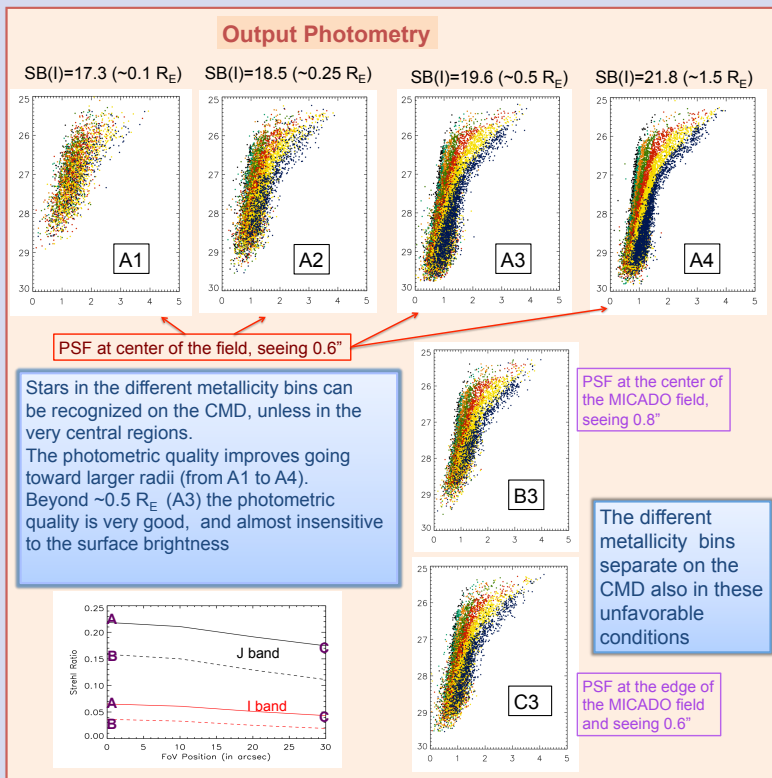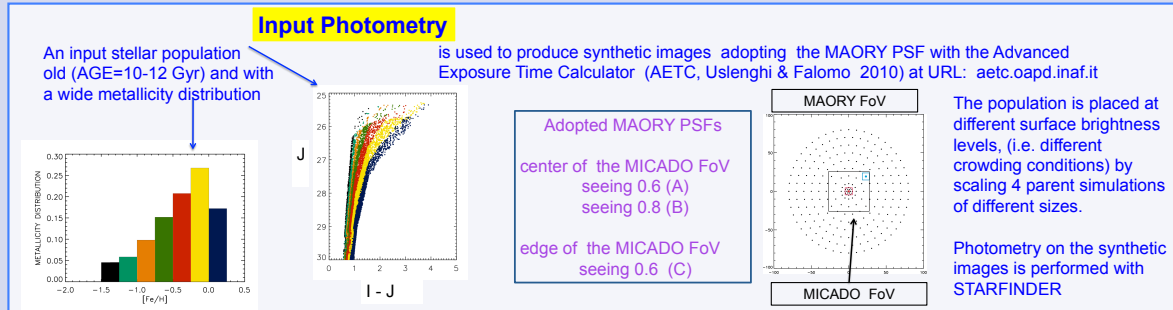# Studying the stellar metallicity gradient in Virgo Ellipticals with E-ELT photometry of resolved stars

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The imaging capabilities currently foreseen for the E-ELT will allow us to perform accurate stellar photometry in crowded fields. Among the many interesting applications it will be possible to derive the metallicity distribution of stars in high surface brightness regions of galaxies from the color distribution of Red Giant Branch stars (Greggio et al 2012). We show here the results of end-to-end simulations at various locations within a giant Elliptical galaxy in the Virgo Cluster. We use a distance modulus of 31.3, an exposure time of 2 hrs, and the expected performance of MICADO @ E-ELT.

Input Photometry

An input stellar population old (AGE=10-12 Gyr) and with a wide metallicity distribution is used to produce synthetic images adopting the MAORY PSF with the Advanced Exposure Time Calculator (AETC, Uslenghi & Falomo 2010) at URL: aetc.oapd.inaf.it

Adopted MAORY PSFs

center of the MICADO FoV
seeing 0.6 (A)
seeing 0.8 (B)

edge of the MICADO FoV
seeing 0.6 (C)

The population is placed at different surface brightness levels, (i.e. different crowding conditions) by scaling 4 parent simulations of different sizes.

Photometry on the synthetic images is performed with STARFINDER

Output Photometry

SB(I)=17.3 (~0.1 R_E)   SB(I)=18.5 (~0.25 R_E)   SB(I)=19.6 (~0.5 R_E)   SB(I)=21.8 (~1.5 R_E)

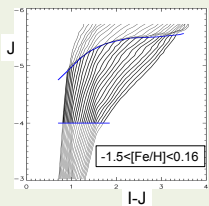A1   A2   A3   A4

PSF at center of the field, seeing 0.6"

Simulated image of a 2.2"x1.9" stellar field at the effective radius of an Elliptical galaxy in Virgo. E-ELT+MAORY+MICADO in the J band (2hrs exposure).
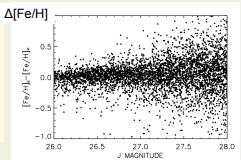

Stars in the different metallicity bins can be recognized on the CMD, unless in the very central regions.
The photometric quality improves going toward larger radii (from A1 to A4).
Beyond ~0.5 R_E (A3) the photometric quality is very good, and almost insensitive to the surface brightness

B3

PSF at the center of the MICADO field, seeing 0.8"

The different metallicity bins separate on the CMD also in these unfavorable conditions

C3

PSF at the edge of the MICADO field and seeing 0.6"

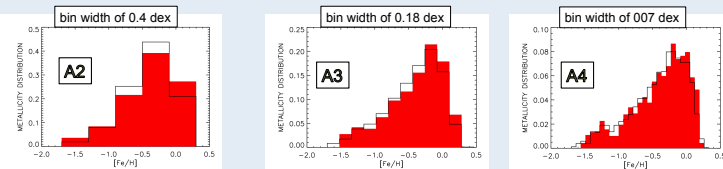### How well can we determine the metallicity of individual stars?

For each object on the output CMD, [Fe/H] is derived by interpolation on theoretical loci.
We consider only stars in the portion of the RGB in boldface

-1.5<[Fe/H]<0.16

Difference between the interpolated [Fe/H] and that of the input star in the same position on the J-band image for the case A2.
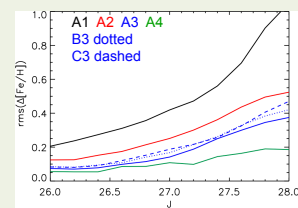
Δ[Fe/H]

The accuracy on [Fe/H] can be quantified as the r.m.s. of the distribution of Δ[Fe/H] of individual stars. The figure below shows how this quantity varies with magnitude for the various SB and PSF considered.

A1 A2 A3 A4
B3 dotted
C3 dashed

rms(Δ[Fe/H])

How well can we derive the metallicity distribution in the stellar field?

bin width of 0.4 dex   A2
bin width of 0.18 dex   A3
bin width of 007 dex   A4
bin width of 0.18 dex   C3

Input (black) and the output (red) metallicity distributions. The [Fe/H] bin has been adjusted to bring the two histograms into best agreement.

The excellent performance of MAORY+MICADO will allow us to measure the metallicity gradients all over the face of Ellipticals in the VIRGO cluster, down to approximately half of the effective radius, with an accuracy better than 0.2 dex.

References:
Falomo, R., Fantinel, D., Uslenghi, M., 2011, SPIE, 8135, 813523
Greggio, L., Falomo, R., Zaggia, S., Uslenghi M., Fantinel, D., 2012, PASP,