A NEW X-RAY/INFRARED AGE ESTIMATOR FOR YOUNG STELLAR CLUSTERS

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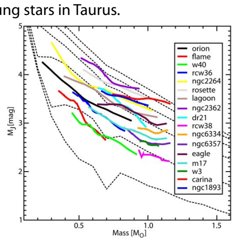
The MYStIX (Massive Young Star-Forming Complex Study in Infrared and X-ray, Feigelson et al. 2013) project seeks to characterize 20 OB-dominated young star forming regions at distances <4 kpc using photometric catalogs from the Chandra X-ray Observatory, Spitzer Space Telescope, UKIRT, and 2MASS.
Here we estimate ages for >5500 out of >30000 MYStIX young stars that are members of ~150 (sub)clusters.

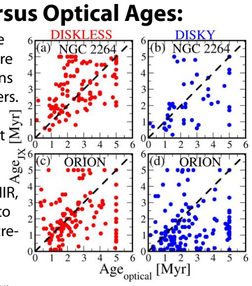
Concept: Our new age method, AgeJX, employs NIR and X-ray photometry. Stellar masses are derived from absorption-corrected X-ray luminosities using the Lx-Mass relation from young stars in Taurus.

J-band magnitudes corrected for absorption and distance are compared to the mass-dependent PMS evolutionary models of Siess et al. (2000) to estimate ages.



AgeJX versus Optical Ages:

* Individual ages are unreliable. But we are interested in Medians of Ages in Subclusters.
* The medians are consistent for all but diskbearing stars in Orion.
* All data (Optical, NIR, X-ray) are affected, to some extent, by accretion and disks. But unlike optical ages, AgeJX gives younger ages for disky stars.

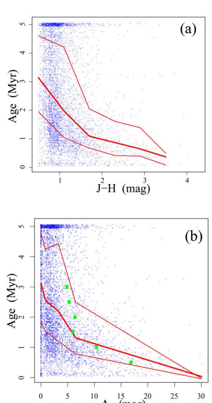


AgeJX's Major Advantages:

* Unlike some other age estimators, AgeJX is sensitive to all stages of evolution, from deeply embedded disky objects to widely dispersed older pre-main sequence stars.
* AgeJX is uniformly applied to the sample of ~150 MYStIX sub-clusters identified by Kuhn et al. (2013; see next poster).

Ages and Reddening:

For all >5500 AgeJX-MYStIX stars, AgeJX versus J-H color (a), and AgeJX versus Av (b). The red thick (thin) lines are medians (25% and 75% quartiles) of AgeJX from a linear B-spline regression. Green points are from Ybarra et al. 2013 (based on the YSO ratio for different disk-bearing classes in Rosette Nebula region).



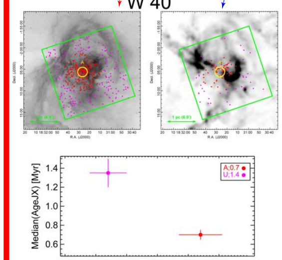
Important science result: The NIR color J-H, a surrogate measure of extinction, can serve as an approximate age predictor for young embedded clusters.

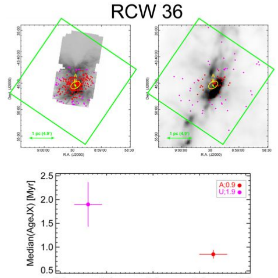
Ages of MYStIX Subclusters:

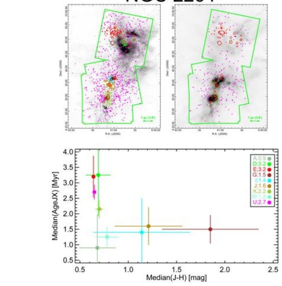
Important science result: the discovery of previously unknown age gradients across many different MYStIX regions and clusters. The ages are often correlated with (sub)cluster extinction and location with respect to molecular cores and ionized pillars on the peripheries of HII regions.

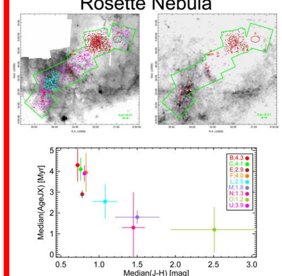
All MYStIX young stars color-coded by (sub)cluster membership superimposed on Spitzer-IRAC 8um image.

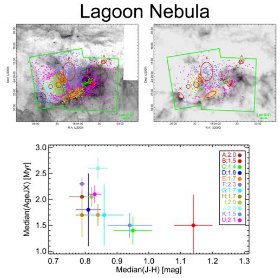
AgeJX sub-sample superimposed on Herschel-SPIRE 500um or on NIR extinction map.

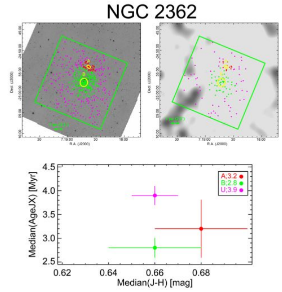


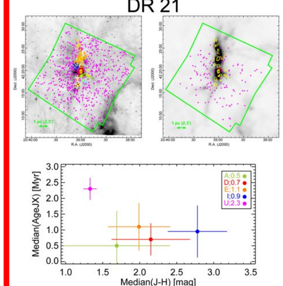


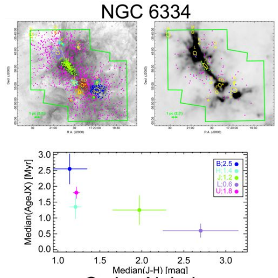


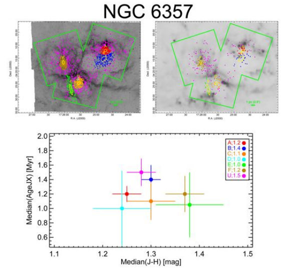


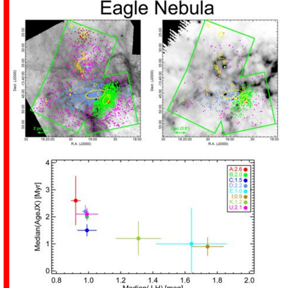


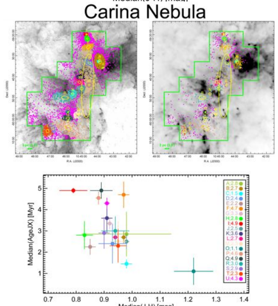


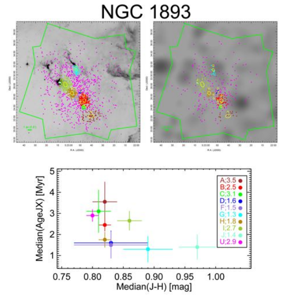












Inferred Age Gradients:

* Core-Halo cluster gradients (Flame/NGC2024, ONC, W40, RCW36, Tr14 in Carina);

* Large-scale inter-cluster gradients (NGC2264, Rosette, Lagoon, Eagle, M17, Carina, NGC 1893);

* Older distributed stellar population (NGC 2264, Rosette, NGC 2362, DR 21, NGC 6334, Carina, NGC 1893);

* Heterogeneous structures/ages in Tr14, Tr15, and Tr 16 regions in Carina.