

INAF-GTO program

VEGAS:

VST survey of Elliptical GALaxies in the Southern hemisphere

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in collaboration with

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VEGAS: science aims

Multi –band imaging of nearby ET galaxies

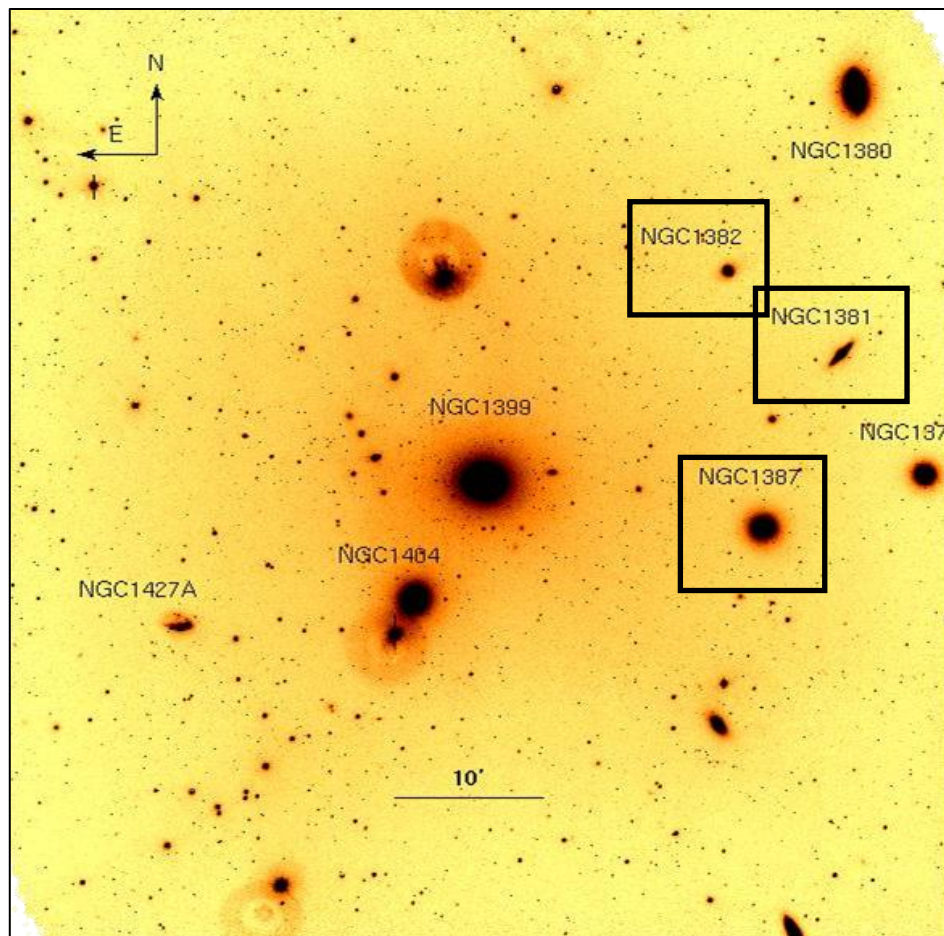
- SB out to 8-10 Re: physical correlations among standard structural parameters (total luminosity, Sersic index, effective radius, ellipticity, boxiness/diskiness)
- g - r, g - i color gradients and the connection with galaxy formation theories;
- GC color and density distribution; GC luminosity function; comparison of GCs integrated colors to the theoretical models (multiple episodes of formation of globular clusters)
- SBF fluctuations for distance and chemical characterization of the stellar population out to 2-3 R_e
- Stellar M/L, stellar masses, M/L gradients
- Study of the long-lived external structure and the diffuse component of the galaxies and their connection with the environment

VEGAS: goals and limits

Survey goals: multiband (u , g , r , i) images of ~ 110 of galaxies with $V_{\text{rad}} < 4000$ km/s in all environments (field to clusters).

Expected SB limits: 27.5 g , 27.0 r , and 26.2 i mag arcsec $^{-2}$ (S/N=10 per arcsec $^{-2}$).

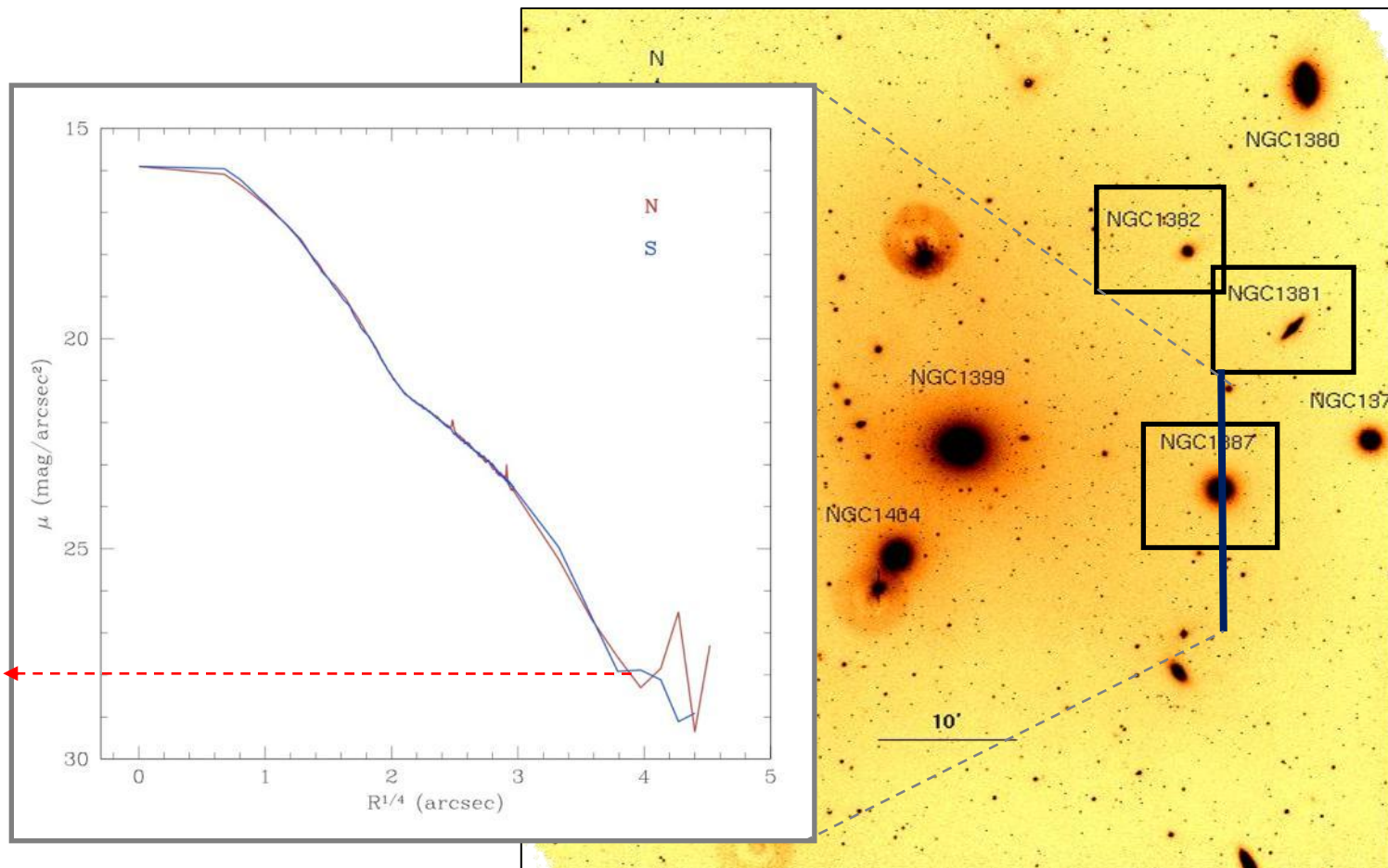
g -band
exp = 7500s
seeing = 1'



VEGAS: goals and limits

Survey goals: multiband (*u*, *g*, *r*, *i*) images of ~ 110 of galaxies with $V_{\text{rad}} < 4000$ km/s in all environments (field to clusters).

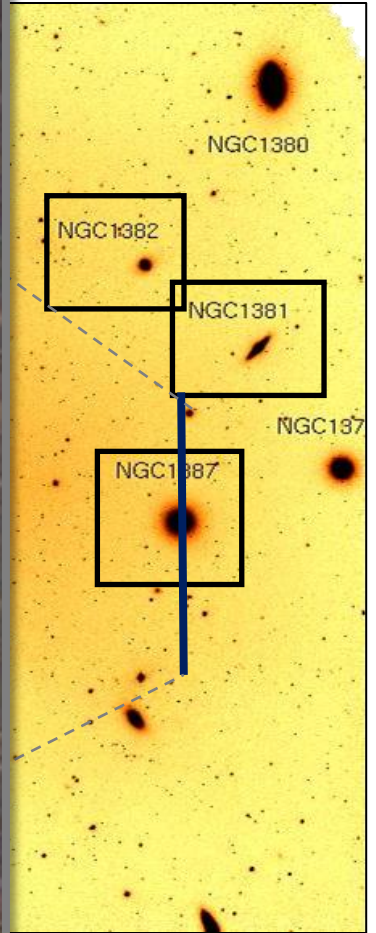
Expected SB limits: 27.5 *g*, 27.0 *r*, and 26.2 *i* mag arcsec⁻² (S/N=10 per arcsec²).



Survey goals: multi
enviro

Expected SB limits:

4000 km/s in all
arcsec⁻²).



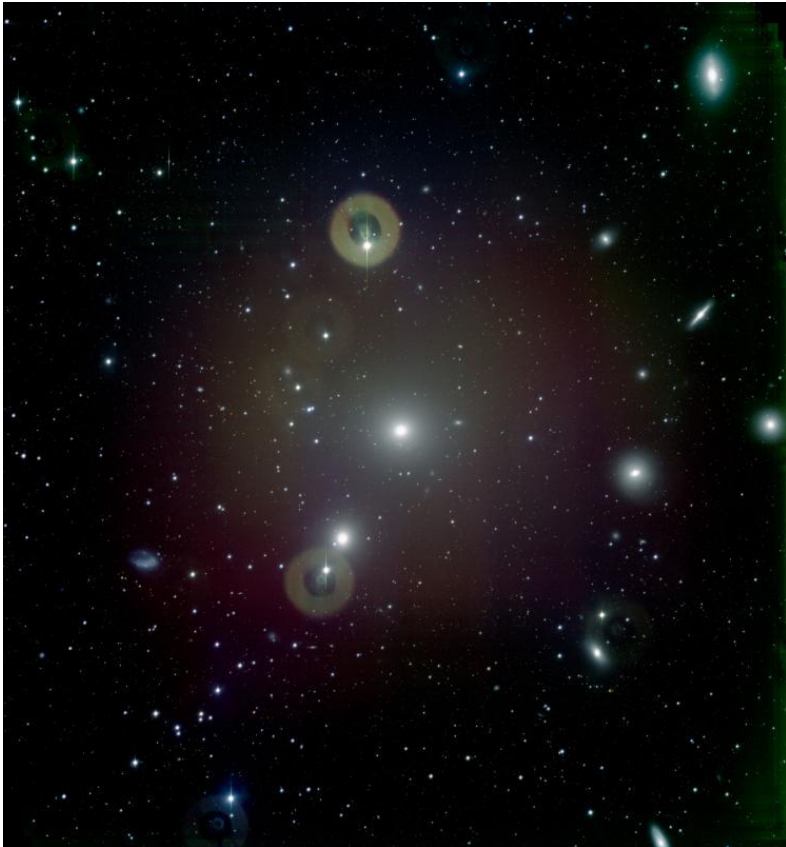
Instead



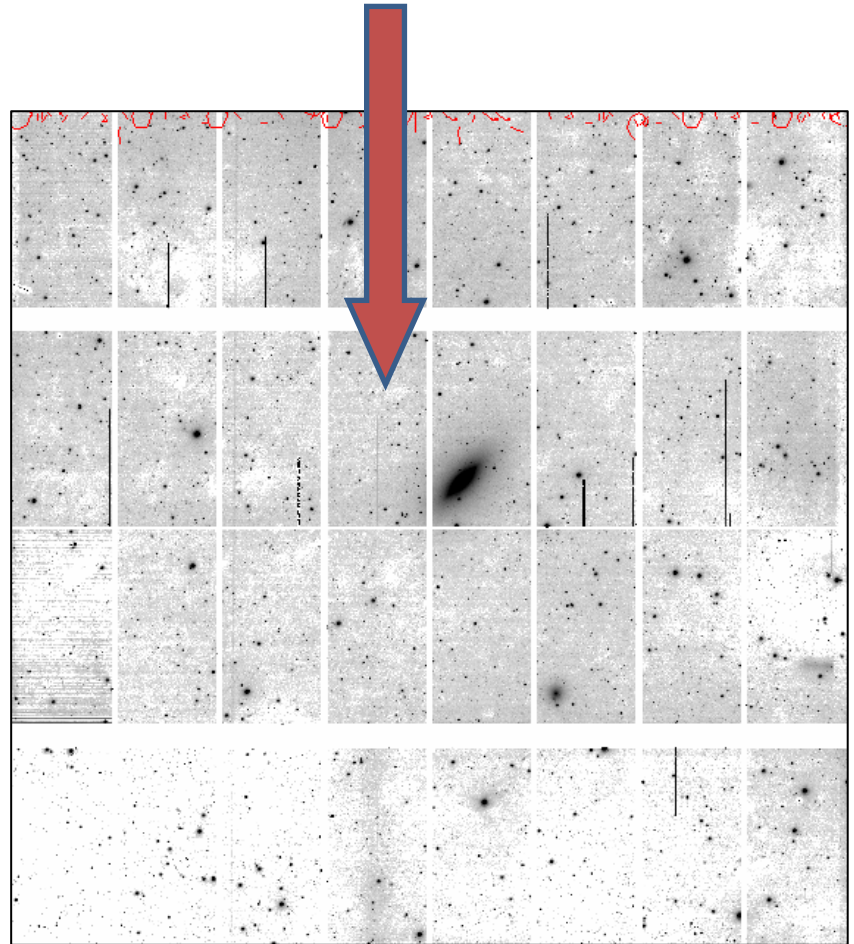
Gustave Courbet, *Self-Portrait (The Desperate Man)*, 1844-1845,

VEGAS: VST performances in galaxy photometry

Now illumination correction is less critical



halo around NGC 1399 (ICL?)

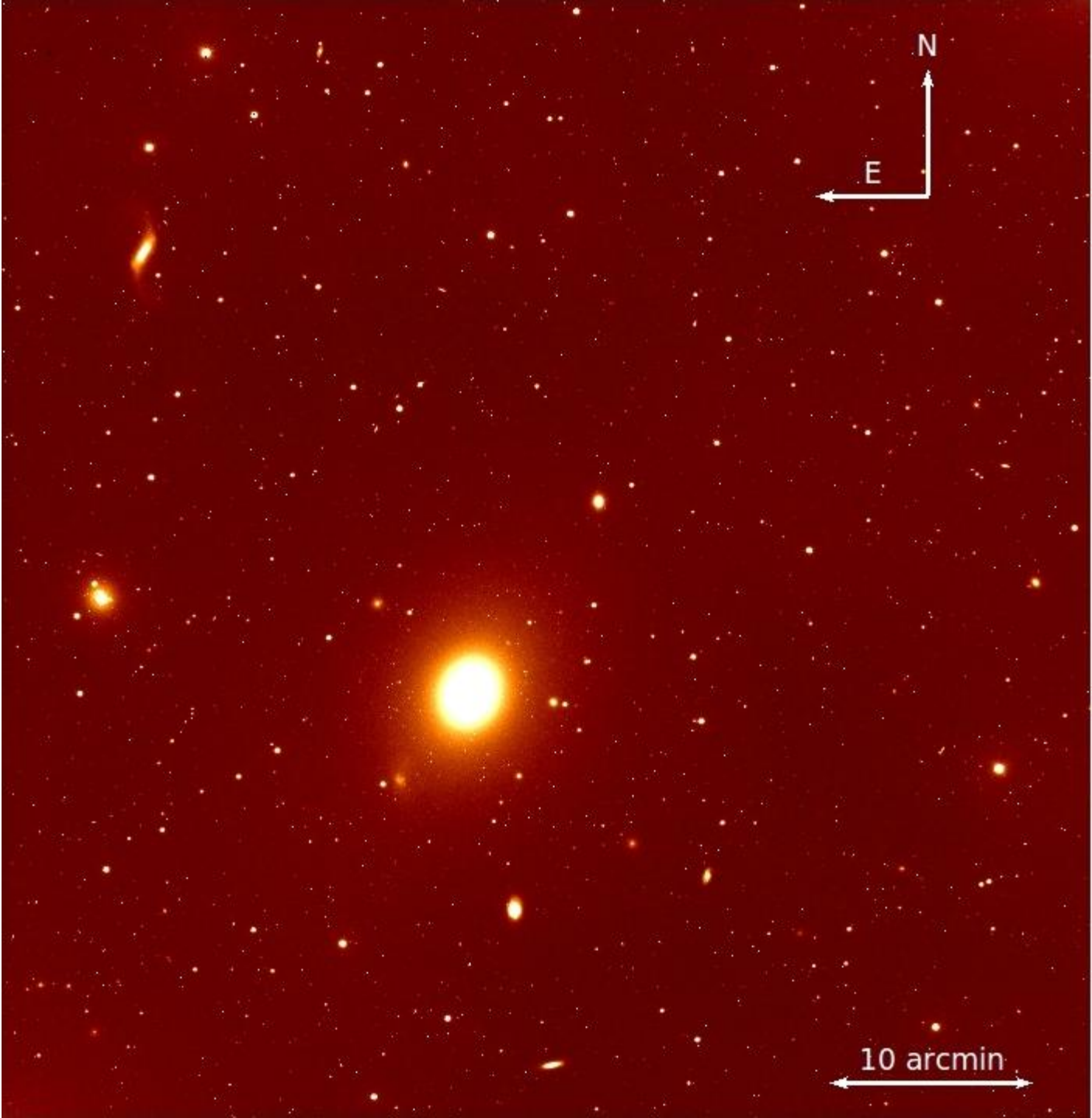


Randomly variable background

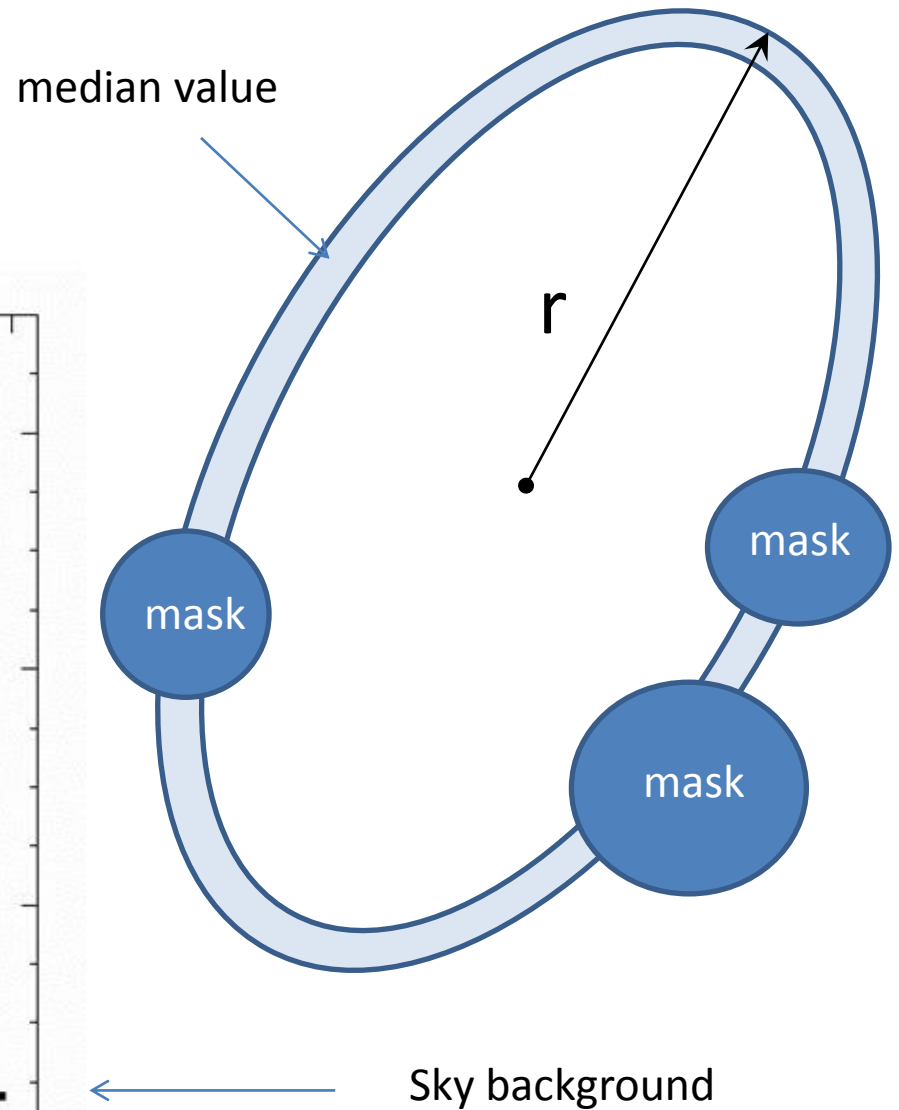
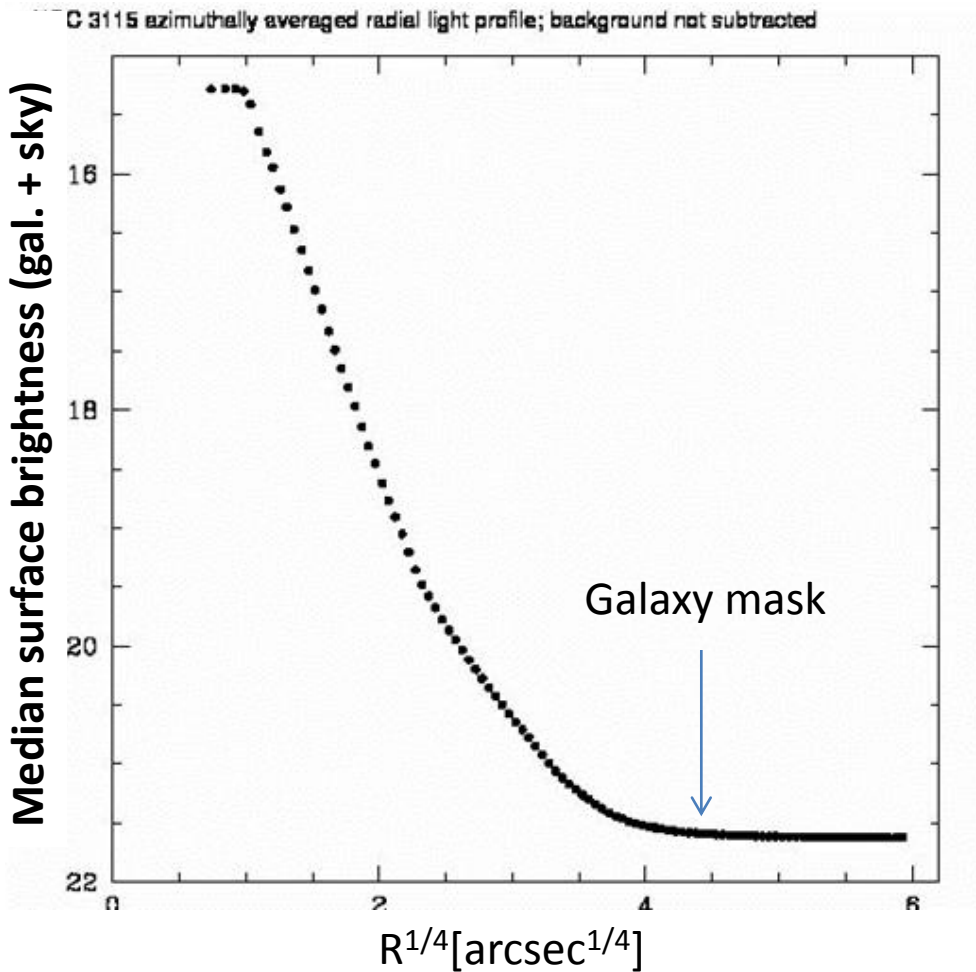
Background determination

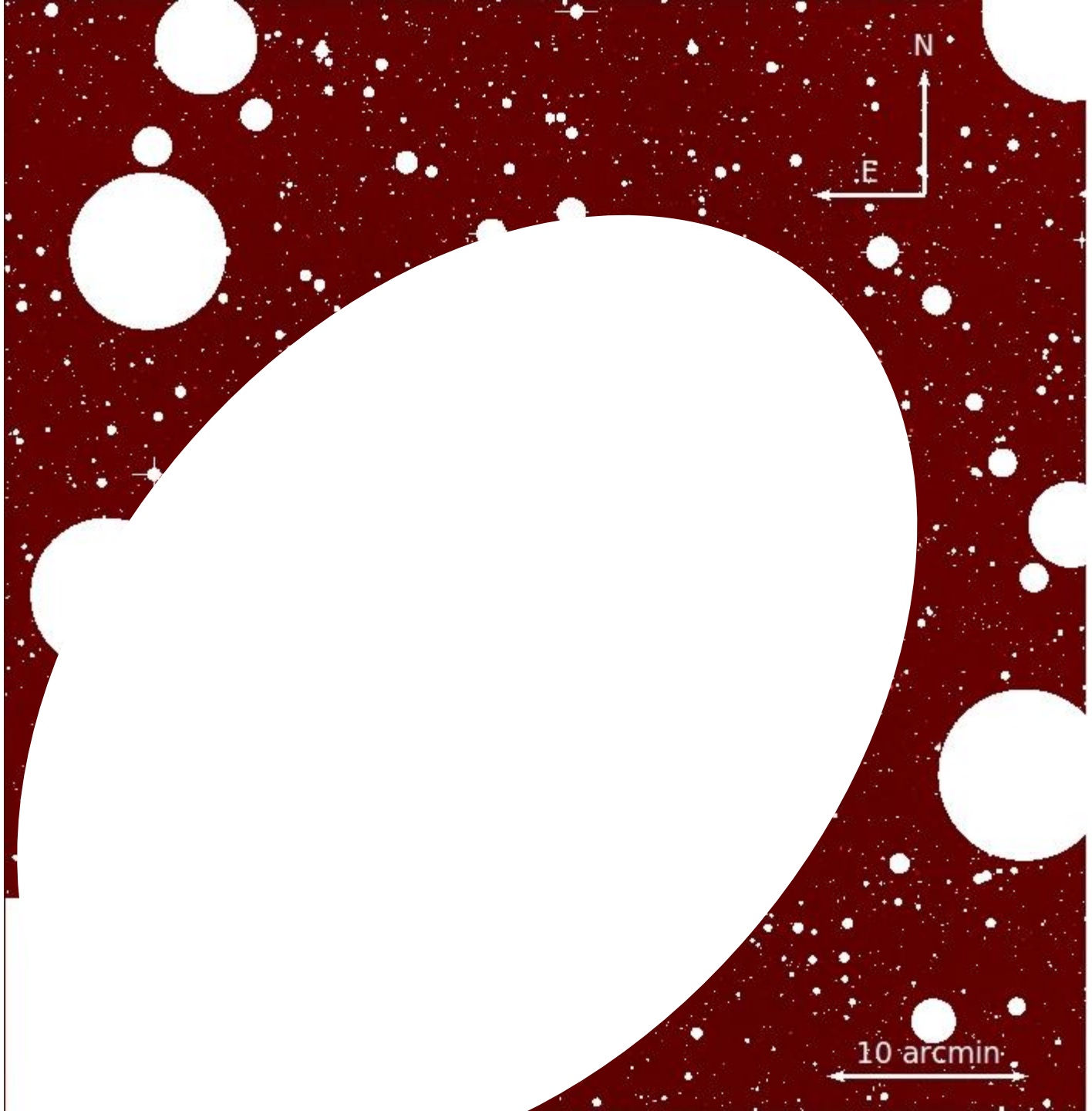
1. Mask the stars automatically
2. Mask the ghost images etc.
3. Find a procedure to set the smallest mask to the galaxy resting on the shape parameters derived by an ellipse fitting to the isophotes
4. Mask the galaxy
5. Fit the rest with some kind of polynomial
6. Reject (O-C) residuals exceeding $\pm\beta\sigma$ and go back to step 5 reducing progressively β from 3 to 1
7. Subtract the final polynomial surface to the image

NGC 4472
field
in g-band



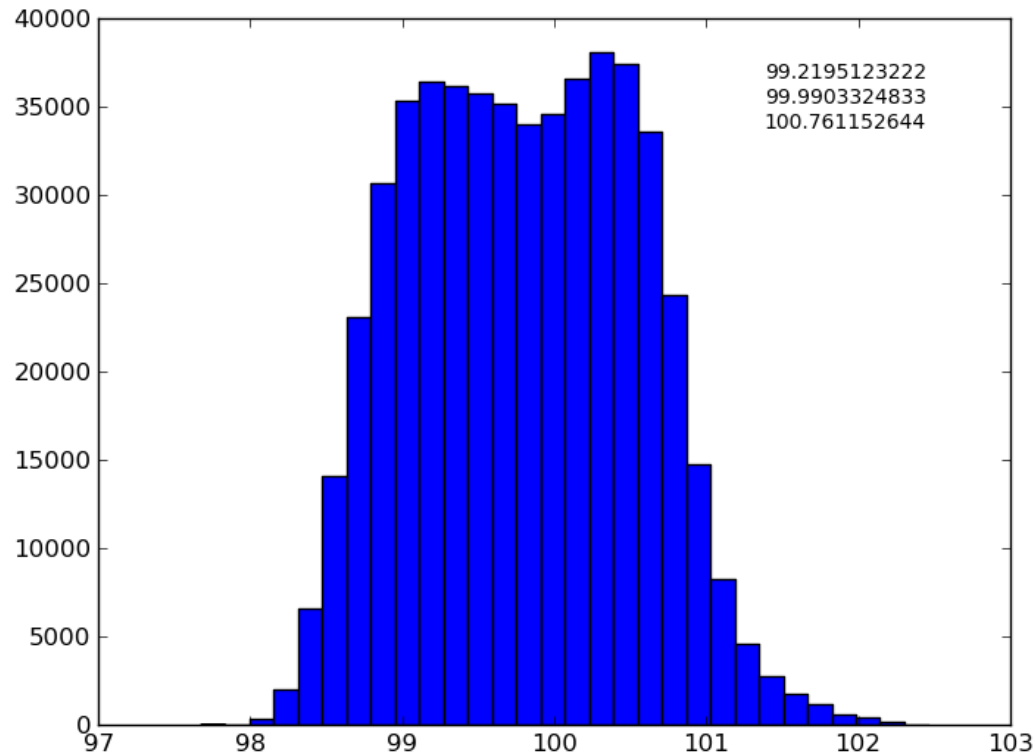
Background determination: azimuthal averaging





Sky background determination

Distribution of the background values:
a nightmare



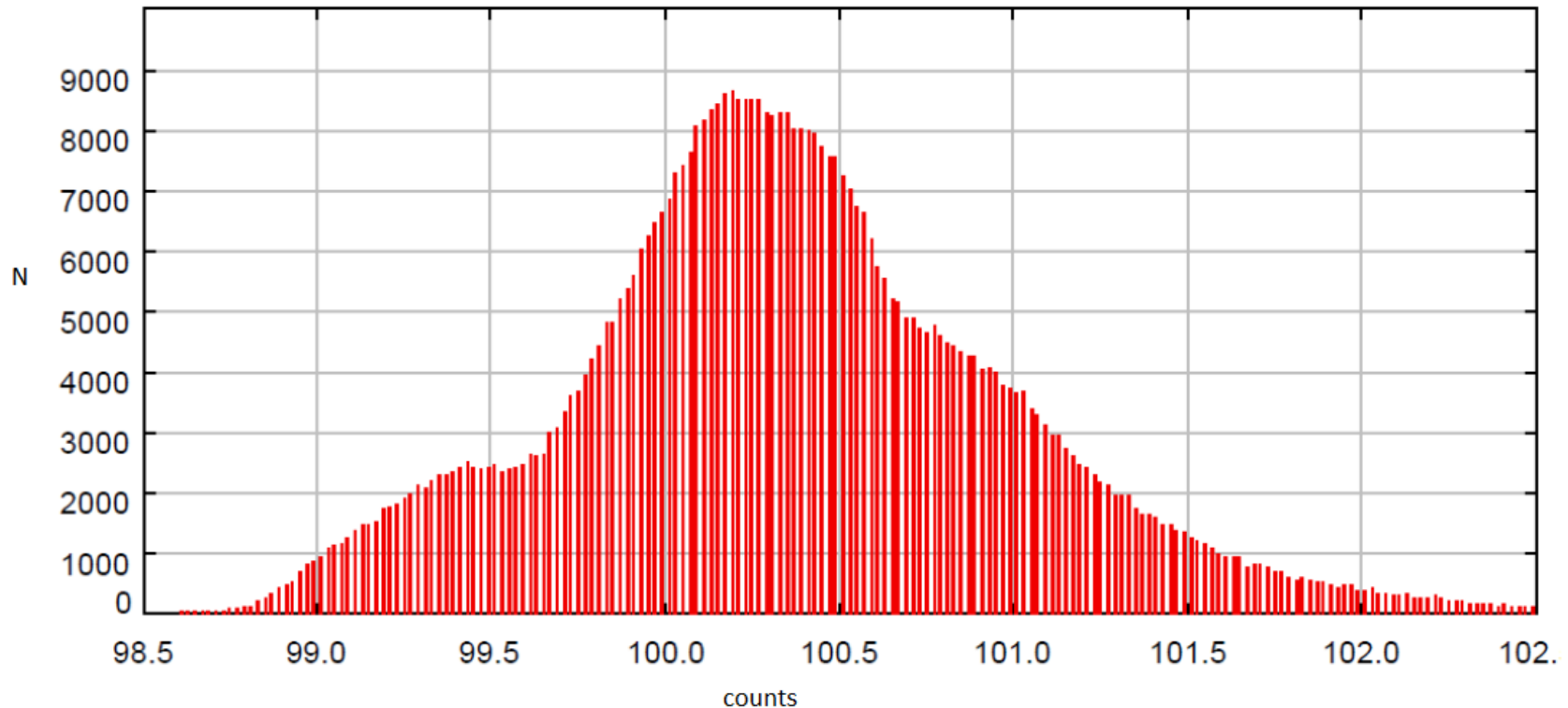
Sky background determination

Distribution of the background values:

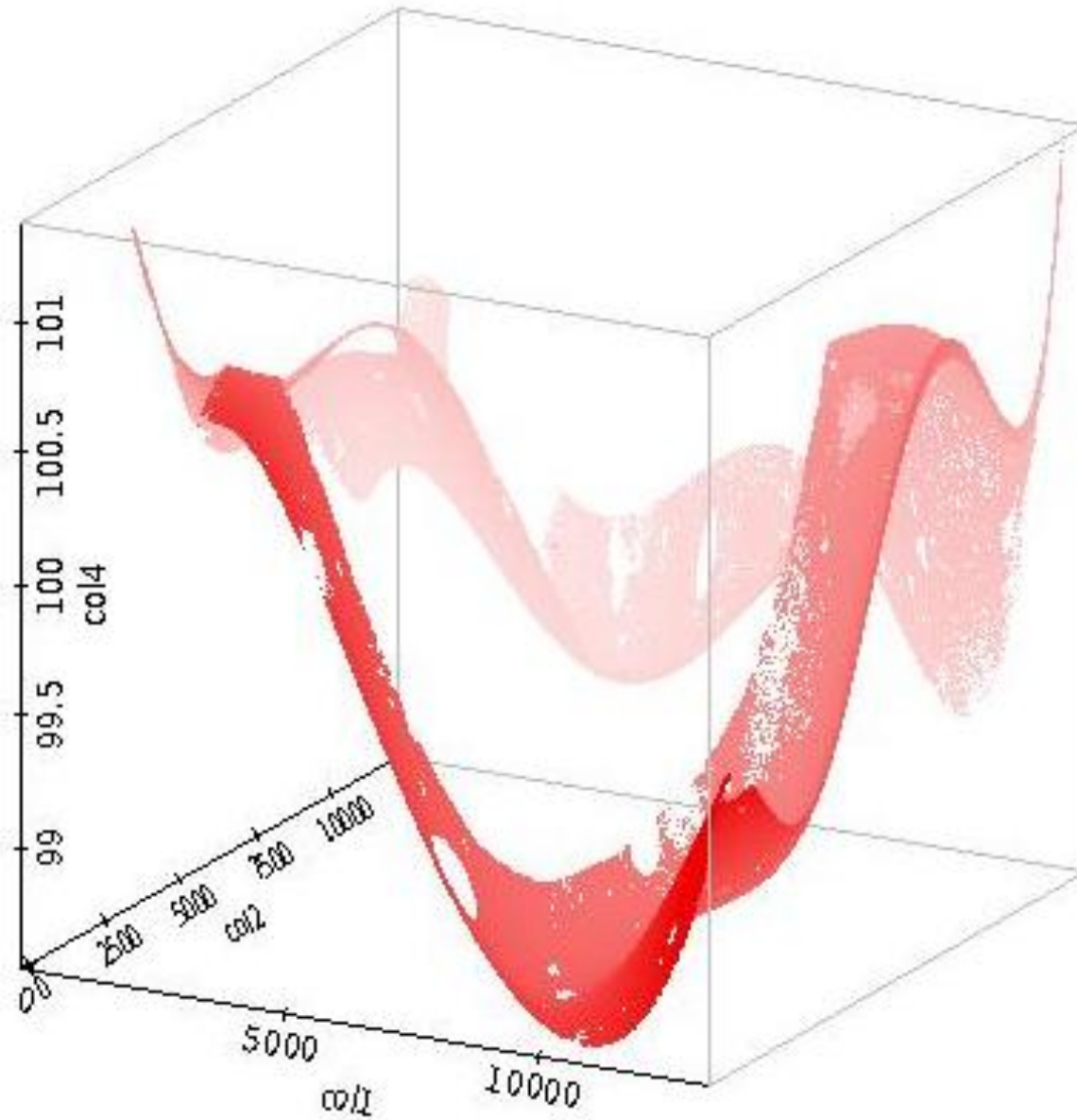
a nightmare

Another, even more dramatic example

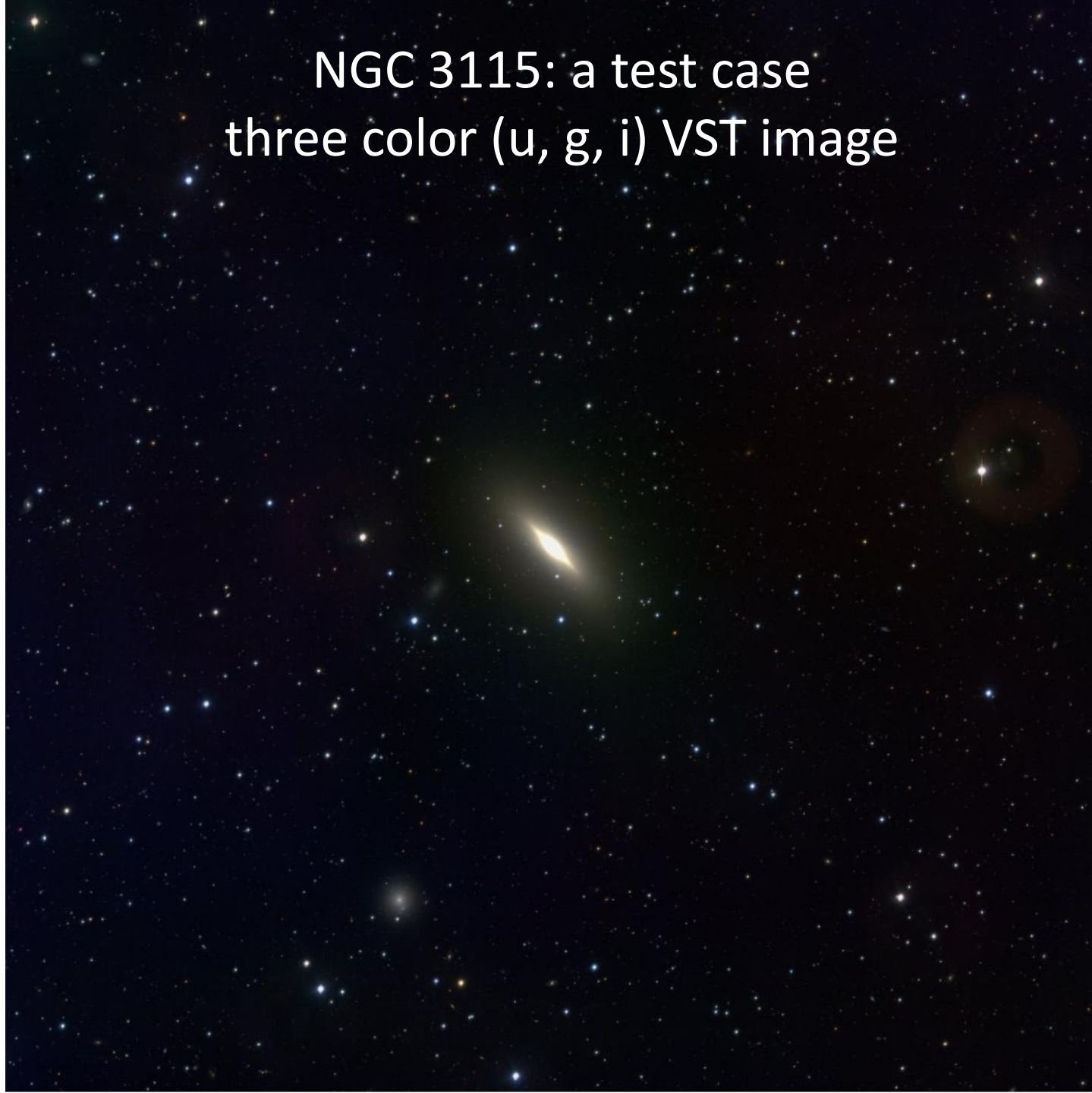
NGC 3115 g _ distribuzione dei punti in conteggi _ senza isola

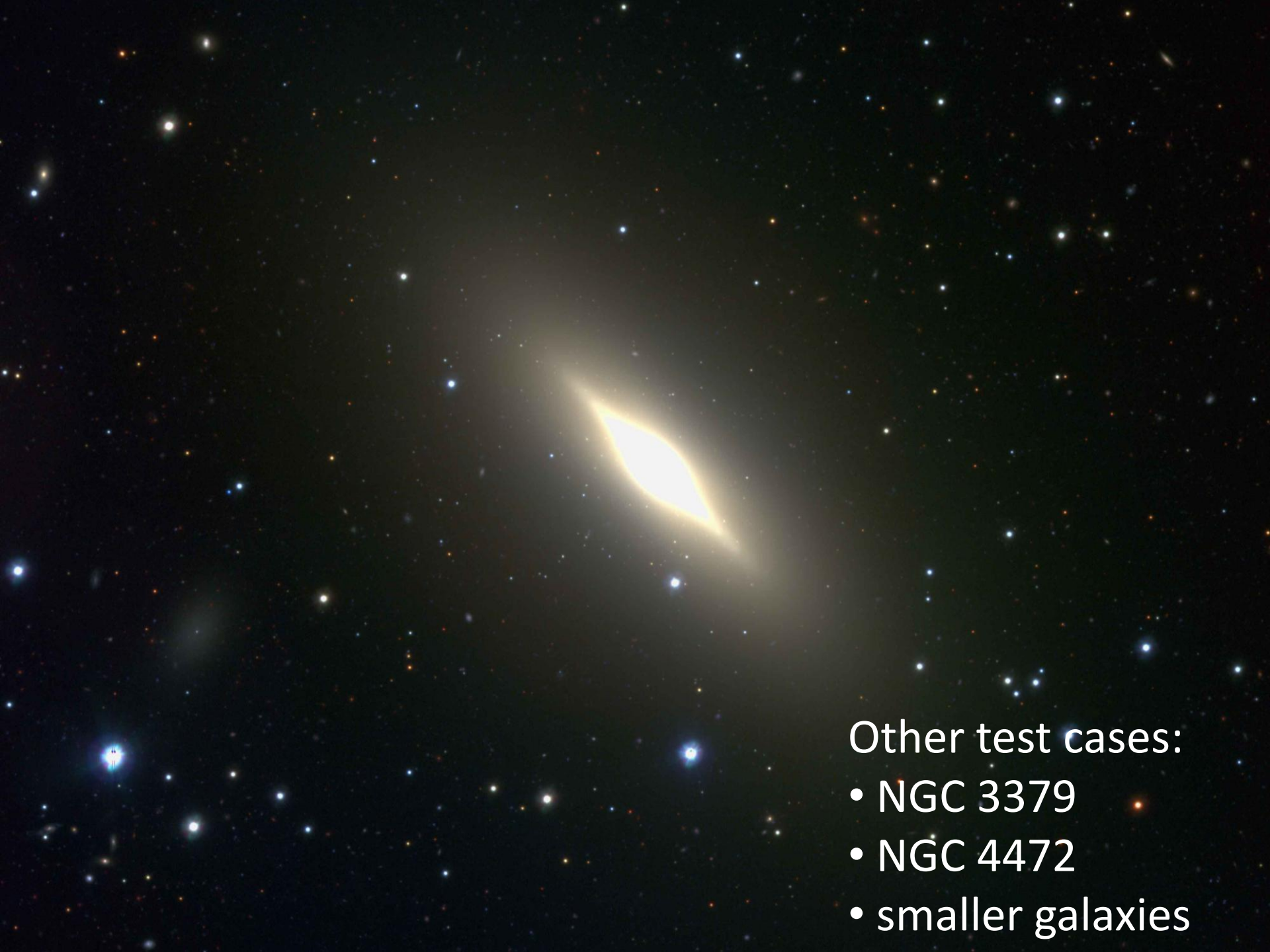


This is how the background looks like



NGC 3115: a test case
three color (u, g, i) VST image





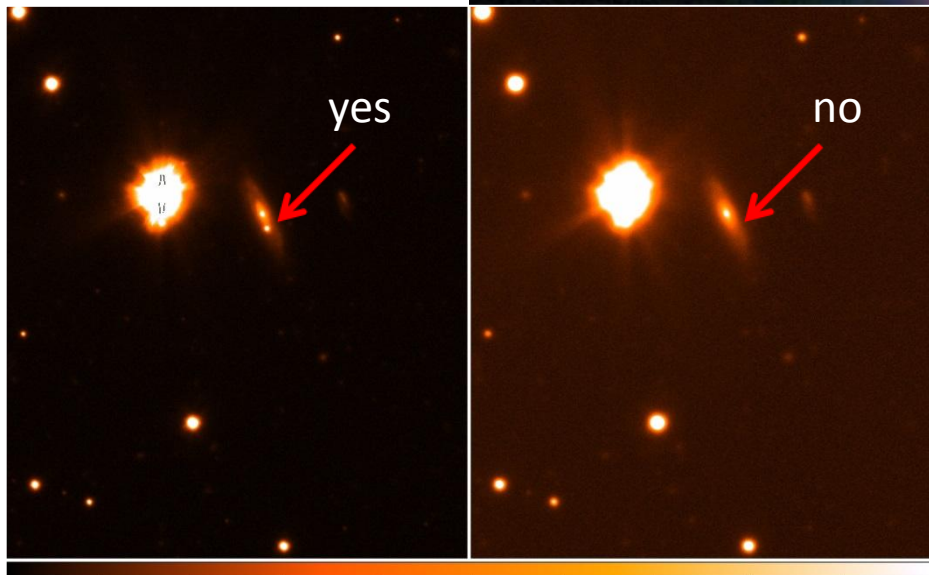
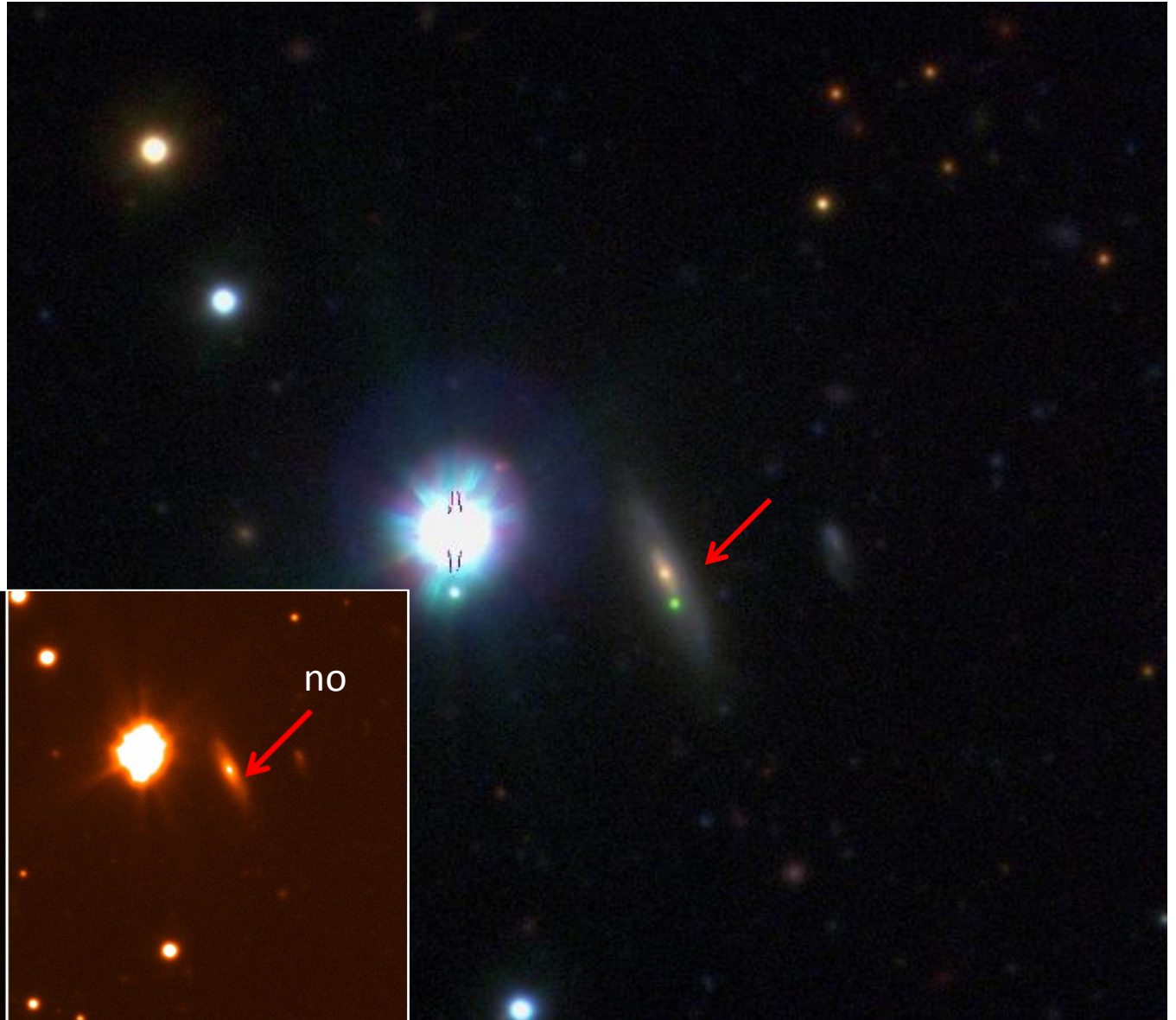
Other test cases:

- NGC 3379
- NGC 4472
- smaller galaxies

Rule No1.: mine VEGAS images



Mining color images: supernova in NGC 3115 field

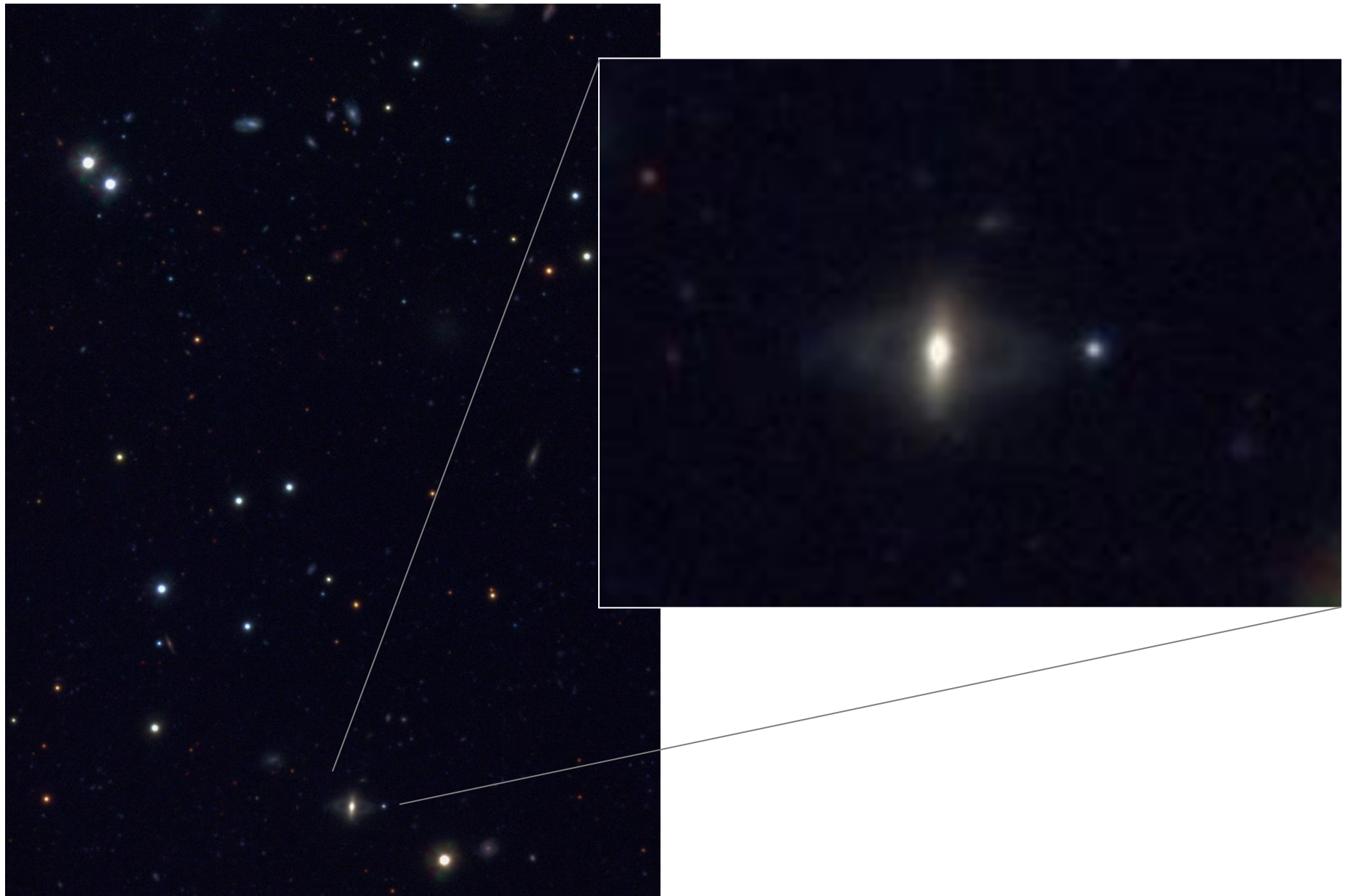


109 130 151 172 194 215 236 258 279

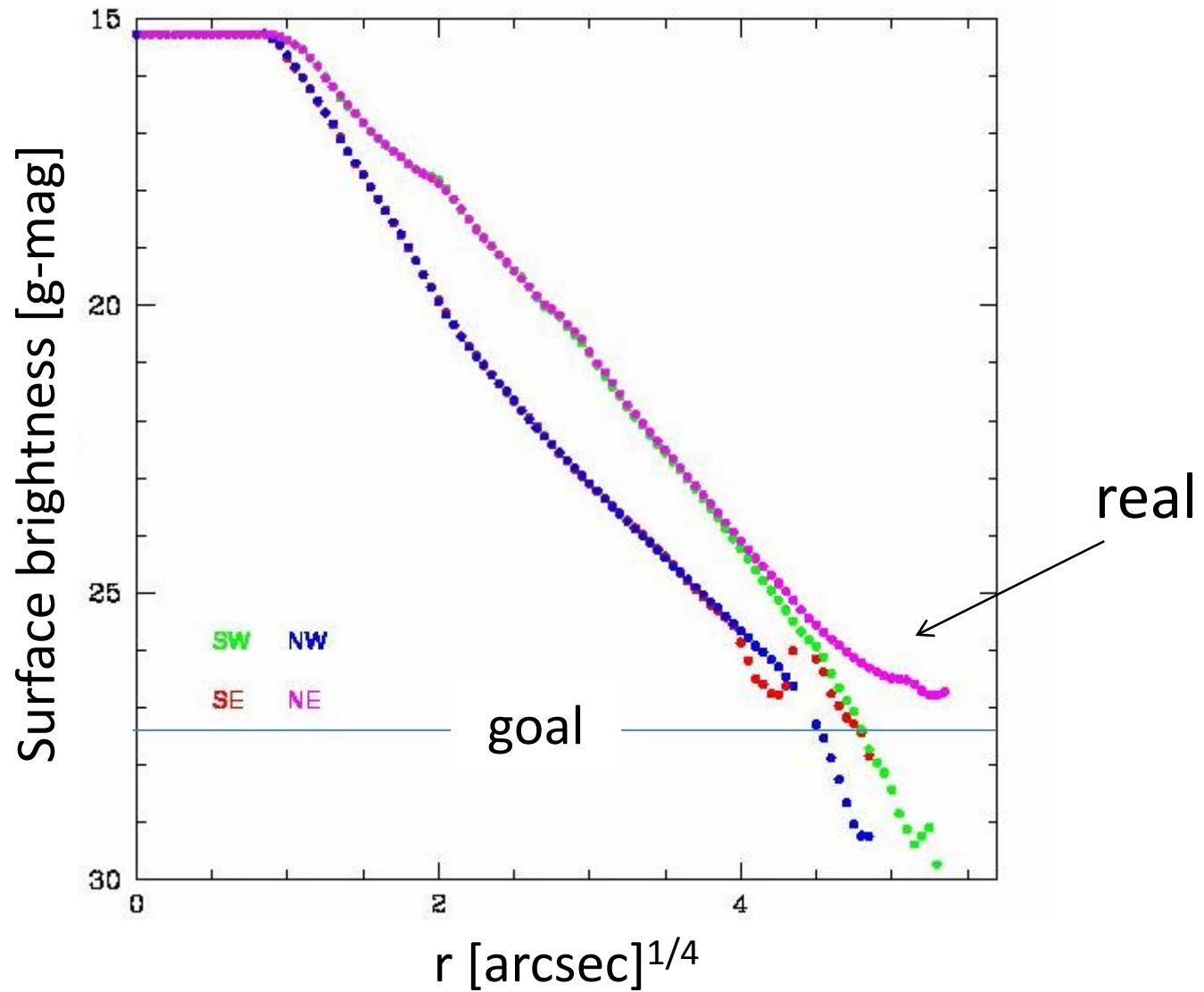
Mining color images: gravitational arc in NGC 3115 field



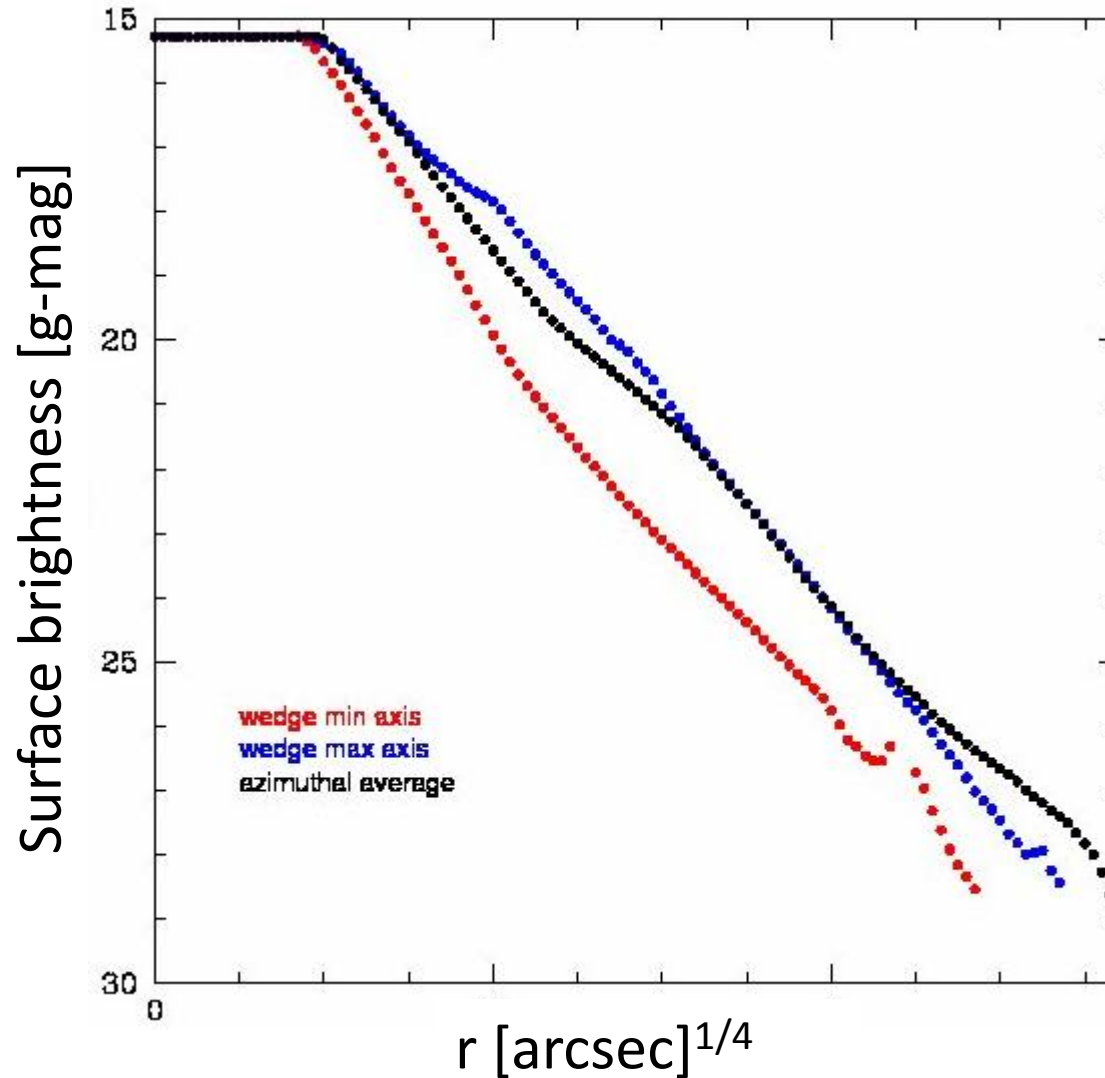
Mining color images: polar ring galaxy in NGC 3115 field



NGC 3115: g-band main axes light profiles

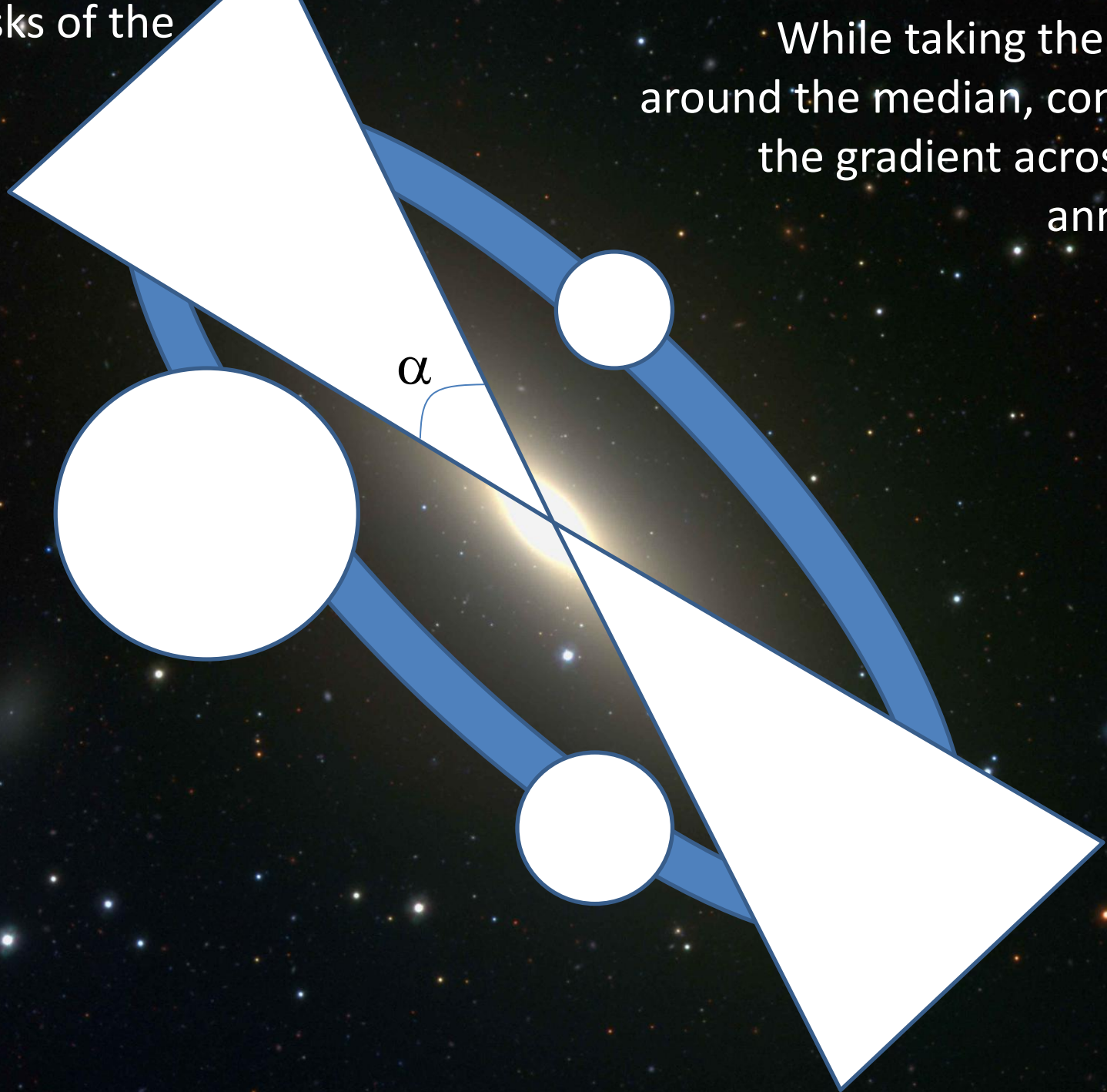


NGC 3115: azimuthally averaged g-band light profile vs averaged main axes profiles

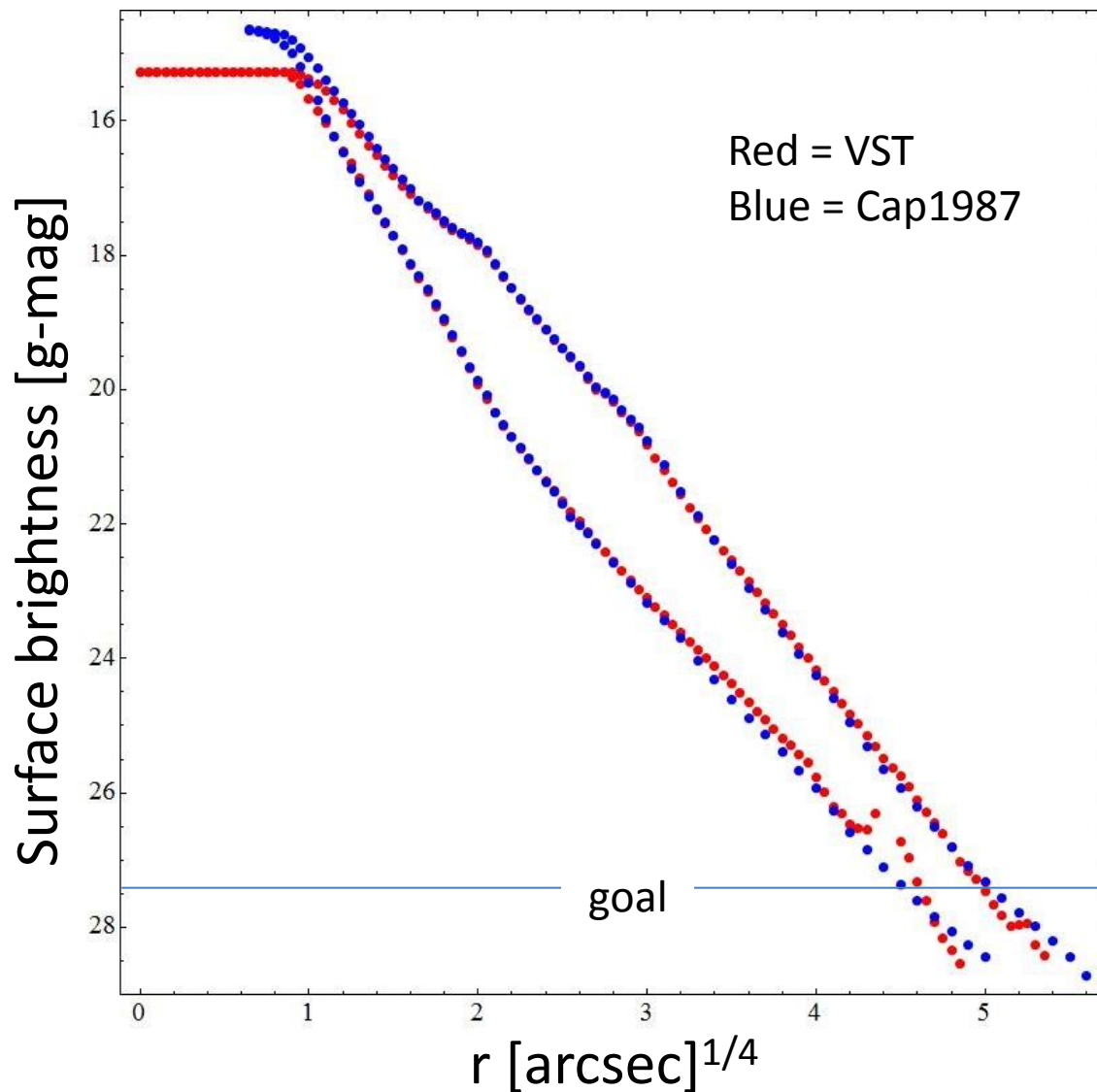


Masks of the
disk

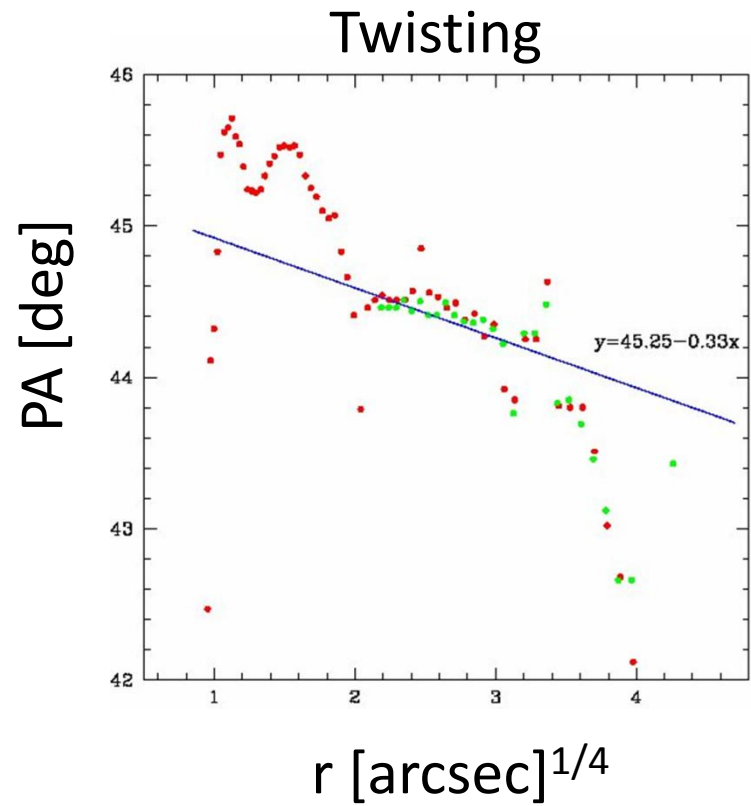
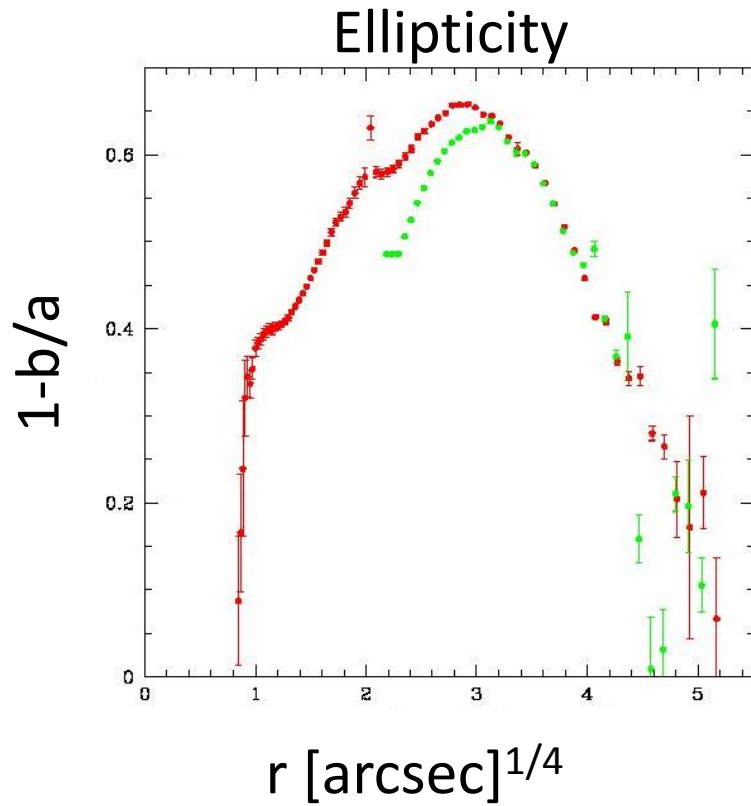
While taking the error
around the median,
consider
the gradient across the
annulus.



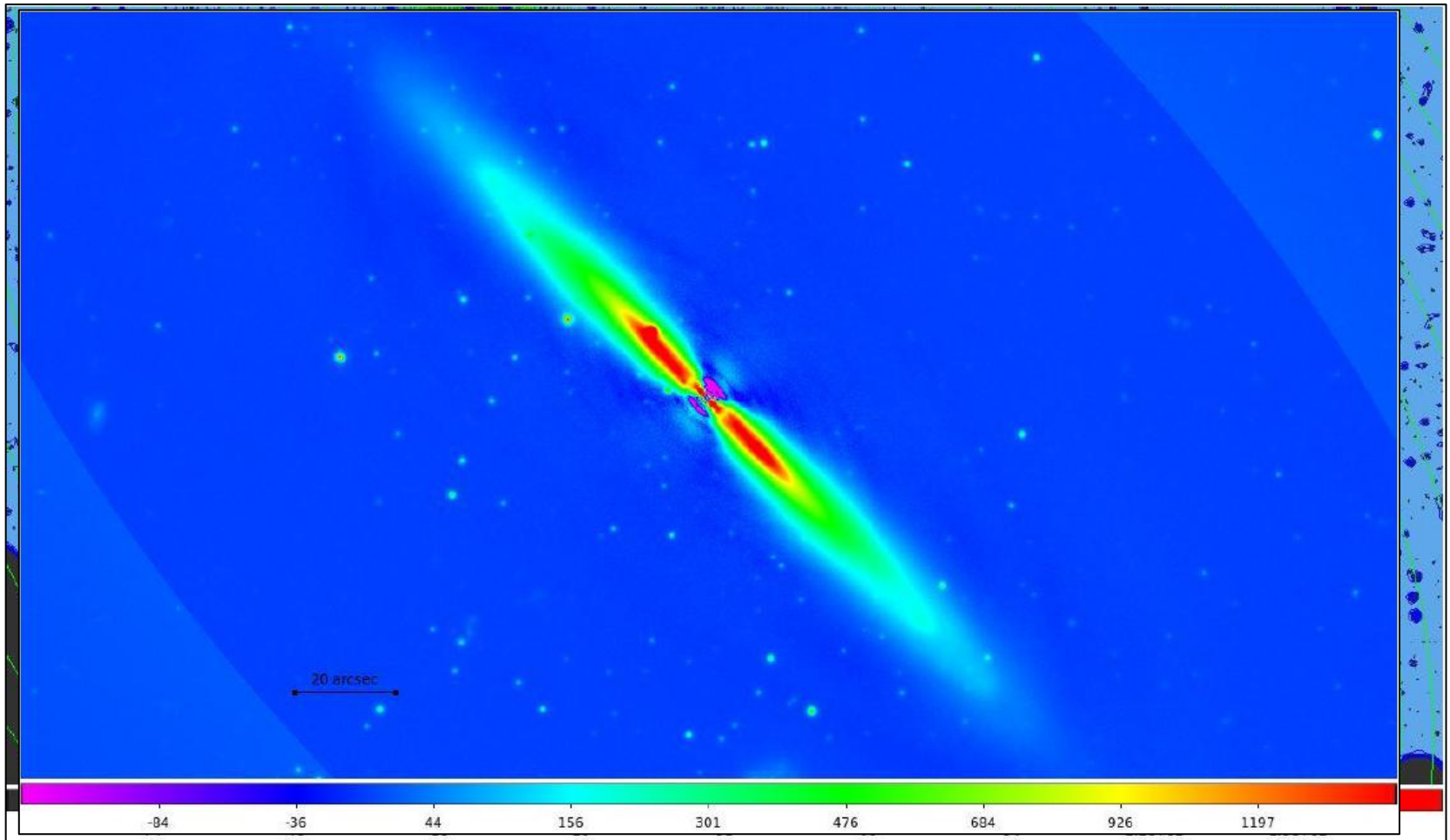
NGC 3115: g-band averaged main axes profiles compared with Capaccioli et al. (1987), B-band [(B-g) = 0.7 mag]



NGC 3115: g-band geometrical parameters

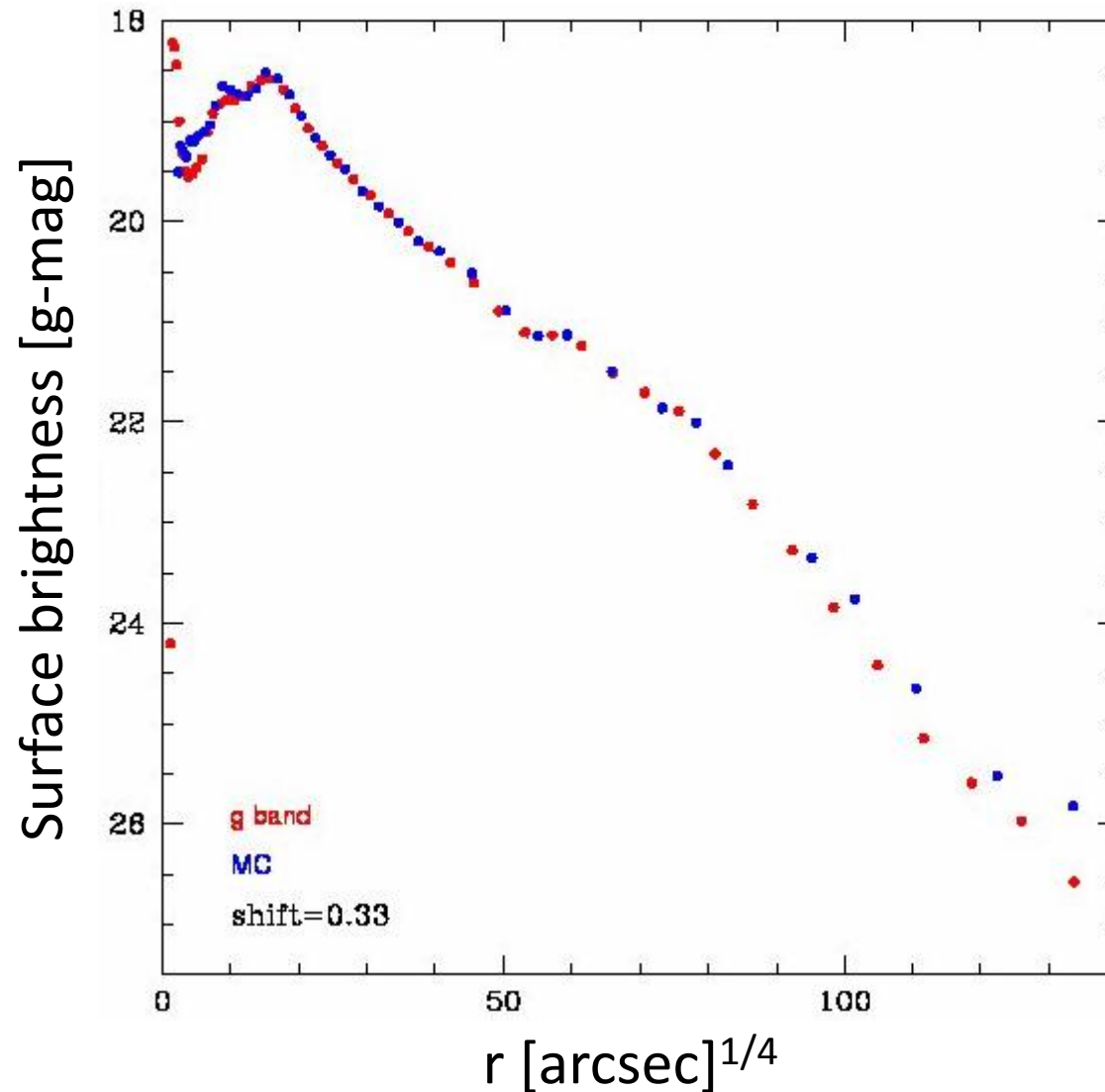


NGC 3115: g-band bulge modelling to extract the disk

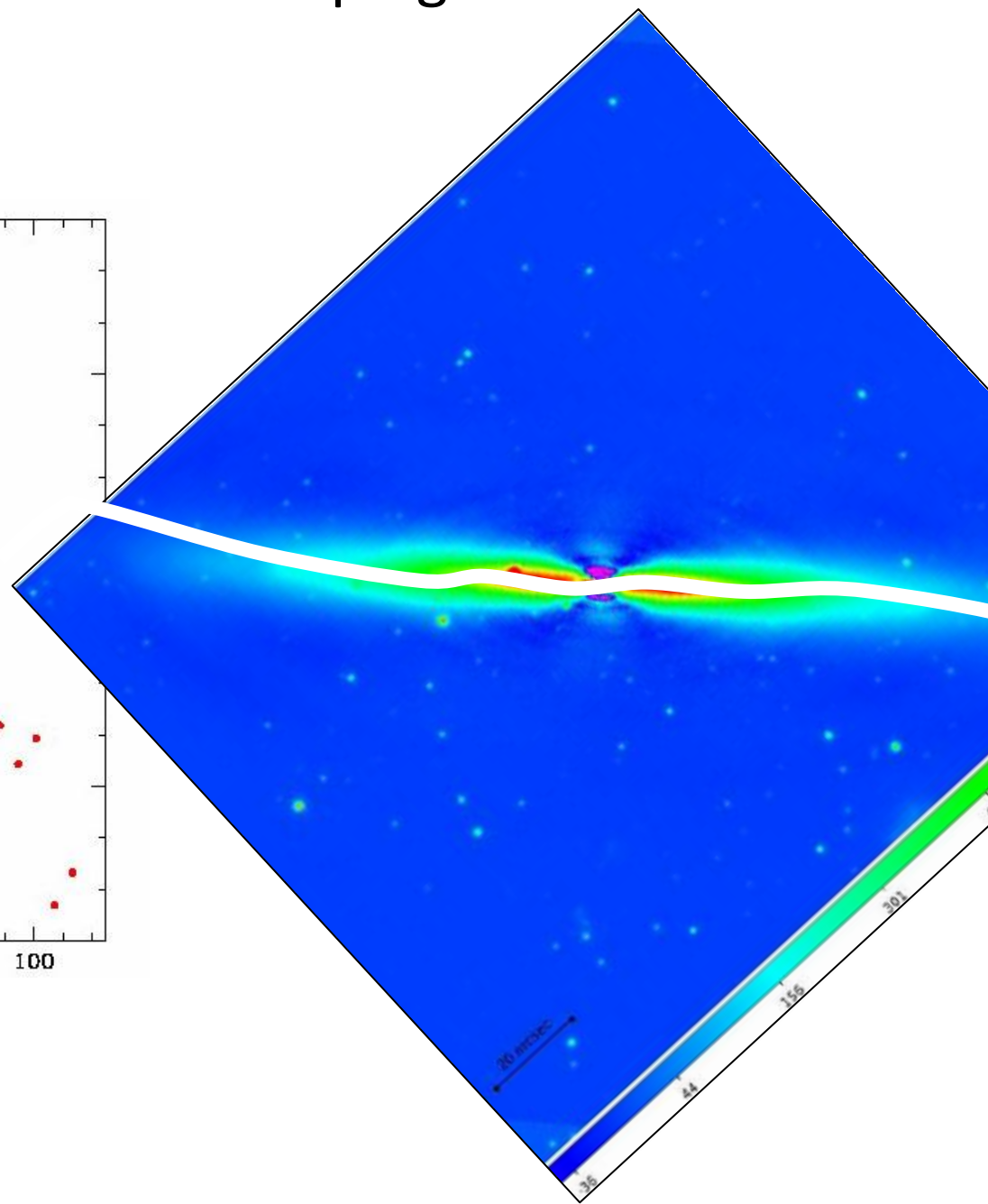
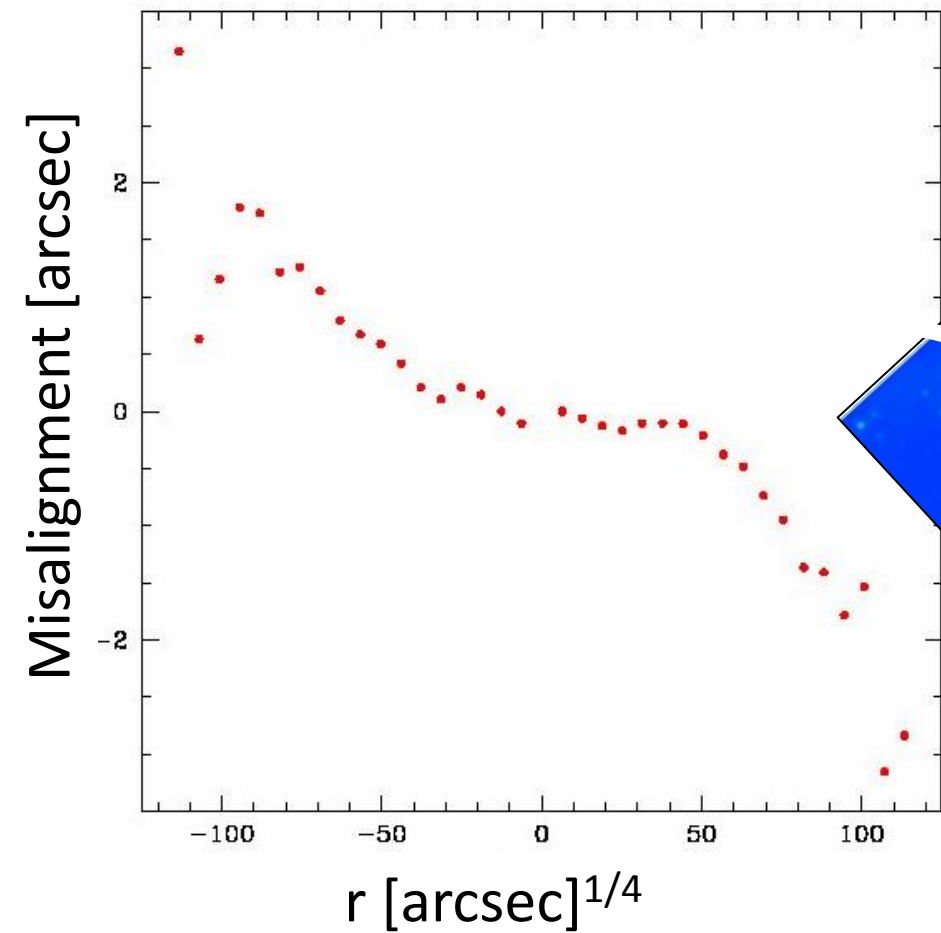


NGC 3115 disk: g-band major axis light profile

Comparison with Capaccioli et al 1993

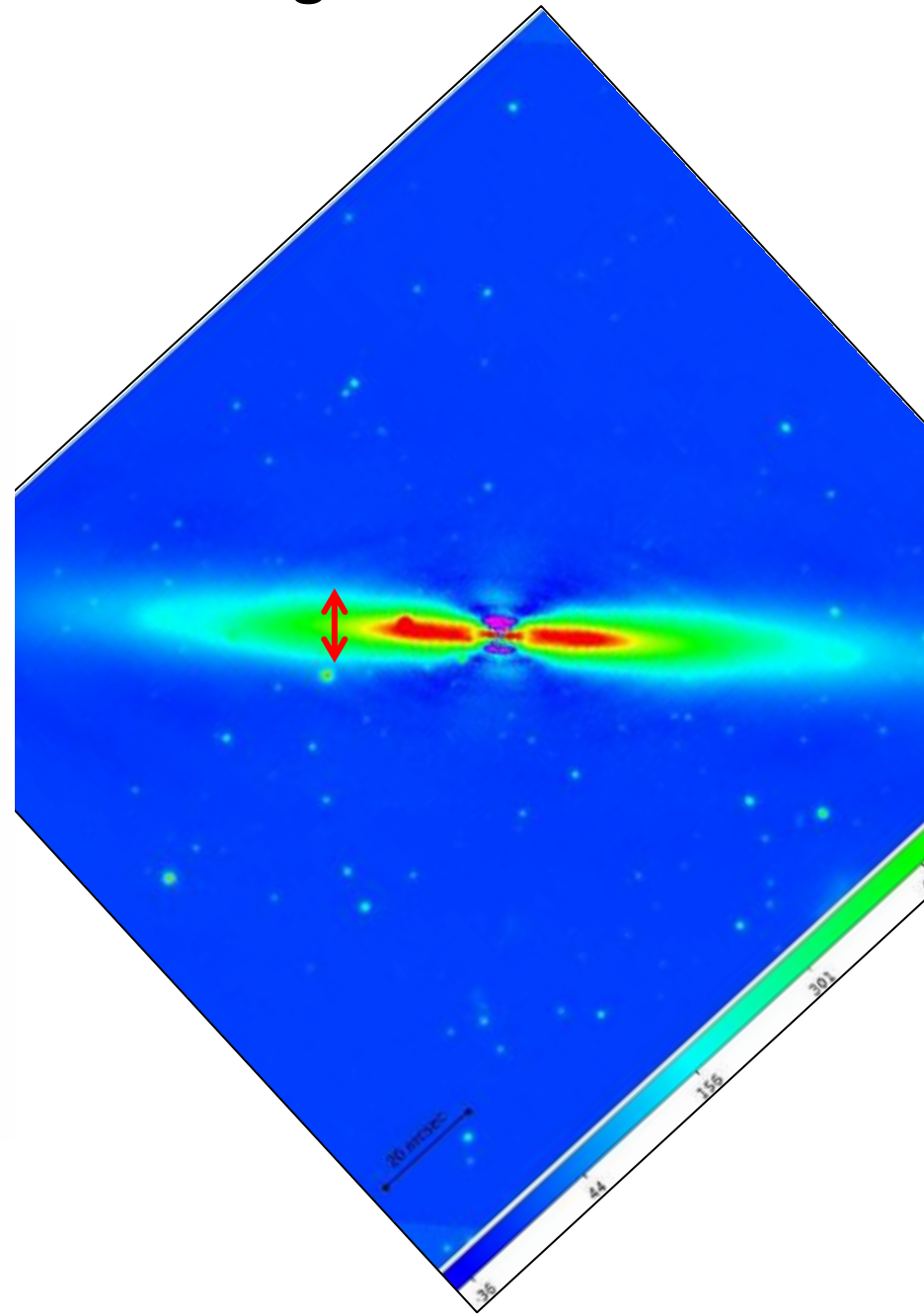
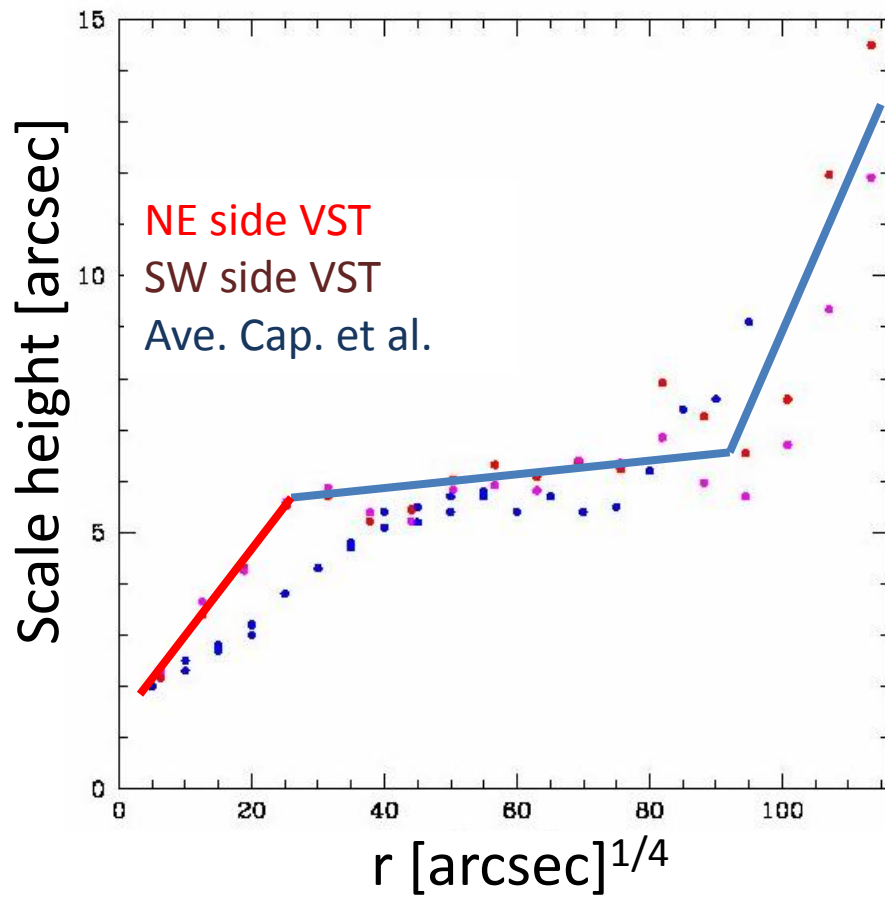


NGC 3115 disk: warping



NGC 3115 disk: scale height

Capaccioli et al., 1988, MNRAS, 234, 335



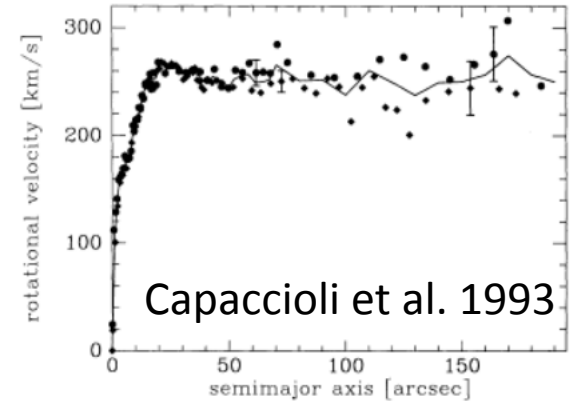
A dynamical toy model (see Capaccioli et al., 1988)

$$\frac{d^2 \ln \varrho(R, z)}{dz^2} = - \frac{4\pi G \varrho}{\langle V_z^2 \rangle} - \frac{V_{\text{rot}}^2}{\langle V_z^2 \rangle} \frac{1/q_\phi^2}{R^2 + R_0^2} \quad \xrightarrow{=1}$$

$$\Phi = \frac{1}{2} V_{\text{rot}}^2 \ln (R_0^2 + R^2 + z^2/q_\phi^2)$$

$$\varrho(R, z) \simeq \varrho_0(R) (1 - z^2/z_0^2)$$

$$z_0^2 \equiv \frac{H_0^2}{1 + H_0^2/2\sigma^2}, \quad H_0^2 \equiv \frac{\langle V_z^2 \rangle}{2\pi G \varrho_0(R)}, \quad \sigma^2 \equiv \frac{\langle V_z^2 \rangle}{V_{\text{rot}}^2} (R^2 + R_0^2)$$

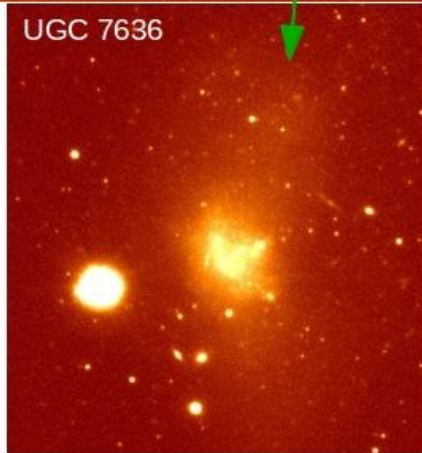
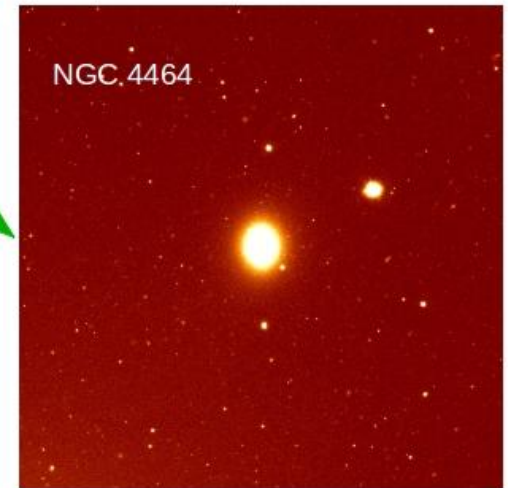
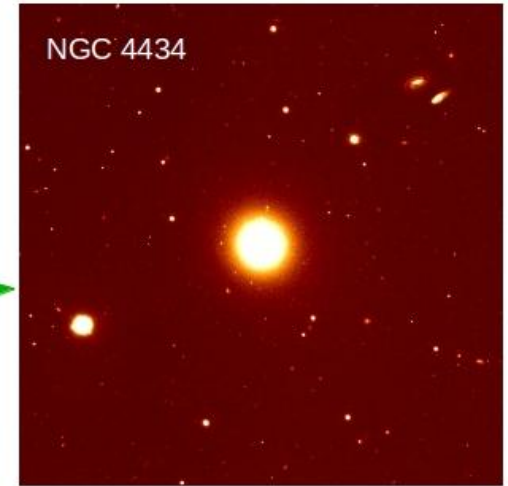
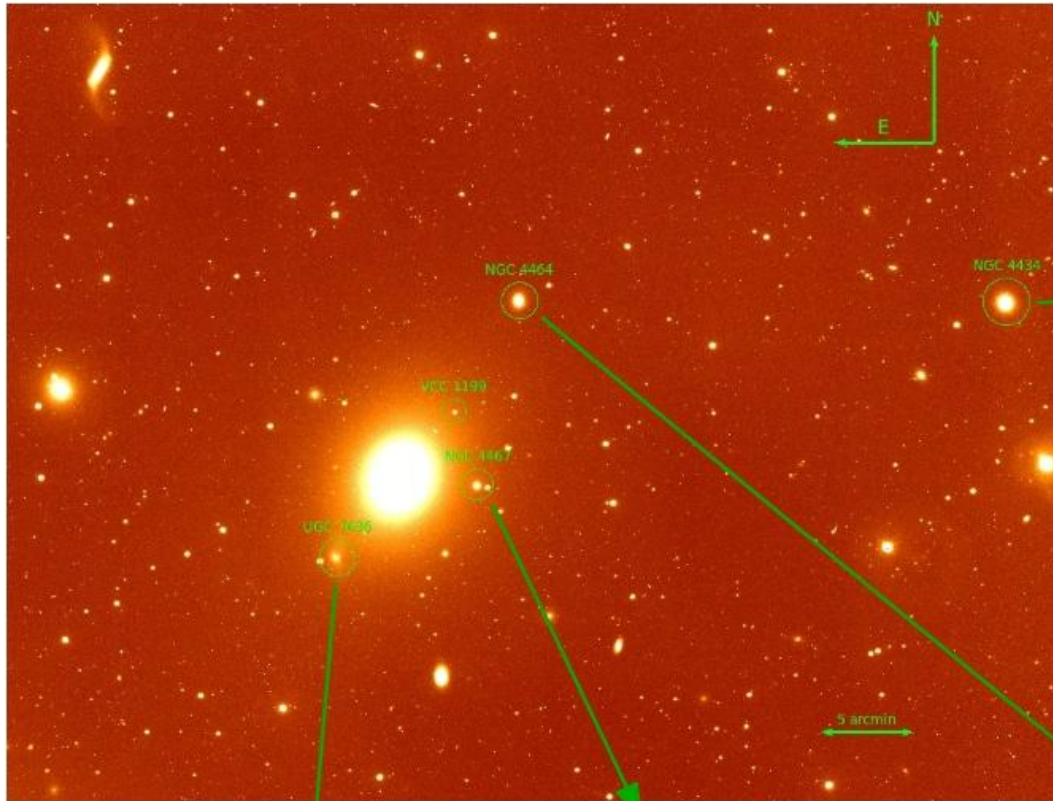


Equivalence between self and external gravity at $R = R_c$, where:

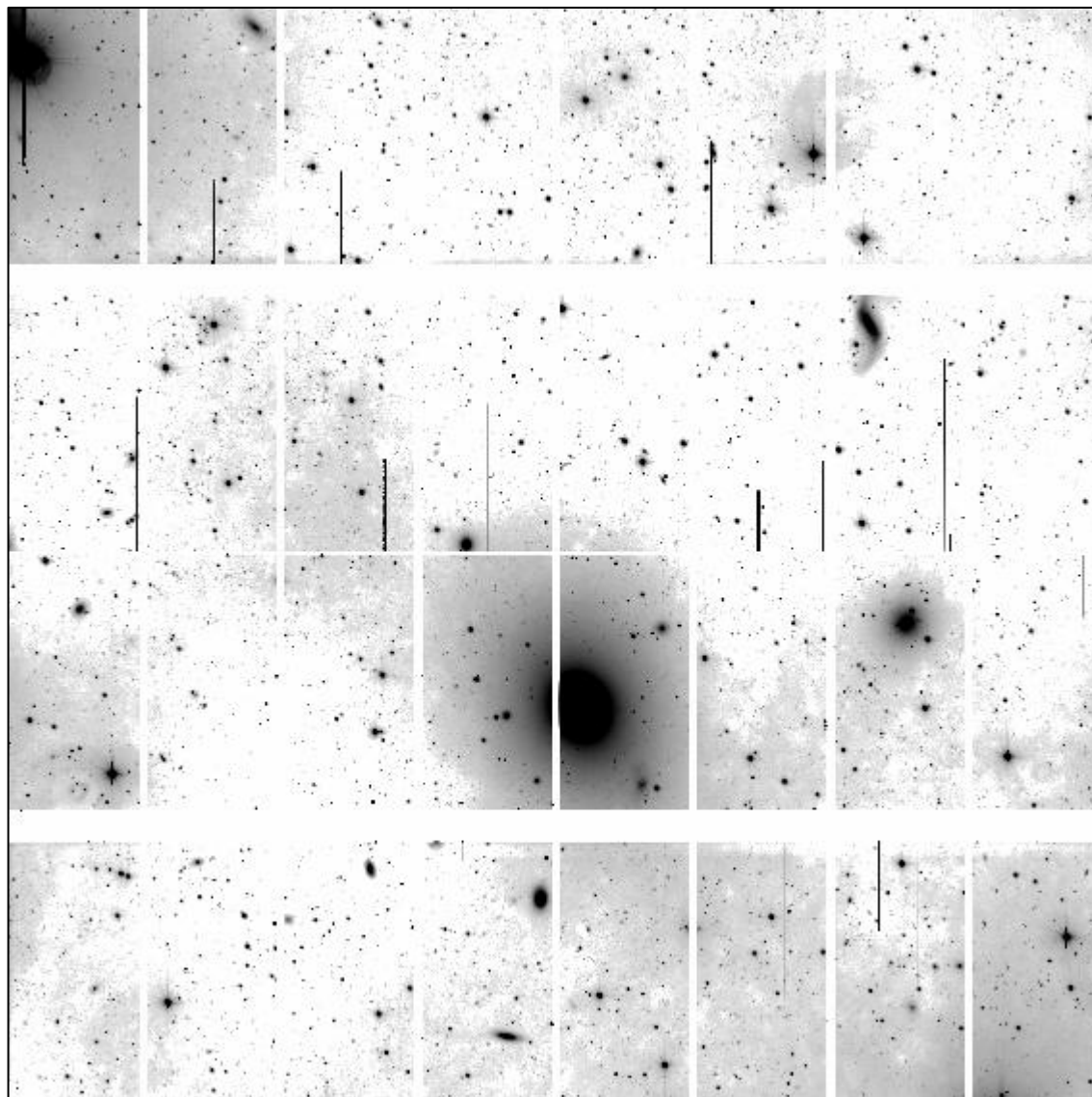
$$(R_c^2 + R_0^2) \varrho_0(R_c) = \frac{V_{\text{rot}}^2}{4\pi G} = (R_c^2 + R_0^2) \varrho_0(0) \exp(-\alpha_c R_c)$$

$$\Sigma_0 = 10^3 M_\odot \text{ pc}^{-2} \times \delta^{-1} \quad \rightarrow \quad M/L_B = 7 \times \delta$$

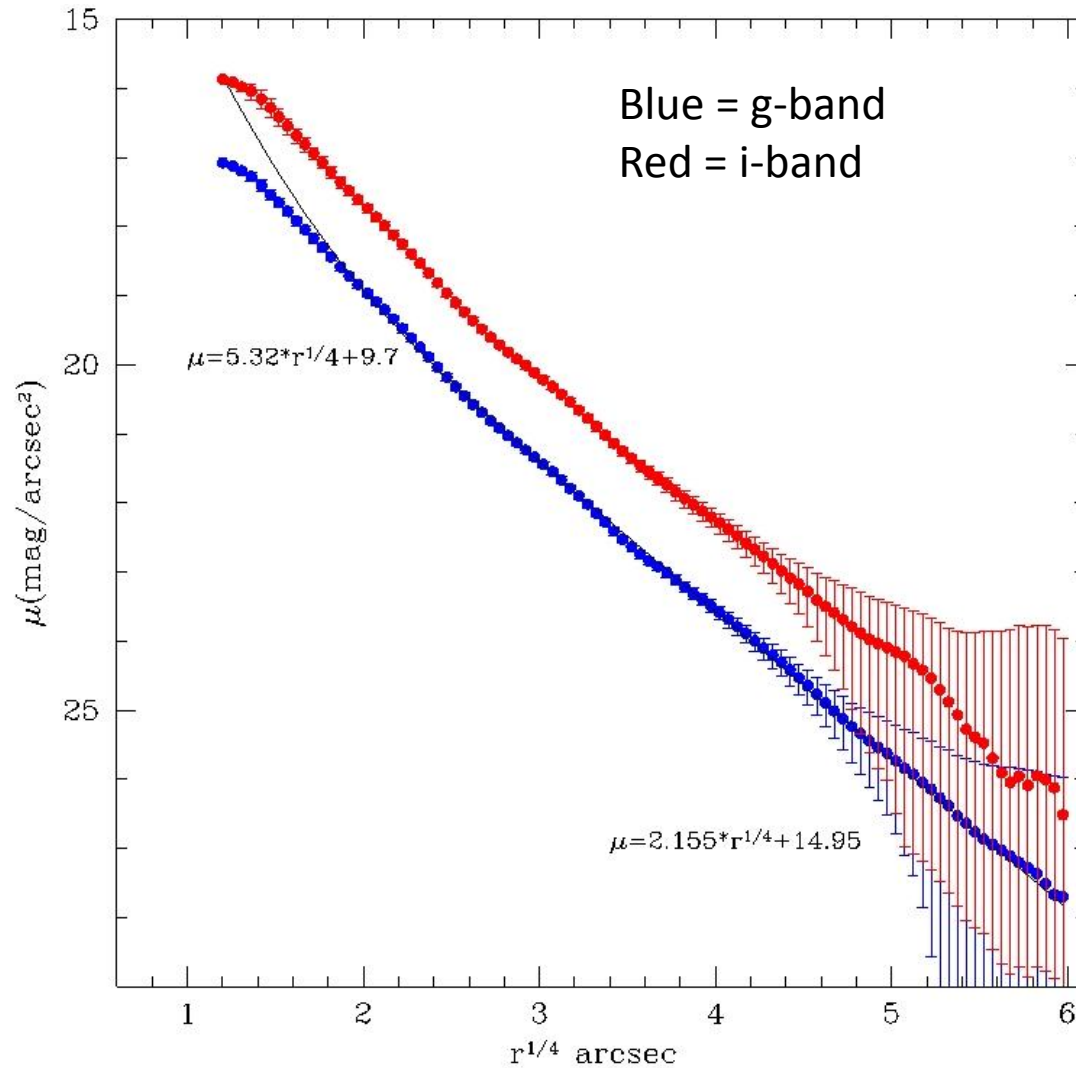
NGC 4472 field



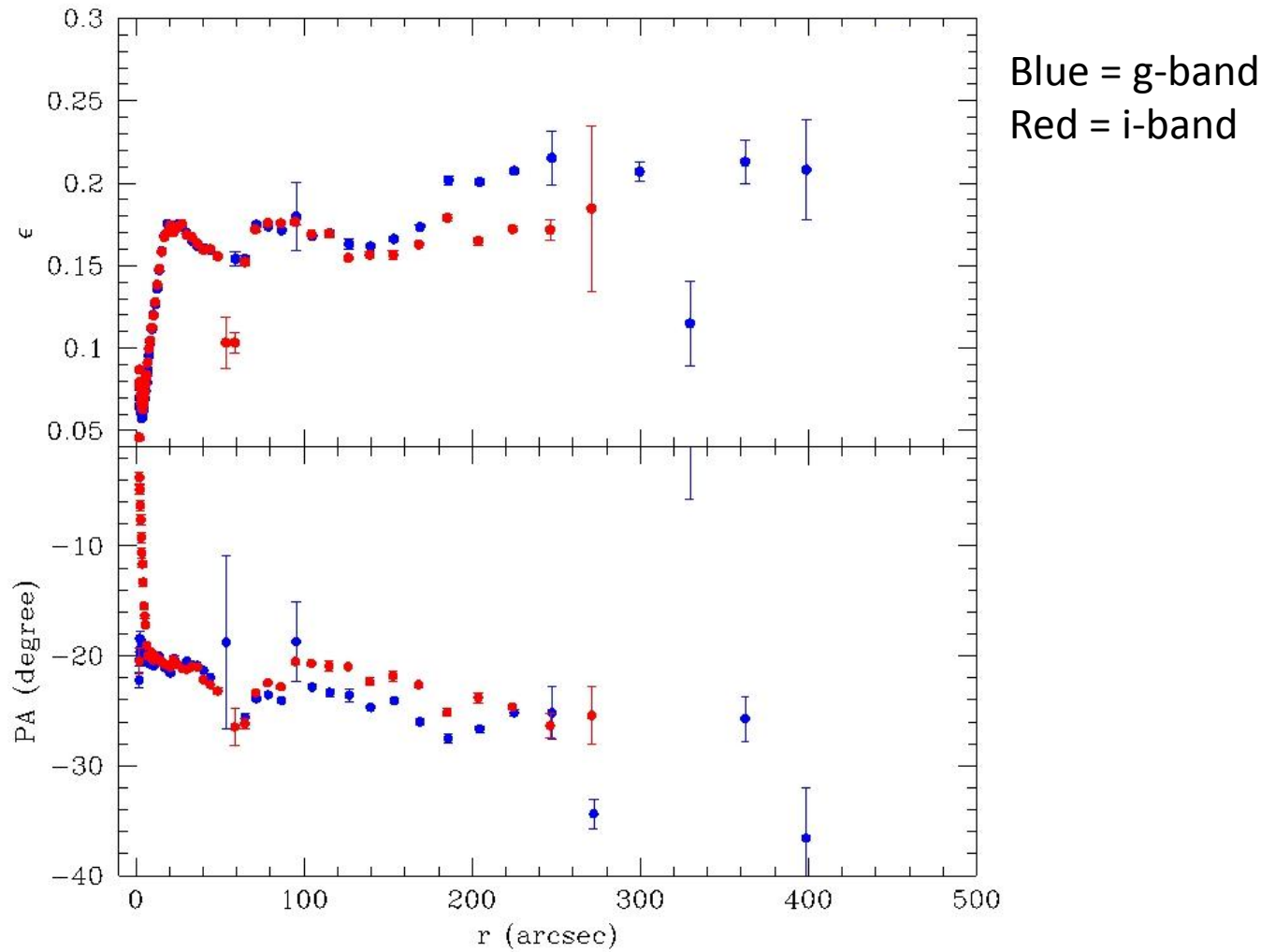
NGC 4472 field: problems with gain & stray light



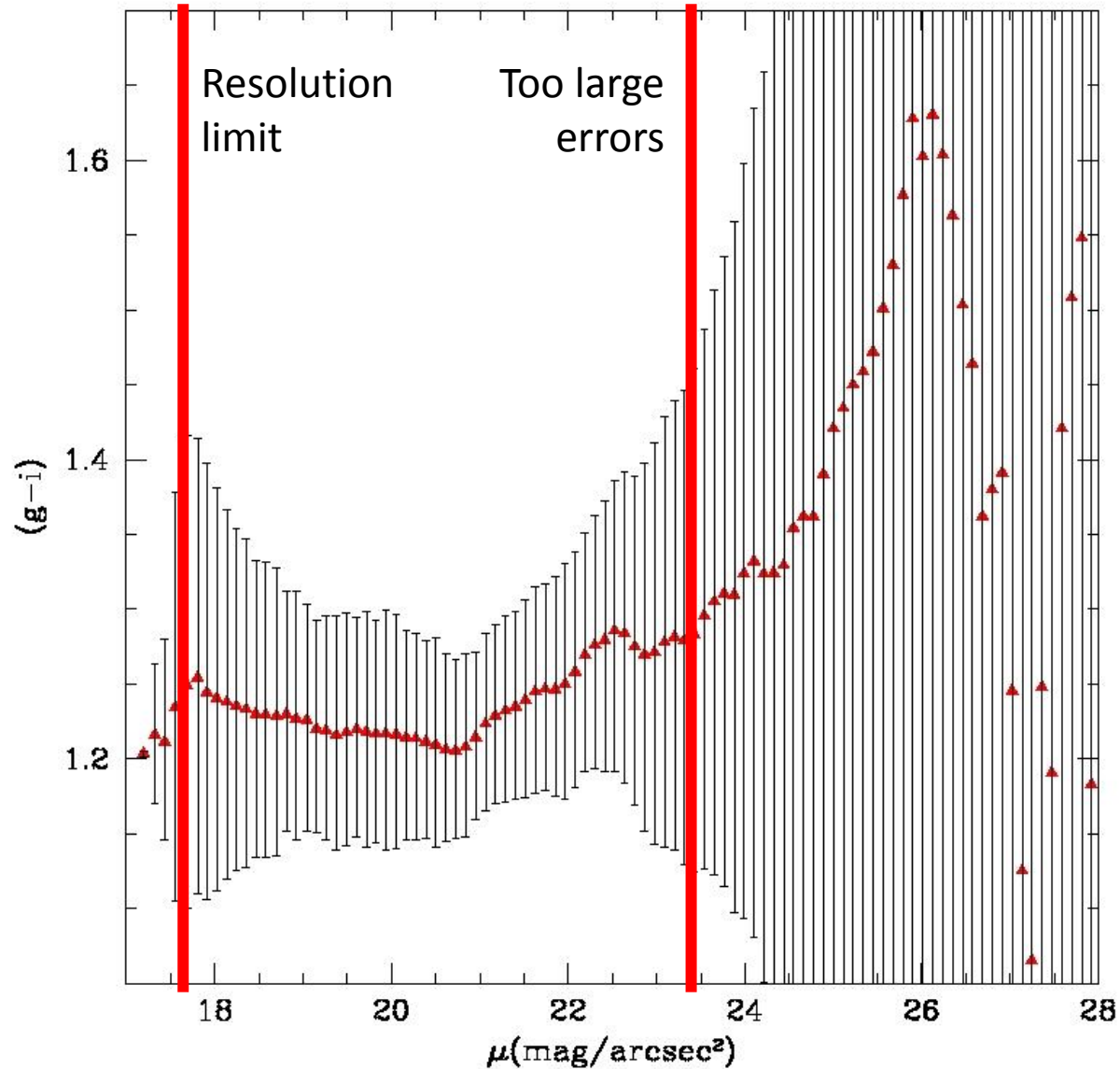
NGC 4472: g & i azimuthally averaged light profiles



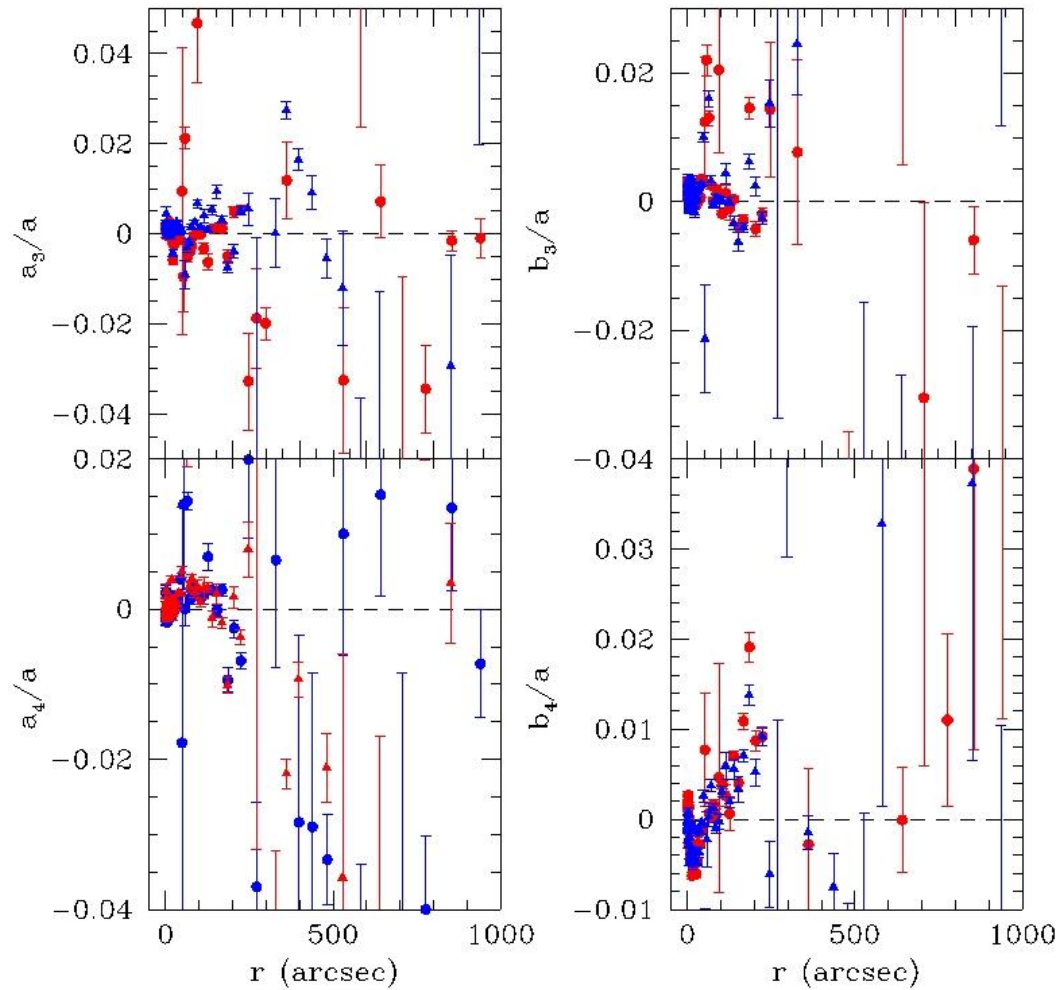
NGC 4472: g & i geometrical parameters



NGC 4472: azimuthally averaged (g - i) color profile

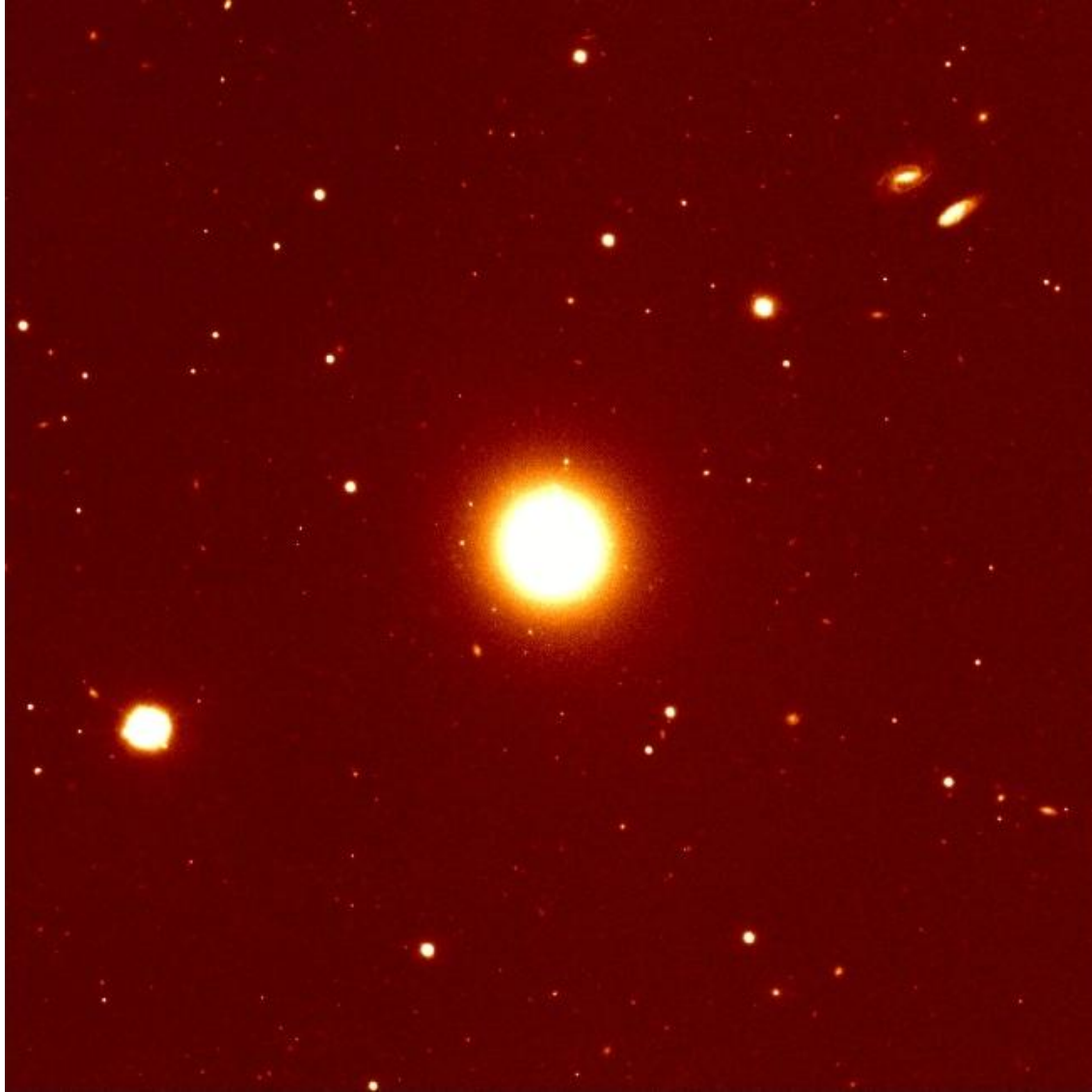


NGC 4472: shape parameters

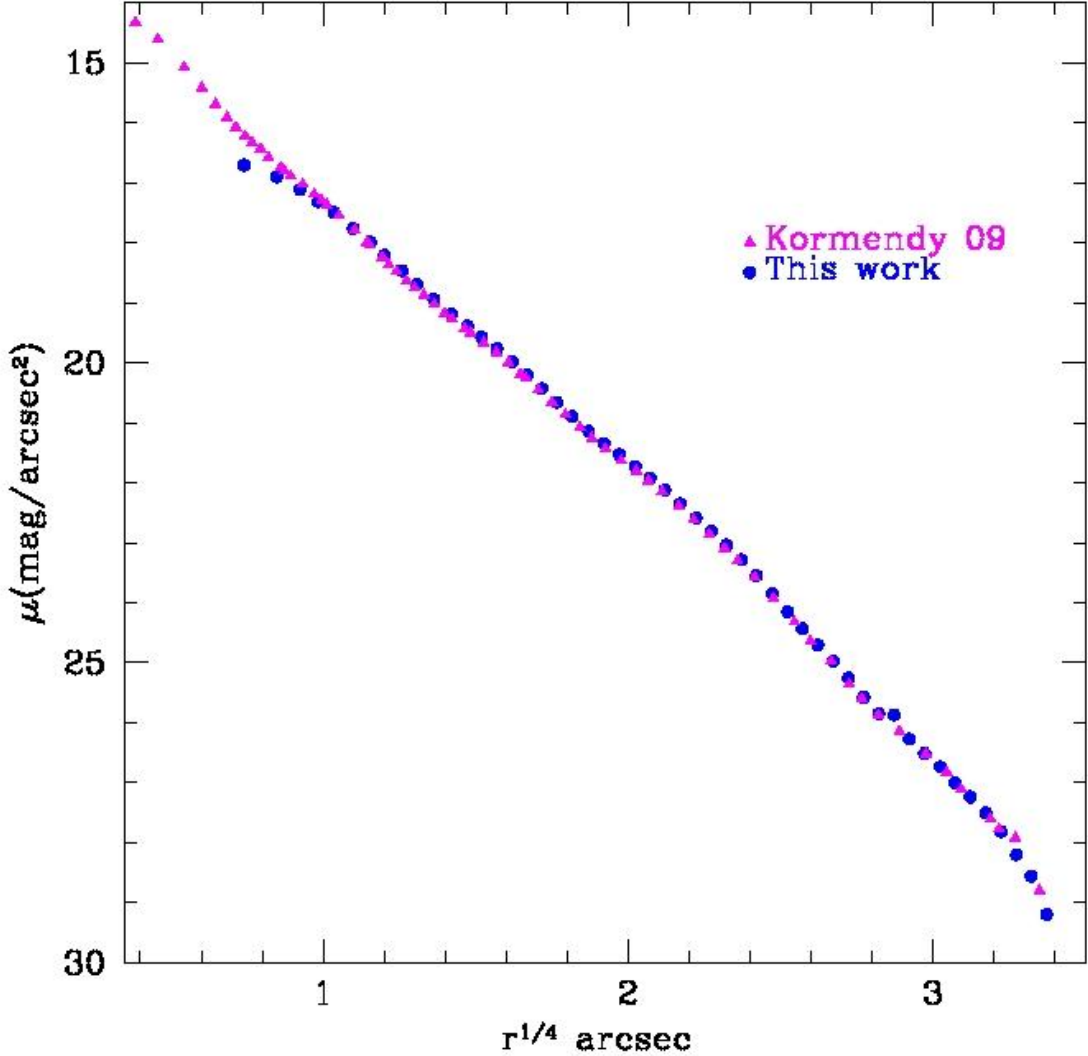


Blue = g-band
Red = i-band

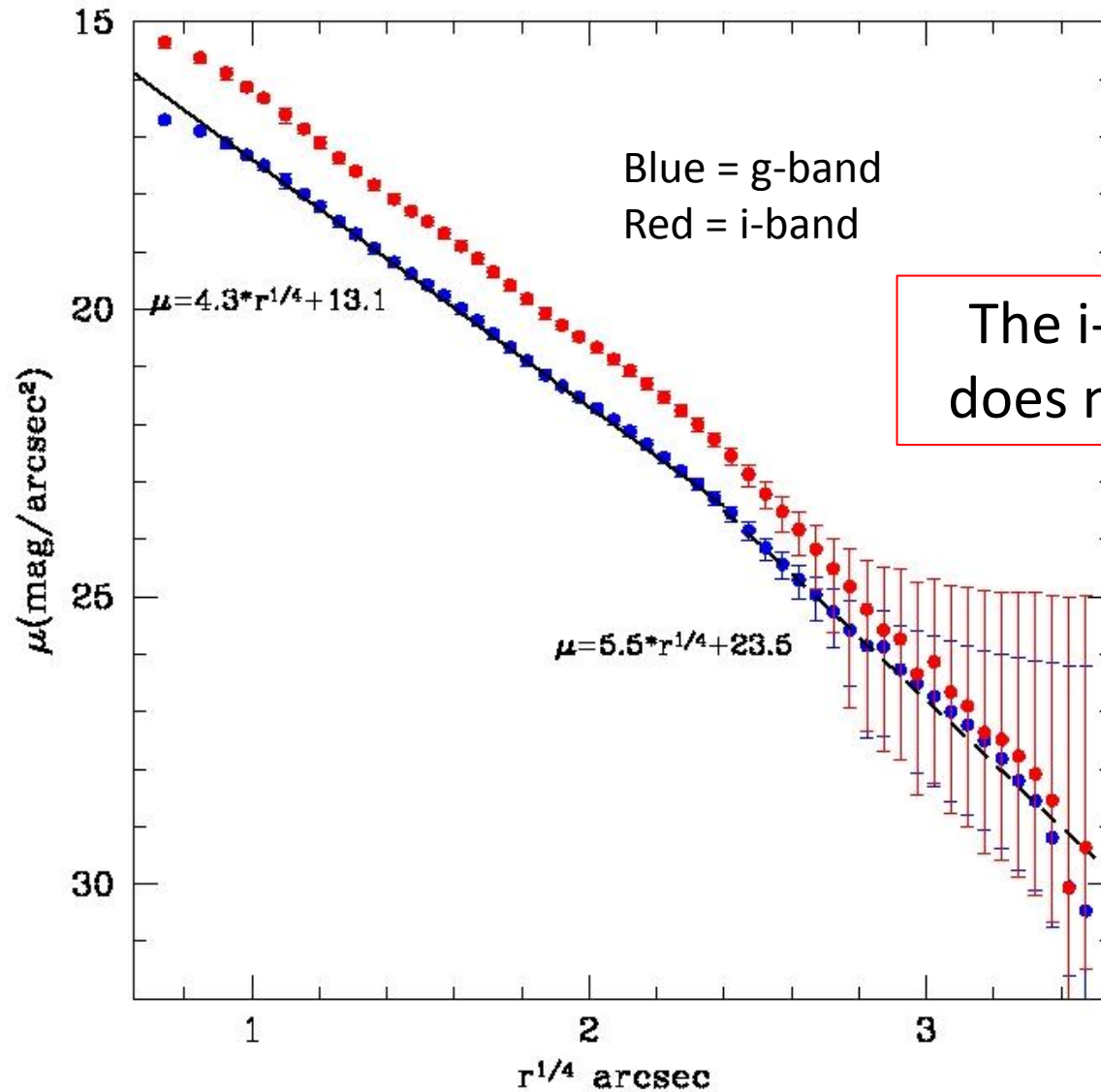
NGC 4434: small galaxy on a side of the frame



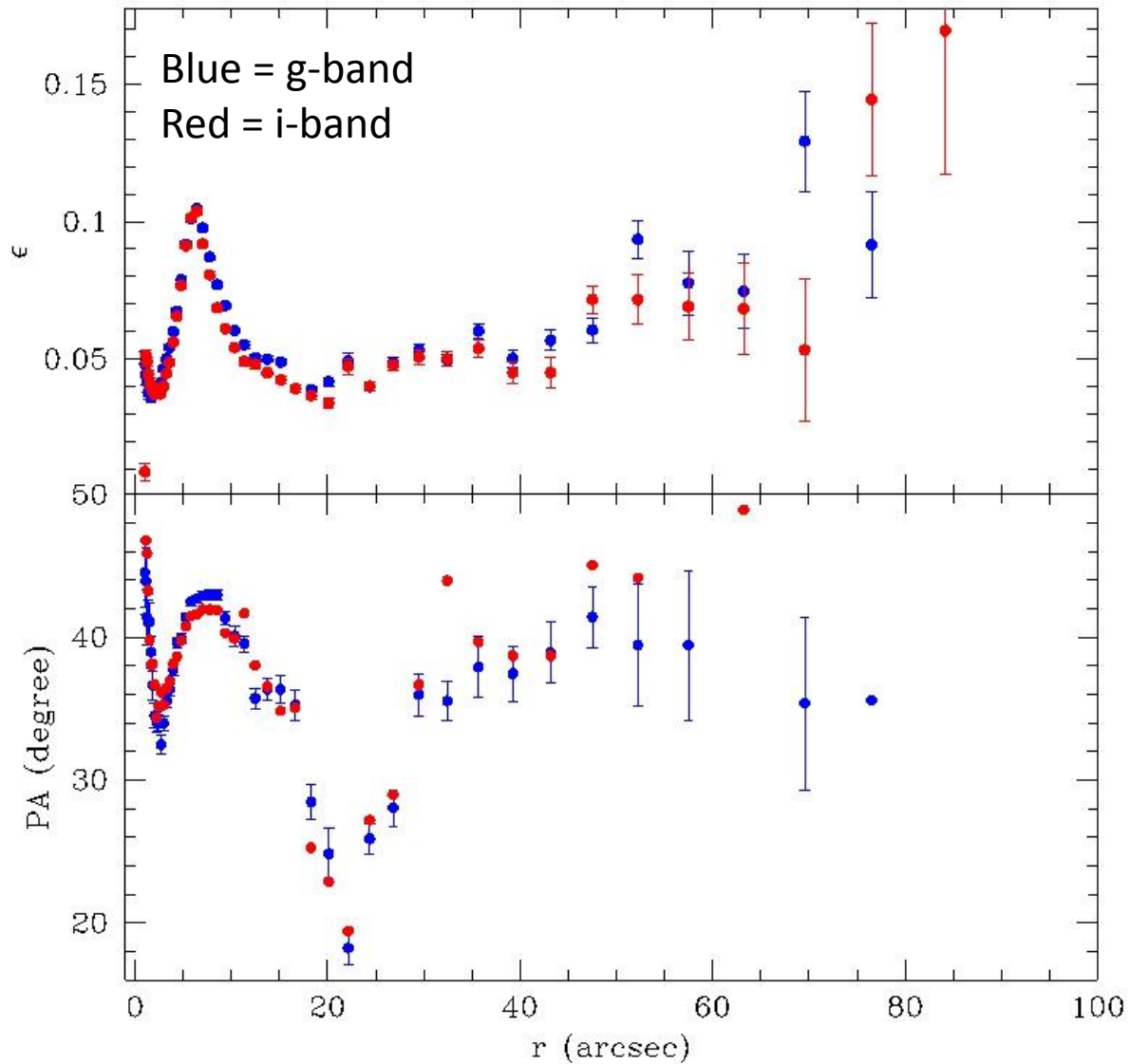
NGC 4434, g-band: comparison with Kormendy (2009)



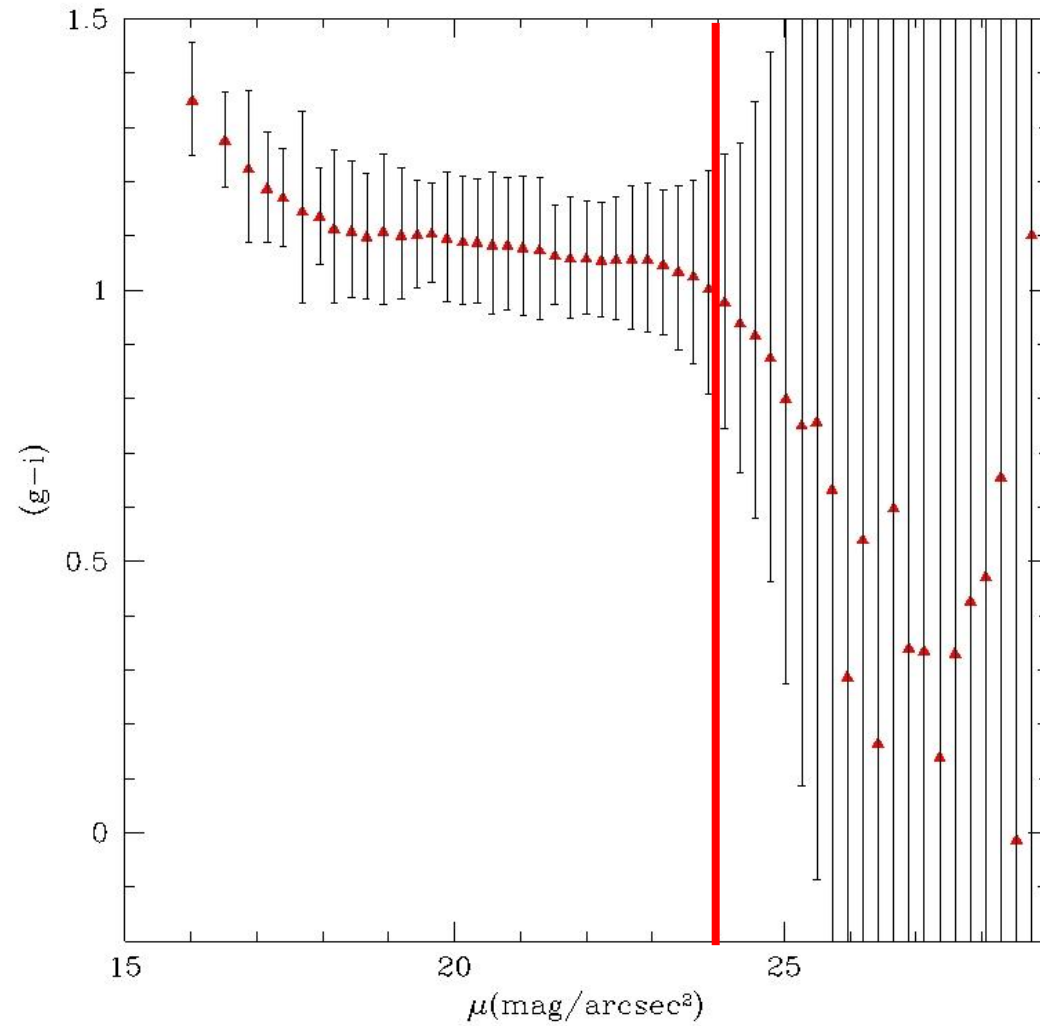
NGC 4434: azimuthally averaged light profile



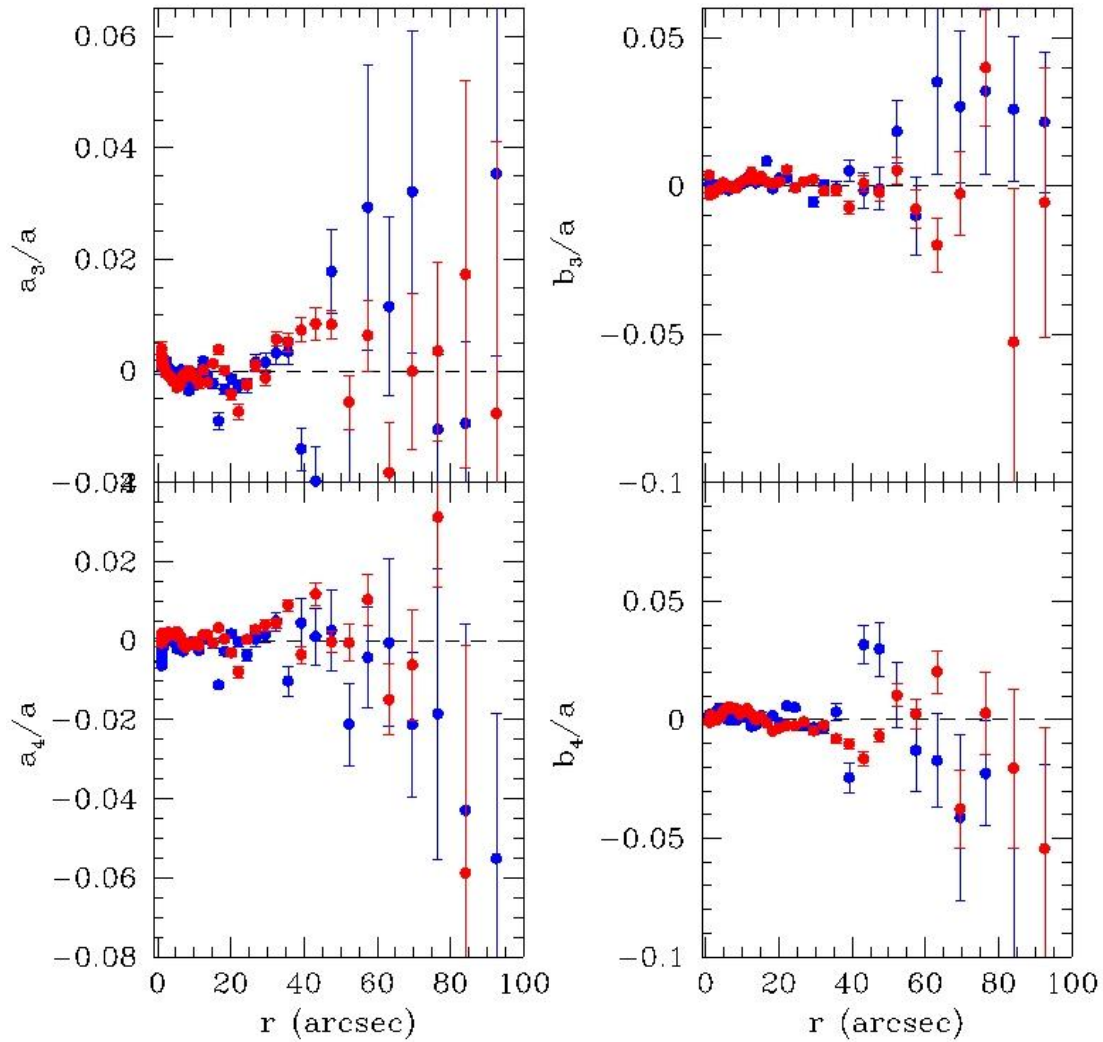
NGC 4434: g & i geometrical parameters



NGC 4434: azimuthally averaged $(g - i)$ color profile



NGC 4434: shape parameters

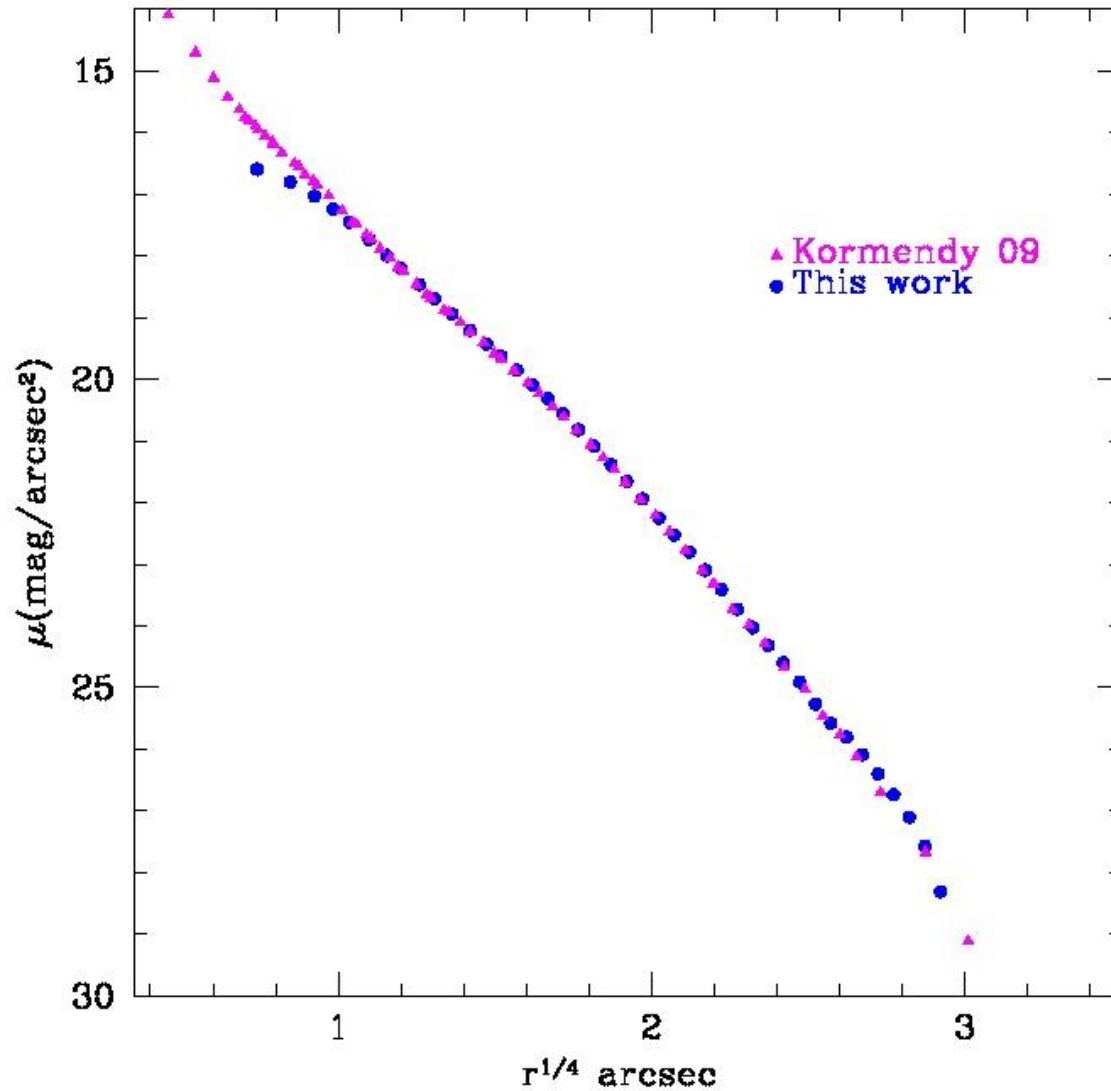


Blue = g-band
Red = i-band

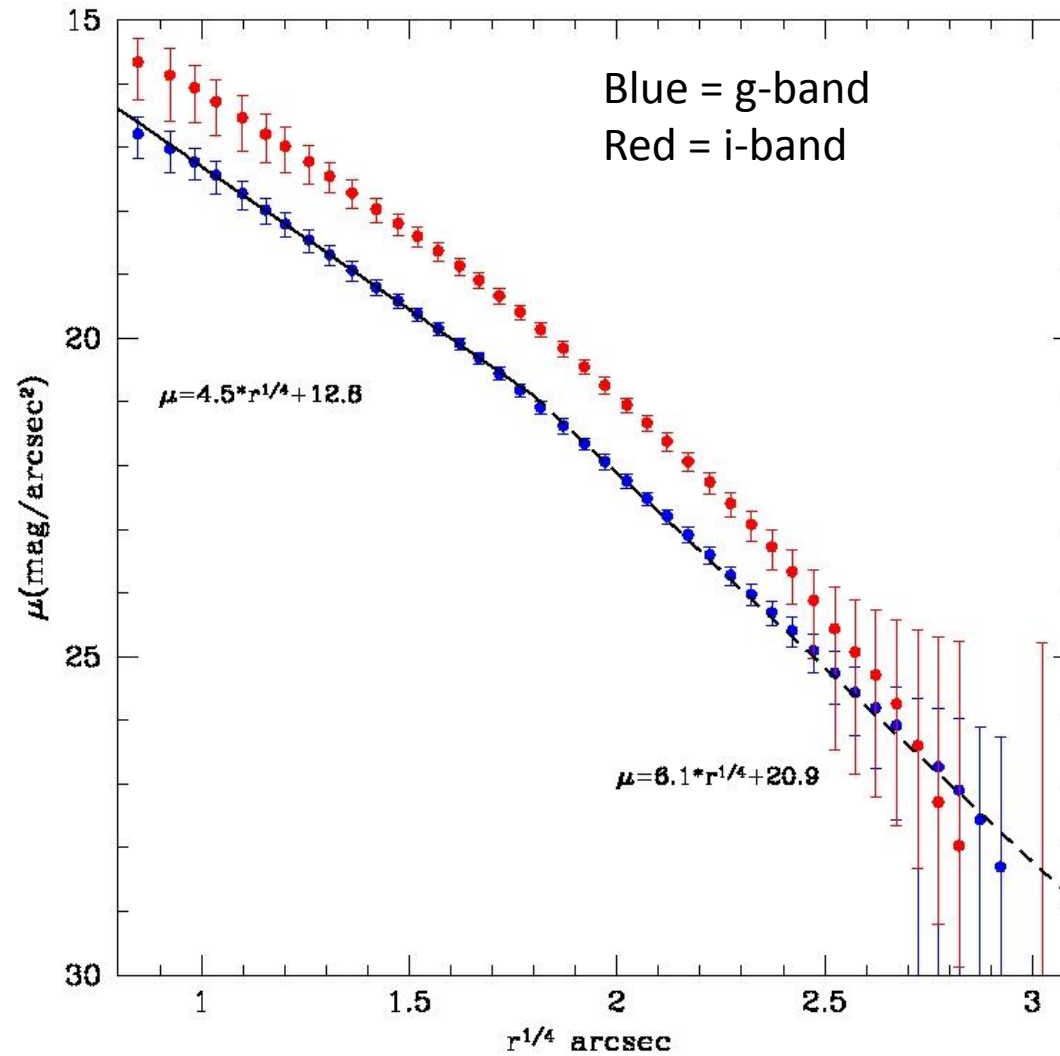
NGC 4464



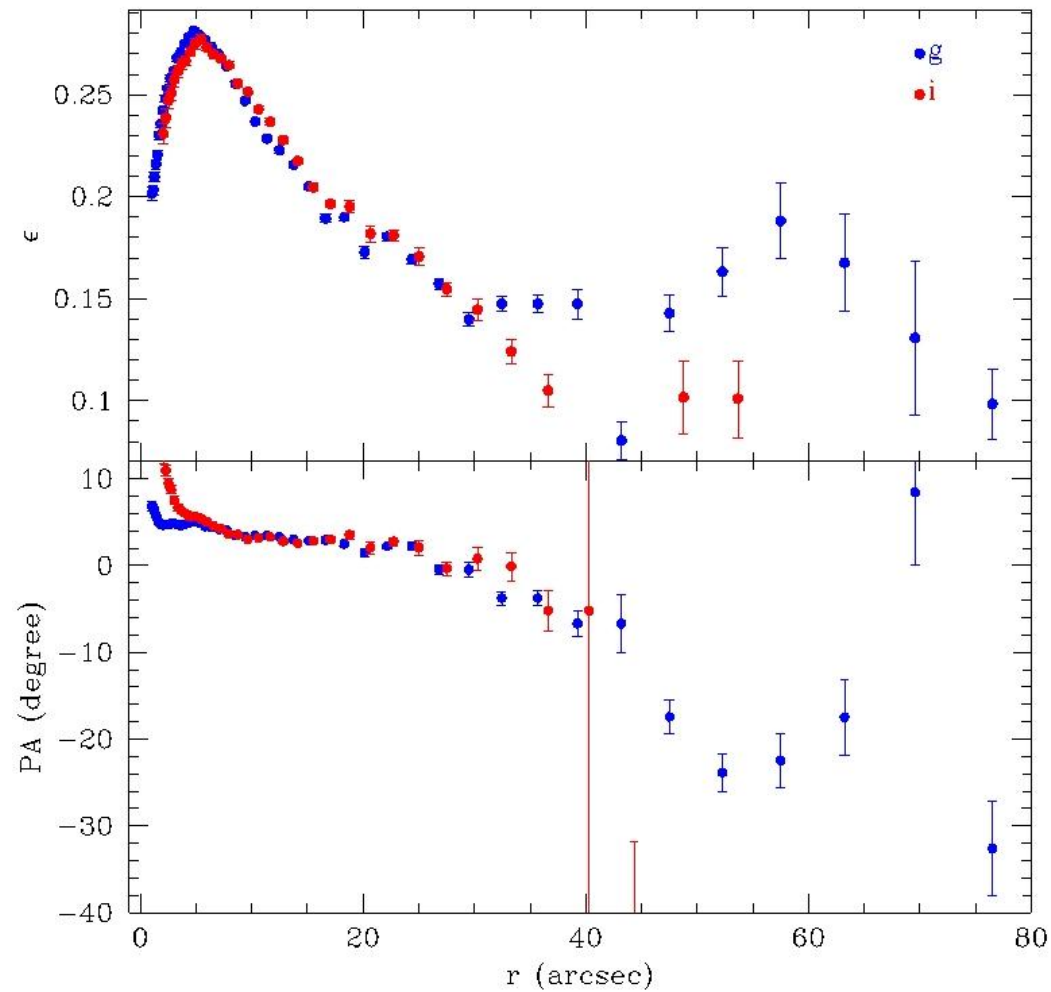
NGC 4464, g-band: comparison with Kormendy (2009)



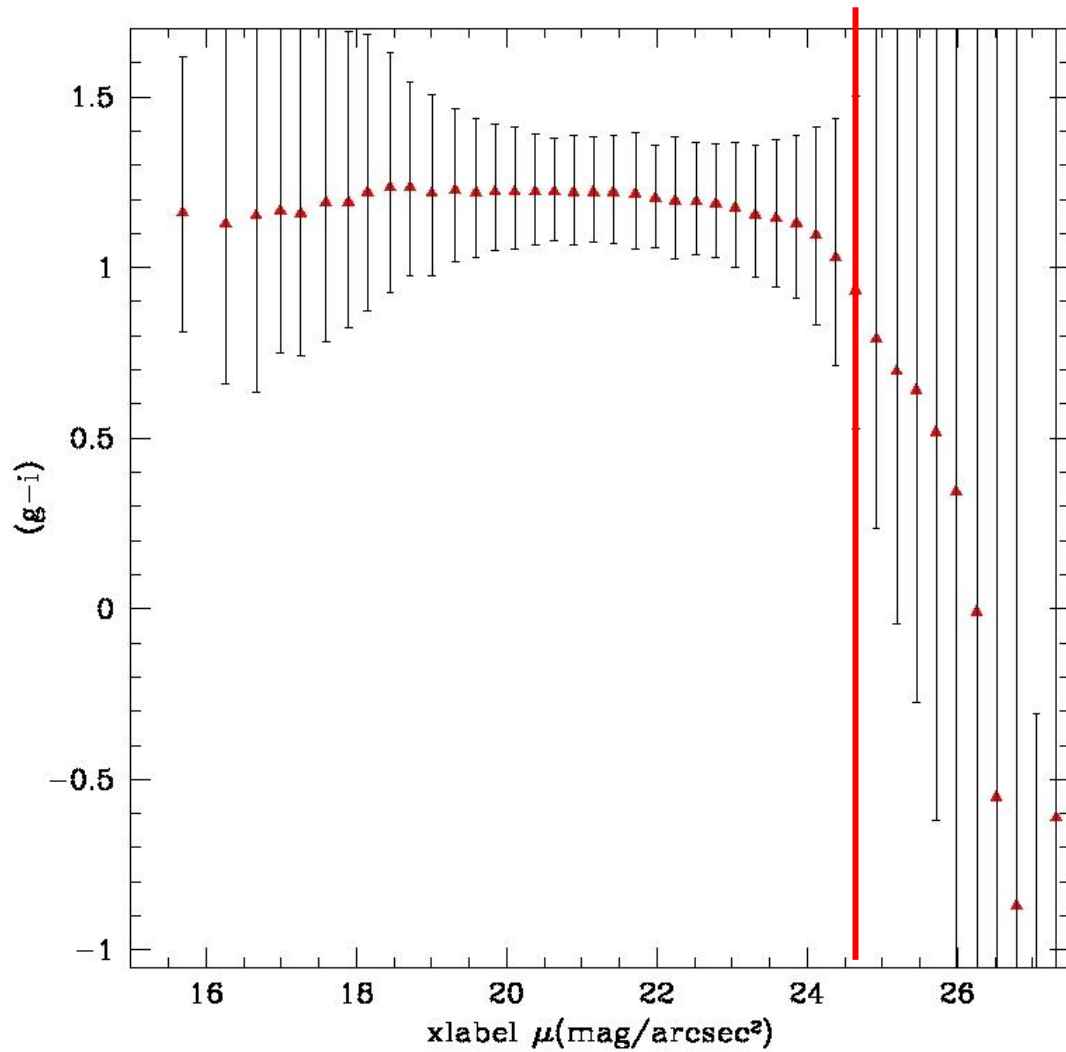
NGC 4464: azimuthally averaged light profile



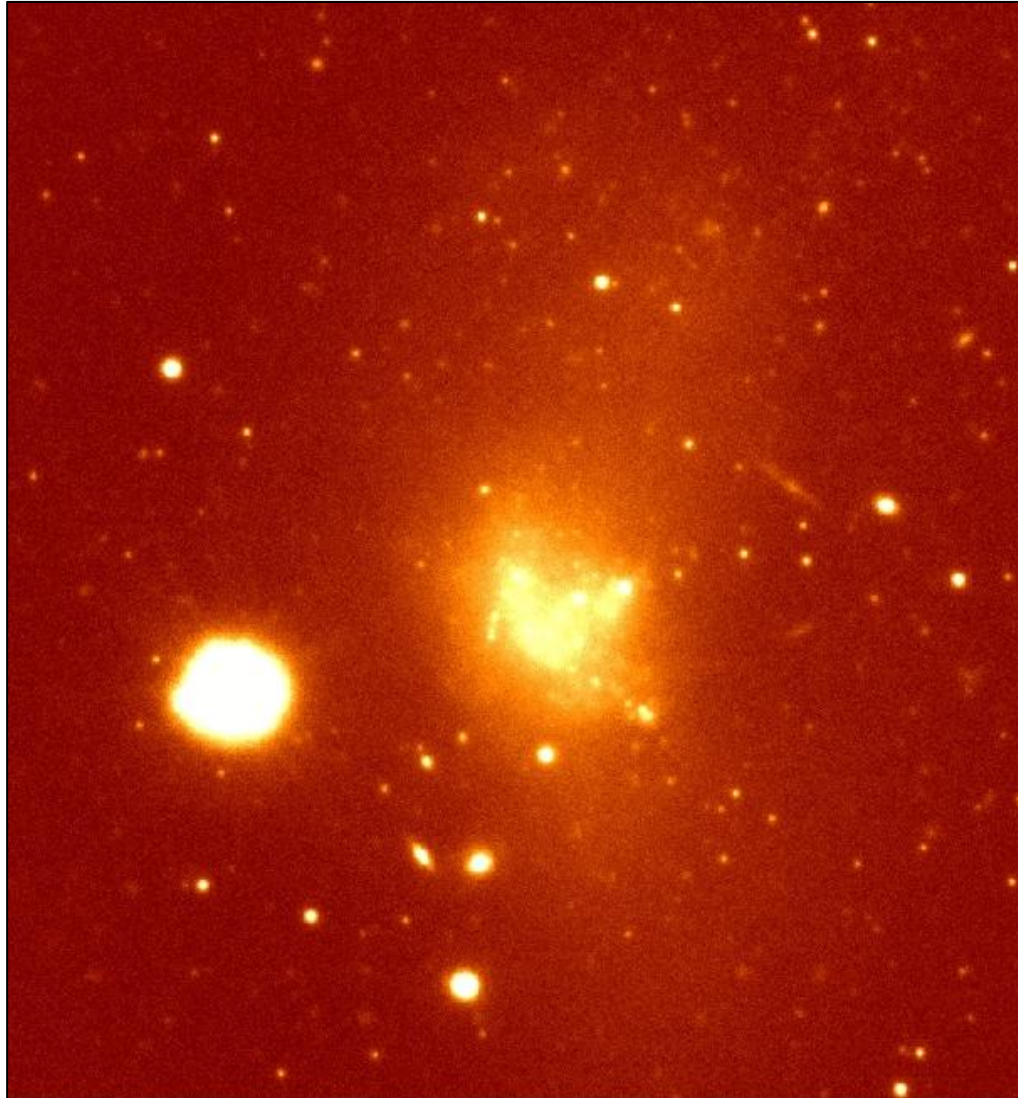
NGC 4464: g & i geometrical parameters

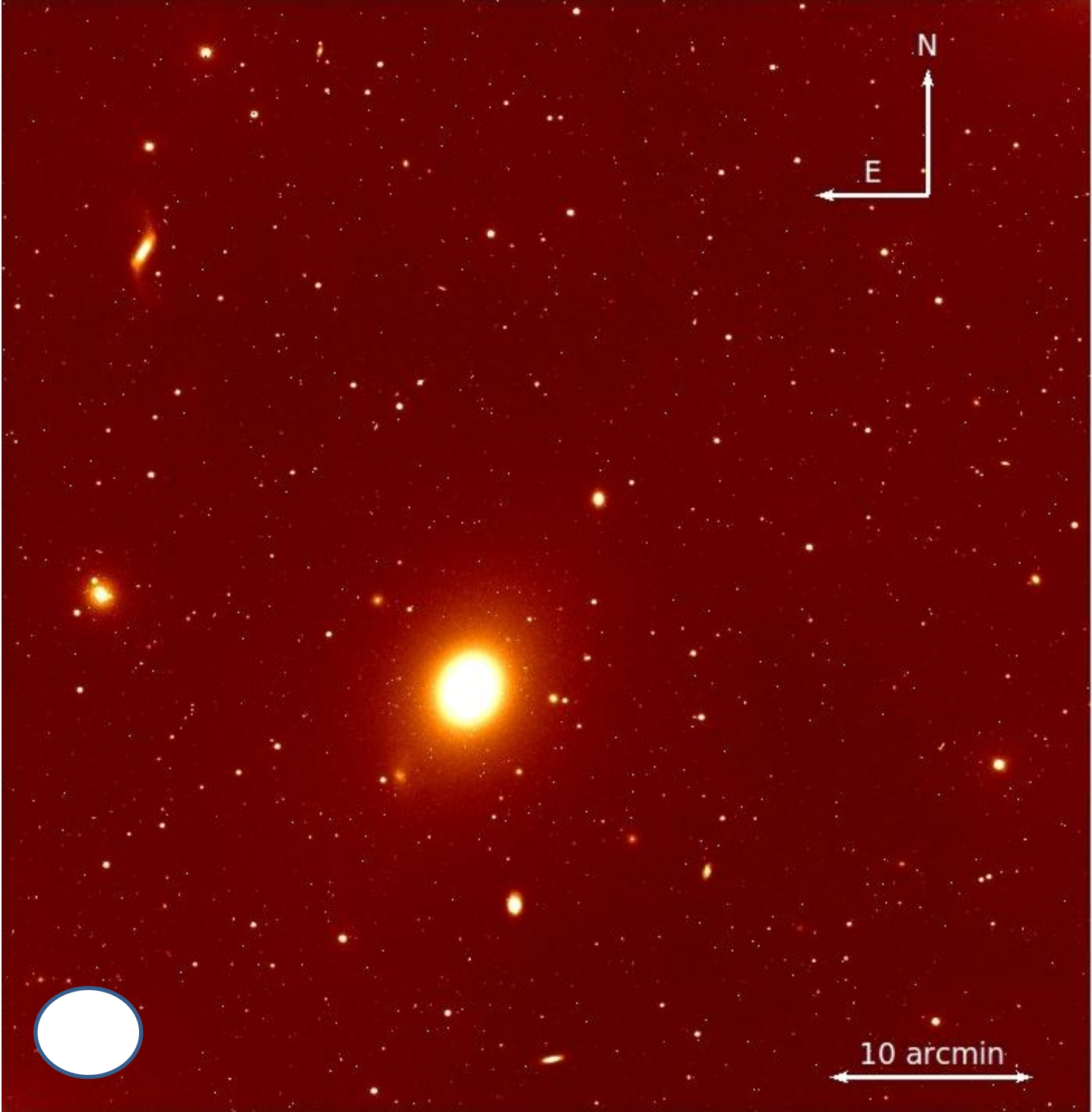


NGC 4464: azimuthally averaged $(g - i)$ color profile

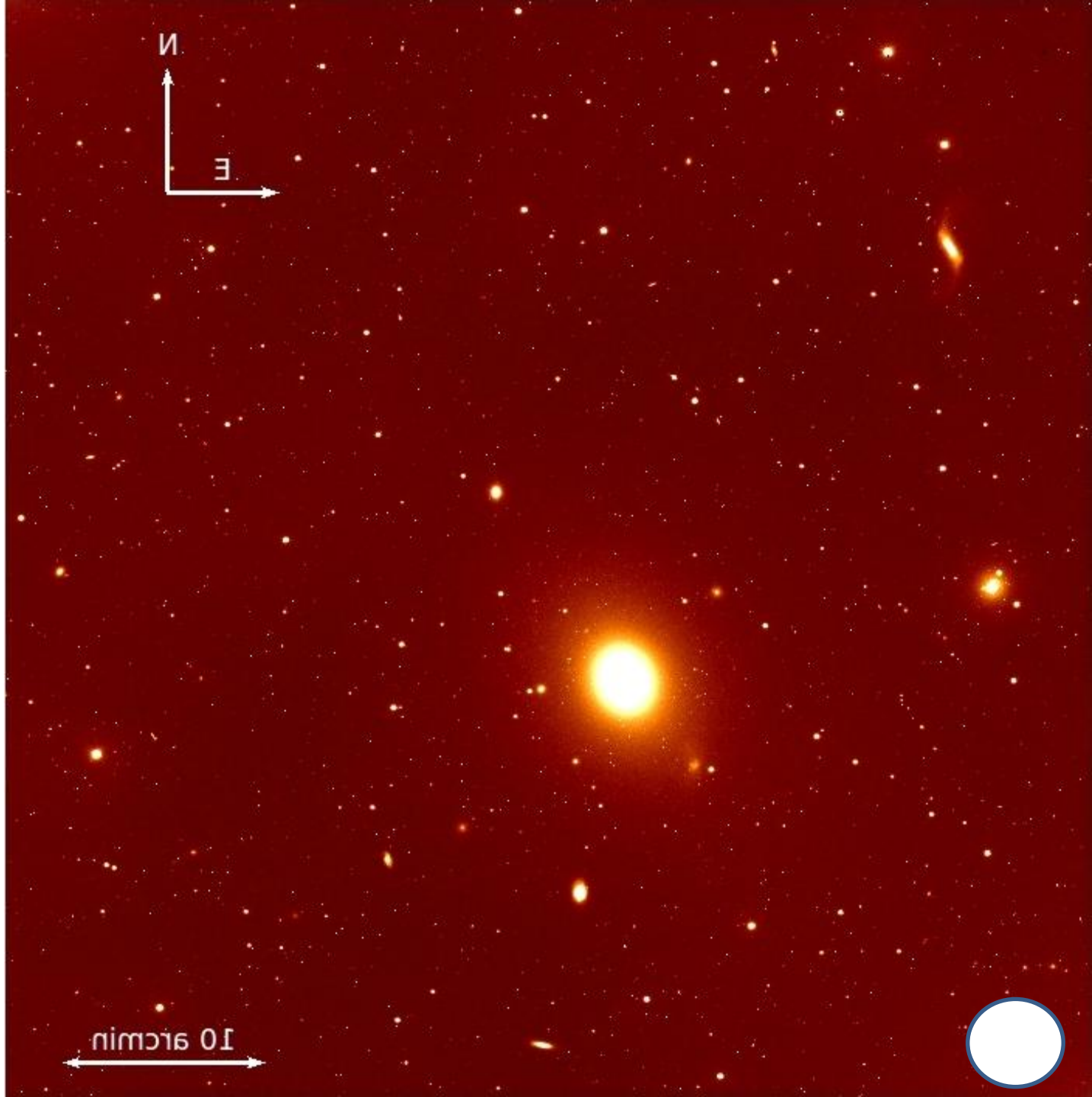


UGC 7836: interacting with NGC 4472

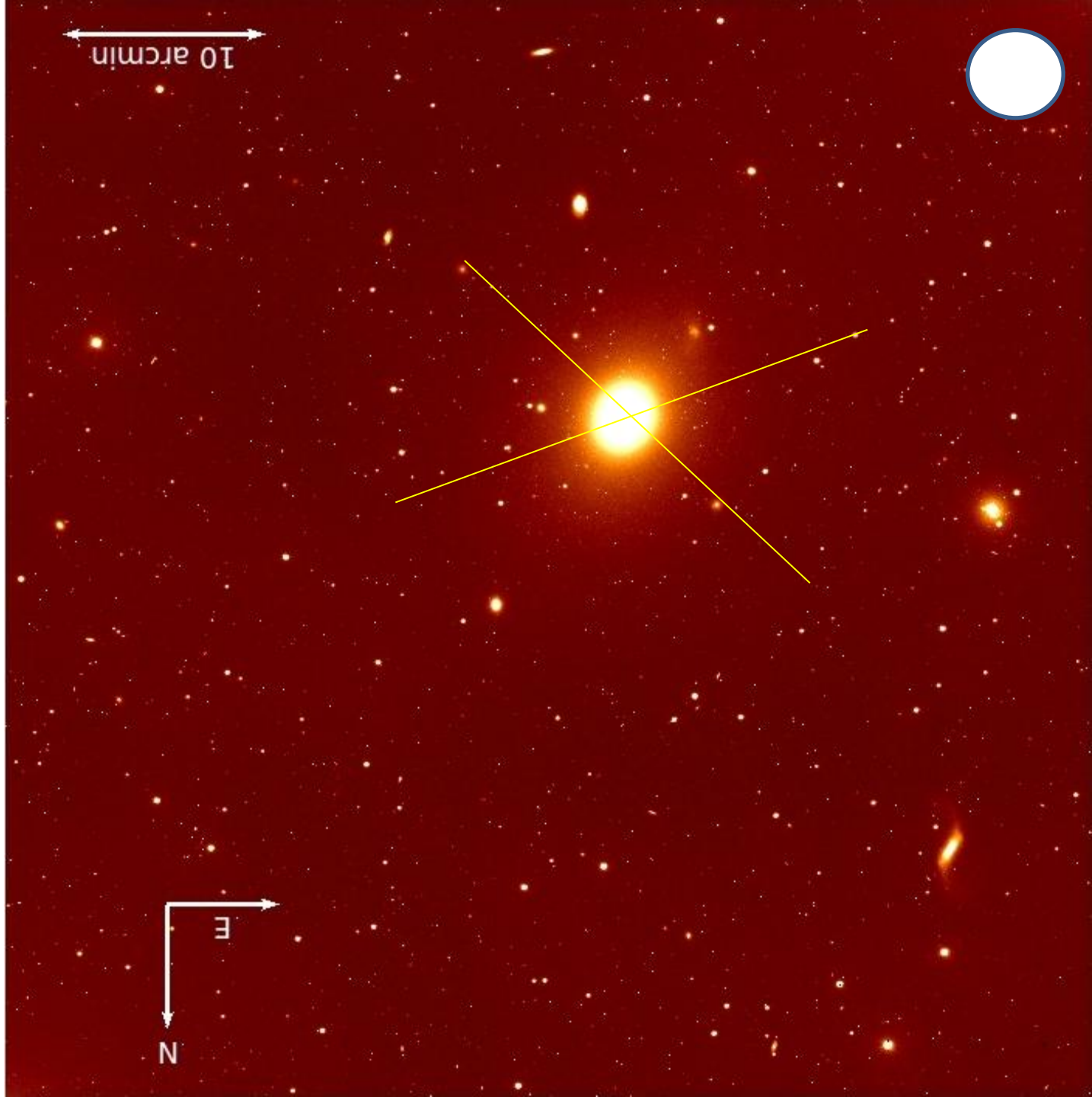




Fold the
image once

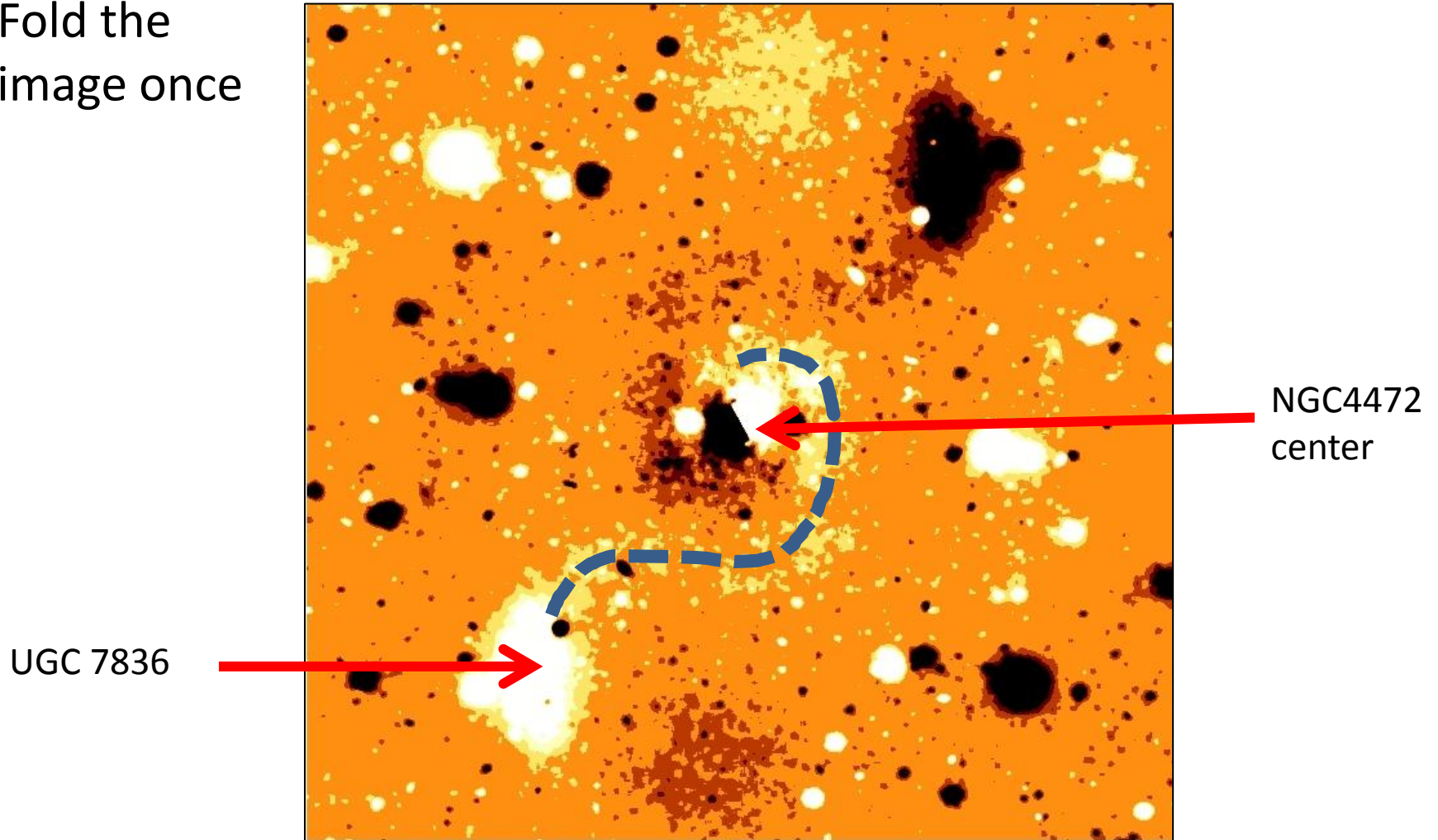


Fold the image
once more, then
subtract it to the
original
centering both
at NGC4472
center.

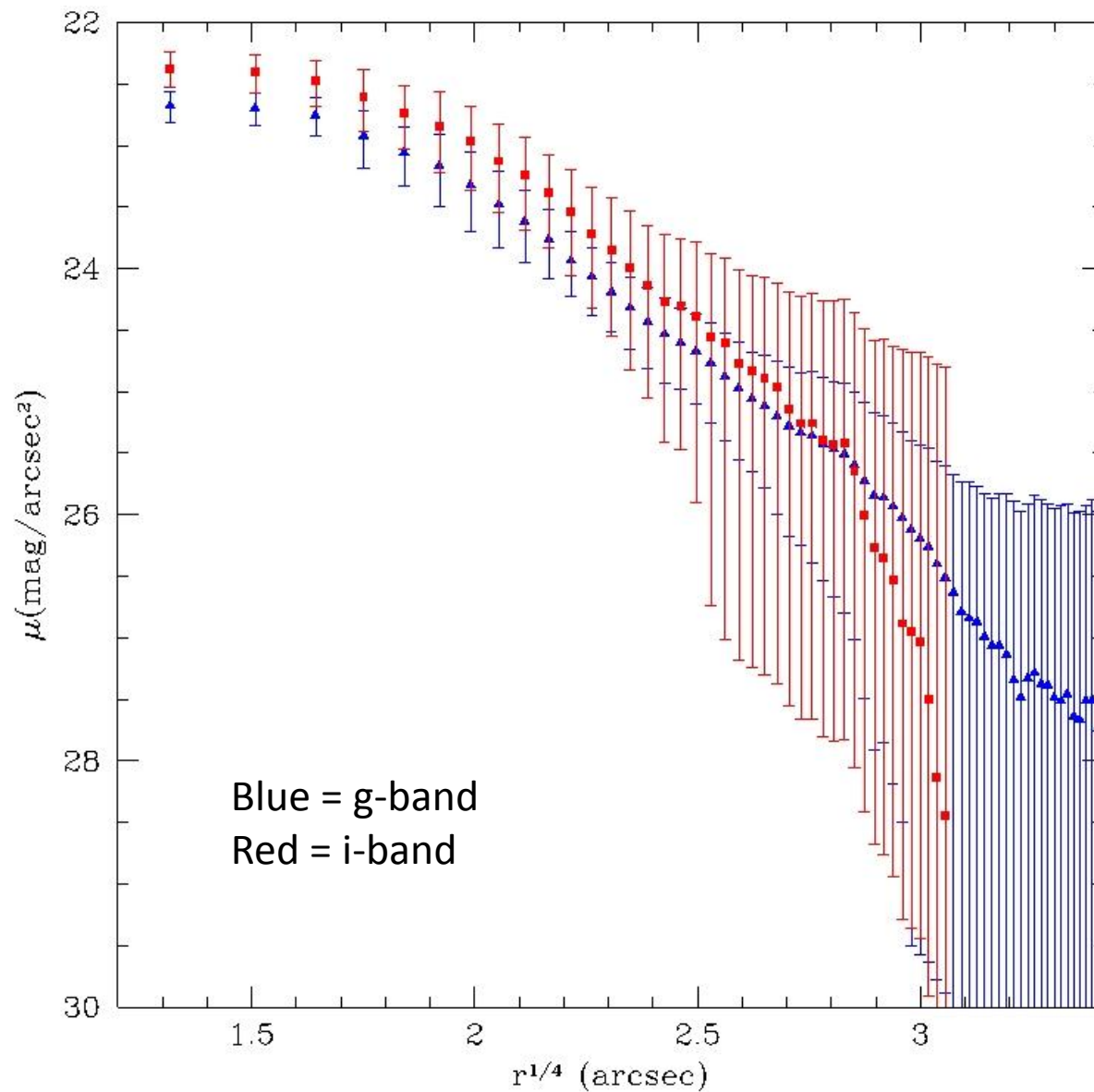


UGC 7836: interacting with NGC 4472 subtracted image (black is negative) showing long plume

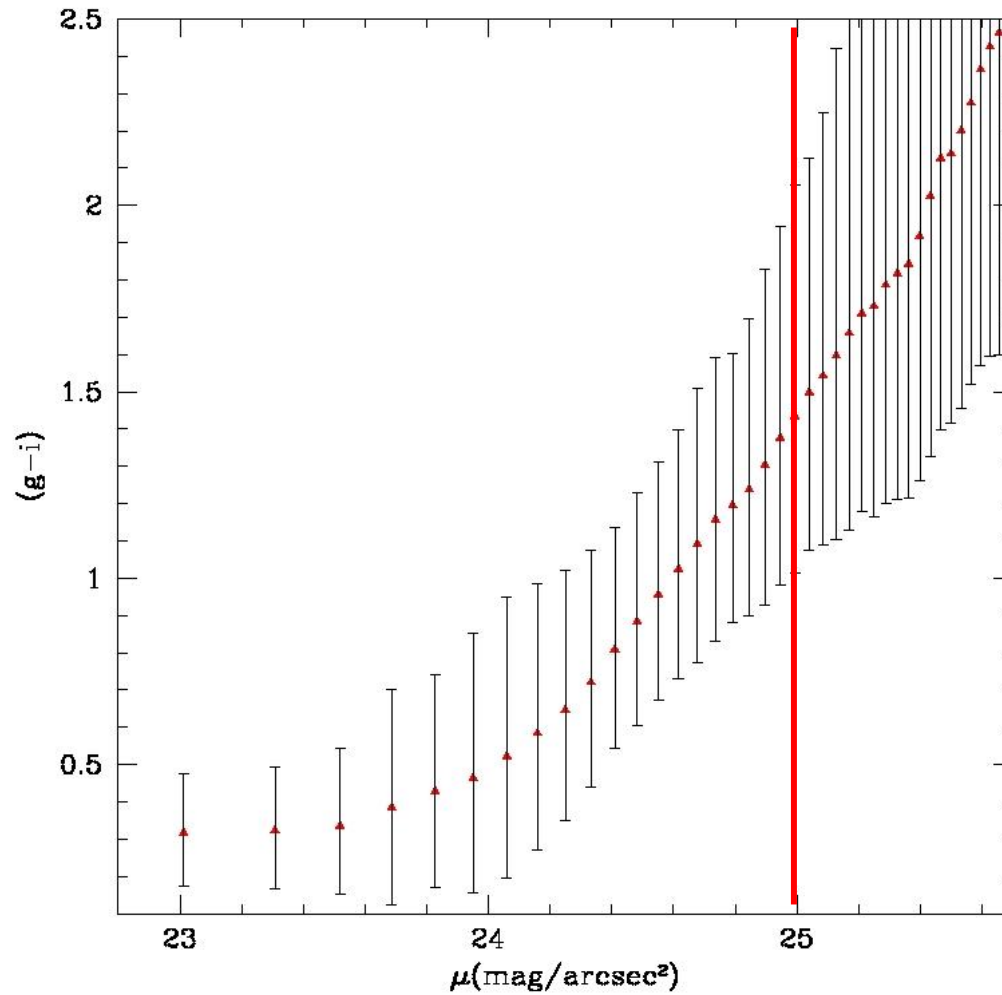
Fold the
image once



UGC 7636: azimuthally averaged light profile



UGC 7636: azimuthally averaged (g - i) color profile



Conclusions

1. The background is difficult to define with galaxies filling the VST field
2. Better results with small size galaxies
3. With 1h exposure in g-band one reaches the 28th mag/arcsec² with an accuracy better than 0.5 mag
4. The i-band images do not work for now
5. (g-i) colors are well defined from just outside the seeing ring to $\mu_g \approx 24.5$ mg/arcsec²
6. Geometrical parameters are well defined in the i-band too
7. VST images must be individually mined for serendipitous discoveries

Many thanks