Studying the factors that determine multiplicity and chemical complexity in Perseus

N. M. Murillo,[1] and N. Sakai[1]

[1] *Star and Planet Formation Laboratory, RIKEN, Japan*

Star formation involves a wide range of physical and chemical processes. To fully comprehend and build a picture of star formation and evolution, we need to understand how each process influences the final outcome. While models provide some insight into this question, observational constraints are needed to fully understand this topic.

Two aspects of protostellar systems that are of interest are their multiplicity and chemical complexity. Multiple protostars are common at all stages and masses of star formation. The chemical complexity of protostellar systems significantly varies among systems. A curious observational occurrence in low-mass star formation is that almost all, if not all, chemically complex systems are multiple protostellar systems (e.g., IRAS16293, NGC1333 IRAS4), but not all multiple protostellar systems are chemically complex (e.g., VLA1623, L1448 N). In addition, within multiple protostellar systems the chemical complexity can vary among components.

Observations of protostellar systems from molecular cloud to disk scales are needed to study which physical and chemical processes determine multiplicity, chemical complexity, and whether there is a relation between both. A large sample including multiple and single protostellar systems is necessary to obtain statistically significant results. The Perseus molecular cloud (d ~ 300pc) is ideal for such studies, given the extensive available data which covers dust continuum, molecular lines, and magnetic fields for a range of scales.

In this talk, a large sample of Perseus protostellar systems observed with the Nobeyama 45m Telescope, Atacama Pathfinder EXperiment (APEX), and Atacama Large Millimeter/submillimeter Array (ALMA) will be presented. Our observations trace scales from molecular cloud to the protostellar envelope (few 100 AU). The spectral set-up includes a range of molecular species that can trace gas distribution, kinematics and temperature toward each protostellar system to study the impact of heating, mass, and accretion on multiplicity and chemical complexity. Further information from smaller scales is obtained from previous studies. Our results suggest that multiplicity is determined by mass, while how that mass is accumulated may be related to chemical complexity.