Young Super Star Cluster Candidates in M82

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SECOND WORKSHOP OF THE COORDINATED PROJECT **"ESTALLIDOS DE FORMACIÓN ESTELAR EN GALAXIAS"** focused on **MASSIVE STAR FORMATION IN DIFFERENT ENVIRONMENTS.**
Granada, January 26-28, 2004

New Theory: G.Tenorio-Tagle, C.Muñoz-Tuñón & S. Silich

Super Star Clusters are the units of the starburst

Many relevant new parameters to study (number of SSCs, position in the starburst, ...)

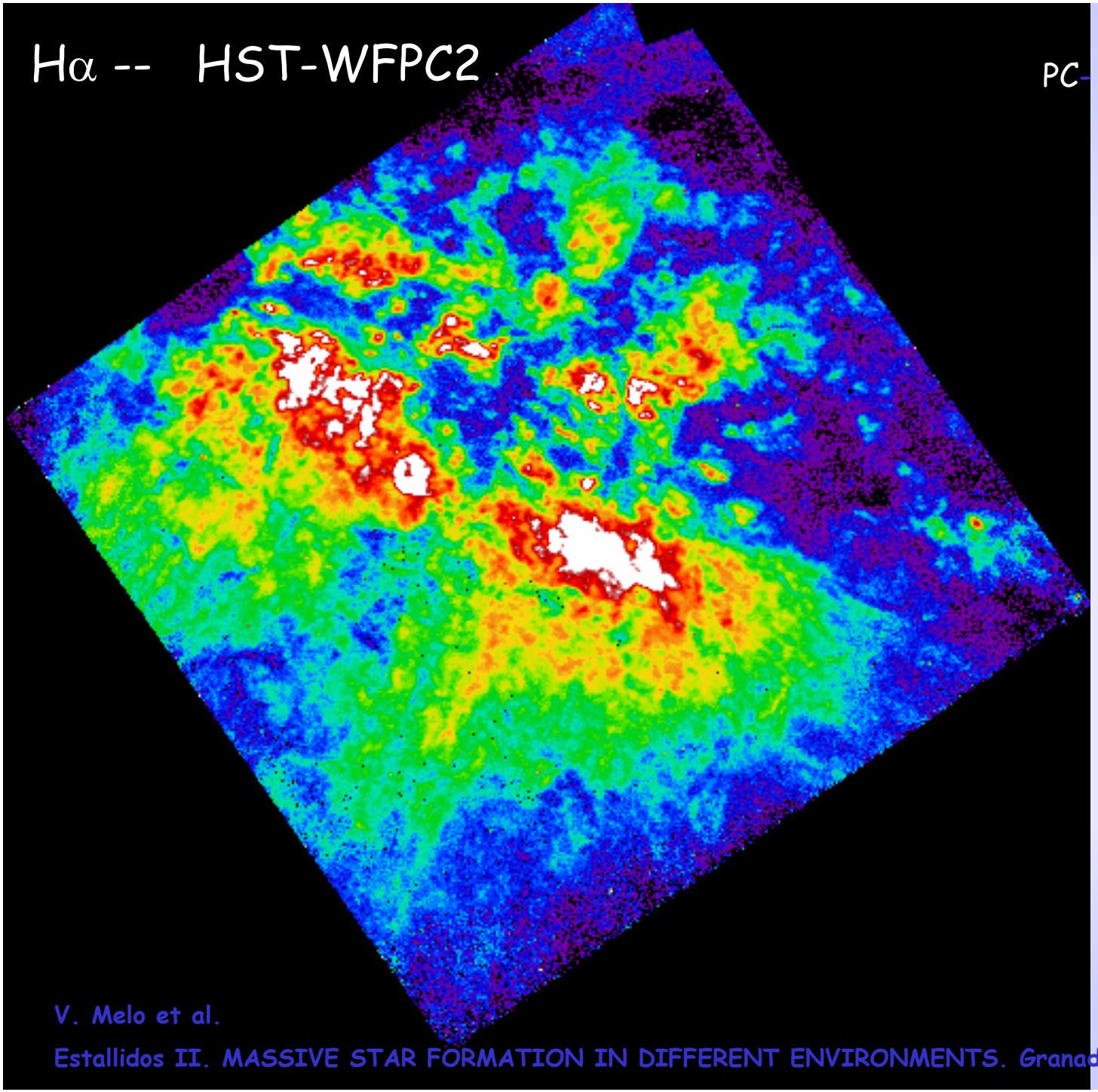
SSCs main features are:

- High masses: few 10^4 - few 10^6 M_o
- Little size: R ~3 pc
- Very young: 1-10 Myr
- High luminosities.

M82

- starburst galaxy
- SGWs filaments
- Subaru



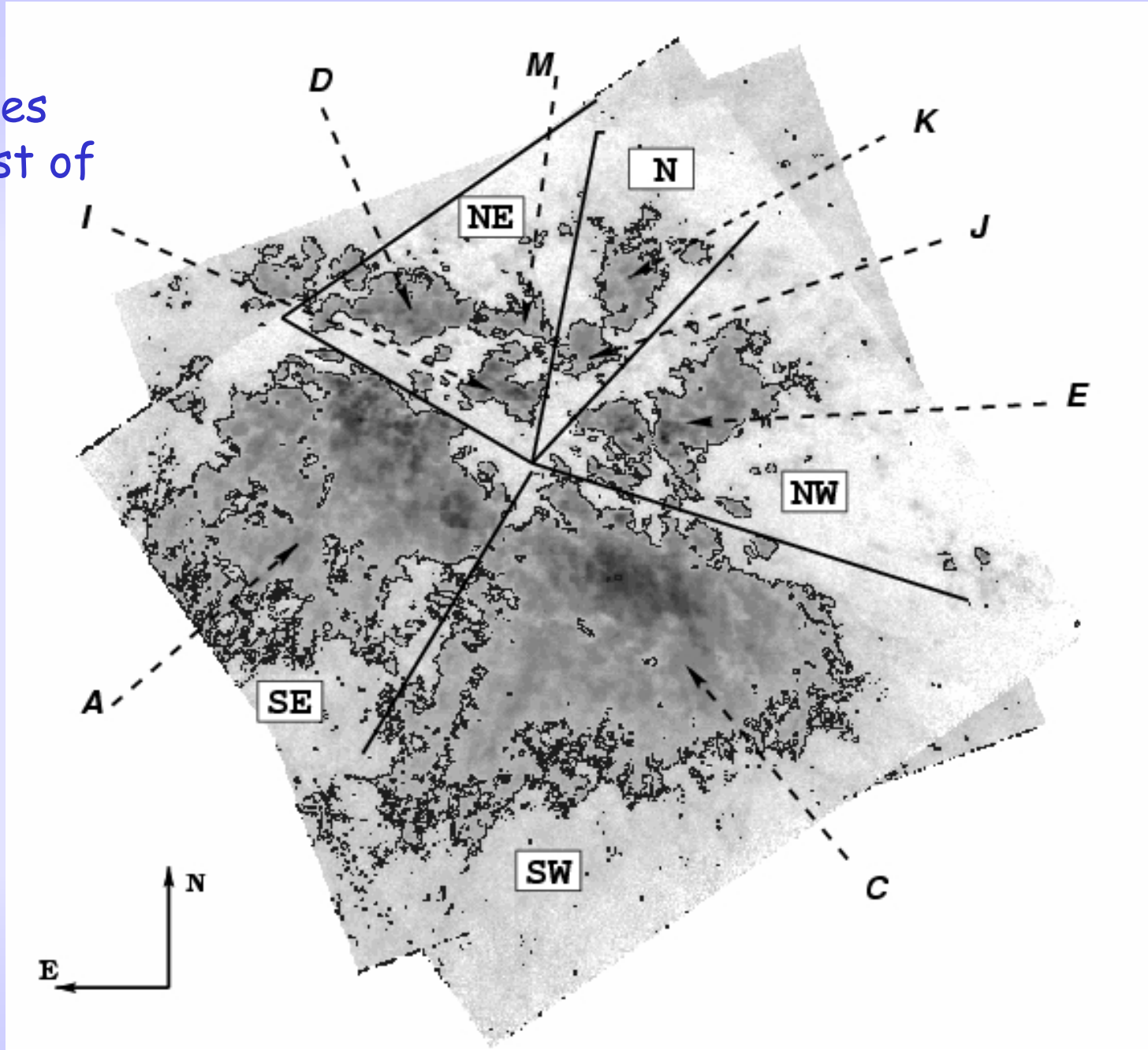

Hα -- HST-WFPC2
PC- FOV= 36.8´´ x 36.8´´
pixel size = 0.046´´
V. Melo et al.
Estallidos II. MASSIVE STAR FORMATION IN DIFFERENT ENVIRONMENTS. Granada,Jan.26-28,2004

Log of the exposures

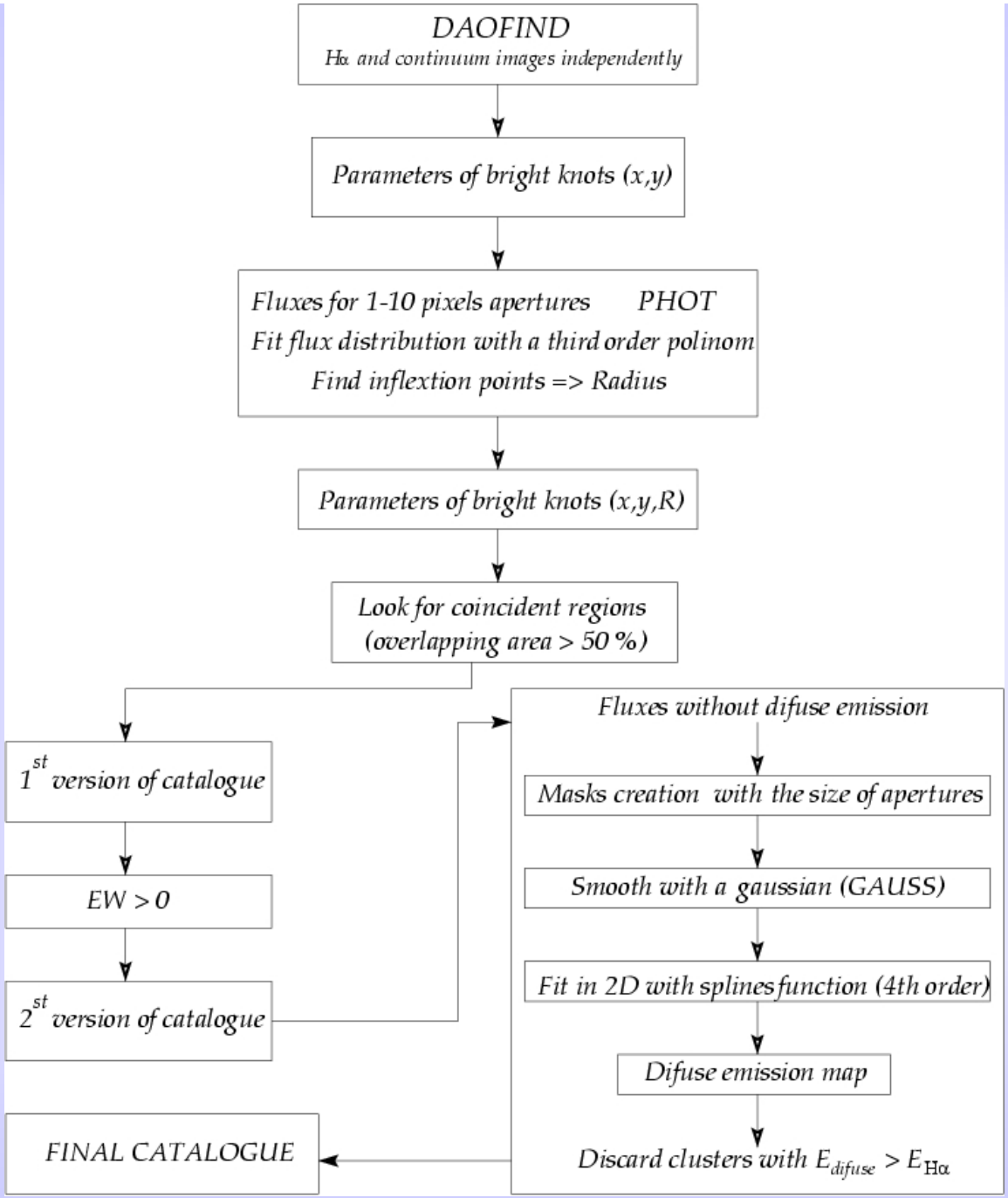
Filter	PI	Band	Images	Exposure time (s)
F656N	Sparks	Hα	u2s04301t-2t	2 x 300
F656N	Shopbell	Hα	u3jv0101r-102r-201r-202r	4 x 500
F658N		NII	u3jv0103r-104r-203r-204r	4 x 600
F547M		Str. y[a]	u3jv0207r-8r	2 x 50
F814W	O´Connell	WFPC2 I	u45t0105r-6r-7r-8r	2 x 200/1200/600
			-hr-ir-jr-kr	260/140/2 x 900
F439W		WFPC2 B	u45t0109r-ar-br-cr	2 x 400/1000/2300
			-lr-mr-nr-or	500/300/2500/1100

[a] Wide Stromgren *y*

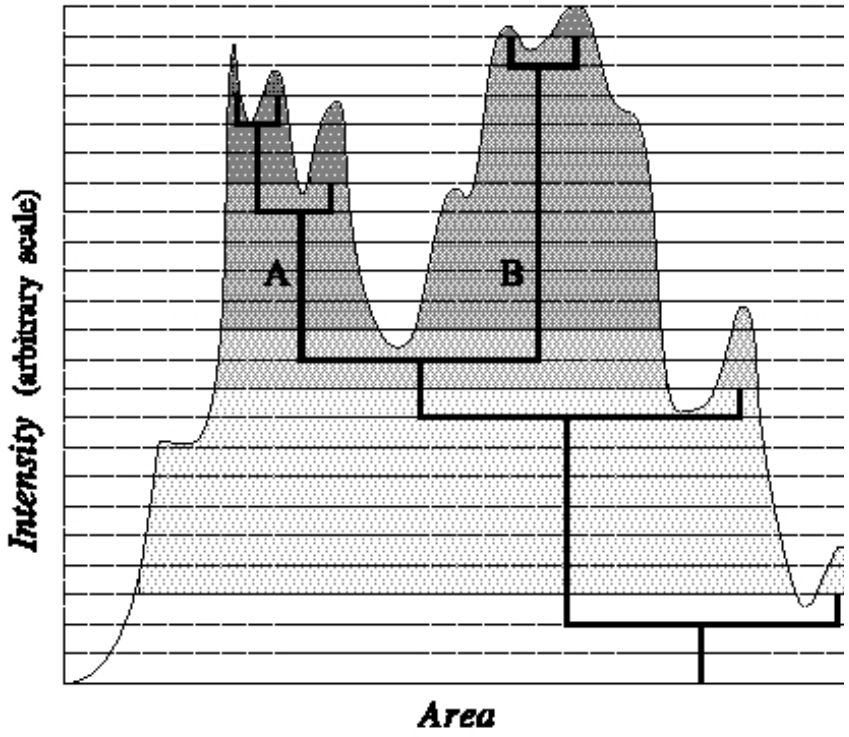
Division of macrostructures in the starburst of M82

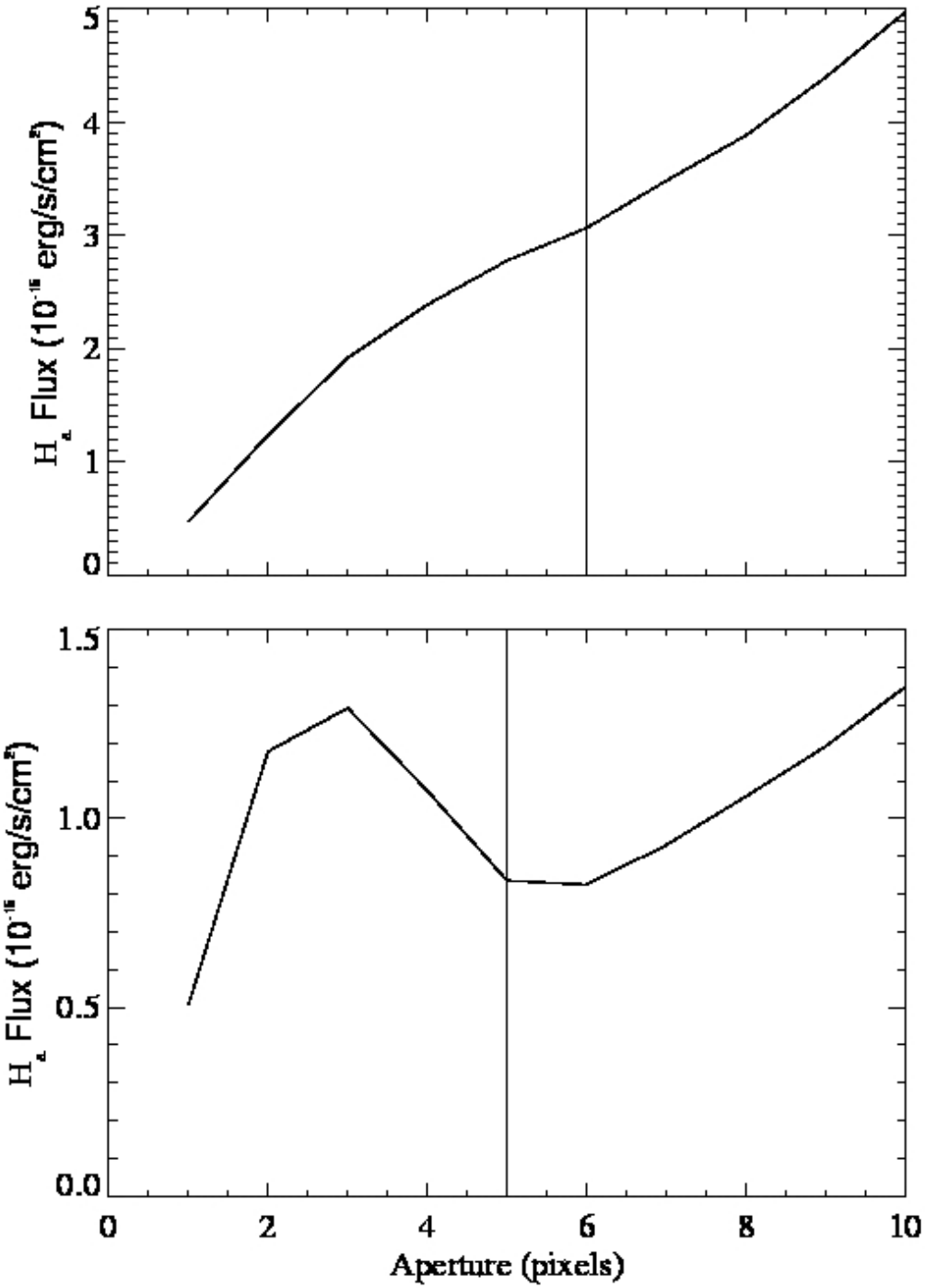


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DAOFIND
Hα and continuum images independently
Parameters of bright knots (x,y)
Fluxes for 1-10 pixels apertures PHOT
Fit flux distribution with a third order polinom
Find inflextion points => Radius
Parameters of bright knots (x,y,R)
Look for coincident regions
(overlapping area > 50 %)
1st version of catalogue
EW > 0
2st version of catalogue
FINAL CATALOGUE
Fluxes without difuse emission
Masks creation with the size of apertures
Smooth with a gaussian (GAUSS)
Fit in 2D with splines function (4th order)
Difuse emission map
Discard clusters with $E_{difuse} > E_{H\alpha}$

Method to find the radius of SSCs -->



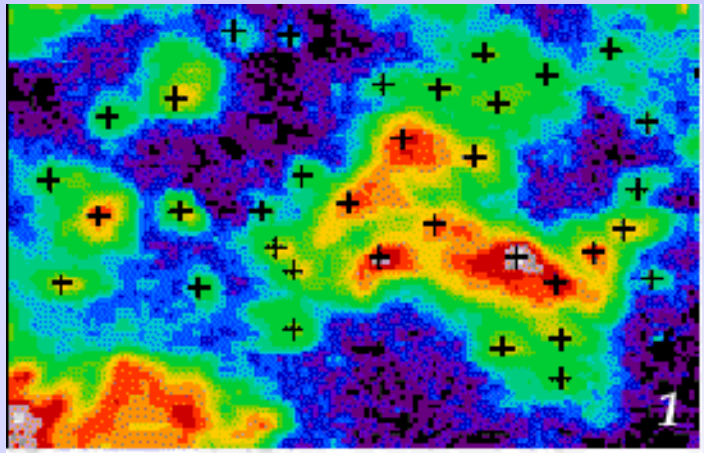


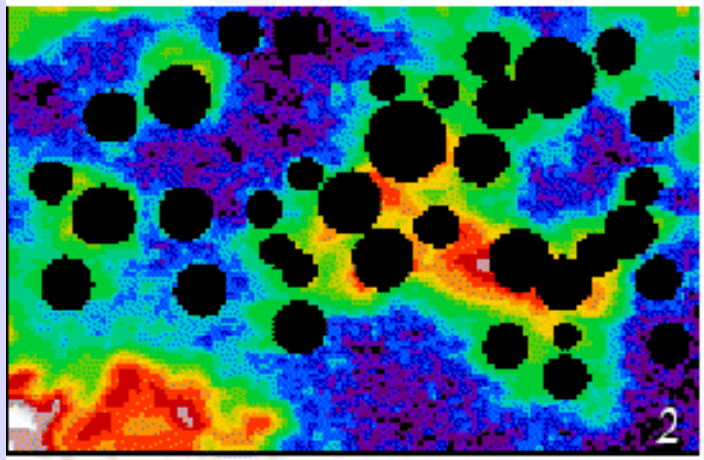
Back

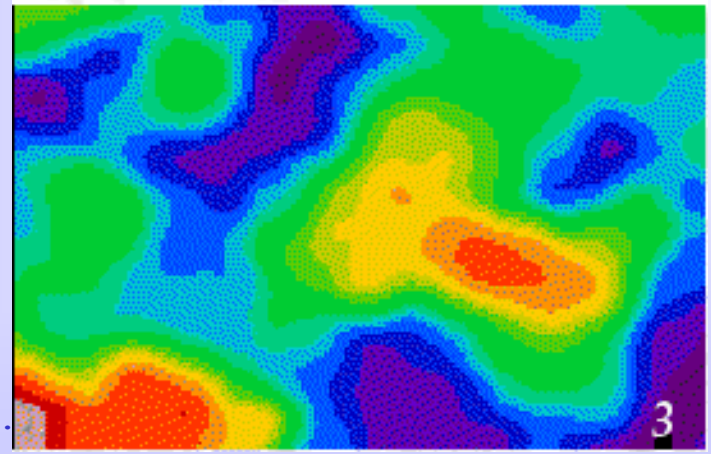
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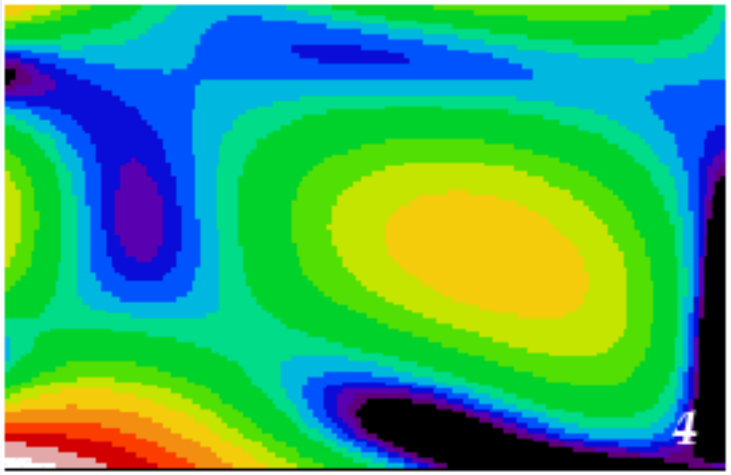
Estallidos II. MASSIVE STAR FORMATION IN

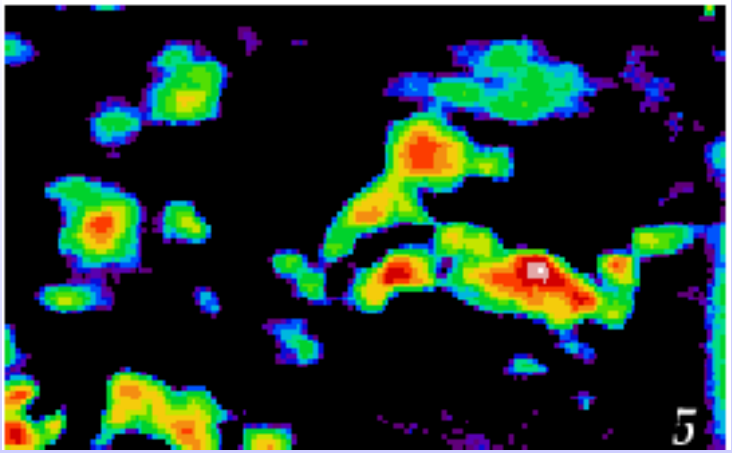
Diffuse Emission Map

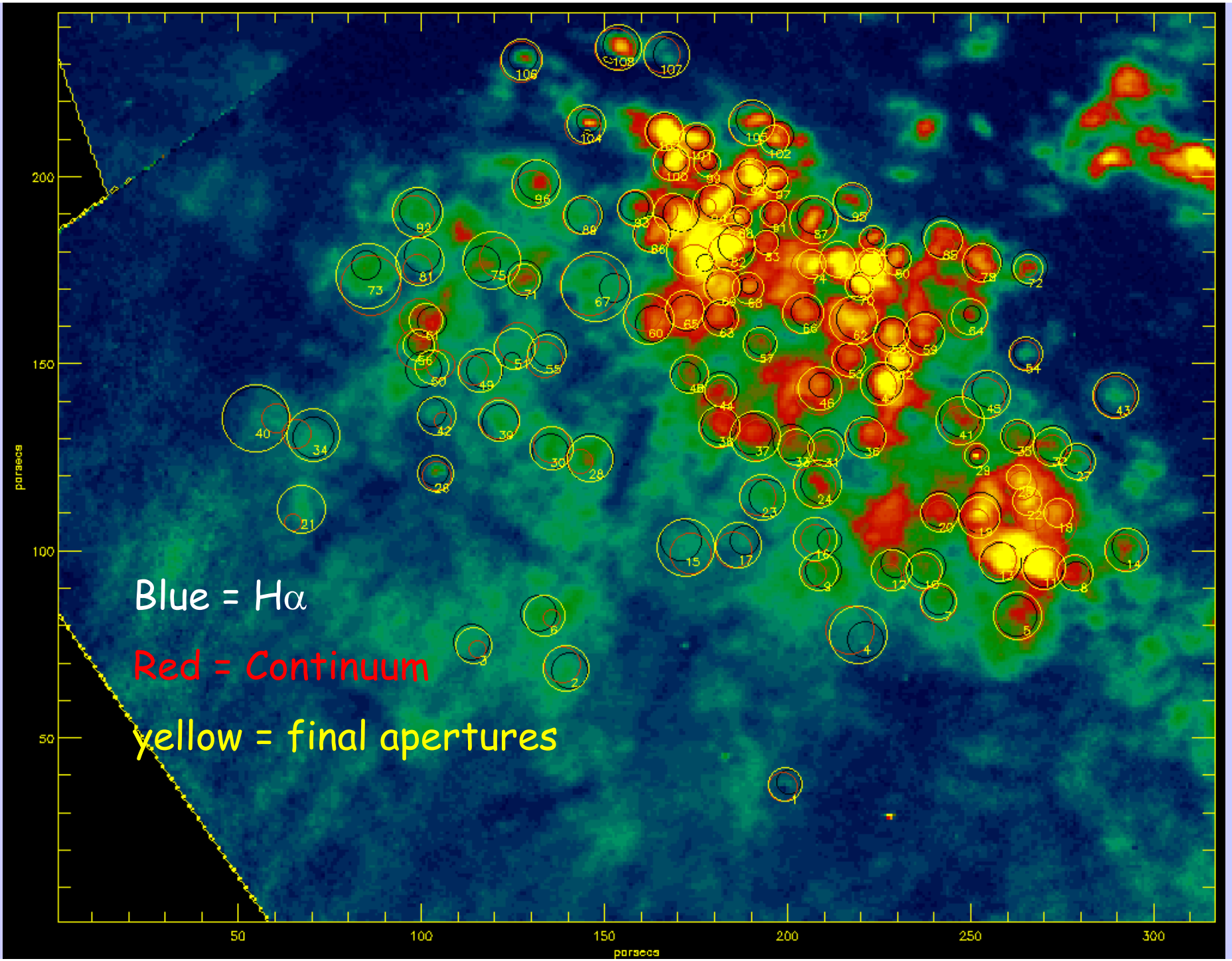




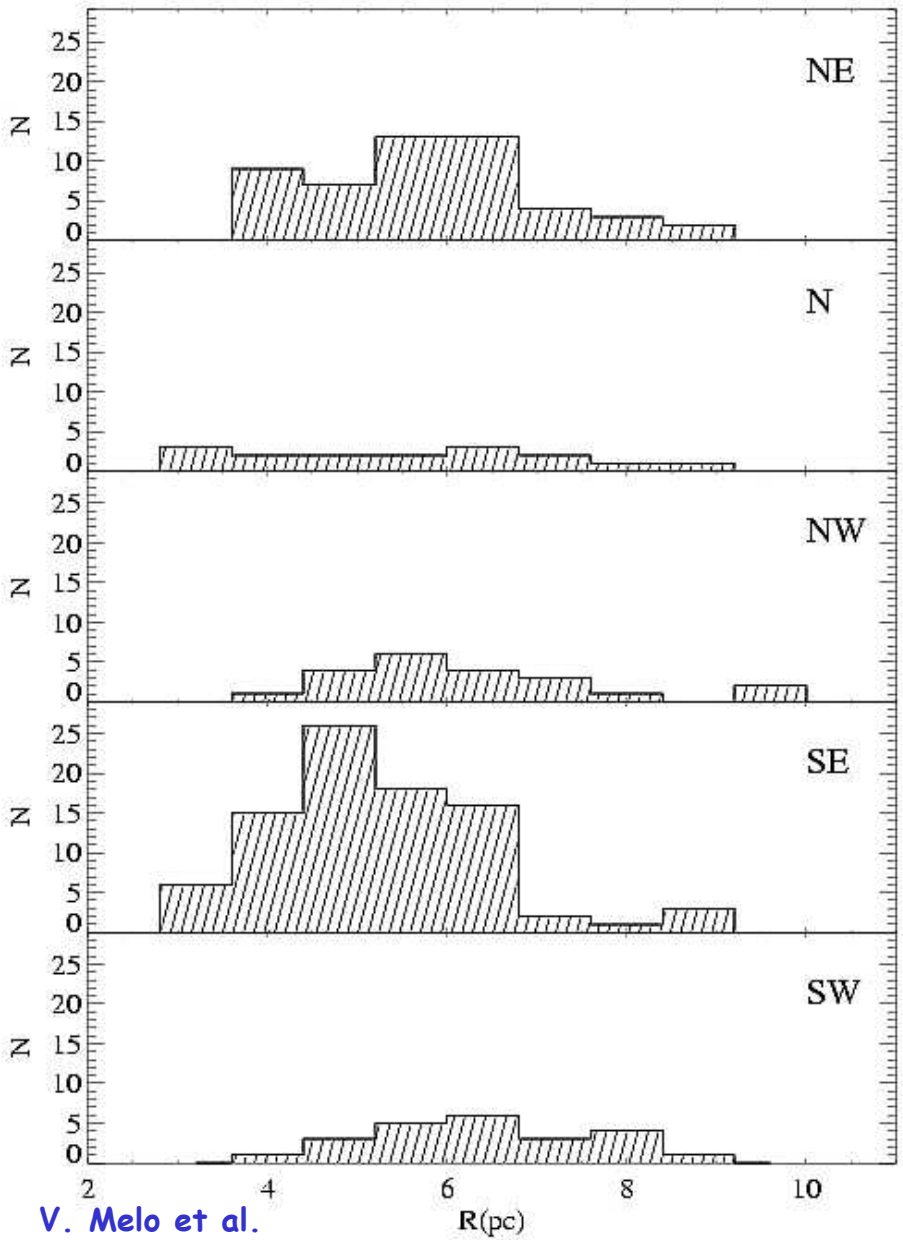


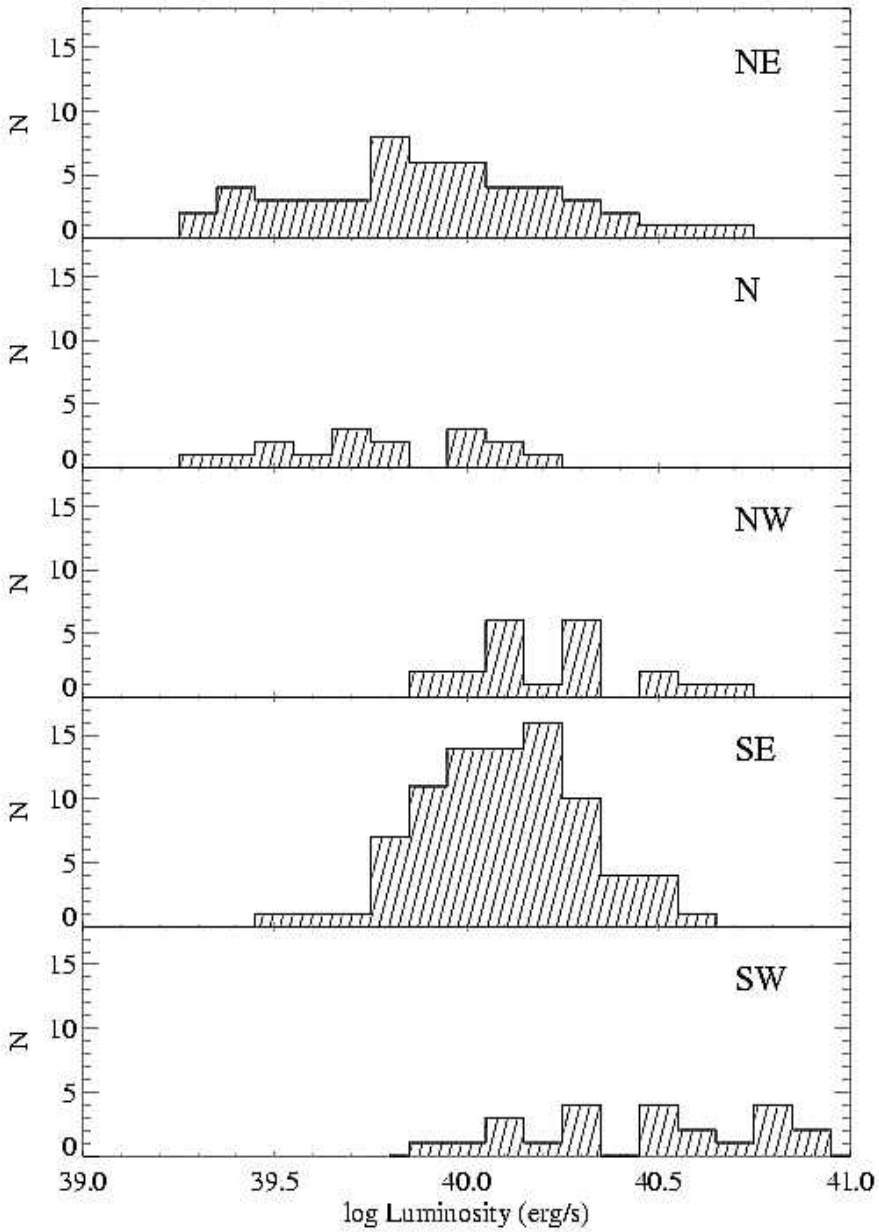





Blue = Hα
Red = Continuum
yellow = final apertures
parsecs
parsecs
50
100
150
200
250
300

Corrected by galactic and internal extinction





V. Melo et al.

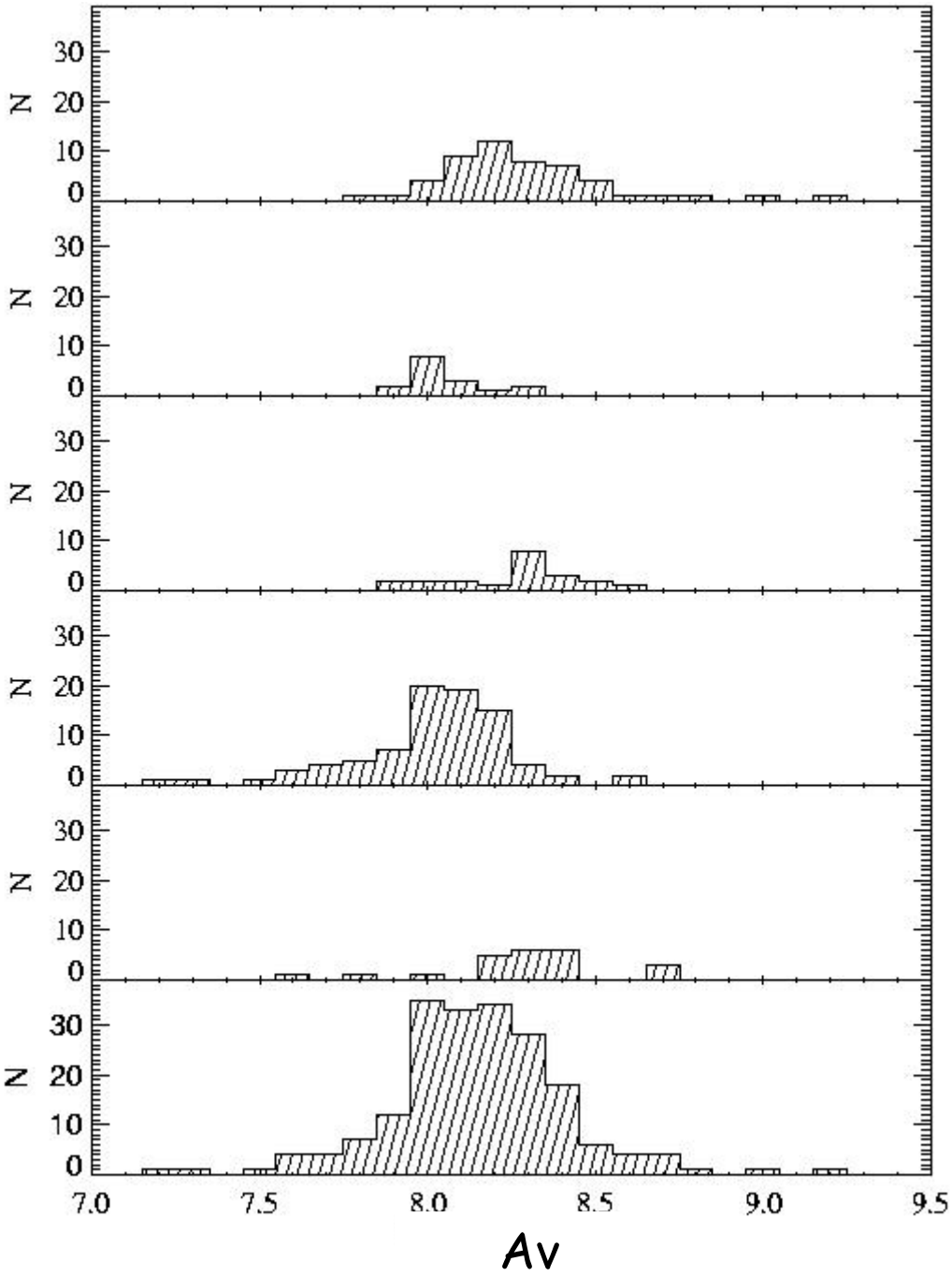
Two colours:

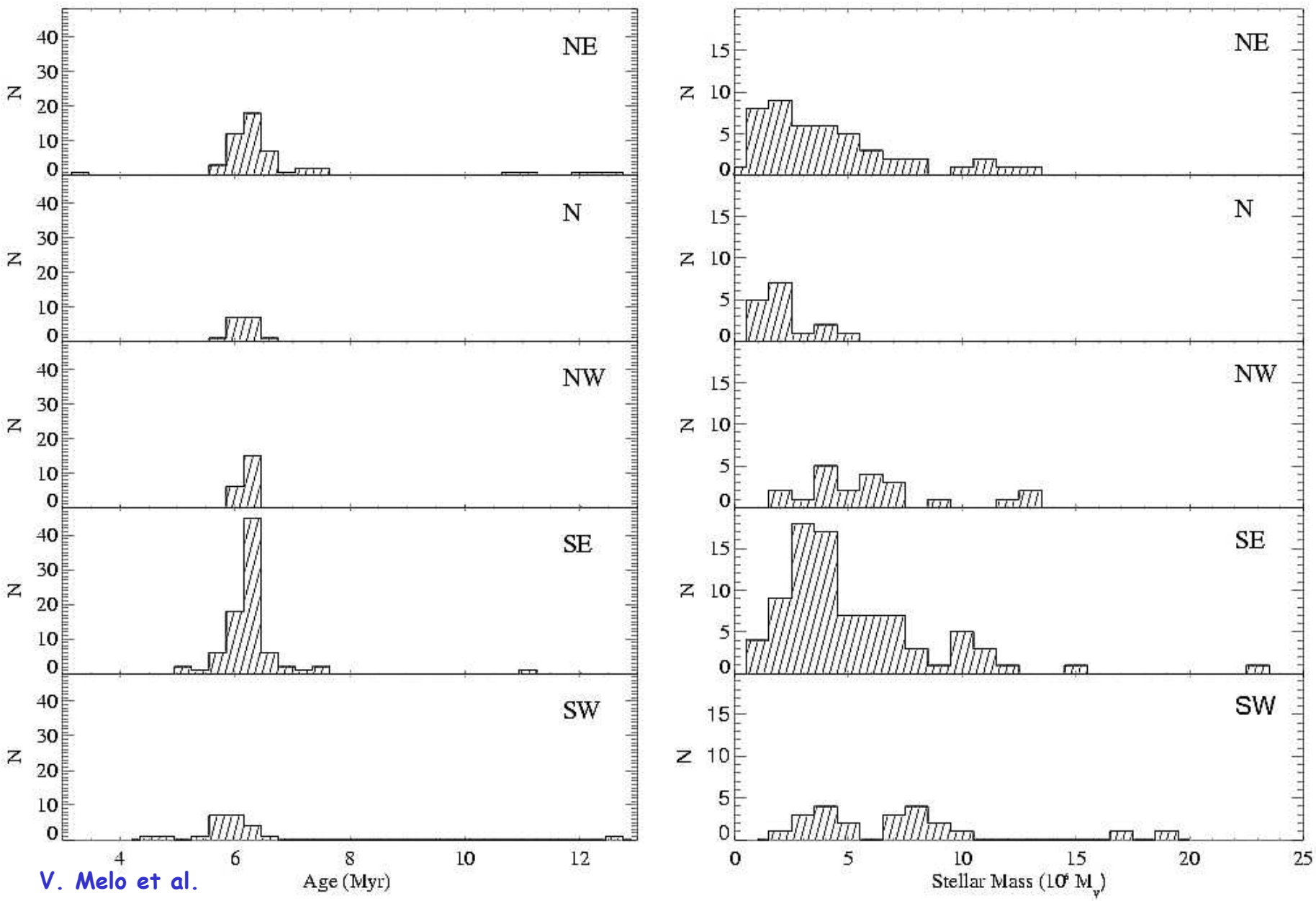
- (I - y)

- (B - y)

=> estimation of extinction

We are working in a better estimation of Av.





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NGC 1569

Anders et al. MNRAS 2003(astro-ph/0309153)

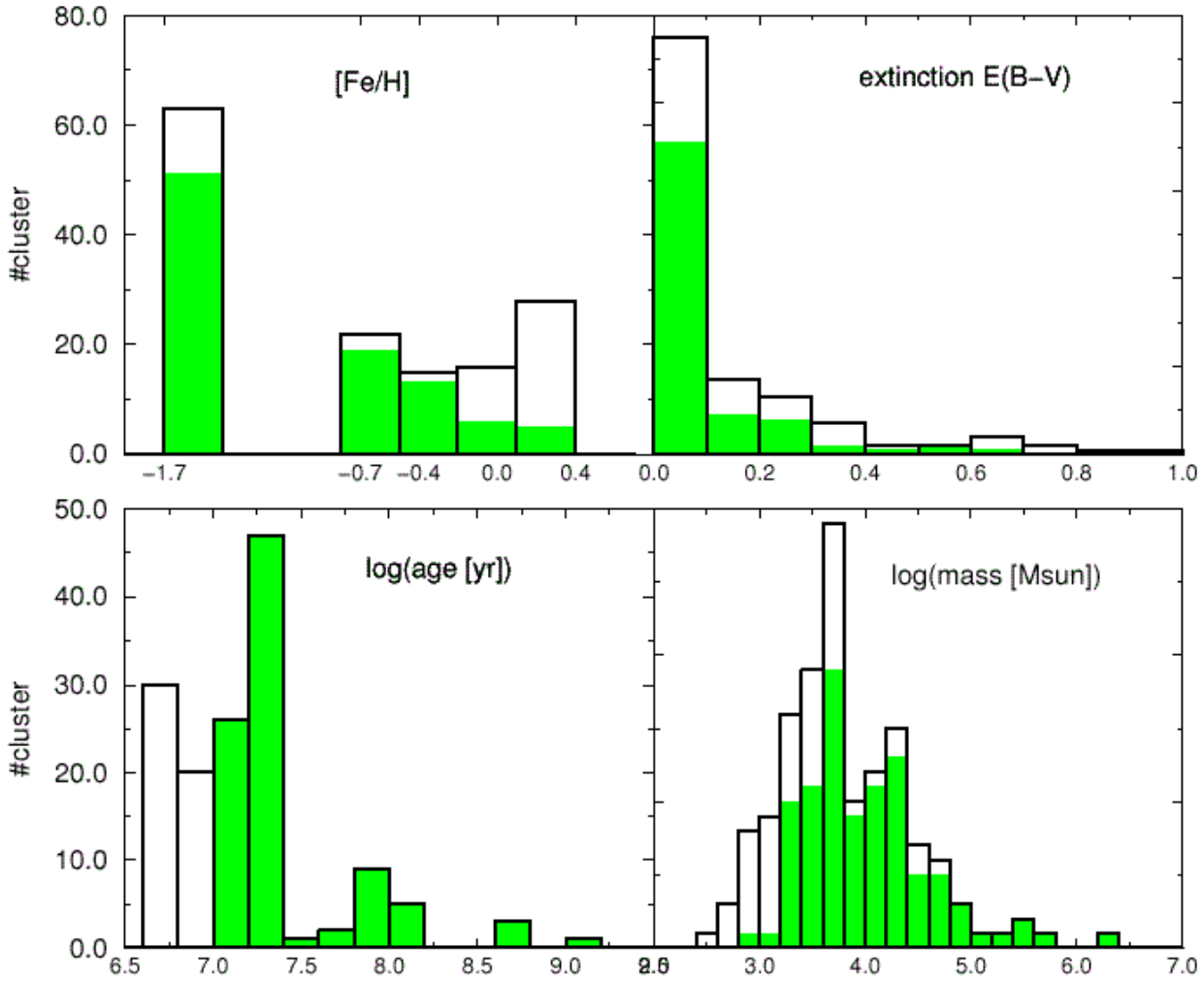


Figure 5. Parameter distributions of the clusters in the small FoV; open histograms: all ages, shaded histograms: only ages > 8 Myr.

Galactic globular clusters have a gaussian shaped mass distribution ⇒ $\langle \log(M_{GC}[M_o]) \rangle_{MW}$ = 5.5 (σ = 0.5)

(Ashman et al. 1995)

NGC 6745

De Grijs et al. 2003,MNRAS 343, 1185

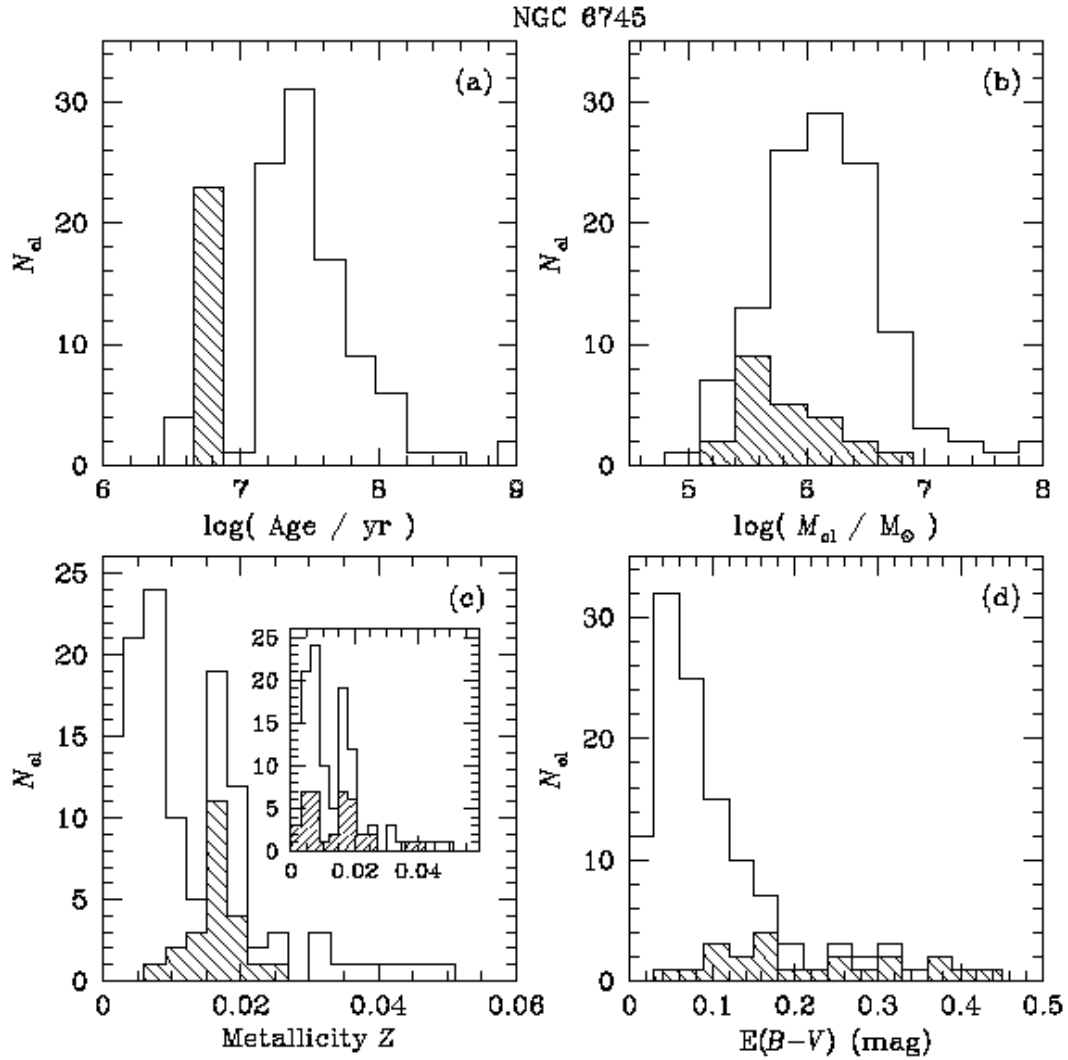
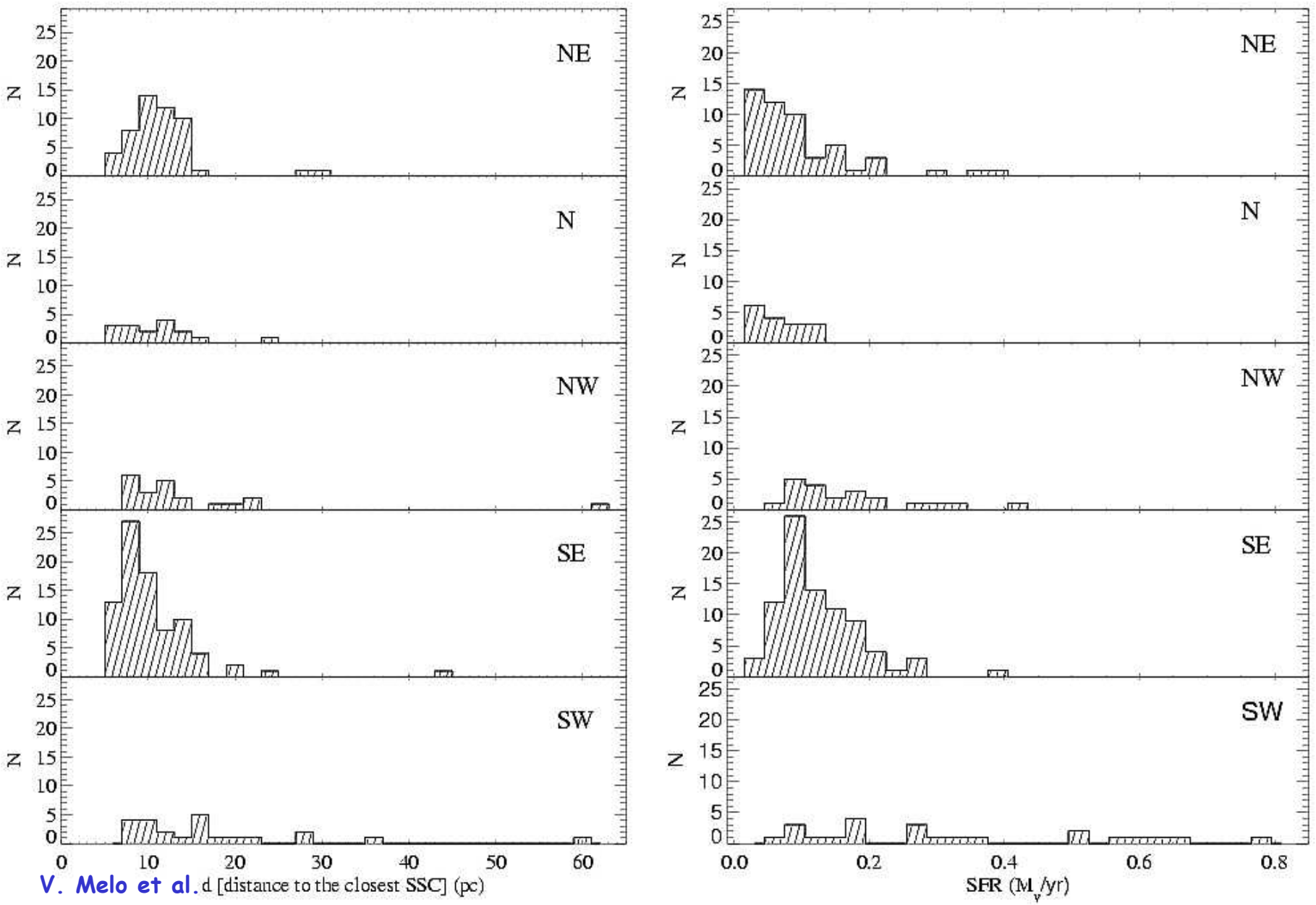
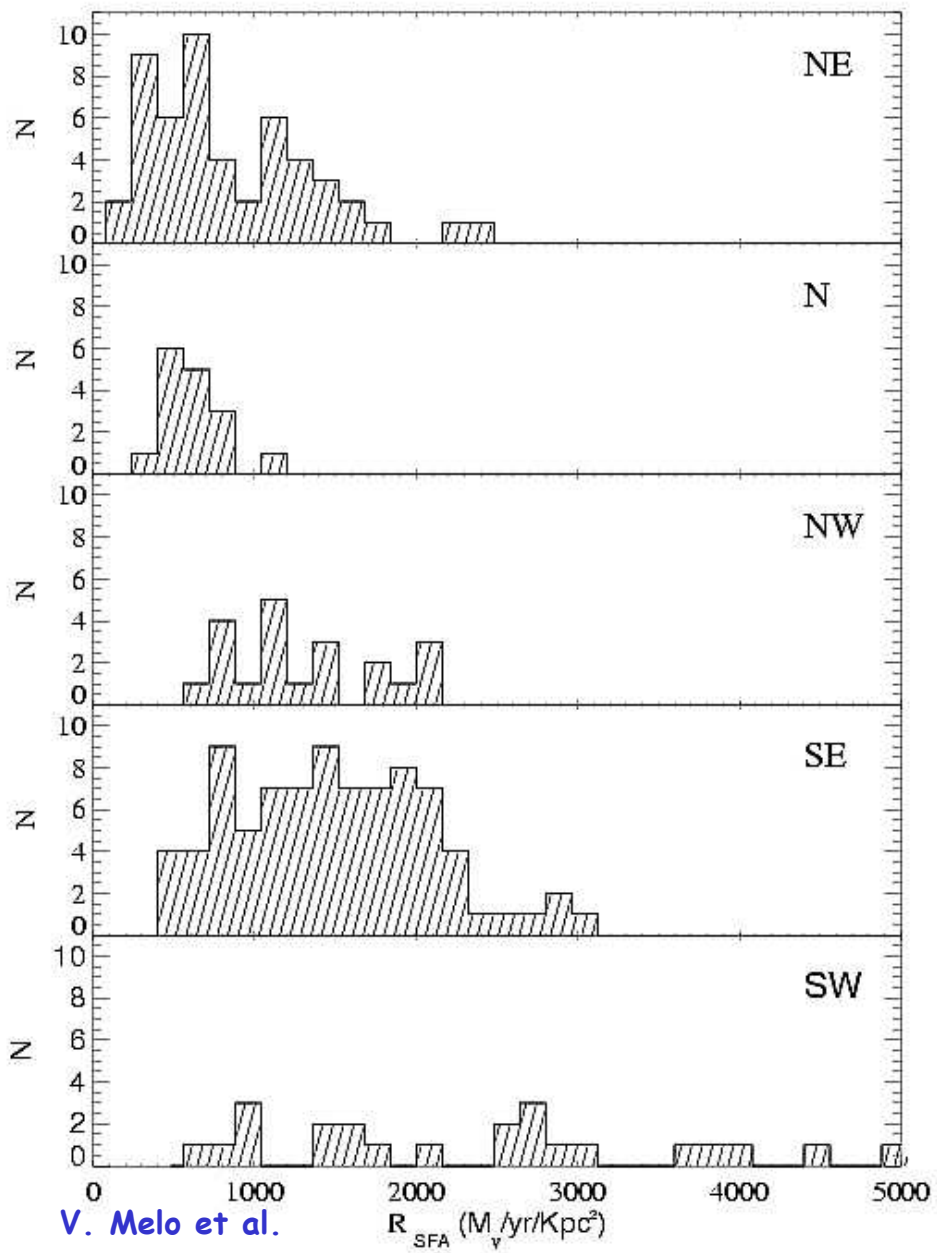


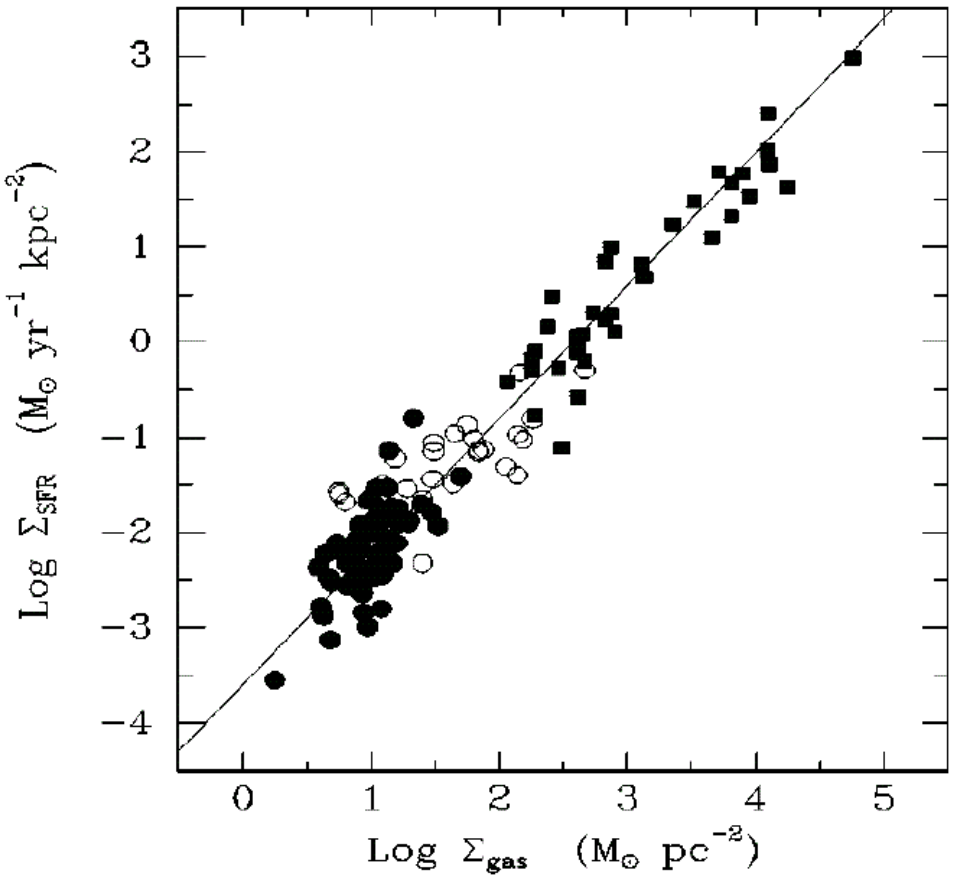
Figure 9. Age, mass, metallicity and extinction distributions of the clusters in NGC 6745, based on our four-passband fitting technique used to determine age, metallicity and extinction estimates simultaneously. Although the main properties of these distributions are reasonably correct, the shaded histograms are affected significantly by the age–metallicity degeneracy: the shaded histograms, corresponding to the young-ag at close-to-solar metallicity (panel c), compared to the other clusters that peak at much lower metallicities. The metallicity distribution of the clusters in the most actively star-forming region connecting the main galaxy witl

$6.5 < \log (M_{cl}/M_o) < 8.0$


NE
N
NW
SE
SW
N
0
5
10
15
20
25
0
10
20
30
40
50
60
d [distance to the closest SSC] (pc)
0.0
0.2
0.4
0.6
0.8
SFR (M$_v$/yr)



V. Melo et al.



Kennicutt, ARA&A 1998, 36, 189

Macr.	Size (pc)	ρ	M	σ(M)	L	σ (L)
NE	201.3 x 120.8	2097	2.43	2.79	39.87	0.44
N	161 x 64.4	1640	1.13	1.69	39.79	0.41
NW	185.2 x 120.8	939	4.92	2.03	40.11	0.33
SE	242 x 242	1486	3.77	2.13	40.09	0.21
SW	281.8 x 241.5	338	8.39	10.23	...	...
Total	**563.5 x 563.5**	**627**	**3.50**	**2.58**	**40.08**	**0.27**

R(pc)	σ (R)	d(pc)	σ (d)	SFR	σ (SFR
5.75	1.25	11.10	2.67	0.032	0.066
...	...	10.26	2.33	...	...
4.89	2.24	...	...	0.038	0.192
5.36	1.34	...	...	0.104	0.054
6.89	1.63	15.31	6.77	...	...
5.39	**1.62**	**8.09**	**4.64**	**0.079**	**0.076**

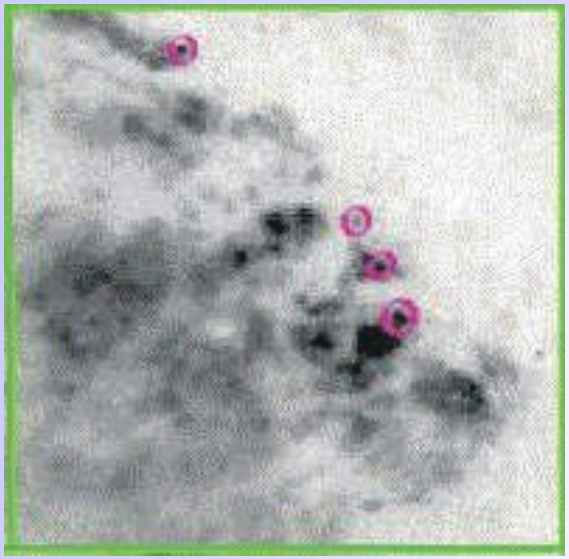
Mass units 10^6 M_o

Luminosity in logaritmic scale

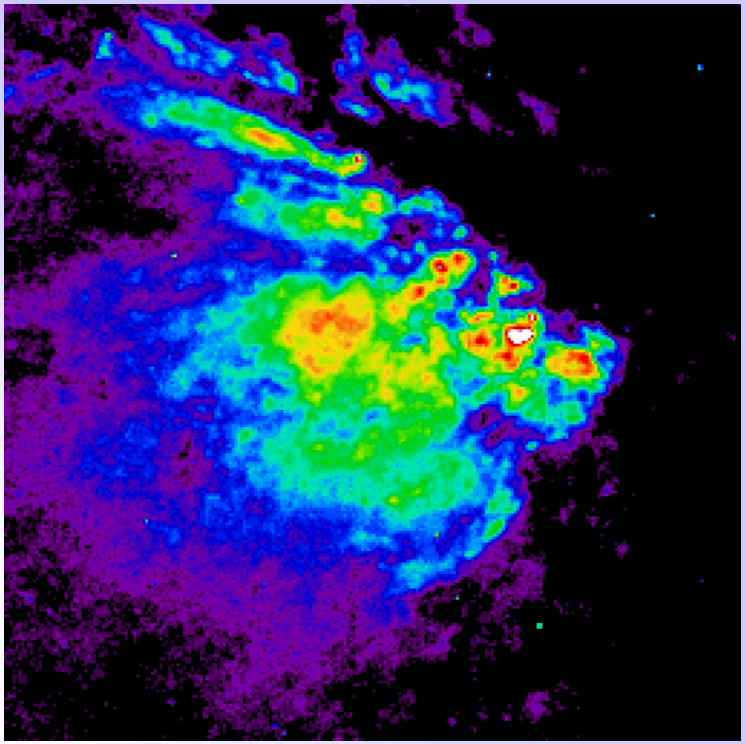
PhD work...to finish by the end of 2004

- Analyse the SSCs in other starburst galaxies. Compare with M82 parameters (the SGW paradigm)
- Complete the catalogue with the NICMOS band: better knowledge of extinction, mass and age AND, look for more evolved clusters (age larger than 10 Myears).
- Morphology of Hα emission in relation with the location of the SSCs of the catalogue... SUBARU image + WIYN

NGC 253



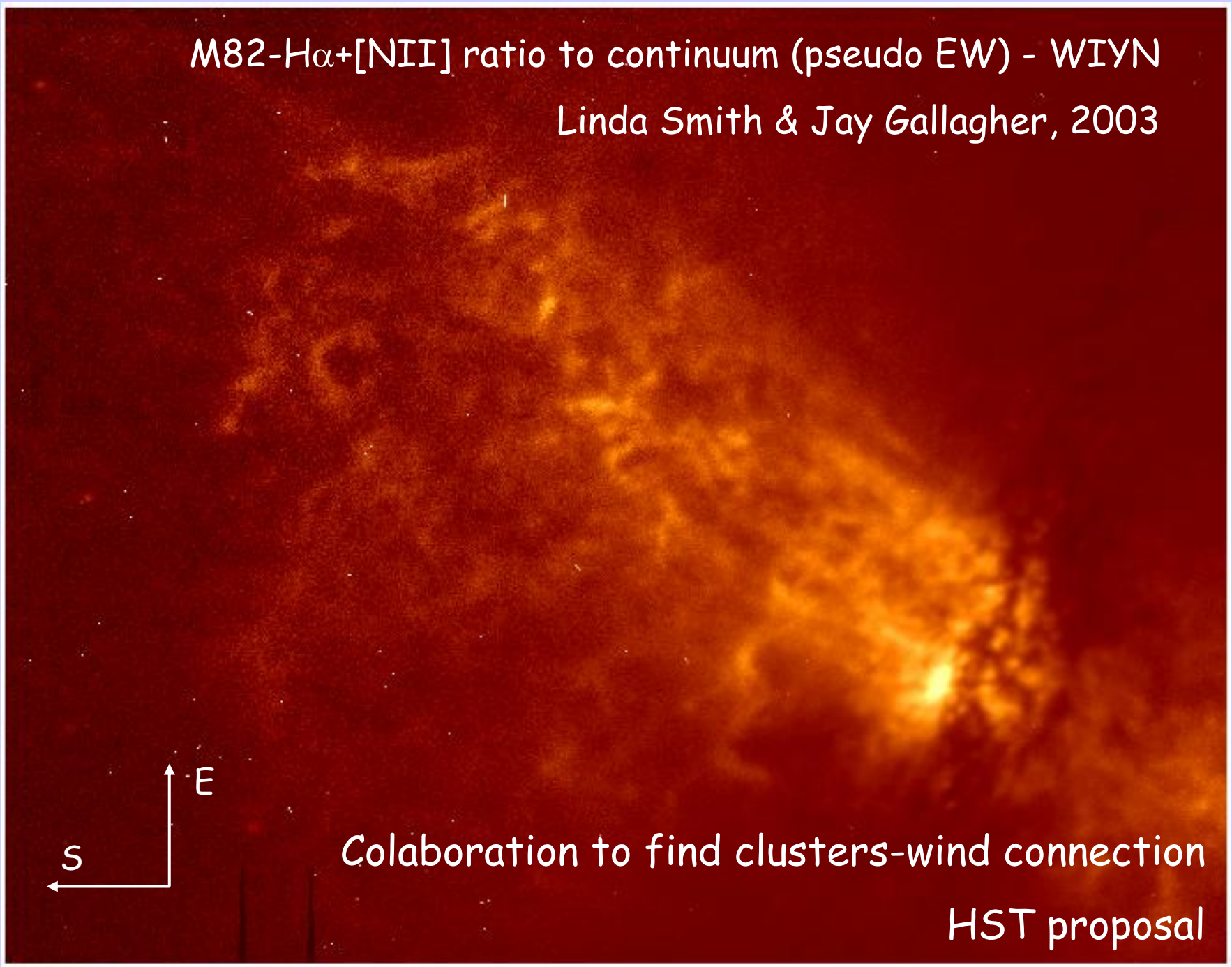
Watson et al.(1996) proposed 4 SSCs in NGC 253

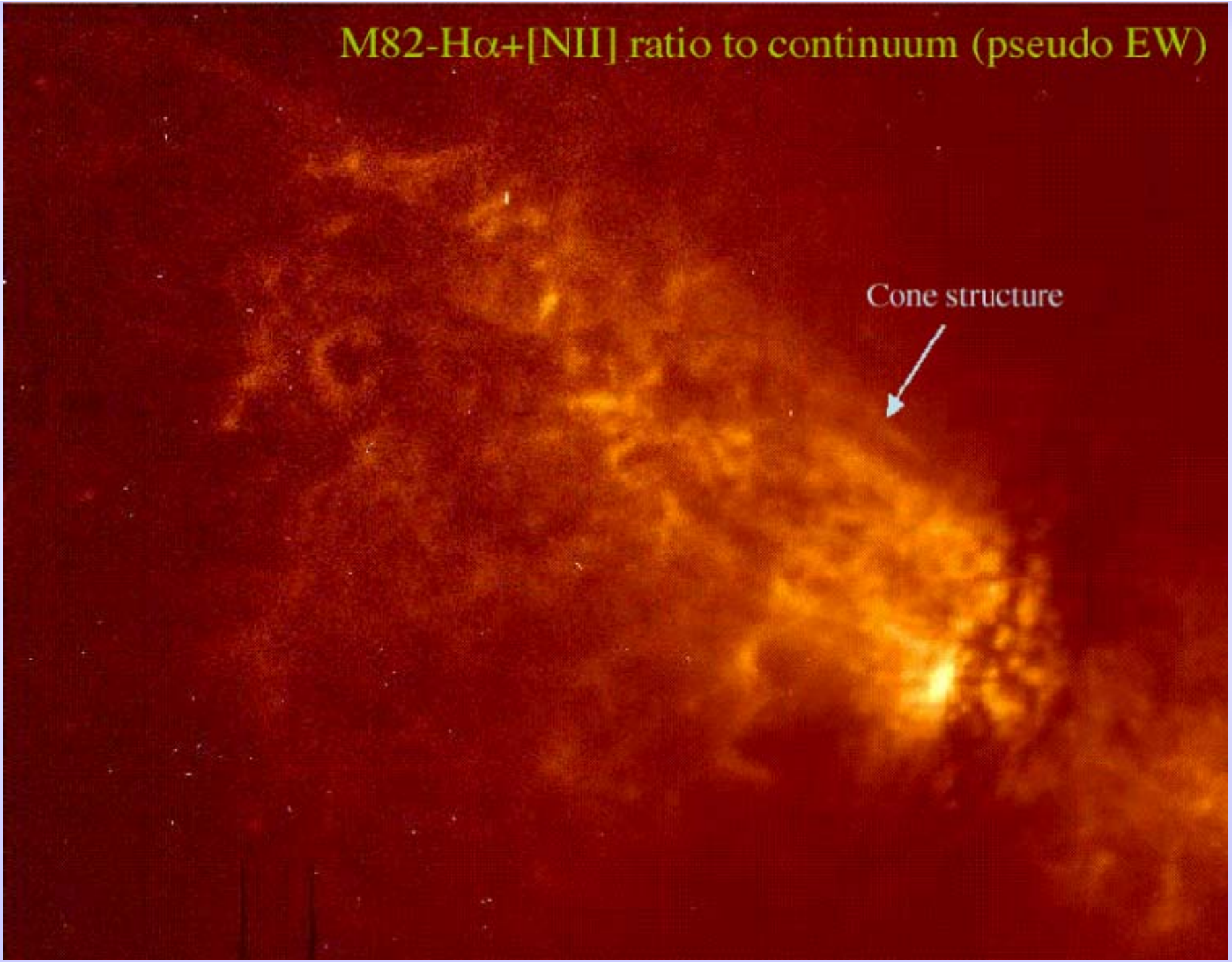


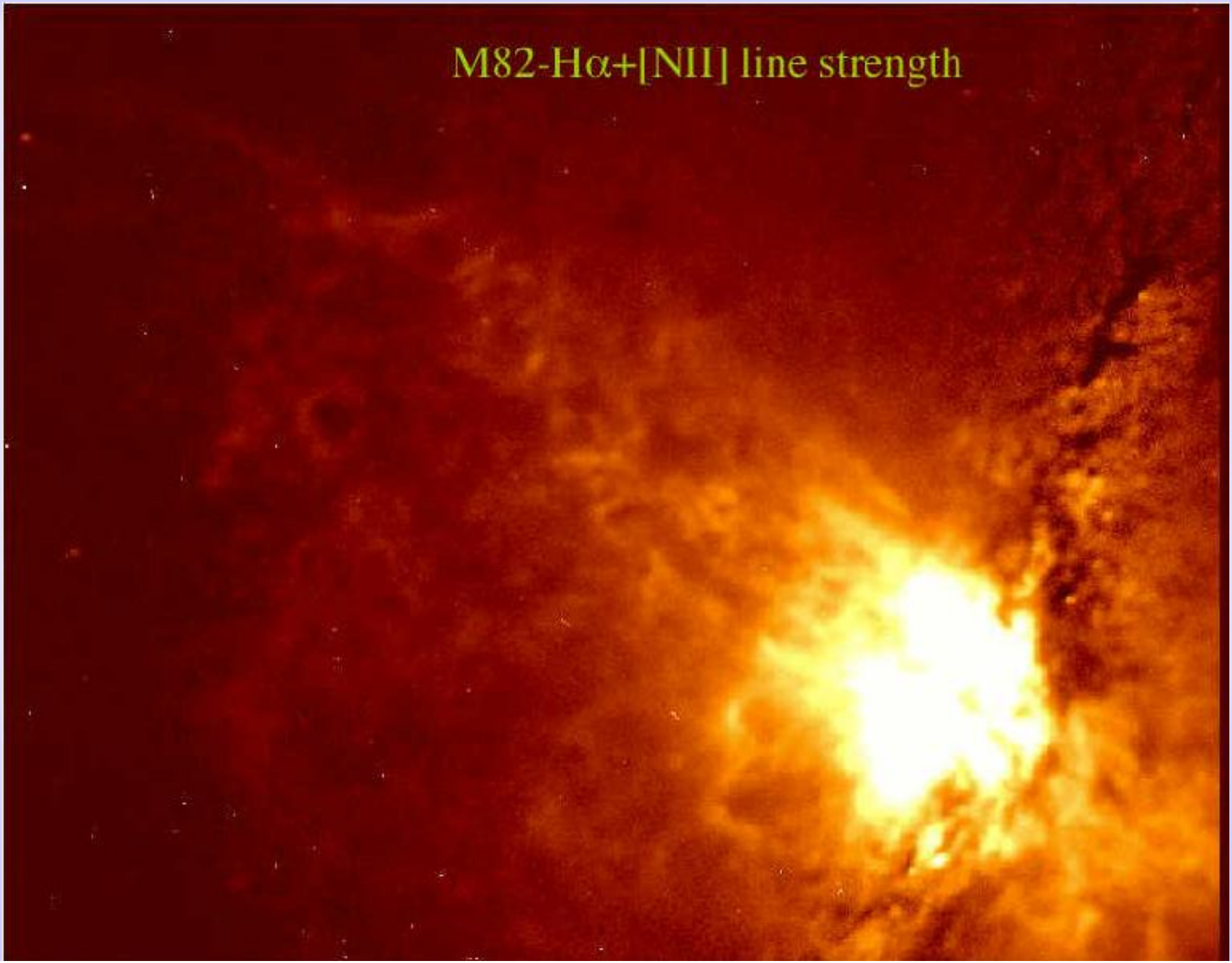
Density of SSCs	
NGC 253	197 x 180 pc & N = 4 SSCs
	N° SSC/area = 113 SSCs/kpc^2
M82	242 x 242 pc & N = 87 SSCs
	N° SSC/area = 1486 SSCs/kpc^2
Tipical distance to the nearest SSC (pc)	
NGC 253	14 - 90 pc
M82	8.09 $\pm$ 4.64 pc

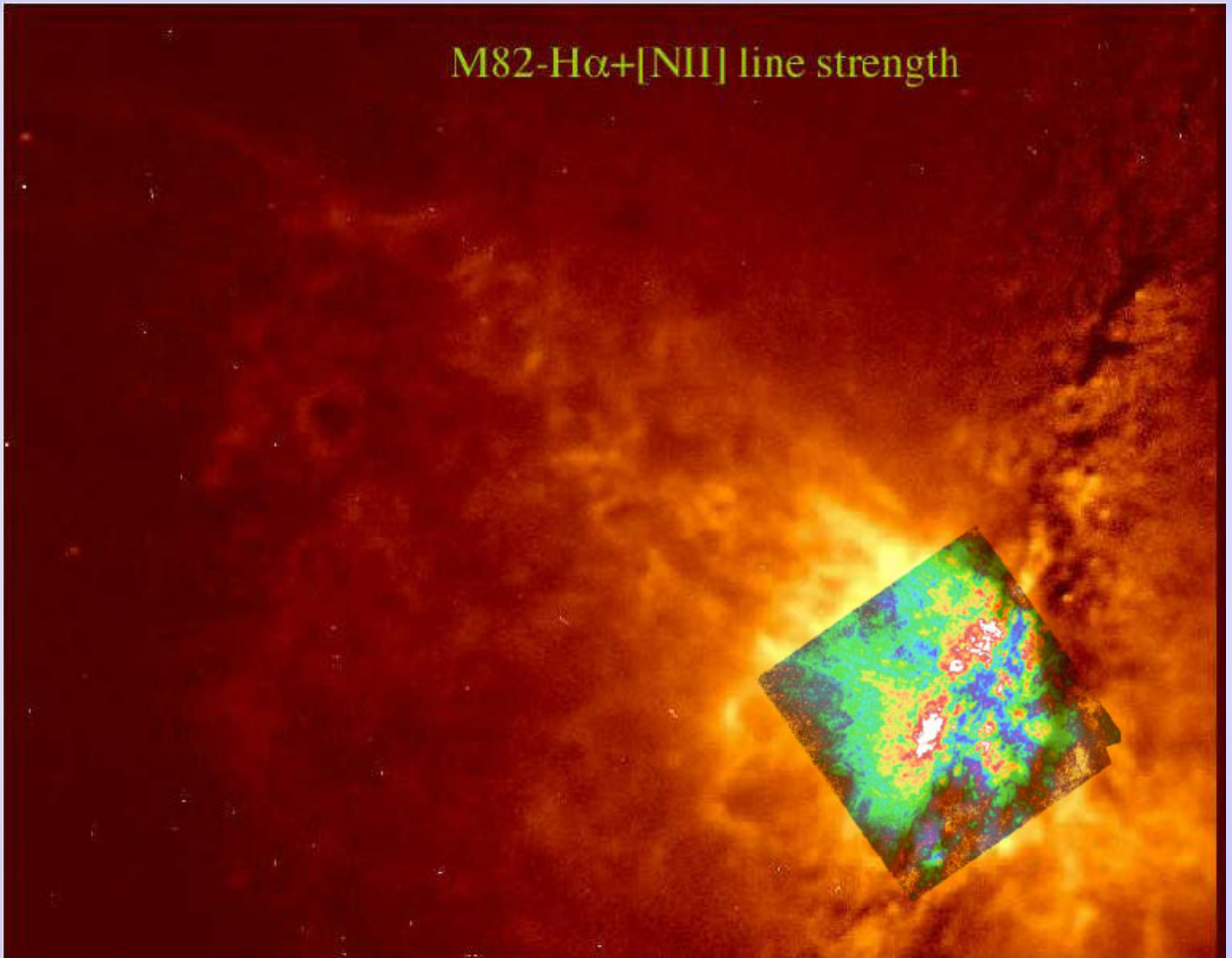
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M82-Hα+[NII] ratio to continuum (pseudo EW) - WIYN
Linda Smith & Jay Gallagher, 2003
E
S
Colaboration to find clusters-wind connection
HST proposal


M82-Hα+[NII] ratio to continuum (pseudo EW)
Cone structure


M82-Hα+[NII] line strength


M82-Hα+[NII] line strength