P125a Signs of the global and local infall in a 70 μm dark massive clump

Kaho Morii (University of Tokyo), Patricio Sanhueza, Fumitaka Nakamura (NAOJ/SOKENDAI), Ken′ichi Tatematsu (NAOJ), Takeshi Sakai (University of Electro-Communications)

Understanding gas dynamics is a key for understanding star formation. Recent observations of infrared dark clouds (IRDCs), the birthplace of high-mass stars, imply the necessity of core growth by feeding gas from the surroundings (e.g., Morii et al. 2023). To investigate the gas dynamics around cores and the prevalence of a high-mass infall rate, we performed ALMA observations of a 70 μm dark high-mass clump AGAL337.541–00.082, embedded in an IRDC. It is a massive (1180 $M_\odot$), dense (0.45 $\mathrm{g\,cm^{-2}}$), and cold (12 K) region, thought to be in the early stages of high-mass star formation. Previous ALMA observations revealed 19 cores, including two intermediate-mass cores (10 and 4 $M_\odot$) associated with east-west CO outflows at the clump center, embedded in a sub-clump with a mass of $\sim$100 $M_\odot$. We find a clump-scale velocity gradient from north to south using the N_2H^+ (J=1–0) line. The position-velocity diagram shows the velocity gradients in the sub-clump and around two intermediate-mass cores. We estimate the infall rate from the velocity gradient to be $\sim 2\times10^{-3} M_\odot\,\mathrm{yr^{-1}}$, which is high enough for the cores to become massive within a free-fall time. We also find the local infall motion from the blue asymmetry profile in HNC (J=3–2). Assuming a spherical infall around the cores, a similarly high infall rate was estimated ($\sim 3\times10^{-3} M_\odot\,\mathrm{yr^{-1}}$). The detection of such a high infall rate in IRDCs implies the role of gas feeding towards the cores to form high-mass stars and confirms the potential of 70 μm dark IRDC clumps to form high-mass stars.