GENESIS

GENeration and **E**volution of **S**tructures in the **Is**m

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The formation of stars is intimately linked to the structure and evolution of molecular clouds in the interstellar medium (ISM). We propose to explore this link with a new approach by **combining far-infrared maps of dust** (***Herschel***) and **cooling lines** (C+ with ***SOFIA***) with **molecular line maps**. Dedicated **analysis tools** will be used and developed to analyze the maps and compare them to simulations in order to identify for the underlying physical processes. This joint project relies on the complementary expertise of the members of the **Cologne KOSMA group** (structure identification methods and SOFIA), the **Bordeaux LAB** star formation group (Herschel and spectro-imaging maps) , and the Bordeaux **GeoStat team of INRIA** institute (experts in nonlinear methods for the analysis of complex systems).

To understand the genesis of stars, it is necessary to disentangle the relative importance of *gravity, turbulence, magnetic fields*, and *radiation* from diffuse gas, to molecular clouds and collapsing cores, and to study the role of filaments. Using innovative new analyzing tools developed by the GeoStat team, we will analyze the Herschel images as well as new spectro-imaging surveys from ground-based telescopes, and THz spectroscopy using SOFIA. The comparison with similar analysis on simulated clouds will allow us to derive the underlying physical process which explains **cloud evolution and the formation of dense structures**. We select template clouds that cover a representative parameter space of mass, temperature, and star-formation activity to test the different evolutionary stages and the diversity in star-forming clouds. Close collaboration with the Cologne group is required to profit from their long-lasting expertise of quantifying cloud structure (e.g. Delta-variance) and statistical measures (e.g. N-PDFs) for these innovative methods and analysis tools that will be developed by the Bordeaux partner (LAB) in an interdisciplinary effort together with GeoStat. We will also explore the coupling of **turbulence** with **heating- and cooling processes** that leads to structural changes and that may help us to improve our understanding of the role of feedbacks to regulate the star formation efficiency. More precisely we aim at identifying the spatial scales of the transition phase from atomic to molecular hydrogen, at determining the location of the dissipation of turbulence and get insight into other structure generating processes.

The project does not aim at a full understanding of star formation within 3 years, but it constitutes an important step forward as it will make systematic use of a wealth of existing, yet not fully exploited archival data, carefully chosen new observations, and sophisticated tools to analyze and interpret the data. As such, it will shed new light on how molecular clouds and stars form and may well be the starting point for many studies to follow.