Contribution ID: **68** Contribution code: **CC02** Type: **Talk**

What determines star formation in the Galaxy

Wednesday, January 7, 2026 10:05 AM (15 minutes)

Star formation is a complex, multi-variate process, with competing physical mechanisms (e.g., gravity, turbulence, magnetic field) being entangled. What determines the rate and efficiency of star formation remains a fundamental question in the field of star formation. We Utilize the probability distribution function of gas column density (N-PDF) to separate turbulence-dominated gas and gravitationally bound gas, finding a remarkably tight linear correlation between the gravitationally bound gas mass and the star formation rate (SFR), valid more than 4-5 orders of magnitude of star forming clouds in the Milky Way, include regions in the Galactic Central Molecular Zone (CMZ) . This result demonstrates that gravitationally bound gas is the star forming gas that people have long been looking for, and it is the key to determine star formation in the Galaxy. Once gravitationally bound, gas exhibits a consistent star formation efficiency to be converted into stars. This new correlation can well explain some classic puzzles like the existence of Av=8 threshold for star formation, and why the CMZ has very low star formation efficiency. It also provides a new perspective to the theoretic and simulation work of star formation.

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Session Classification: Contributed talks

Track Classification: CC02: ISM and Astrochemistry