

Unravelling the Mysteries of Star and Planet Formation with ALMA

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The Atacama Large Millimetre/submillimetre Array (ALMA) is an astronomical telescope located on the Chajnantor plateau in northern Chile. An international partnership between North America, Europe, and Asia, ALMA is composed of 66 antennas working together as an interferometer to provide astronomers with the highest angular resolution, image fidelity, and sensitivity for observations in the 100 GHz to 1 THz region of the electromagnetic spectrum.

Stars form deep within molecular clouds, where the resident gas and dust effectively hide the process from telescopes operating at visible wavelengths. As well, the cold dense gas which collapses to produce (proto)stars emits thermal radiation predominantly at far infrared and longer wavelengths. This same gas produces millimetre and submillimetre molecular line emission. Together, these thermal and line emission processes provide discriminating probes of the physical (and chemical) processes taking place during star formation. While forming, most Sun-like stars are surrounded by a disk of circumstellar material within which we expect planets to form. To uncover the specific processes leading to planet formation, however, one needs exquisite angular resolution and extreme sensitivity to separate planets from the star and disk.

Despite only now reaching final completion, ALMA has undertaken four years of early science observations. Already star and planet formation investigations with ALMA are transforming our understanding of these fields. ALMA has uncovered important astrochemistry, including a detection of sugar - a building block of life - in the disk around a forming star. ALMA has revealed the destructive power of nearby massive stars on the potentially planet-forming disks around young low-mass stars. Most excitingly, ALMA has revealed structure in disks, indicative of planetary dynamics, and evidence for the coagulation processes required to form these very same planets.

In this talk I will discuss the role of technology in providing the measurements necessary to unravel these mysteries of star formation.