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Chronology of Episodic Accretion in Protostars - an ALMA survey of the CO and H2O snow lines

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Contributed talk

Abstract:
Episodic accretion is nowadays a well accepted process in low-mass star formation, but its origin and influence on star forming process are not yet fully understood. We present an ALMA survey of N2H+ (1 − 0) and HCO+ (3 − 2) toward 39 Class 0 and Class I sources in the Perseus molecular cloud. N2H+ and HCO+ are destroyed via gas-phase reactions with CO and H2O, respectively, and are thus used to trace the CO and H2O snowline locations. If the snowline location is at a much larger radius than that expected from the current luminosity, then a past accretion burst has likely occurred that has shifted the snowline outward. Among our sample, we find that ~96% of the sources are post-burst sources from N2H+, and 7/17 Class 0 sources and 1/10 Class I sources are post-burst sources from HCO+. Assuming that the refreeze-out timescales are 1000 yr for H2O and 10,000 yr for CO, respectively, we derive the intervals between the burst episodes to be ~2400 yr and ~10,000 yr for the Class 0 and Class I stages. The median mass-accretion rate during the burst is found to be ~ (1.8–4.2)×10^5 Msun/yr, which, together with the burst frequency, enable us to construct a mass accumulation history. We suggest that episodic accretion could start from the earliest evolutionary stage and that the burst frequency decreases with time from the Class 0 to Class I stages. If an accretion burst is triggered by an infalling fragment, this result suggests that fragmentation is prone to occur at the earlier evolutionary stage or that the fragments tend to fall more often onto the central source.

Presenter: Dr HSIEH, Tien-Hao

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