Age - metallicity relation in the MCs clusters

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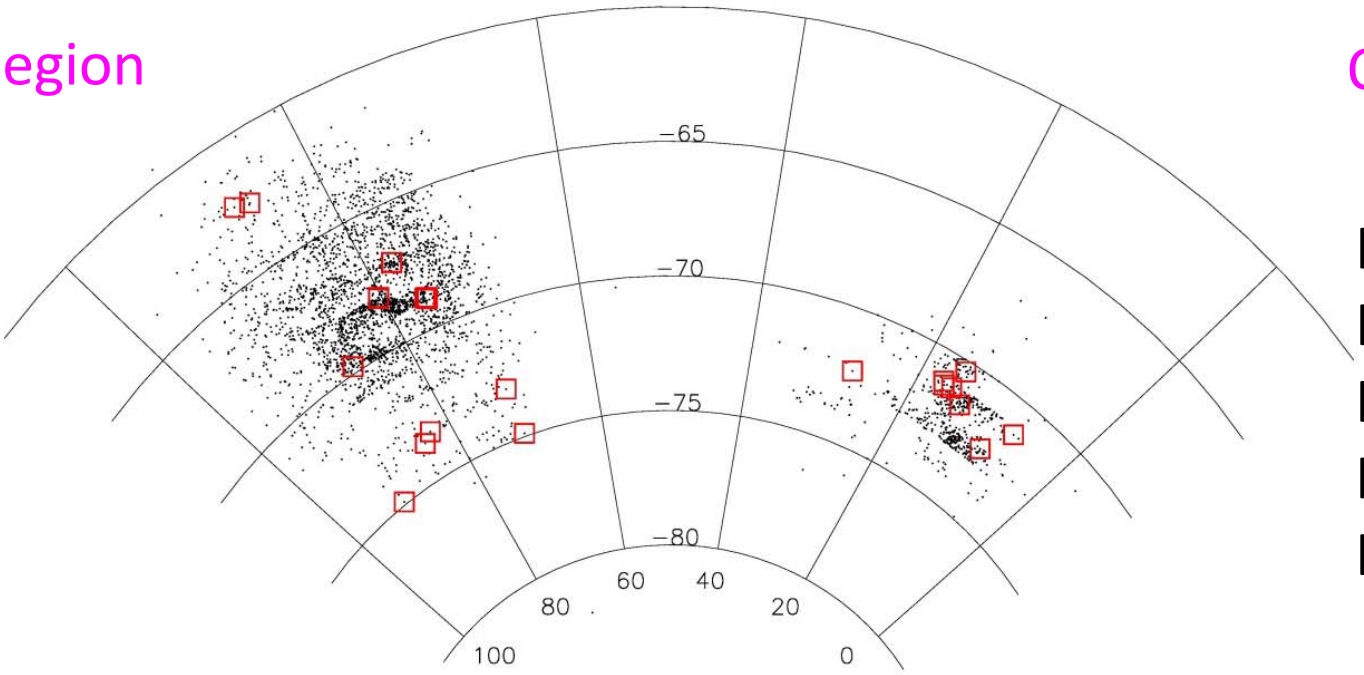
- **Goal**
  - trace evidence of an age metallicity relation (AMR) in the Magellanic Clouds (MCs).
  - correlate it with the interactions of the MCs and
  - correlate the AMR with the spatial distribution of the clusters.

- **Observations**
  - 15 LMC and 8 SMC clusters, scattered all over the area of these galaxies, to cover a wide spatial distribution and metallicity range.
  - In the LMC we study small open star clusters, young up to 2 Gyr
  - The selected LMC clusters were observed with the 1.54m Danish Telescope in Chile, using the Danish Faint Object Spectrograph and Camera (DFOSC).
  - The SMC clusters were observed with the ESO 3.6m Telescope, also in Chile, using the ESO Faint Object Spectrograph and Camera (EFOSC).
  - 1997-2002

Data

LMC
Central Region

KMK1
KMK3
KMK8
KMK32
KMK49
KMK50
HS153



LMC
Outer parts

KMHK81
KMHK1042
KMHK1278
KMHK1381
KMHK1399
KMHK1640
SL36
SL620

SMC

L11, L17, L80, L113, NGC330, NGC361, NGC376, NGC419

- **Methods**
  - Isochrone fitting was used to determine the ages and metallicities.
  - We used Strömgren filters in order to achieve reliable metallicities from photometry.

❑ Excellent metallicity indicator for late type stars

(Richtler, 1988, 1989 ; Grebel & Richler, 1992)

❑ Particularly efficient when performed with a CCD in dense star fields like the MCs.

Strömgren filters

- **Mean wavelength and half-widths of response functions**

	u	v	b	y	β_{narrow}	β_{wide}
Peak wavelength (nm)	350	411	467	547	485.8	485
Half-width (nm)	30	19	18	23	2.9	12.9

- **Indices**

b-y, m_1, c_1, β

m_1 = (v - b) - (b - y)

c_1 = (u - v) - (v - b)

$\beta = \beta_{narrow} - \beta_{wide}$

- **Use**

y magnitudes are well-correlated with Johnson-Morgan V mags.

m1 is sensitive to the metallicity (measure of line blanketing).

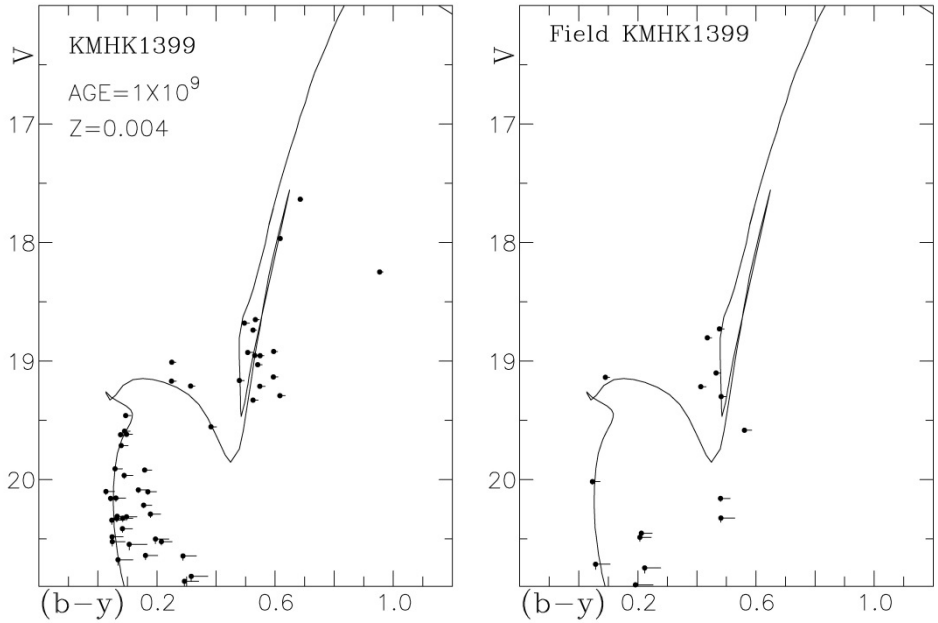
b-y is sensitive to stellar temperature (measure of continuum).

c1 is sensitive to the surface gravity (measures Balmer discontinuity strength).

Example cluster KMHK 1399

•AGE

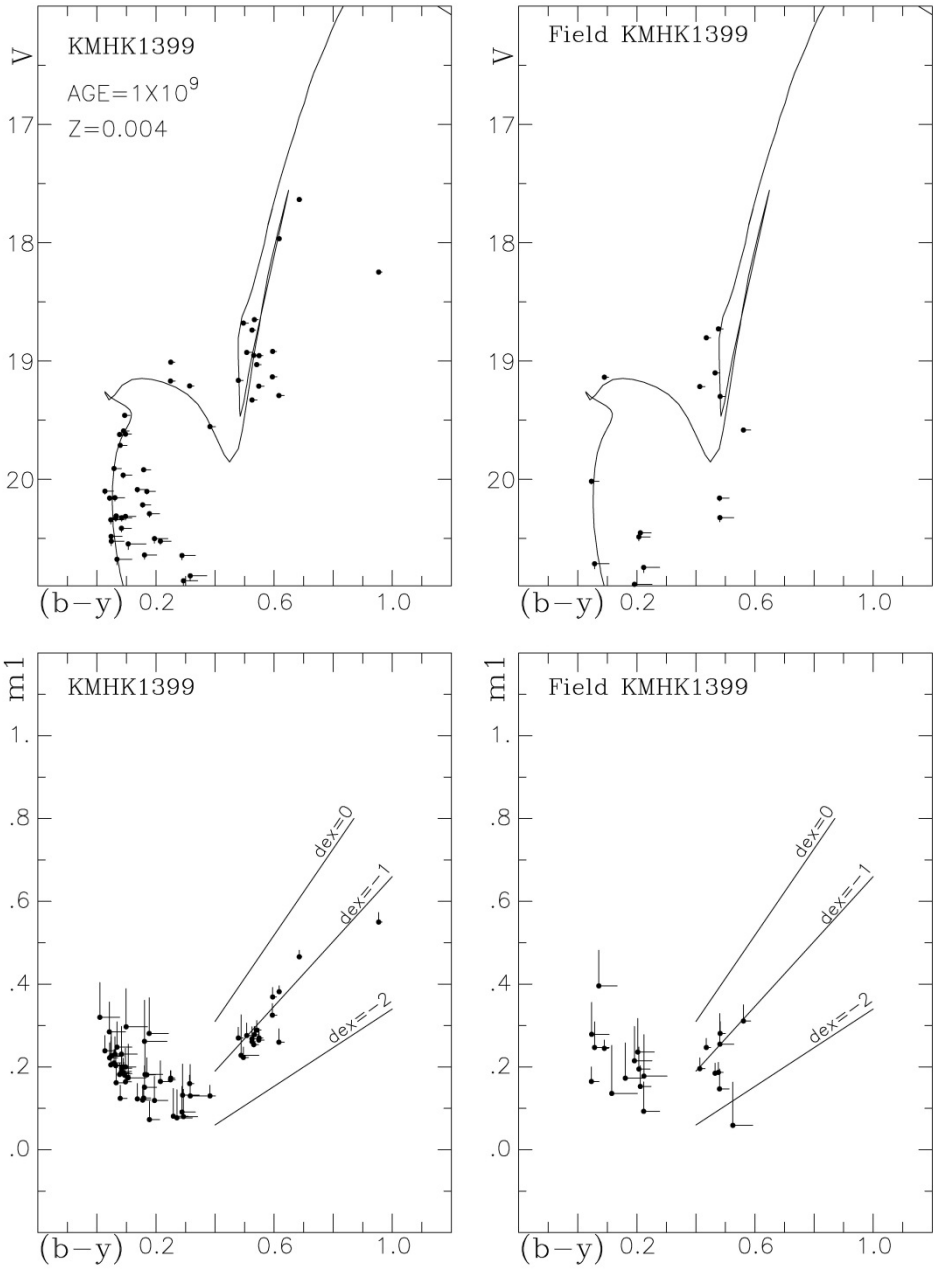
1. A central region around each cluster (~0’.75 radius), in order to include the largest proportion of cluster members.
2. A region characterizing the nearby field stellar population (same area).
3. Produce the Strömgren V, (b-y) CMDs. Comparison of the two diagrams may determine of the cluster members.
4. Then we fit the isochrone that best describes the stellar population of the cluster. (Padova Isochrones with an appropriate transformation for the Strömgren magnitudes).
5. The isochrones provide the parameters of age in Gyr and metallicity Z.



Example cluster KMHK 1399

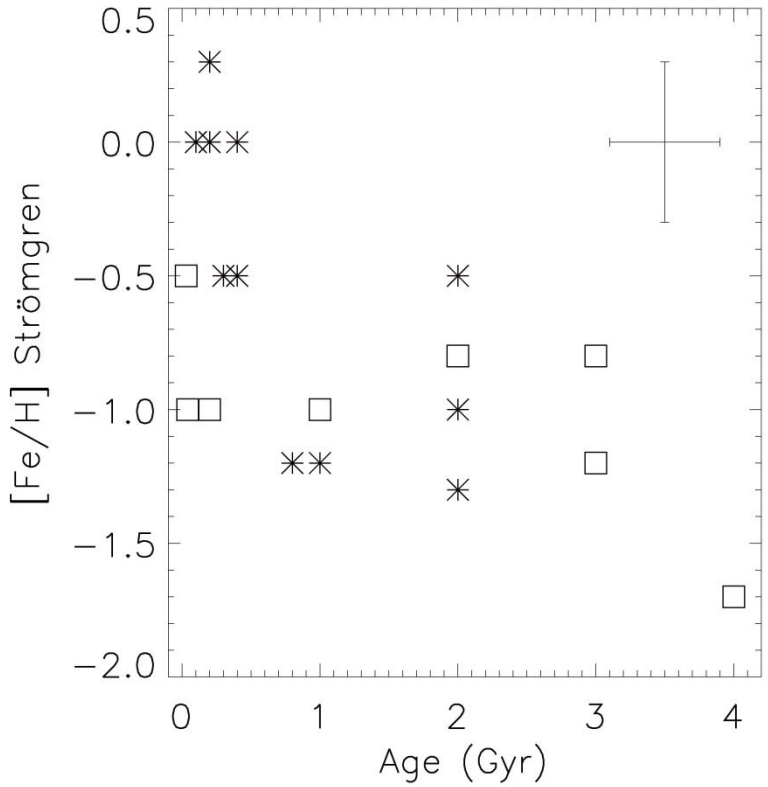
•Metallicity

1. The diagrams m1, (b-y) from the Strömgren magnitudes were produced for the cluster and the field.
2. Three lines of constant metallicity (Hilker et al., 1995) are overplotted.
3. We trace the red supergiants of the cluster on the V, (b-y) CMD. We again have to compare with red supergiants of the field.
4. Following the red supergiants on m1, (b-y) diagram we compare with the model lines and derive the metallicity value [Fe/H].
5. When cluster supergiants an not be determined we adopt metallicity estimated by the isochrones.



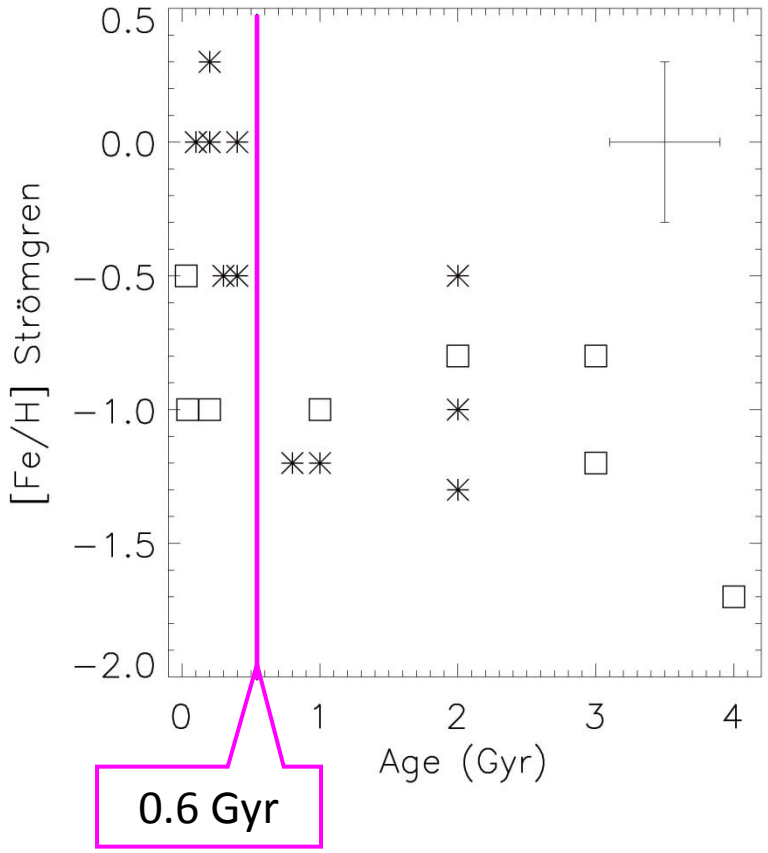
Age - metallicity relation

✳ : LMC
□ : SMC



Age - metallicity relation

✳ : LMC
□ : SMC

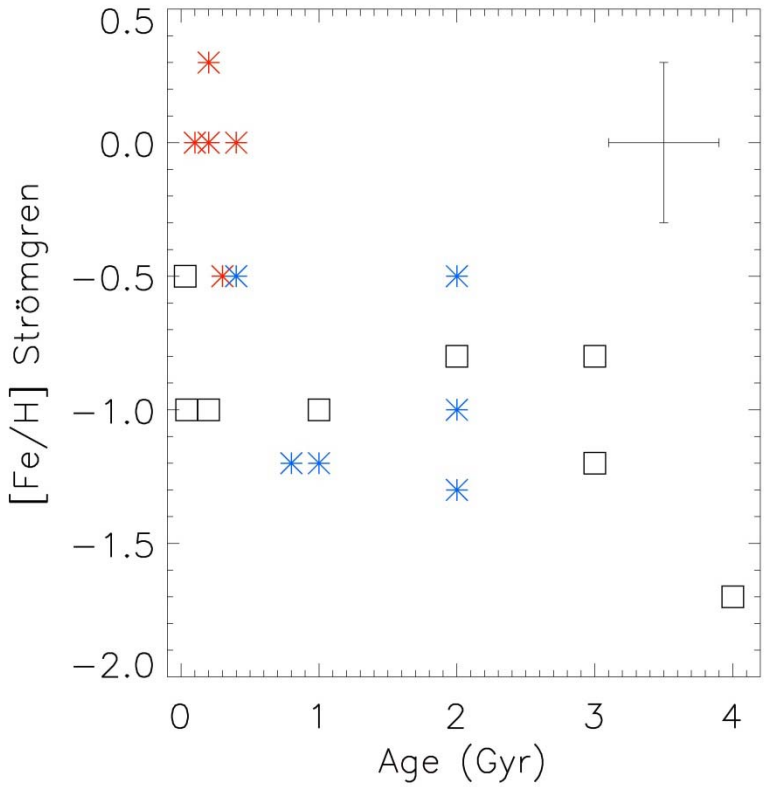


Age - metallicity relation

✳ : LMC
outer parts

✳ : LMC
central parts

: SMC



Results

- The LMC displays a clear trend of AMR with higher metallicities found in the young clusters, a result expected in the normal evolution of a galaxy's stellar content.
- LMC shows an increase in metallicity at ages of about 0.6 Gyr. This could be the result of the most recent encounter in the LMC-SMC that has produced intense star formation in the LMC.
- A clear spatial metallicity gradient is observed in the LMC. The clusters with metallicities -1.0 to -1.5 are those found in the outer regions of the LMC. This is an indication that the recent star formation in the LMC occurs in the central regions.
- In the SMC there is no indication of an AMR relation, possibly because of the small sample we used or because of a different history of star formation in this galaxy; however, this investigation again displays the known result that the LMC is more metal rich than the SMC galaxy.


Thank you !!!