Results from the Herschel Gould Belt survey: Toward a new paradigm for star formation on GMC scales ?

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Résumé

An overview of the results from the Herschel Gould Belt survey will be presented. The Herschel images of nearby interstellar clouds all reveal a rich network of filamentary structure and suggest an intimate connection between these filaments and the formation process of prestellar cores. Remarkably, filaments are omnipresent even in unbound, non-star-forming complexes and seem to be characterized by a narrow distribution of widths around ¯ 0.1 pc. This characteristic width approximately corresponds to the sonic scale below which interstellar turbulence becomes subsonic in diffuse gas, supporting the view that the filaments may form as a result of the dissipation of large-scale turbulence. In active star-forming regions, most of the prestellar cores identified with Herschel are located within gravitationally unstable filaments above a critical threshold ¯ 16 Msun/pc in mass per unit length or ¯ 160 Msun/pc^2 in gas surface density. Altogether, the Herschel results favor a scenario in which interstellar filaments and prestellar cores represent two key steps in the star formation process: first large-scale magneto-hydrodynamic turbulence stirs up the gas, giving rise to a universal web-like structure in the interstellar medium, then gravity takes over and controls the further fragmentation of filaments into prestellar cores and ultimately protostars. This scenario provides new insight into the inefficiency of star formation, the origin of the initial mass function, and the global rate of star formation in galaxies. Despite an apparent complexity, global star formation may be governed by relatively simple universal laws from filament to galactic scales. In addition to these science highlights, the legacy of the survey will include complete samples of nearby prestellar cores and Class 0 protostars. This will provide a unique database for follow-up, higher-resolution studies of the physics of individual cores and protostars with NOEMA and ALMA.

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