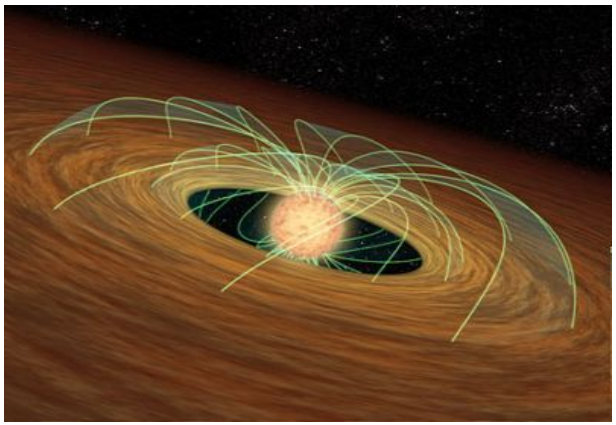
OmegaCAM mini-survey of circumstellar discs in nearby galactic star-forming regions



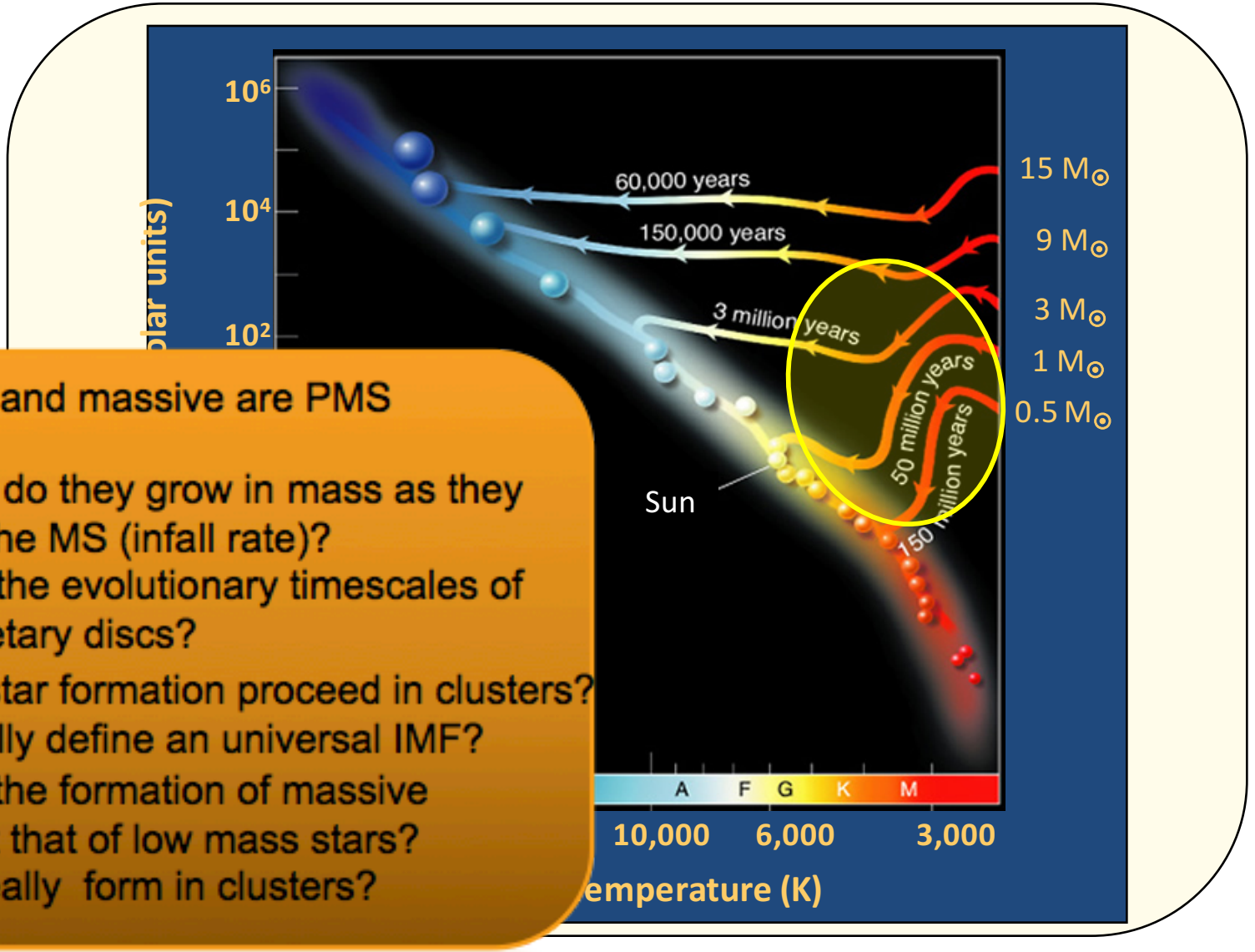
Giacomo Beccari

-ESO, HQ-

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

Star Forming Regions

Objective: physical properties of PMS stars



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?

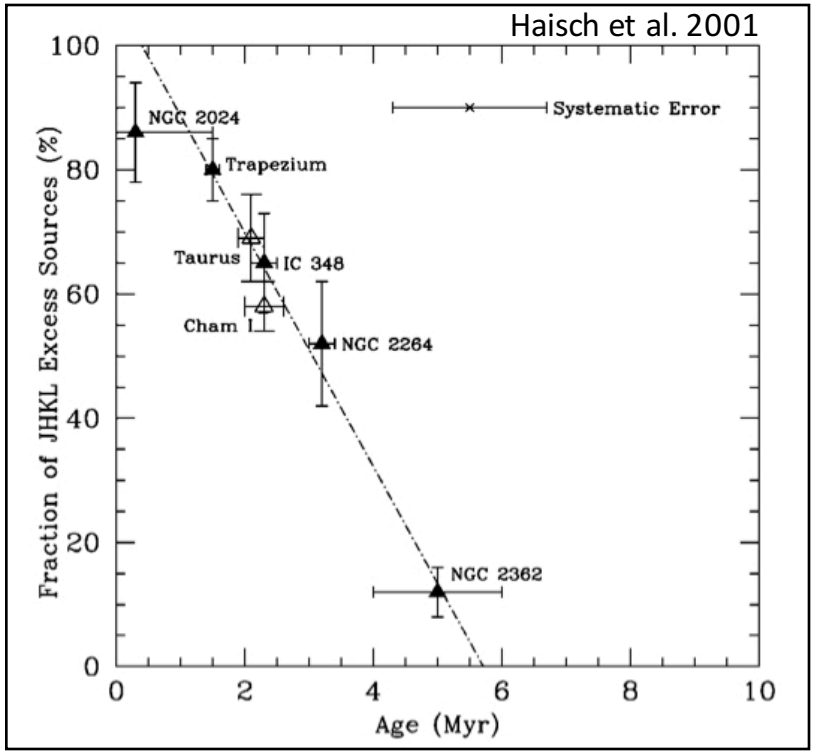
How does star formation proceed in clusters?

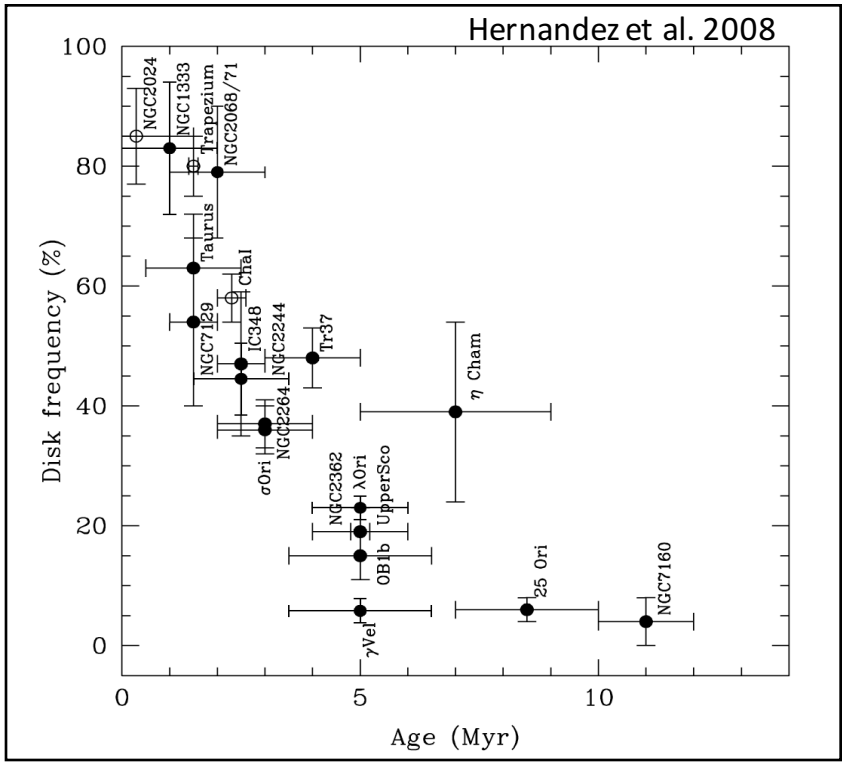
Can we really define an universal IMF?

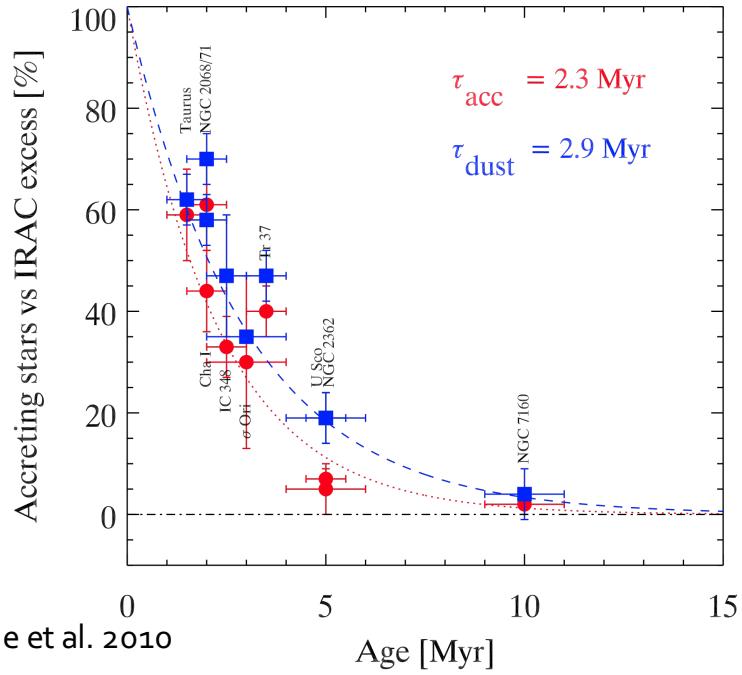
How does the formation of massive stars affect that of low mass stars?

Do stars really form in clusters?

Disc evolution, pre-main sequence







Fedele et al. 2010

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.

The *Gaia*-ESO Survey: Catalogue of H⋆ emission stars⋆,⋆⋆

G. Traven[1], T. Zwitter[1], S. Van Eck[2], A. Klutsch[3], R. Bonito[4,5], A. C. Lanzafame[3,6], E. J. Alfaro[7], A. Bayo[8], A. Bragaglia[9], M. T. Costado[7], F. Damiani[5], E. Flaccomio[5], A. Frasca[3], A. Hourihane[10], F. Jimenez-Esteban[11,12], C. Lardo[13], L. Morbidelli[14], E. Pancino[9,15], L. Prisinzano[5], G. G. Sacco[14], and C. C. Worley[10]

Gaia-ESO Survey: Analysis of pre-main sequence stellar spectra

A. C. Lanzafame[1,2], A. Frasca[2], F. Damiani[3], E. Franciosini[4], M. Cottaar[5], S. G. Sousa[6,7], H. M. Tabernero[8], A. Klutsch[2], L. Spina[4], K. Biazzo[2], L. Prisinzano[3], G. G. Sacco[4], S. Randich[4], E. Brugaletta[1], E. Delgado Mena[6], V. Adibekyan[6], D. Montes[8], R. Bonito[9,3], J. F. Gameiro[6], J. M. Alcalá[10], J. I. González Hernández[11,25], R. Jeffries[12], S. Messina[2], M. Meyer[5], G. Gilmore[13], M. Asplund[14], J. Binney[15], P. Bonifacio[16], J. E. Drew[17], S. Feltzing[18], A. M. N. Ferguson[19], G. Micela[3], I. Negueruela[20], T. Prusti[21], H.-W. Rix[22], A. Vallenari[23], E. J. Alfaro[24], C. Allende Prieto[11,25], C. Babusiaux[16], T. Bensby[18], R. Blomme[26], A. Bragaglia[27], E. Flaccomio[3], P. Francois[16], N. Hambly[19], M. Irwin[13], S. E. Koposov[13,28], A. J. Korn[29], R. Smiljanic[31], S. Van Eck[32], N. Walton[13], A. Bayo[24,34], M. Bergemann[13], G. Carraro[35], M. T. Costado[24], B. Edvardsson[29], U. Heiter[29], V. Hill[30], A. Hourihane[13], R. J. Jackson[12], P. Jofré[13], C. Lardo[27], J. Lewis[13], K. Lind[13], L. Magrini[4], G. Marconi[35], C. Martayan[35], T. Masseron[13], L. Monaco[35], L. Morbidelli[4], L. Sbordone[33], C. C. Worley[13], and S. Zaggia[23]

(Affiliations can be found after the references)

Received 5 August 2014 / Accepted 14 January 2015

The VISTA⋆ Carina Nebula Survey

II. Spatial distribution of the infrared-excess-selected young stellar population

P. Zeidler[1,2], T. Preibisch[1], T. Ratzka[1,3], V. Roccatagliata[1], and M. G. Petr-Gotzens[4]

[1] Universitäts-Sternwarte München, Ludwig-Maximilians-Universität, Scheinerstr. 1, 81679 München, Germany
[2] Astronomisches Rechen-Institut, Zentrum für Astronomie der Universität Heidelberg, Mönchhofstr. 12-14, 69120 Heidelberg, Germany
[3] Institute for Physics/IGAM, NAWI Graz, Karl-Franzens-Universität, Universitätsplatz 5/II, 8010 Graz, Austria
[4] European Southern Observatory, Karl-Schwarzschild-Str. 2, 85748 Garching, Germany

-VVV-

-Spitzer(GLIMPSE/MIPSGAL)-
-WISE-

The INT Photometric Hα Survey of the Northern Galactic Plane (IPHAS)

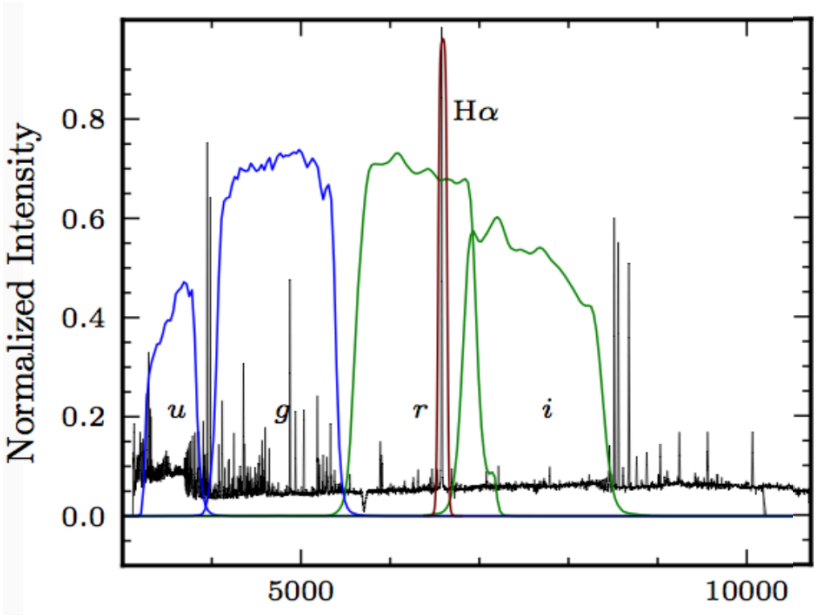
Janet E. Drew,[1⋆] R. Greimel,[2] M. J. Irwin,[3] A. Aungwerojwit,[4] M. J. Barlow,[5] R. L. M. Corradi,[2] J. J. Drake,[6] B. T. Gänsicke,[4] P. Groot,[7] A. Hales,[5] E. C. Hopewell,[1] J. Irwin,[3] C. Knigge,[8] P. Leisy,[9,2] D. J. Lennon,[2] A. Mampaso,[9] M. R. W. Masheder,[10] M. Matsuura,[11] L. Morales-Rueda,[7] R. A. H. Morris,[10] Q. A. Parker,[12,13] S. Phillipps,[10] P. Rodriguez-Gil,[4,9] G. Roelofs,[7] I. Skillen,[2] J. L. Sokoloski,[6] D. Steeghs,[6] Y. C. Unruh,[1] K. Viironen,[9] J. S. Vink,[1] N. A. Walton,[3] A. Witham,[8] N. Wright,[5] A. A. Zijlstra[11] and A. Zurita[14]

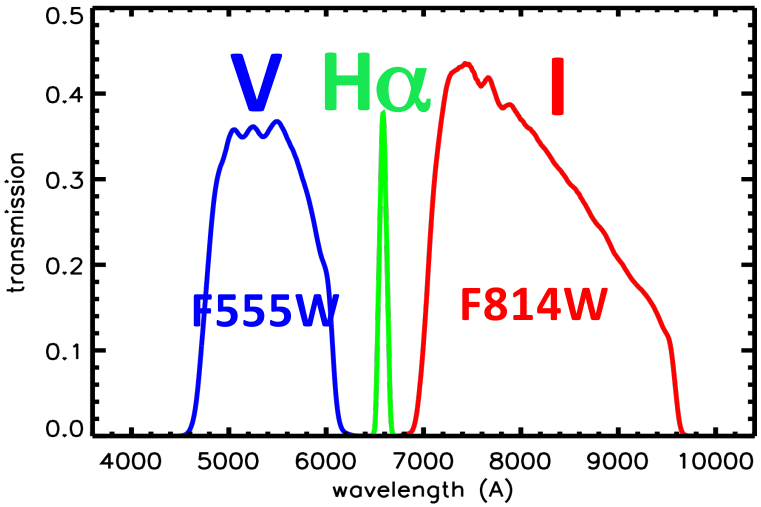
The VST Photometric Hα Survey of the Southern Galactic Plane and Bulge (VPHAS+)

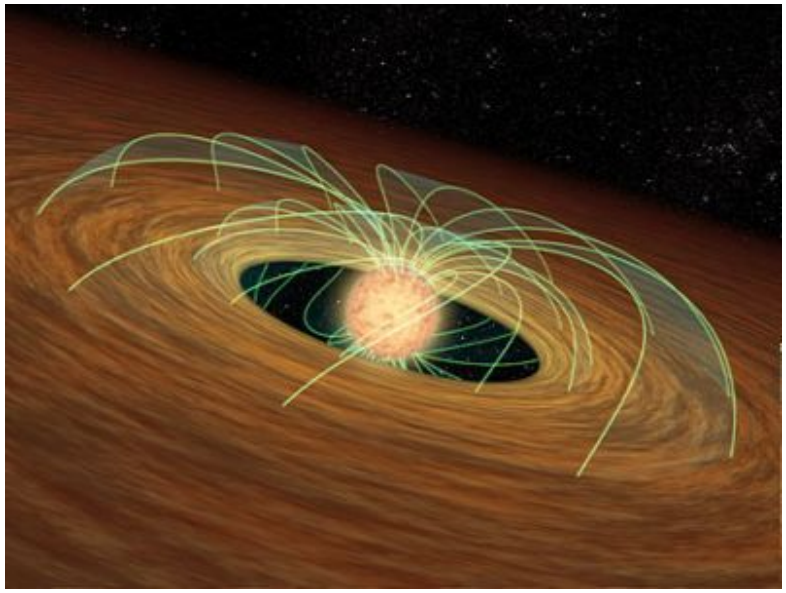
J. E. Drew[1], E. Gonzalez-Solares[2], R. Greimel[3], M. J. Irwin[2], A. Kupcu Yoldas[2], J. Lewis[2], G. Barentsen[1], J. Eislöffel[4], H. J. Farnhill[1], W. E. Martin[1], J. R. Walsh[5], N. A. Walton[2], M. Mohr-Smith[1], R. Raddi[6], S. E. Sale[7], N. J. Wright[1], P. Groot[8], M. J. Barlow[9], R. L. M. Corradi[10], J. J. Drake[11], J. Fabregat[12], D. J. Frew[13], B. T. Gänsicke[6], C. Knigge[14], A. Mampaso[10], R. A. H. Morris[15], T. Naylor[16], Q. A. Parker[13], S. Phillipps[14], C. Ruhland[1], D. Steeghs[6], Y.C. Unruh[17], J. S. Vink[18], R. Wesson[19], A. A. Zijlstra[20]

PMSs: optical photometry

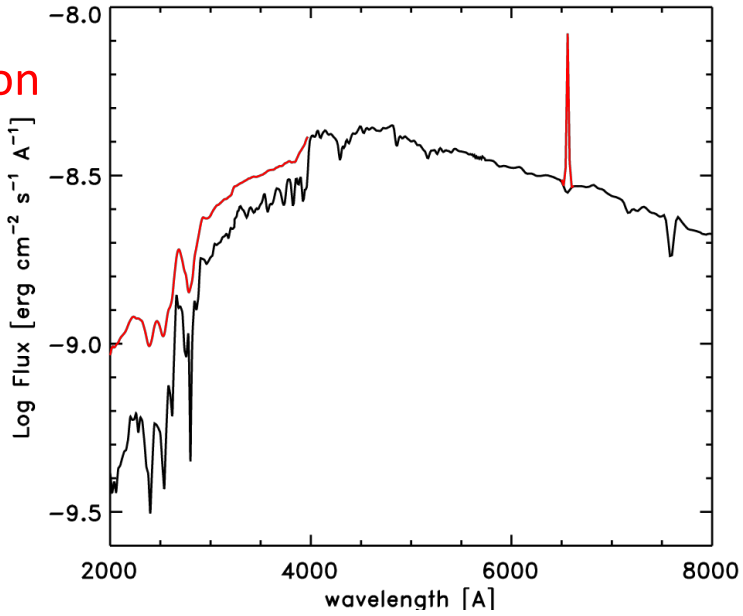
ACS/WFC3@HST (24 orbits in Halpha; Cycle 20; PI De Marchi)
OmegaCAM@VST (90h in P96; PI Beccari)

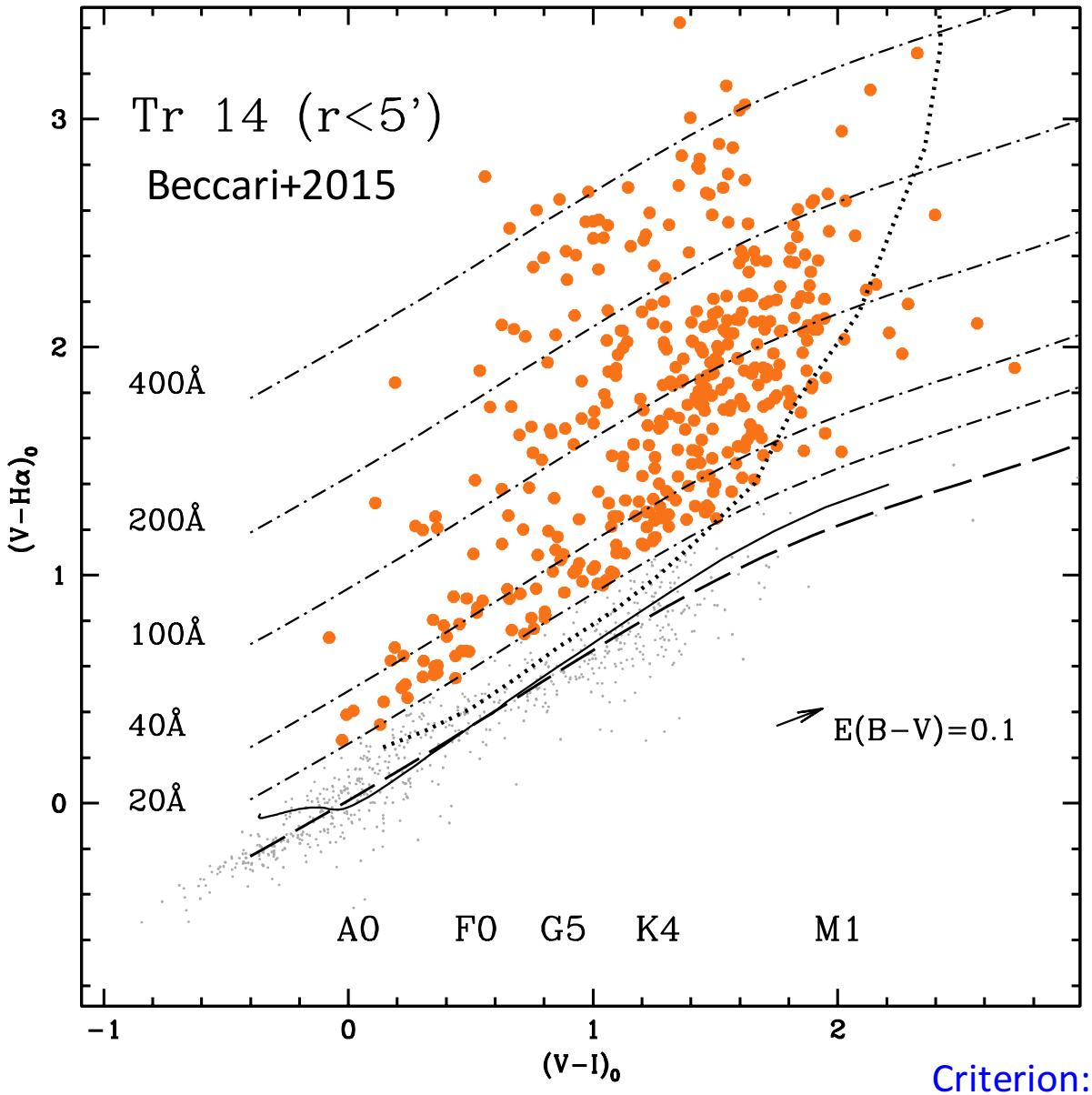






Typical signature:
Hα excess emission



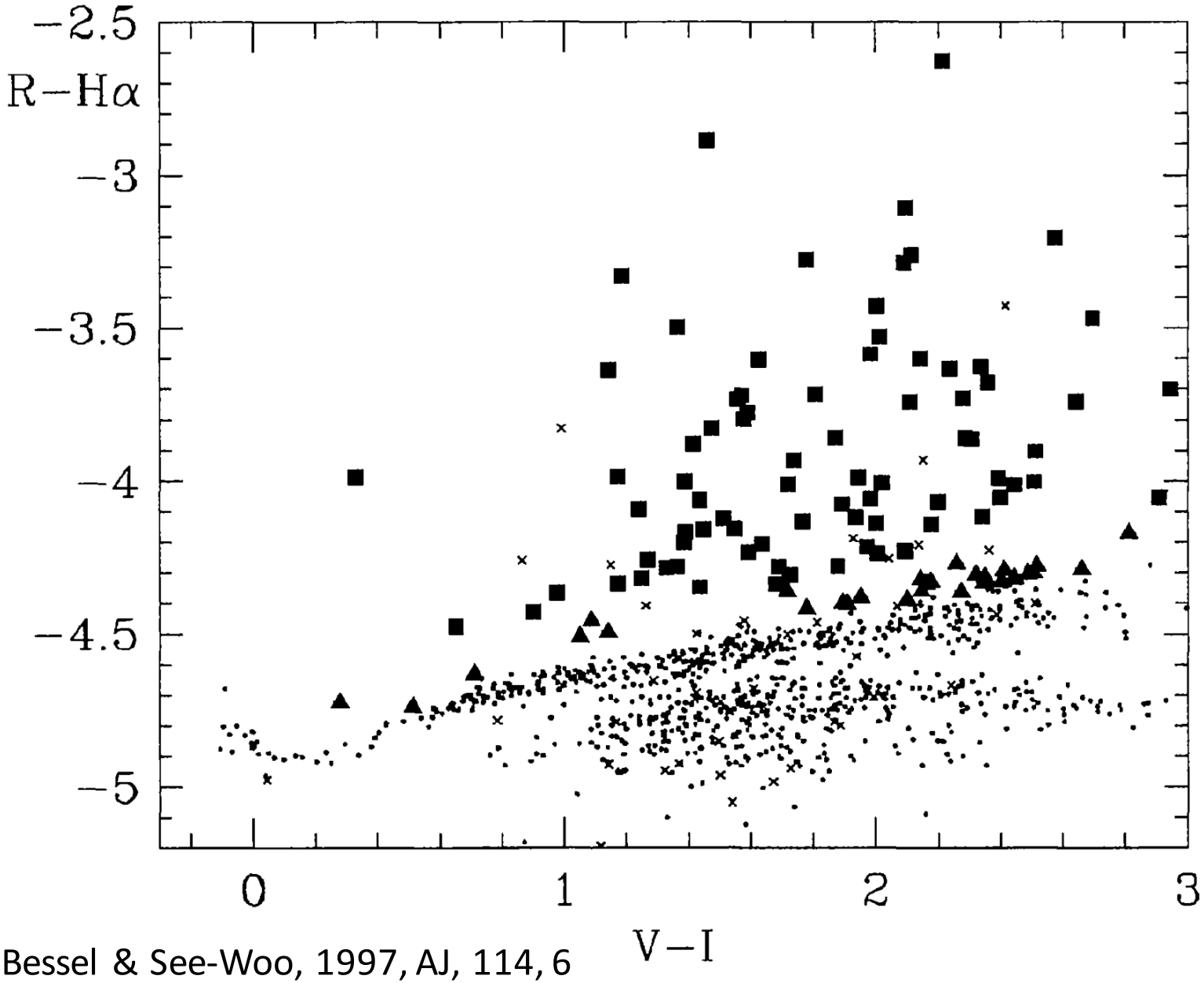


$$W_{eq}(H\alpha) = \mathrm{RW} \times [1 - 10^{-0.4 \times (H\alpha - H\alpha^{C})}]$$

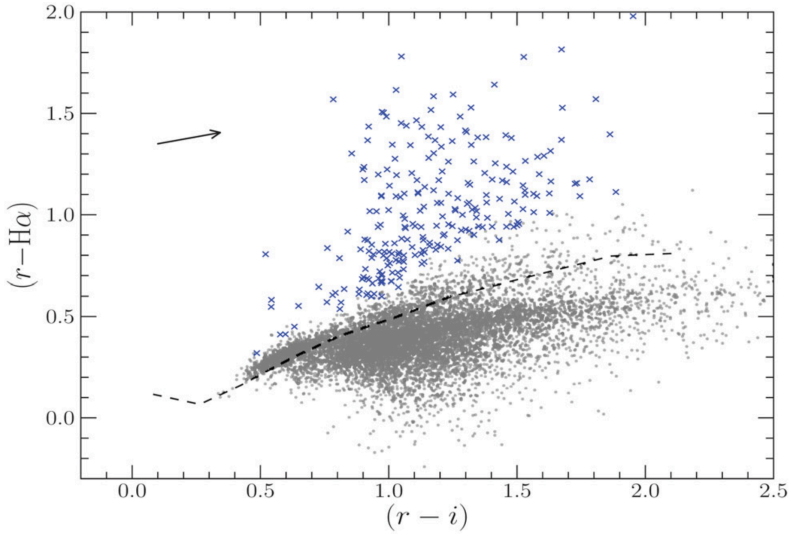
RW= rectangular width of the filter
Hα = Hα magnitude
$H\alpha_C$ = continuum around the Hα line derived from (V-I)

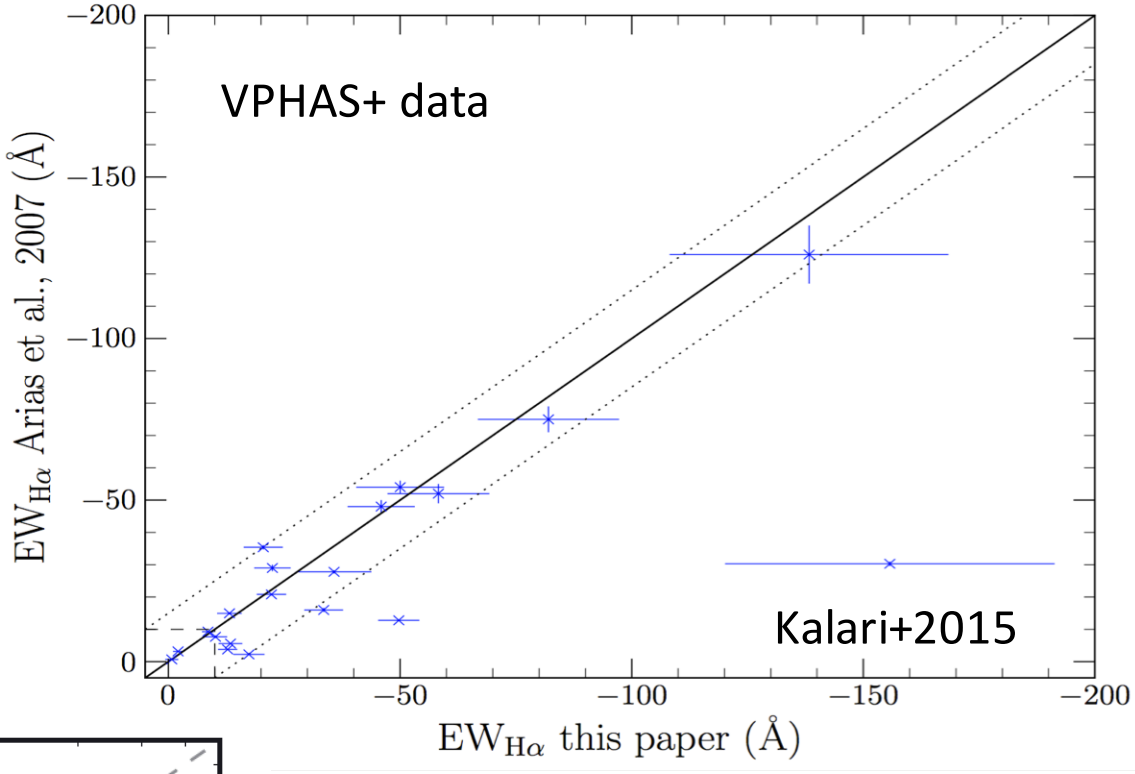
Criterion:

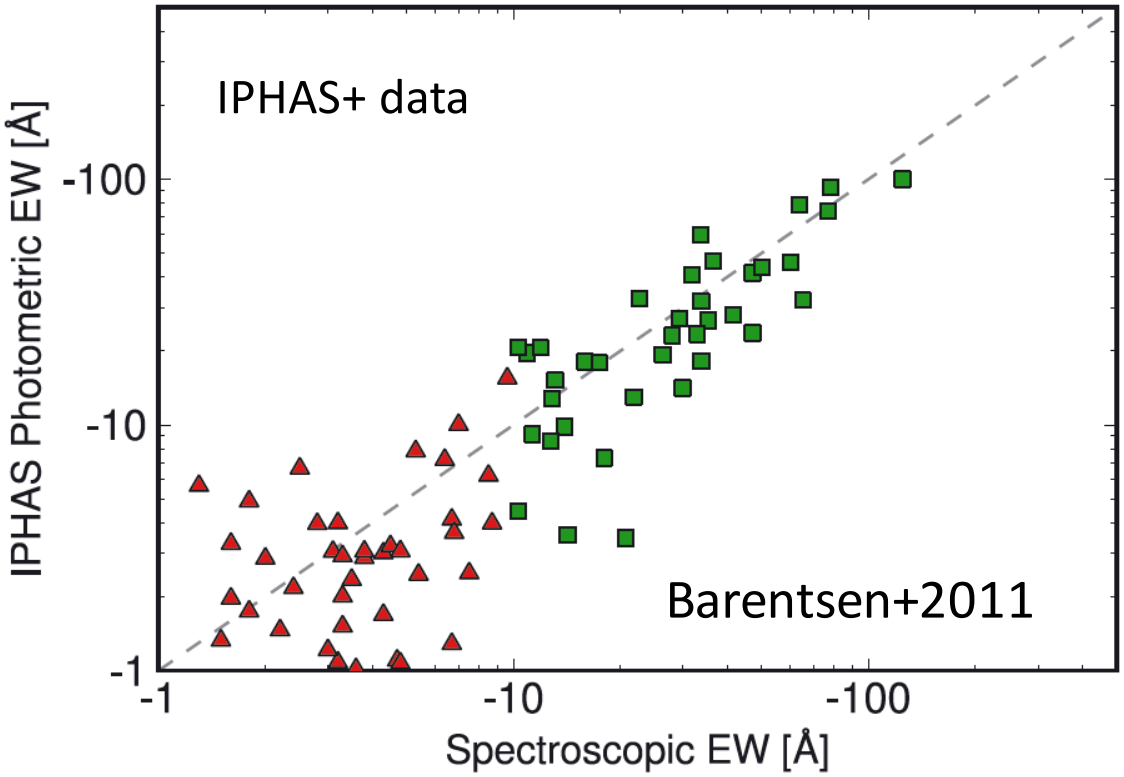
V-I > 0 (avoid contamination from Ae/Be stars)
W_{eq}(Hα)> 20 Å (avoid contamination from active chromospheres)
5σ above the reference line (σ = error on V-Hα color)

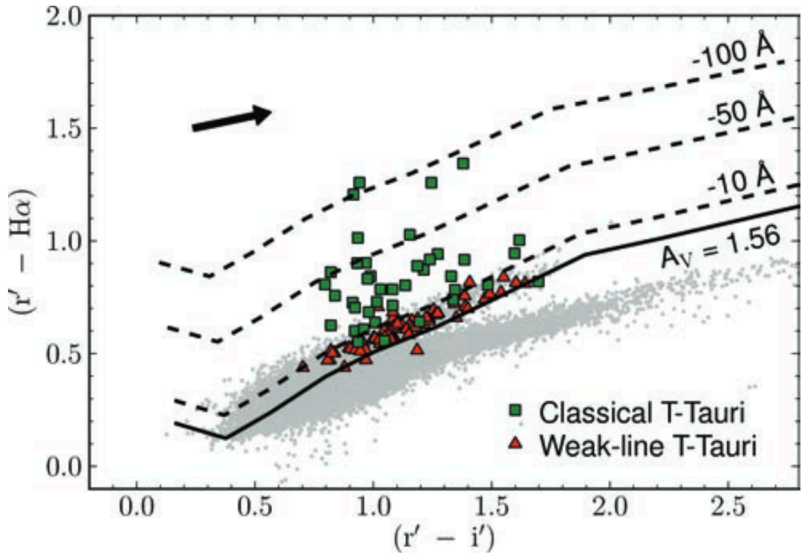


Sung, Bessel & See-Woo, 1997, AJ, 114, 6

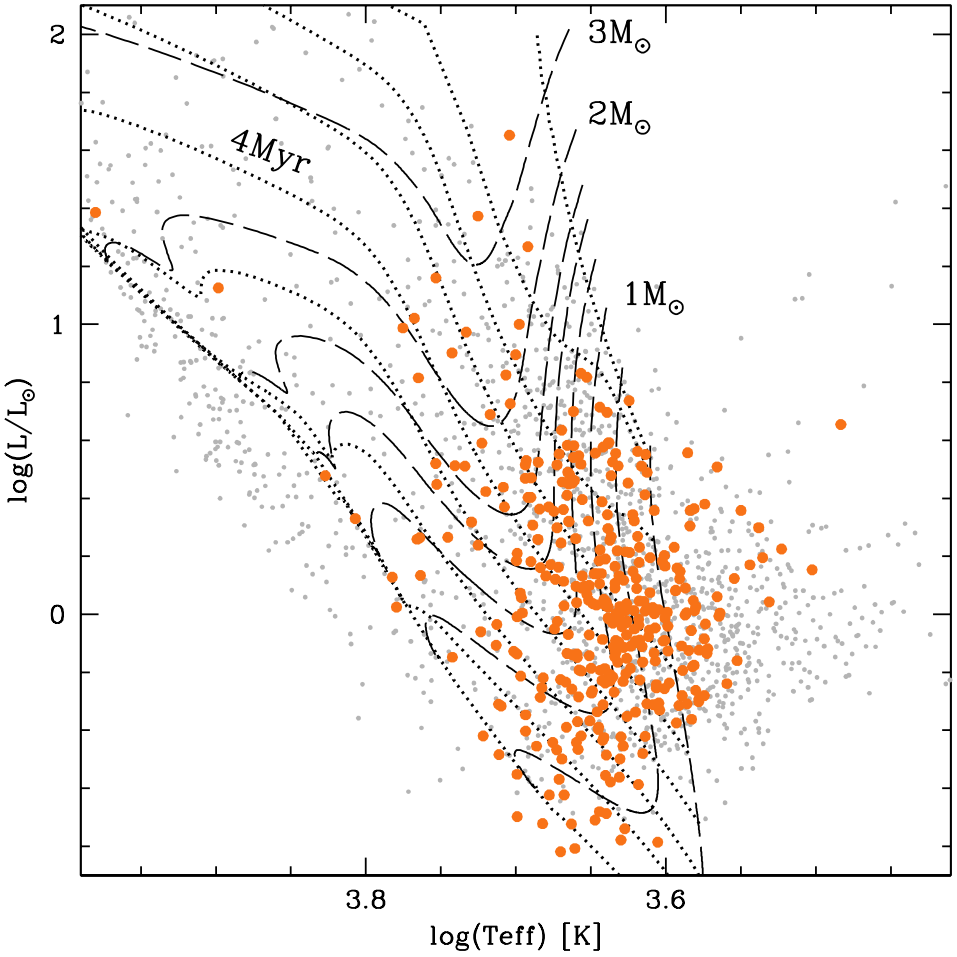

$(r-\mathrm{H}\alpha)$
$(r-i)$

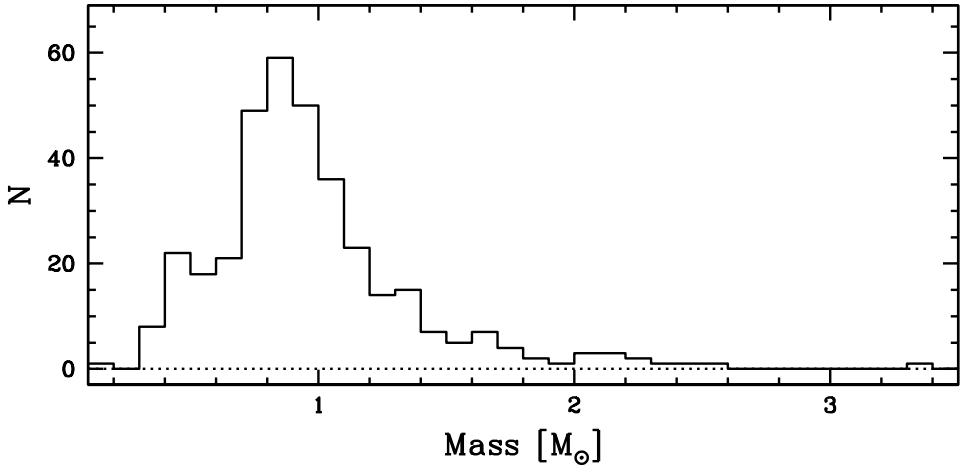

VPHAS+ data
Kalari+2015
$\mathrm{EW_{H\alpha}}$ Arias et al., 2007 (Å)
$\mathrm{EW_{H\alpha}}$ this paper (Å)

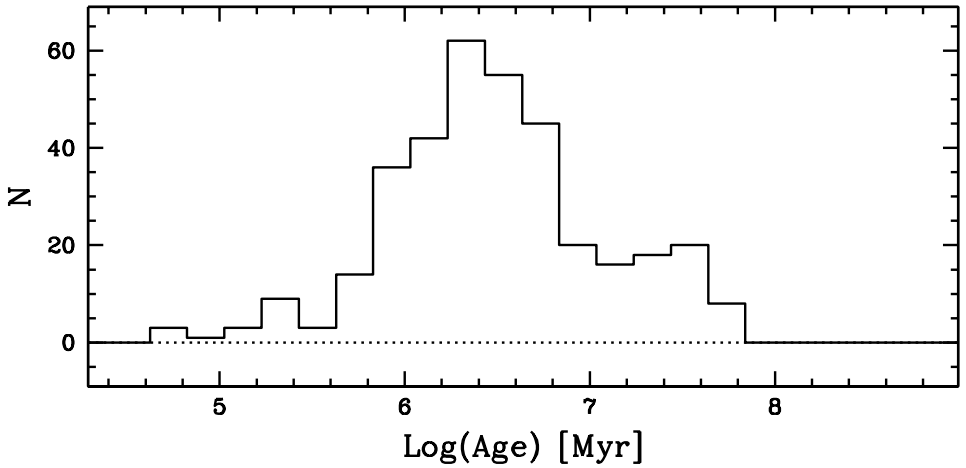

IPHAS+ data
Barentsen+2011
IPHAS Photometric EW [Å]
Spectroscopic EW [Å]


-100 Å
-50 Å
-10 Å
A_V = 1.56
Classical T-Tauri
Weak-line T-Tauri
$(r' - \mathrm{H}\alpha)$
$(r' - i')$

TTaury study: HR diagram







Beccari et al. (2015)

Stars physical parameters for more that 1000 PMSs

- **Hα luminosity $L_{H\alpha}$ gives accretion luminosity L_{acc} via relationship calibrated using spectroscopic data** (e.g. Dahm 2008)

$$\text{Log}\,(L_{acc}) = \text{Log}\,(L_{H\alpha}) + (1.72 \pm 0.25)$$

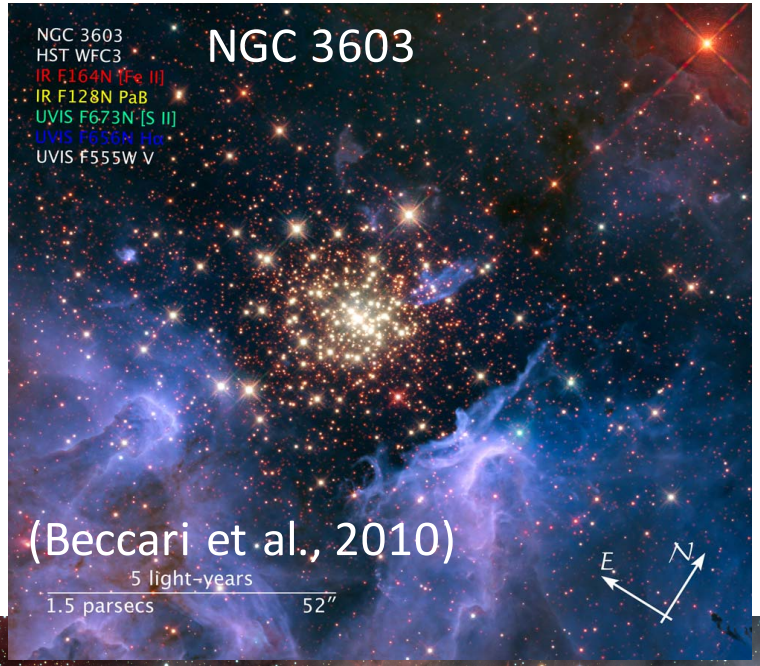
- **Mass $M_\star$ radius $R_\star$ and age $t_\star$ from PMS isochrones in HR diagram**

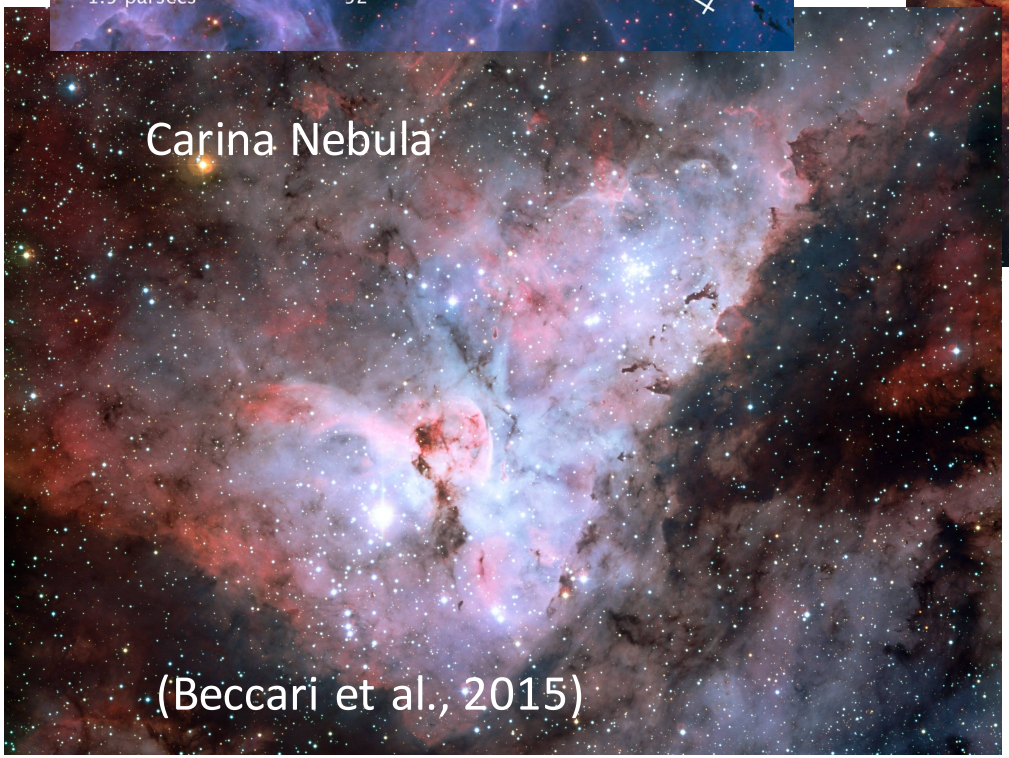
- **Free fall equation gives mass accretion rate $\dot{M}$**

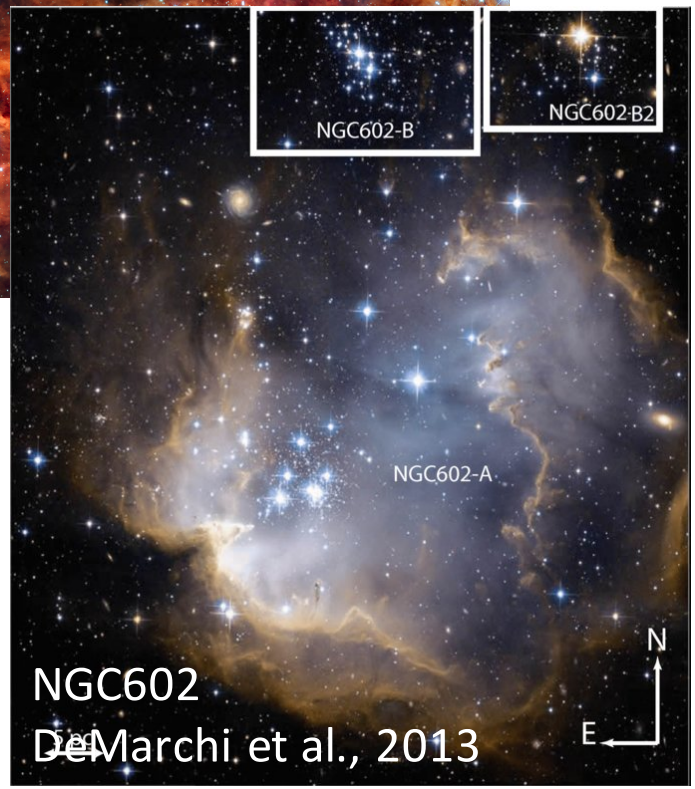
$$L_{acc} \simeq \frac{GM_*\dot{M}}{R_*}\left(1 - \frac{R_*}{R_{in}}\right)$$

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

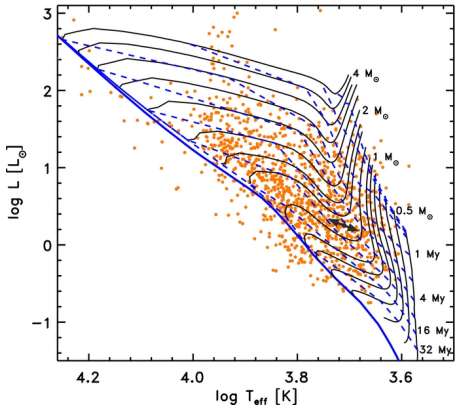
PMS objects in a number of star-burst clusters (MW, LMC, SMC)

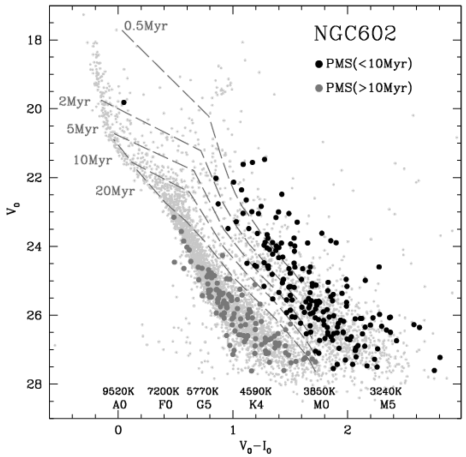


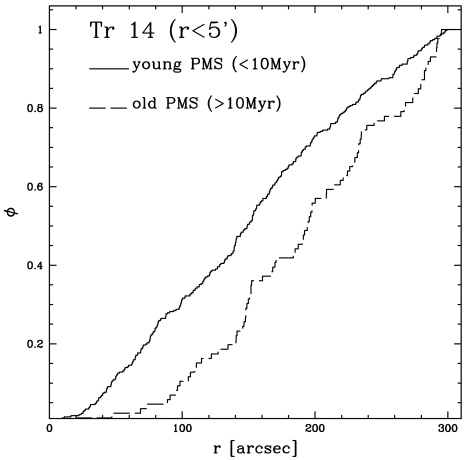




IN ALL YMCs WE STUDIED SO FAR…





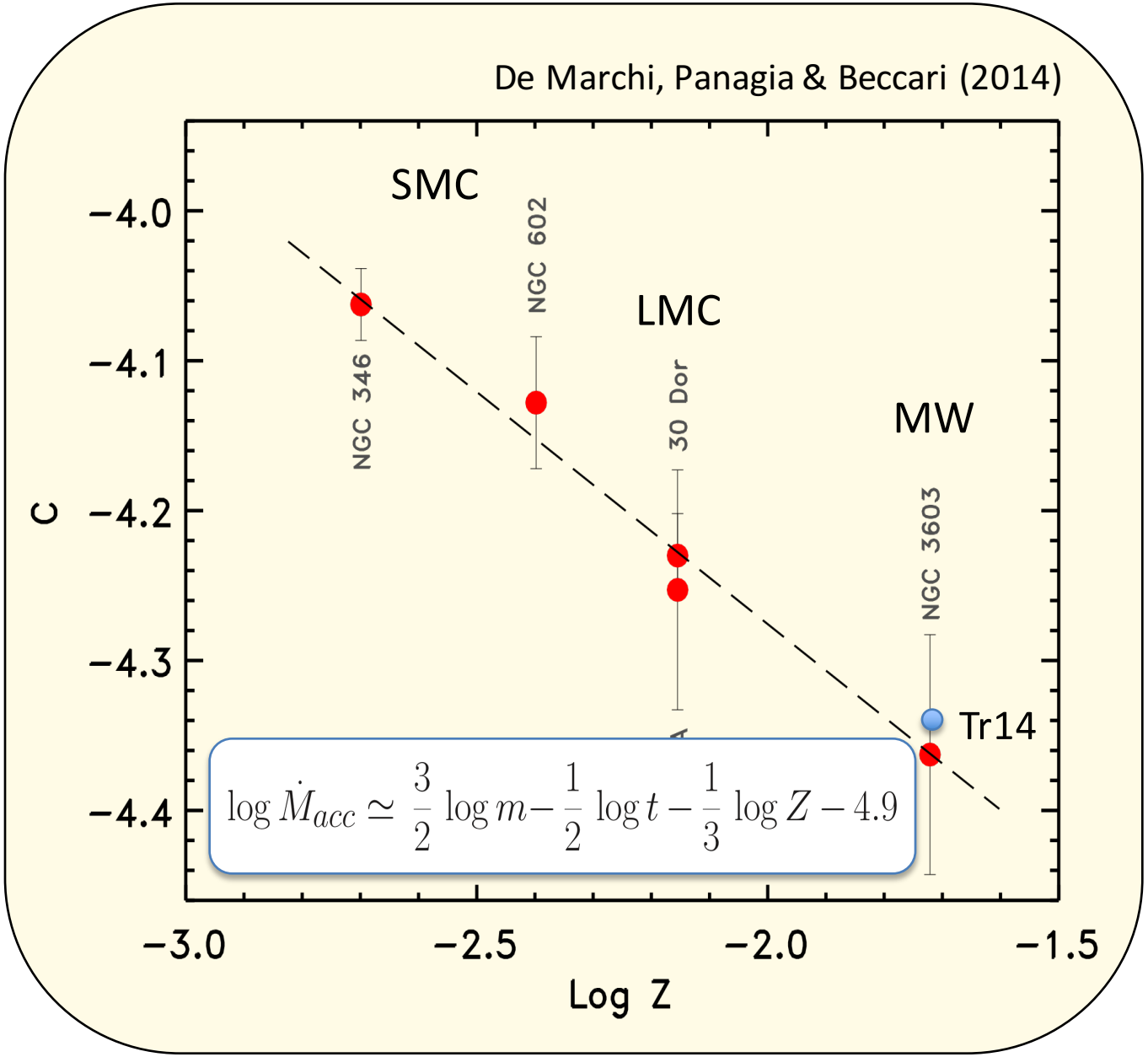


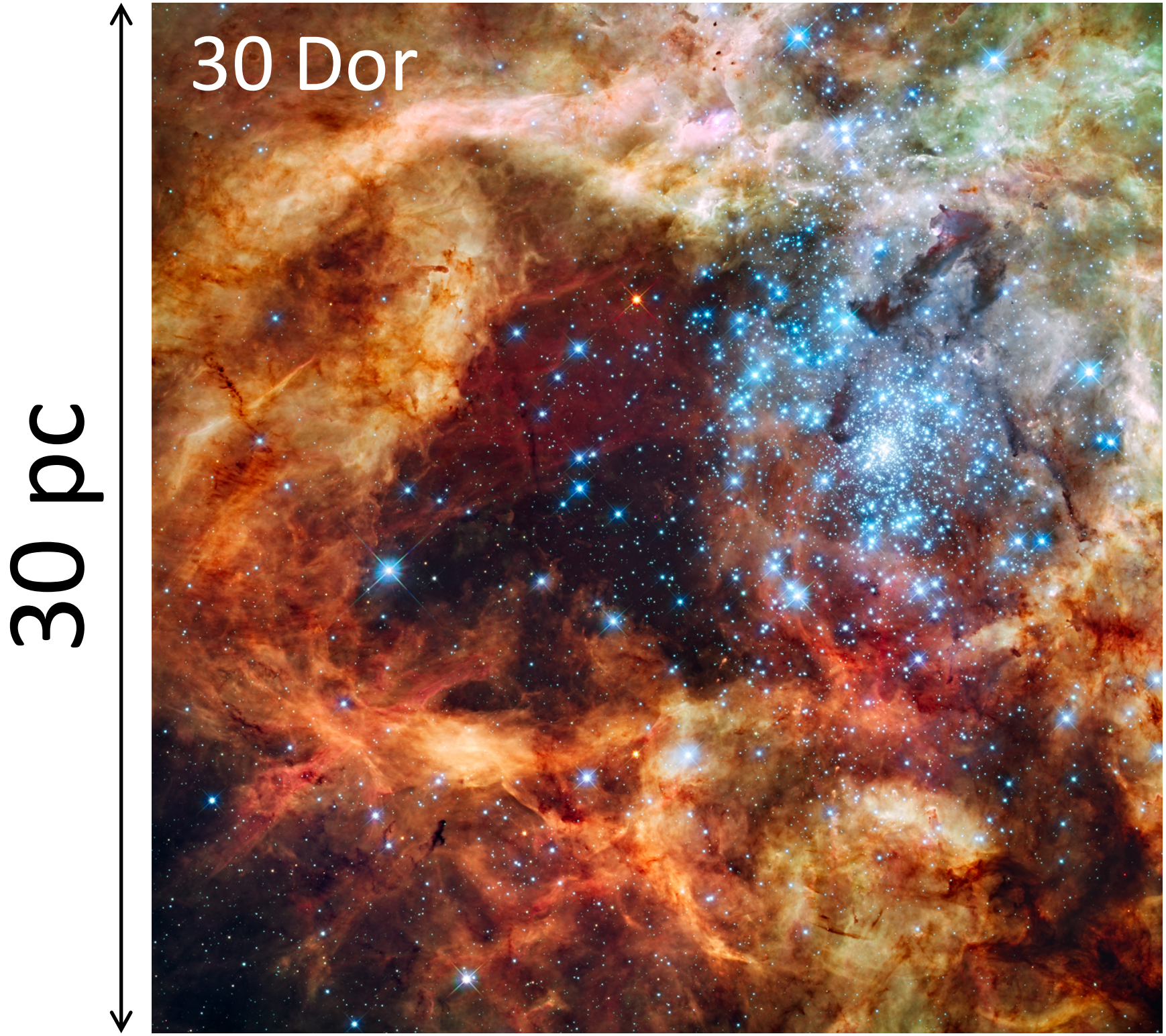
1) 10-30 Myr age spread

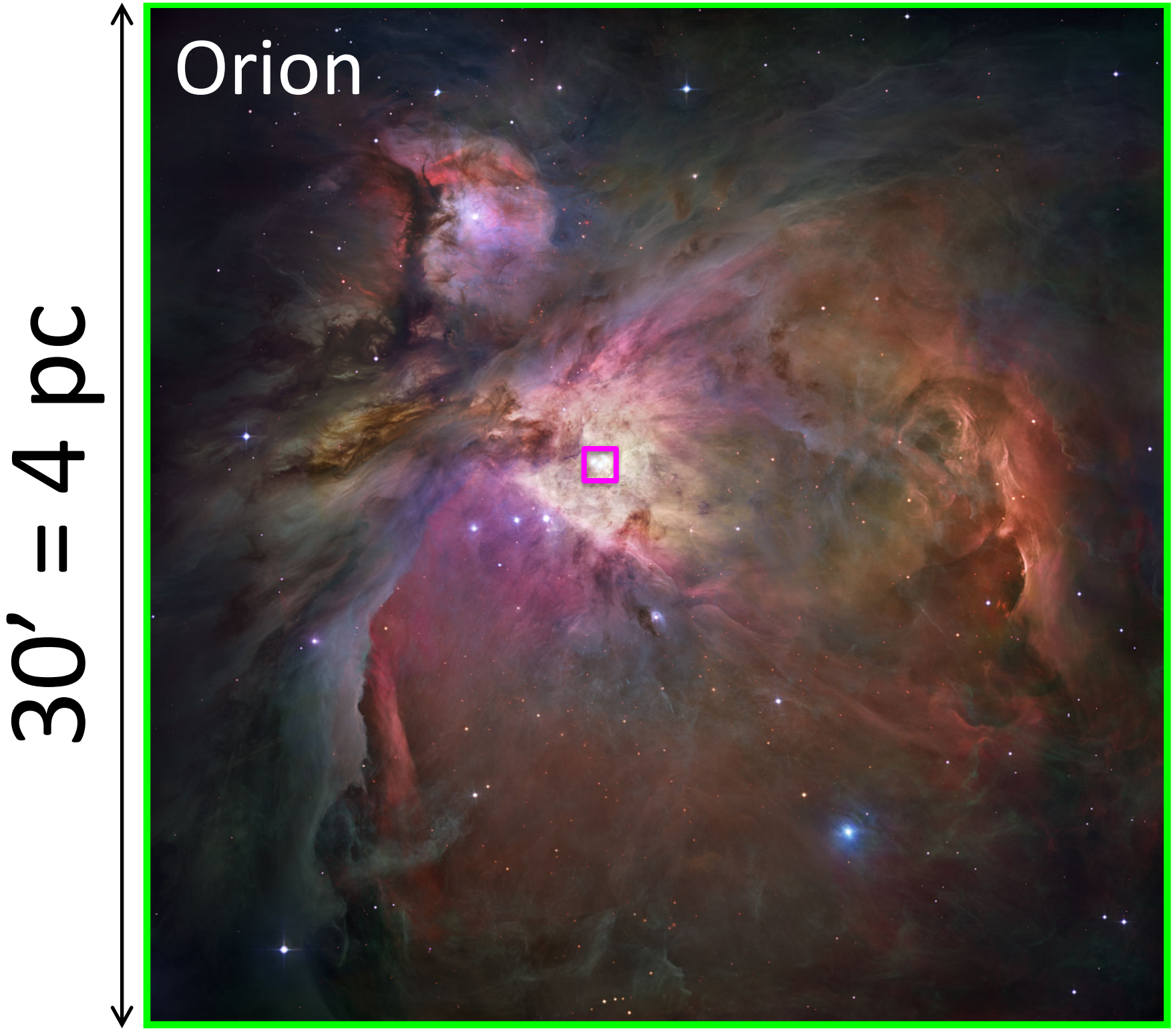
2) 20%-30% of the PMS with Hα excess emission are older than 10Myr

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

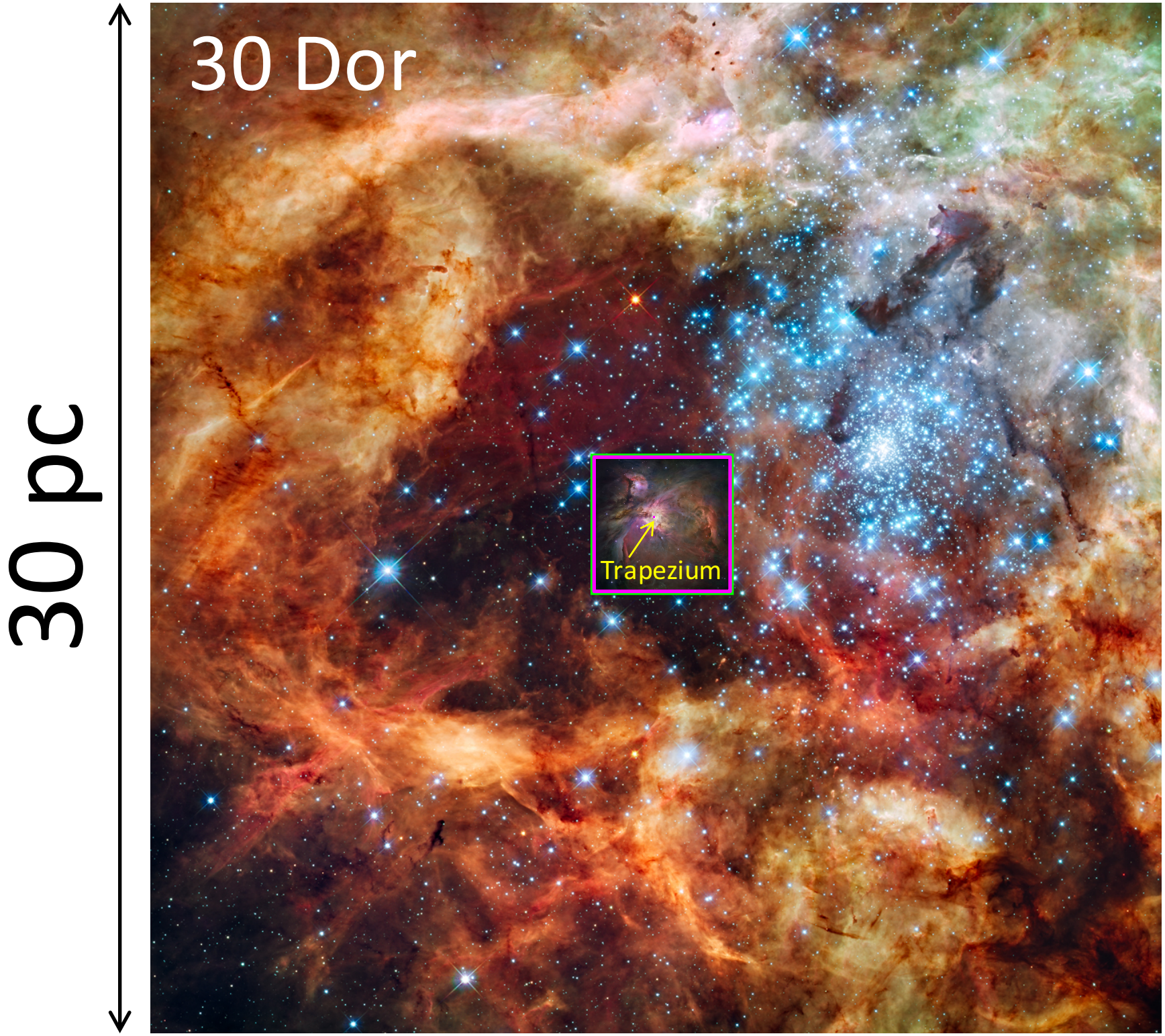
4) Accretion rate and metallicity

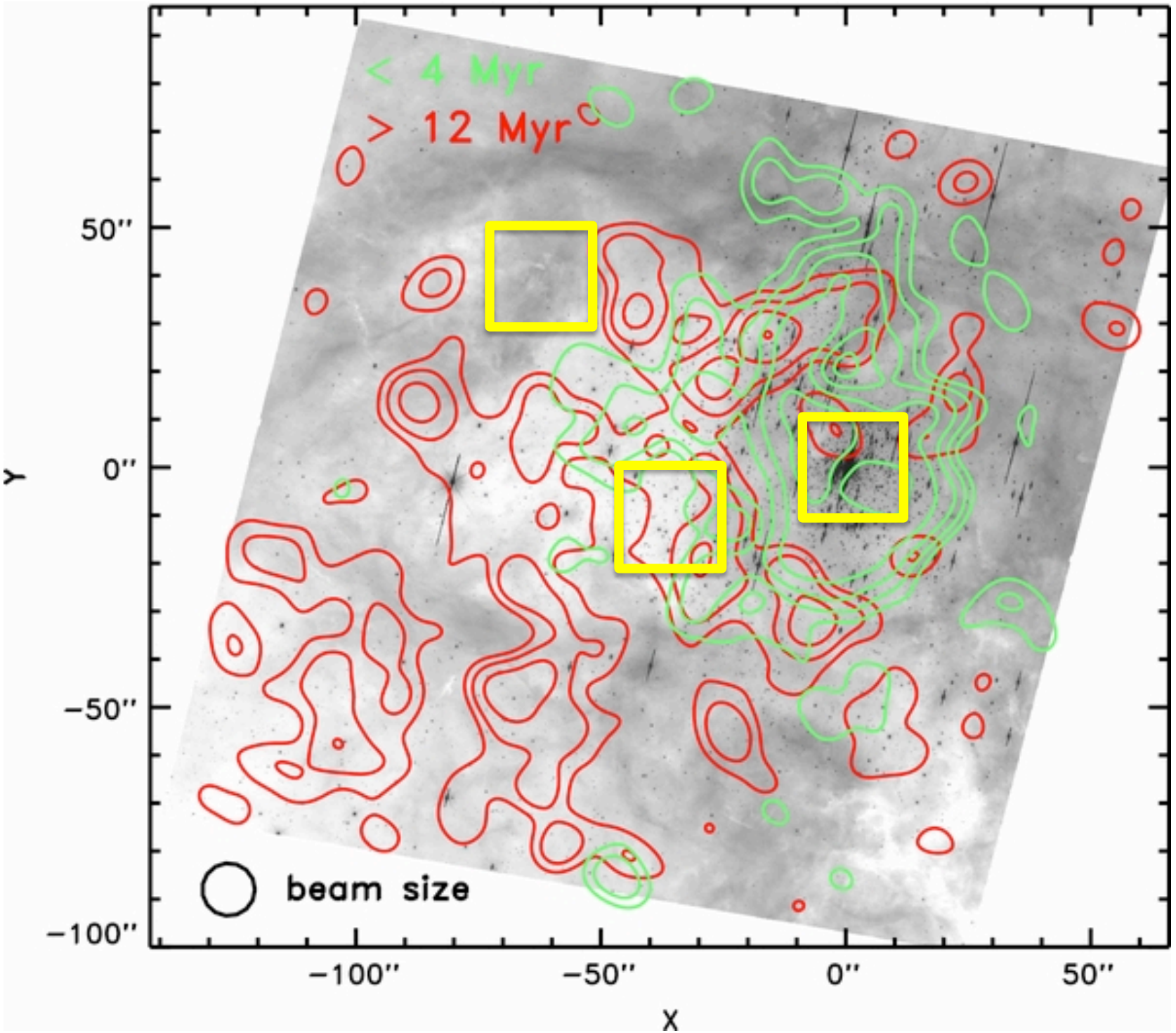


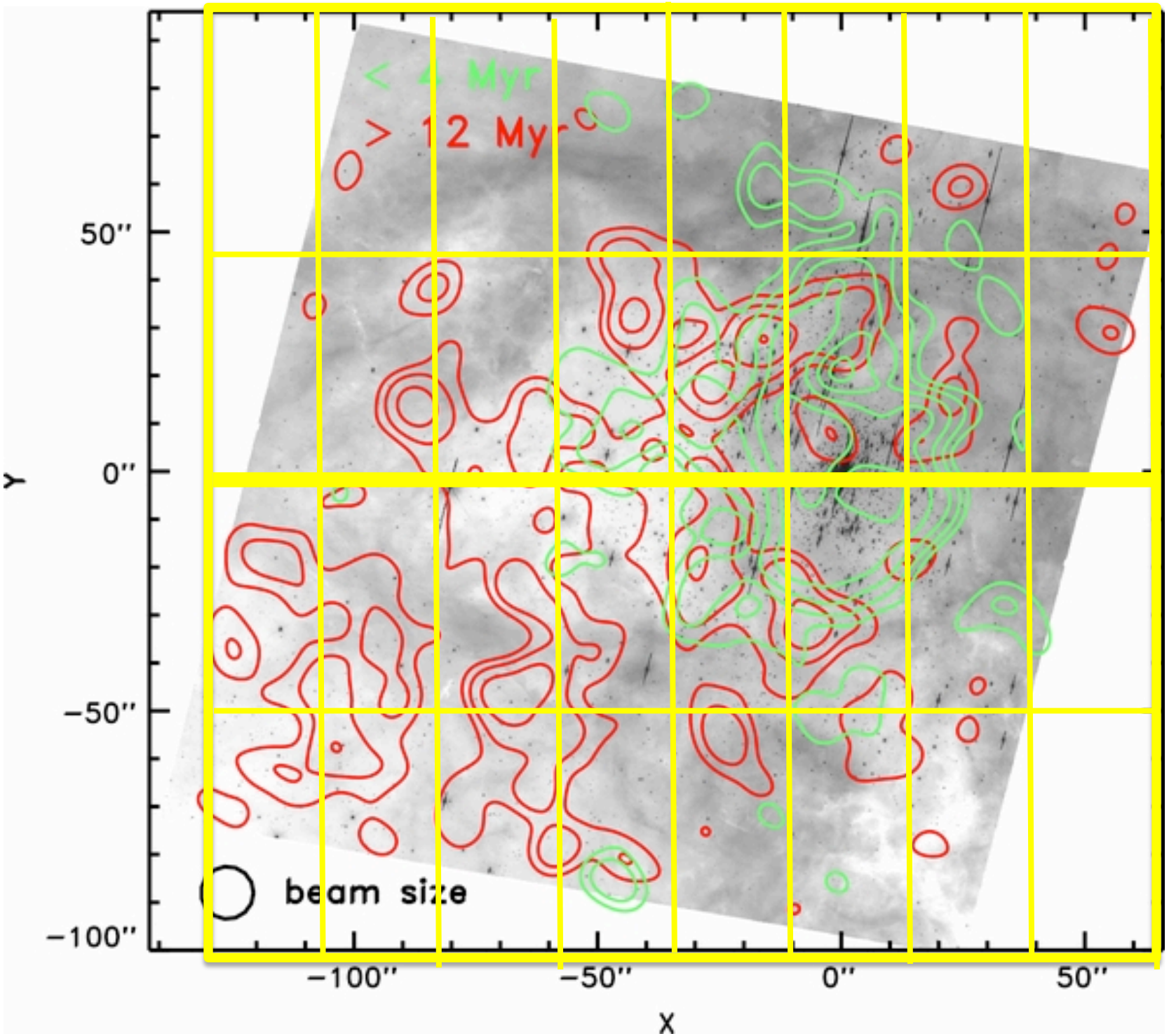

30 Dor
30 pc

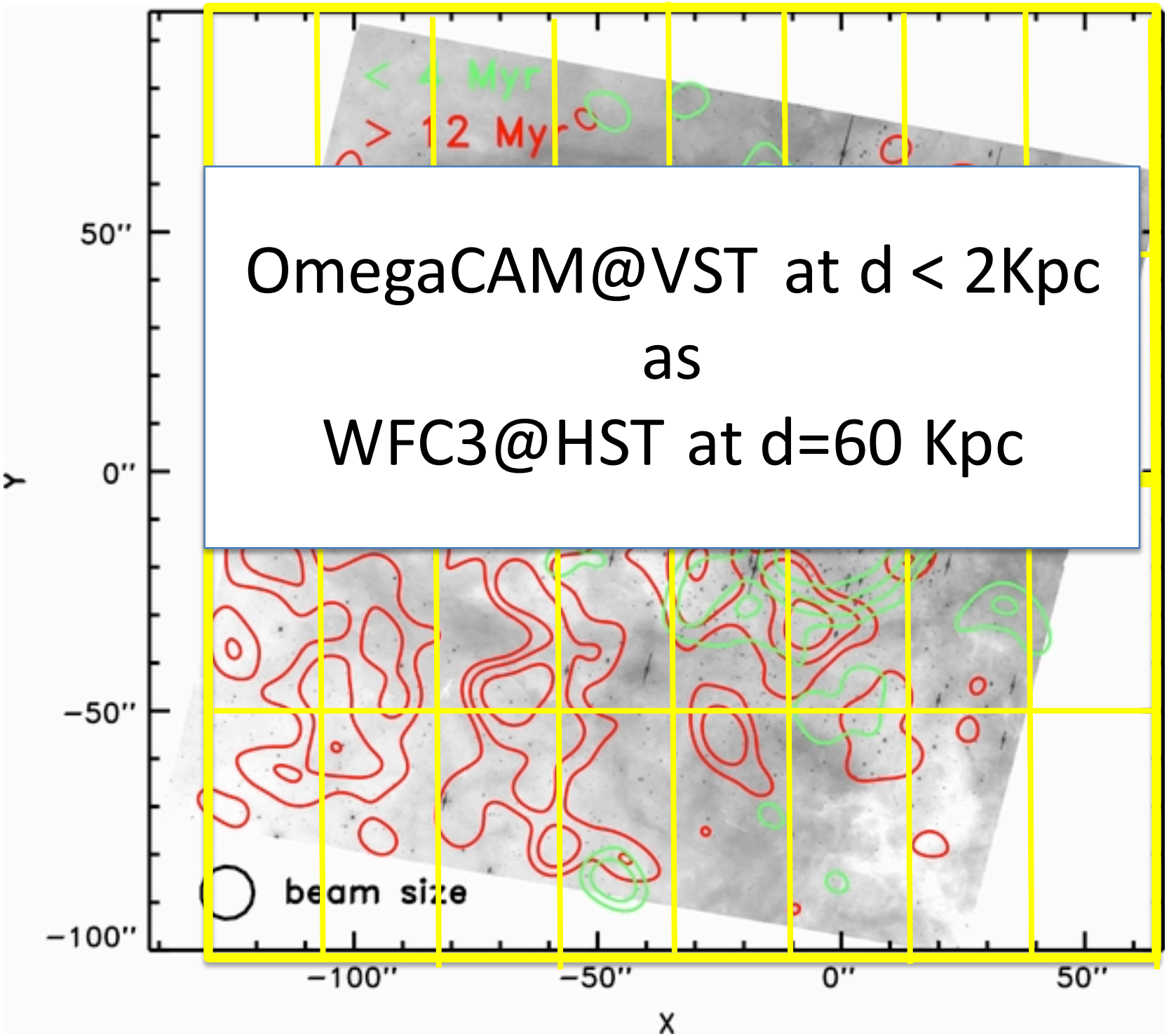

Orion
30’ = 4 pc


0.05 pc


30 Dor
Trapezium
30 pc


< 4 Myr
> 12 Myr
beam size
50''
0''
−50''
−100''
−100''
−50''
0''
50''
Y
X


< 4 Myr
> 12 Myr
beam size
50''
0''
−50''
−100''
−100''
−50''
0''
50''
Y
X



OmegaCAM@VST at d < 2Kpc

as

WFC3@HST at d=60 Kpc

Conclusions

- **Multiple generations always seen, Δt ~ 10 Myr**

  Star formation episodes not spatially correlated

  Younger generation usually more concentrated

- **At low Z accretion process stronger and longer**

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

➔ We have: 24 HST orbits (WFC3): mostly LMC/SMC
90h OmegaCAM: Gamma Vel, UpperSco, Ophiucus, Cha I, Orion, EtaCha, Haffner 18


Star formation ... made in Europe
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Reader
JWST webinar
RSSD
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SMAC
TSE
Intranet
IDL Help
Simbad
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made in europe
Guido De Marchi
Martino Romaniello
Francesco Paresce
Elena Sabbi
Morten Andersen
Nino Panagia
Giacomo Beccari
Loredana Spezzi
Marco Sirianni
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mail
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Recent papers
Paper I
Paper II
Paper III
Paper IV
Paper V
STScI May Symposium
Paper VI
Paper VII
Paper VIII
Paper IX
Older papers
2004
2002
2000
1998
1994
Introduction
We are a group of European scientists interested in the
ation properties of young clusters in the Local
Group, mostly the Galaxy and Magellanic Clouds
e provides a selection of our papers. Some are
published, others have been submitt
are still being written. You can scroll down or use the
navigation bar on the left to sele
s that you want to see. If you want to know more about a paper,
please write to us at
ssd.esa.int
www.starformation.eu
Recent papers
Paper I (2010)
Photometric determination of the mass accretion rates of pre-main sequence stars. I. Method and application to the SN1987A field
Guido De Marchi (ESA), Nino Panagia (STScI, INAF-CT, Supernova Ltd), Martino Romaniello (ESO)