

DEEP NIR PHOTOMETRY OF GCs NGC3201 & 47Tuc

A new age estimation method for GCs



L. Troisi

G. Bono, R. Buonanno (INAF-OAR, Univ. of Rome Tor Vergata), A. Calamida (ESO)

P.B. Stetson, + Romans + M. Dall'Ora, A. Dotter, S. Degl'Innocenti, M. Monelli, M. Nonino, S. Ortolani, P. G. Prada Moroni, D. van den Bergh, M. Zoccali, S. Cassisi, A. Pietrinferni, P. Amico, S. D'Odorico, E. Marchetti



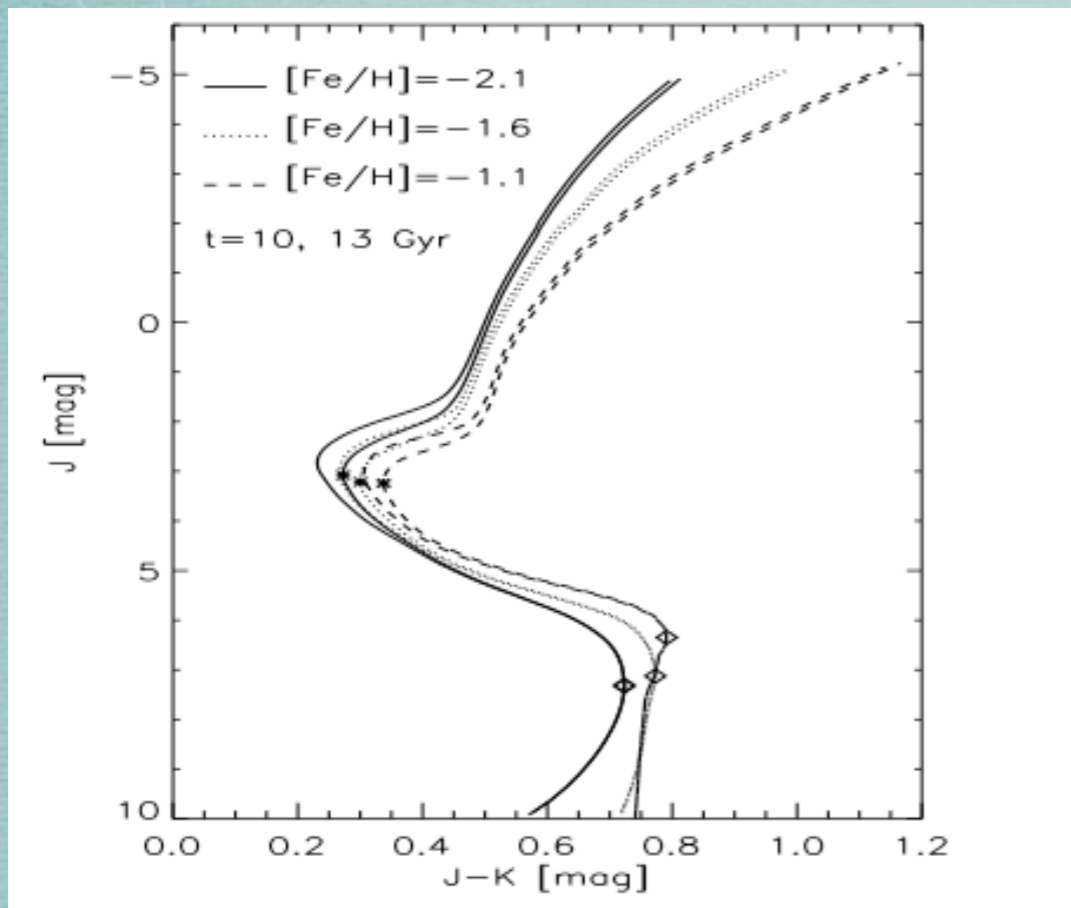
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OUTLINE

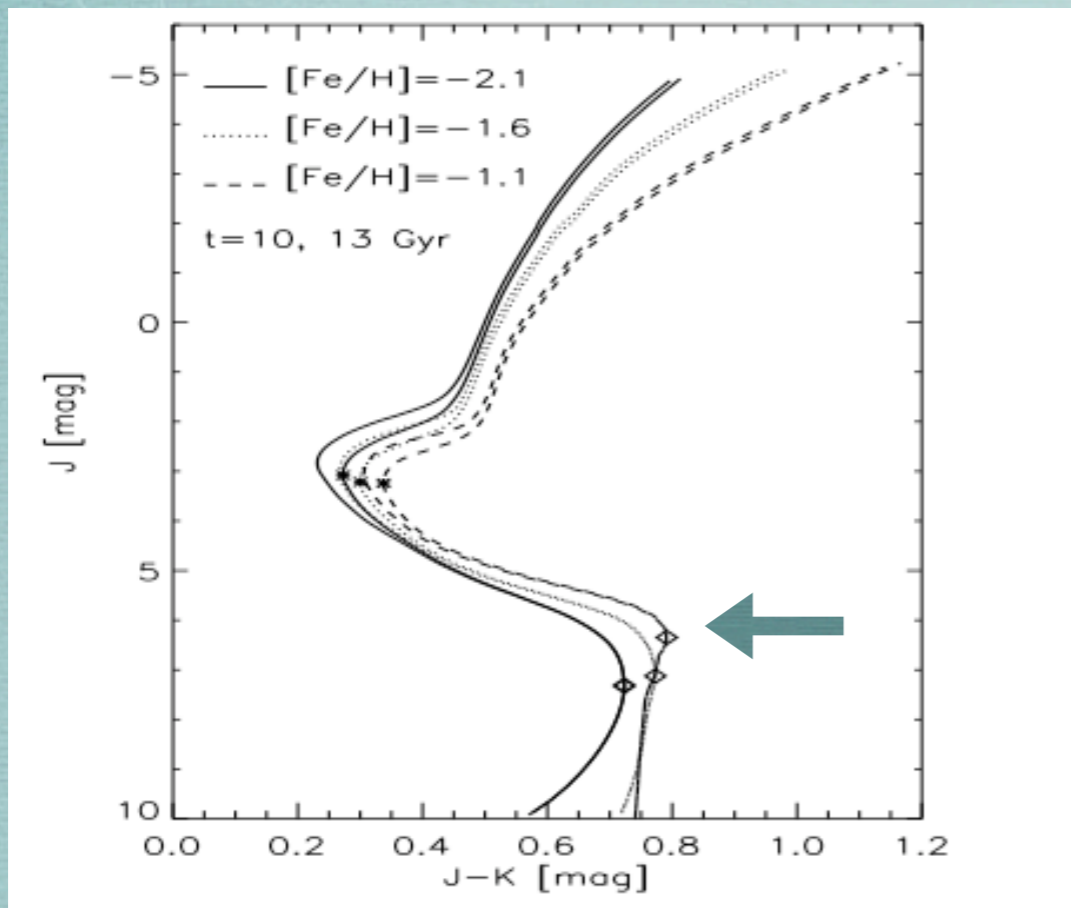
- a method to estimate the age of GCs
- the case of NGC3201
- the case of 47Tuc
- future developments



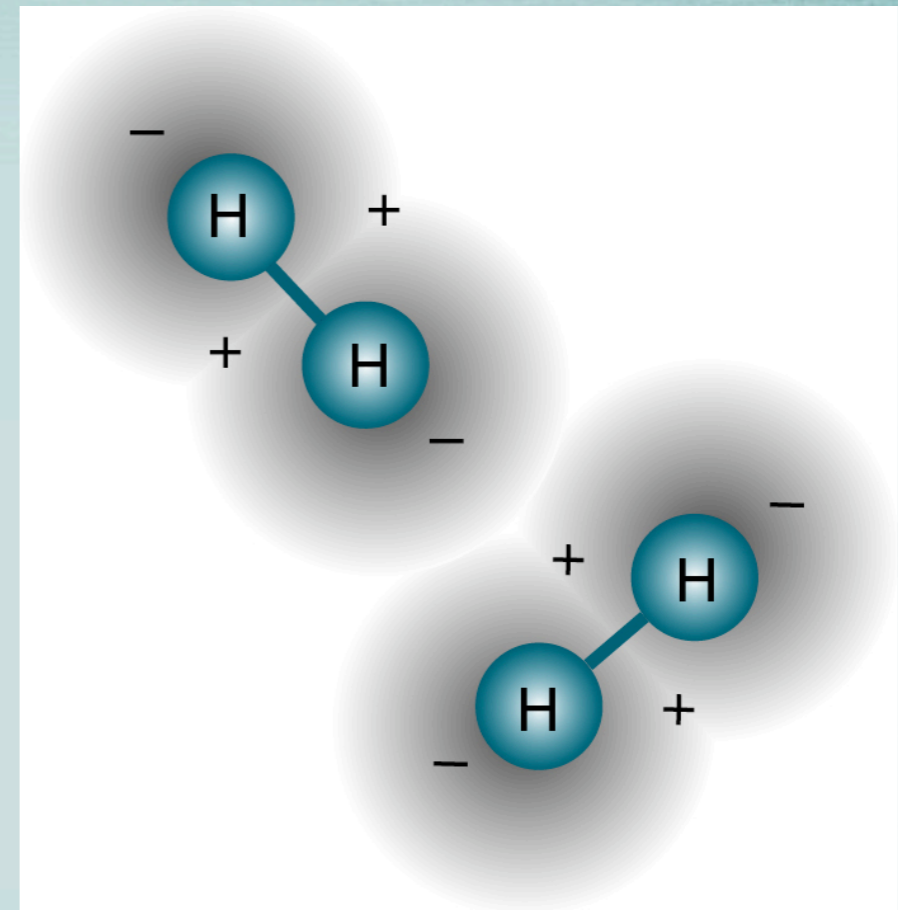
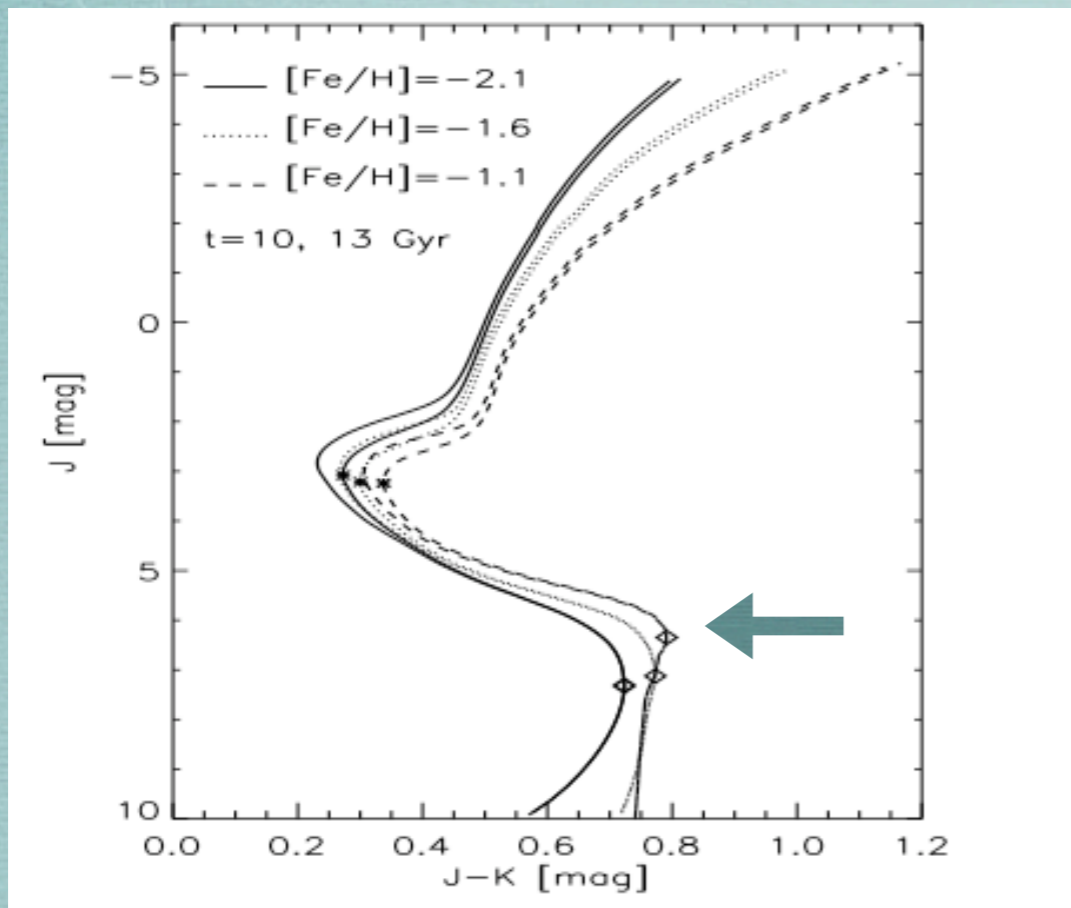
CIA: THE THEORY



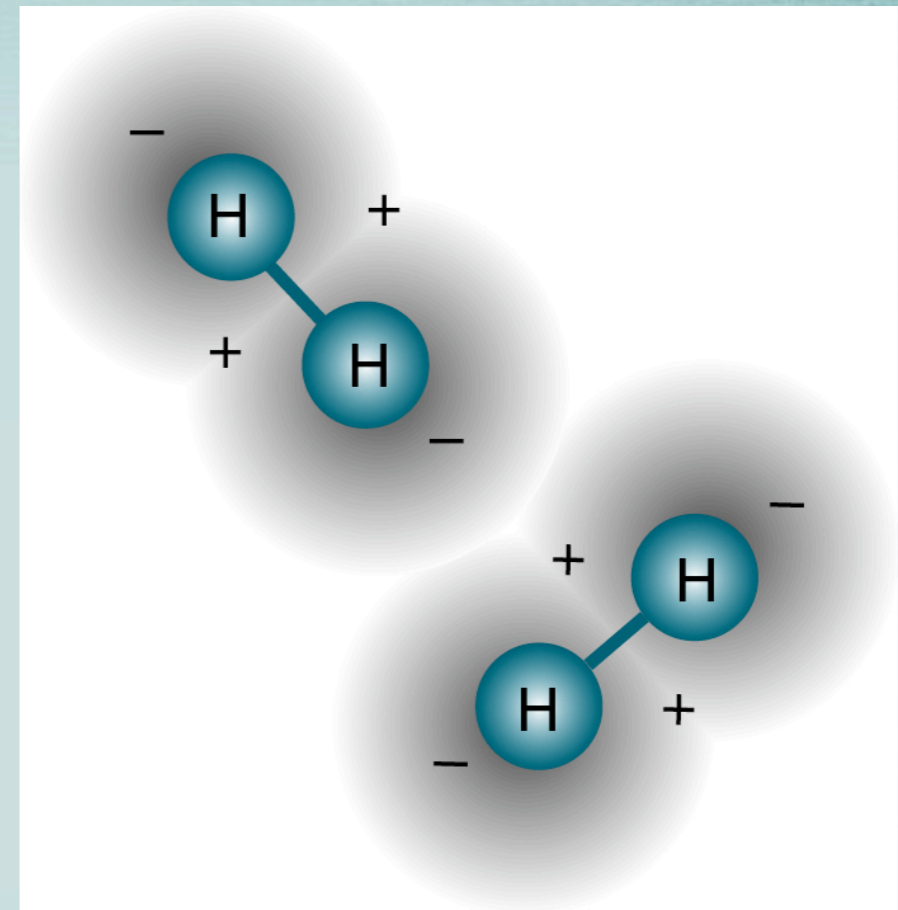
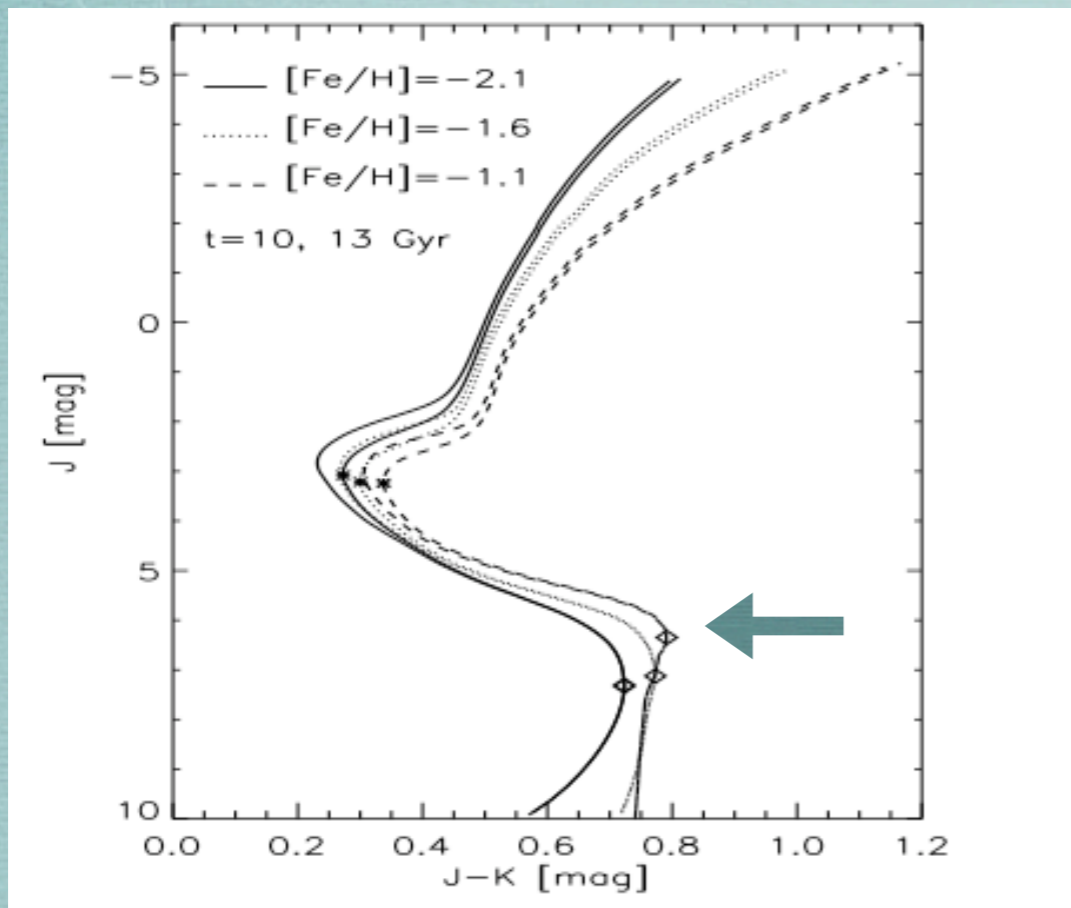
CIA: THE THEORY



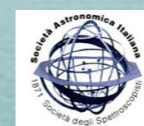
CIA: THE THEORY



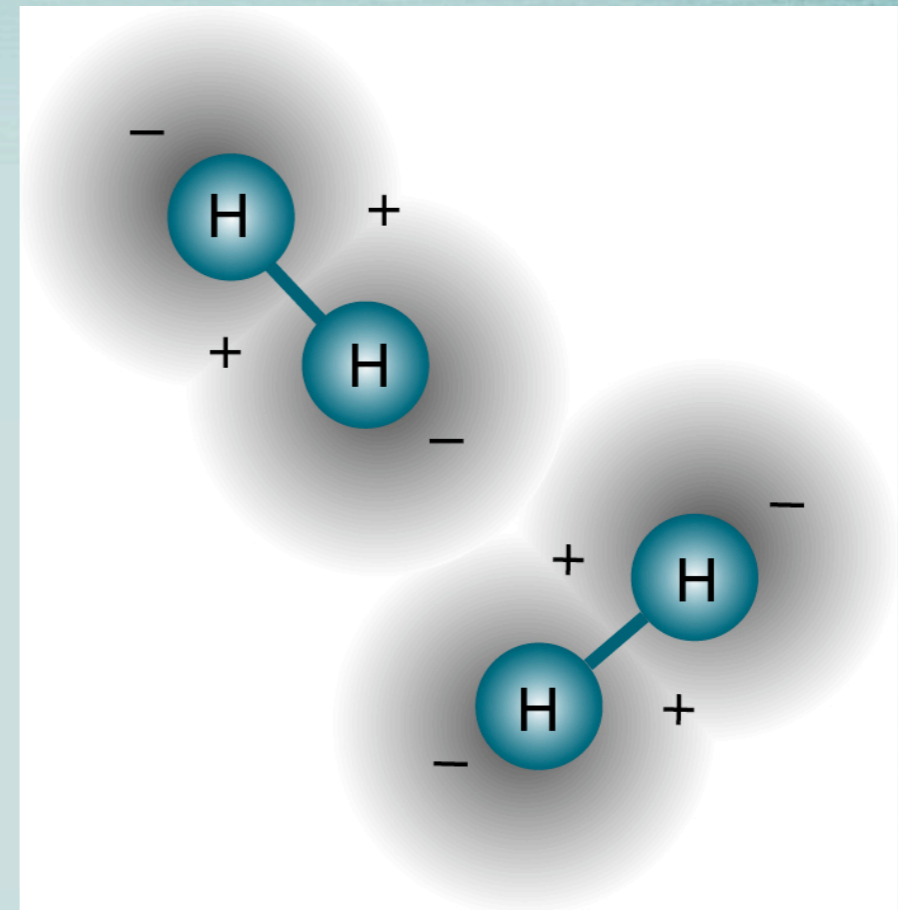
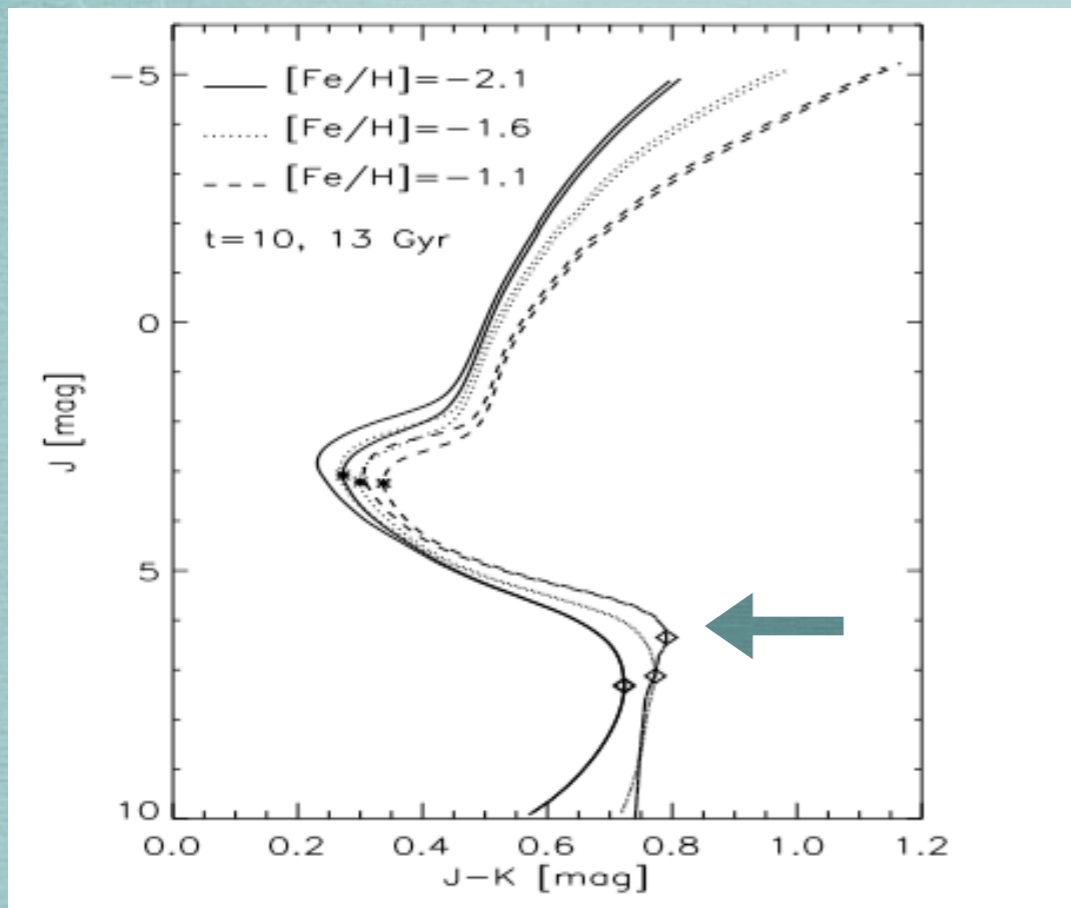
CIA: THE THEORY



$$0.7 \mu\text{m} < \lambda < 40 \mu\text{m}$$

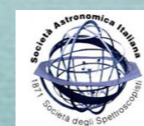


CIA: THE THEORY



$0.7 \mu\text{m} < \lambda < 40 \mu\text{m}$

→ **NIR** & MIR bands

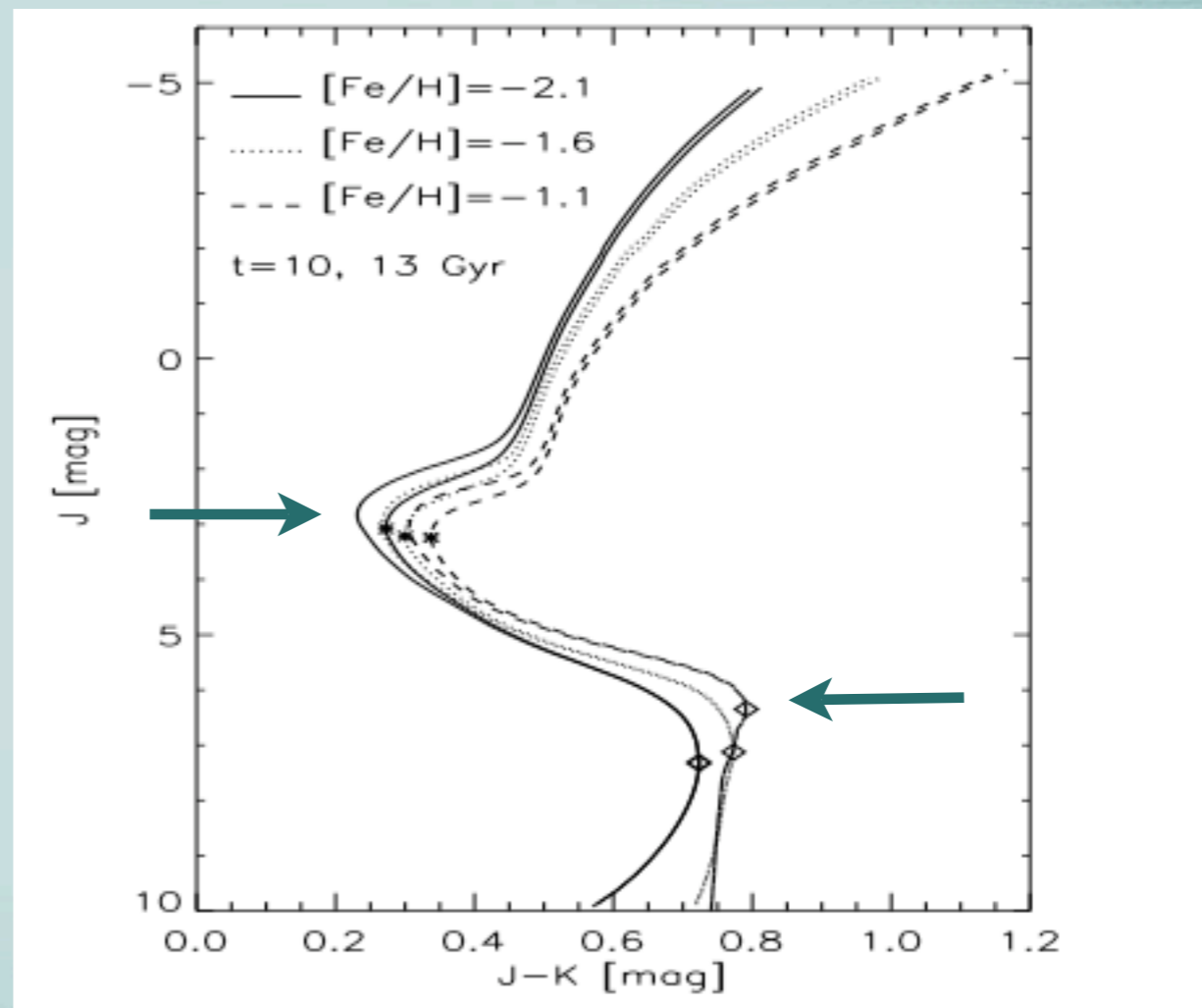


CIA: THE METHOD



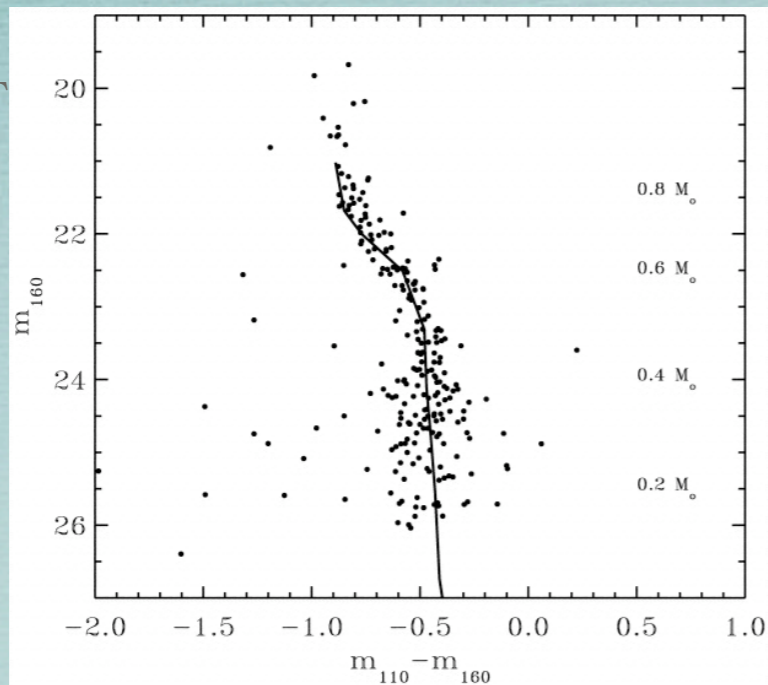
PROs

- no distance, no reddening dependance!
- very good age indicator at fixed Z
- faint MS stars are brighter in NIR than in optical



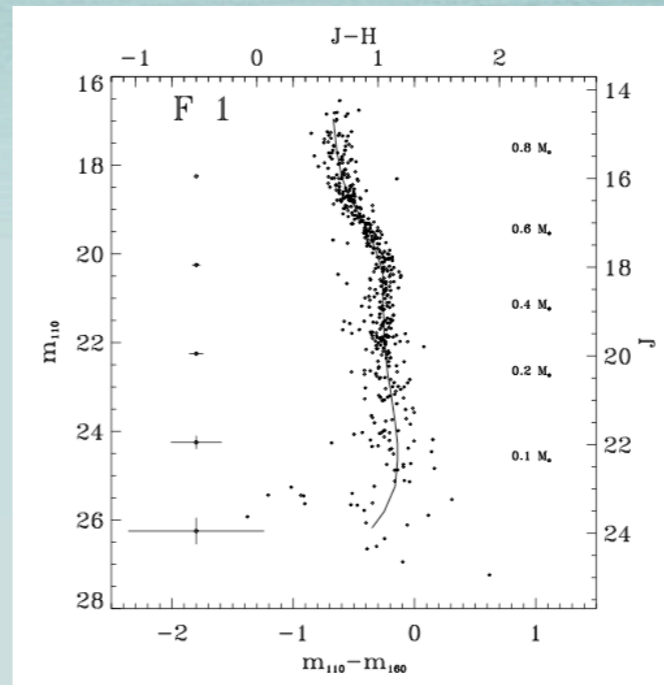
CIA

ω Cen
NICMOS@HST



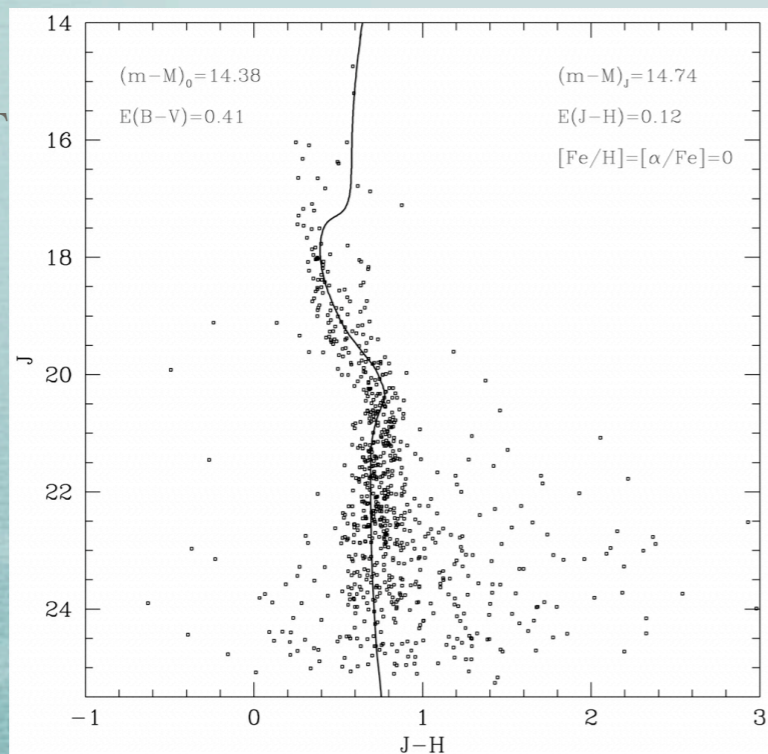
Pulone et al 1997

M4
NICMOS@HST

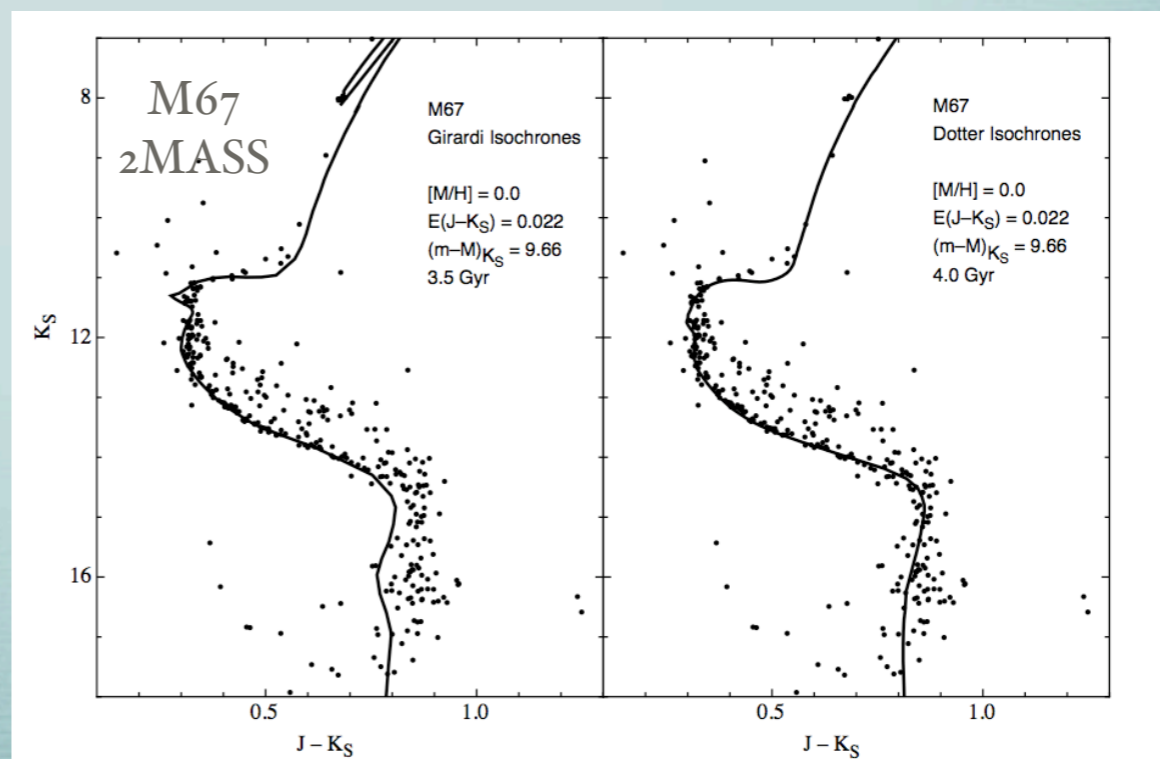


Pulone et al 1998

galactic bulge
NICMOS@HST



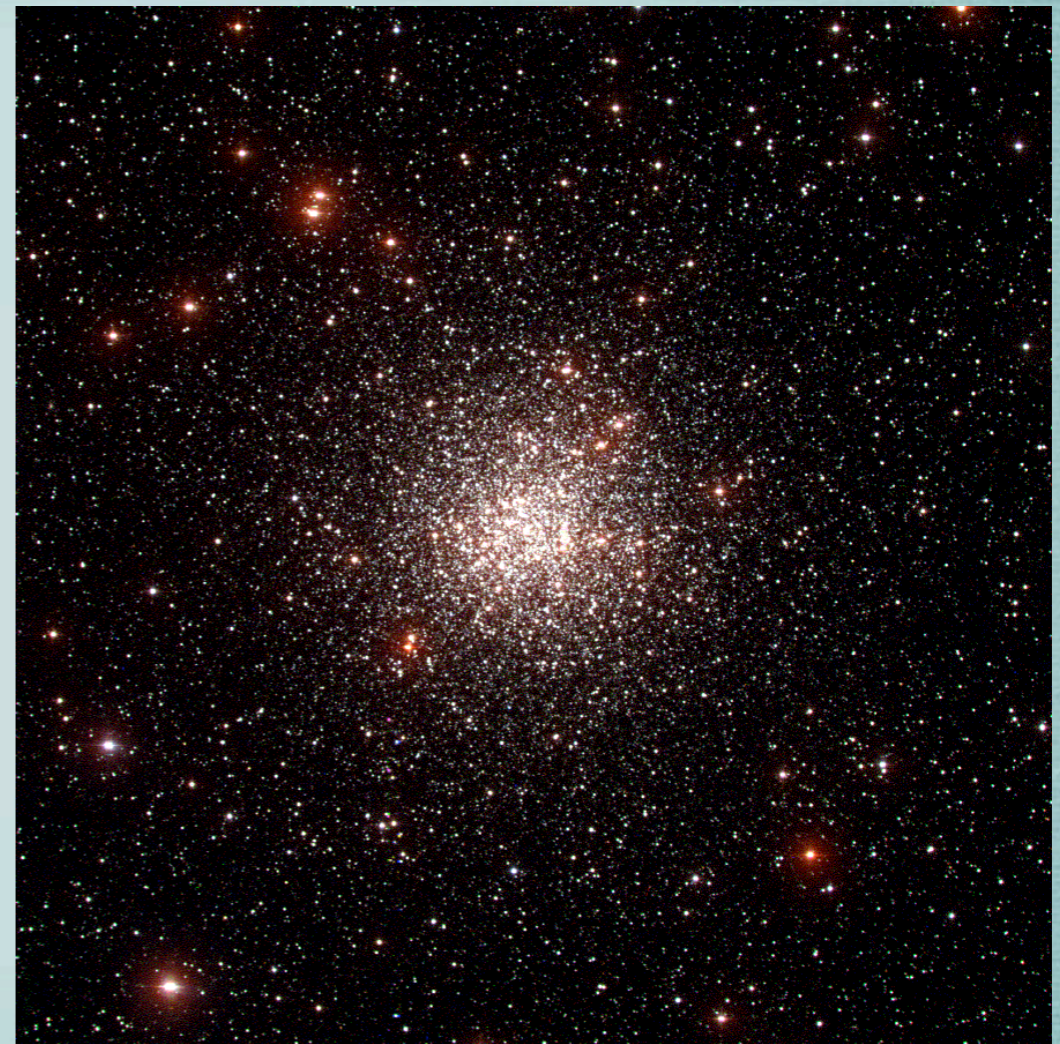
Zoccali et al 2000



Sarajedini et al 2009

NGC3201

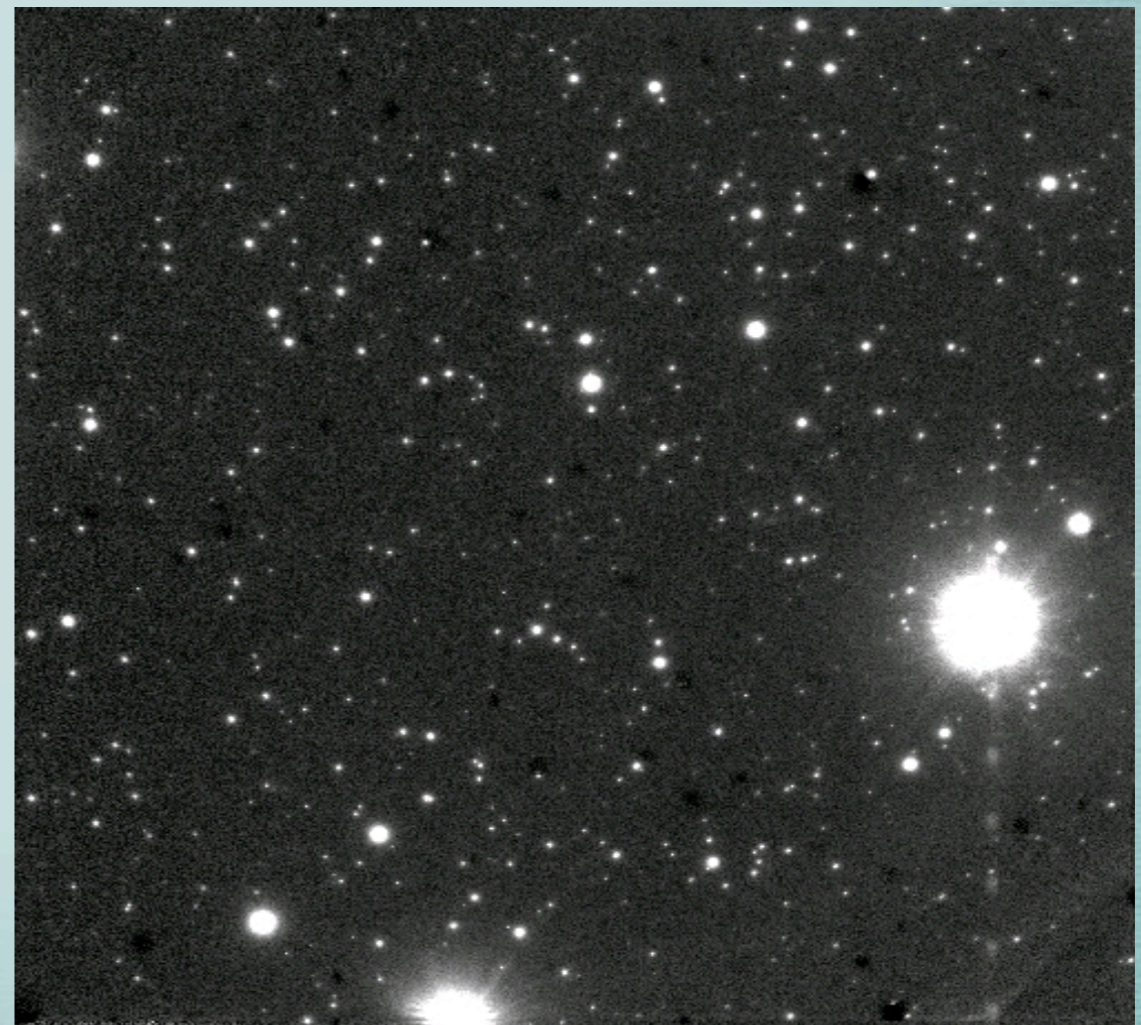
- $\mu = 13.36 \pm 0.06$, $E(B - V) = 0.25 \pm 0.02$
(Layden & Sarajedini 2003; Mazur et al. 2003)
- $[Fe/H] = -1.54 \pm 0.10$ dex (Kraft & Ivans 2003; Covey et al. 2003), very accurate
- $[\alpha/Fe] \sim 0.2 - 0.4$ (Pritzl et al. 2005), very accurate
- $\log \rho = 2.69 L_{\odot} \text{ pc}^{-3}$ (Harris 2003)
- $r_t \sim 28$ arcmin (Harris 2003)
- highly retrograde orbit
- differential reddening
- field contamination



NGC3201:

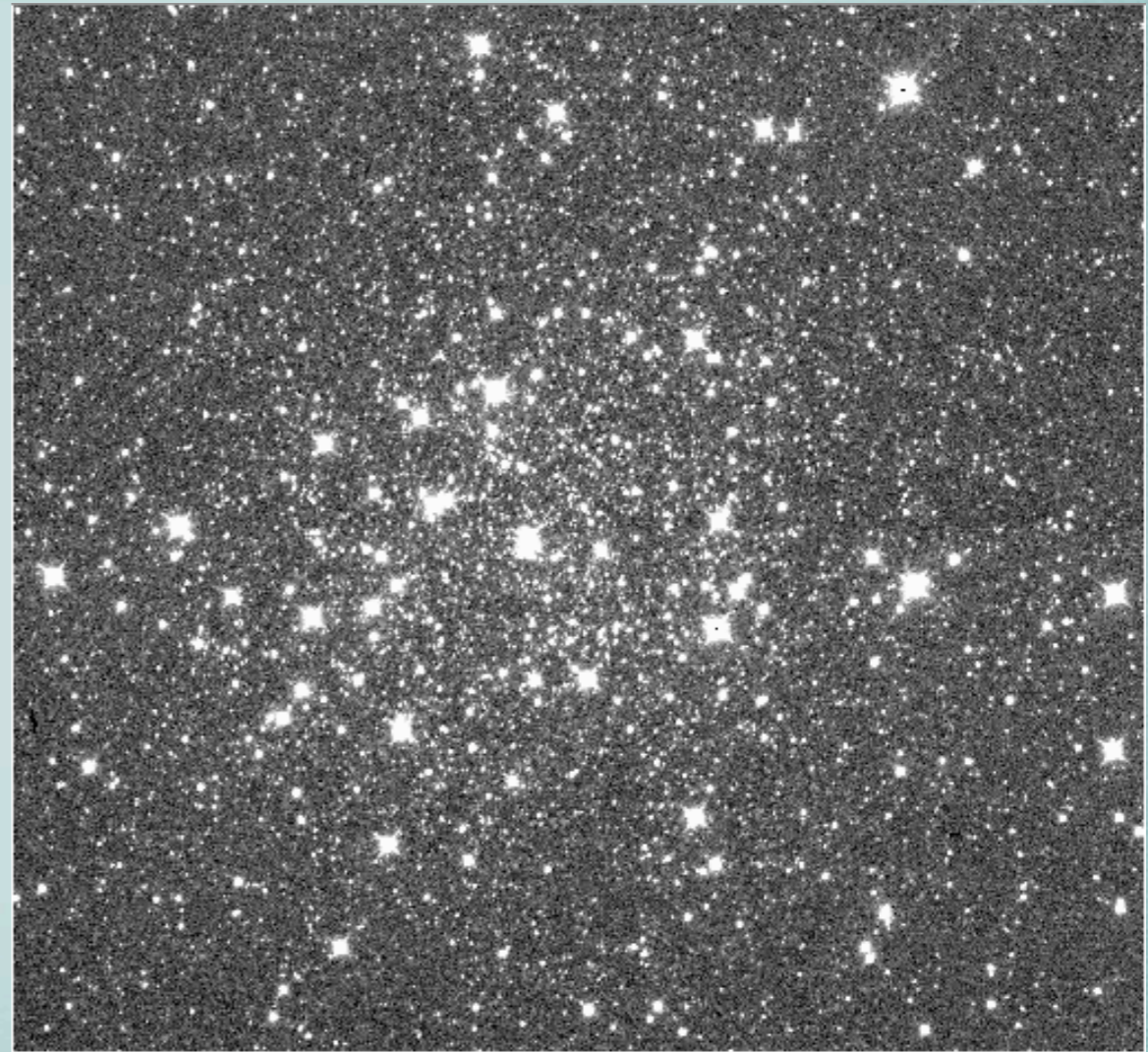
MAD (introduced by Gilmozzi) DATASET

- 0.028 arcsec/pixel
- FoV= 2 arcmin²
- 4 pointings
- three J-band and five K-band images for each pointing (DIT=10 sec, NDIT=24)
- seeing 0.6-0.8 arcsec,
FWHM J-band ~ 0.12 arcsec,
FWHM K-band ≤ 0.1 arcsec



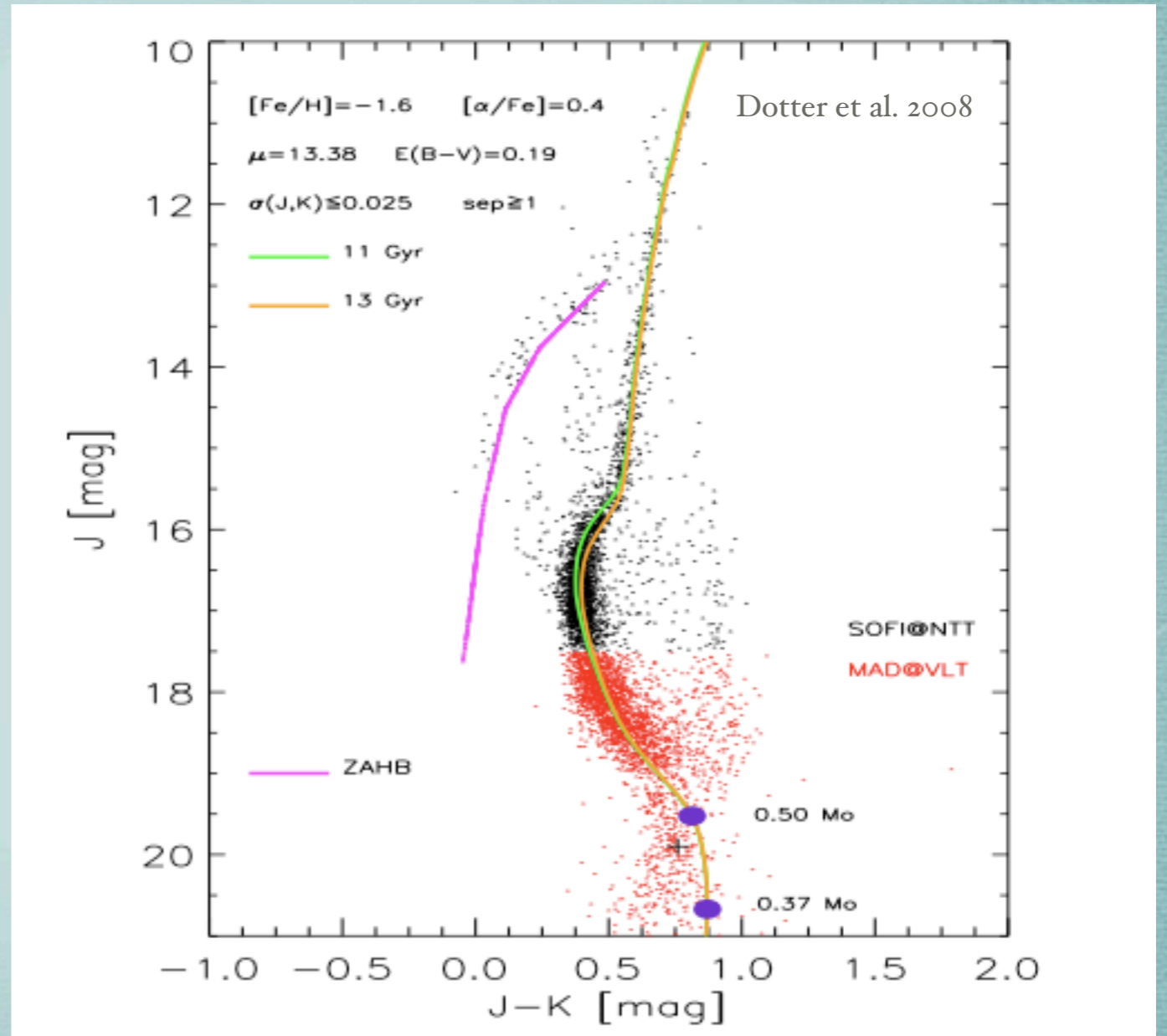
NGC3201: SOFI DATASET

- FoV = 4.92×4.92 arcmin
- pixel scale = 0.288 arcsec/pixel
- 10 minuts J-band
- 40 minuts K-band
- $\approx 20 \times 18$ arcmin around cluster center



NGC3201: RESULTS

• bending for $J > 19.5$



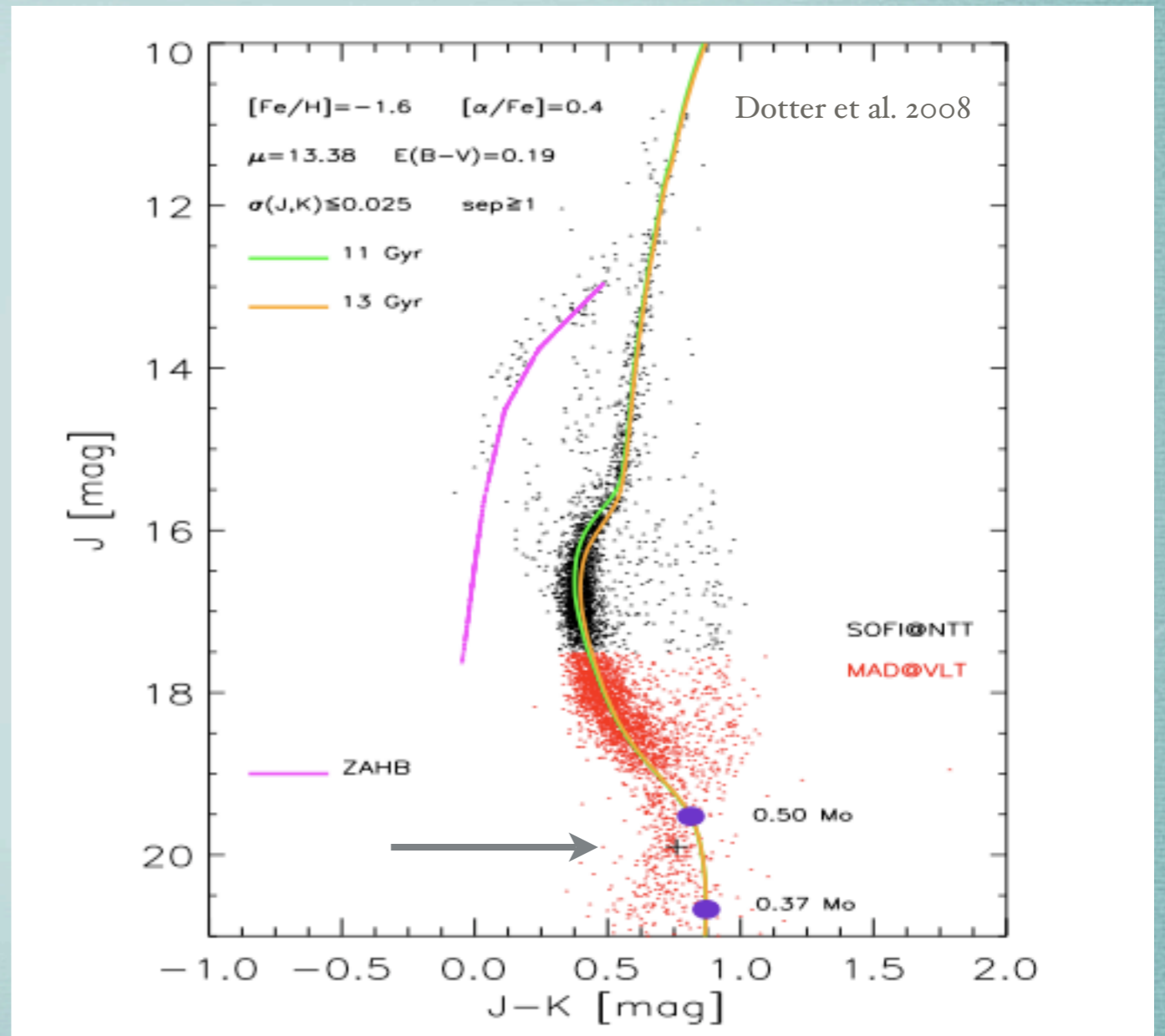
Calamida et al. 2009



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NGC3201: RESULTS

• bending for $J > 19.5$



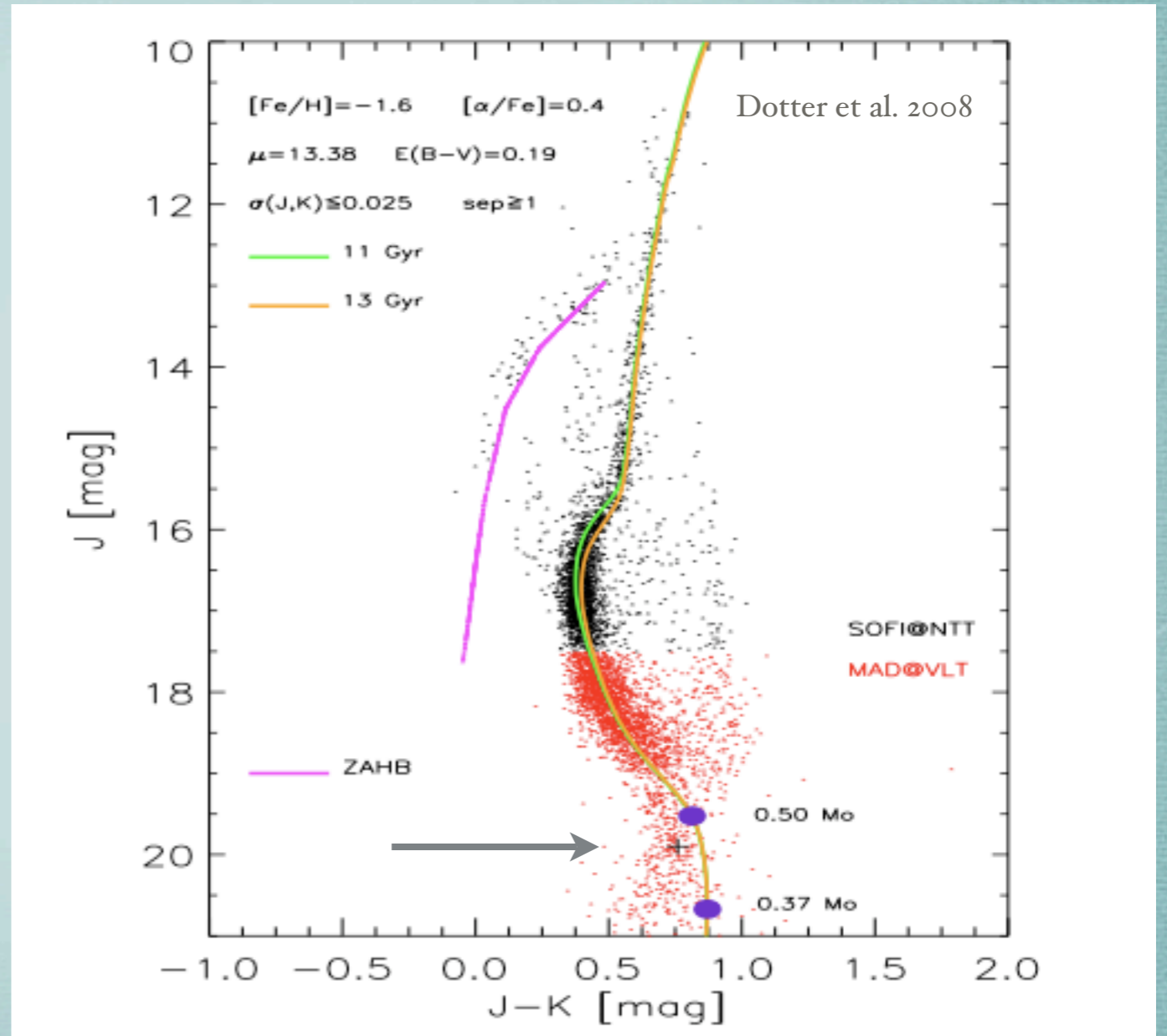
Calamida et al. 2009



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NGC3201: RESULTS

- bending for $J > 19.5$
- knee at $J \sim 19.90 \pm 0.03$
and $J-K \sim 0.76 \pm 0.02$



Calamida et al. 2009

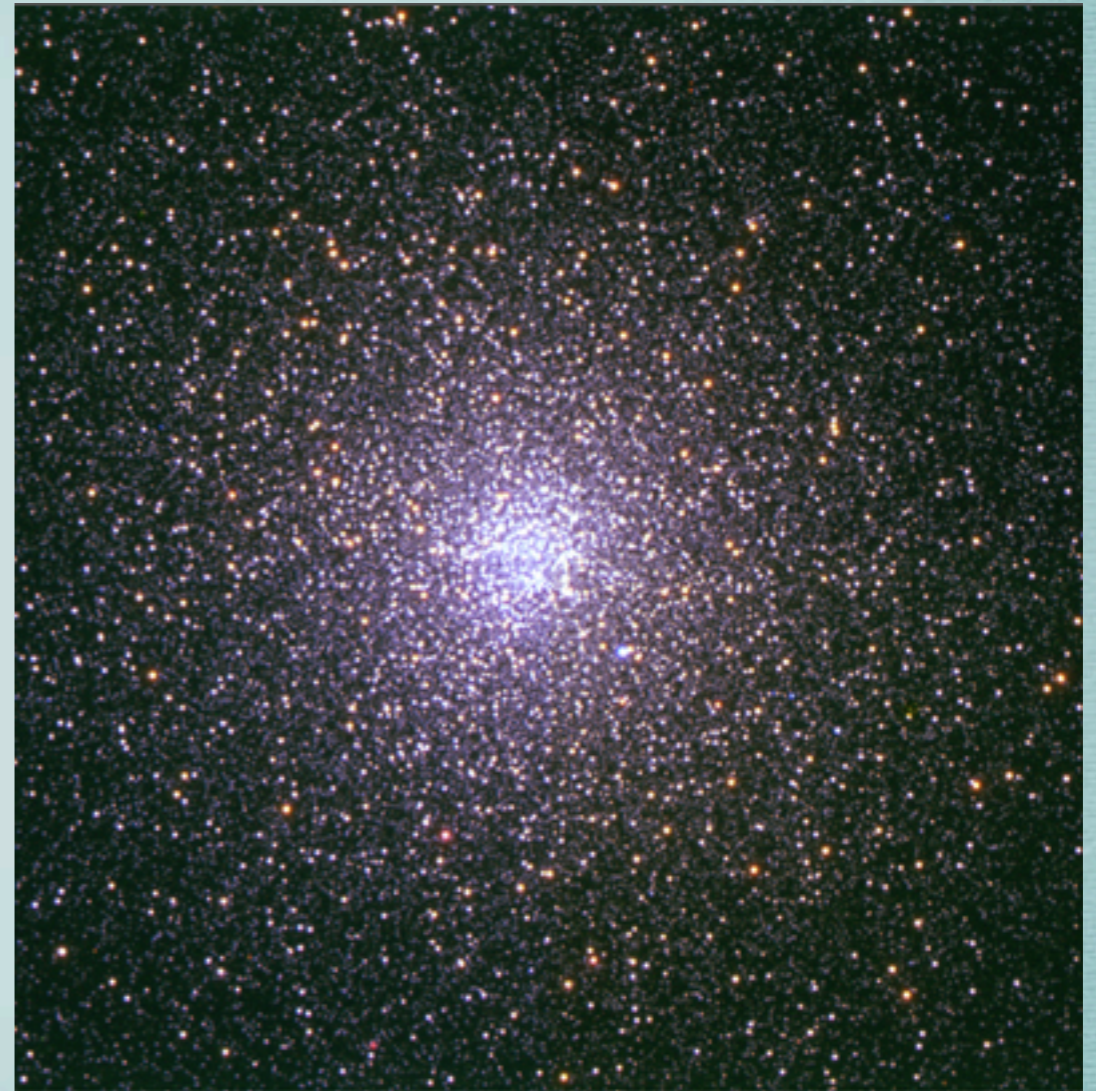


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47Tuc

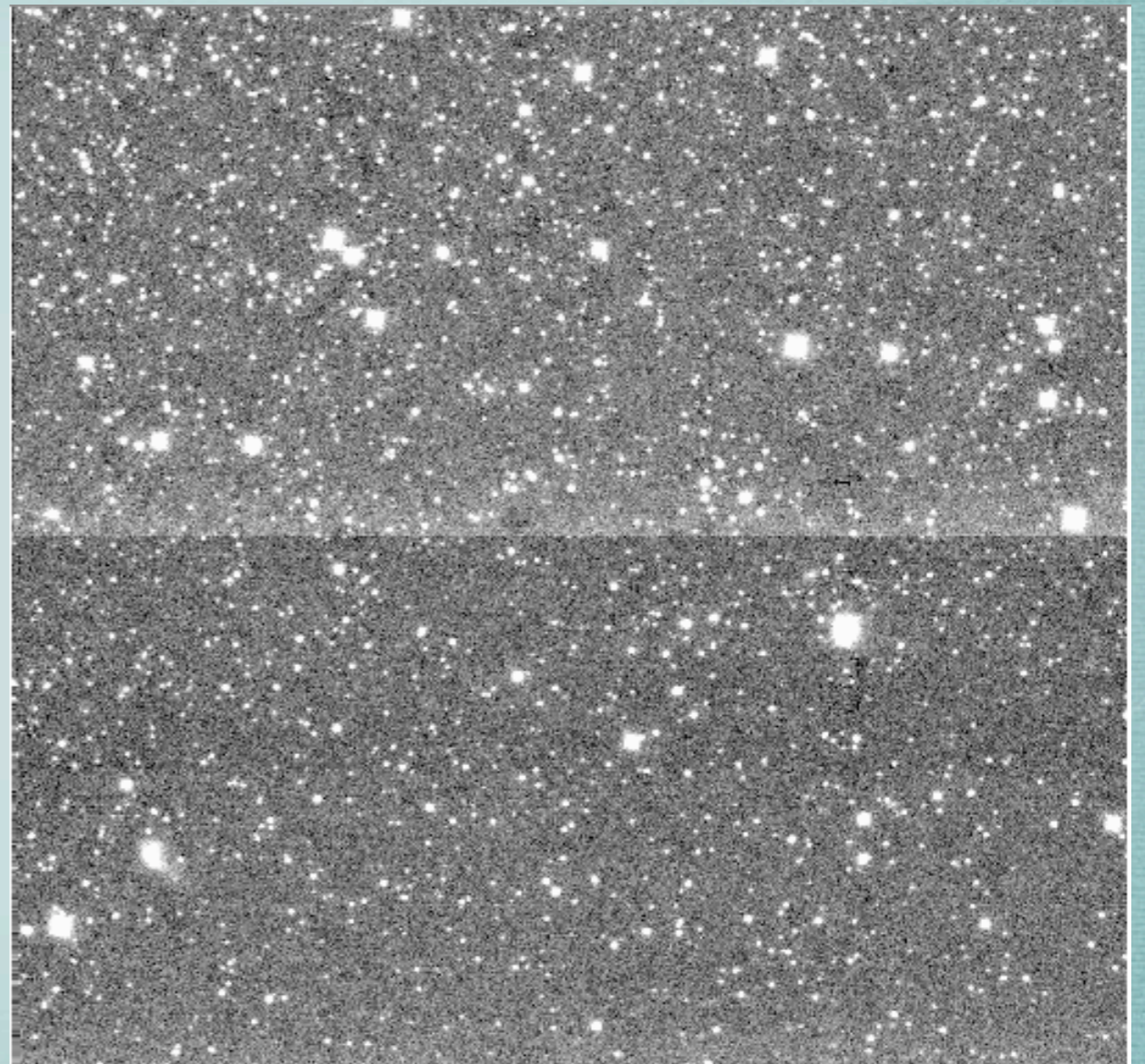
- $\mu = 13.37, E(B - V) = 0.04$
- $[Fe/H] = -0.76$ dex
- $\log \rho = 4.81 L_{\odot} pc^{-3}$

(Harris 2003)



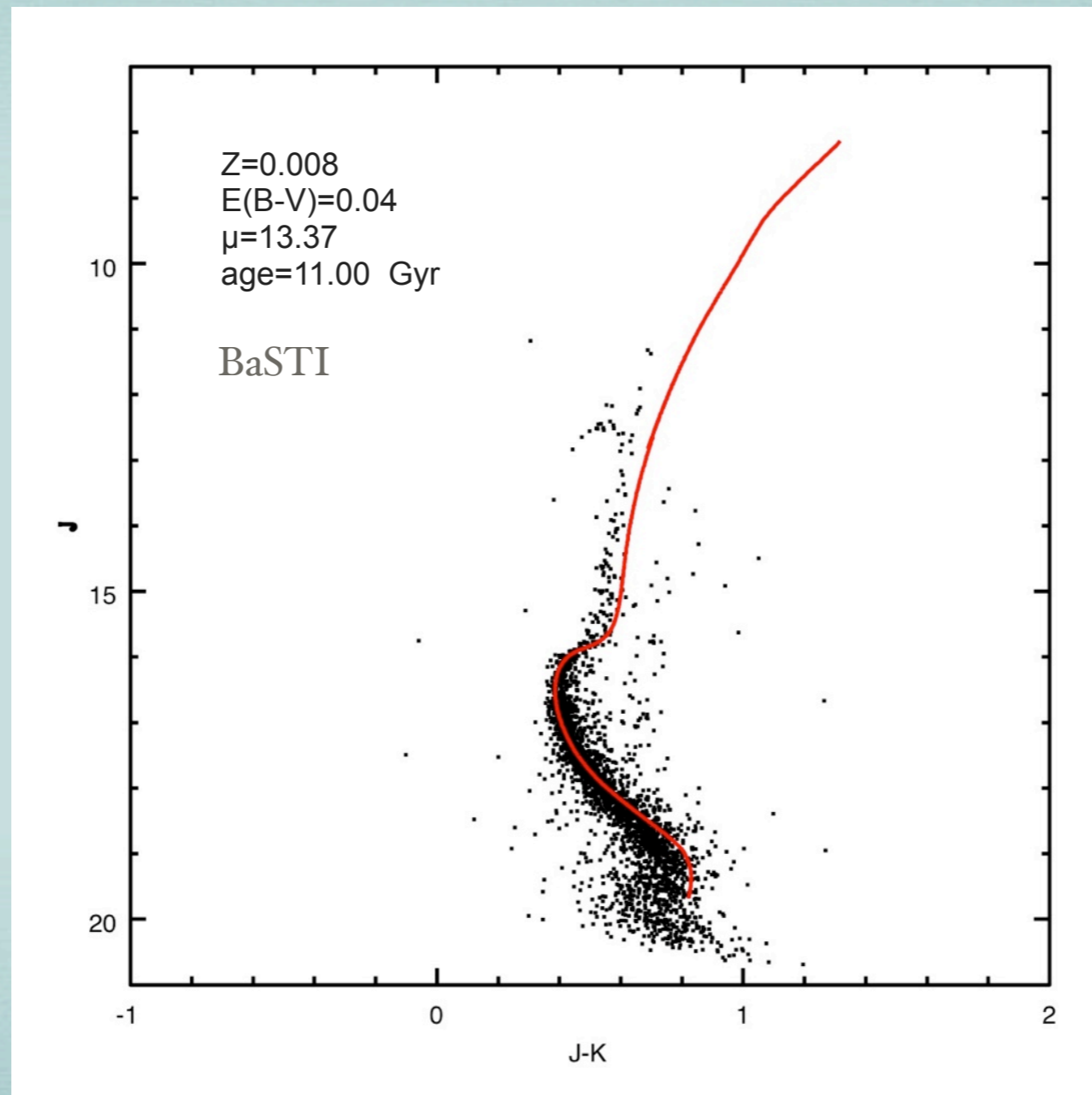
47Tuc: SOFI DATASET

- 0.288 arcsec/pixel
- FoV= 4.95 arcmin²
- 1 pointing
- 23 H-band images, 14 J-band images and 30 K-band images (DIT=3 sec, NDIT=14÷33)
- seeing H-band 0.75÷1.01 arcsec, seeing J-band 0.78÷0.94, seeing K-band 1.04÷1.44 arcsec



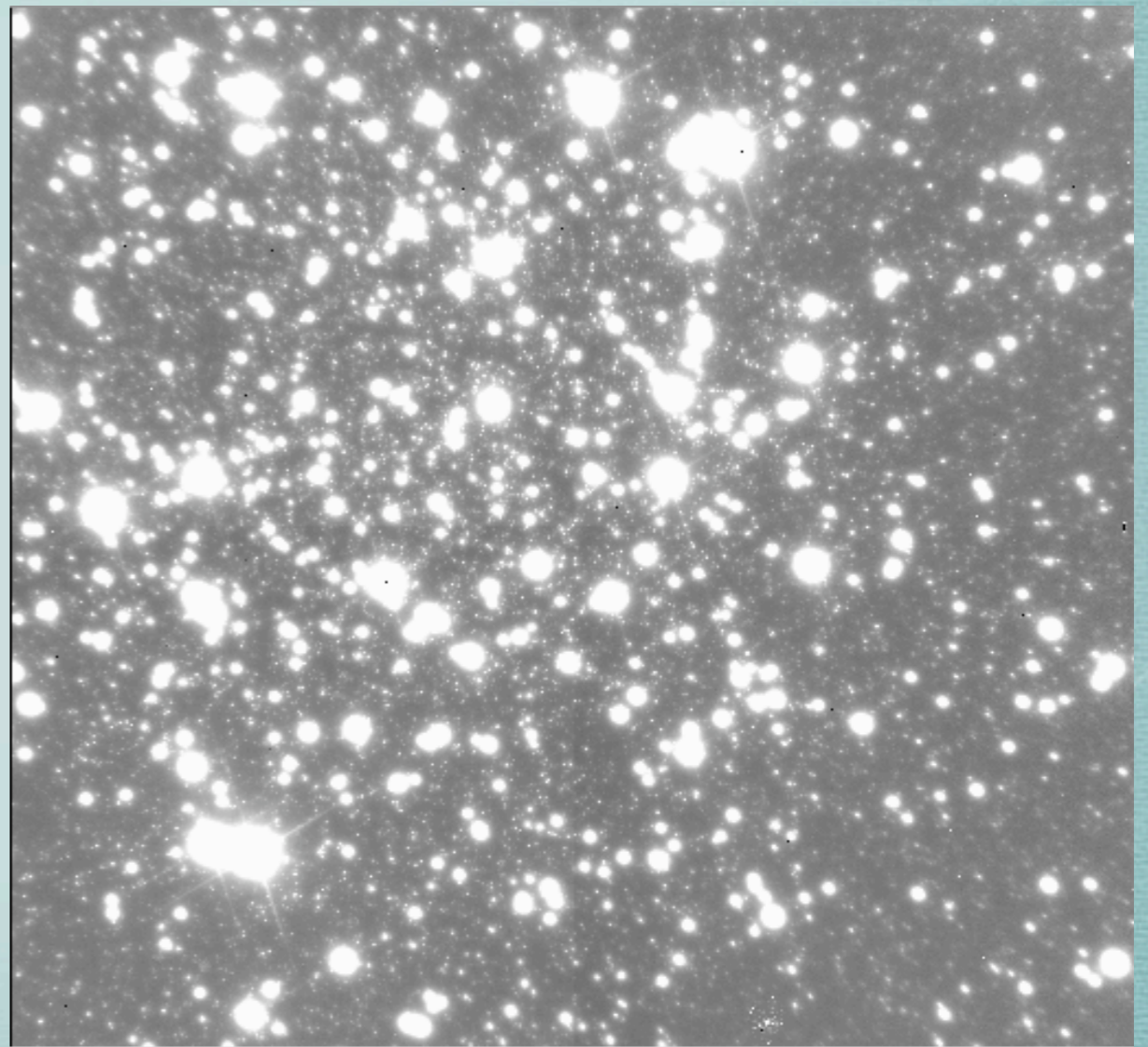
47 Tuc:

SOFI PRELIMINARY RESULTS

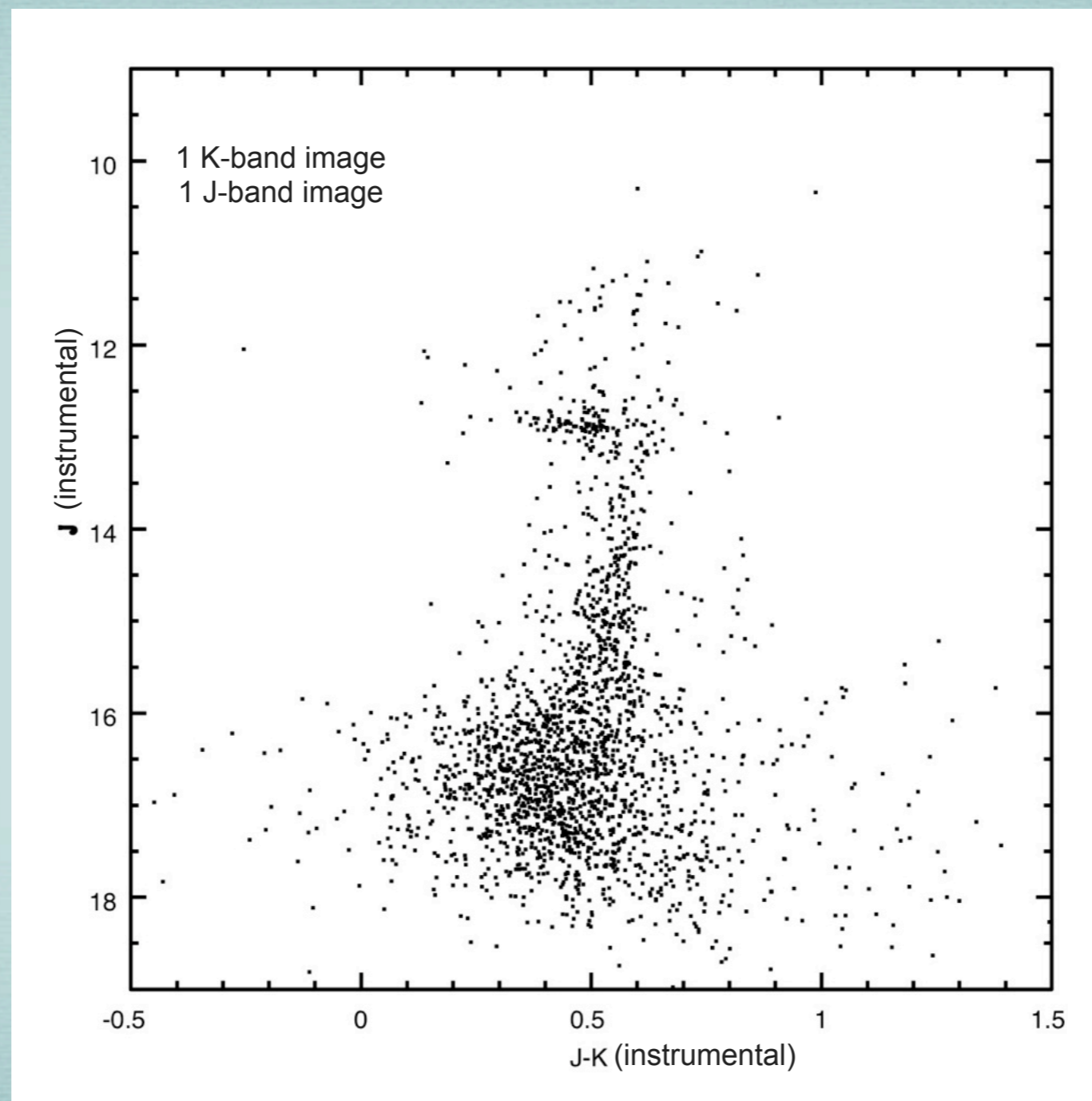


47Tuc, THE SHAPE OF THINGS TO COME: MAD DATASET

- 0.028 arcsec/pixel
- FoV= 2 arcmin²
- 1 pointing
- 63 J images and 57 K images
(DIT=10 sec, NDIT=3)
- seeing 0.8 arcsec
- FWHM J-band ~0.13 arcsec
FWHM K-band ~ 0.09 arcsec

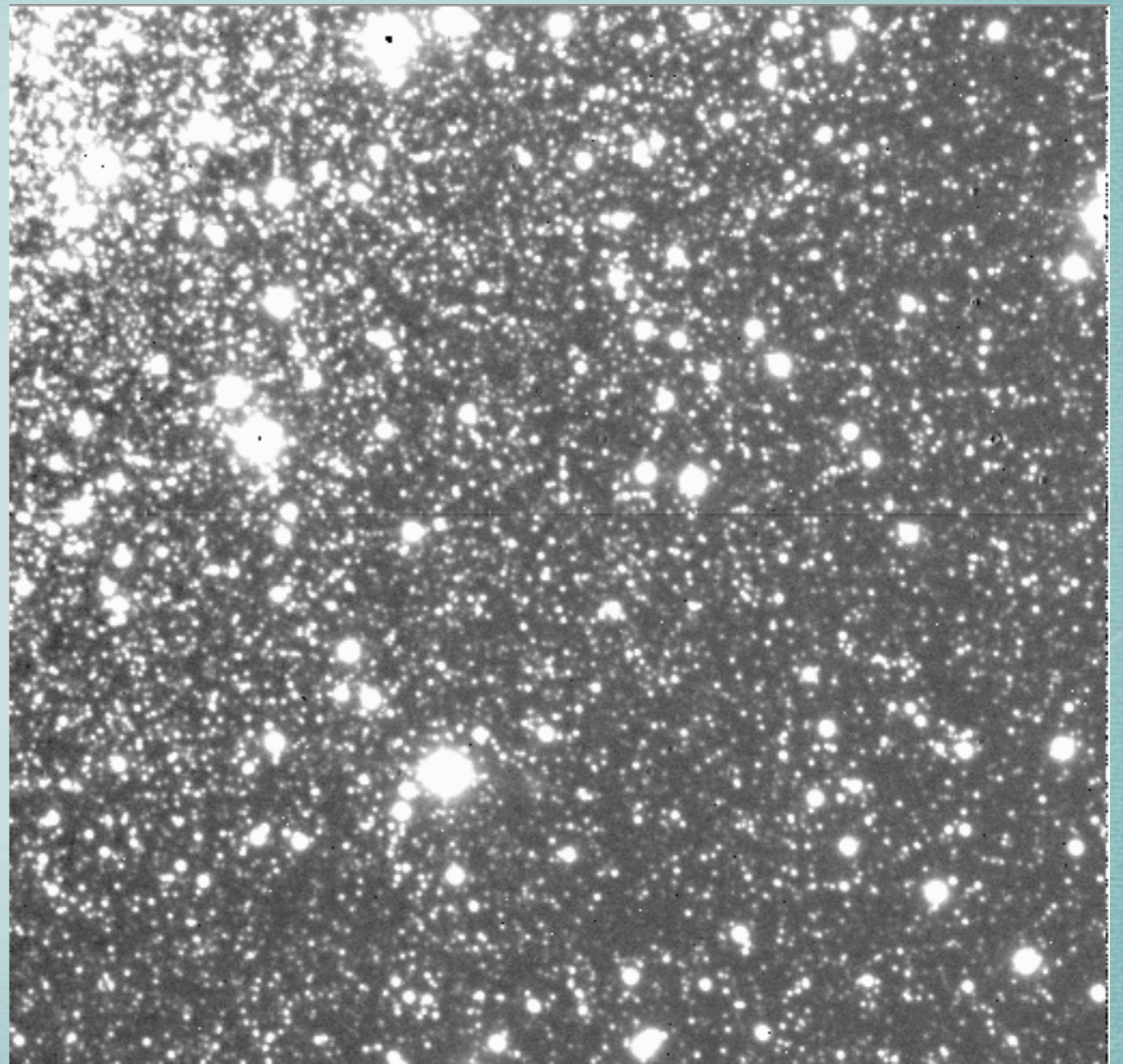


47Tuc, THE SHAPE OF THINGS TO COME: MAD DATASET

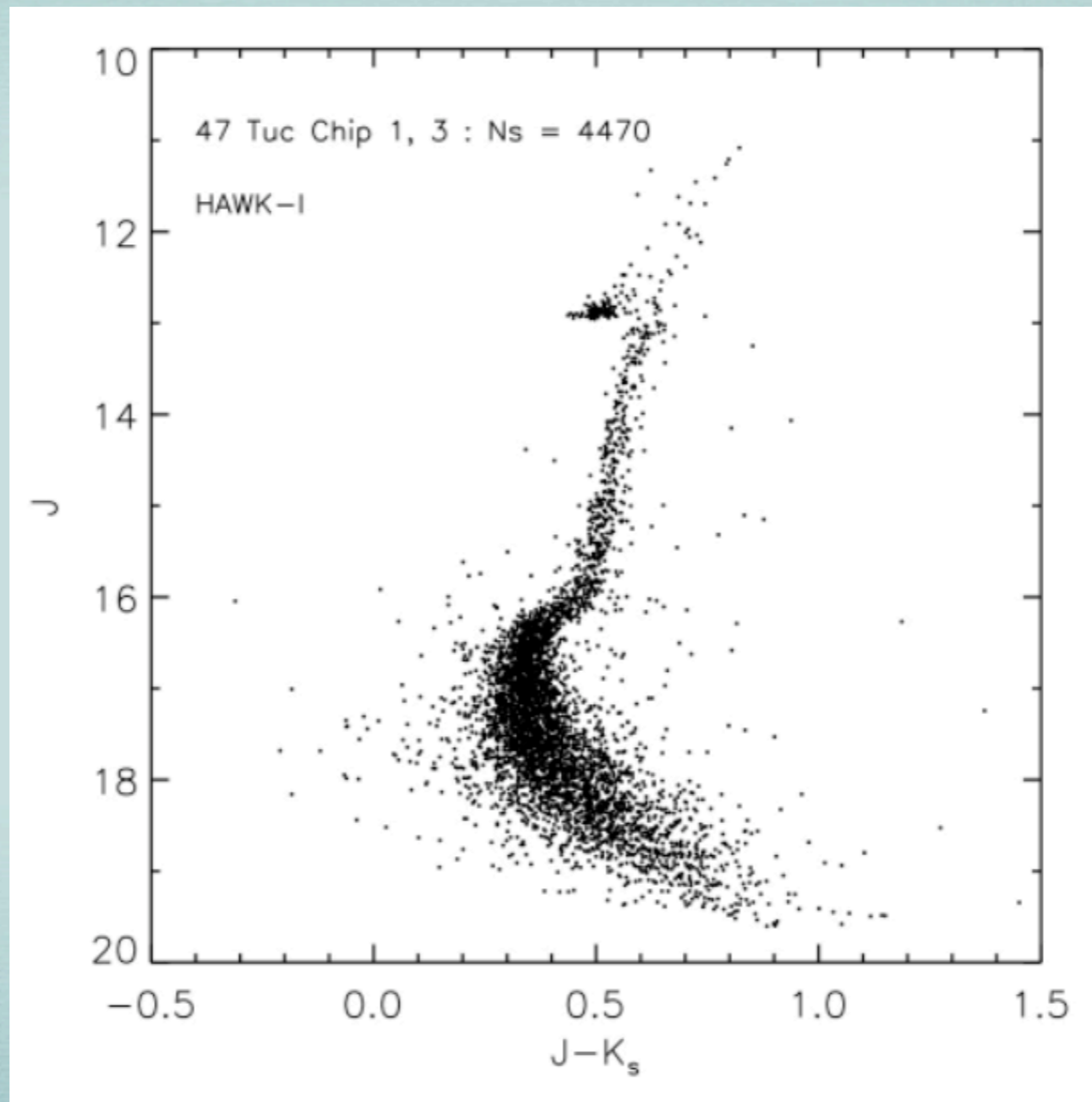


47Tuc, THE SHAPE OF THINGS TO COME: HAWK-I DATASET

- 0.106 arcsec/pixel
- FoV = 7.5 arcmin²
- 1 pointing
- 50 J-band images and 50 K-band images
- seeing 0.4÷0.9 arcsec



47Tuc, THE SHAPE OF THINGS TO COME: HAWK-I DATASET



47Tuc, FUTURE DEVELOPMENTS: NEXT STEPS

- reduce the entire MAD dataset
 - 5 pointings
 - 212 K-band images
 - 133 J-band images
- reduce the entire HAWK-I dataset
 - 1 pointing
 - 50 K-bands images
 - 50 J-band images
- more SOFI images:
 - 2000 dataset: 2 pointings, 12 H-band images, 14 J-band images, 12 K-band images
 - 2002 dataset: 1 pointing, 60 H-band images, 60 J-band images, 60 K-band images
 - 2005 dataset: 1 pointing, 5 H-band images, 3 J-band images, 11 K-bands images
- more than 299 min in H-band, 214 min in J-band and 578 min in K-band



47Tuc, FUTURE DEVELOPMENTS: NEXT STEPS

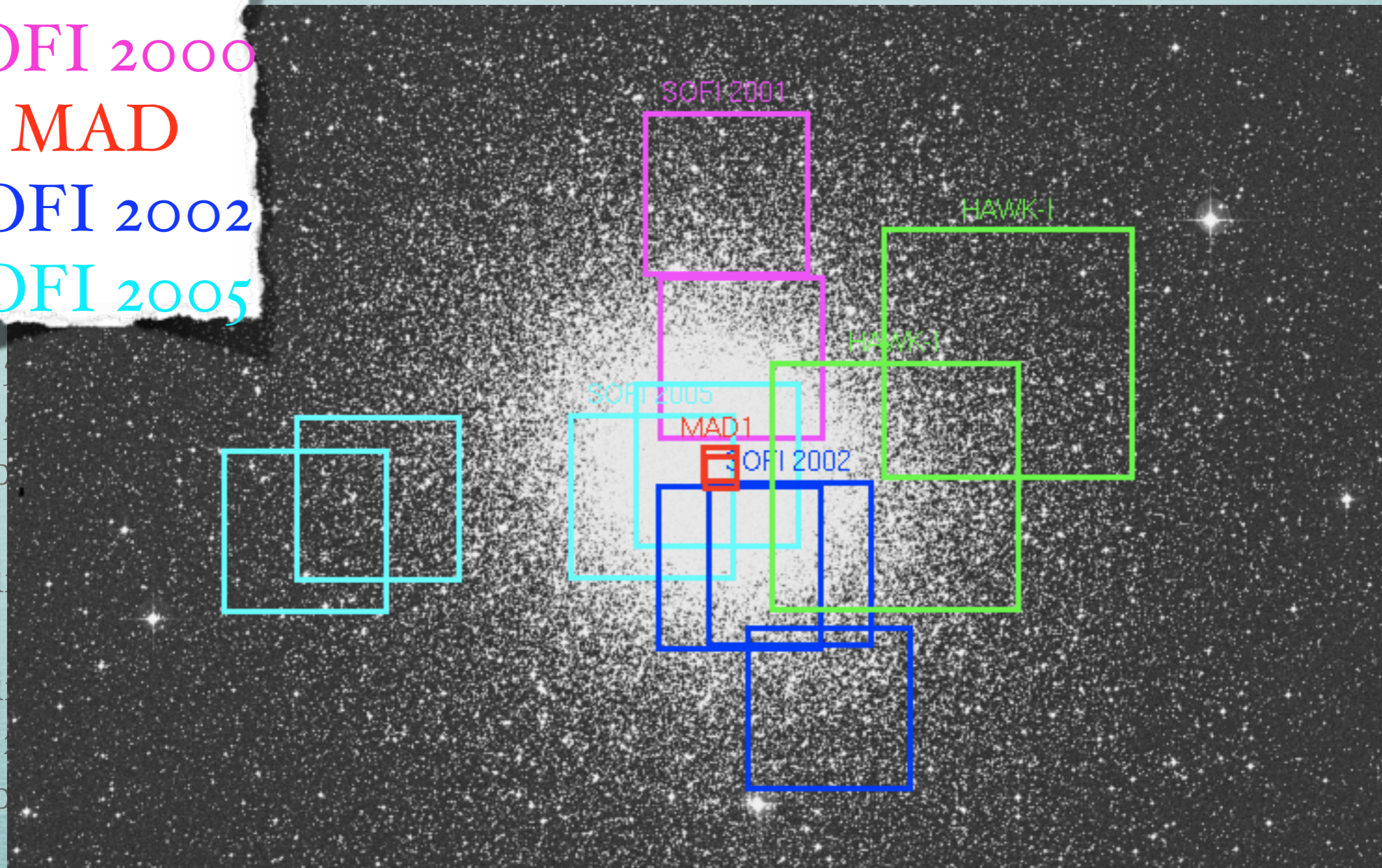
HAWK-I

• SOFI 2000

MAD

• SOFI 2002

• SOFI 2005



band
band
ages



THANK YOU FOR YOUR
ATTENTION!



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