P124a Universality of relation between SFR and mass of dense gas

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Essentially the same relation between star formation rate (SFR) and mass of dense gas above the threshold ($M_{\rm dense}$) is found in nearby Galactic clouds [SFR=$4.6\times10^{-8}M_{\odot}{\rm yr}^{-1}$ $\times(M_{\rm dense}/M_{\odot}$) – Lada et al. 2010] and external galaxies [SFR=$1.8\times10^{-8}M_{\odot}{\rm yr}^{-1}\times(M_{\rm dense}/M_{\odot})$ – Gao & Solomon 2004]. A very similar relation can be derived from the Herschel results in nearby clouds (Andre et al. 2014), suggesting that the star formation scenario sketched above may well apply to the ISM of other galaxies. In other words, there may be a quasi-universal "star formation law" converting the dense molecular gas of supercritical filaments into stars above the threshold at $A_{\rm V}>8$. They, however, used the different dense gas tracers. To investigate the universal star formation law converting the dense molecular gas into stars, wide-field mapping observations in the same dense gas tracers are crucial. We have carried out wide-field mapping observations with a spatial resolution of ∼0.04 pc in HCN(1–0) toward Ophiuchus, Aquila, and Orion B using the MOPRA 22m, IRAM 30m, and Nobeyama 45m telescope. The SFRs in each region are estimated to be ∼1-30$\times10^{-6}M_{\odot}{\rm yr}^{-1}$ from the number of the Class II objects. The mass of dense gas $M_{\rm dense}$ is estimated to be ∼400–3000 $M_{\odot}$. We found that the relationship between SFR and the mass of dense gas can be expressed as SFR=$3.0\times10^{-8}M_{\odot}{\rm yr}^{-1}\times(M_{\rm dense}/M_{\odot})$. The same relationship is found in the external galaxies. These results suggest the universality of the star formation law converting the dense gas into stars.