# Velocity Gradients in Relation to Spatial Scales of Star-forming Dense Cores in the Perseus Molecular Cloud

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Stars originate from massive dense cores of gas and dust. Cold gas and dust in interstellar molecular clouds clump up due to turbulent motion and form regions called dark clouds that are slightly denser than their surroundings. When those dark clouds grow to a certain size and mass, gravity forces them to further collapse into star-forming dense cores. Initial conditions of a star-forming core, such as its mass, rotation rates and angular momentum, are vital to the study of star formation, and I set out to explore possible relationships between the rotation rates of star-forming cores and their size. Using local velocity gradients and interstellar ammonia integrated intensity, I subdivided four star-forming regions in the Perseus Molecular Cloud, B5, L1448, L1451, and IC348, into smaller sub-regions. By fitting a solid-body-rotation model to ammonia spectrum data of those sub-regions, I was able to derive sub-regions' velocity gradients as measures of their rotation rates. Using velocity and density maps of the region, the I showed the existence of sub-regions inside pre-defined star-forming cores that exhibit rotations different from that of the overall core. By comparing the rotation rates of sub-regions to their region size, I found that smaller sub-regions rotate more like solid-bodies and that rotation rates of sub-regions dramatically increased at the size of less than 0.2 parsecs. The newly discovered radius of 0.2 parsecs matches up with the perviously discovered radius of coherence and provides new insight to defining the boundaries of star-forming dense cores.

**Awards Won:**