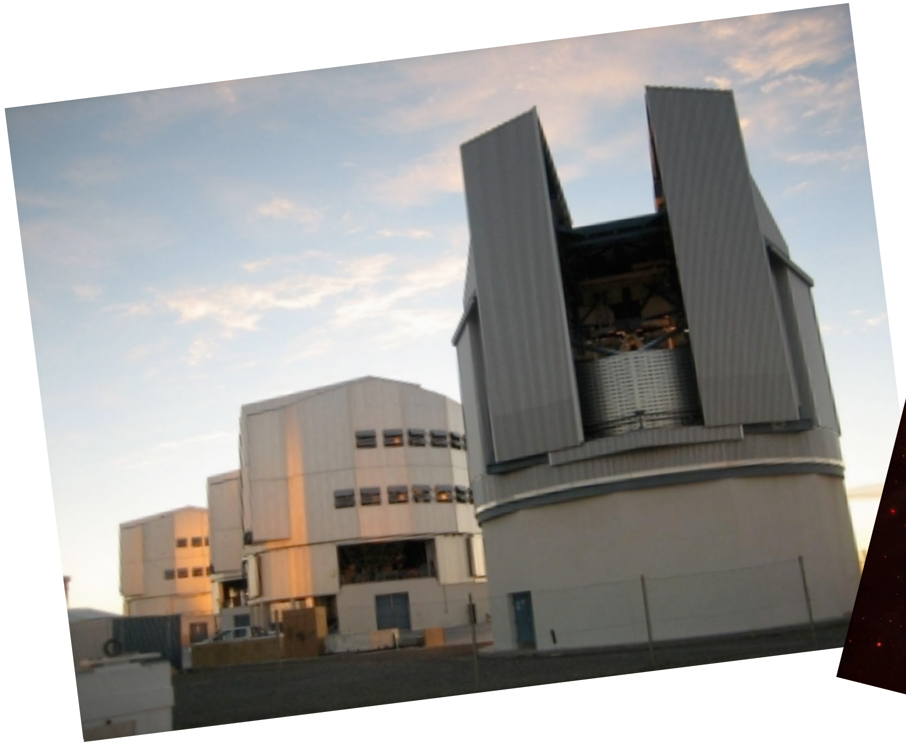
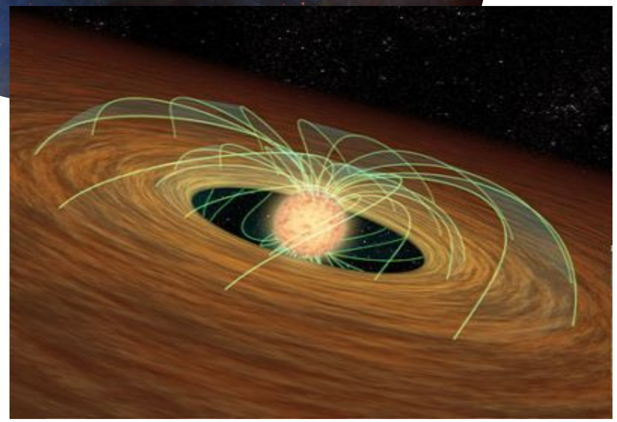
Accretion **D**iscs in **H**alpha with **O**mega**CAM**

- ADHOC Survey -





Giacomo Beccari

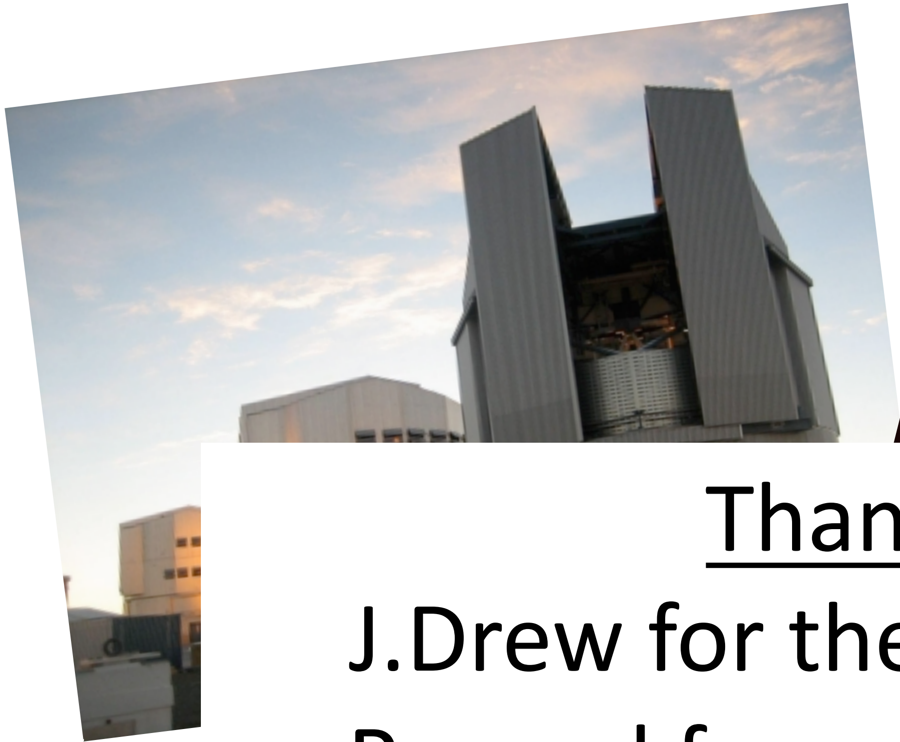
-ESO, HQ-

VST in the era of the large sky surveys
CapodimonteNaples, Italy - 05-08/06/2018

T. Jerabkova, M. Petr-Gotzens, G. De Marchi, N. Panagia, V. Kalari, J. Drew, L. Testi, C. Manara, M. Romaniello
G. Carraro, S. Mieske, W. de Wit, D. Fedele, N.J. Wright, J.R. Walsh, D. Mardones, E. Martin, J. Vink

Accretion **D**iscs in **H**alpha with **O**mega**C**AM

- **ADHOC Survey** -

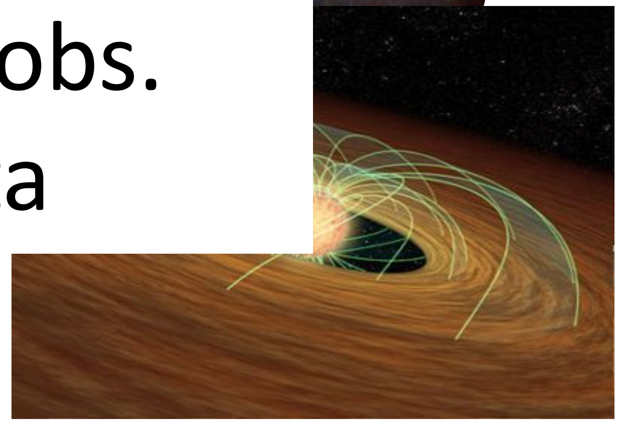


Thanks to:

J.Drew for the H-alpha filter

Paranal for running the obs.

CASU for the red. data



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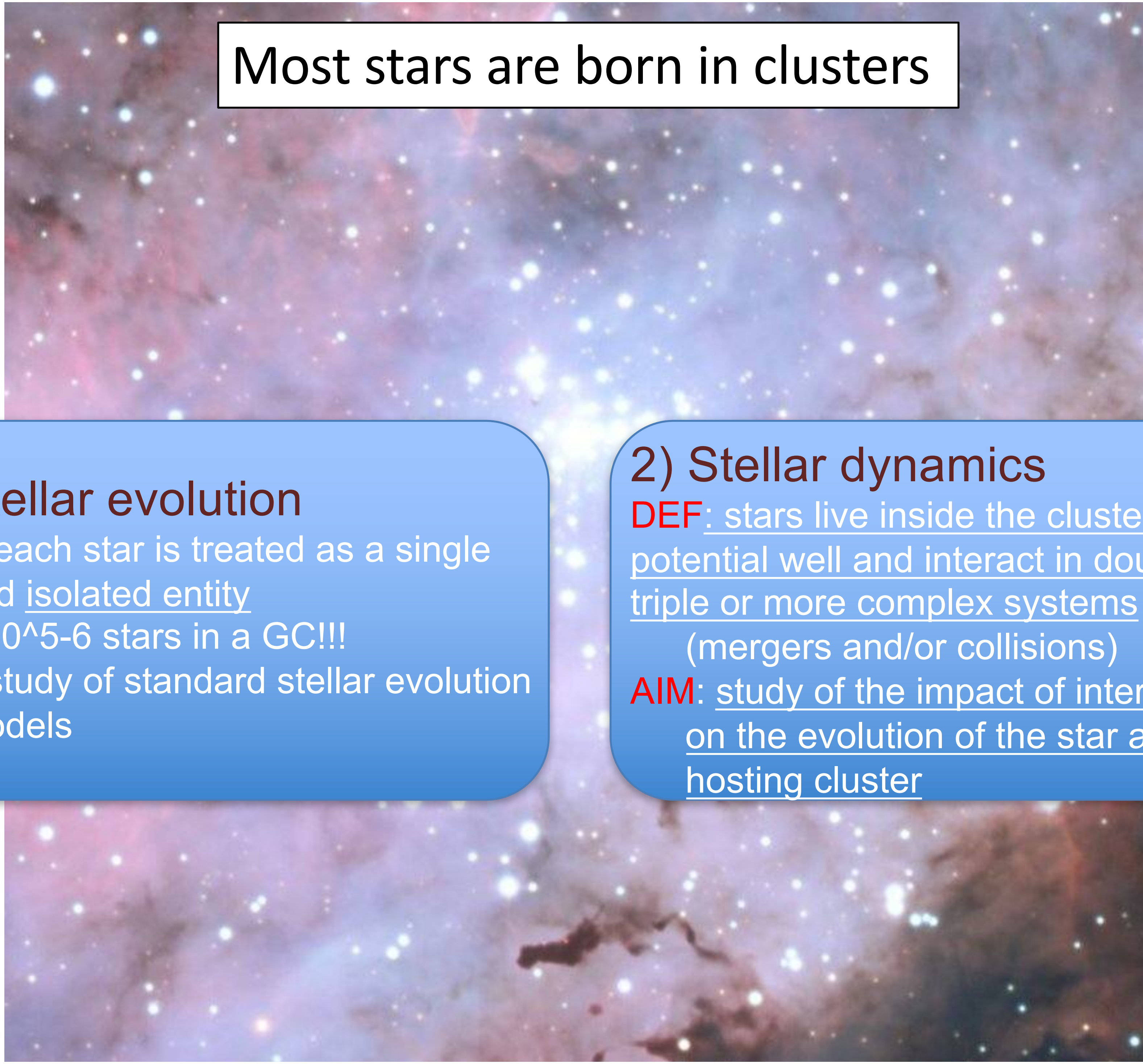
Most stars are born in clusters

Most stars are born in clusters



1) Stellar evolution

DEF: each star is treated as a single and isolated entity

N.B. 10^5-6 stars in a GC!!!

AIM: study of standard stellar evolution models

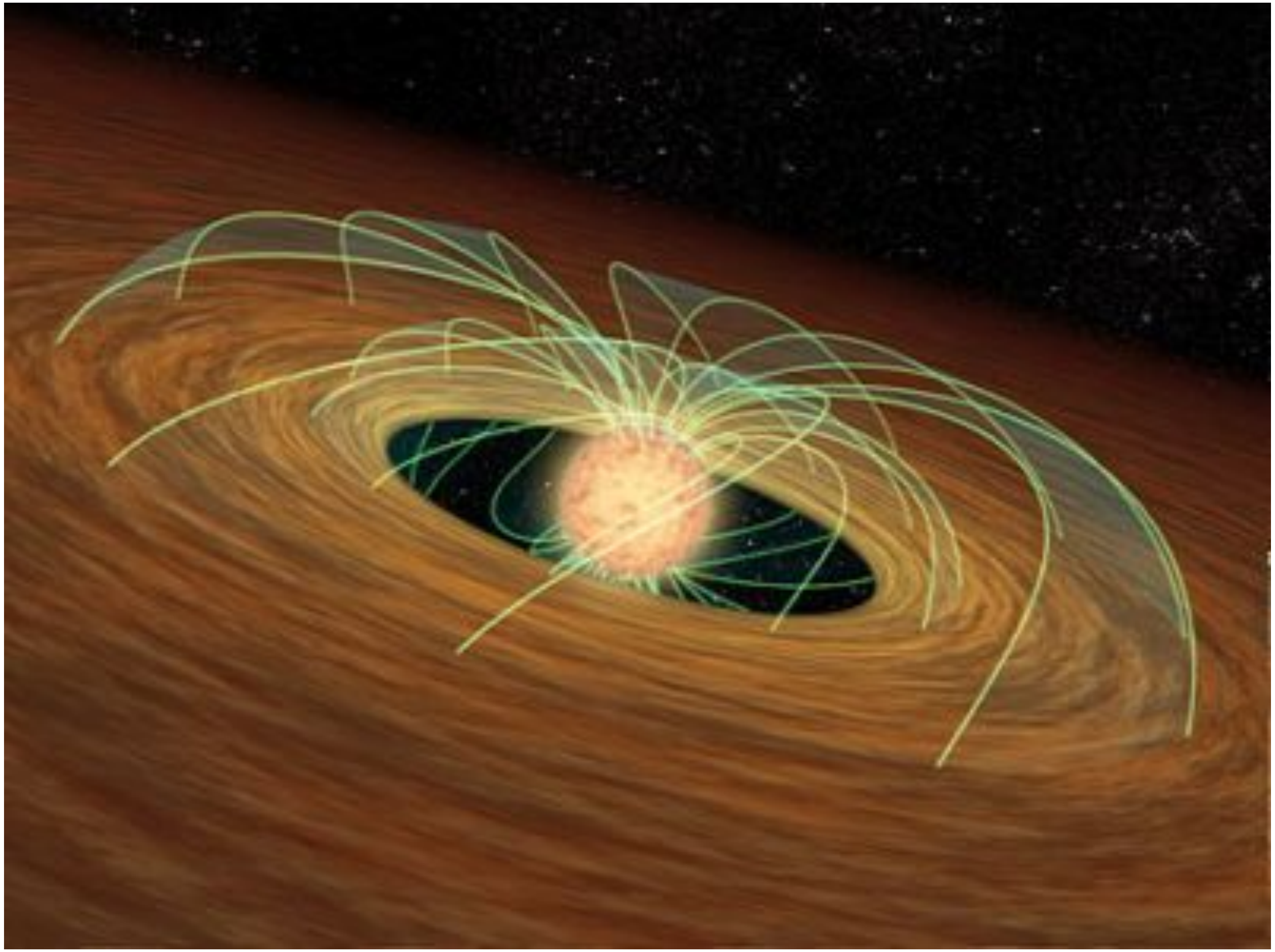
2) Stellar dynamics

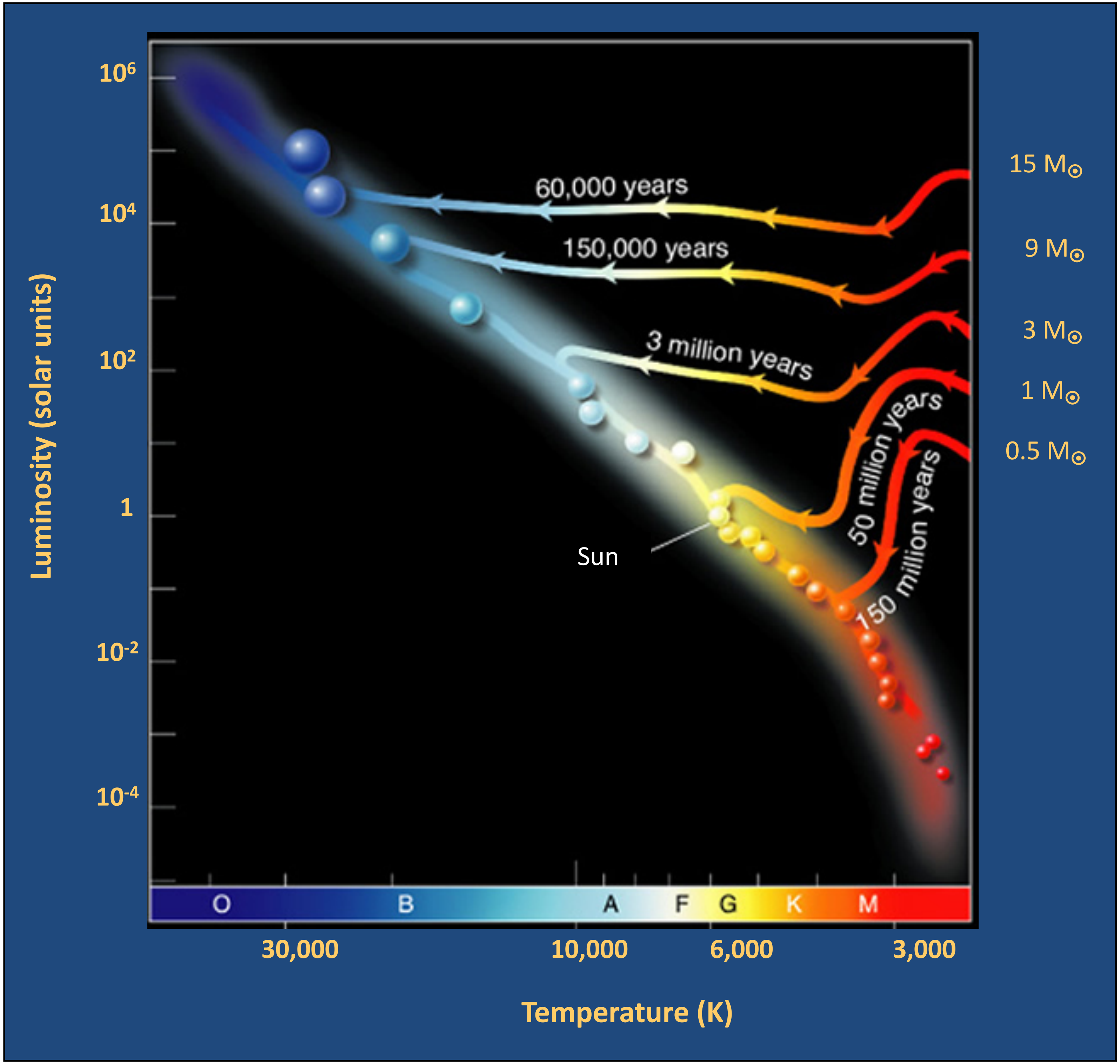
DEF: stars live inside the cluster potential well and interact in double triple or more complex systems (mergers and/or collisions)

AIM: study of the impact of interactions on the evolution of the star and the hosting cluster

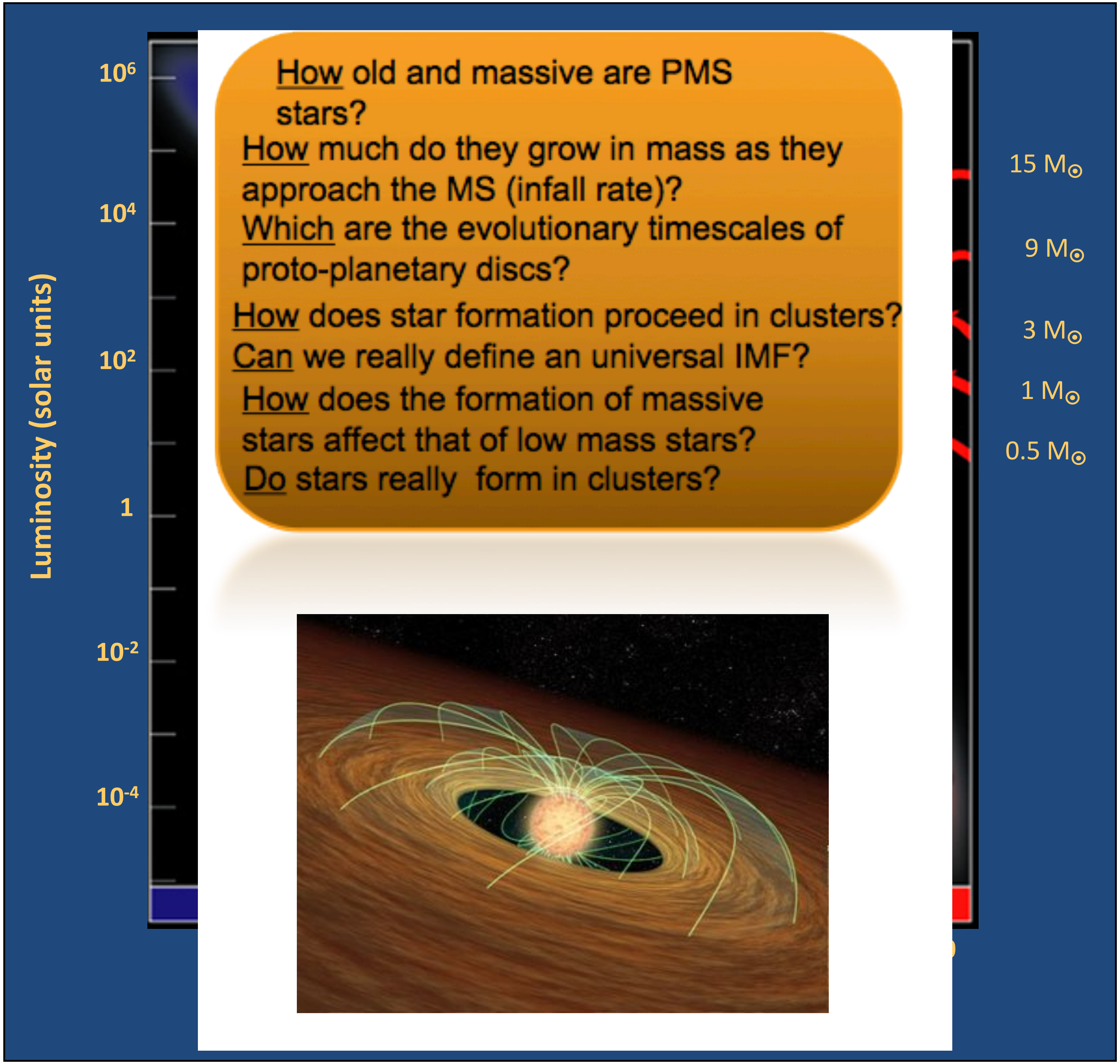
Young Massive Clusters (<10My)

Stellar Evolution: physical properties of PMS stars

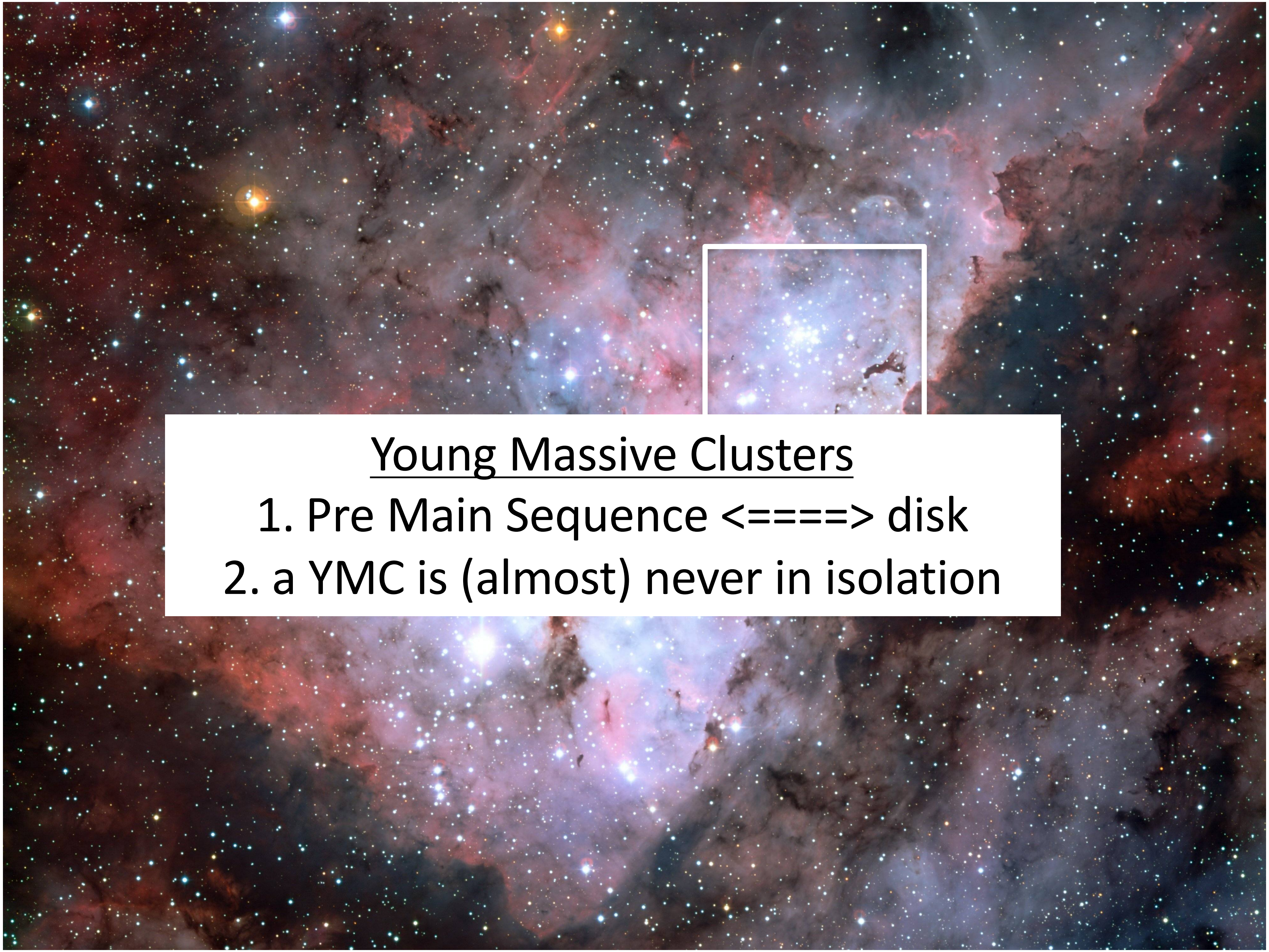




Luminosity (solar units)
10^6
10^4
10^2
1
10^-2
10^-4
60,000 years
150,000 years
3 million years
50 million years
150 million years
Sun
15 M⊙
9 M⊙
3 M⊙
1 M⊙
0.5 M⊙
O
B
A
F
G
K
M
30,000
10,000
6,000
3,000
Temperature (K)



How old and massive are PMS stars?
How much do they grow in mass as they approach the MS (infall rate)?
Which are the evolutionary timescales of proto-planetary discs?
How does star formation proceed in clusters?
Can we really define an universal IMF?
How does the formation of massive stars affect that of low mass stars?
Do stars really form in clusters?
Luminosity (solar units)
10^6
10^4
10^2
1
10^{-2}
10^{-4}
15 $M_\odot$
9 $M_\odot$
3 $M_\odot$
1 $M_\odot$
0.5 $M_\odot$

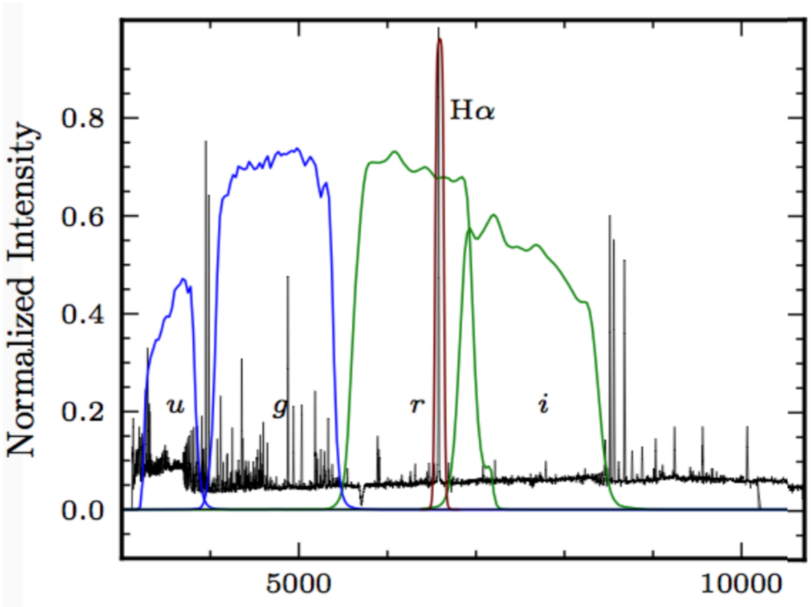


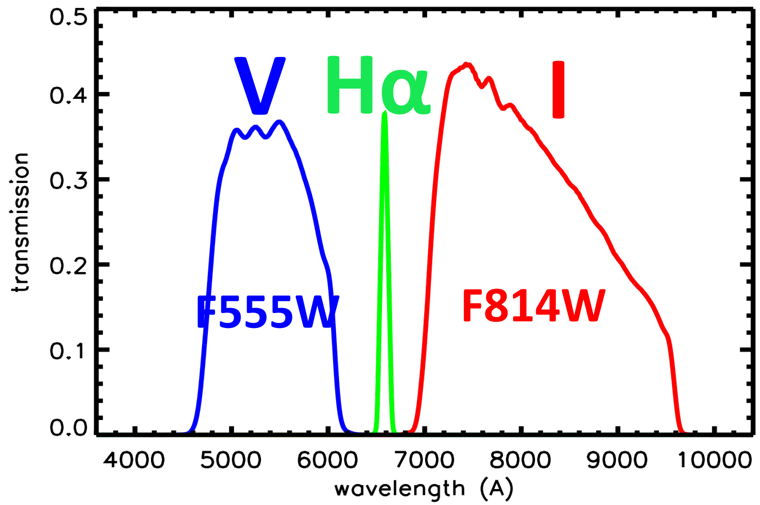
<u>Young Massive Clusters</u>

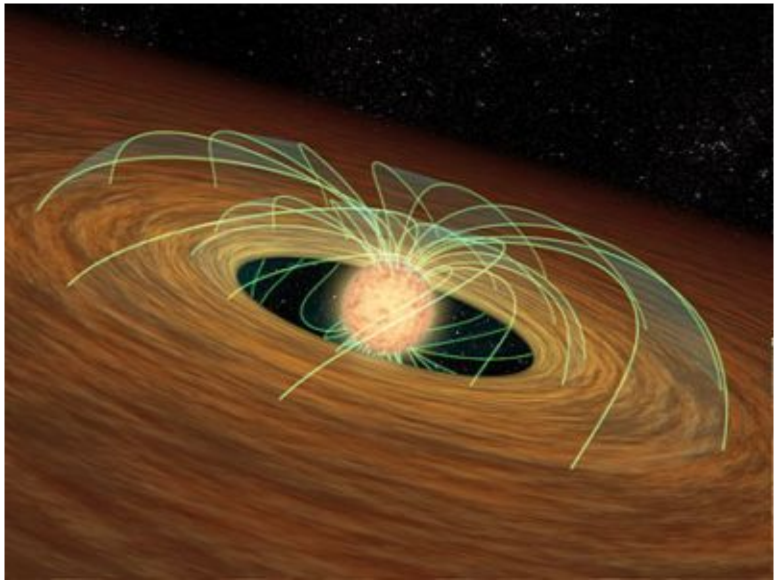
1. Pre Main Sequence <====> disk

2. a YMC is (almost) never in isolation

PMS in YMS: optical photometry



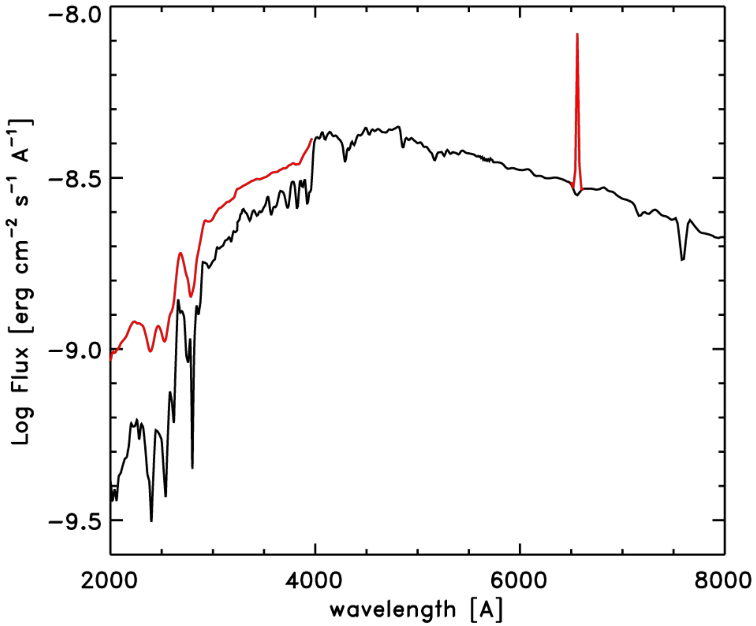




Hα excess emission

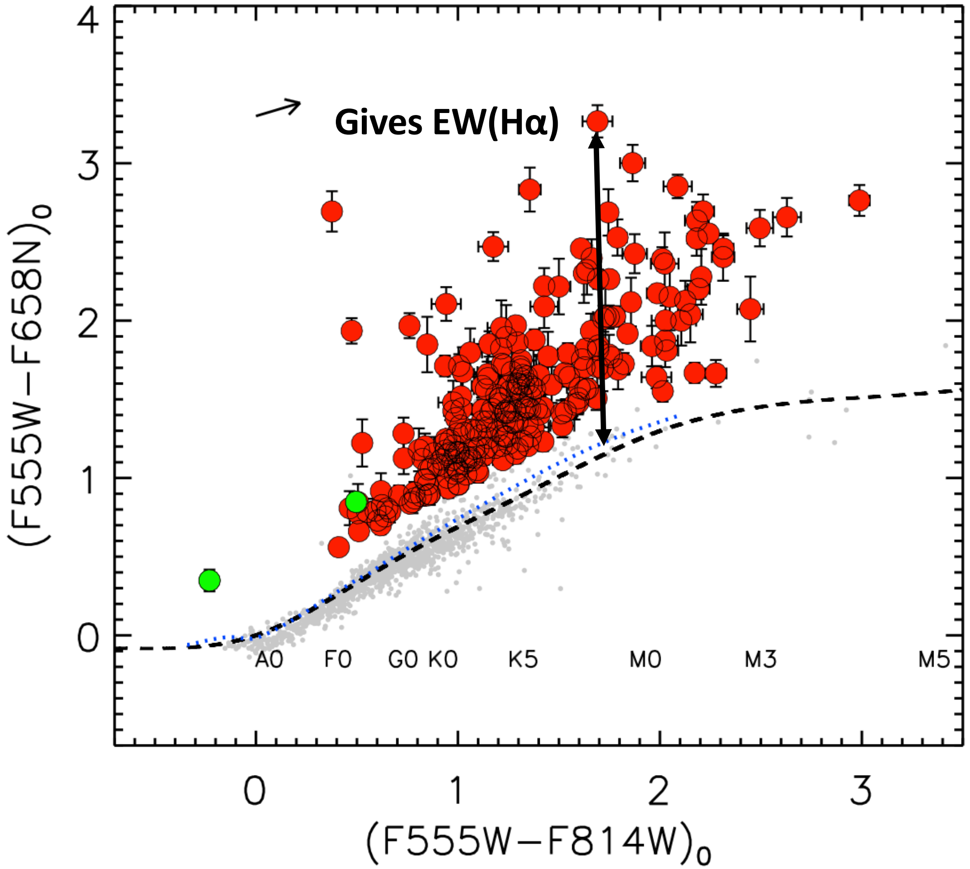
↓

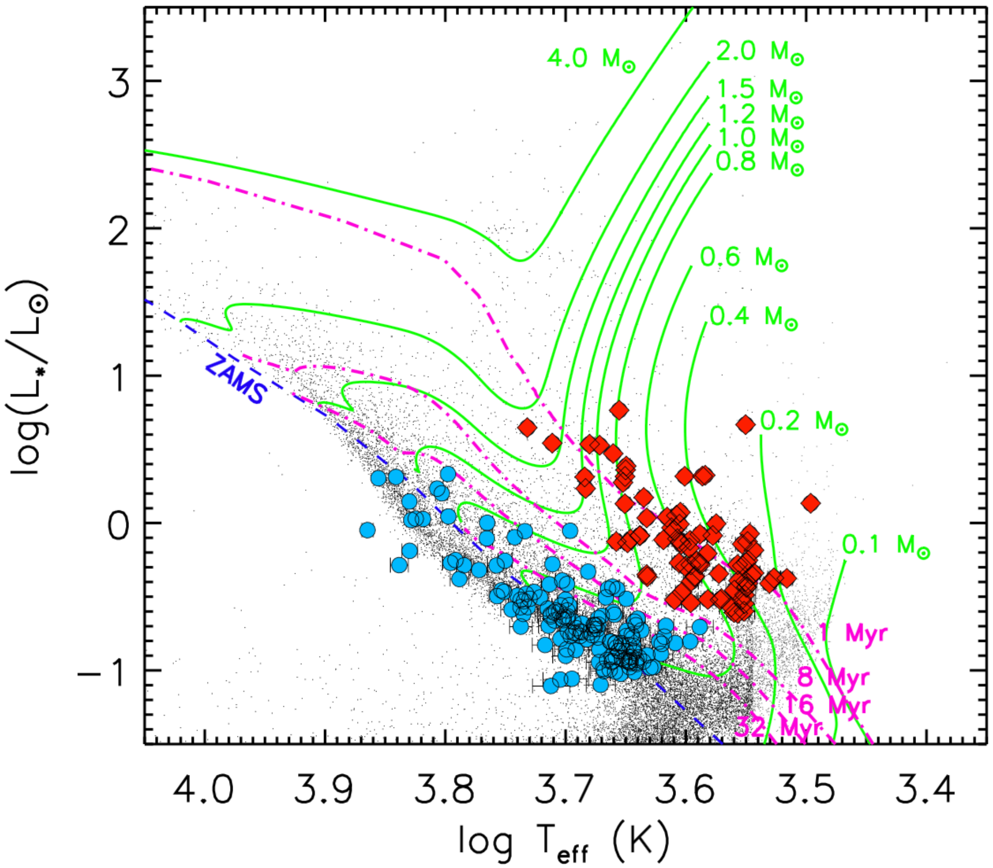
Ongoing accretion



PMSs: optical photometry - LH95

Biazzo, Beccari et al 2018 (ApJ sub.)





- **We can study how star formation has proceeded in space and time**

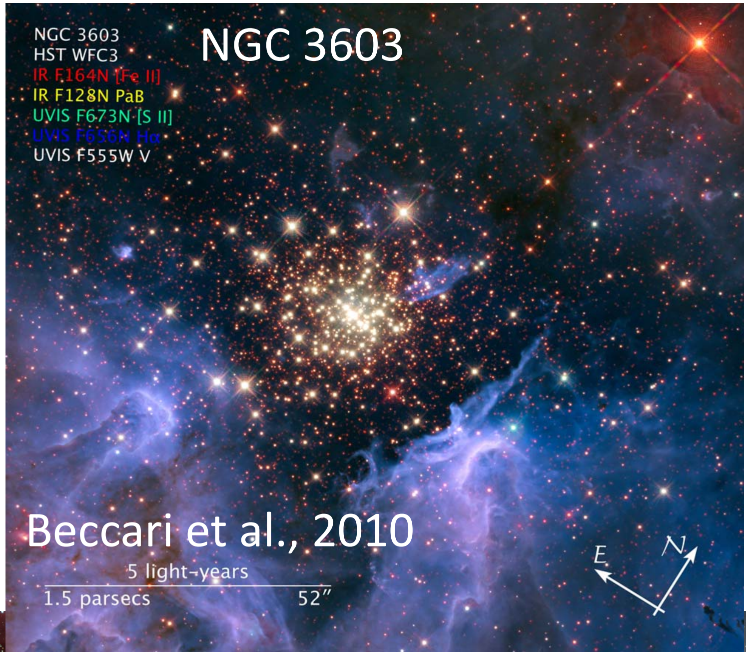
$$W_{eq}(H\alpha) = \mathrm{RW} \times [1 - 10^{-0.4\times(H\alpha - H\alpha^c)}]$$

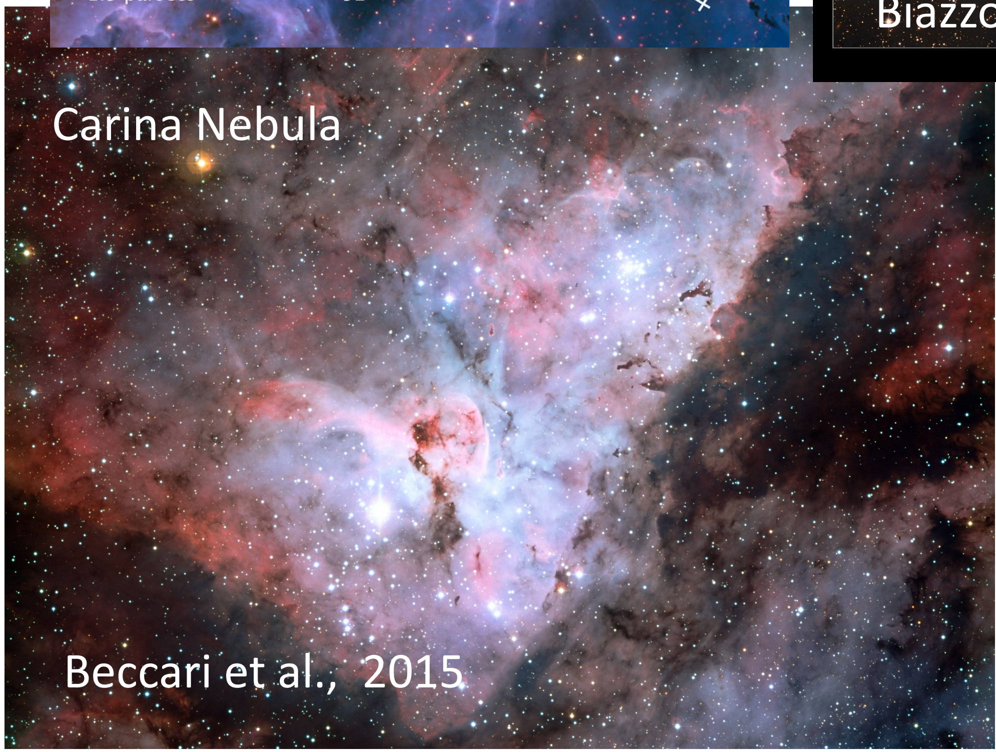
RW= rectangular width of the filter

Hα = Hα magnitude

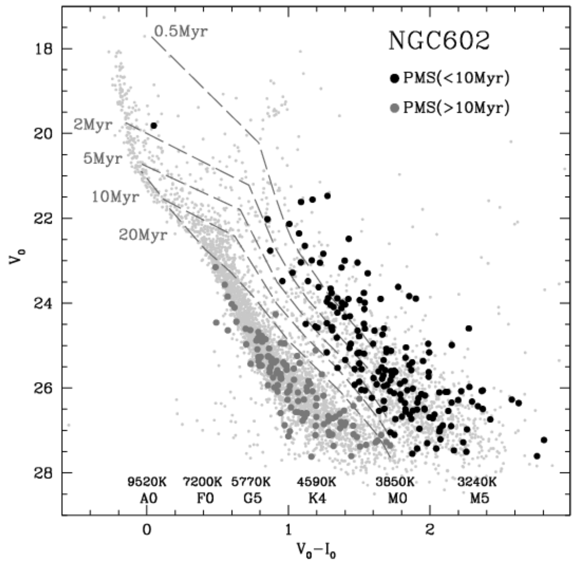
$H\alpha_C$ = continuum around the Hα line derived from (V-I)

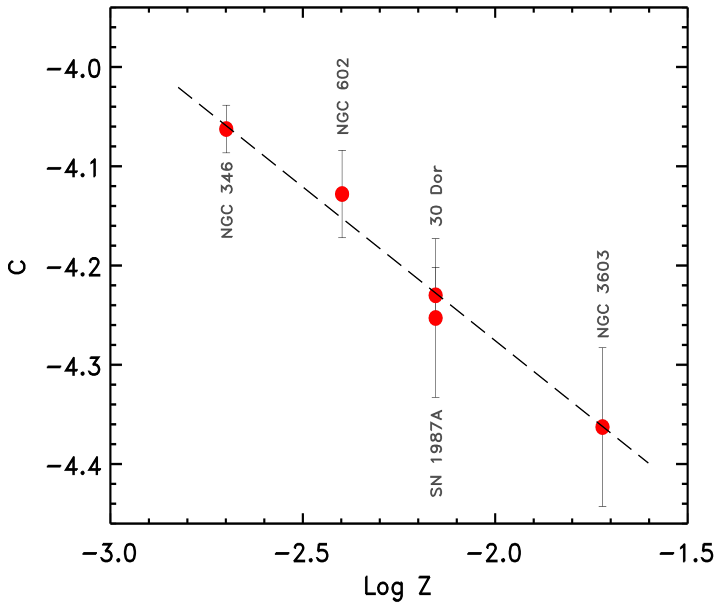
PMS objects in a number of star-burst clusters (MW, LMC, SMC)





IN ALL YMCs WE STUDIED SO FAR…





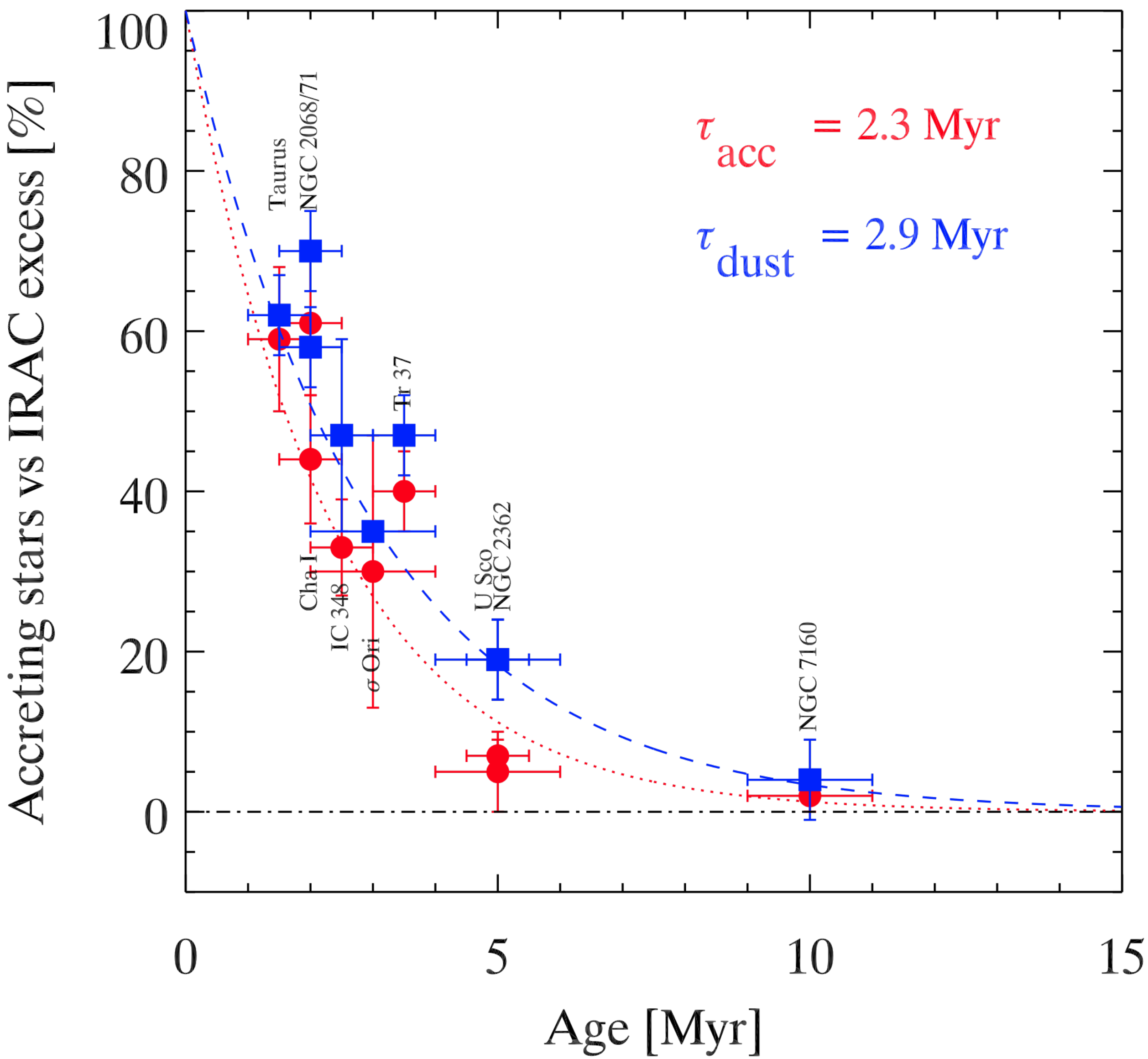
1) 10-30 Myr age spread

2) 20%-30% of the PMS with Hα excess emission are older than 10Myr

3) Young (<10My) and old (>10Myr) generations do not share the same spatial distribution (young one more centrally concentrated

4) $\log \dot{M}_{acc} \simeq \frac{3}{2} \log m - \frac{1}{2} \log t - \frac{1}{3} \log Z - 4.9$

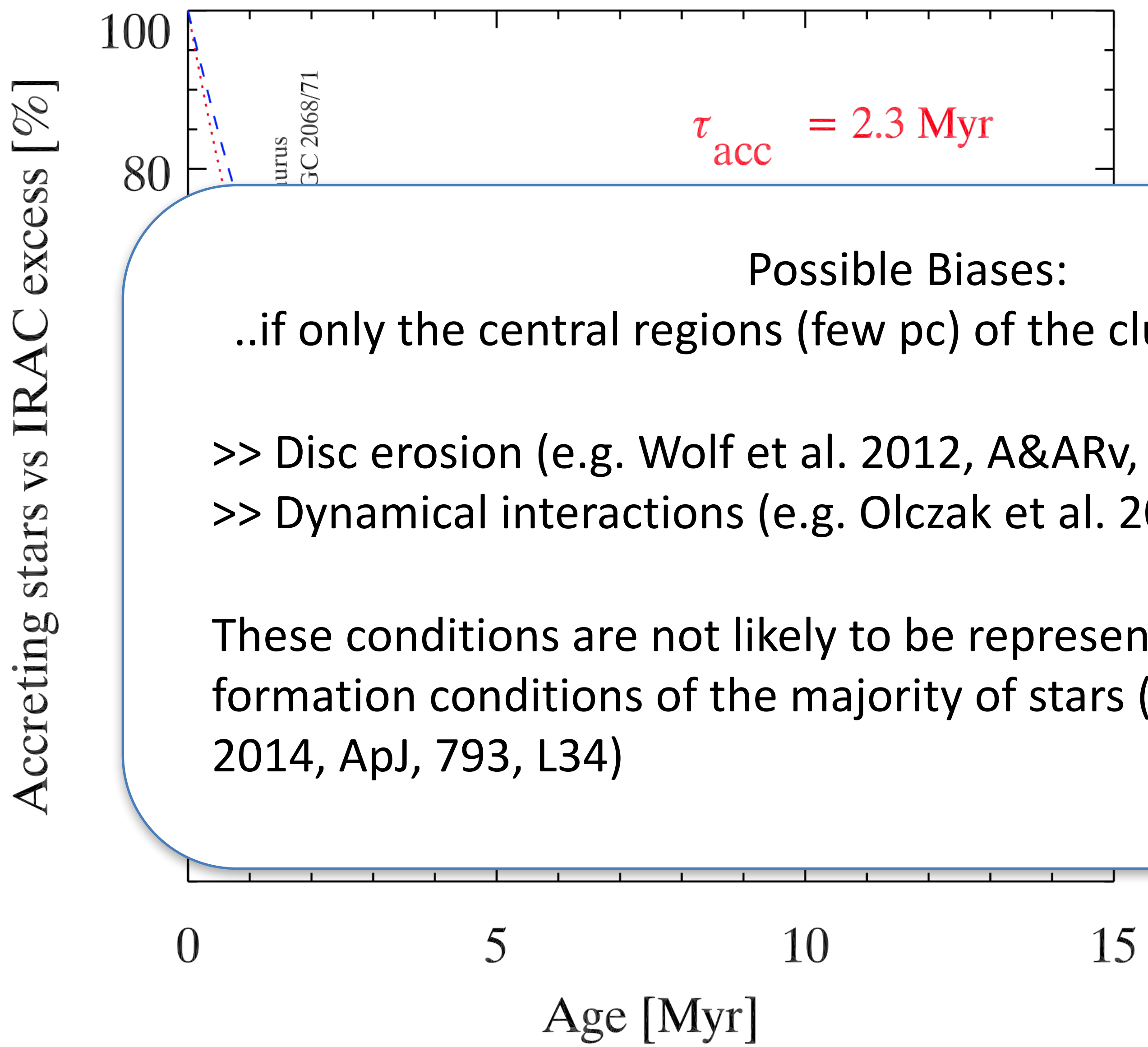
Pre-Main Sequence: Disc evolution



IR and/or spectroscopy:
Spatial Resolution limits
Limited surveyed area (1-3pc)
Time consuming (few 10th)
Lack of homogeneity
Close-by low-mass/density env.

Fedele et al. 2010

Pre-Main Sequence: Disc evolution



Possible Biases:

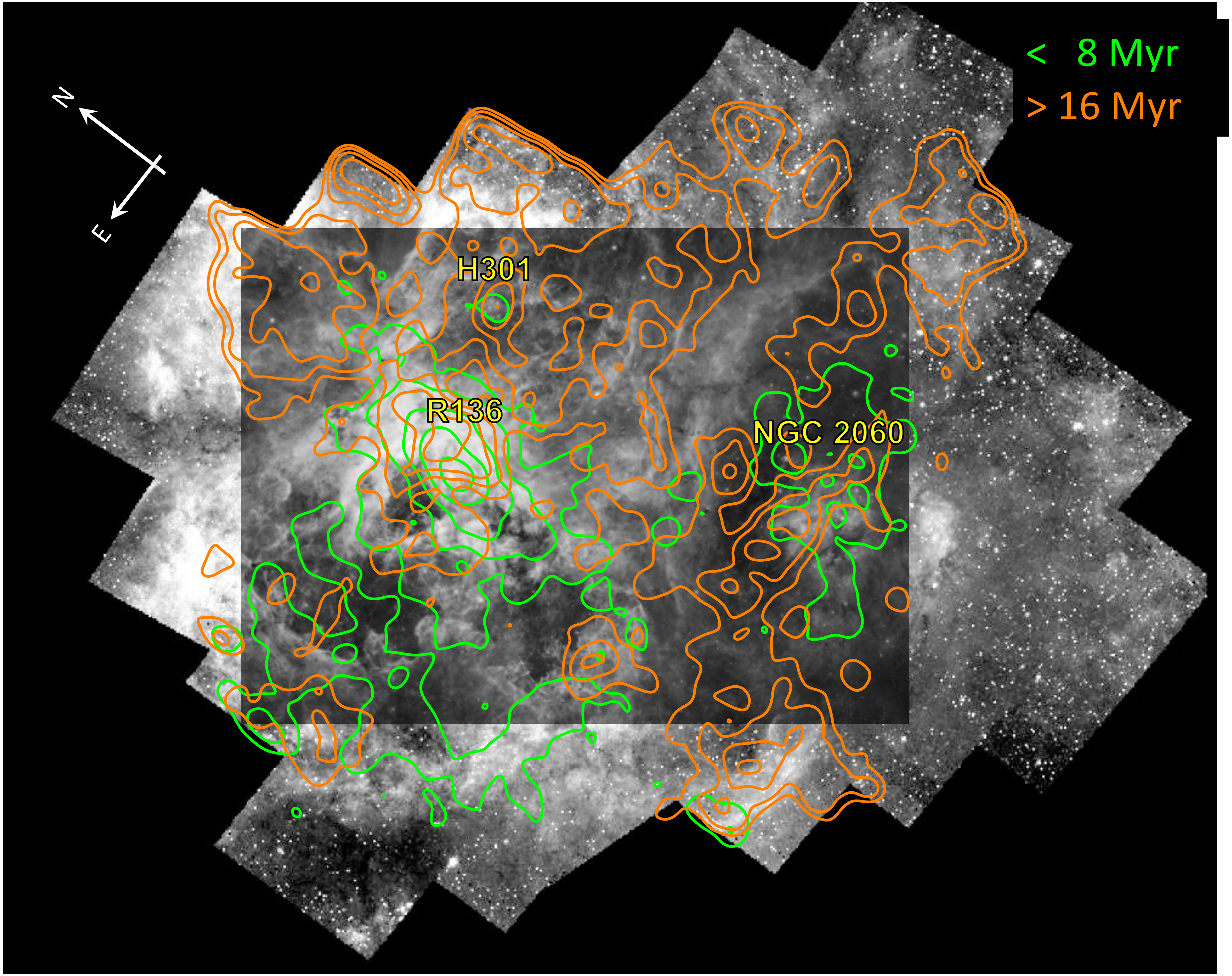
..if only the central regions (few pc) of the clusters are observed...

>> Disc erosion (e.g. Wolf et al. 2012, A&ARv, 20, 52)
>> Dynamical interactions (e.g. Olczak et al. 2010, A&A 509, A63)

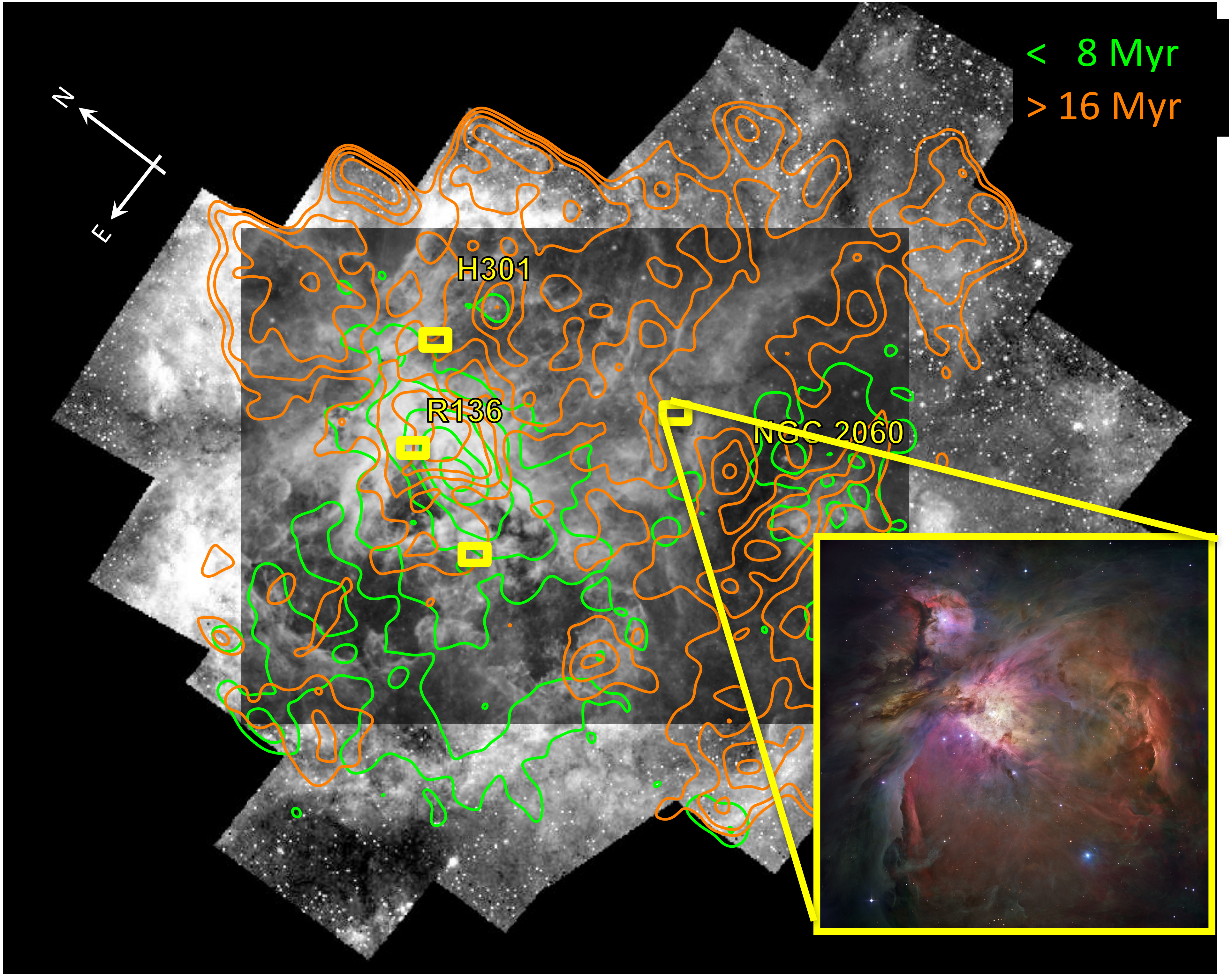
These conditions are not likely to be representative of the formation conditions of the majority of stars (see Pfalzner et al. 2014, ApJ, 793, L34)

-3pc)
Time consuming (few 10^{th})
Lack of homogeneity
Close-by low-mass/density env.

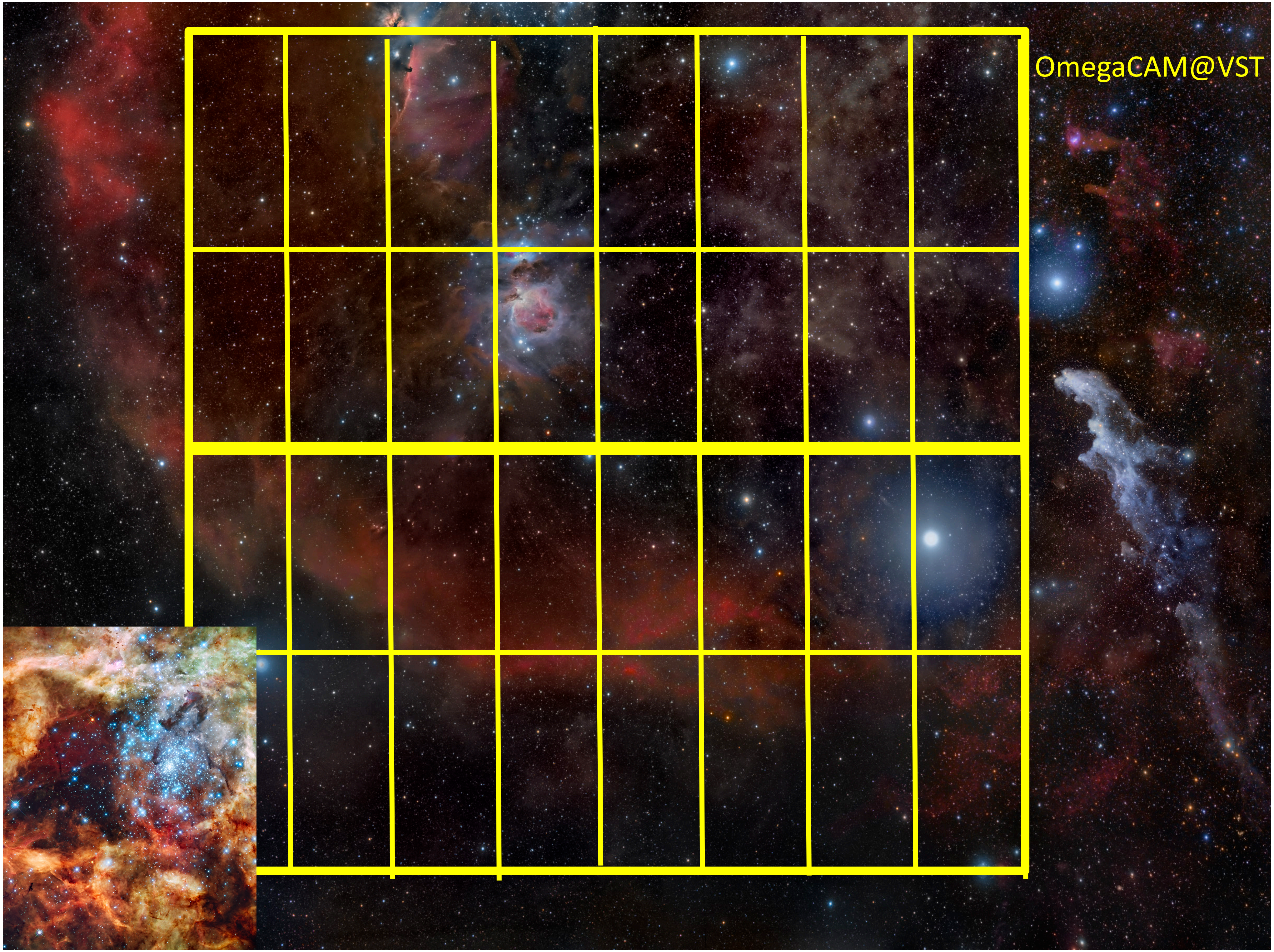
Fedele et al. 2010

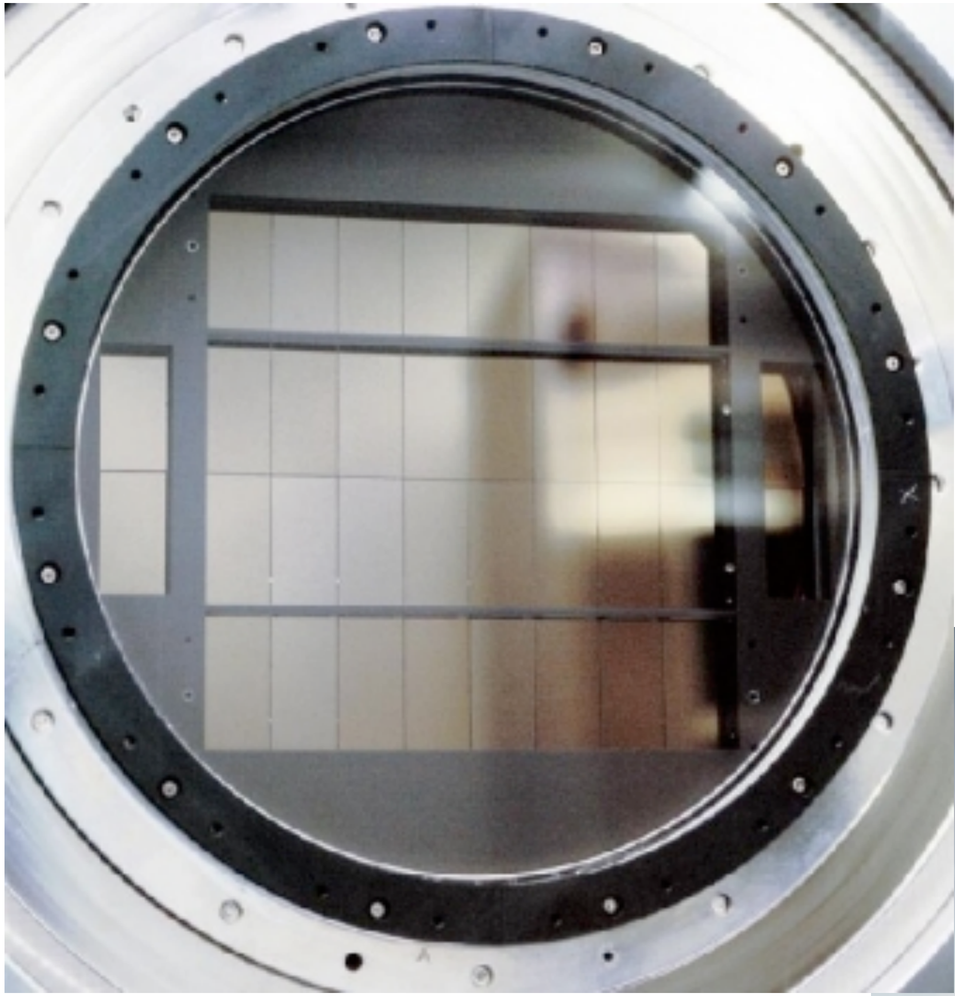


N
E
H301
R136
NGC 2060
< 8 Myr
> 16 Myr



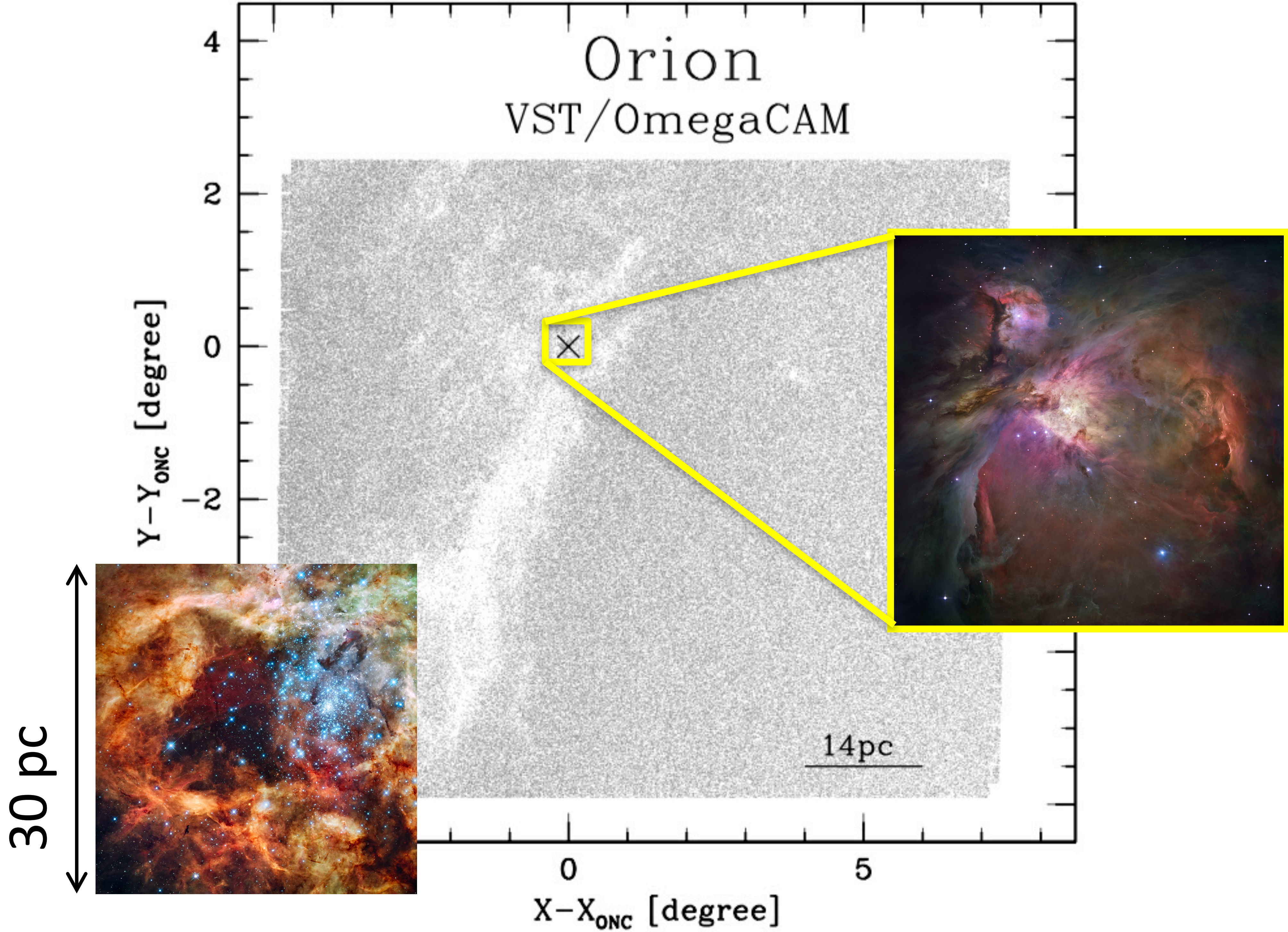
< 8 Myr
> 16 Myr
N
E
H301
R136
NGC 2060


OmegaCAM@VST

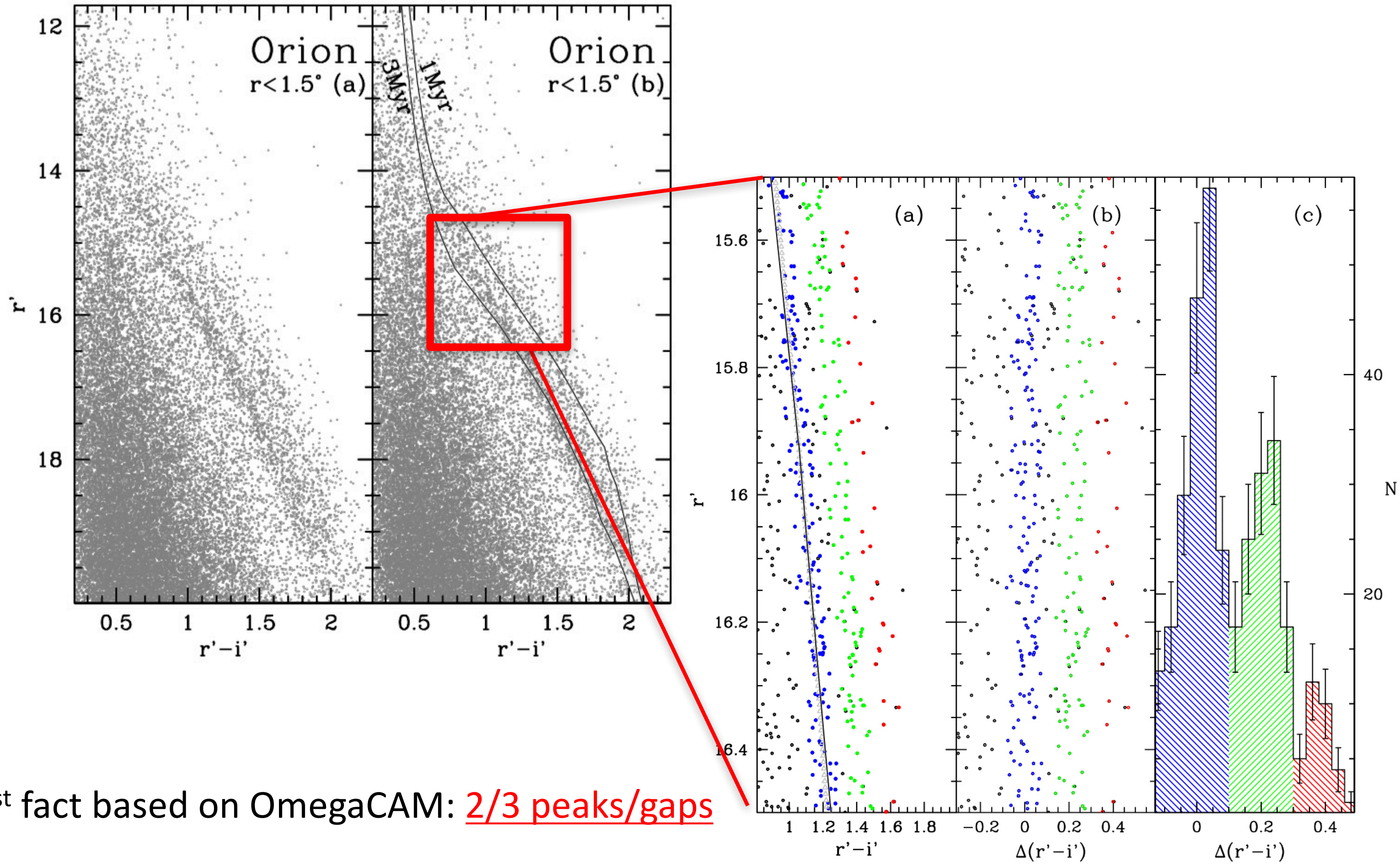


OmegaCAM: 1degx1deg
Filters: u,g,r,i,z,Halpha
VST: 2.6m telescope

355hr@VST; PI Beccari: Gamma Vel, UpperSco, Ophiucus, Cha I, Orion, EtaCha, Haffner 18, Lupus...


Orion
VST/OmegaCAM
4
2
0
−2
$Y - Y_{ONC}$ [degree]
0
5
$X - X_{ONC}$ [degree]
14pc
30 pc

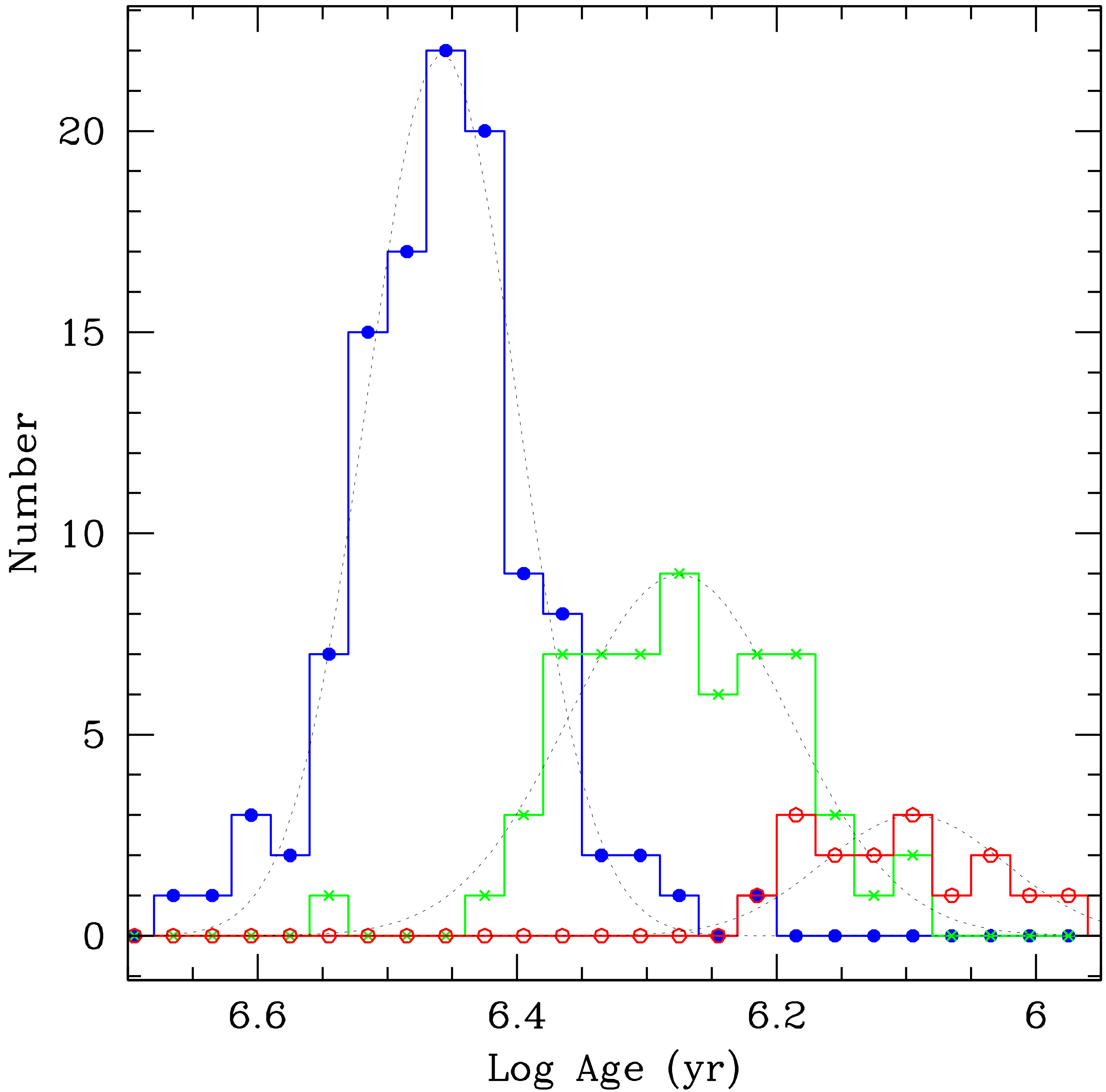
Multiple parralel and discrete Pre-Main Sequences!?!



1st fact based on OmegaCAM: 2/3 peaks/gaps

Beccari+2017

Opt 3: Different ages?

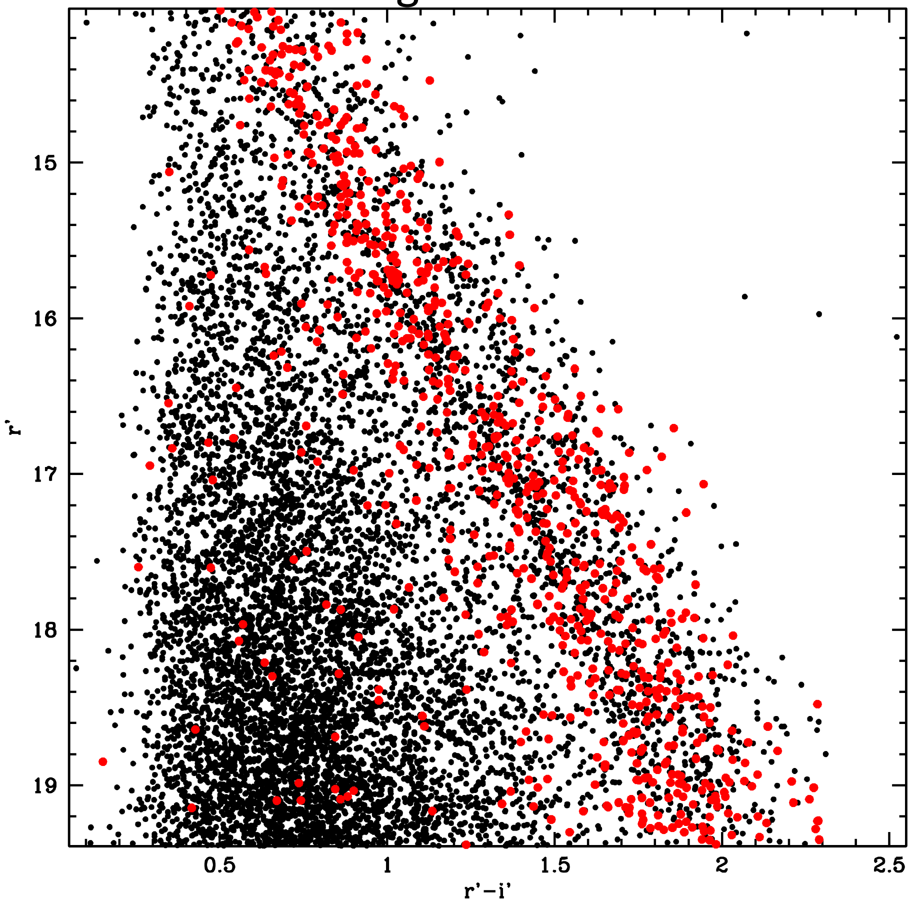


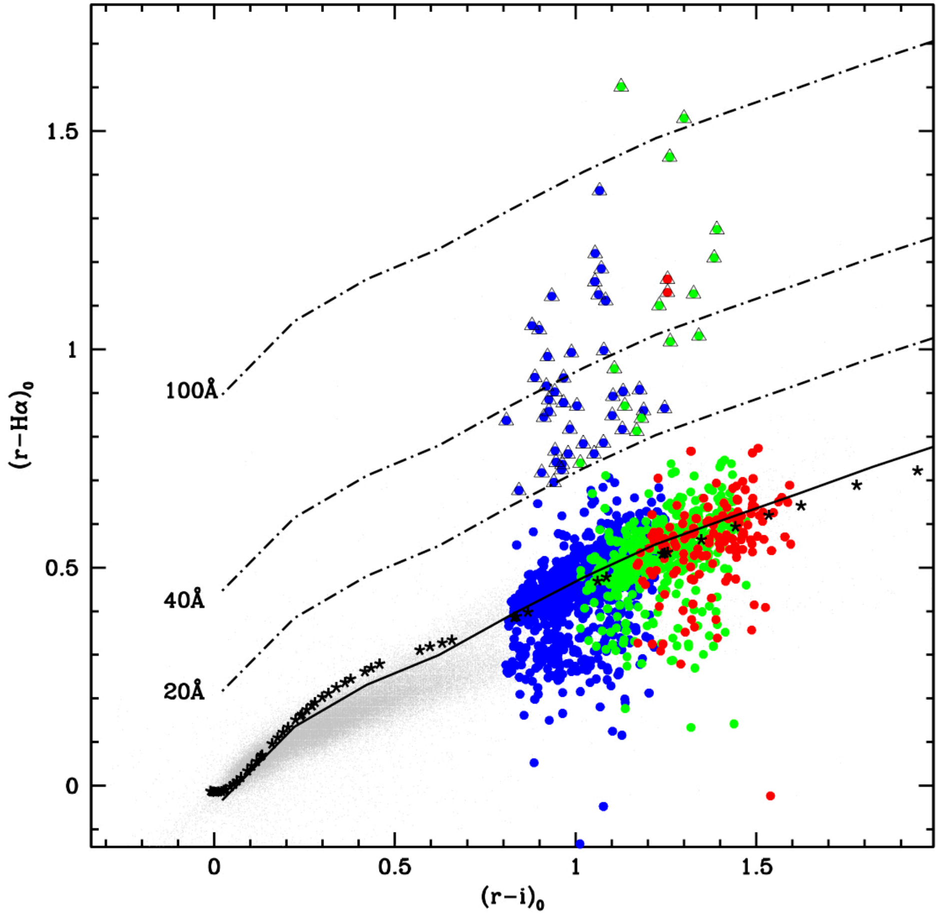
Rotation vs Age : Disk-locking

Accreting disk → AM removal

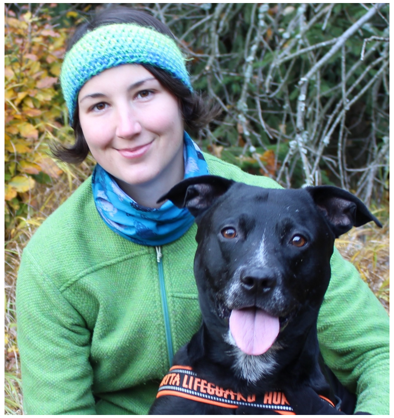
● disks with IR ex. from SPITZER

S. T. Megeath+12

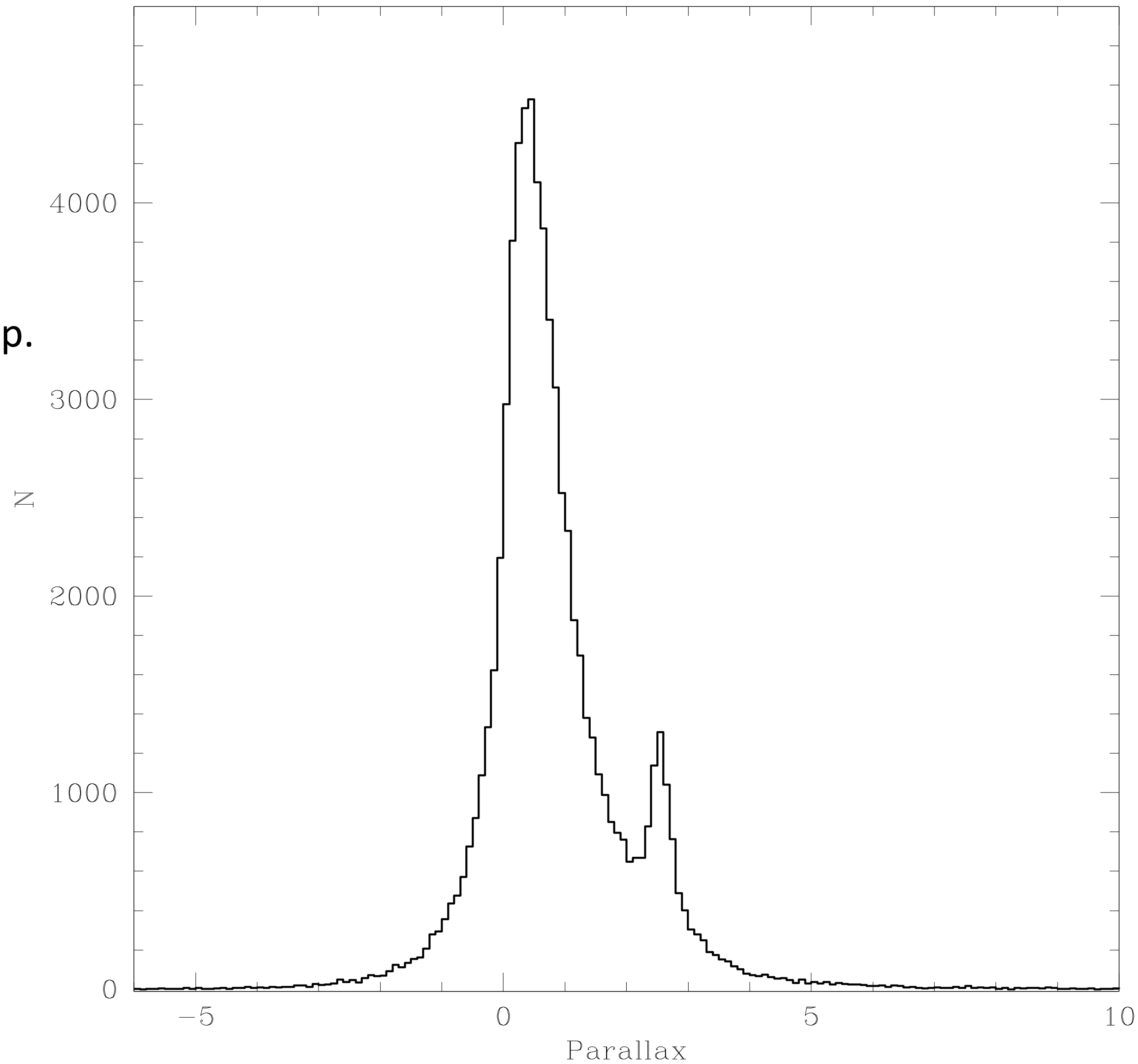




ONC seen by OmegaCAM…and Gaia DR2



Jerabkova et al 2018, in prep.



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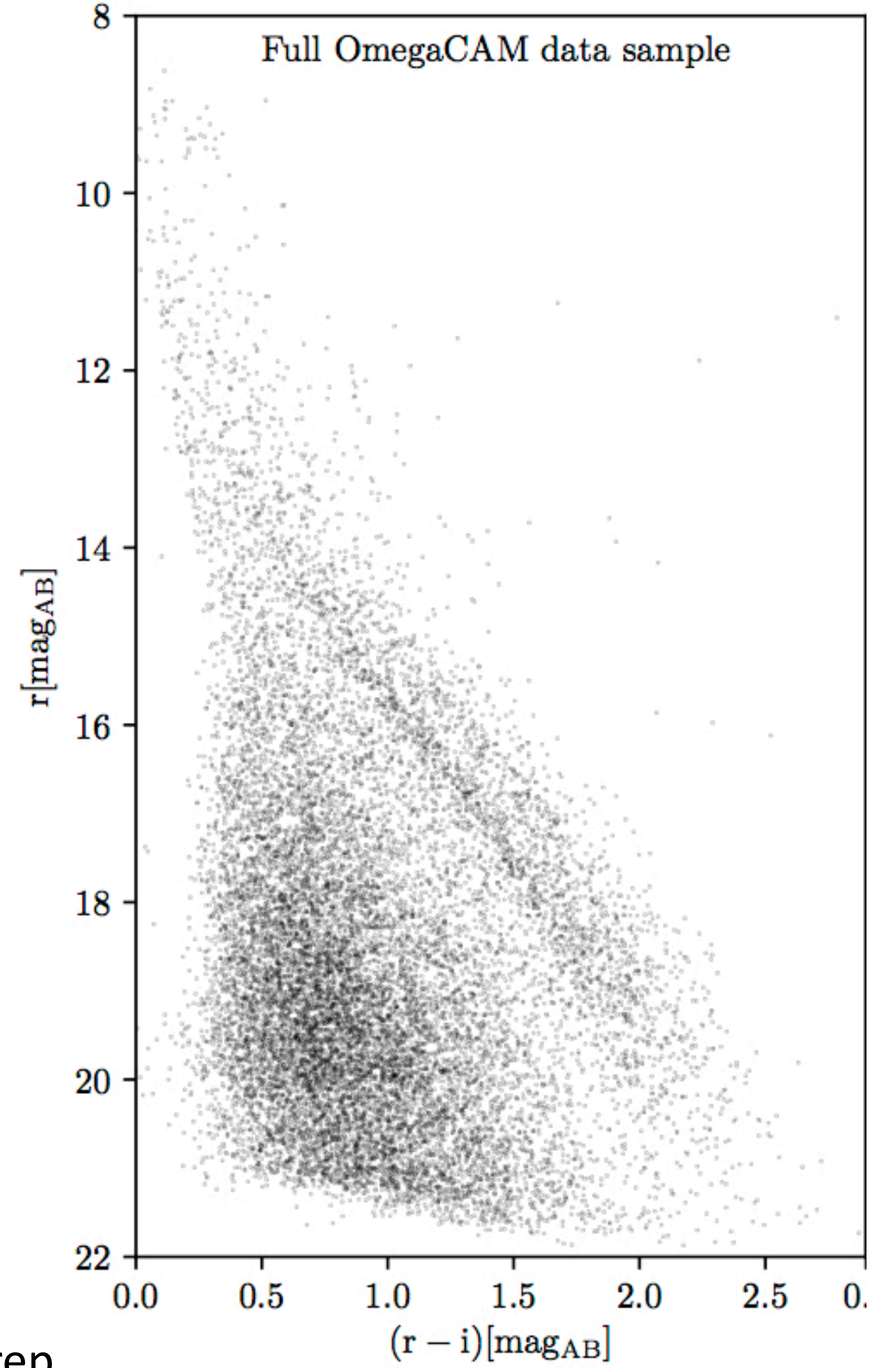

Jerabkova et al 2018, in prep.

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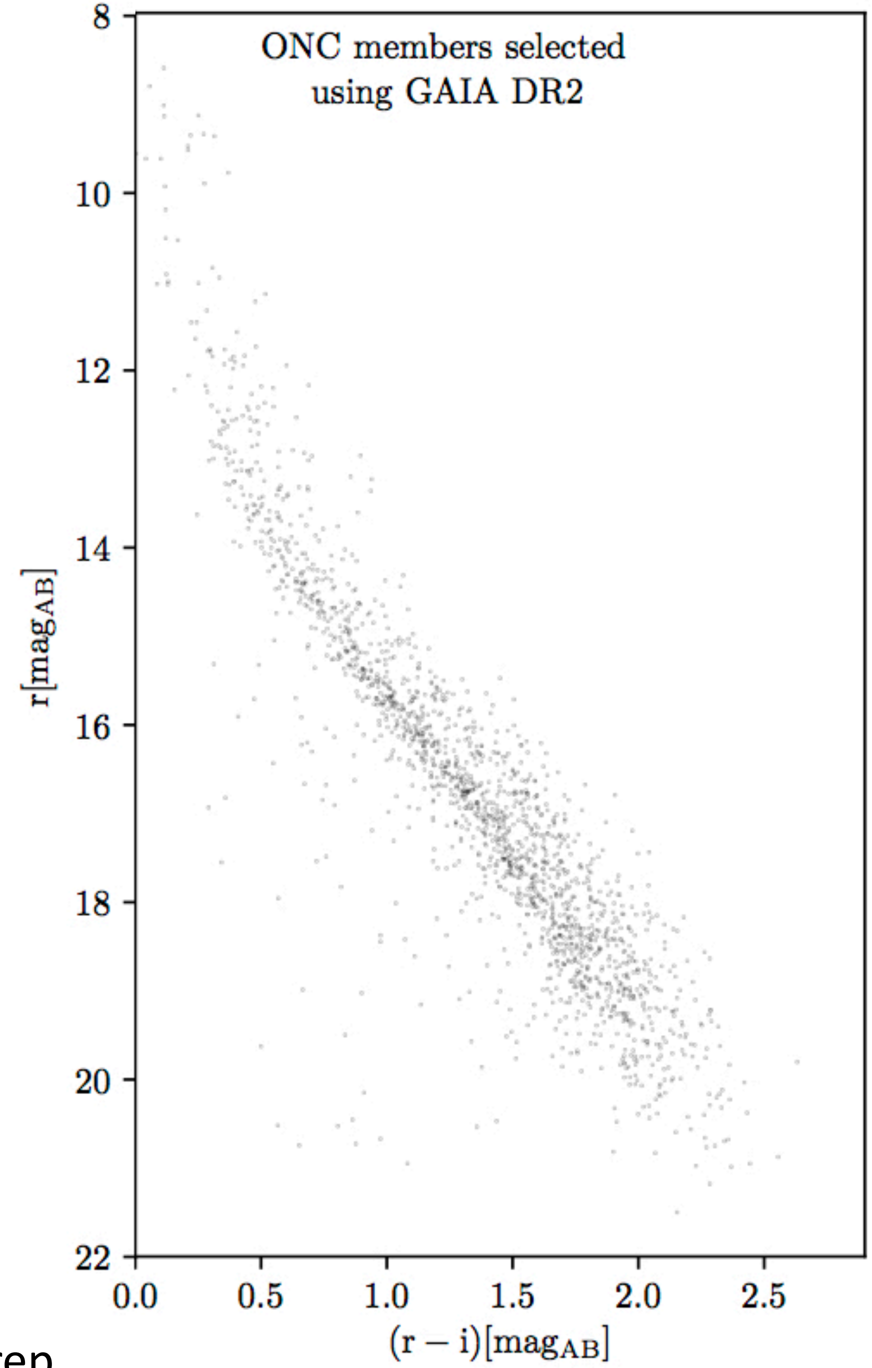

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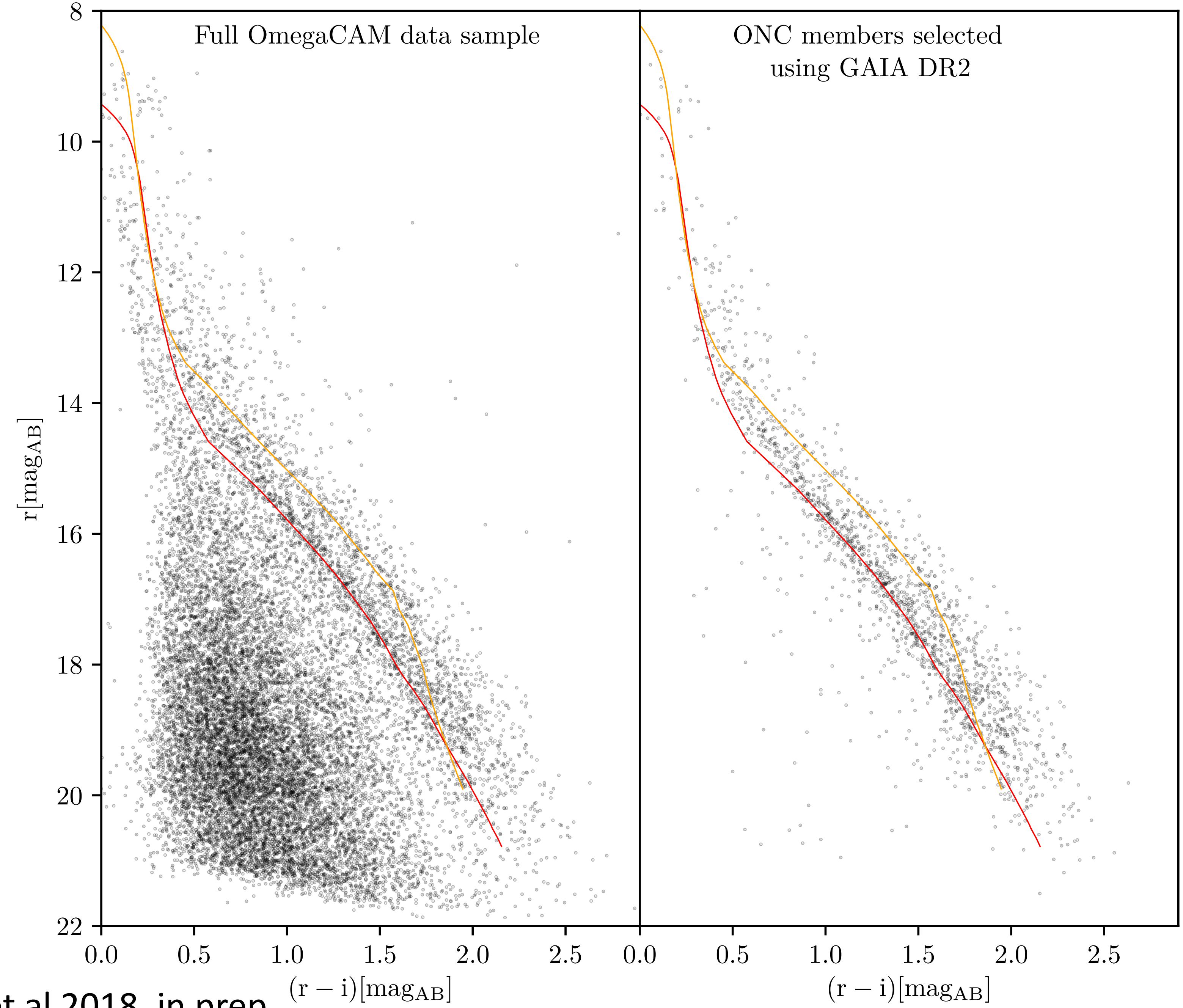

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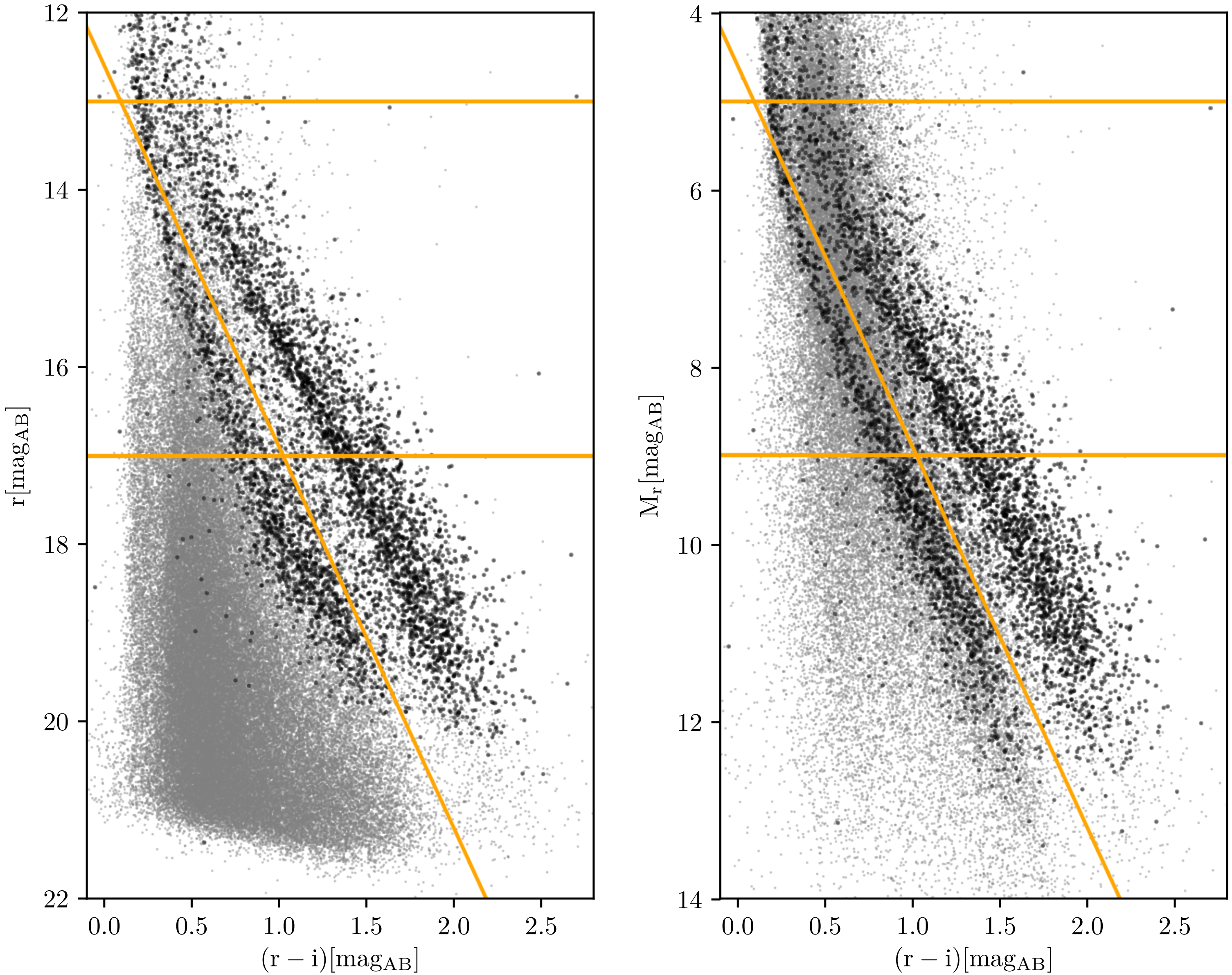
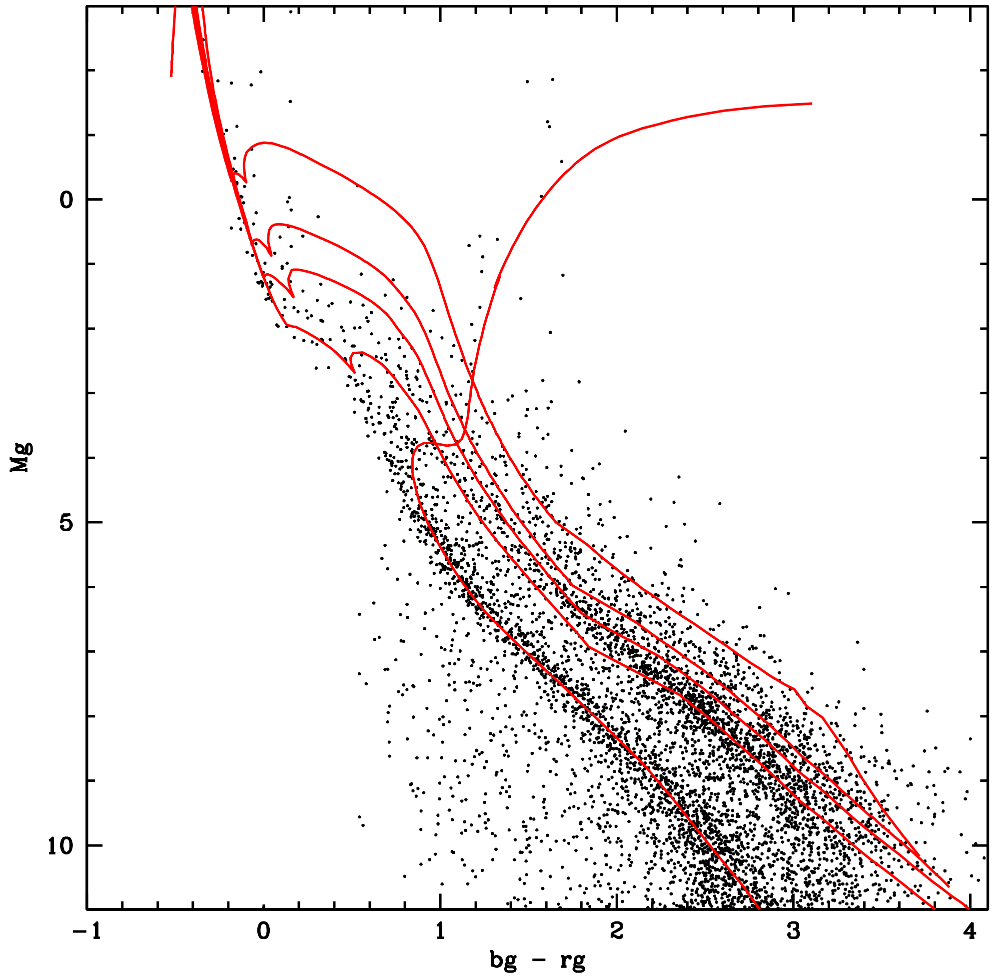


1. ~2.3<plx<~2.8
2. sigma_plx<10%

Jerabkova et al 2018, in prep.

ONC seen by OmegaCAM…and Gaia DR2



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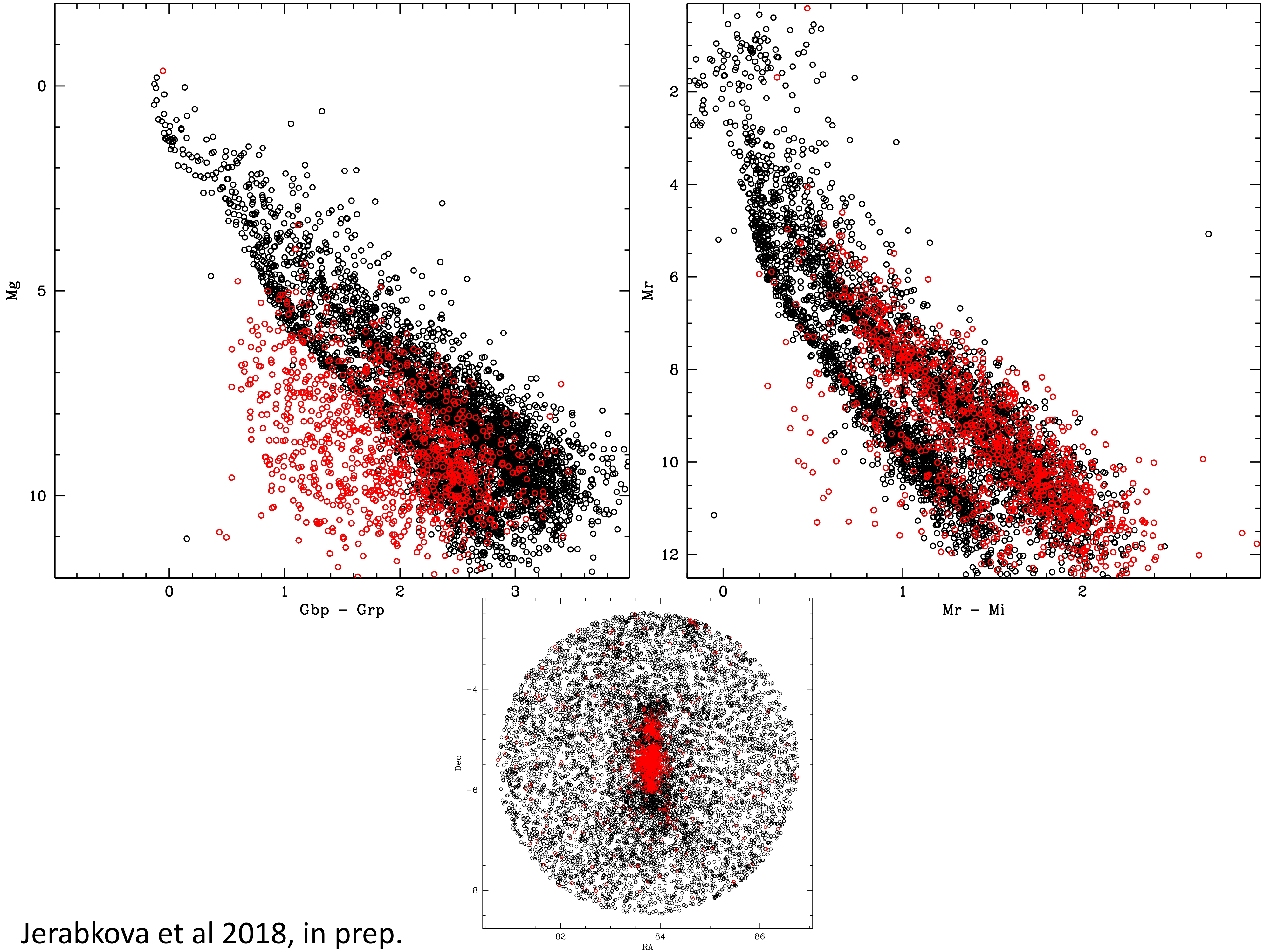

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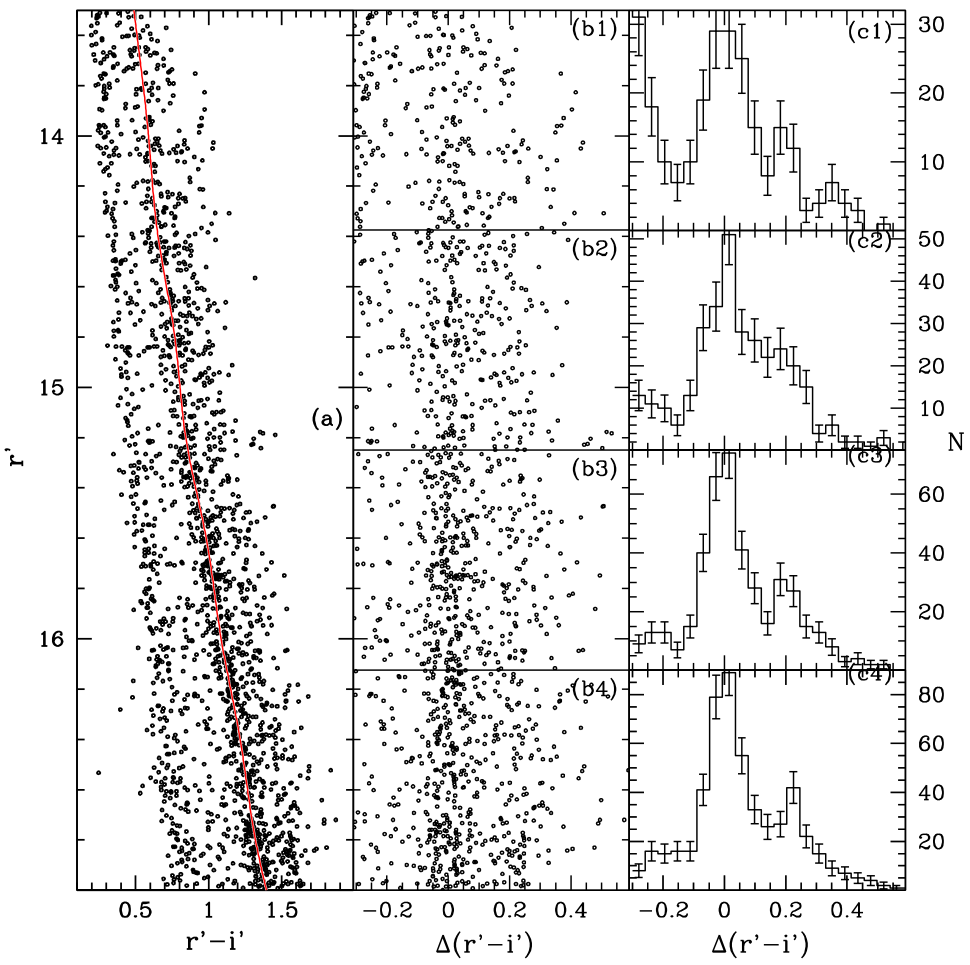

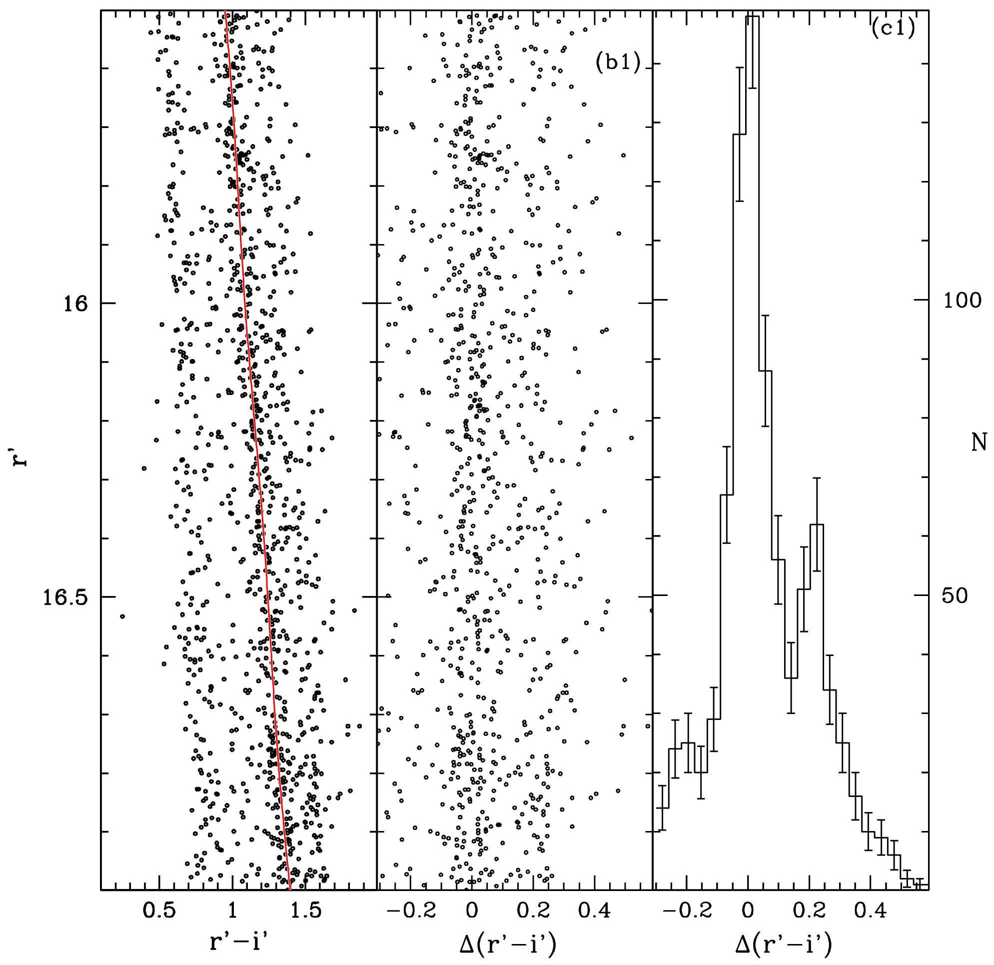

ONC seen by OmegaCAM…and Gaia DR2

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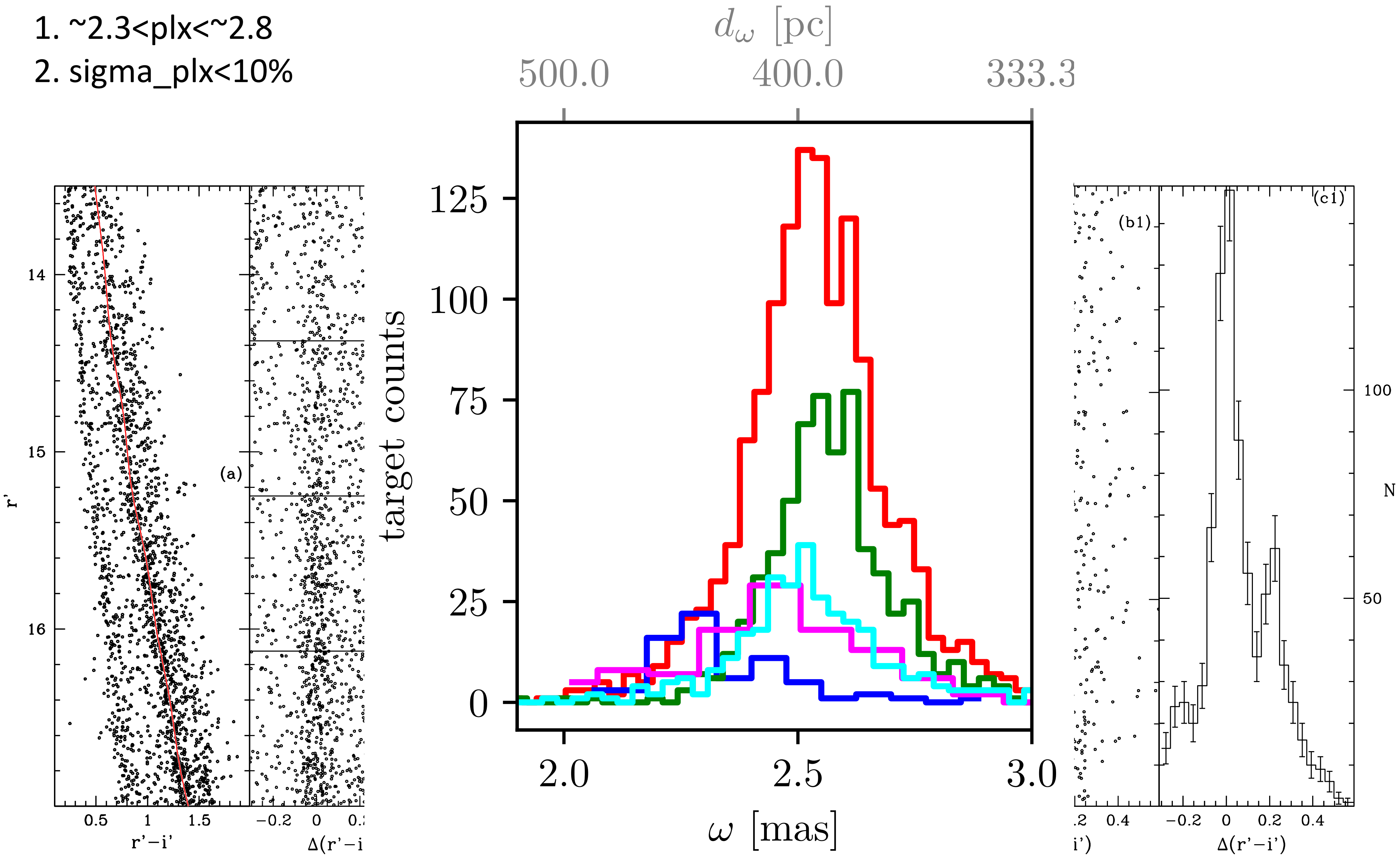
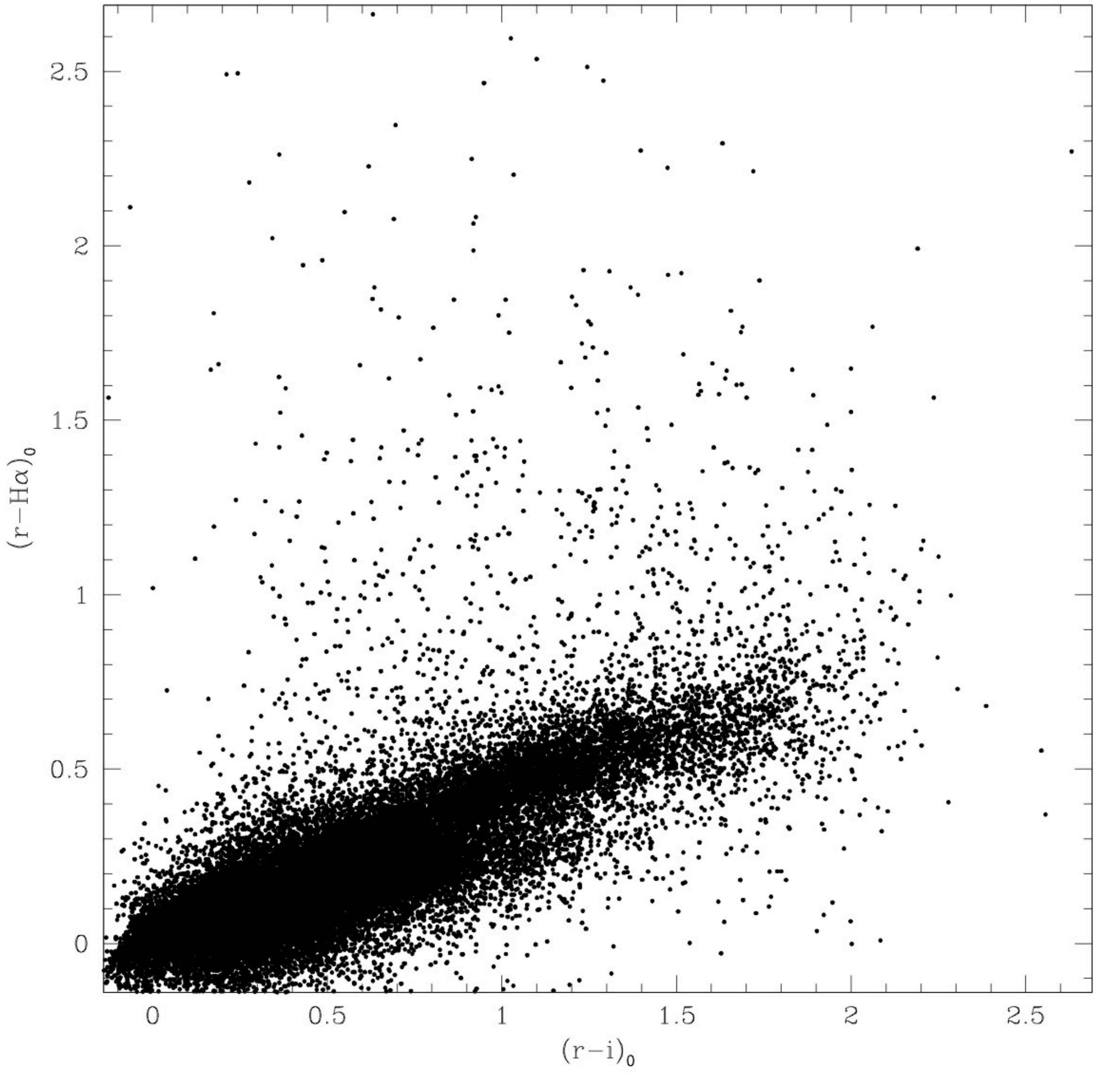


ONC seen by OmegaCAM…and Gaia DR2



ONC seen by OmegaCAM…and Gaia DR2

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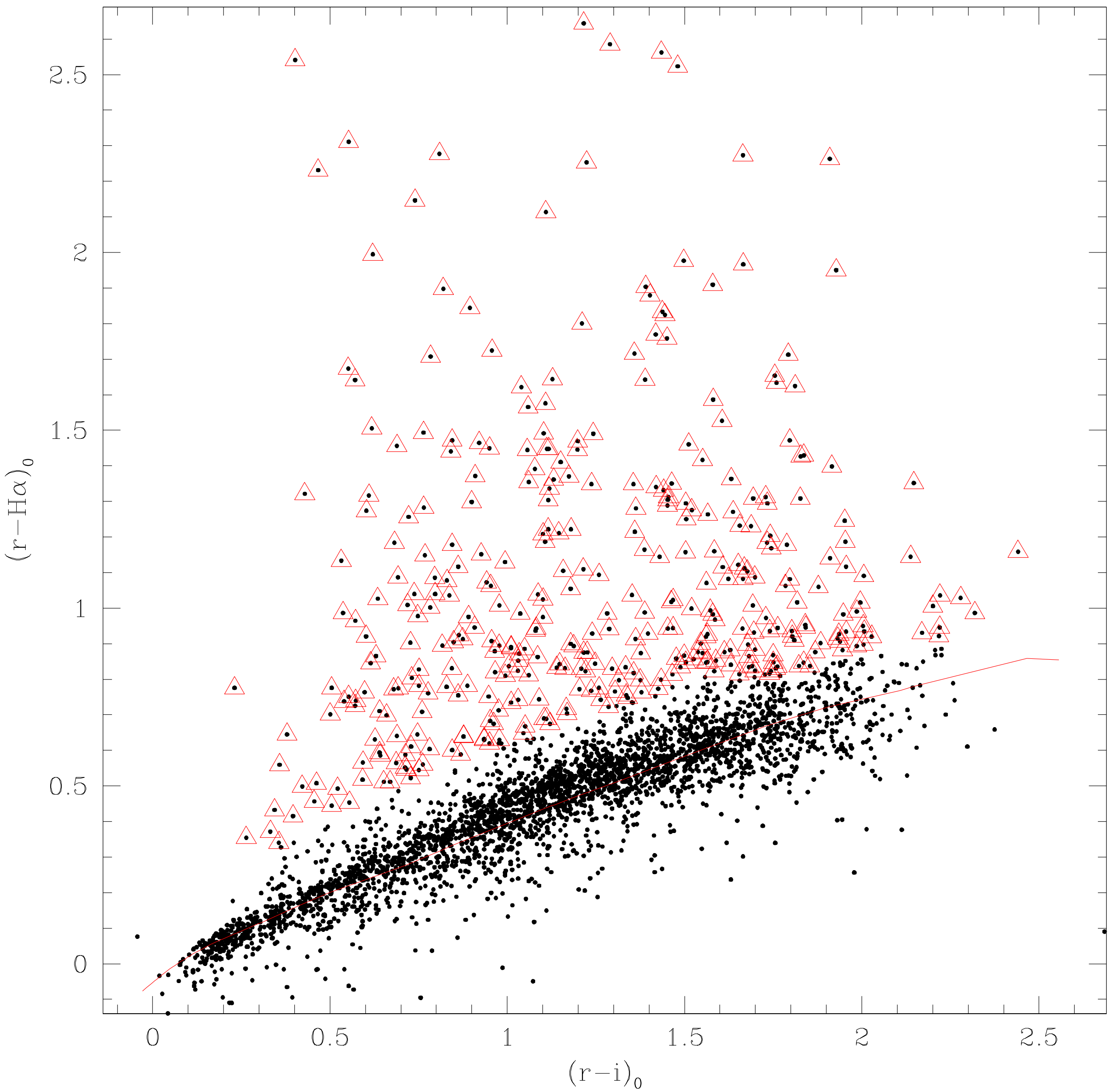

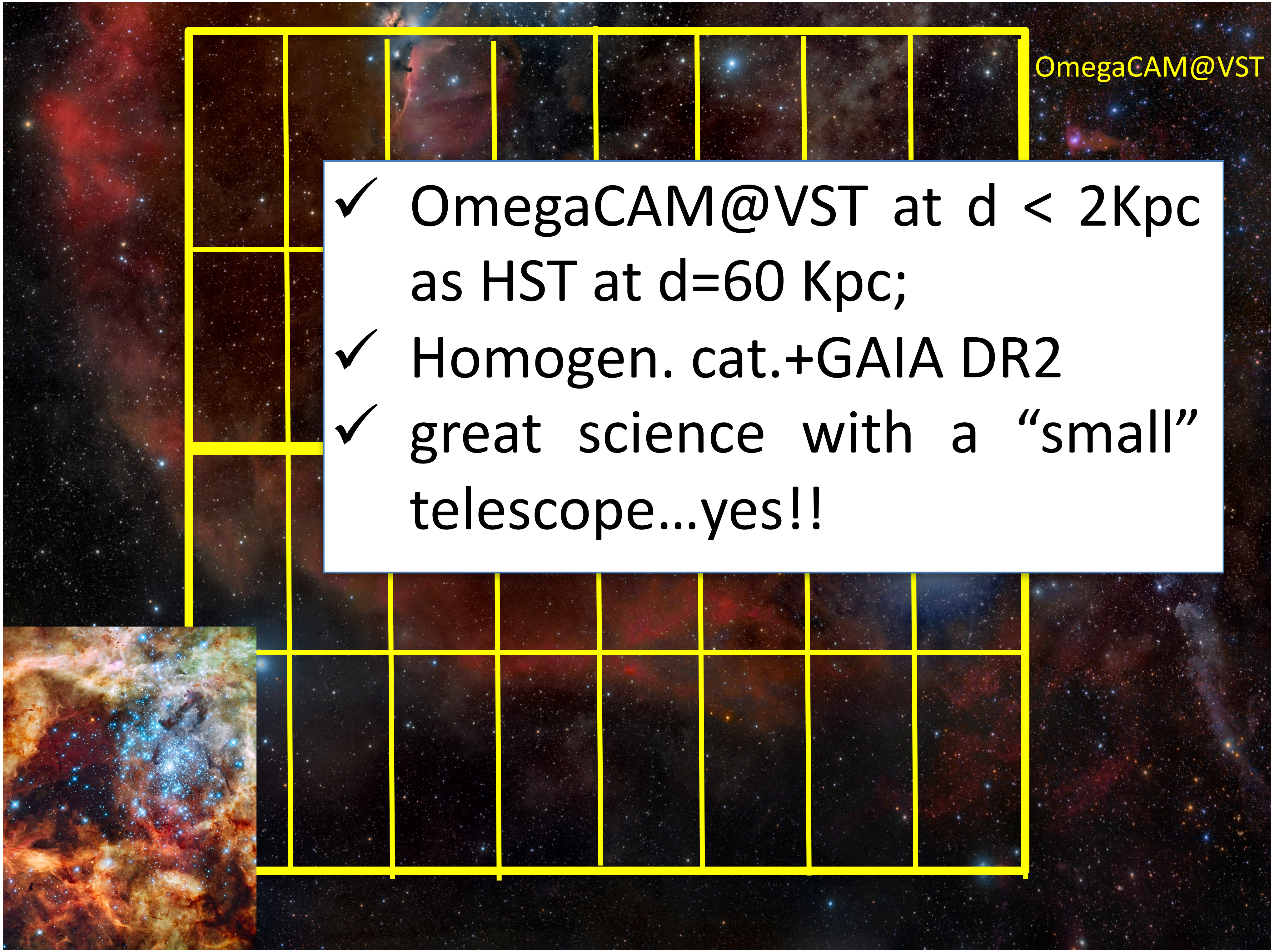

- ✓ OmegaCAM@VST at d < 2Kpc as HST at d=60 Kpc;
- ✓ Homogen. cat.+GAIA DR2
- ✓ great science with a “small” telescope…yes!!