Stellar Astronomy Data Archives

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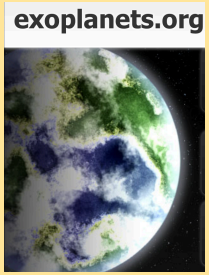
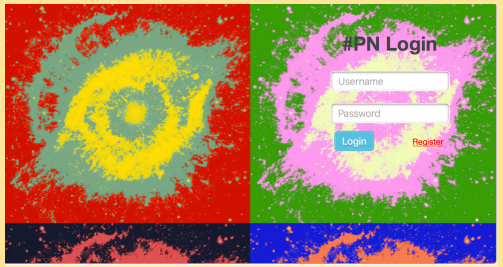
Some On-line Databases Relevant to Stellar Astronomy

- Star Clusters:
  - https://www.univie.ac.at/webda/
  - http://gclusters.altervista.org/
- O Stars:
  - https://gosc.cab.inta-csic.es/
- (M)LTY Stars / Brown Dwarfs:
  - dwarfarchives.org
- Circumstellar Disks:
  - circumstellardisks.org
- Exoplanets:
  - exoplanets.org
- Planetary Nebulae:
  - http://hashpn.space/





The “Boutique” Side of Modern Astronomy

- These are curated data sets that include:
  - homogeneous information harvested from large data archives
  - inhomogeneous, small observation sets
  - scientific interpretation deriving from the astronomical literature

- “Thematic archives” on a small scale

Statistics	
Simbad contains on *2018.12.05*	
10,114,702	objects
34,040,701	identifiers
351,159	bibliographic references
18,163,834	citations of objects in papers

Must be published

- SIMBAD links galactic/stellar sources with basic catalog information, plus all publications that mention or tabulate data on a source, but:
  - not searchable in a scientifically useful way; not a lot of data “columns”
  - any individual datum not transparently connected to its source
  - no quality assessment; most recent measurement quoted, not always the “best”.

http://simbad.u-strasbg.fr/simbad/sim-basic?Ident=HBC+722&submit=SIMBAD+search

Basic data :

V* V2493 Cyg -- Variable Star of FU Ori type

Other object types:	* (CoKu,USNO,...), Y*? ([GRS2009],[RGS2011]), Em* (HBC,[KW97]), TT* (Ref), FU* (Ref), SN* (PTF), V* (V*), IR (2MASS)
ICRS coord. *(ep=J2000) :*	20 58 17.0282353931 +43 53 43.339695195 (Optical) [0.0229 0.0277 90] A 2018yCat.1345....0G
FK4 coord. *(ep=B1950 eq=1950) :*	20 56 29.0634299154 +43 42 03.018616870 [2.6002 2.4501 0]
Gal coord. *(ep=J2000) :*	085.1136205144764 -01.2008610436491 [0.0277 0.0229 0]
Proper motions *mas/yr* :	-0.593 -2.908 [0.049 0.052 90] A 2018yCat.1345....0G
Radial velocity / Redshift / cz :	V(km/s) -28.21 [0.91] / z(spectroscopic) -0.000094 [0.000003] / cz -28.21 [0.91] (Opt) B 2018yCat.1345....0G
Parallaxes *(mas)*:	1.2973 [0.0313] A 2018yCat.1345....0G
Spectral type:	K0-M7 D 2014AJ....147..140G
Fluxes (8) :	B 19.678 [~] D 2009ApJ...697..787G V 18.023 [~] D 2009ApJ...697..787G R 17.67 [~] D 2011A&A...528A.125A I 15.233 [~] D 2009ApJ...697..787G G 12.5472 [0.0030] C 2018yCat.1345....0G J 13.252 [0.045] C 2003yCat.2246....0C H 12.213 [0.046] C 2003yCat.2246....0C K 11.459 [0.043] C 2003yCat.2246....0C

SIMBAD query around with radius 2 arcmin

Interactive AladinLite view

VizieR photometry viewer

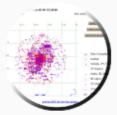
Search within radius Max 30 arcsec

Identifiers (11) :

An access of full data is available using the icon Vizier near the identifier of the catalogue

V* V2493 Cyg	2MASS J20581702+4353433	[ARB2011] NIR 8	[RGS2011] J205817.03+435343.2
CoKu LkHA 188 G4	PTF 10qpf	[GRS2009] SST J205817.0+435343.3	Gaia DR2 2162221781048591360
HBC 722	USNO-B1.0 1338-00391463	[KW97] 53-18	

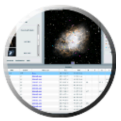
Plots and Images



plot

radius 10 arcmin

CDS portal



CDS Simplay

(requires flash)

Aladin applet

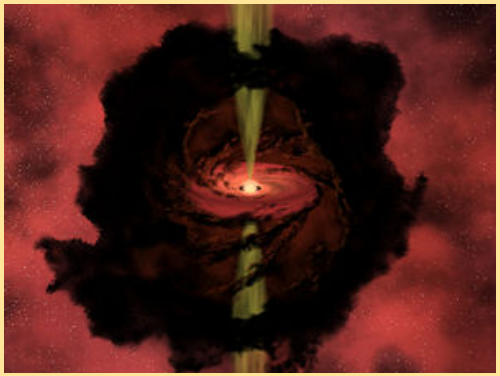
References (80 between 1850 and 2019) (Total 80)

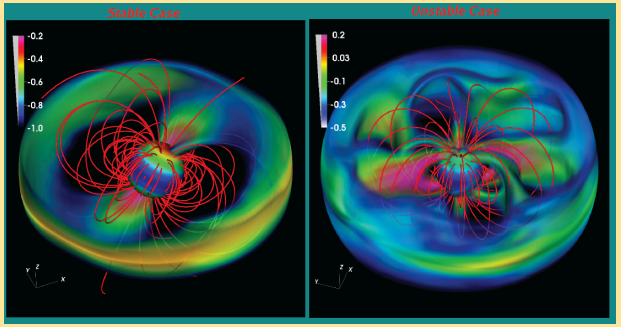
Simbad bibliographic survey began in 1850 for stars (at least bright stars) and in 1983 for all other objects (outside the solar system).

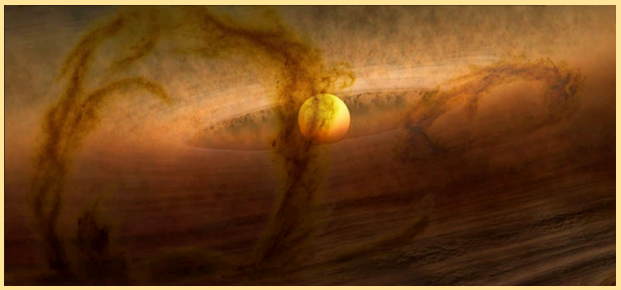
What’s Missing?

What's Missing?

Young Stars!

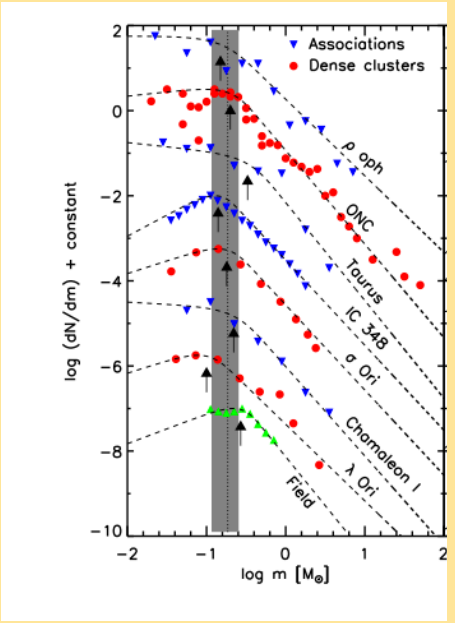


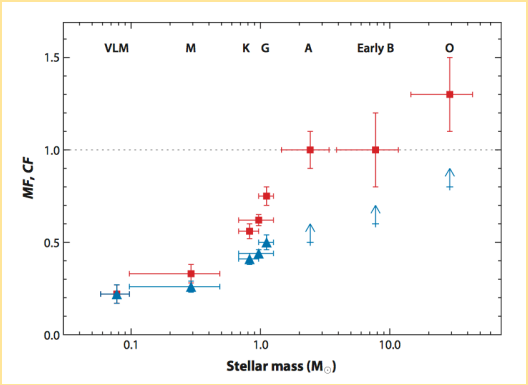




Science Motivations for a Young Star Database

- Membership in Star Forming Regions and Benchmark Open Clusters
- Pre-Main Sequence Stellar Evolution
- The Initial Mass Function
- Age Spreads in Young Star Clusters
- Star Formation History across GMCs
- Circumstellar Disk Evolution ➔ Planet Formation
- Disk-Mediated Stellar Rotational Evolution
- Age-Activity Evolution
- Stellar Age Indicators
- Stellar Multiplicity (a, m2/m1)
- Cluster Kinematics





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Search »

Clear all entries

Search By:

- Object
- Cluster Association
- Data Availability
- Data Value Query

Return:

Display < 500 Rows

- Table Columns
- Plots

YSOC provides an interface to query and visualize a growing database of ultimately ~100,000 Young Stellar Objects located within 1-1.5 kpc of the Sun.

Resource was built by several Caltech undergraduate students and two postdocs.

Initial funding came from NSF.
Data ingestion work funded by NASA.

The Young Stellar Object Corral

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Young Stellar Objects Corral (YSOC) Team

Concept and Design: Lynne Hillenbrand

Principal Design and Development: Adric Riedel (V2.0), Nairn Baliber (V1.0)

Student Development Contributors:

David Qu	Full-Stack Software Development
Lyra Cao	Science Software Development
Krzystof Findeisen	Front-end Development
Daniel Feldman	V0.1 Concept Design and Development

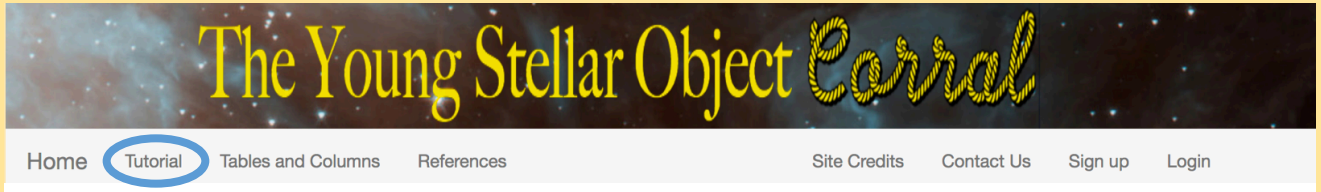
Student Data Acquisition Contributors:

Ismael Mireles
Phillip Carr
Ronnel Boettcher
Jessica Li

Advisors:

J. Mazzarella, S. Ramirez, J. Carpenter, L. Rebull, K. Findeisen, A.M. Cody

Funding Provided by:



Executing the search (by clicking the floating green Search button off to the right), returns a basic table containing the single object:

Star Name	RA	DEC	mem_num	Cluster
GDR1 2162221776736976896	314.57094762	43.89536000	None	LkHa 186

Showing 1 to 1 of 1 entries

If the source is a multiple star system or close pair within the 2" search radius, more than one line would be returned. YSOC designates each individual object with its own name and associated data, and also blended objects where the available data (e.g. photometry or spectral type) actually represent multiple stars within the observational apertures.

The *Star Name*s used in YSOC are typically those from large catalogs such as Gaia, 2MASS, WISE (in that order of preference). As noted above, clicking on an entry under the *Star Name* column takes you to a page for just that star, where everything that YSOC knows about the object is displayed, including more familiar names and all available primary data and derived parameters. Here is an example.

GDR1 3337983608187597312

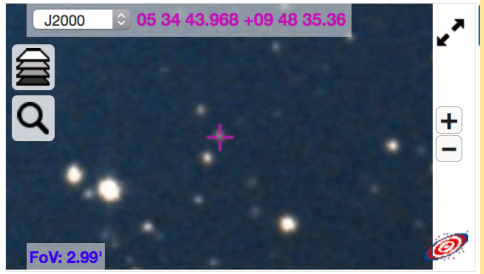
Associated with: Lam Ori

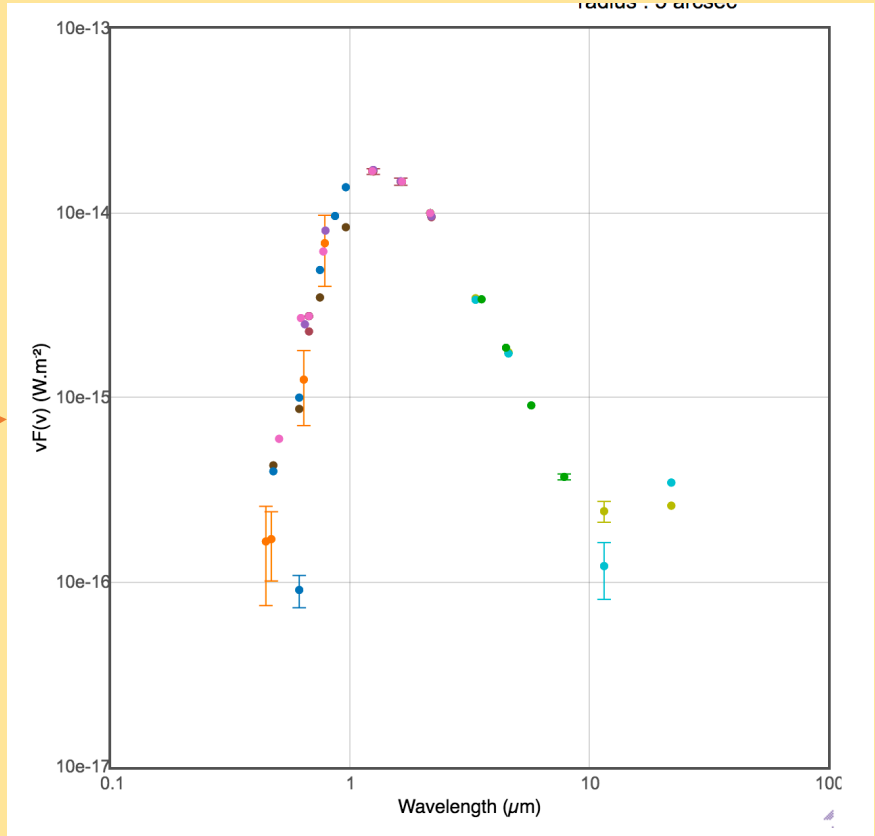
Other proposed memberships:

Alternate Name(s):

GDR1 3337983608187597312
GDR2 3337983612483353472
2MASS 05344396+0948355
2MASS J05344396+0948355
simbad [SFR2008] L32
[SFR2008] L32
LOri 69
LOri-069
[MJO2008] J053443.9+094835
LOri-CFHT 69
hernandez2010 2902
LOri-CFHT 069
PSO J053443.971+094835.483
WISEA J053443.98+094835.4
LOri069

Simbad Search
Vizier References
Vizier SED





Fiducial Data

Search:

Parameter	Value	Error	Unit	Reference
bin_desc	SB		[char]	sacco2008
cluster_name	Lam Ori		[char]	YSOC
mem_num	4		[integer]	YSOC
mem_notes	gaia DR2-based		[char]	YSOC
ra	05 34 43.968		h m s	gaiacollaboration2016
dec	+09 48 35.3589		d m s	gaiacollaboration2016
ra_deg	83.68320011		deg	gaiacollaboration2016
dec_deg	9.80982191		deg	gaiacollaboration2016
pm_ra	0.956	0.204	mas/yr	gaiacollaboration2018
pm_dec	-1.942	0.163	mas/yr	gaiacollaboration2018
rv	22.56	3.48	km/s	maxted2008
plx	2.5548	0.1129	mas	gaiacollaboration2018
st_dist	391.4201	17.2974	pc	gaiacollaboration2018
spt	M5.5		[char]	bayo2012
spt_num	65.5		[decimal allowed]	bayo2012
spt_lit	M5.5		[char]	bayo2012
H_alpha	-8.12	0.47	0.1nm	bayo2012
LiI_6708	0.56	0.02	0.1nm	bayo2011
NaI_8190	2.66	0.02	0.1nm	maxted2008
NII_6583	-0.76	0.13	0.1nm	bayo2012
SII_6717	-0.46	0.11	0.1nm	bayo2012
SII_6731	-0.5	0.1	0.1nm	bayo2012
Av	0.0	0.62	mag	YSOPY
Agaia	1.712	0.33155	mag	gaiacollaboration2018
Teff	3000.0	95.1	K	YSOPY
log_Teff	3.477	0.01	log K	YSOPY
L_star	0.082	0.01	Lsun	YSOPY
log_L_star	-1.085	0.05	log Lsun	YSOPY
M_star	0.116	0.02	Msun	YSOPY
log_M_star	-0.935	0.05	log Msun	YSOPY
age_star	1.593	0.65	Myr	YSOPY
log_age_star	6.202	0.16	log yr	YSOPY
disk_desc	Diskless		[char]	bayo2012

We track stellar and circumstellar values:

- Basic observables
- Derived properties

- Declared “fiducial” as well as all other values

U	21.958	0.299	mag	bell2013
Rc	16.89	0.01	mag	barradoynavascues2007
Ic	15.2	0.0	mag	barradoynavascues2007
g_sloan	19.39	0.031	mag	flewelling2016
r_sloan	18.122	0.007	mag	flewelling2016
i_sloan	16.179	0.007	mag	flewelling2016
z_sloan	15.285	0.005	mag	flewelling2016
y_opt	14.784	0.005	mag	flewelling2016
gaia_g	16.9212	0.0019	mag	gaiacollaboration2018
gaia_bp	18.8586	0.0351	mag	gaiacollaboration2018
gaia_rp	15.5341	0.0047	mag	gaiacollaboration2018
tm_J	13.384	0.027	mag	cutri2003
tm_H	12.774	0.027	mag	cutri2003
tm_K	12.425	0.027	mag	cutri2003
tm_flags	"AAA,0"		[char]	cutri2003
J	13.28	0.01	mag	barradoynavascues2007
S_3p6	12.1	0.02	mag	hernandez2010
S_4p5	12.02	0.02	mag	hernandez2010
S_5p8	12.05	0.03	mag	hernandez2010
S_8	12.04	0.04	mag	hernandez2010
W_3p4	12.268	0.024	mag	wright2010
W_4p6	12.012	0.022	mag	wright2010
W_12	11.969	0.363	mag	wright2010
W_22	8.778		mag	wright2010
wise_flags	"AACU,0000"		[char]	wright2010

Our Young Star Portfolio

Color Key:

Complete clusters Incomplete clusters Empty clusters

Star Forming Regions

- 118 Tau
- Taurus
  - L 1495
  - L 1544
  - L 1551
- Oph
  - rho Oph Core
    - Oph-N
  - L 1709
  - L 1689
  - L 1688
- CrA
  - R CrA
- Upper CrA
- Sco-Cen
  - LCC
  - UCL
  - Upper Sco
  - HD 141569
- Perseus
  - NGC 1333
  - IC 348
  - Per OB2
- Kappa Ori
- Serpens
  - Serpens South
  - Serpens Main
  - W 40
- North America-Pelican
  - North America
  - Gulf of Mexico
    - LkHa 186
  - Pelican Hat
  - Pelican
- Mon R2
  - GGD 12-15
  - GGD 17
  - IRAS 06046-0603
- GGD 4
- AFGL 490
- Auriga-California
- Canis Majoris
- CB 34
- Cepheus
  - Cep OB2
  - Cep OB3b
    - L 1211
  - Cep OB4
    - NGC 7822
    - Be 59
  - Cep OB6
- Cepheus Bubble
  - NGC 7129
  - IC 1396
  - NGC 7160
  - S 140
  - Trumpler 37
- Cha
  - Cha I
  - Cha II
  - Cha III
- Cygnus Rift
  - Cygnus OB7
  - IRAS 20050+2720
- Herbig Ae/Be clusters
  - BD+40 4124
  - LkHa 101
  - MWC 297
  - NGC 7023
  - VY Mon
  - XY Per
- High Latitude Clouds
  - MBM 12
  - MBM 16
  - MBM 18
  - MBM 20
  - MBM 7
- IC 5146
- L 1206
- L 998
- Lac OB1
- Lupus
  - Lupus I
  - Lupus II
  - Lupus III
  - Lupus IV
  - Lupus V
  - Lupus VI
- NGC 2264
- Orion
  - Sig Ori
  - Lam Ori
  - 25 Ori
  - Orion A
    - ONC
    - L 1641
    - ONC Flanking
      - NGC 1977
      - NGC 1980
      - NGC 1981
  - Orion B
    - L 1630
      - NGC 2068
      - NGC 2023
      - NGC 2071
      - NGC 2024
    - L 1622
  - Orion Ia
- S 106
- S 131
- Vela
  - Trumpler 10
  - Vel OB2
  - Vel OB4

Moving Groups

- Ursa Major
- bet Pic
- AB Dor
- Car-Near
- Tuc-Hor
- TW Hya
- Columba
- 32 Ori
- Carina
- chi01 For
- eps Cha
- Octans
- Argus
- Car-Vel
- Cas-Tau
- Castor
- Cha-Near
- Her-Lyr
- Hyades Super
- IC 2391 Super
- Oct-Near

Open Clusters

- Hyades
- Coma Ber
- eta Cha
- Pleiades
- IC 2602
- IC 2391
- alf Per
- Praesepe
- Blanco 1
- NGC 2547
- IC 2395
- NGC 2362
- h and chi Per
  - chi Per
  - h Per
- Collinder 121
- NGC 2232

Other Categories

- Field
- unknown

Functionality

The Young Stellar Object Corral

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Search By:

- Object
- Cluster Association
- Data Availability
- Data Value Query

Search »

Clear all entries

Return:

Display < 500 Rows

- Table Columns

Display column errors Use sexagesimal RA/Dec

Columns to Display

Enter comma-space separated column names for search results table

spt, g_sloan, tm_J, tm_H, tm_K

*By **tm_K**, did you mean:*

tm_K -- 2MASS Ks only|mag|

tm_K (2MASS K)

Choose Column(s)

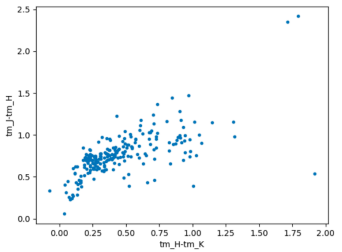
- Plots

Plotting

Enter plotting variables to plot color-color, color magnitude, or other diagrams such as tm_J - tm_H vs tm_H - tm_K or tm_K vs tm_K - W_4p6 or Li_6708 vs spt_num

tm_J - tm_H vs. tm_H - tm_K

y1 y2 x1 x2



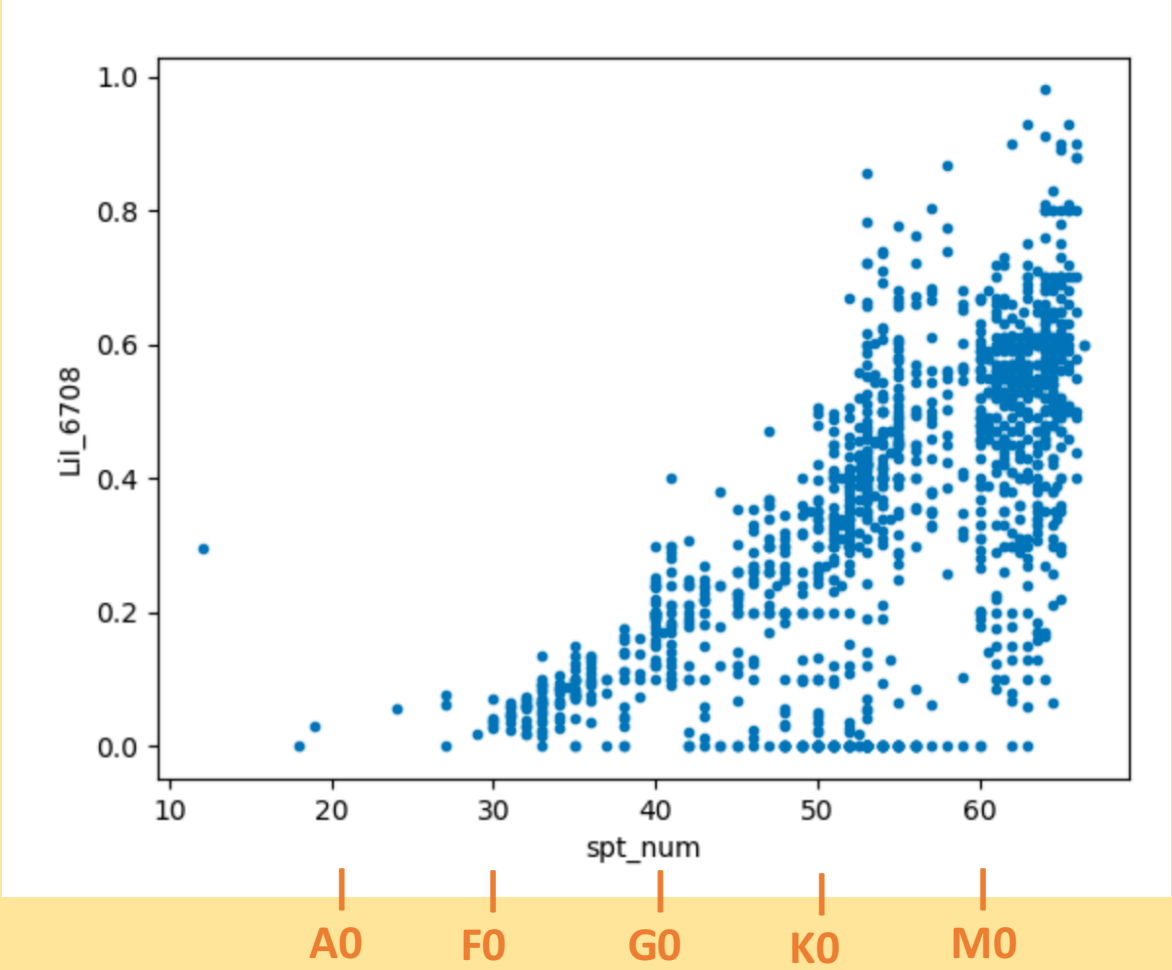
Search Results

Copy CSV Print New Tab

Filter results: Placeholder

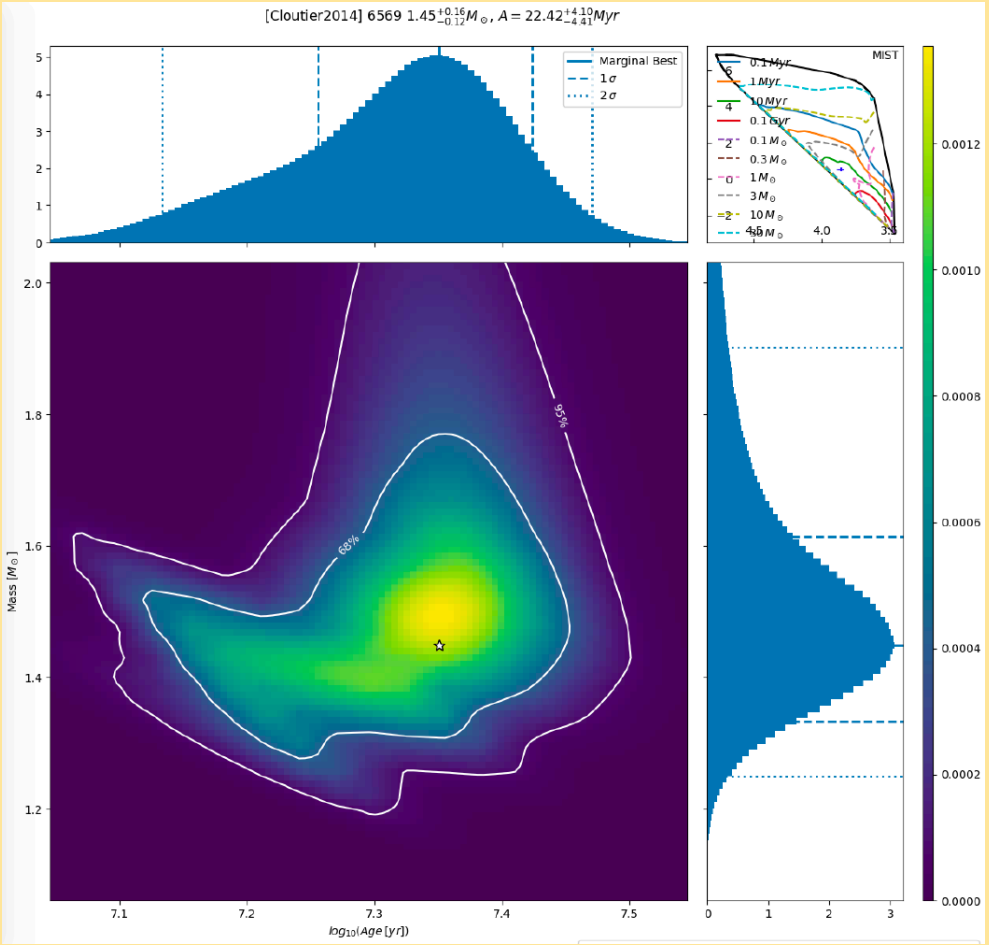
Star Name	RA	DEC	spt_lit ([char])	g_sloan (mag)	i_sloan (mag)	tm_J (mag)	tm_K (mag)	mem_num	Cluster	Refs
2MASS J05133031+0725087	78.37631400	7.41911100		17.401	16.137	13.444	12.315	0	Iam Ori	flewelling2016, flewelling2016, cutri2003, cutri2003
2MASS J05144830+1321424	78.70127800	13.36177800		20.188	18.217	14.826	13.117	0	Iam Ori	flewelling2016, flewelling2016, cutri2003, cutri2003
2MASS J05175693+0542177	79.48721600	5.70492500	M5	19.709	16.49	13.672	12.560	2	Iam Ori	koenig2015, flewelling2016, flewelling2016, cutri2003, cutri2003
2MASS J05183876+0807091	79.66150300	8.11920300	M3.5	20.39	16.822	13.838	12.511	2	Iam Ori	koenig2015, flewelling2016, flewelling2016, cutri2003, cutri2003
2MASS J05190122+0438429	79.75510100	4.64525200		18.809	17.255	14.928	13.299	0	Iam Ori	flewelling2016, flewelling2016, cutri2003, cutri2003
2MASS J05190848+0725294	79.78536800	7.42484300	M7	21.863	17.343	13.873	12.897	2	Iam Ori	koenig2015, flewelling2016, flewelling2016, cutri2003, cutri2003
2MASS J05193994+0538189	79.91644400	5.63858400	M5.5	18.538	15.673	12.957	11.984	4	Iam Ori	koenig2015, flewelling2016, flewelling2016, cutri2003, cutri2003

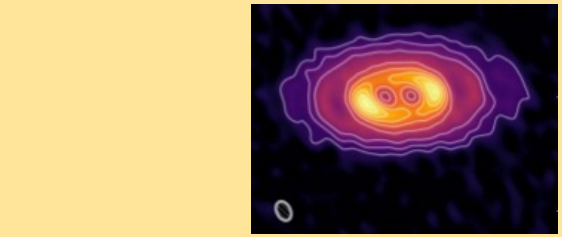
Example Query Output



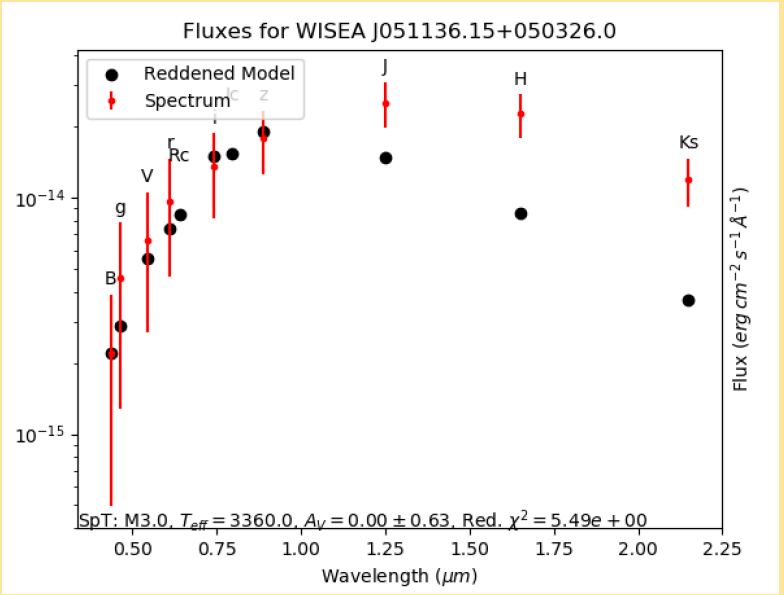
Value-Added Content

HR Diagrams and Stellar Mass/Age

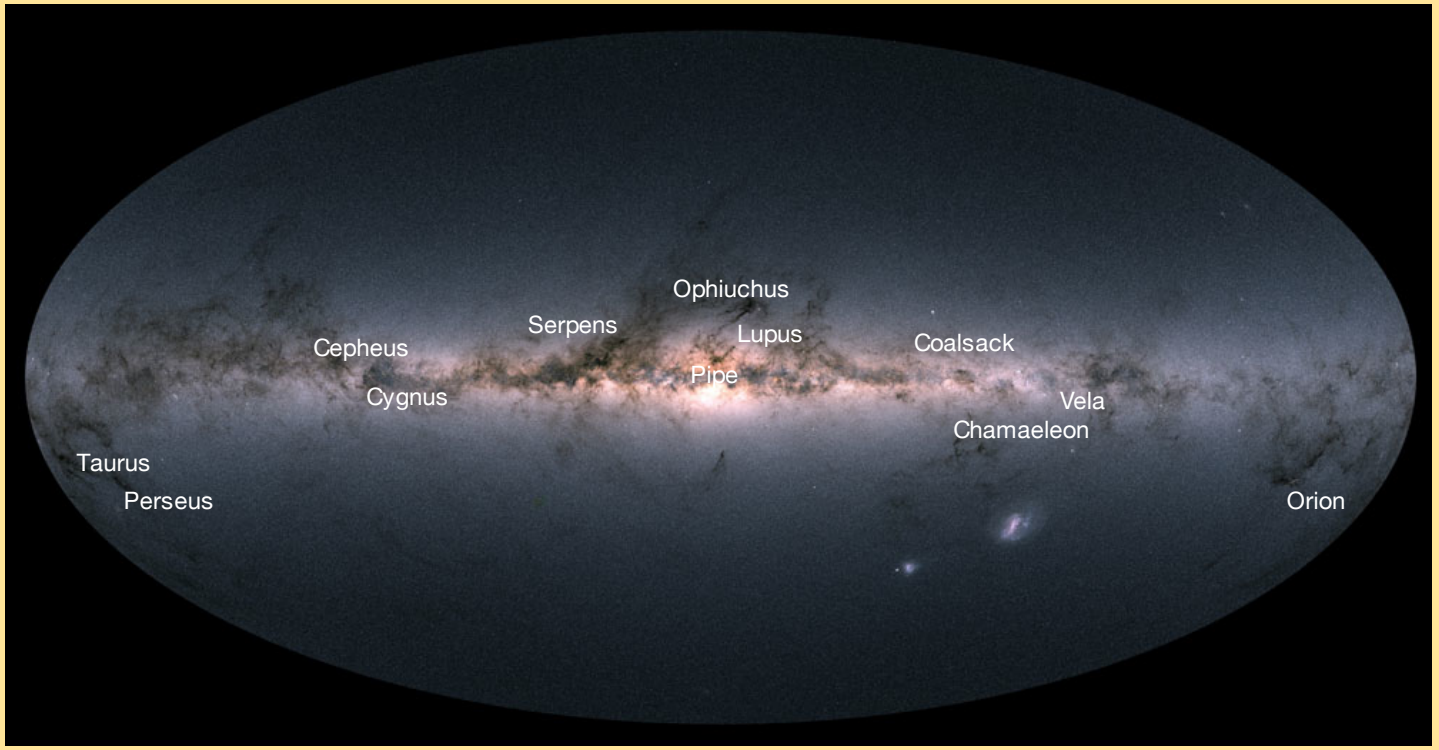




Spectral Energy Distributions

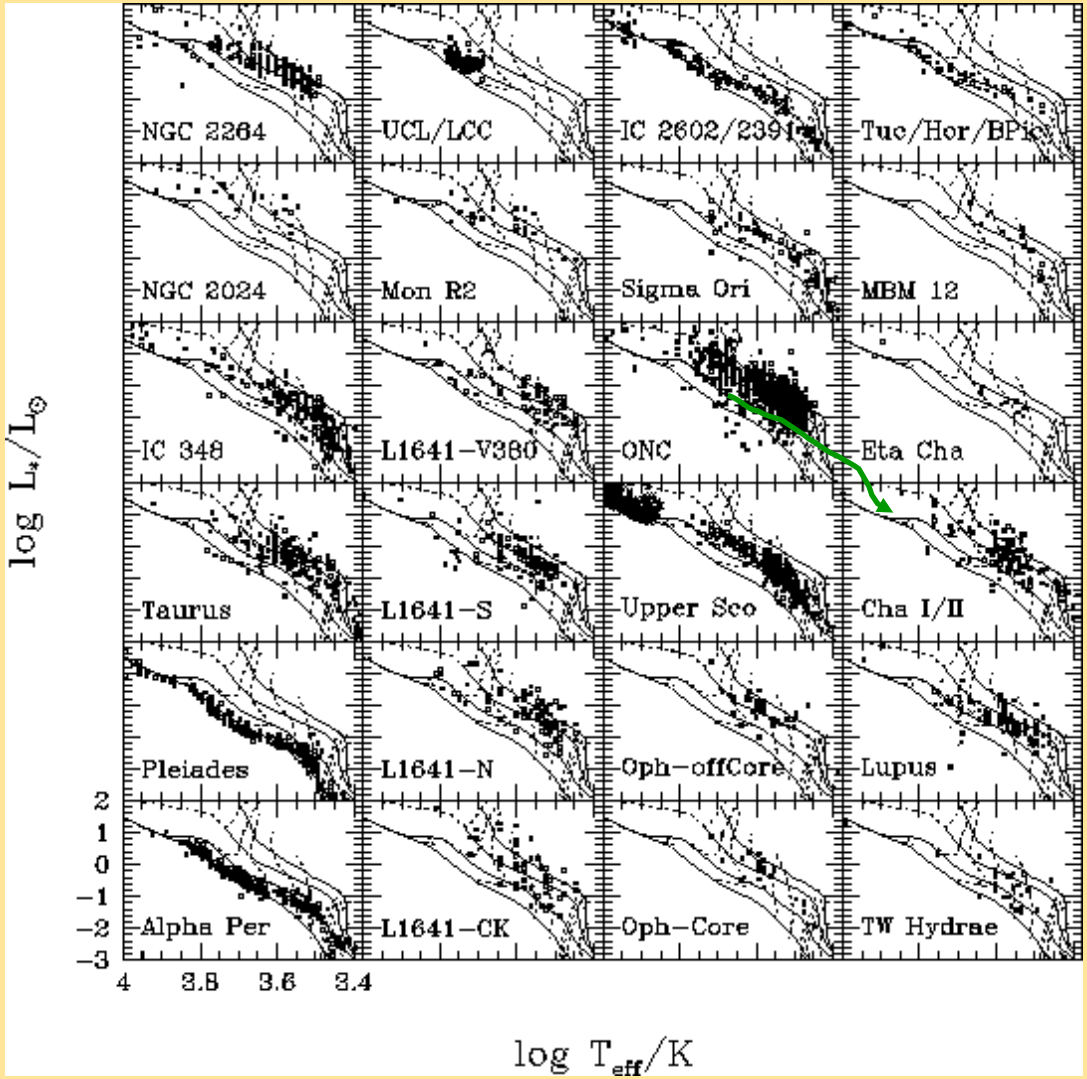


Star Formation, Nearby in The Galaxy



ESA / Gaia

15 Years Ago:

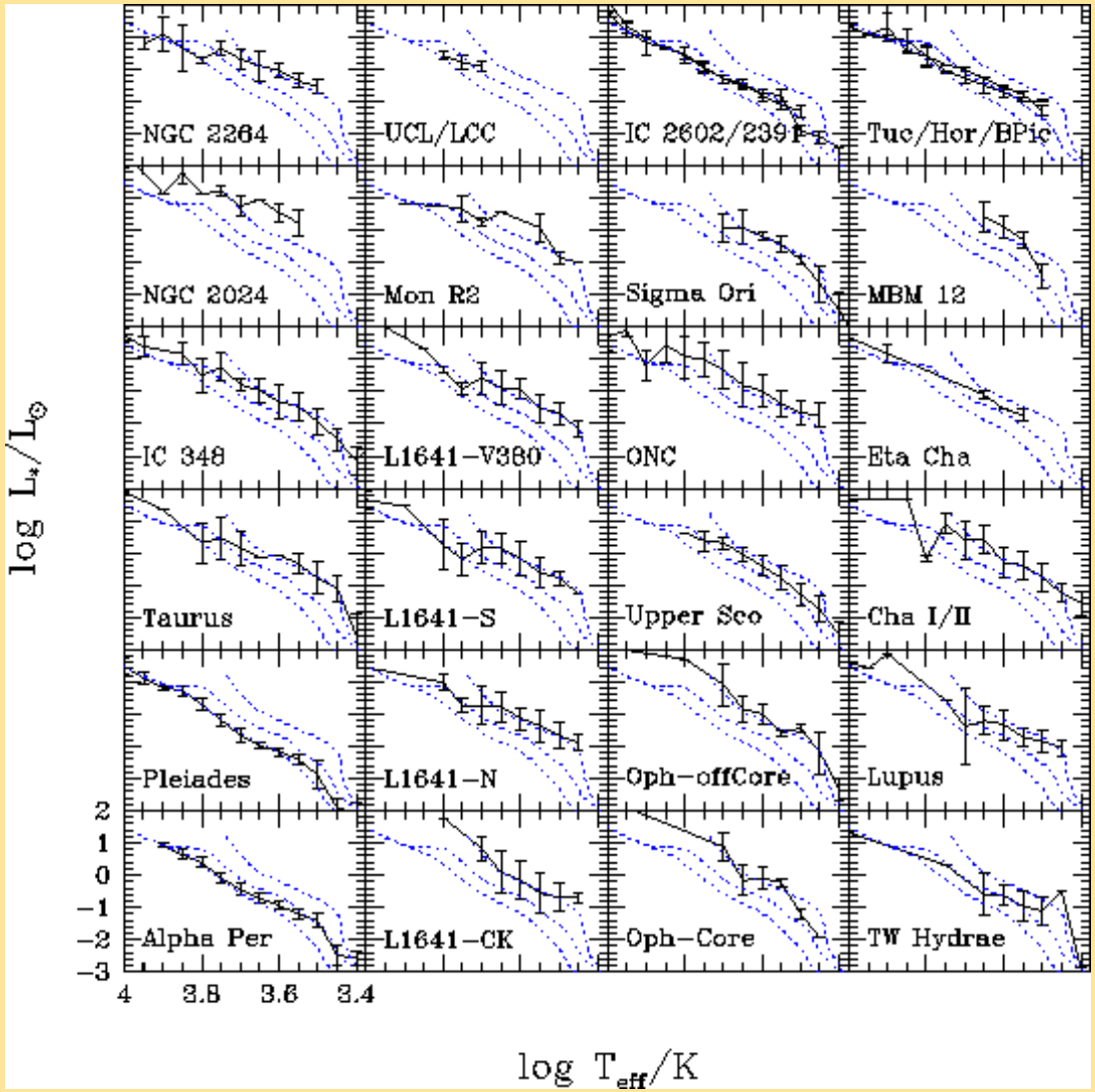


Stellar evolution towards the main sequence:

<1 - 120 Myr

(solar vicinity star-forming regions and young clusters)

15 Years Ago:



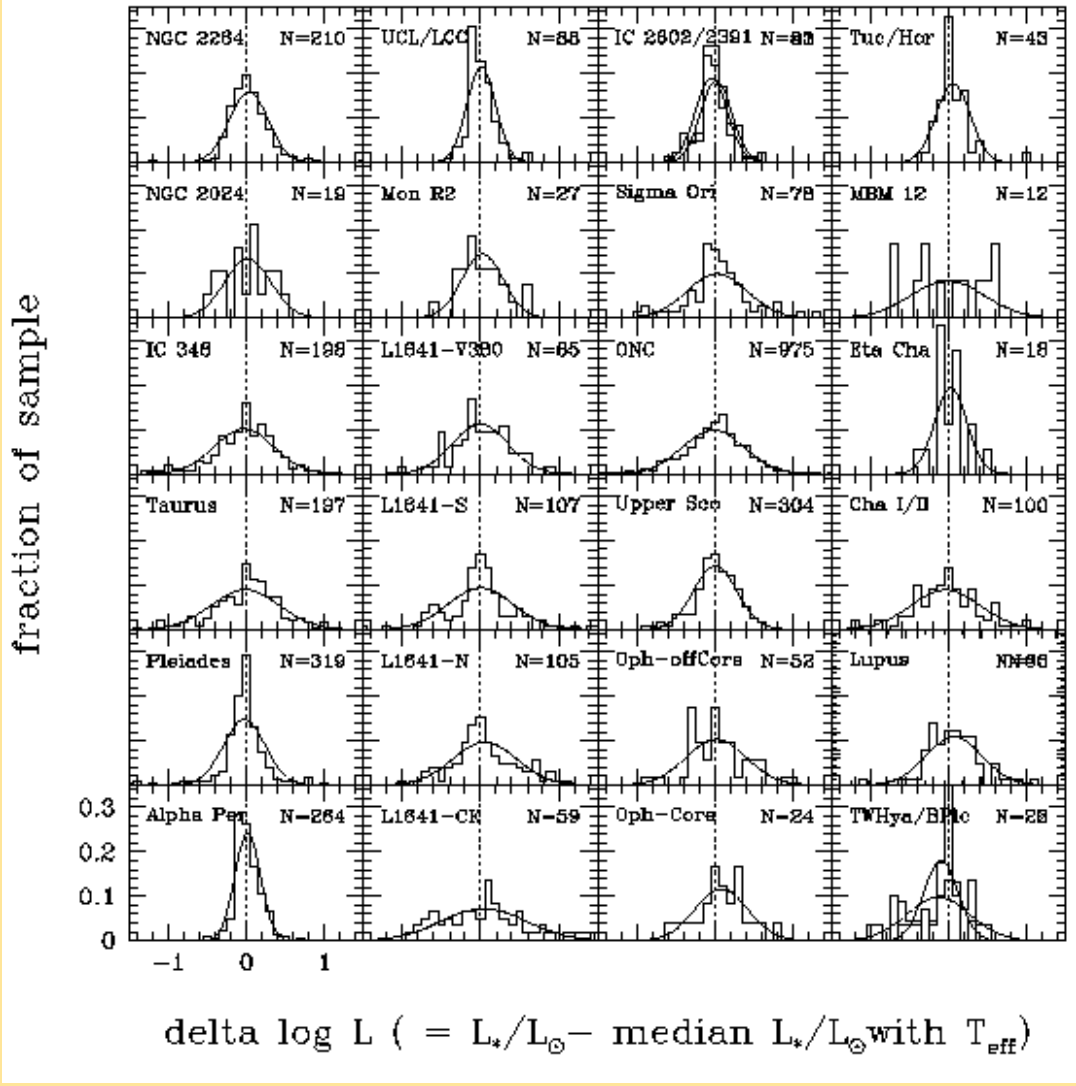
Observed median luminosity

(empirical isochrones)

Do tracks correctly predict stellar ages?

Do luminosity spreads correspond to age spreads?

15 Years Ago:



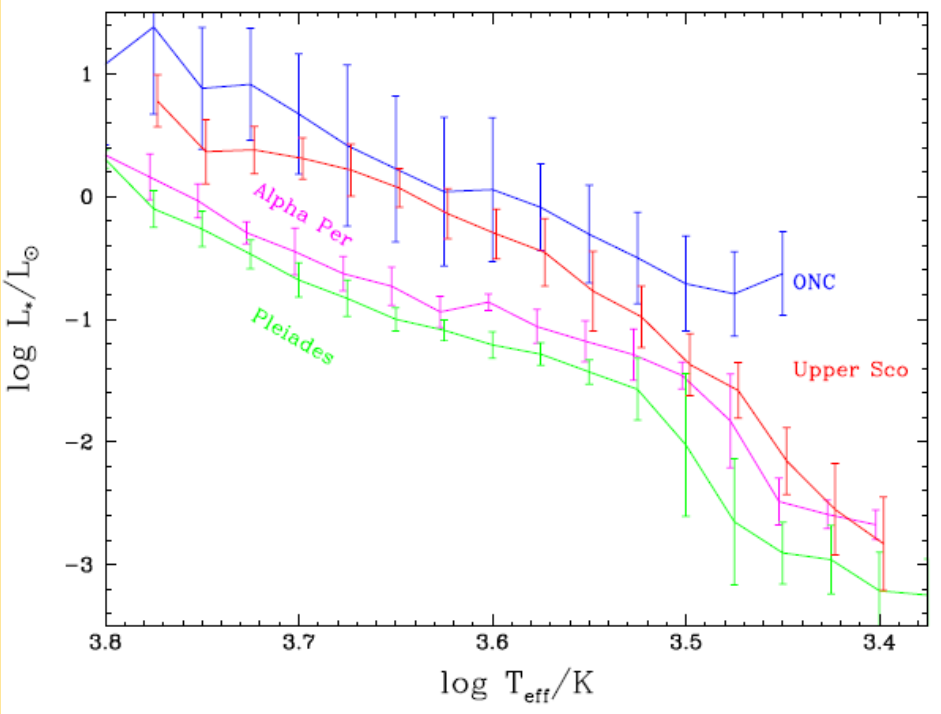
Observed luminosity dispersions

Gaussian fits appear adequate.

However, subtle deviations from pure Gaussian may convey important information apropos
- -- s.f. history
- -- binarity

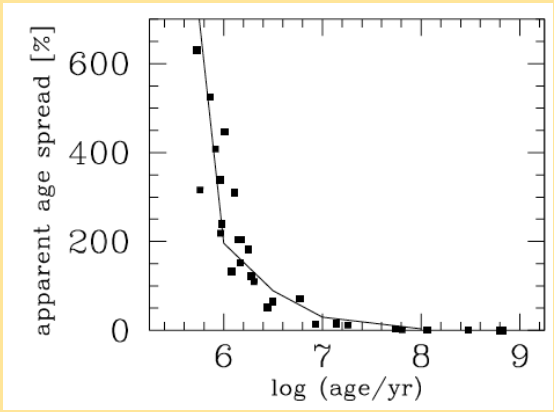
Median Luminosity vs Effective Temperature

15 Years Ago:



Observed scatter in log L/L_o diminishes from ~0.5 dex at 1 Myr to ~0.15 dex at >10 Myr. Becomes consistent with estimated empirical uncertainties.

Can we do better?



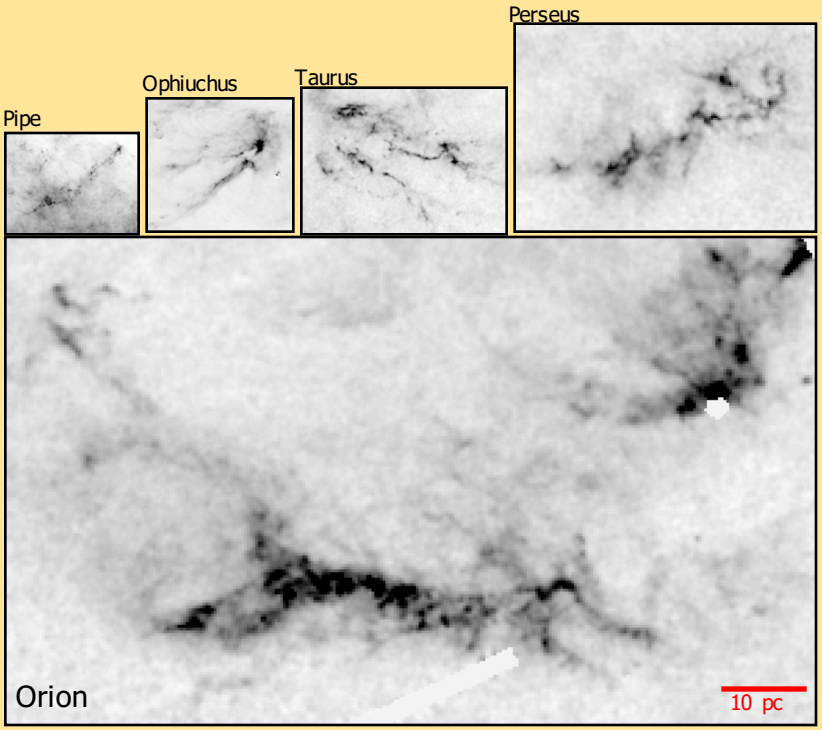
Locally, Extinction Traces Molecular Clouds $\ell > 10^o$

Molecular clouds have a few x10^4 Msun to a few x10^5 Msun, and span tens of pc.

Star formation efficiency low ~1-2%.

Forming clusters contain few hundred to few 10^4 stars. Also a more widely distributed young population.

Angular scales are large, and current young star census information is incomplete.

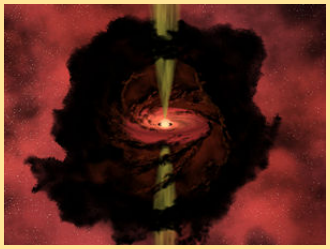


Alves, Lombardi & Lada

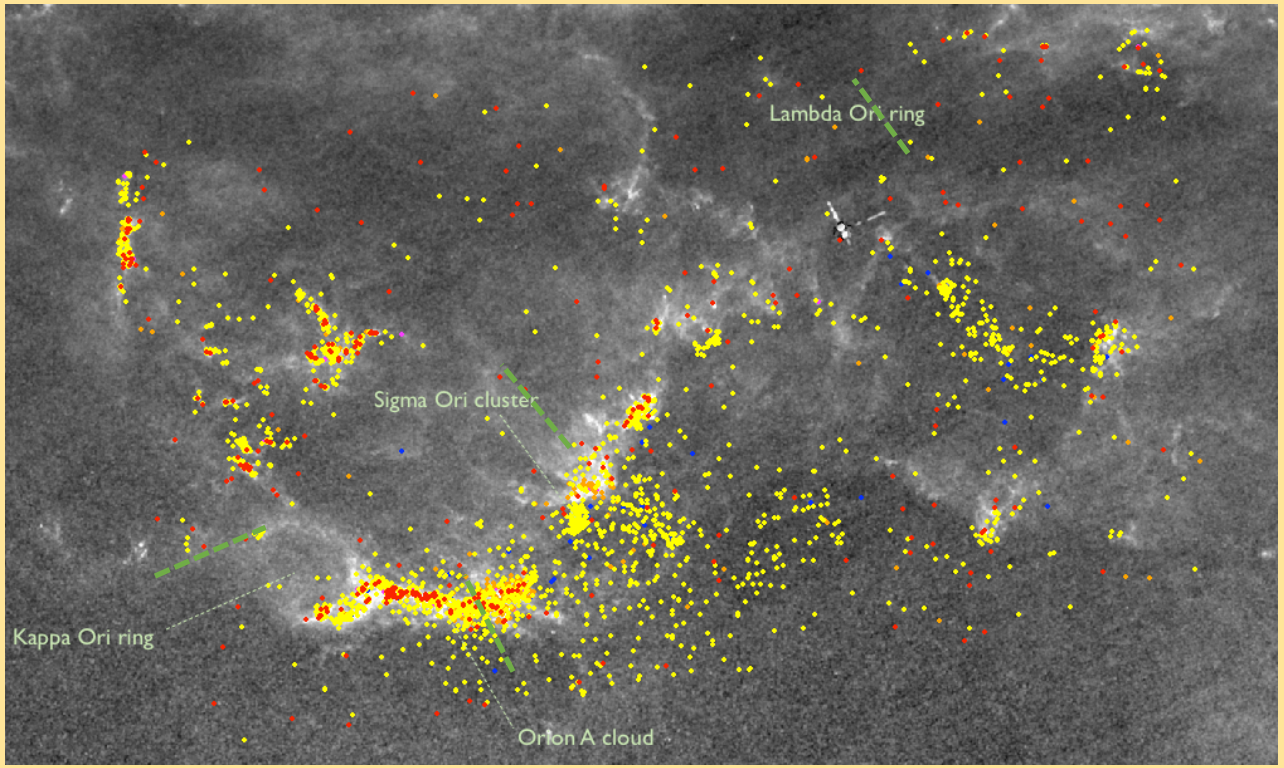
NEED SURVEYS!

- 2MASS - nearIR
- GALEX – UV
- WISE - midIR
- (K2) - variability
- PanSTARRS - opt
- Gaia – astrometry!

Where Are the Young Stars?



- Infrared excess
- Photometric variability
- Halpha emission
- X-ray emission
- CMDs

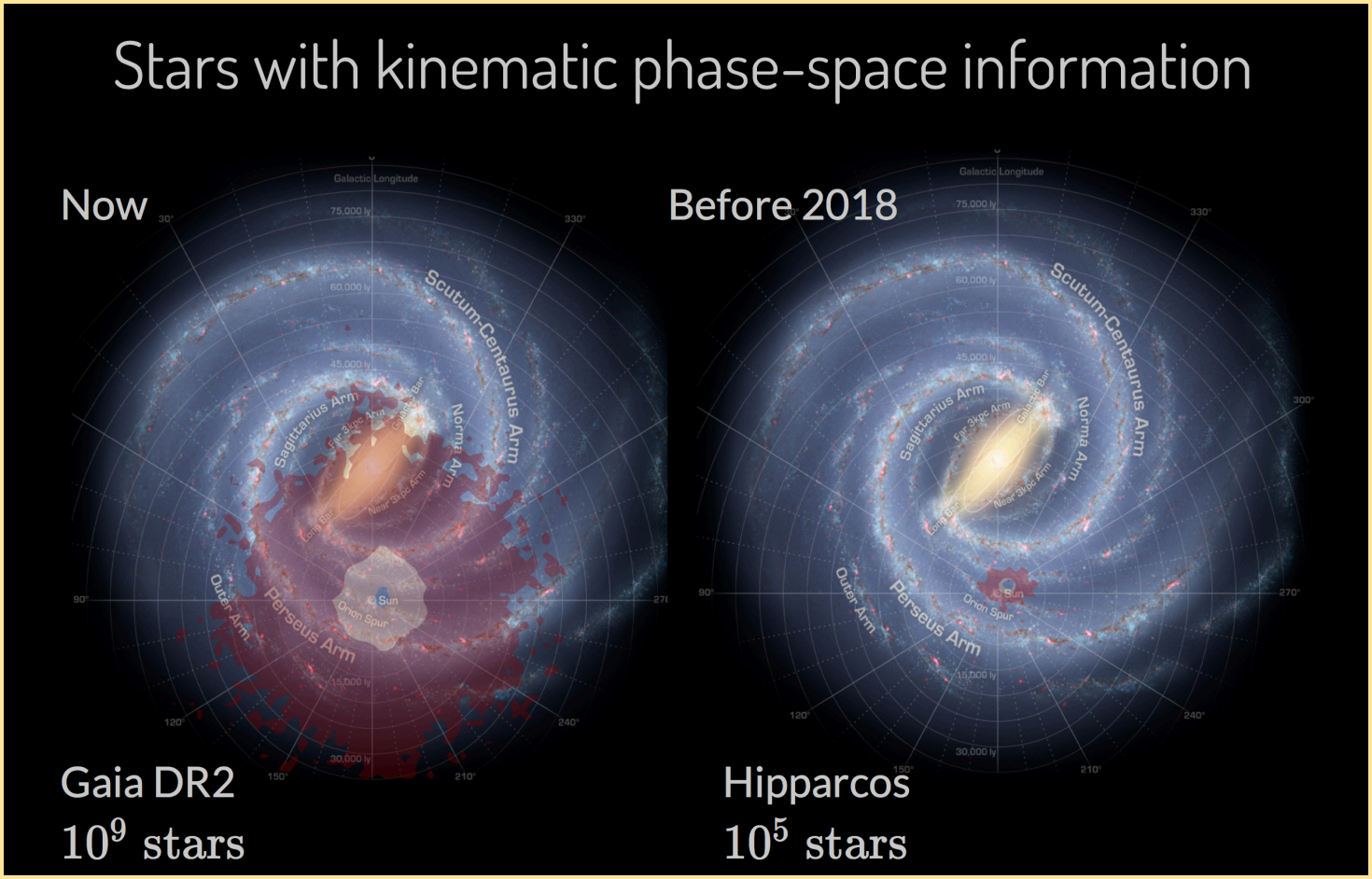


Xavier Koenig

The Promise of Gaia

DR2 at G=15 mag & G=17 mag:

- parallax uncertainties better than 0.04 & 0.1 mas.
- proper motion uncertainties better than 0.07 & 0.2 mas/yr



slide courtesy of ***Yuan-Sen Ting***

galaxy artwork by ***Robert Hurt***

Progress Enabled by *Gaia* for Young Star Clusters

- Solidify cluster membership:
  - confirm/reject existing candidate members
  - identify of new secure members based on plx and pm

- Revise stellar and circumstellar characteristics.

- Probe cluster internal kinematics at the sub-km/s level -- for the first time.

The Future for YSOC

- Do a formal “release” and advertise that we are open for business
- Write a memo on “how to publish your YSO data” in order for us to easily include it, e.g. better-standardized column headings and units.
- Add content
  - new clusters
  - revised cluster membership
  - new data
- Implement new capabilities
  - IPAC/firefly tools?
  - SED dust model fitting

Challenges for YSOC

- Historical precedents in the field that should be preserved and built upon
- Inhomogeneous and disparate and growing data sets – how to set "fidicial"?
- Ongoing scientific reinterpretation (e.g. membership)
- All young stars are variable -- at some flux level, on some time scale, over some range of wavelengths.
- Binaries (=astrophysics) and blends (=observational limit of data)

[Some of these are the same issues faced by Exoplanet and NED archives.]

- Although the task is finite, the task is large
  - I need a coder.
  - I need a data collector with OCD.

Broader Issues

- Major, large homogeneous archives

  versus / and

- Boutique, curated special-interest databases