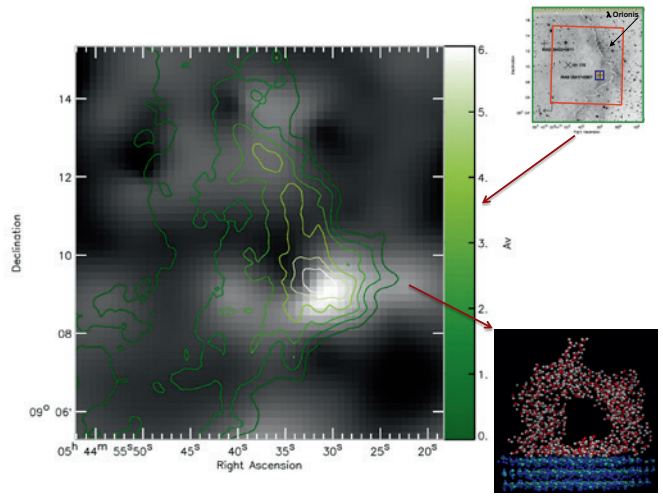
Colloquium

SFB 956

Conditions and Impact of Star Formation

30.06.2014
Monday 4:00 pm

Physikalische Institute Köln
Lecture Hall III
Zülpicher Straße 77 | 50937 Köln



Dr. Helen Fraser
The Open University, Astronomy Division, UK

Mapping the Frozen Void: What can ice tell us about star-formation?

In regions of star- and planet- formation conditions are sufficiently cold, ‚dense' and dark that molecules and atoms acrete onto interstellar dust, forming layers of condensed molecular solids, or ices. The icy material is dominated by water, which under interstellar conditions forms a porous, amorphous material, whose hydrogen bonding structure and chemical and physical properties drastically influence interstellar solid-state chemistry, the gas-solid synergy of ISM regions, and the ‚stickiness' of interstellar dust - and therefore whether or not it can impact on planet formation mechanisms around or beyond the snow line of protoplanetary disks.

Our research focuses on interstellar ice, and combines observational data with laboratory techniques and theoretical molecular dynamics calculations. We have recently focused on developing methods of spatially mapping ice distribution across pre-stellar cores, on scales of up to 10' x 10'. Such direct methods offer a rather different insight, on a significantly different astronomical scale, to the innovative, yet indirect, methods of inferring CO snow-lines from N2H+ imaging with ALMA. Our ice maps show that ice can be detected in regions where dust densities are relatively sparce, and way beyond the ‚CO gas edge' or detectable ‚dust emission edge' of a cloud. These transition regions are very interesting, as they probe the interface between the diffuse and dense ISM. The question then arises how and why ice might exist on interstellar dust grains in regions where we had not previously thought it could be possible. The potential for developing the technique in the JWST E-ELT METIS era will be highlighted.

This requires innovative laboratory techniques. By working with nano-fabrication experts we have developed nano-templated surfaces, which realistically represent interstellar dust grains. I will show that both optical and desorption properties of the surfaces change with scaling, and discuss the results in the context of interstellar chemistry. The results show the influence dust grain surfaces and their chemical composition can have on gas-solid synergies. The porosity of interstellar ices remains a bone of contention. using neutron scattering we can show that all interstellar ices are porous, and elucidate some very interesting data on the pore size and shape distribution, and the rate of collapse. These results are corroborated by molecular dynamics simulations. Finally I hope to showcase our latest experimental adventure. Using a THz SHRIM instrument, developed for atmospheric observations utilizing ALMA receiver technology, we are attempting to observe emission spectra from desorbing gas and radical species just above ice surfaces. The first data, from simple ice heating and desorption will be presented. The context in which such laboratory experiments can be applied to data from Herschel and ALMA will be discussed.