THE IMF OF CLASS II OBJECTS IN THE ACTIVE SERPENS CLOUD CORE

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Abstract Based on ISOCAM mid-IR photometry and Arnica/NOT near-IR photometry we find two separate generations of Young Stellar Objects (YSOs) in the Serpens Cloud Core. The youngest generation consists of several sub-clusters (0.12 pc diameter) of Class I and flat-spectrum sources, probably formed in a microburst of star formation within the last 10^5 yrs. The population of Class II sources, which are spatially more distributed, has a luminosity function (LF) for which an age of 2 Myr is the best fit to models.

The Serpens Cloud Core is an active star formation region of mainly low mass stars (Eiroa & Casali, 1992) located at b^{II}= 5 deg, l^{II}= 32 deg, and a distance of 260 pc. It is known for its rich collection of Class 0 sources (Casali et al. 1993). Based on LW2 (6.7 μm) and LW3 (14.3 μm) photometry obtained with ISOCAM and J (1.25 μm), H (1.65 μm), and K (2.2 μm) photometry with the ARcetri Near-Ir CAmera (ARNICA) at the 2.56 m Nordic Optical Telescope, La Palma, we have doubled the sample of IR-excess YSOs in the Serpens Cloud Core and classified them as Class I sources, flat-spectrum sources, or Class II sources based on the spectral energy distribution from near- to mid-IR.

We find a strong tendency of clustering of the Class I and flat-spectrum sources towards the NW-SE oriented ridge of dense cores traced by the mm data. These protostar candidates are most likely found close to their birth place. Each sub-cluster is typically 0.12 pc in diameter and contains between 6 and 12 protostar candidates. All must have formed from the same core at about the same time, and it is highly unlikely that these sources are older than a few 10^5 yrs. The surface density in these sub-clusters is in the range 500-1100 pc^{-2}, and the *local* star formation efficiency is found to be ~ 9 % by hypothesizing that the protostar candidates follow the same IMF as the Class II sources (see Kaas et al. 2004). These results could put important constraints on models of cloud fragmentation and core formation inside gas clumps.

The Class II sources cluster at a scale of about 0.25 pc, but have also a relatively scattered distribution. For the Class IIs we have estimated the stellar luminosities and searched for the best fit of synthetic luminosity functions (LFs) based on three different input IMFs and various star formation (SF) histories (see Kaas et al. 2004). Taking into account the relatively coarse LF and the fact that we can not put too much confidence on the observed peak at 0.09 $L_\odot$ since it is practically at the completeness limit, we can conclude that ages less than 2 Myr are implausible both in the case of coeval and continuous SF histories. Both the Scalo (1998) and the Kroupa, Tout & Gilmore (1993) IMFs are compatible with our data down to the completeness limit for the age of 2 Myr, as is the Salpeter (1955) IMF at the high luminosity end.

The observed Class II LF fits a roughly co-eval star formation scenario about 2 Myr ago with an underlying IMF of the three-segment power-law type, which is similar to the Class II mass function for ρ Ophiuchi (Bontemps et al. 2001). For this age 20 % of the Class II objects in our study should be young brown dwarfs, although spectroscopic confirmation remains. This means only about 3 % of the mass. It seems likely that the compact clusters of Class I and flat-spectrum sources will evolve into the looser clusters of 0.25 pc found for the Class II objects over a few 10^6 yrs. It is highly plausible that the current Class II population formed in a similar fashion about 2 Myr ago. These results support the suggestion of Casali et al. (1993) that the star formation history in Serpens has proceeded in several phases.

References

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