Density structure and fragmentation of infrared-dark filaments

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1 Abstract

Far-infrared dust imaging surveys of Galactic molecular clouds with Herschel have revolutionized our observational understanding of the link between the structure of the cold interstellar medium and the star formation process, emphasizing the role of filaments. In the nearby clouds of Gould's Belt (d ¡ 0.5 kpc), the Herschel results suggest that fragmentation of ∼0.1 pc wide "supercritical" filaments is the dominant mode of at least solar-type star formation. However, due to limited resolution, Herschel data cannot resolve the transverse size of filaments beyond ∼0.5 kpc and cannot probe fragmentation into individual pre-/proto-stellar cores beyond ∼1 kpc, in giant molecular clouds, more representative of star formation on galactic scales than nearby clouds. Higher-resolution imaging made possible by JWST at mid-infrared wavelengths are crucially needed to test the filament scenario supported by studies of nearby star formation regions and investigate whether it holds throughout the Milky Way, and in particular in high-mass star-forming regions.

I will present our accepted JWST Cycle 1 project, which takes advantage of the unique resolution and sensitivity of JWST in the mid-infrared and will target six infrared-dark filaments at distances d∼1.5 − 8 kpc in the Galactic disk to obtain high-dynamic-range absorption maps at 7.7 μm. The mean line masses of the filaments range from ∼70 to ∼1000 $M_{\odot}$/pc, which that these are massive, thermally supercritical structures . The spatial resolutions between ∼ 0.004 pc and ∼0.01 pc will be sufficient to resolve the thermal Jeans length, and therefore the smallest fragments, in all targets. This was not achieved by *Spitzer* or *Herschel* observations.

Furthermore, I will show other applications of MIRI instruments in the field of star formation that will be observed in the coming years.