Core Fragmentation and Disk Stability in High-Mass Star Formation: The link between observations and simulations

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In recent years, we have been able to resolve rotating structures surrounding the most luminous cores and find differentially rotating disk-like structures, making a case for high-mass star formation being a scaled-up version of low-mass star formation in this context. However, the fragmentation mode and the properties of these disk-like structures have yet to be comprehensively characterised. Using the IRAM NOrthern Extended Millimeter Array (NOEMA) and the IRAM 30-m telescope, the CORE survey has obtained high-resolution (∼0.35”, 700 AU at 2 kpc) observations of 20 well-known highly luminous star-forming regions in the 1.37 mm wavelength regime in both line and dust continuum emission. I will present our findings on the disk-scale kinematics of the sample with a focus on the W3(H2O) star-forming region. We find that different fragmentation processes can contribute to the final stellar mass distribution within a single region, with core fragmentation on large scales and disk fragmentation on smaller spatial scales. With temperature information obtained from radiative transfer modelling of the dense-gas tracer CH3CN, we are able to study the Toomre stability of these structures and predict their fate in the disk fragmentation scenario. Furthermore, we use radiation hydrodynamic simulations to test the applied methods and investigate the limits of what current observations can unveil.

Outflow Disks