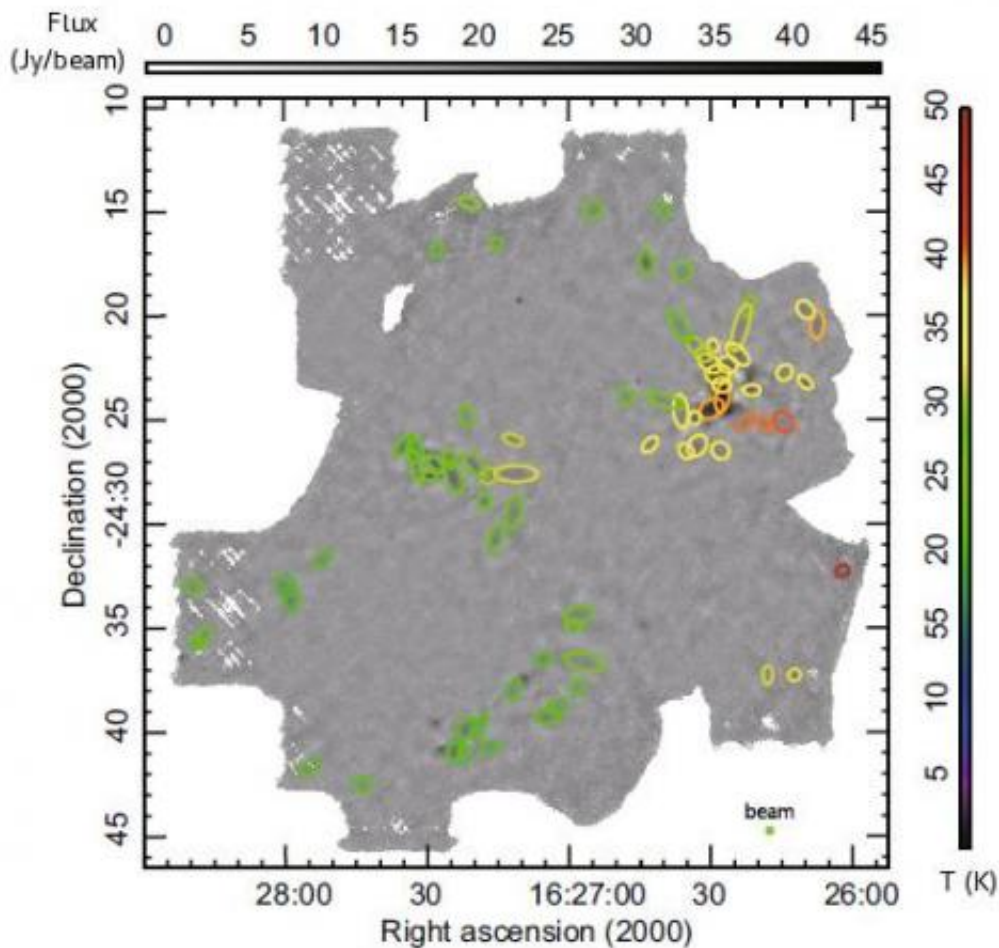


# The earliest stages of star formation in the Ophiuchus molecular cloud

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75 cores were detected in the Ophiuchus molecular cloud flux intensity map, and are displayed with measured  $^{12}\text{CO}$  excitation temperature in units of K, coded as shown in the color bar on the right. Semi-axis of the ellipse plotted in the map is the FWHM of the Gaussian profile of the core. Credit: Science China Press

Molecular cores are dense condensations within molecular clouds, in which stars are born. Guoyin Zhang et al. obtained 350  $\mu\text{m}$  dust continuum data using the SHARC-II camera at the Caltech Submillimeter Observatory (CSO) telescope. A 350  $\mu\text{m}$  map covering 0.25 deg<sup>2</sup> of the Ophiuchus molecular cloud was created by mosaicing 56 separate scans. 75 cores have been identified on this high angular resolution map. The core mass function (CMF), which is the mass distribution of dense cores. They found that the whole and prestellar CMF are both well fitted by a log-normal distribution. This finding suggests that turbulence influences the evolution of the Ophiuchus molecular cloud. Their work, entitled "350  $\mu\text{m}$  map of the Ophiuchus molecular cloud: core mass function", was published in *SCIENCE CHINA Physics, Mechanics & Astronomy*.

The Ophiuchus molecular cloud is one of the closest dark nebulae. The prime constituent of an molecular cloud is molecular hydrogen, which is a non-polar molecule and non-effective at emitting photons at the typical dark nebula temperatures around 10 K. The observations in optical and near-infrared is severely affected by dust extinction. Submillimetre telescopes have the ability to trace the continuum emission from dust.

The Caltech Submillimeter Observatory (CSO) is a 10.4 m diameter telescope, which is housed in a compact dome at 4070 m altitude near the summit of Mauna Kea (Hawaii, USA). The air is dry, clean and calm, which greatly reduces the wind and water effects on submillimetre observations. The CSO telescope had an [angular resolution](#) of 9 arcsecond.. This angular resolution is 3 times better than Herschel at the same band, and 2 times better than SCUBA/JCMT at 850  $\mu\text{m}$  band.

Zhang et al. obtained data tracing the dust continuum in the Ophiuchus molecular cloud at 350  $\mu\text{m}$  from the SHARC-II camera at the CSO telescope over three consecutive nights. A large 350  $\mu\text{m}$  map of the Ophiuchus molecular cloud was created by mosaicing 56 separate scans

of the Ophiuchus molecular cloud, with a field coverage of  $0.25 \text{ deg}^2$ . This map was analyzed using the GaussClumps algorithm, in which 75 cores have been detected. The dust and the gas couple together within high density regions of the molecular clouds, such as dense cores. The excitation temperatures, which were derived from FCRAO  $12\text{CO}$  data, help to improve the accuracy of the masses of the cores.

Protostellar cores have embedded self-luminous sources. Protostellar cores have lost some mass because of accretion onto the embedded protostar, or the existence of bipolar outflows. These changes could mean that protostellar cores no longer exhibit the same initial conditions as starless cores. Therefore, in order to better characterize the initial conditions of star formation, the differentiation of protostellar cores from starless cores needs to be investigated. They used the Spitzer c2d catalogs to separate the cores into 63 starless cores and 12 protostellar cores.

The [core](#) mass function (CMF), which is the mass distribution of dense cores, is important for understanding the stellar initial mass function (IMF). The study of the CMF is therefore potentially important for understanding the IMF. The similarity between the CMF and the IMF suggests that stars may form at the same efficiency in all cores although this remains unclear. Salpeter initially postulated a power law form for the IMF. In contrast, Chabrier suggests a log-normal form of the IMF. Ballesteros-Paredes et al. calculated the CMF using numerical models of turbulent fragmentation of molecular clouds, resulting in a form that does not follow a single power-law, and instead is more similar to a log-normal function. Padoan and Nordlund have deemed the slope of the CMF to be dependent on the slope of the turbulent energy spectrum. Previous research has shown that a log-normal distribution arises when the central limit theorem is applied to isothermal turbulence.

The log-normal cumulative functional form were used to fit the CMF. In

order to avoid introducing an error in the direct fitting of the power law cumulative functional form of the CMF, They used a Monte Carlo method adopted by Li et al.. They found that the whole and prestellar CMF can be well fitted by log-normal distributions. This finding suggests that turbulence influences the evolution of the Ophiuchus [molecular cloud](#).

**More information:** Zhang G Y, Li D, Hyde A K, et al. 350  $\mu\text{m}$  map of the Ophiuchus molecular cloud: core mass function. *Sci China-Phys Mech Astron*, 2015, 58: 029701. [phys.scichina.com:8083/sciGe/E...abstract509184.shtml](http://phys.scichina.com:8083/sciGe/E...abstract509184.shtml)

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