P115b Star Formation Signatures in the 70 μm Dark High-mass Clump G23.477

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The investigation of high-mass infrared dark clouds allows to constrain the initial conditions of high-mass star formation. We observed a 70 μm dark high-mass clump G23.477+0.114 (d$\sim$4.9 kpc) using ALMA Band-6 at an angular resolution of $1''.2$. In the autumn annual meeting 2020, we reported the identification of cores embedded in the clump and the discovery of outflows in this clump for the first time (P119a).

Here, we present the unveiled star formation signatures with some line emission; N_2D^+ (3–2), DCO^+ (3–2), DCN (3–2), CO (2–1), SiO (5–4), H_2CO (3–2), and CH_3OH (4–3). The 11 cores (1.1$\sim$19 $M_\odot$) identified using dendrograms are subvirialized cores. At least four protostellar cores are associated with outflows and H_2CO/CH_3OH line emission. Five cores are regarded as prestellar cores. Two cores have no outflow in CO/SiO but are associated with H_2CO/CH_3OH. From one of them (ALMA 1) with a mass of $\sim$14 $M_\odot$, strong N_2D^+ emission was detected. In addition, the $C^{18}O$ depletion factor in ALMA 1 is similar to the values measured in prestellar cores rather than protostellar cores, suggesting ALMA 1 is in the early phase of the protostellar formation. It is expected that with $\sim$1000 $M_\odot$, G23.477 should form high-mass stars. The non-detection of turbulent high-mass cores suggests that in order to form high-mass stars the current cores require to accrete a significant amount of mass, favoring competitive accretion scenarios over the turbulent core accretion model. Alternatively, virialized high-mass prestellar cores could appear later in the evolution of the cluster formation.