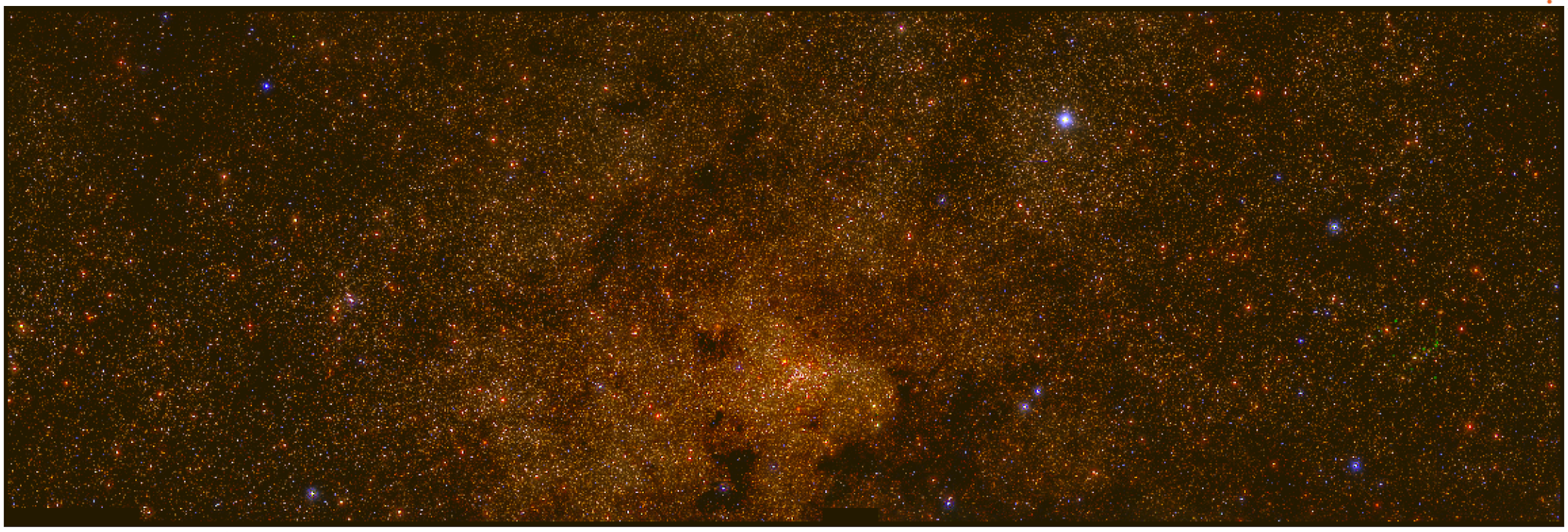
The star formation history and metallicity in the Galactic inner bulge revealed by the RGBB



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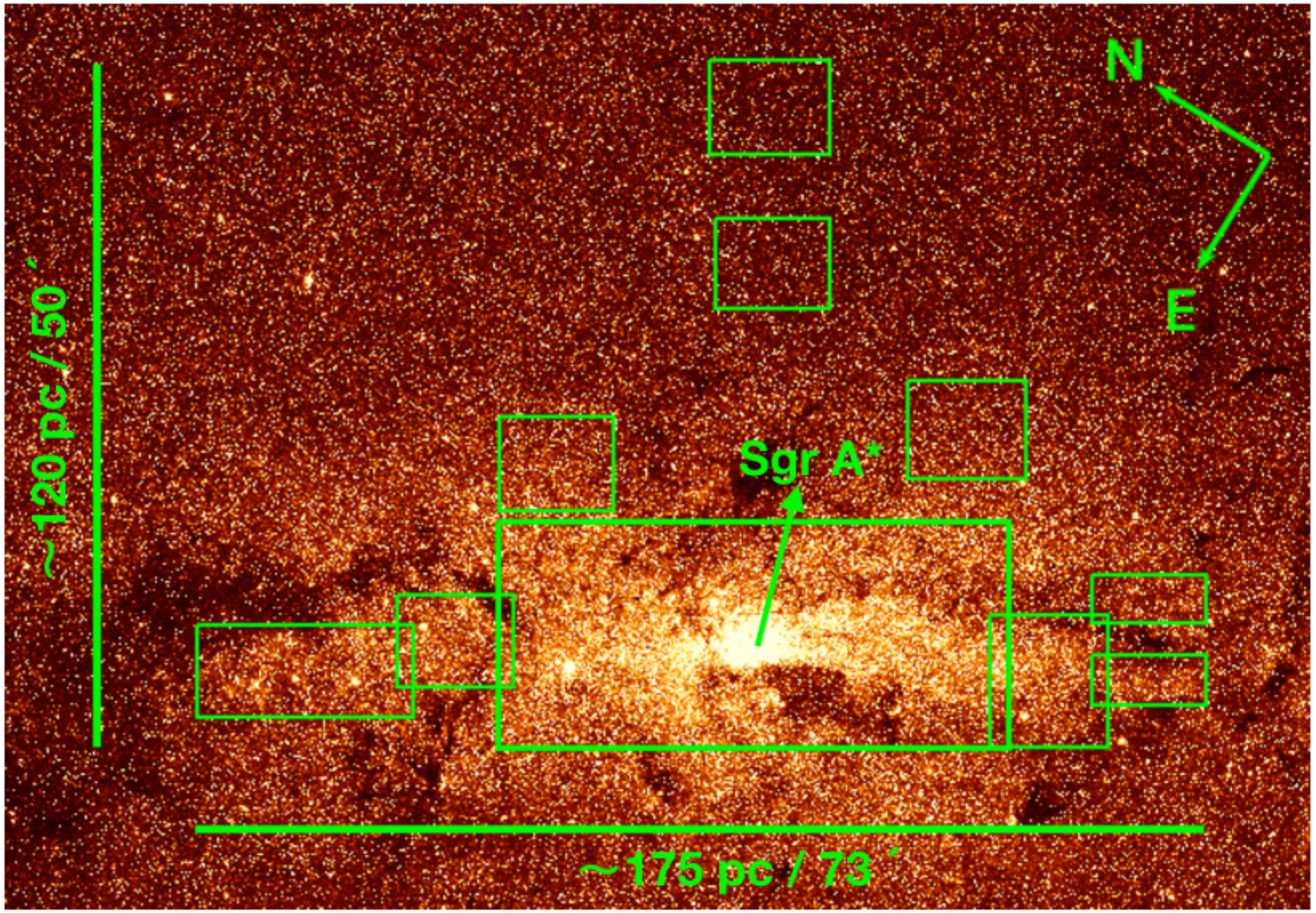
EXCELENCIA SEVERO OCHOA

R. Schödel, A. T. Gallego-Calvente, H. Dong, E. Gallego-Cano, J. H. V. Girard, M. Hilker, P. T. de Zeeuw, A. Feldmeier-Krause, S. Nishiyama, F. Najarro and N. Neumayer

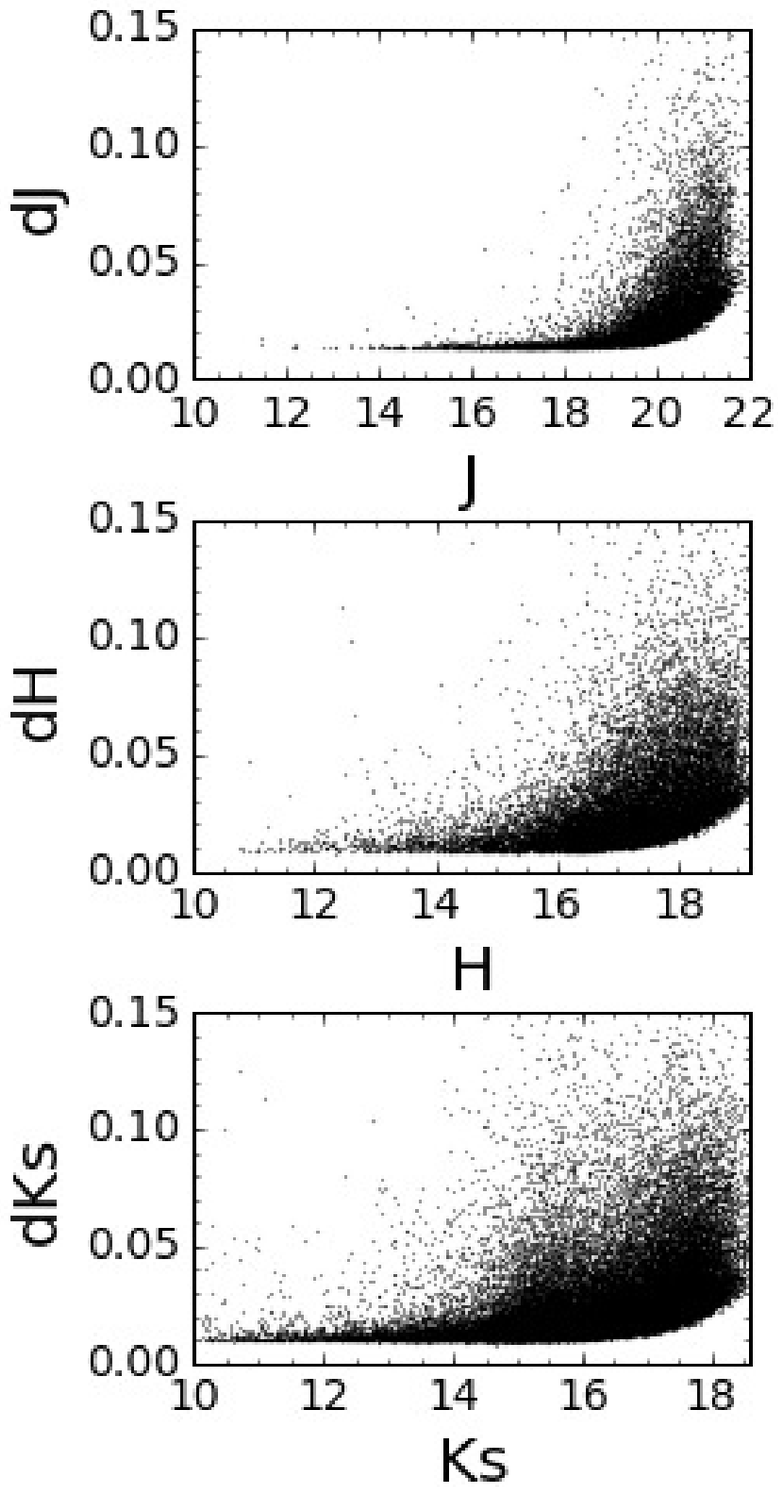
The GALACTICNUCLEUS survey

- JHK_s imaging survey
- High angular resolution 0.2''

Speckle Holography
(Schödel et al. 2013)



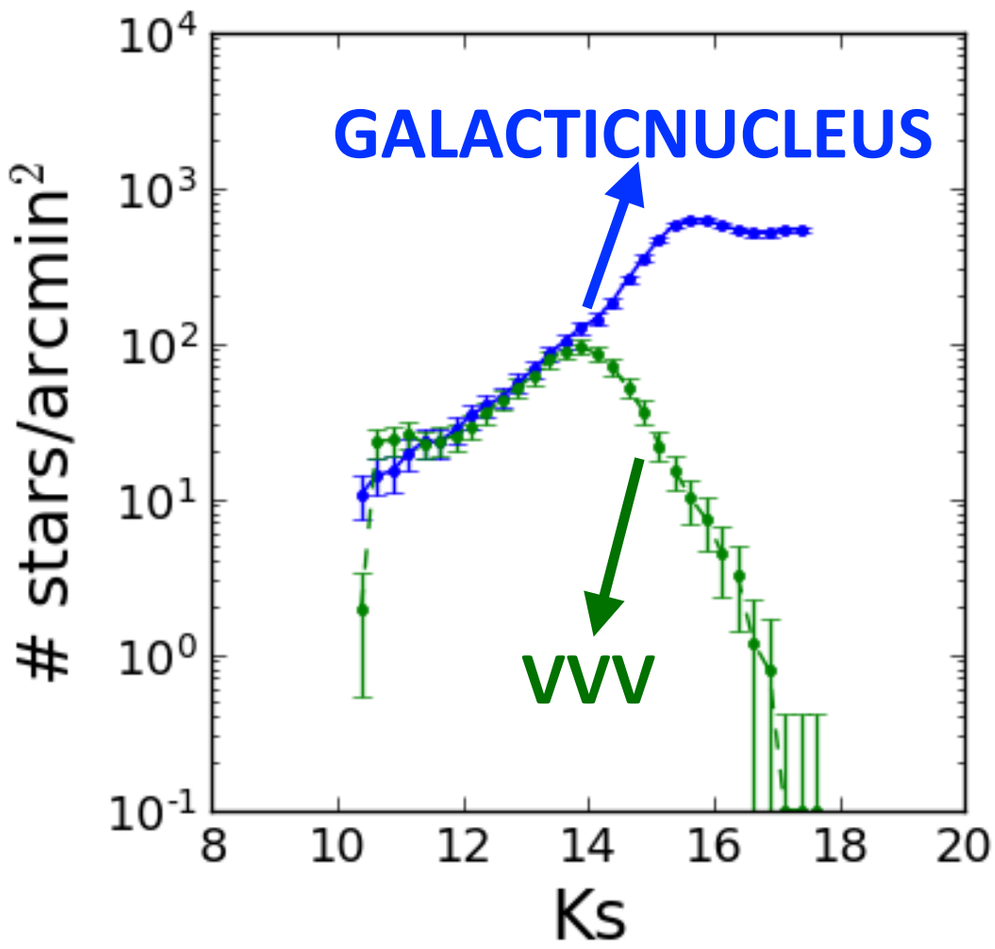
Data quality



- Uncertainties below 0.05 at
  - J ≲ 20
  - H ≲ 17
  - Ks ≲ 16

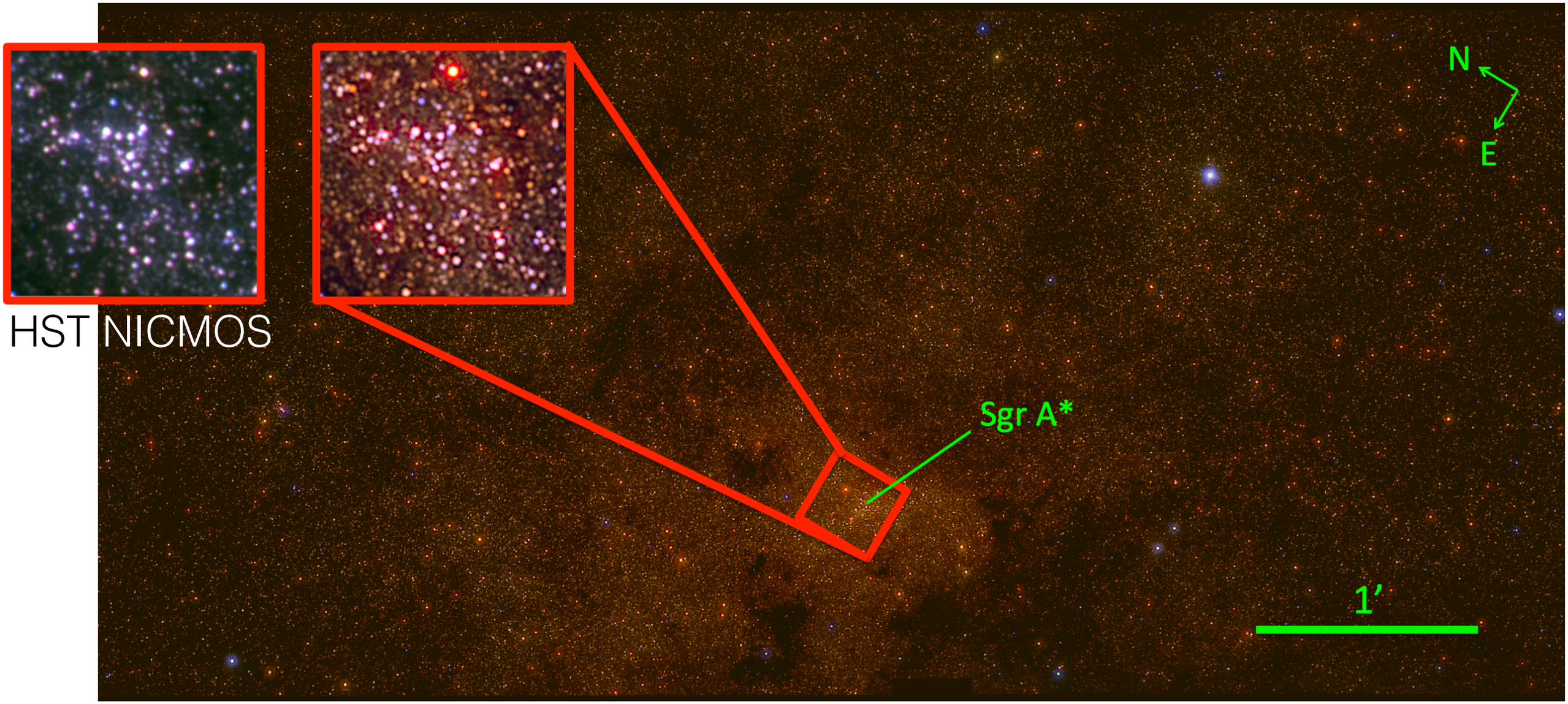
Zero Point computed using SIRIUS/IRTF
(Nagayama et al. 2003)

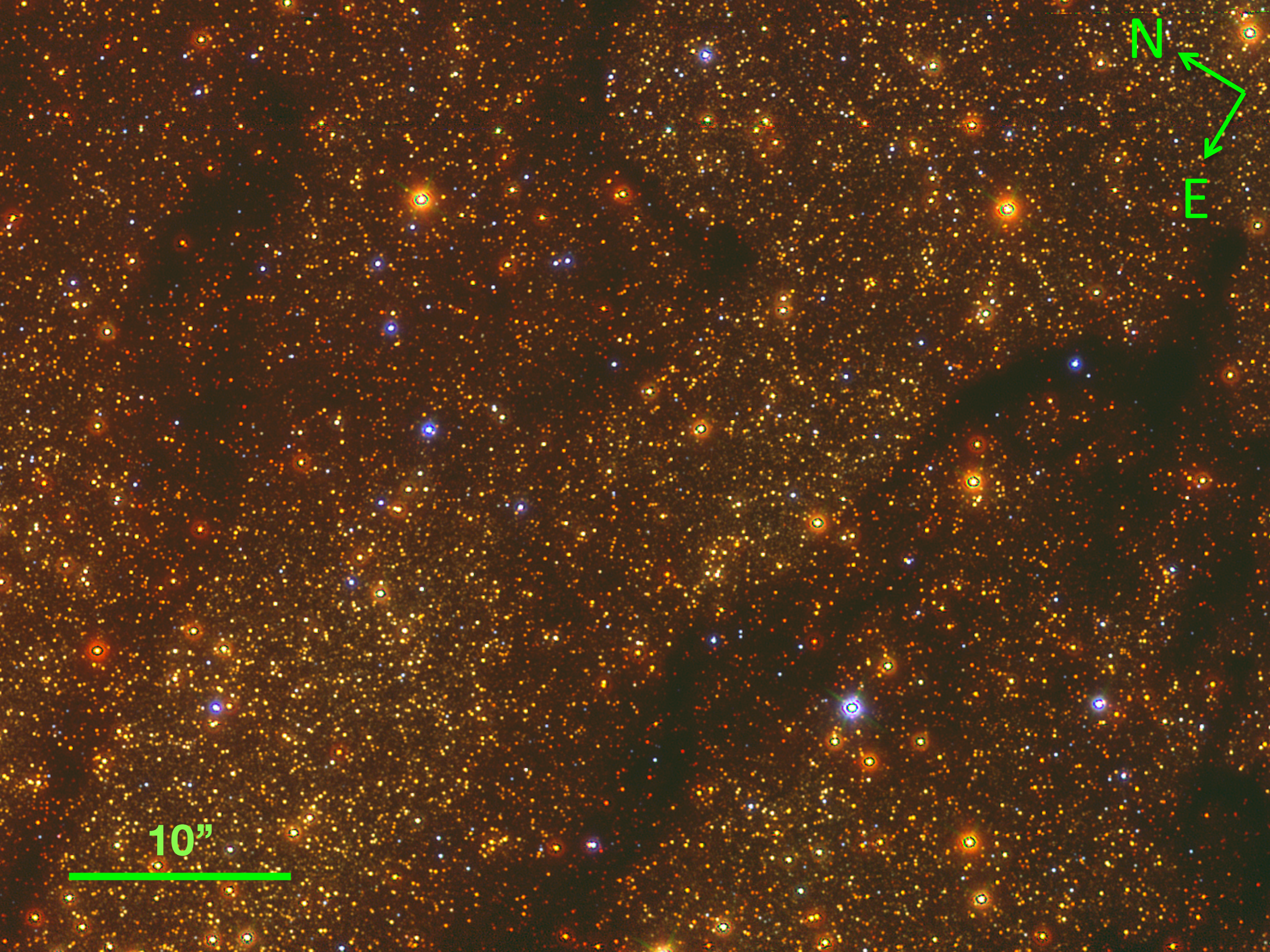
- Systematic uncertainties of 0.036 mag



The final product

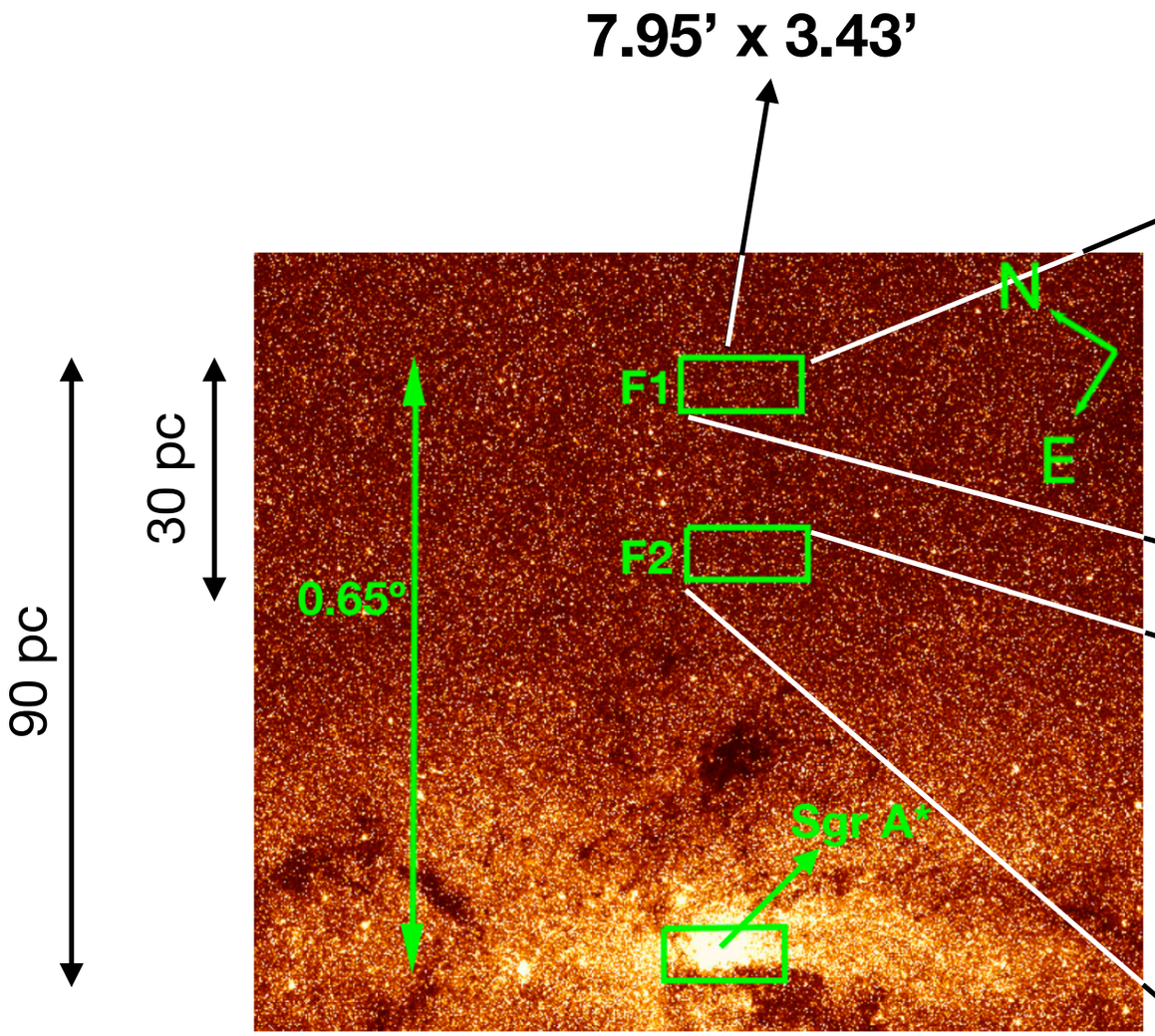
RGB image using JHKs bands

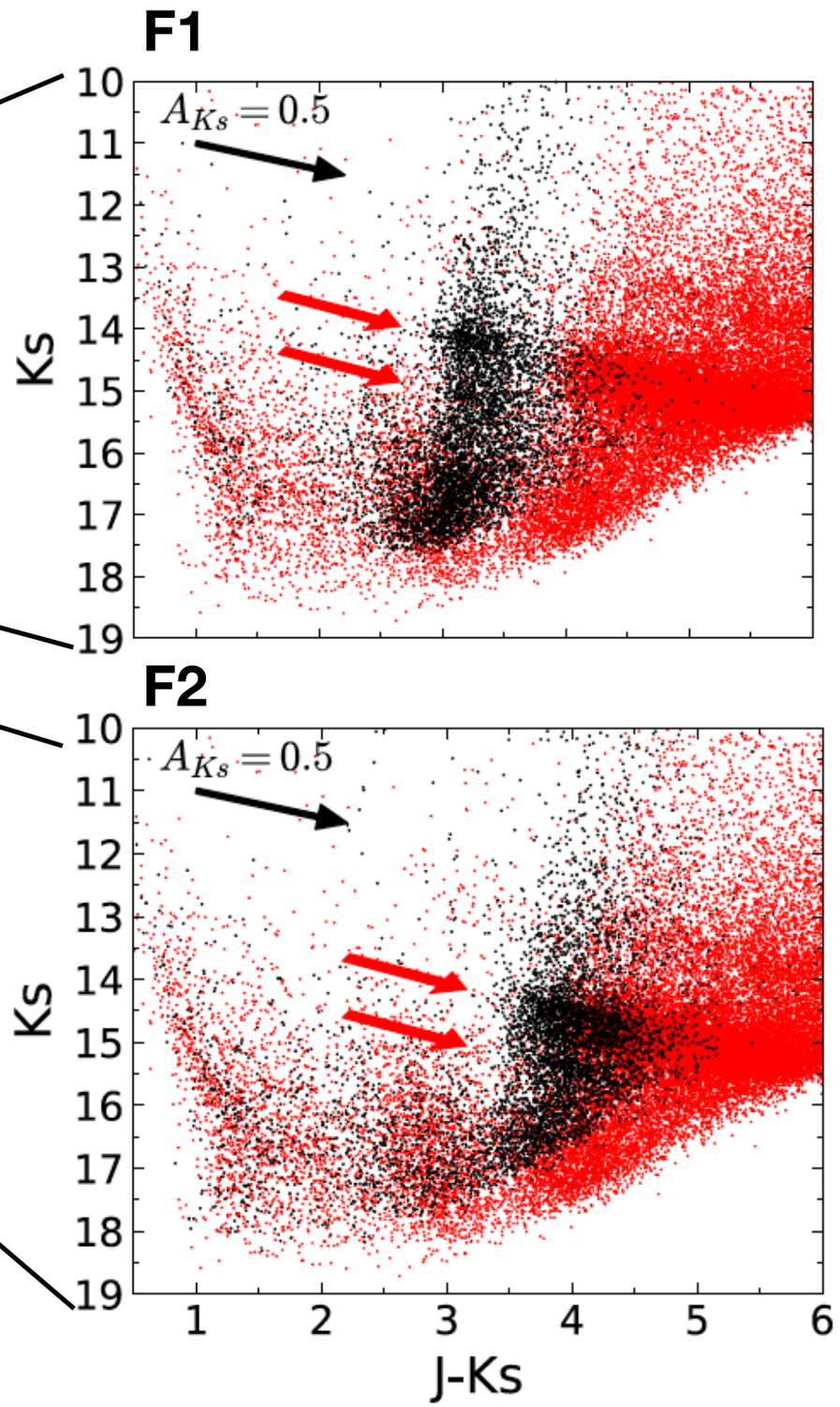



N
E
10”


N
E
10”

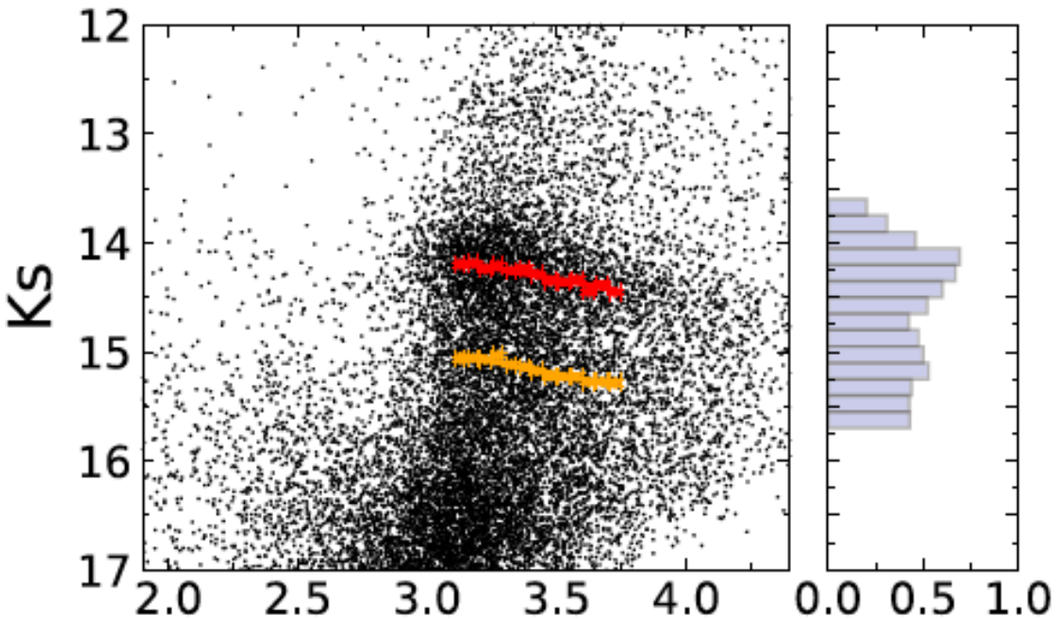
The Inner Bulge





Two features detected

F1



	A_{Ks_bright}	A_{Ks_faint}
F1	1.19 ± 0.08	1.20 ± 0.08
F2	1.47 ± 0.10	1.48 ± 0.10

$$\alpha = -\frac{\log(1+\frac{1}{m})}{\log(\frac{\lambda_{\mathrm{eff}_1}}{\lambda_{\mathrm{eff}_2}})}$$

	α_{bright}	α_{faint}
F1	2.22 ± 0.20	2.21 ± 0.15
F2	2.31 ± 0.12	2.28 ± 0.20

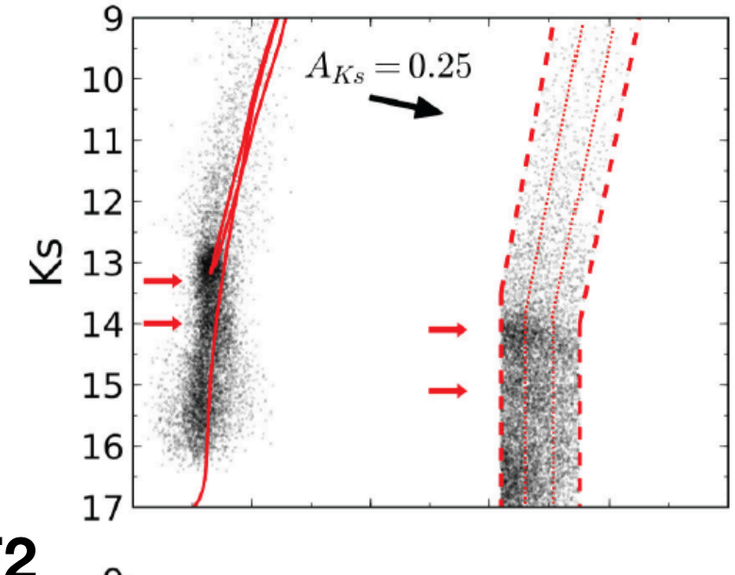
In agreement with α = 2.30 ± 0.08 (Nogueras-Lara et al. 2018a)

Two features detected

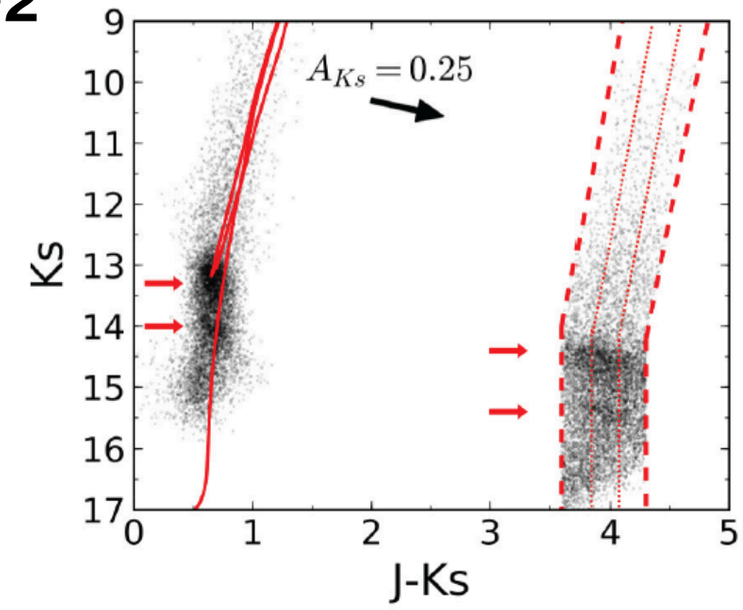
Extinction map

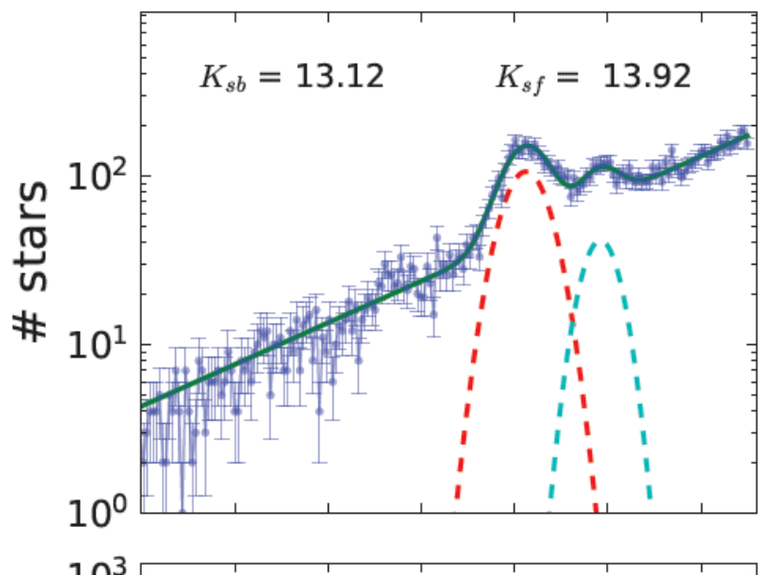
$$\text{ext} = \frac{J - K_s - (J - K_s)_0}{\left(\frac{\lambda_J}{\lambda_{K_s}}\right)^{-\alpha} - 1}$$

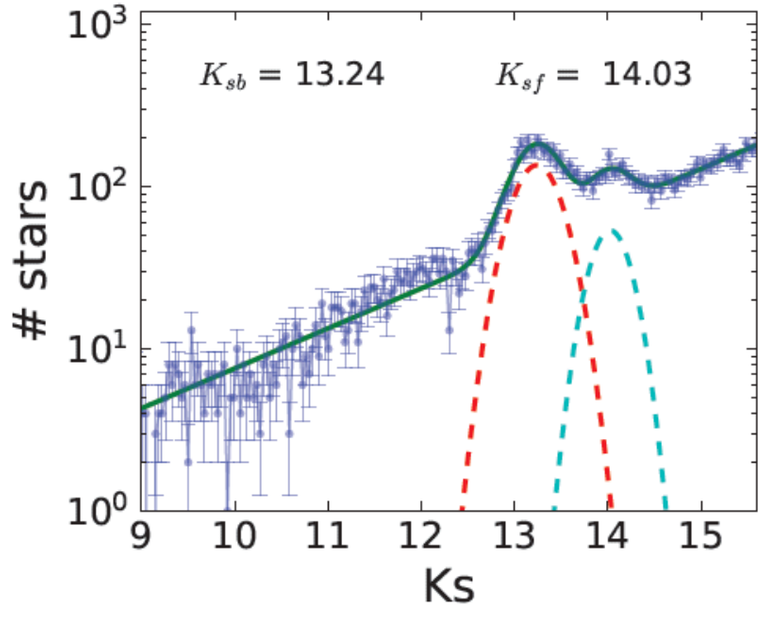
F1



F2







Possible scenarios

1.- RC at different distances

Distance modulus { 8.3 ± 0.4 kpc ; 12.0 ± 0.4 kpc } **Equal extinction**

2.- RC age and metallicity

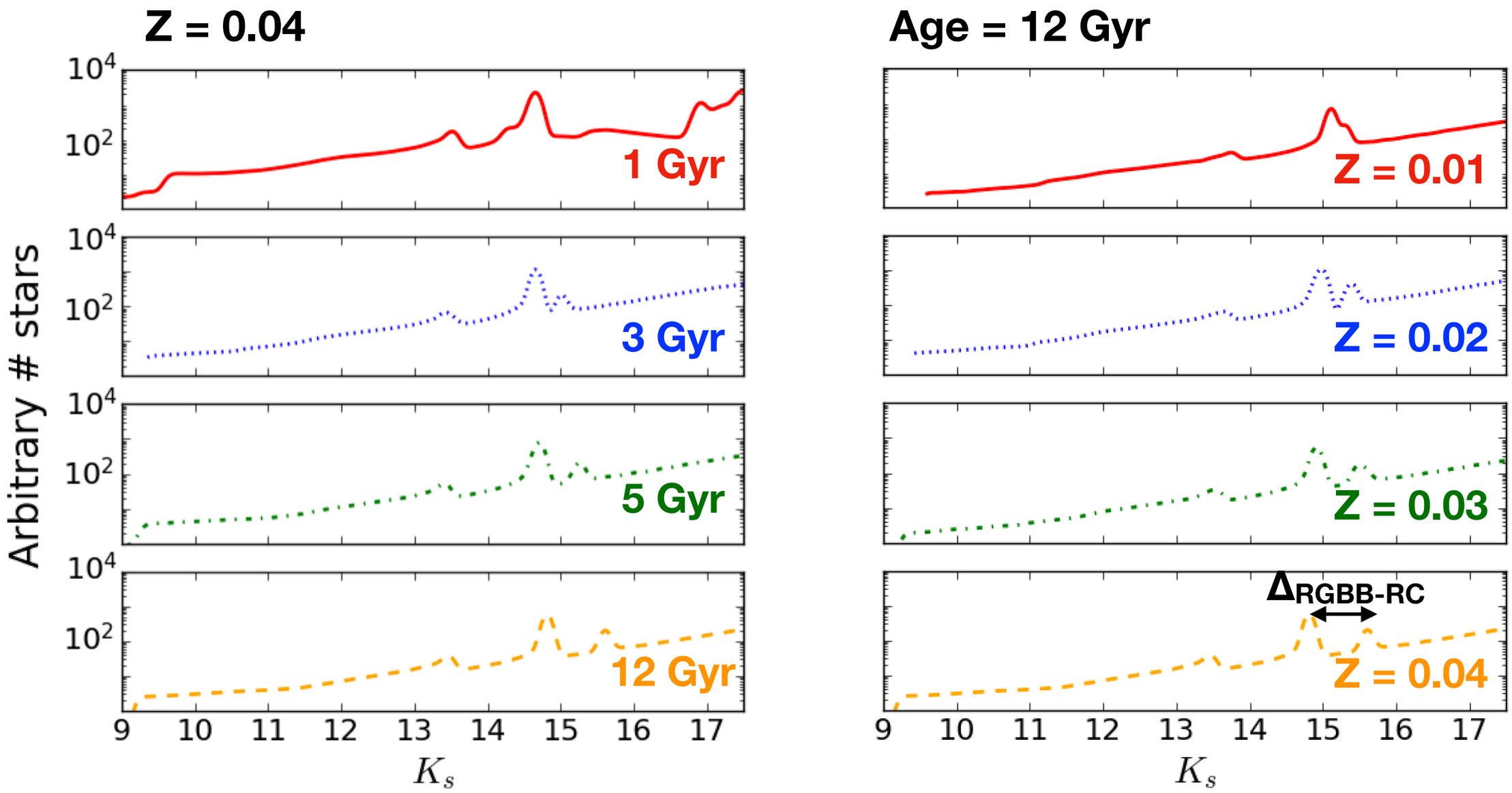
At most 0.5 mag in Ks
(Girardi 2016)

Even less for stars older than 2 Gyr ⇨ 0.2 mag

Possible scenarios

3.- Detection of the RGBB

RGBB
- Old stellar population
- Brightness depends on age and metallicity



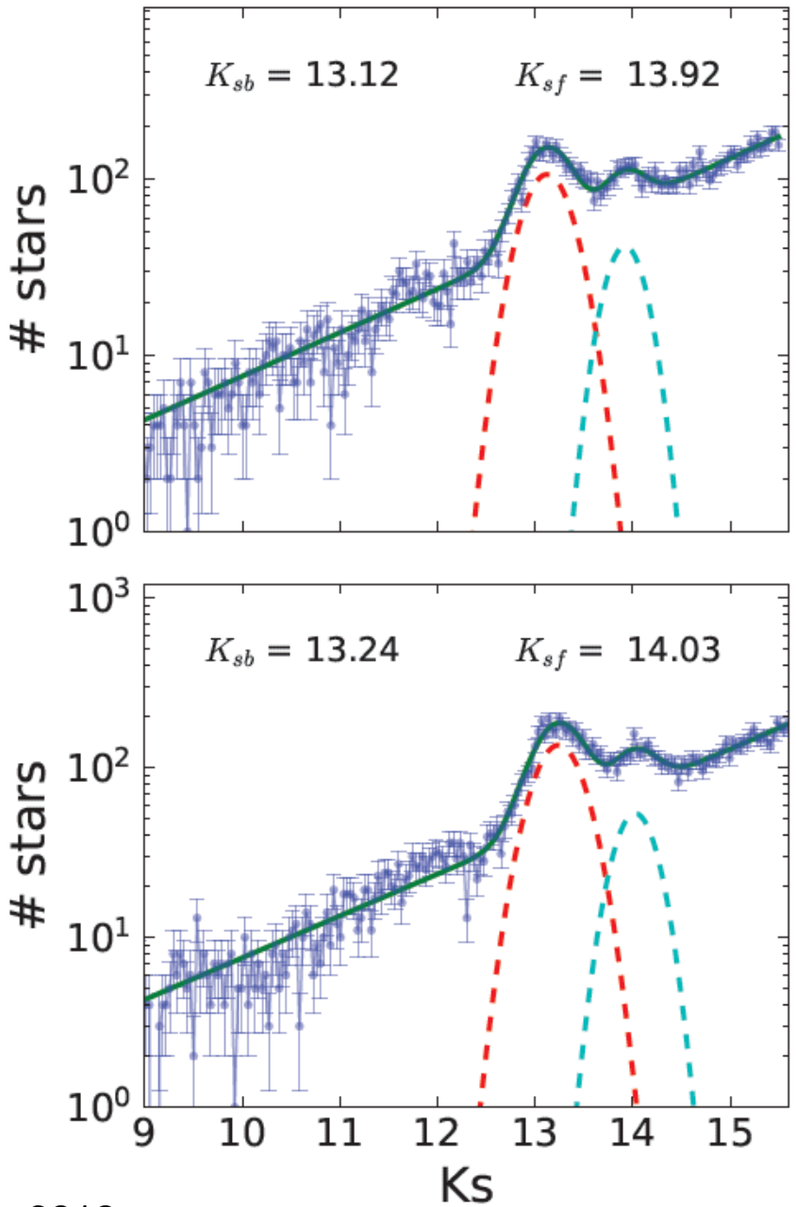
BaSTI models α-enhanced (Pietrinferni et al. 2004, 2006)

Possible scenarios

3.- Detection of the RGBB

$\Delta_{RGBB-RC}$ ⇒ Very dependent on metallicity { F1 0.80 ± 0.03 mag; F2 0.79 ± 0.02 mag }

$f_{RGBB-RC}$ ⇒ Dependent on age { F1 0.32 ± 0.04; F2 0.33 ± 0.04 }

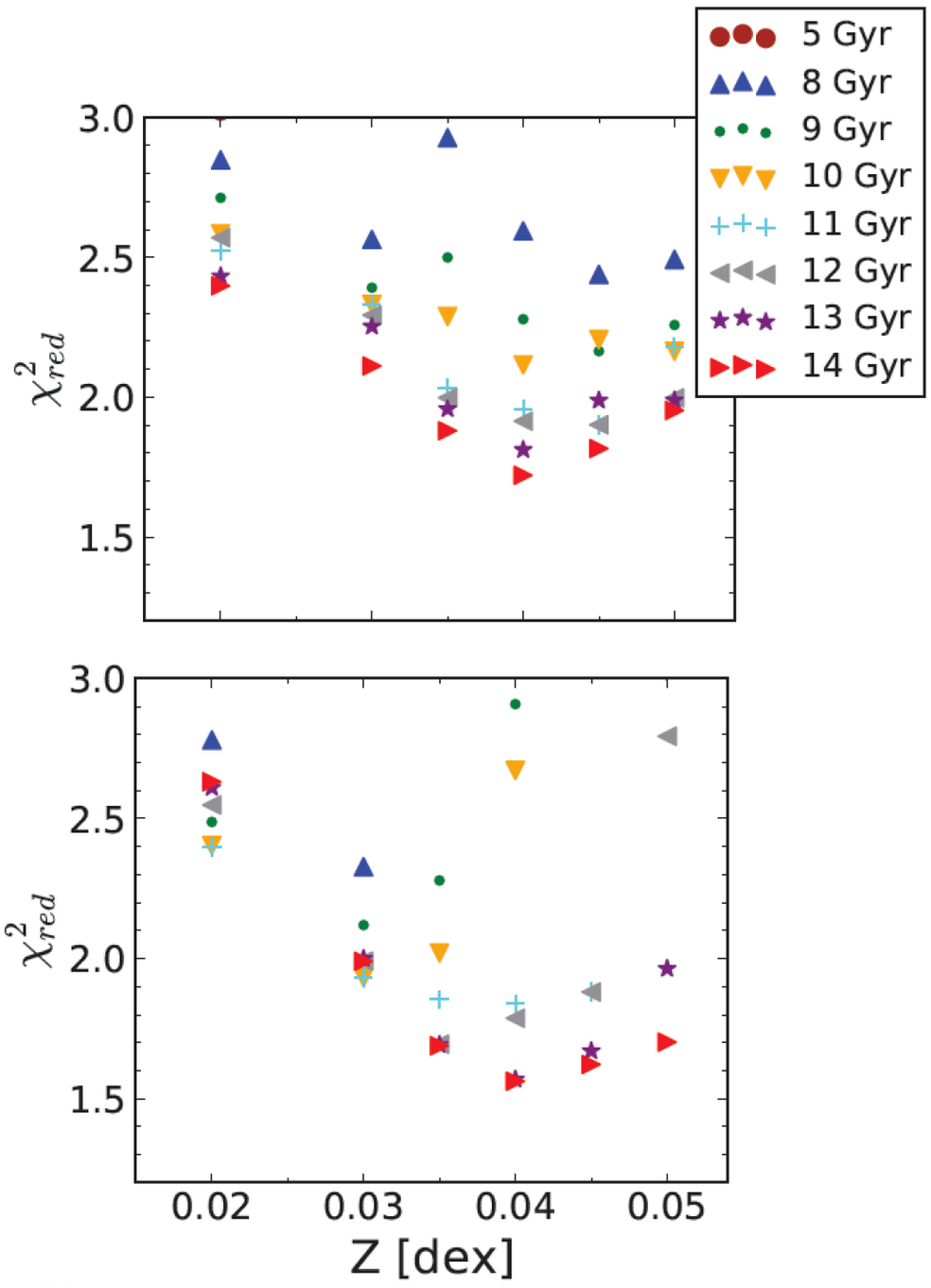


Best fits for ages > 10 Gyr and Z = 0.04

Possible scenarios

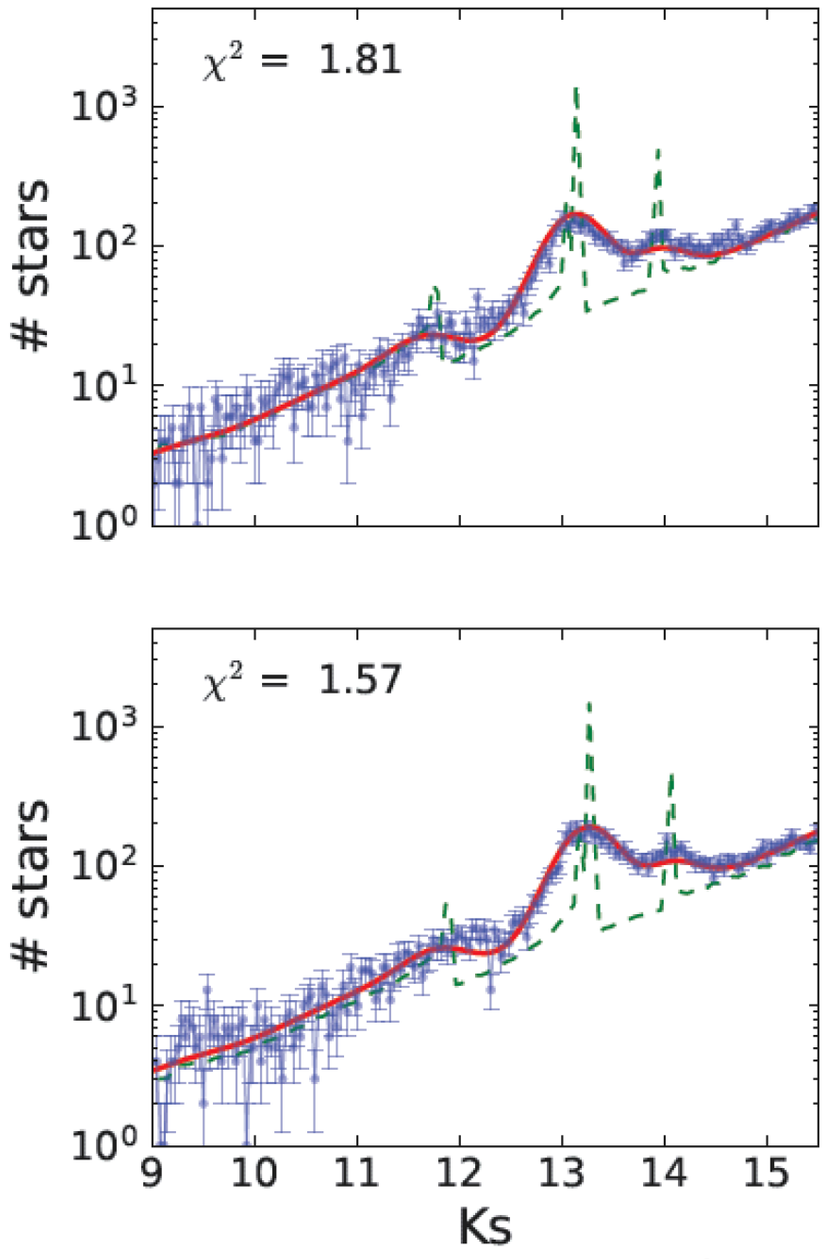
3.- Detection of the RGBB

Fitting theoretical Luminosity functions (BaSTI)



The best fit in both cases:

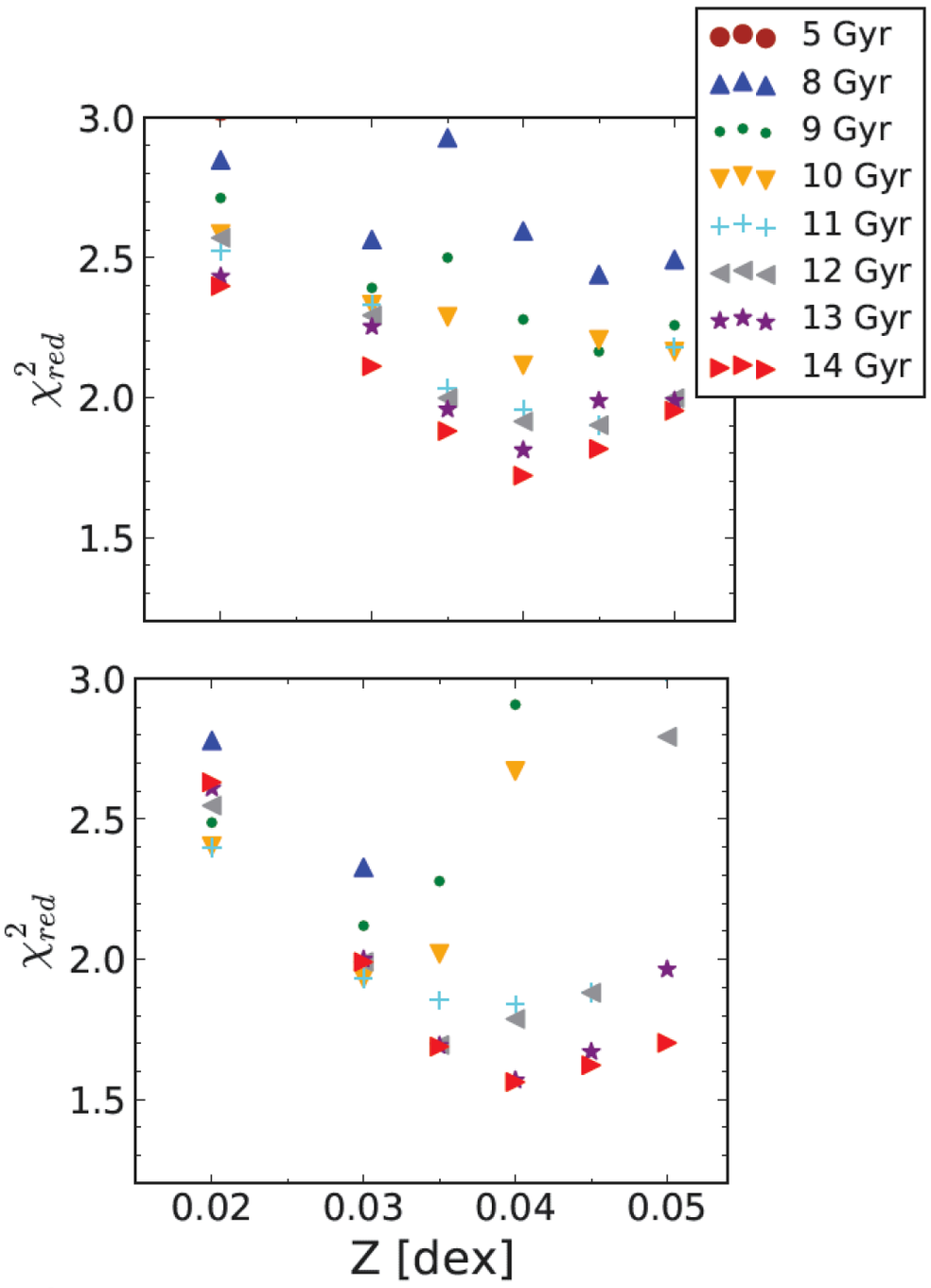
12.8 ± 0.6 Gyr Z = 0.040 ± 0.003



Possible scenarios

3.- Detection of the RGBB

Fitting theoretical Luminosity functions (BaSTI)



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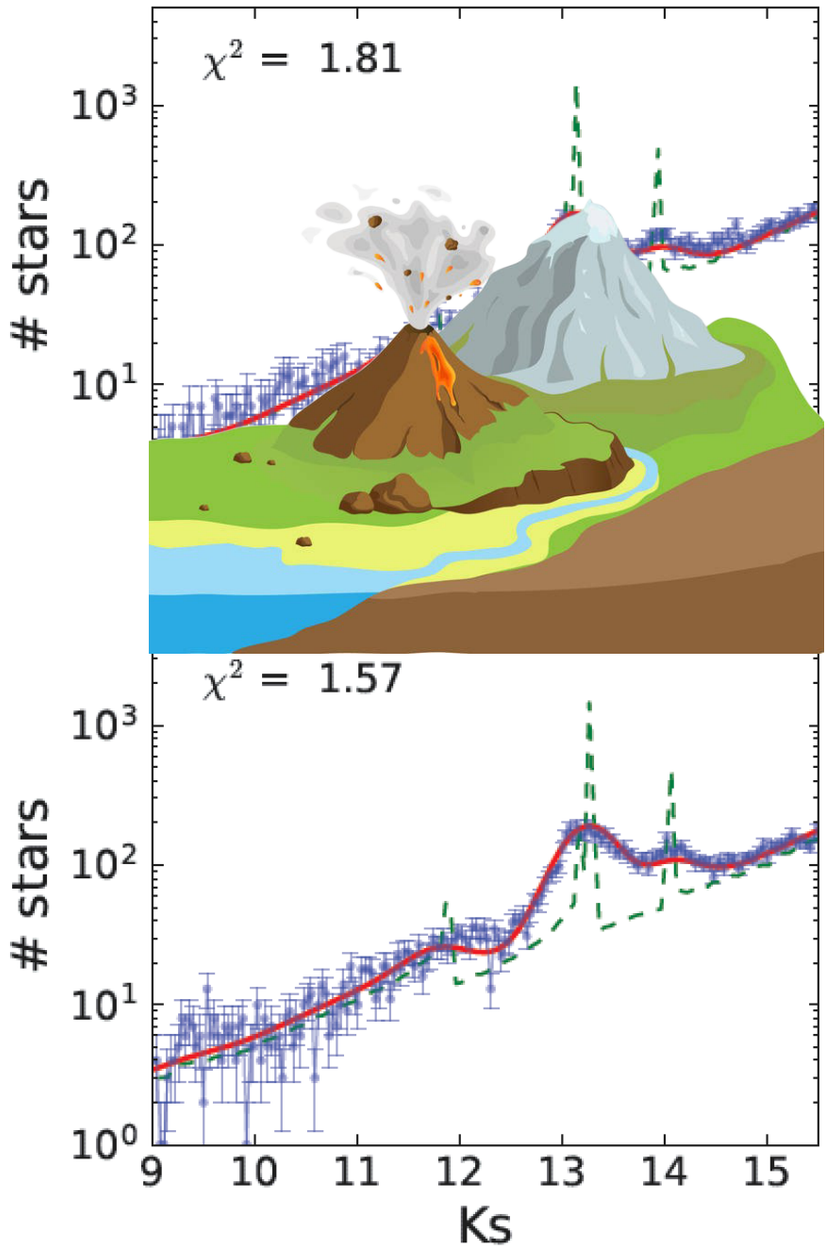

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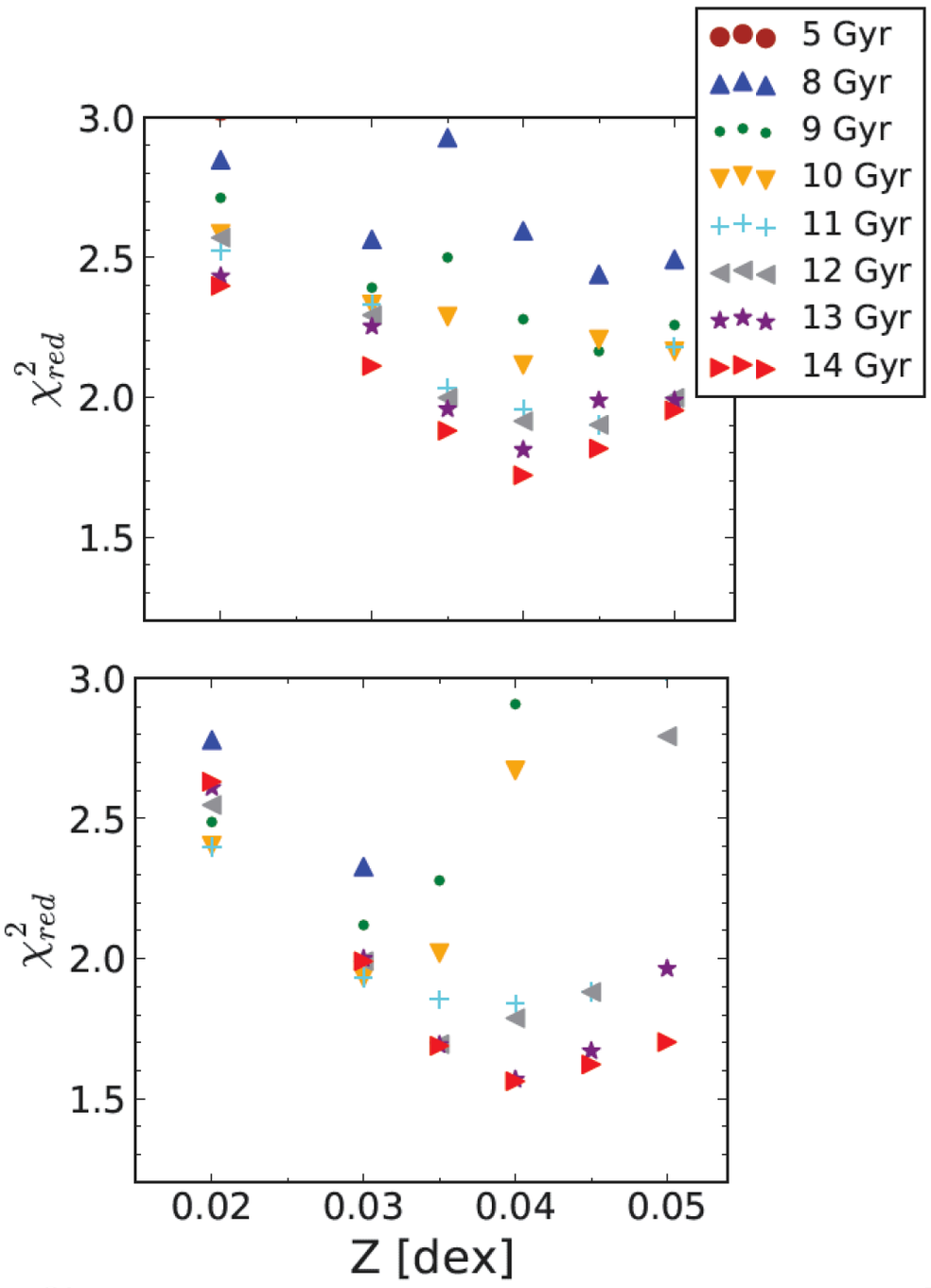
Possible scenarios

3.- Detection of the RGBB

Fitting theoretical Luminosity functions (BaSTI)



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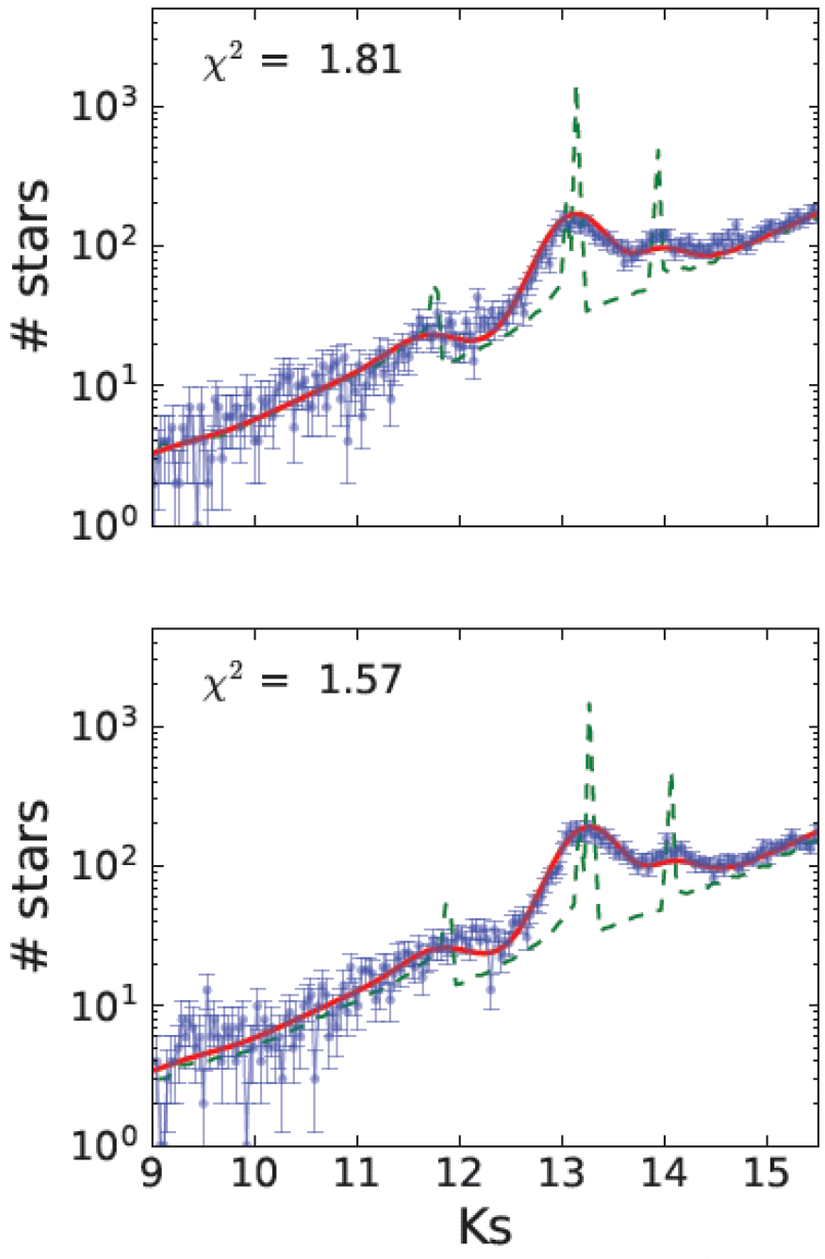


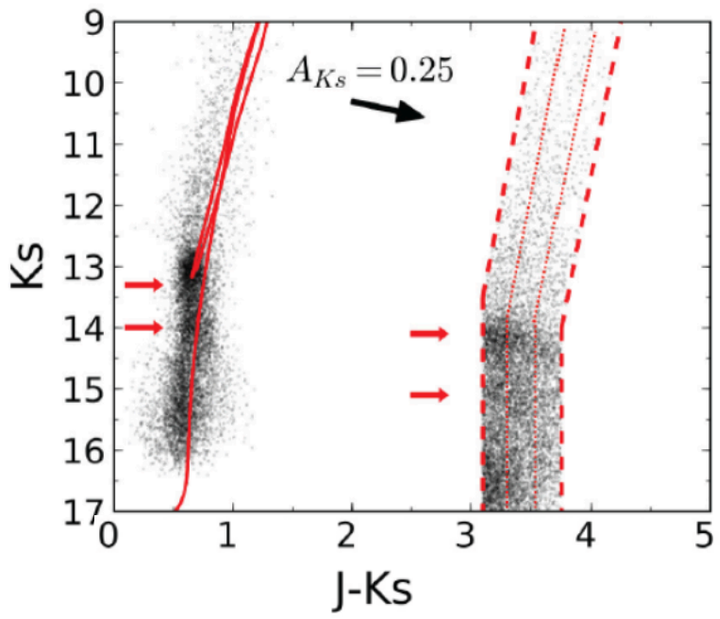
Information from the RGBB

Young stars fraction

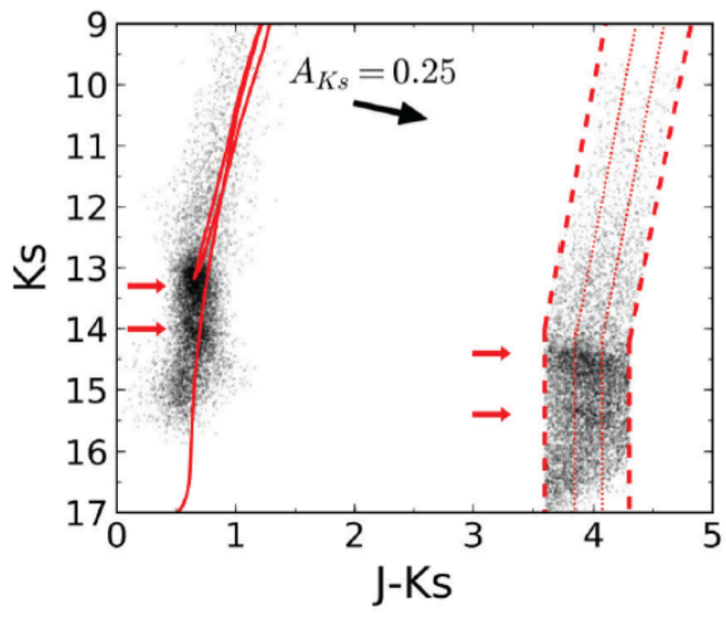
Fitting 2 populations Z = 0.04 { Young, Old } ⟹ **No significant improvement**

Variation with the extinction

F1



F2



No significant variation

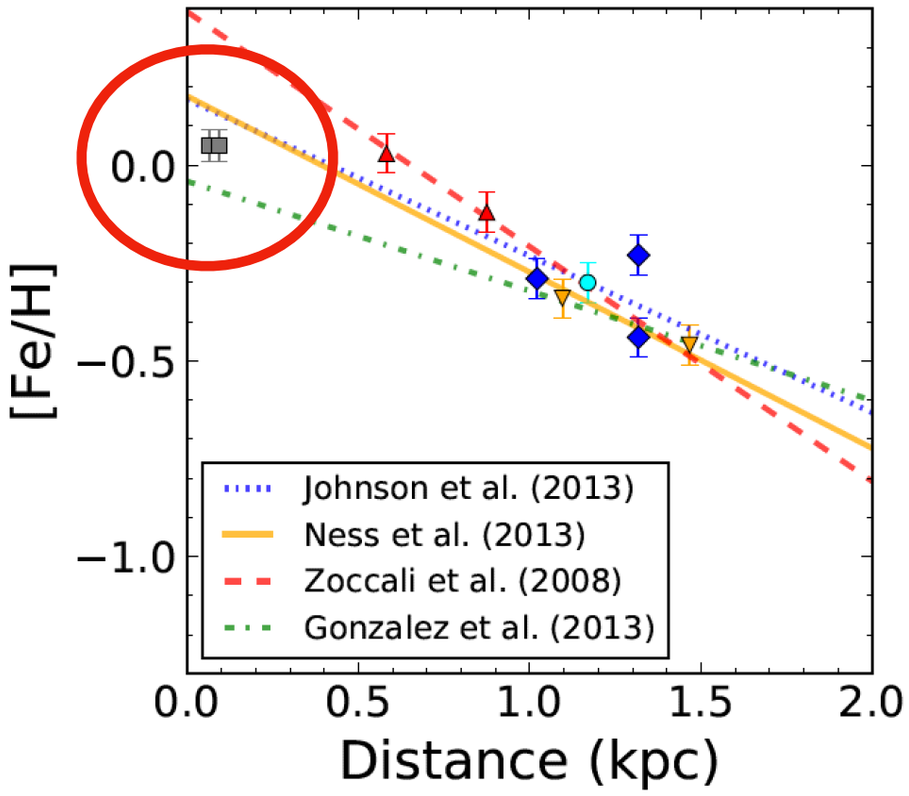
Information from the RGBB

Spatial variation

We selected random regions of 1.8’ ⇨ LF fitting

Everything compatible with the derived age and metallicity

Metallicity gradient



Our results favour a flattening of the metallicity gradient

This is compatible with Rich et al. 2007

Conclusions

1.- Data 0.2” FWHM JHK_s photometry of two fields in the inner bulge

2.- Detection of RC and RGBB

3.- K_s LF fits results in single age stellar population of 12.8 ± 0.6 Gyr and Z = 0.040 ± 0.03 for both fields

4.- No indication of population < 5 Gyr

5.- Metallicity gradient appears to flatten at R < 500 pc

6.- Secondary result: Extinction index consistent with the one for the central field (2.30 ± 0.08).

7.- Stellar population in the nuclear bulge more complex (multi age) than in inner bulge