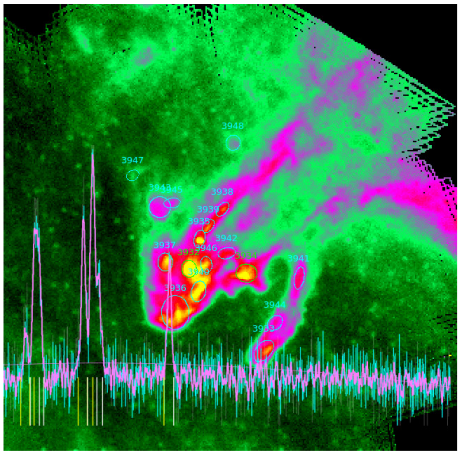
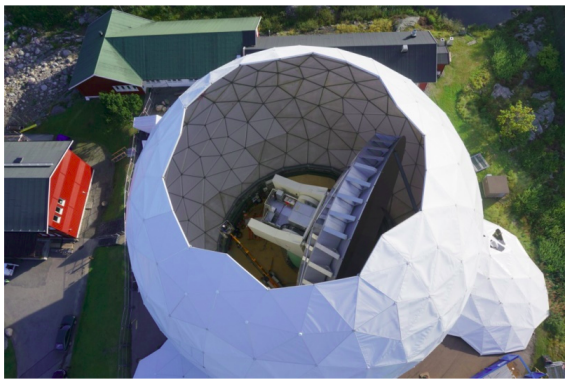
Spectroscopic characterization of low-mass star-forming regions

Stars form in molecular clouds, in compact over-densities called “dense cores”. Understanding the early phases of star formation therefore implies to characterize dense cores, prior to the arrival of a protostar. The similarities between the core mass function (CMF), i.e. the distribution of core masses, and the initial mass function (IMF), i.e. the distribution of initial star masses, suggest that the stellar masses are statistically pre-determined by the cloud fragmentation processes that are responsible for the formation of cores. Two main mechanisms were proposed to explain cloud fragmentation: turbulent fragmentation and gravitational fragmentation. Simulations show that these two mechanisms lead to different predictions for the low-mass tail of the CMF. However, low-mass cores are faint and have attracted only little attention from the community; they remain very weakly constrained. We have observed ~200 candidate low-mass cores in eight different molecular clouds with the Onsala 20-m radiotelescope to determine the fraction of them that are actual dense cores and could eventually give birth to a star.

The aim of this project is to analyze our Onsala data to characterize their volume density, their internal dynamics, and conclude about their gravitational stability. The first step will consist in automatizing the data reduction to obtain clean spectra for all the sources. The obtained spectra will then be analyzed to derive the aforementioned physical quantities and characterize the distribution of low-mass cores in correlation with the properties of their host molecular cloud.





Left: The "Polaris Bear" molecular cloud seen by the Herschel space telescope at 250 µm. Superimposed is a spectrum of the N_2H^+ (J=1-0) molecular tracer obtained with the Onsala 20-m radiotelescope. Right: The Onsala 20-m telescope in its radome during renovation.

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