2023 地球科學暑期學生專題研究計畫（ESSSP 2023）

由 ^{13}CO 發射譜線辨識分子雲中的恆星形成緻密氣體核

Identifying star-forming cores in ^{13}CO emission maps

- Star formation efficiency in molecular clumps -

國立臺灣師範大學光電工程學士學位學程

學生：林柔穎

指導教授：李悅寧 博士、Raffaele Rani 博士

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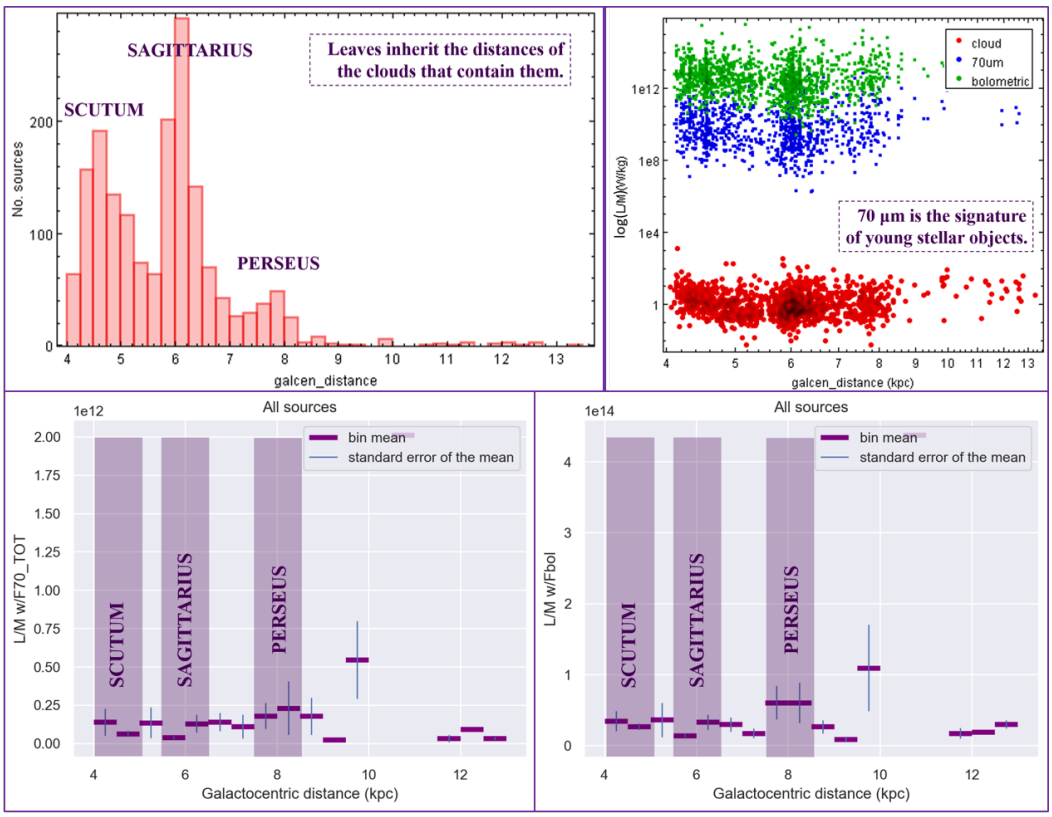
Abstract

Multi-tracer surveys have revealed the hierarchical nature of molecular clouds, showing how high-density, small-scale features are always nested within more rarefied, larger envelopes. The densest regions in a cloud are compact cores, the seeds of star formation. With an algorithm based on dendrograms, graphs and clustering theory (SCIMES), individual gaseous structures (molecular clouds) are identified in the 13CO emission maps of the CO Heterodyne Inner Milky Way Plane Survey (CHIMPS) emission maps. In this project, we find the densest regions within CHIMPS molecular clouds. These regions are encoded within the leaves of the emission dendrogram. We estimate the star formation efficiency (SFE) of each leaf by matching the leaf with infra-red (IR) luminosities measured independently in the Herschel infrared Galactic Plane Survey (Hi-Gal). We then make use of the physical properties of the leaves (e.g. density, size, mass) to search for a connection between the leaves' characteristics, their Galactic environment and SFE. We find that the SFE (defined as the IR luminosity/mass) of the leaves is not influenced by the spiral arms, suggesting that these large-scale features are not direct triggers of star formation. Also, as the star-forming cores (IR emission) are very localized, the luminosity of the leaves increases by smaller amounts than the leaves' mass when larger leaves are considered, thus the SFE decays with increasing mass.



Large-scale structures, such as spiral arms, do not seem to influence the star formation efficiency, but act as regions of source crowding.

Reference

Brunt, 2014, MNRAS
Colombo, 2015, MNRAS
Rigby, 2016, MNRAS
Elia, 2017, MNRAS
Rani, 2022, MNRAS