

Star Formation in Space and Time: The Orion Nebula Cluster

Eric M. Huff and Steven W. Stahler

UC Berkeley

We examine the pattern of star birth in the Orion Nebula Cluster (ONC), with the goal of discerning the cluster's formation mechanism. Outside of the Trapezium, the distribution of stellar masses is remarkably uniform, and is not accurately described by the field-star initial mass function. The deconvolved, three-dimensional density of cluster members peaks at the Trapezium stars, which are truly anomalous in mass. Using theoretical pre-main-sequence tracks, we confirm the earlier finding that star formation has accelerated over the past 10 Myr. We further show that the rate of acceleration has been the same for all masses. Thus, there is no correlation between stellar age and mass, contrary to previous claims. Finally, the acceleration has been spatially uniform throughout the cluster.

Our reconstruction of the parent molecular cloud spawning the cluster shows that it had a mass of 6700 solar masses prior to its destruction by the Trapezium. If the cloud was supported against self-gravity by mildly dissipative turbulence, then it contracted in a quasi-static, but accelerating manner. We demonstrate this contraction theoretically through a simple energy argument. The mean turbulent speed increased to its recent value, which is reflected in the present-day stellar velocity dispersion.

The current ONC will be gravitationally unbound once cloud destruction is complete, and is destined to become a dispersing OB association. We hypothesize that similarly crowded groups seen at the centers of distant OB associations are also unbound, and do not give rise to the Galactic population of open clusters. Finally, accelerating star formation implies that most clumps within giant molecular complexes should have relatively low formation activity. Sensitive infrared surveys could confirm this hypothesis.

Reference: ApJ preprint doi:10.1086/503357

Status: Manuscript has been accepted

Weblink:

Comments:

Email: [sstahler@astro.berkeley.edu](mailto:ssstahler@astro.berkeley.edu)