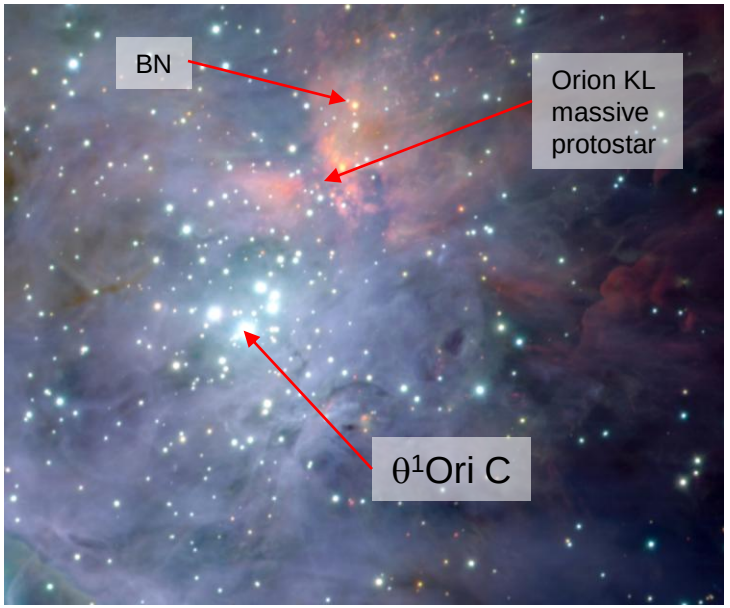
Stellar Dynamical Processes in Massive Star and Star Cluster Formation

Jonathan C. Tan
(University of Florida)
Laurent Eyer
(Geneva Observatory)



Star clusters, like the Orion Nebula Cluster (ONC) pictured right in a JHK image, are the sites of most star formation and essentially all massive star formation (Lada & Lada 2003; de Wit et al. 2005).

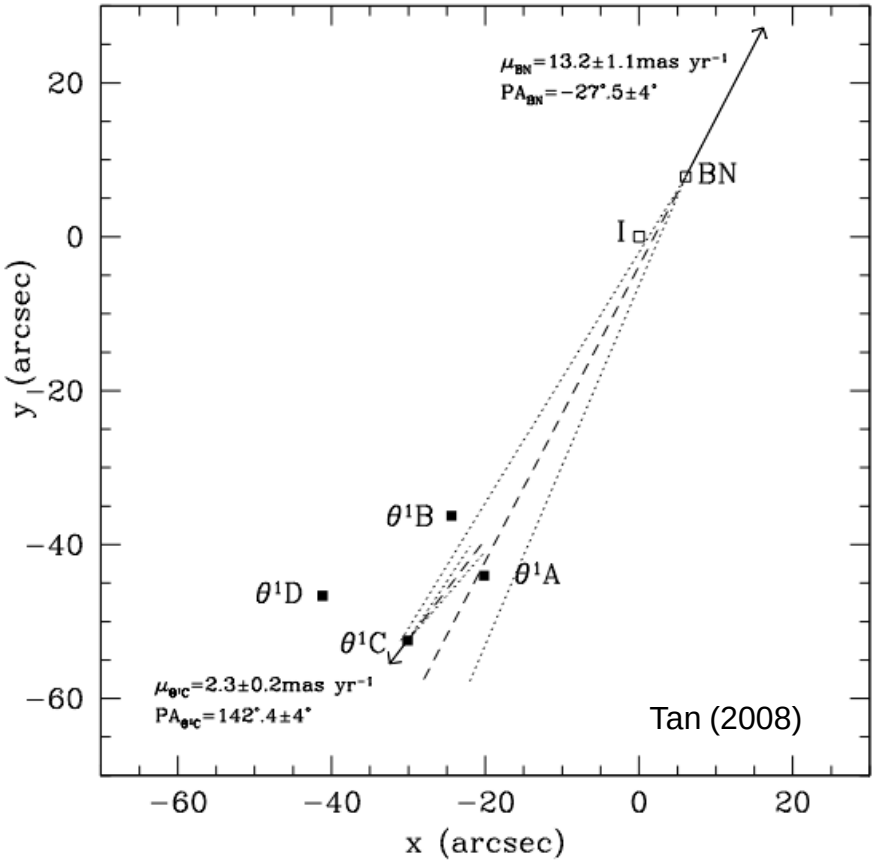
We are studying how precise astrometric measurements by SIM of the nearest young massive stars can constrain their dynamical history. In the particular case of θ^1Ori C, this constrains the properties of a recent dynamical ejection event, which is influencing the Orion KL massive protostar. We are also searching for lower mass candidate runaway stars from the ONC with Hipparcos data. Follow up with SIM can confirm their runaway nature and constrain the formation history of the cluster.

Current Astrometric Knowledge of θ^1OriC and BN in the ONC frame

The Becklin-Neugebauer (BN) star, which is an embedded runaway B star (~10M_{sun}), was ejected by θ^1OriC, which is a hard, recoiling binary, composed of two massive (35, 16 M_{sun}) stars.

BN has made a recent close passage with source “I” in the Kleinmann-Low (KL) region, thought to be the nearest massive (~20M_{sun}) protostar (i.e. undergoing active accretion).

A precise measurement of θ^1OriC motion will allow us to derive BN’s trajectory very precisely (BN and I are too embedded to be observed by SIM), and thus its distance of closest approach to source I and the angle of any deflections it has suffered (thus constraining source I’s mass). This would be the first dynamical mass measurement of a massive protostar.



Runaways from the ONC

This image shows the distribution of Hipparcos catalogued stars (O-blue, B-red, A-green) around the ONC (present position marked with leftmost cross; rightmost cross marks expected position of ONC ~3Myr ago).

We are identifying candidate runaway stars from the Hipparcos data. We will estimate the ability of SIM (and GAIA) to constrain the dynamical history of these stars, and how this information can be used to constrain formation history of the ONC. This will place constraints on theories of star cluster formation: specifically fast (Elmegreen 2007) versus slow (Tan et al. 2006) formation scenarios.