From Interstellar Clouds to Star-Forming Galaxies:
Universal Processes?, E68, 1 of 2
Proceedings IAU Symposium No. 315, 2016
P. Jablonka, Ph. André, & F. van der Tak, eds.

doi:10.1017/S1743921316008309

Core mass function: a comparison study between Orion A and other massive filamentary clouds.

Zhiyuan Ren[1] **and Di Li**[1]

[1]National Astronomical Observatories of China,
20A Datun Road, Chaoyan District, Beijing, China
email: `renzy@nao.cas.cn`

Abstract. As a giant compact filamentary cloud, Orion A has a similar morphology with those more distant filaments in infrared dark clouds as revealed in Herschel surveys. We compared their core mass functions and found a similar power law index of $N(>m) \propto m^{-1.0}$ for the high-mass end, which may possibly indicates a common case for massive filamentary clouds. We also show that the measured mass function for a certain cloud would largely depend on its distance, thus call for caution in interpreting individual measurements of CMF.

keywords: ISM: clouds – stars: mass function

---

1. Introduction

Core mass function is an important physical property to reflect the mass assembly in molecular clouds and might sensitively determine the stellar initial mass function (e.g. Michel *et al.*2011). Recent studies show that a considerable fraction of giant molecular clouds are shaped in filamentary morphologies (André 2013). The unique properties of the filamentary clouds might be presented in their core mass function (CMF). Good targets for the CMF studies include Orion A and massive molecular clouds sample in recent Herschel surveys (Ragan *et al.*2012). Orion A has a similar total mass with the other clouds (several 10^3 $M_\odot$), but has the smallest distance and is located in the outer Galaxy. To facilitate a more meaningful comparison in terms of physical properties, we simulated an Orion A cloud observation at 3.0 kpc, typical of source distances in Ragan *et al.*sample. The simulated image is produced by reducing the angular scale by a factor of 0.15 (450 pc/3000 pc) and then convolving the image with the Herschel/PACS 160 μm beam size ($8''$). The cores are identified using the 2D Gaussian fit around each local emission peak. The 3kpc image and core-fit is shown in Figure 1a. The original core masses can be directly adopted from Nutter & Ward-Thompson (2007).

2. Results and discussion

Figure 1b presents the cumulated CMF of the three samples, Orion A original, Orion A at 3 kpc, and entire Ragan+ sample. The original and 3kpc Orion A samples has largely different CMFs. The Original CMF is steeper than the Ragan *et al.*sample, i.e., more biased towards the low-mass end, while the 3kpc CMF becomes flatter than the Ragan *et al.*sample. The difference for 3kpc Orion A sample is due to the decreased spatial resolution. The power-law fitting for the high-mass end (> 4 $M_\odot$) yields $N(>m) \propto m^{-1.0}$ and $m^{-0.67}$ for the original and 3kpc Orion A samples, and $N(>m) \propto m^{-0.67}$ for Ragan *et al.*sample. There are five clouds in Ragan+ sample with the most regular cylindrical filamentary structures, including G316.72, G11.11, IRDC 18223, IRDC 18434, and IRDC 19175. The CMFs of the total five objects and individual ones are shown in Figure 1c. The power-law fitting gives $N(>m) \propto m^{-1.0}$. The individual cloud CMFs show variation but still the power law around $N(>m) \propto m^{-1.0}$.

Although Orion A shows a shallower CMF at 3.0 kpc, the lower mass range (0 to 100 $M_\odot$) can still be fitted by $N(>M) \propto M^{-0.95}$. The CMF for a broader range in Orion molecular cloud also shows a similar power law of $N(>M) \propto M^{-0.8}$ to $M^{-0.9}$ (Ikeda *et al.*2007). The supercritical filaments in the Herschel Gould Belt survey are found to have $N(>M_{\rm line}) \propto M_{\rm line}^{-1.2}$ for the accumulated form, which is slightly lager than the massive filaments presented here, but still shallower than the typical Salpeter power-law $N(>m) \propto m^{-1.35}$ (accumulative form). This should be mainly attributed to the source selection that tends to the high-mass clouds. In

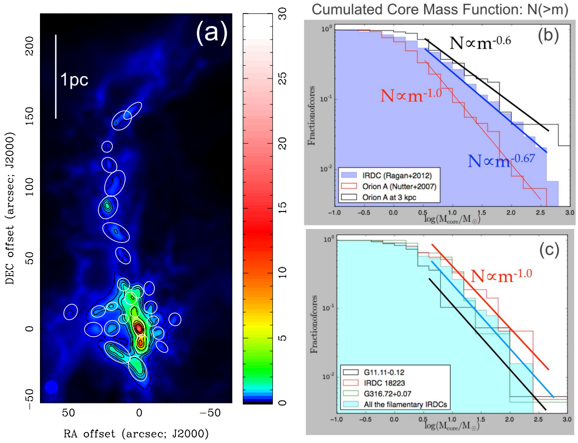

Figure 1. (a) The Orion A image at JCMT 450 μm band assuming it located at D=3.0 kpc. (b) The cumulative core mass function of Orion A (original and 3kpc) and Ragan+ sample. (c) The cumulative core mass function of the most regular cylindrical clouds in Ragan+ sample.

lower-mass clouds, the CMF might be significantly stepper. For example, in the Pipe Nebula (Rathborne *et al.*2009), the CMF is $dN/dM \propto M^{-p}$, $p > 2.0$, due to the near absence of cores more massive than 5 $M_{\odot}$.

3. Summary

We compared the cumulative core mass functions Orion A and other typical massive filamentary clouds in recent Herschel observations (Ragan *et al.*sample). Both Orion A and Ragan *et al.*sample show a similar power-law form of $N(>M) \propto M^{p}$ with index $p \simeq 1.0$. Assuming Orion A having a distance of 3.0 kpc, its CMF becomes much shallower, but with the most massive cores excluded, the power-law index would still be close to 1.0. It is possible that $p = 1.0$ may represent a general condition for the CMF in relatively massive filaments, and its physical background should be further investigated.

References

André, P. 2013, *Astro-ph:* 1312.6232
Arzoumanian *et al.* 2015, *Astro-ph:* 1509.01819
Ikeda, N., Sunada, K., Kitamura, Y. 2007, *ApJ*, 669, 1194
Michel, M., Kirk, H., Myers, P. 2011, *ApJ*, 735, 51
Nutter, D. & Ward-Thompson, D. 2007, *MNRAS*, 374, 1413
Ragan, S. *et al.* 2012, *A&A*, 547, 49
Rathborne, J. *et al.* 2009, *ApJ*, 699, 742