Studying star clusters as tracers of the LMC's chemical enrichment

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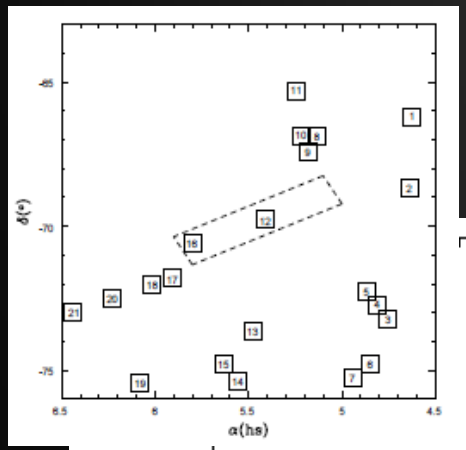
Observations

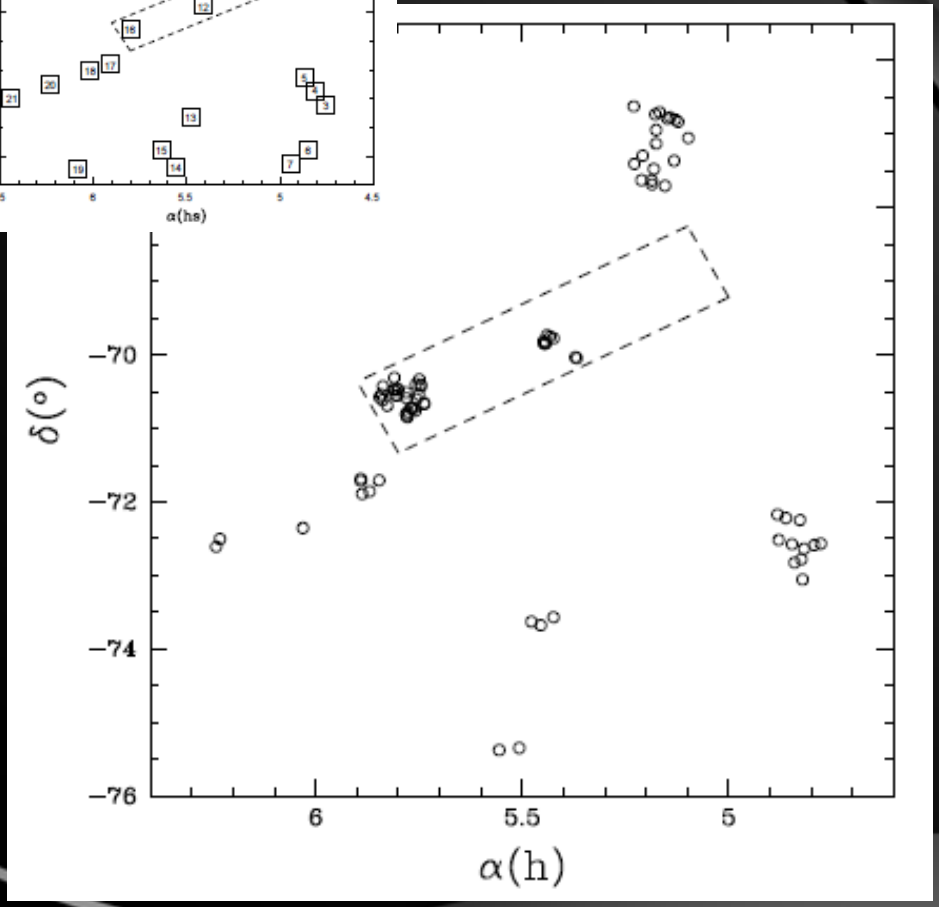
C, T_1 (Washington system)

81 clusters:

39 (bar)
27 (inner disk)
15 (outer disk)

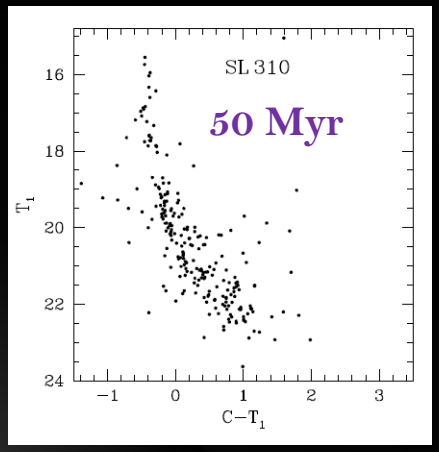
44 unstudied clusters

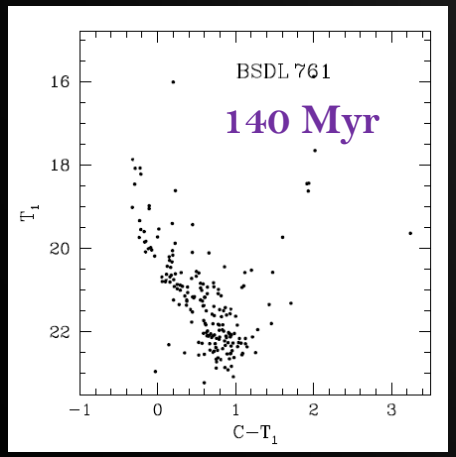


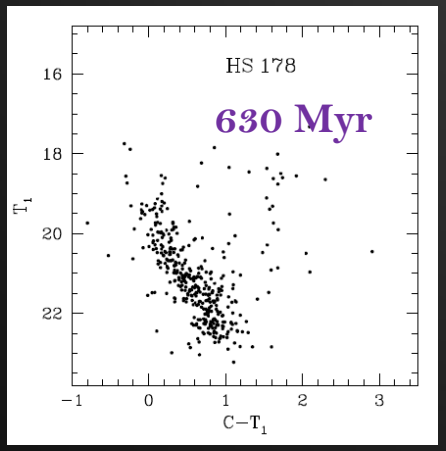


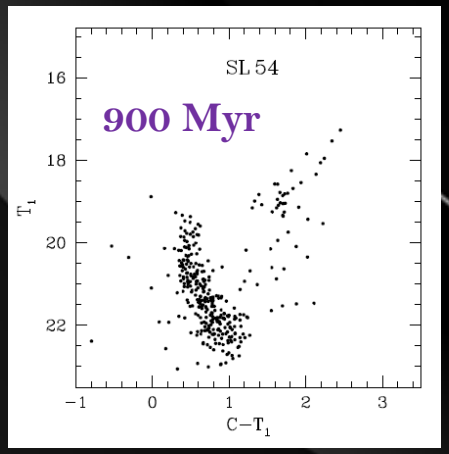
Cluster properties

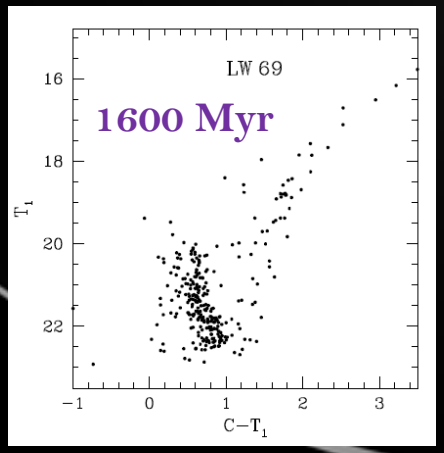
- Washington CMDs + decontamination procedure (Piatti 2012)

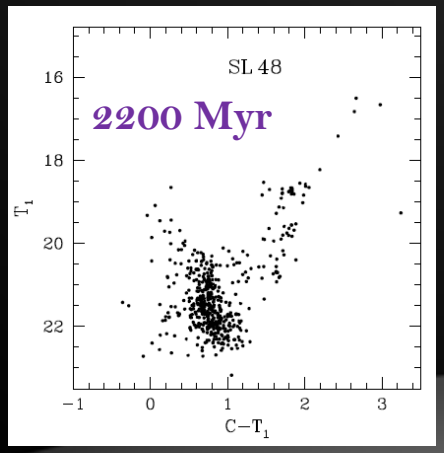












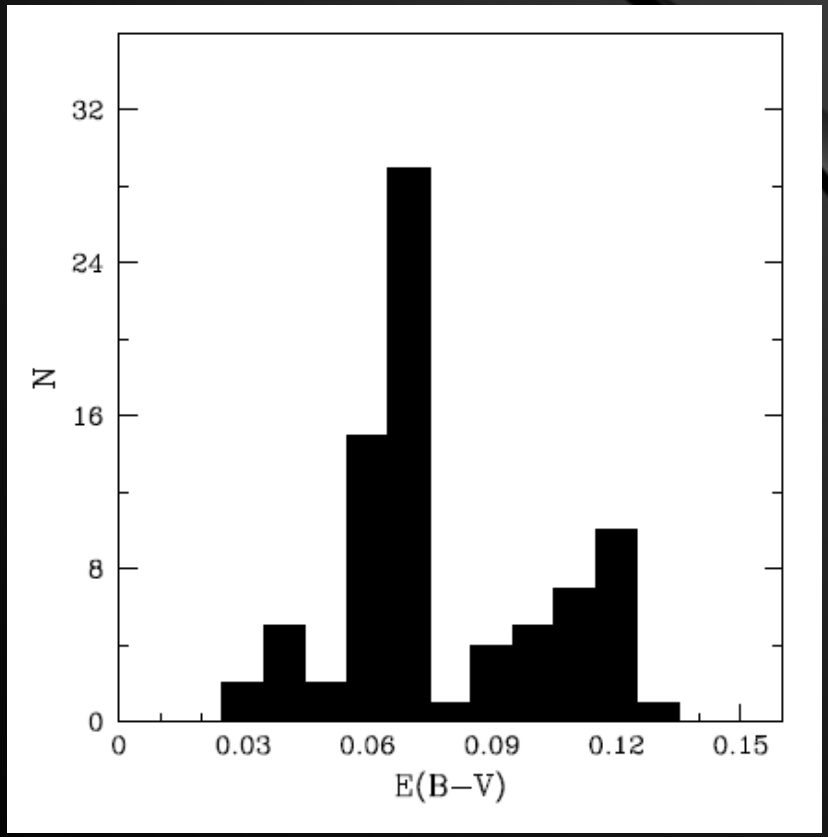
Cluster properties

- Reddening and Distance

  Burstein & Heiles (1982)

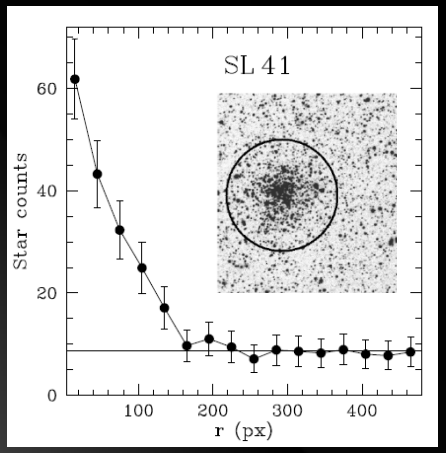
  $0.03 \leq E(B\text{-}V) \leq 0.13$

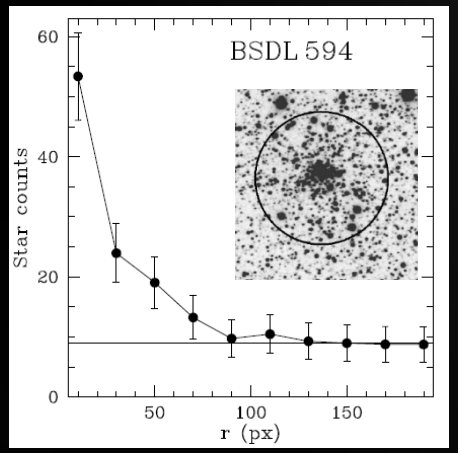
$(m\text{-}M)_0 = 18.50 \pm 0.10$
(Saha et al. 2010)

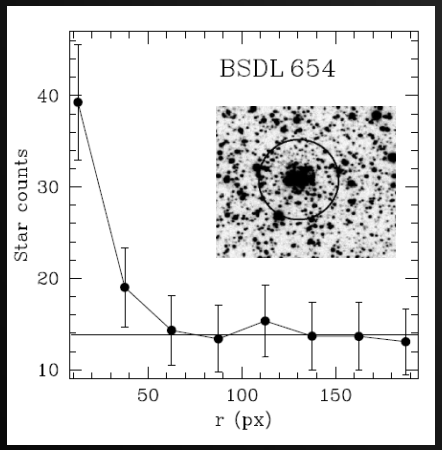


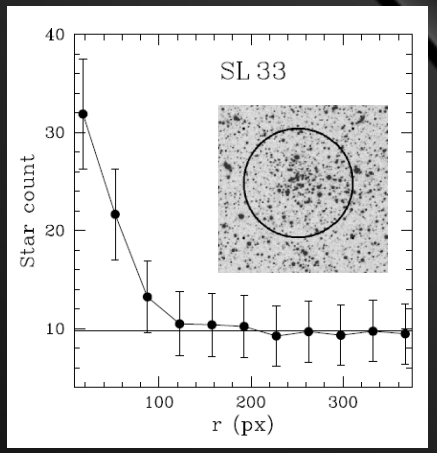
Cluster properties

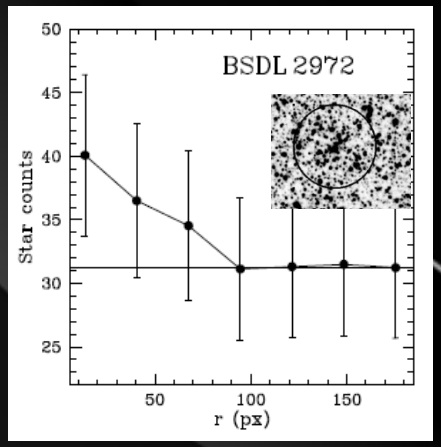
- Angular radii / Linear Radii : 4 – 20 pc

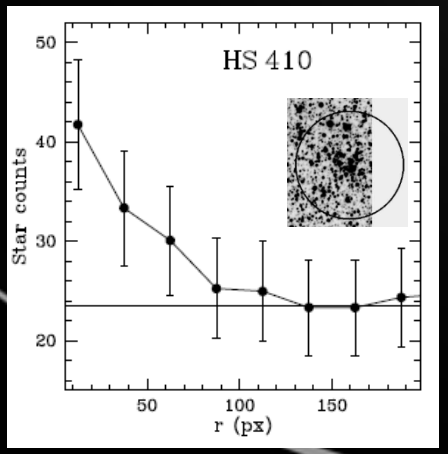


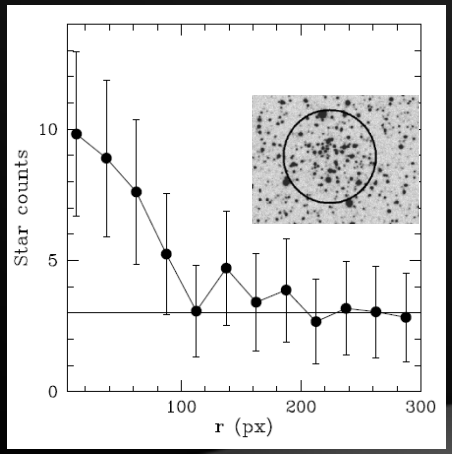












Cluster properties

- Ages & Metallicities

1. Theoretical isochrones (Girardi et al. 2002)

$$Z = \begin{cases} 0.019 \\ 0.008 \\ 0.004 \end{cases} \qquad [Fe/H] = \begin{cases} 0.0 \\ -0.4 \\ -0.7 \end{cases}$$

$$E(C\text{-}T1) = 1.97\ E(B\text{-}V)$$

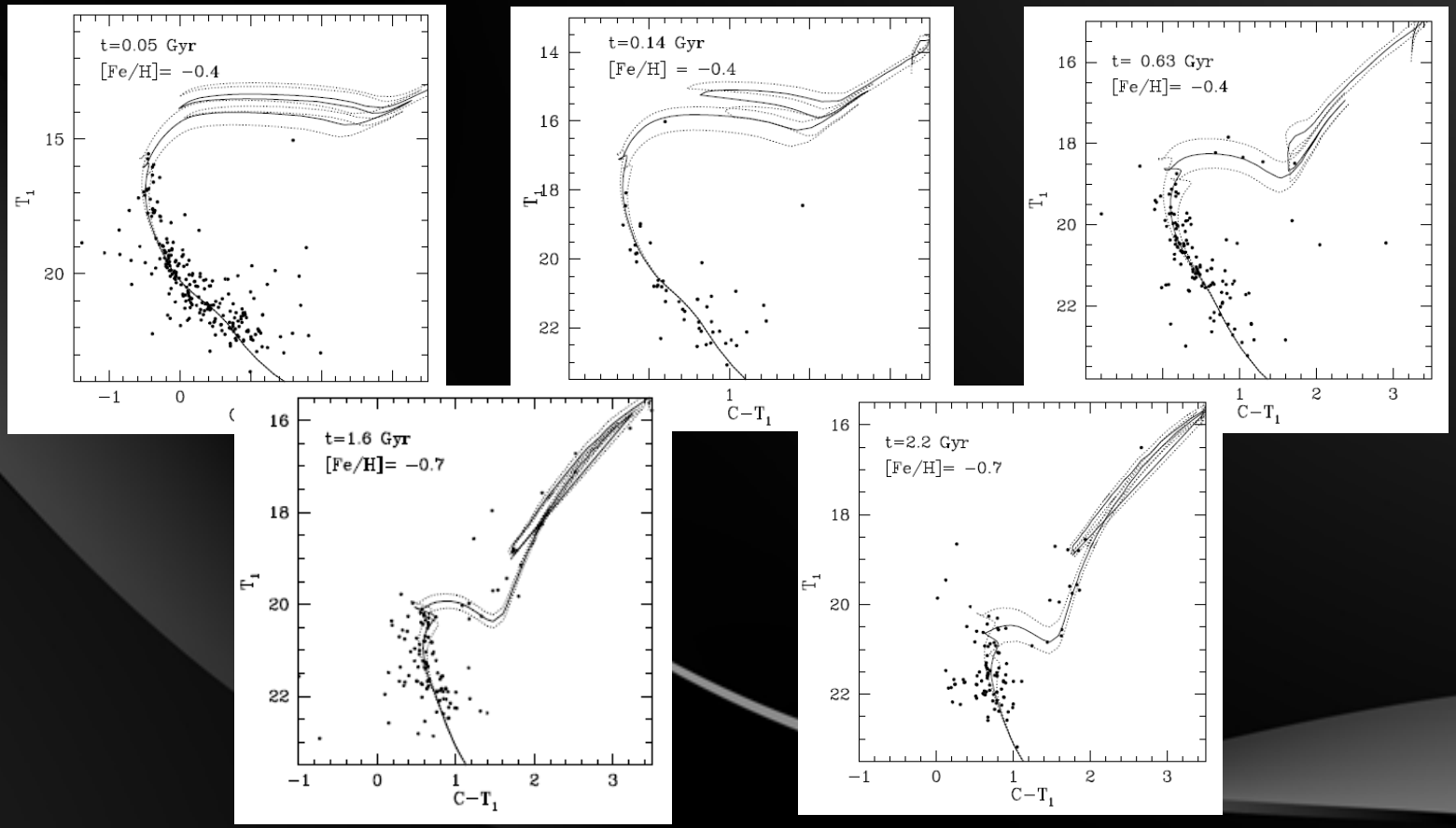
$$M_{T1} = T_1 + 0.58\ E(B\text{-}V) - (V\text{-}M_V)$$

(Geisler & Sarajedini 1999)

Cluster properties

- Ages & Metallicities

  1. Theoretical isochrones (Girardi et al. 2002)



Cluster properties

- Ages & Metallicities

  2. Morphological index δT_1

$$t\,(\mathrm{Gyr}) = 0.23 + 2.31\,\delta T_1 - 1.80\,\delta T_1^{\,2} + 0.645\,\delta T_1^{\,3}$$

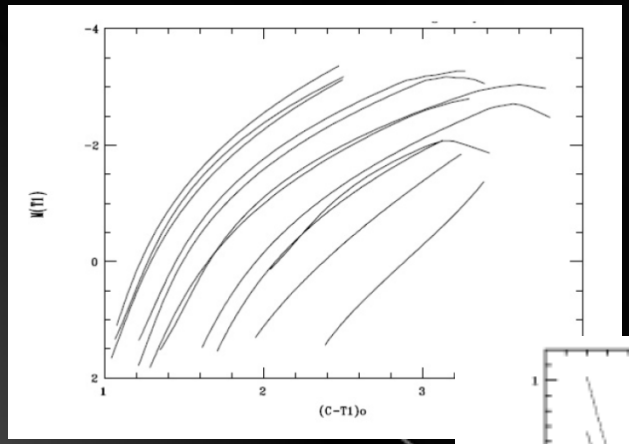
(Geisler et al. 1997)

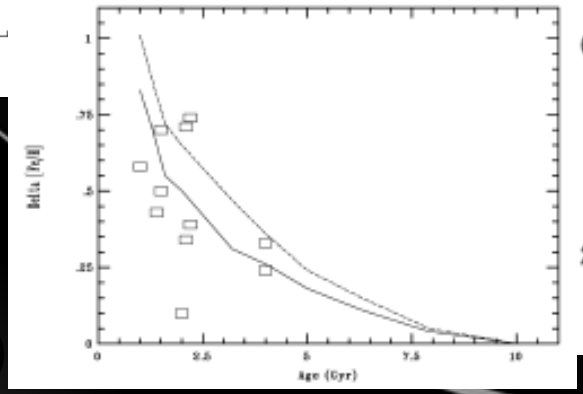
Cluster properties

- Ages & Metallicities

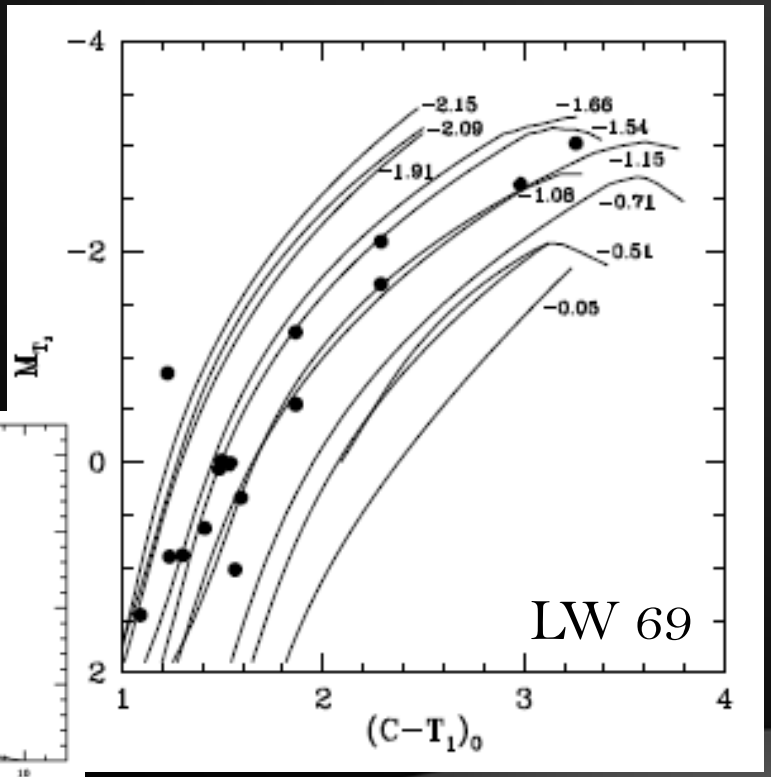
  3. Standard Giant Branch (SGB) procedure

Geisler & sarajedini (1999)

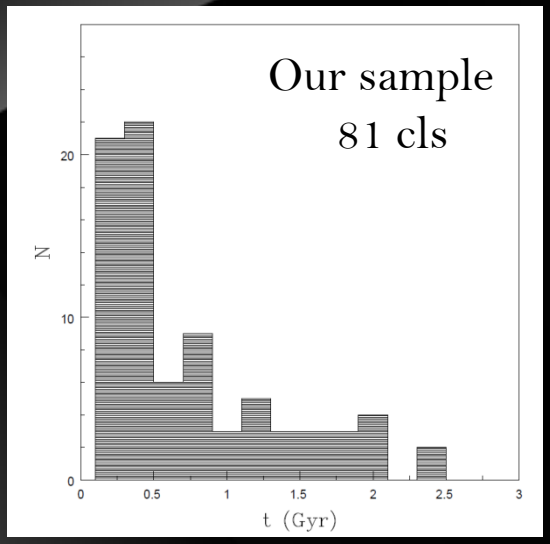


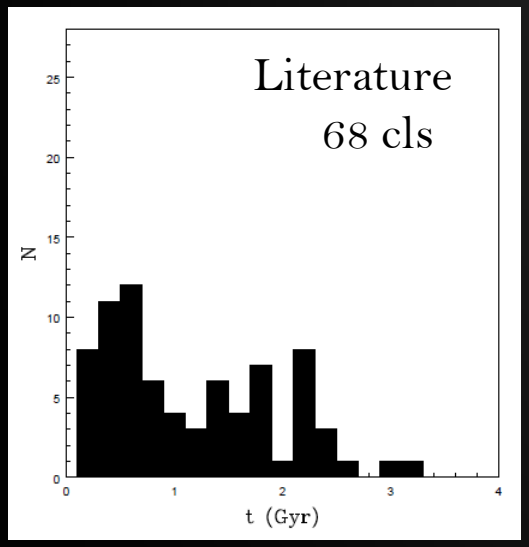


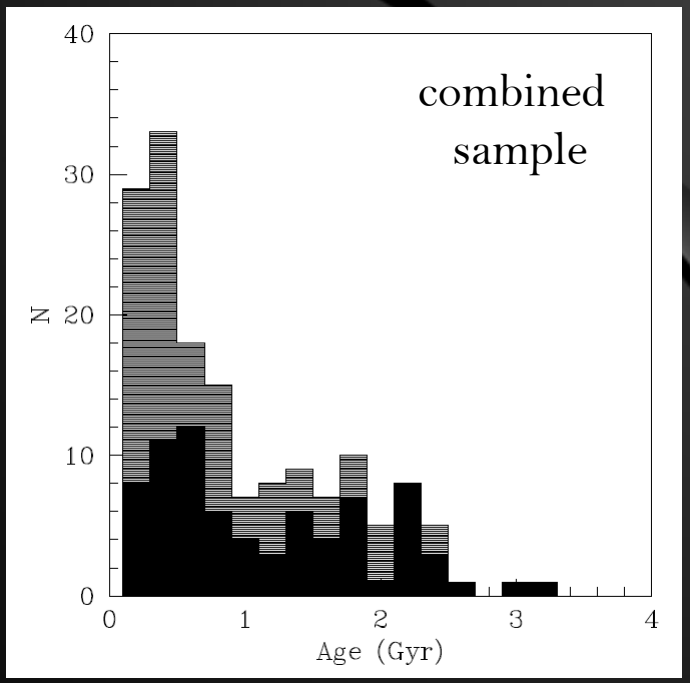
Geisler et al. (2003)

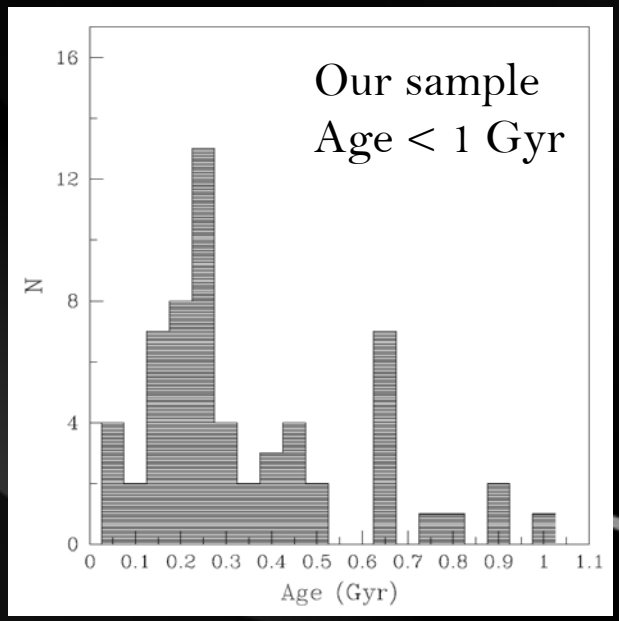


Age , Metallicity & Deprojected distance



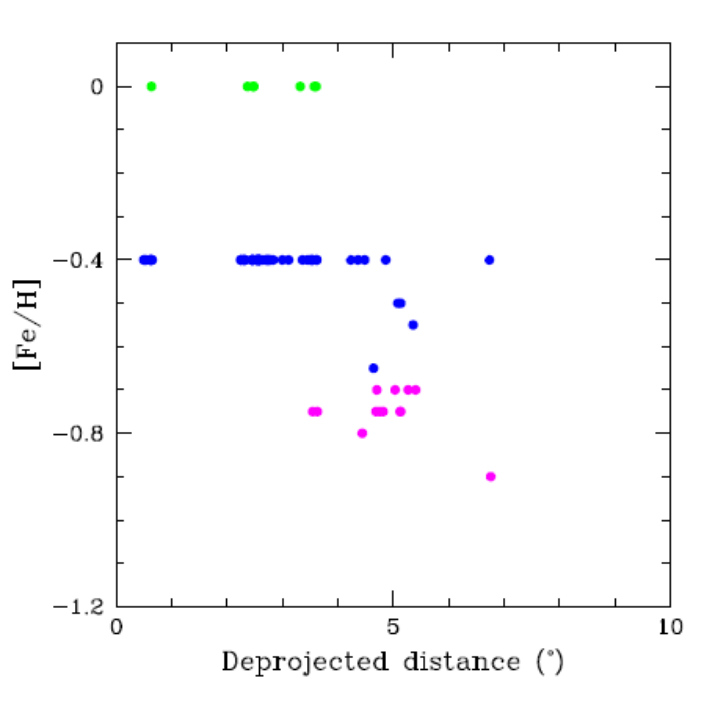


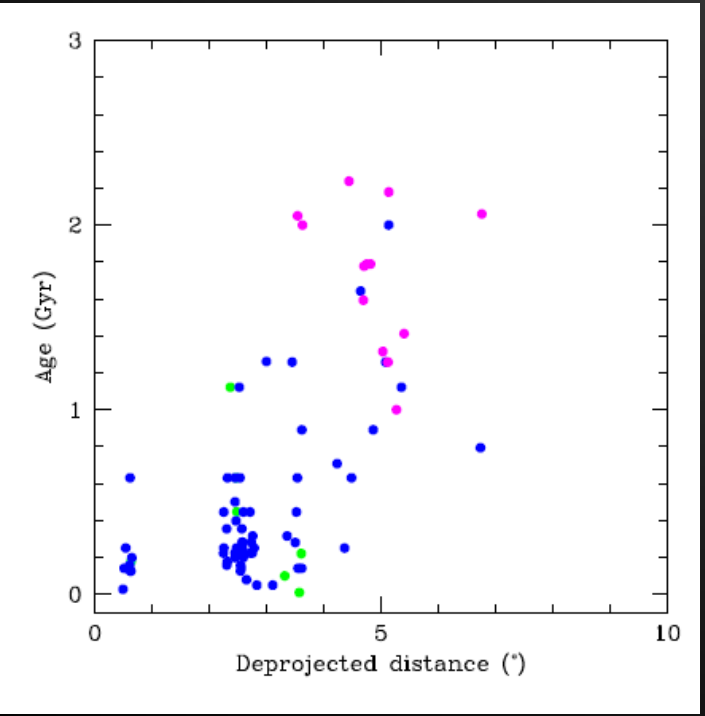




Age , Metallicity & Deprojected distance

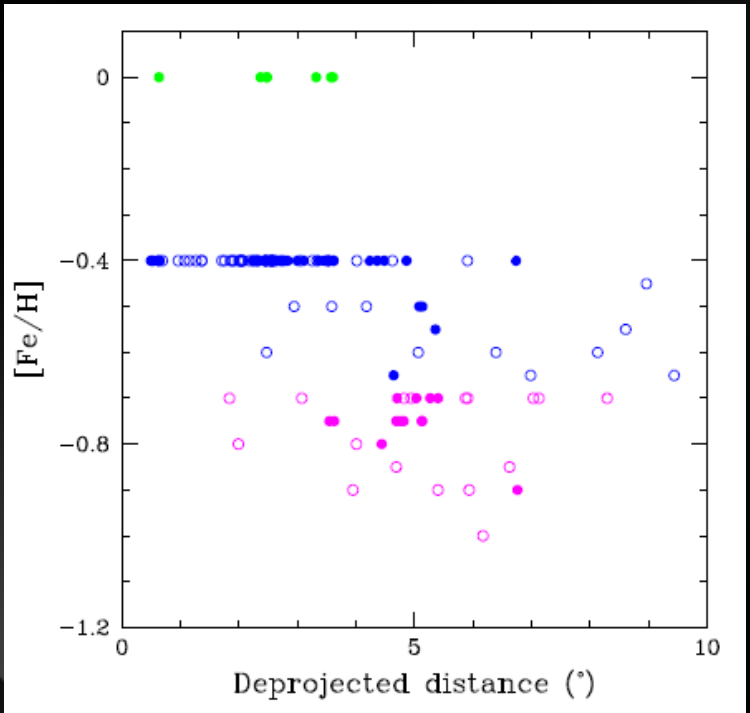
Our sample:

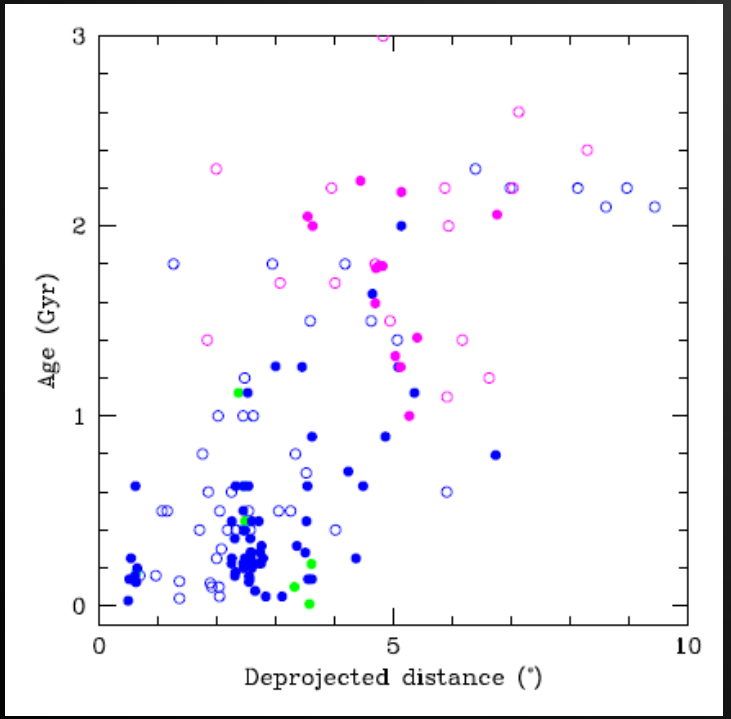




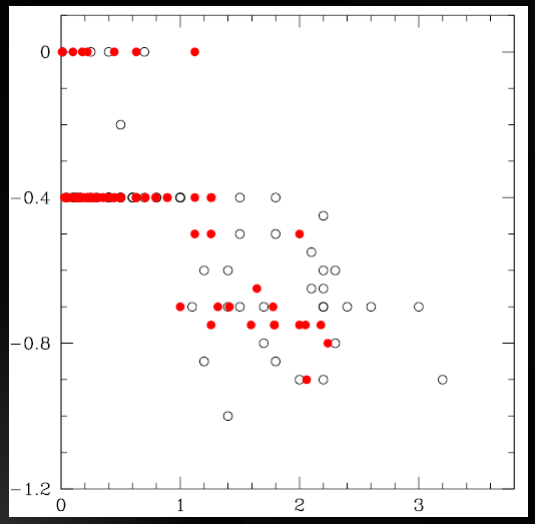
Age , Metallicity & Deprojected distance

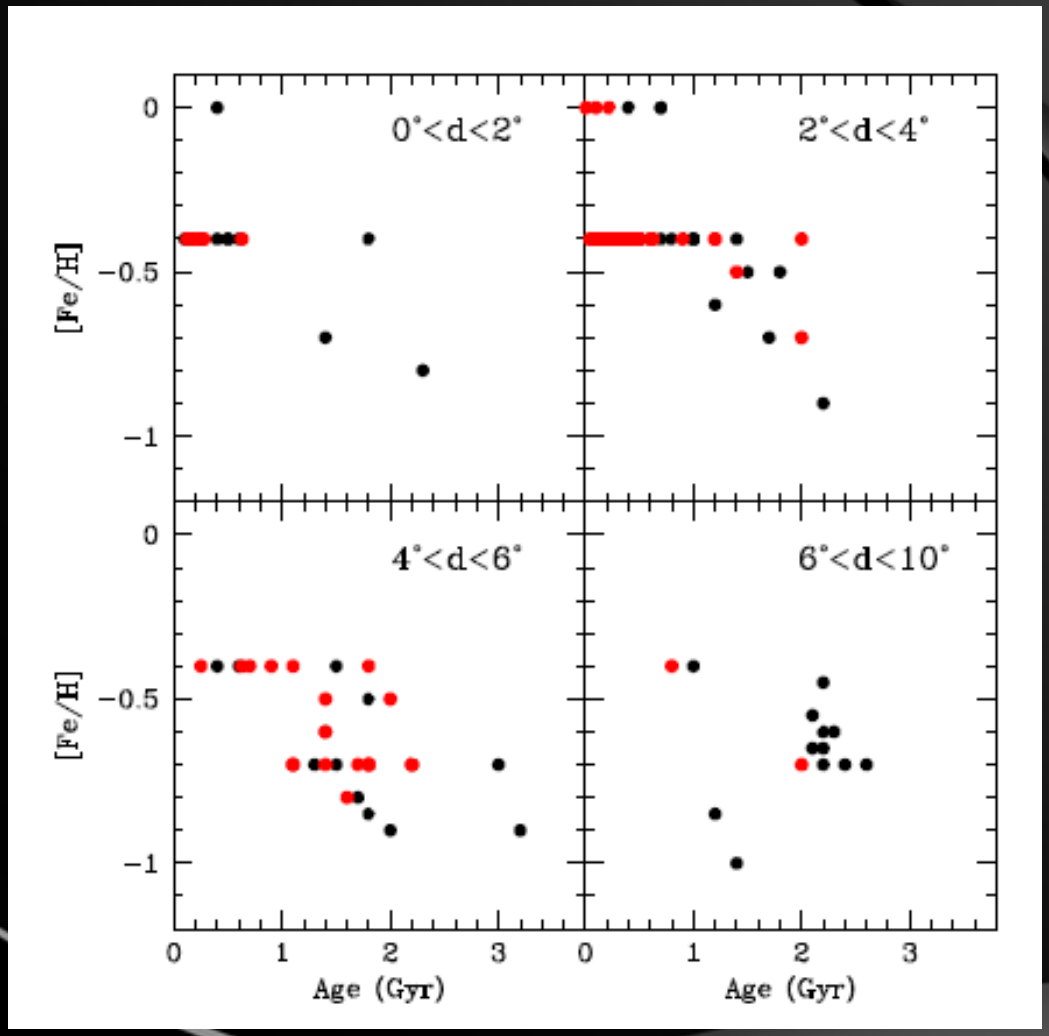
Combined sample:





Age – Metallicity Relation





- Studied sample
- Literature

Binary & Multiple systems

- Physical reality
- Formation epochs

Cluster	Age (Gyr)	Deprojected distance (°)
SL 33	2.0 ± 0.2	5.13
BSDL 25	–	5.13
H88-188	0.45 ± 0.05	2.71
BSDL 794	—	2.70
HS 156	1.0 ± 0.1	2.52
HS 154	0.50 (PU00)	2.54
SL 460	0.028 ± 0.003	0.49
BSDL 1614	0.40 / 1.0 (PU00)	0.49
SL 691	0.16 ± 0.02	2.31
SL 692	0.20 ± 0.02	2.31
HS 414	0.28 ± 0.03	2.57
SL 716	0.25 ± 0.03	2.57
SL 748	0.22 ± 0.03	2.71
BSDL 3118	—	2.,72
KMK88-52	0.18 ± 0.02	0.63
BSDL 1423	—	0.62
BSDL 1452	—	0.63
KMK88-53	—	0.64
KMK88-54	—	0.64
KMK88-57	0.63 ± 0.07	0.62
BSDL 1759	—	0.60
KMK88-56	0.25 (PU00)	0.586
NGC 1969	0.16 ± 0.01	0.54
NGC 1971	0.13 ± 0.01	0.54
NGC 1972	0.13 ± 0.01	0.54
BSDL 1783	—	0.64
BSDL 3050	0.22 ± 0.02	2.53
BSDL 3072	0.28 ± 0.03	2.58
KMHK 1389	0.16 ± 0.01	2.55
KMHK 1408	0.22 ± 0.02	2.56
BSDL 3063	—	2.56

Conclusions

1. 81 studied clusters:
   Radii: 4 pc ≤ r ≤ 20 pc
   Metallicities: -1.1 ≤ [Fe/H] ≤ 0.0
   Ages: 0.01 ≤ t (Gyr) ≤ 2.2
   250 Myr (main peak)
   630 Myr (secondary peak)

2. *inner disk* → Metal–rich clusters, young clusters
   $[Fe/H]_{cl} < -0.4$ → all over the disk
   Intermediate age clusters → larger deprojected distances

3. AMR: independent from the LMC region considered

4. We investigated some binary and multiple cluster systems and determined their formation epochs