Master's thesis project in Space, earth and environment

Investigating ice-gas transitions in early star formation

Background

Interstellar clouds, the birth-sites of solar mass stars, provide the initial building blocks of gas and dust for the formation of planets in protostellar disks. Therefore, the chemistry of these clouds is intimately linked to the composition of planetary systems. In our quest to assess habitability of planets around other stars we are especially concerned with the amount of water and organics available to planetary objects as they form. However, it is not even well understood under which interstellar conditions water will exist in the gas-phase instead of being completely bound to ices covering the dust-grains – something that is crucial to know to properly assess its availability in planet-forming disks.

This Thesis project aims at investigating the peculiar environment in Barnard 5, a dark molecular cloud in the Perseus constellation where young solar-type stars are on the verge of being born. Here, both water and complex organic molecules have been found to exist in the gas-phase although temperatures are only about 10 degrees above absolute zero, and the mechanism by which the molecules have been converted from ice to gas-form is still a mystery. To discern between theories, observations of molecular distributions in the region will be analysed and, together with other published data, be compared to predictions by models.

Task description

The student will reduce and analyse molecular line emission data observed with the Onsala 20 meter telescope. The observations will be used to map the distribution and velocity structure of two different molecules tracing different gas conditions: dense dark cores and evaporated gas. If there is interest from the student, the project could also include chemical modeling of the Barnard 5 environment, in terms of modifying and running an existing code of theoretical chemistry evolution.

Required education and potential course requirements

The course "Interstellar Medium and Star Formation" (RRY041) is required and "Radio Astronomical techniques and interferometry" (RRY131) is highly recommended for this project.

Computational skills with some common programming/scripting language (e.g., Python, Matlab) are required if the student choose to do complementary chemical modeling.

Credits: 30 or 60 credits

Starting time: Any time.

Contact information to supervisor

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