, even in pre-stellar phases, partly becuase we lack large statistics on ice observations in pre-stellar cores, and also becuase we still have significant data requirements for accurate models, which themselves require additional constraints on their initial conditions. The problems are cyclic.

Our current project attacks these issues from two concurrent angles. First, benefitting from the plethora of background star observations our team completed with AKARI, we now have ice inventories across a range of pre-stellar evolutionary stages, as well as water ice detections towards 100's of objects. From this huge increase in background star ice statistics, we can start to constrain astrochemical models in their pre-stellar phases. Furthermore, to extract ice abundances requires accurate laboratory spectroscopic data and processing. We are developing a suite of astrophython tools (to be made public in late 2015) to simplify the fitting process to astronomical data. Here I will highlight the laboratory data needs from an observational astronomy perspective, and show how our laboratory work contributes.

Secondly, our team is developing novel methods in astrochemical models - attacking the pre-stellar chemistry not from initial conditions input and then running steady state / time dependent models, but rather constraining the models with known observables and working backwards to find out where the probability of initial condition values lie. We can then revert the issue and look at temporal ice evolution and predict gas phase abundances. All of this is dependent on the ice observational data, and of course the solid-state ice chemistry modelling within the computer. We will highlight Uk efforts in both surface reactivity, desoprtion and ice observations to illustrate the Uk's efforts at this time in this field.
We look to forging closer links with the KIDA community and others working with similar aims.

*Intervenant