DALKIDS

Dark vs Light

in KiDS galaxies with Strong Lensing

Chiara Spiniello

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Astro Fit 2 Astronomy Fellowships in Italy

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THE FIRST SUPER-COMPACT MASSIVE STRONG LENS

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Nuovi autori, Nuovi scenari… Vecchie galassie

EARLY-TYPE GALAXIES

- ★ **Contain more than half of the total mass of the Universe and are responsible for its chemical enrichment**
- ★ **Complex morphology and kinematics (e.g. KDC)**
- ★ **Old Stellar Population**
  BUT
  final results of merger and evolution of structure in the Universe
- ★ **High fraction of internal dark matter or Not-universal Initial Mass Function**
- ★ **Two-phase formation scenario**

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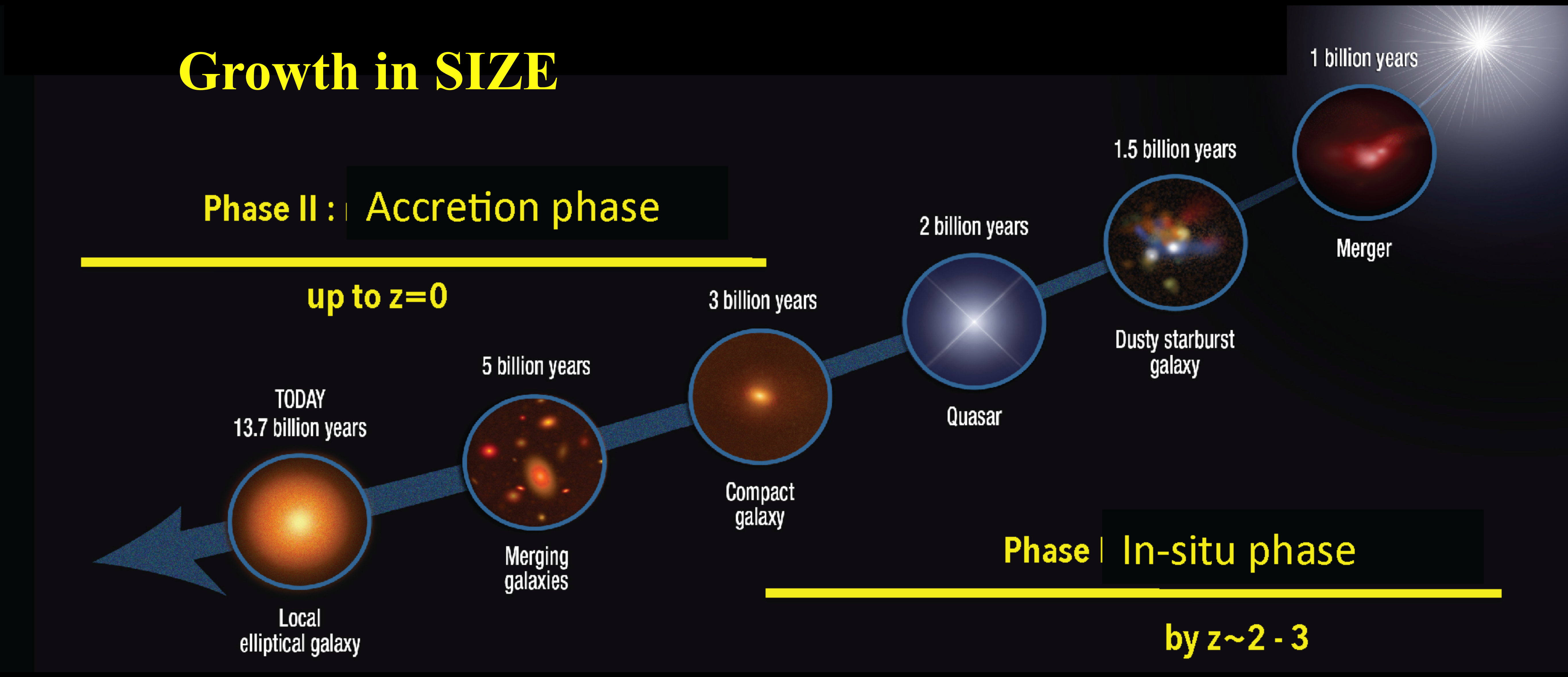
Two-phase formation scenario

TWO-PHASE FORMATION SCENARIO



Growth in MASS

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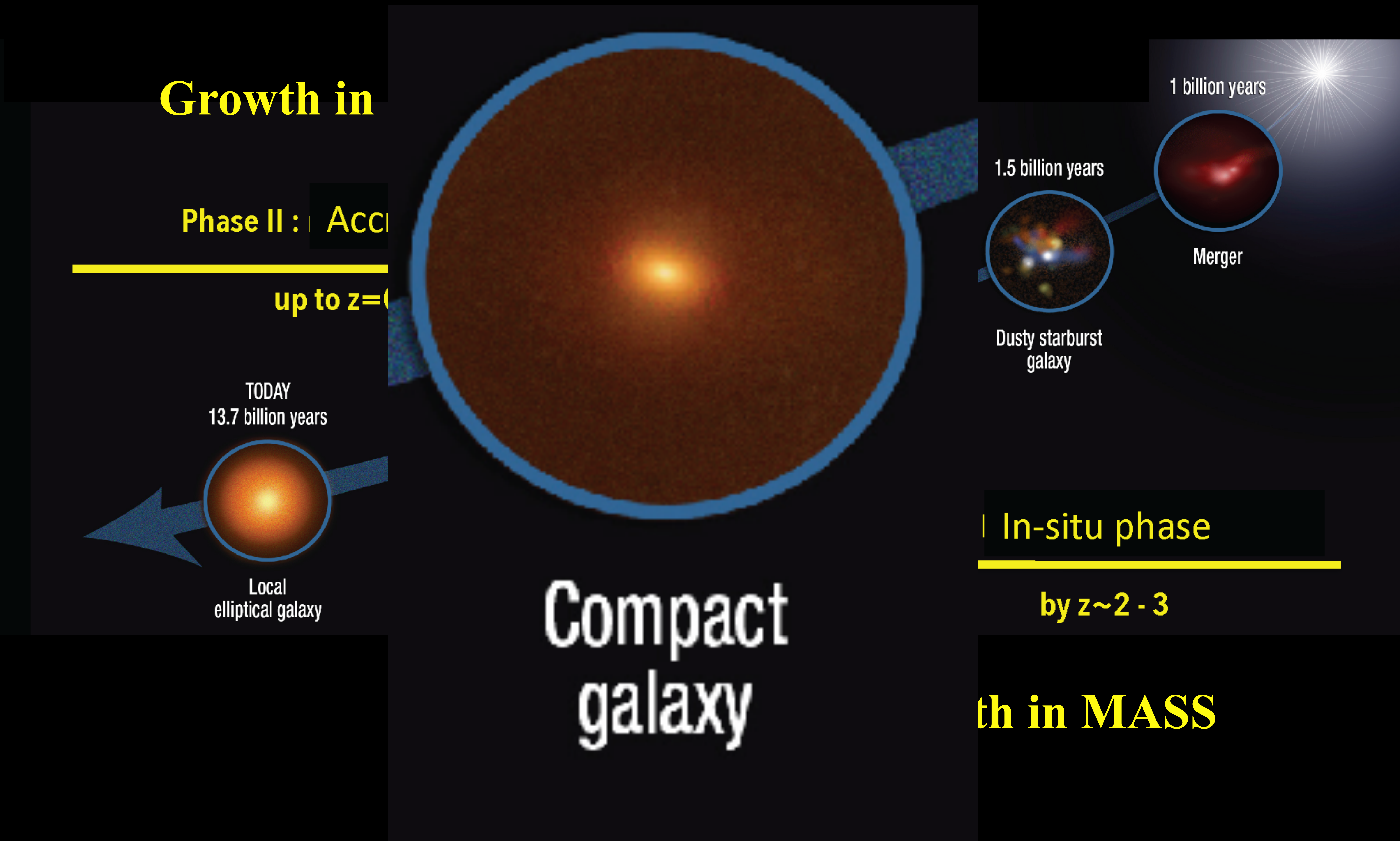
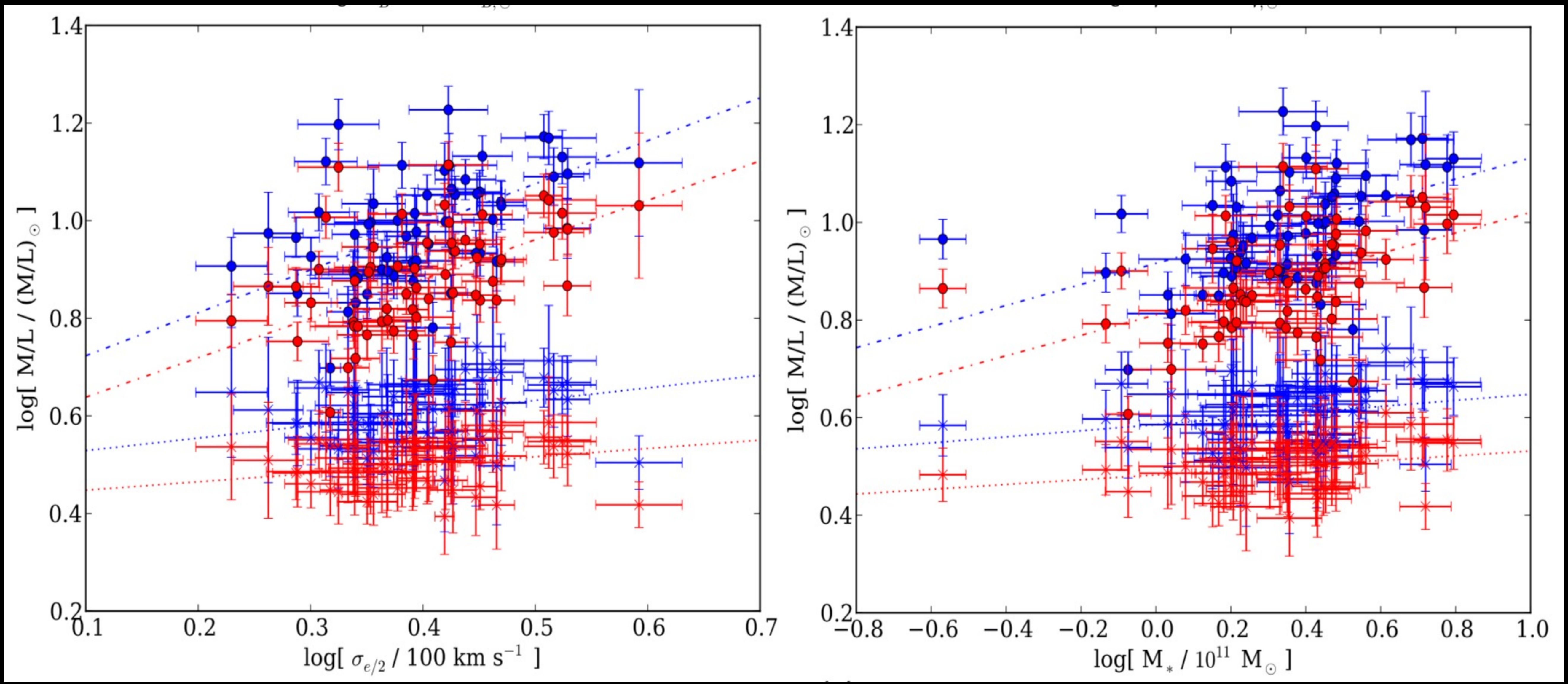


DARK MATTER FRACTIONS vs IMF

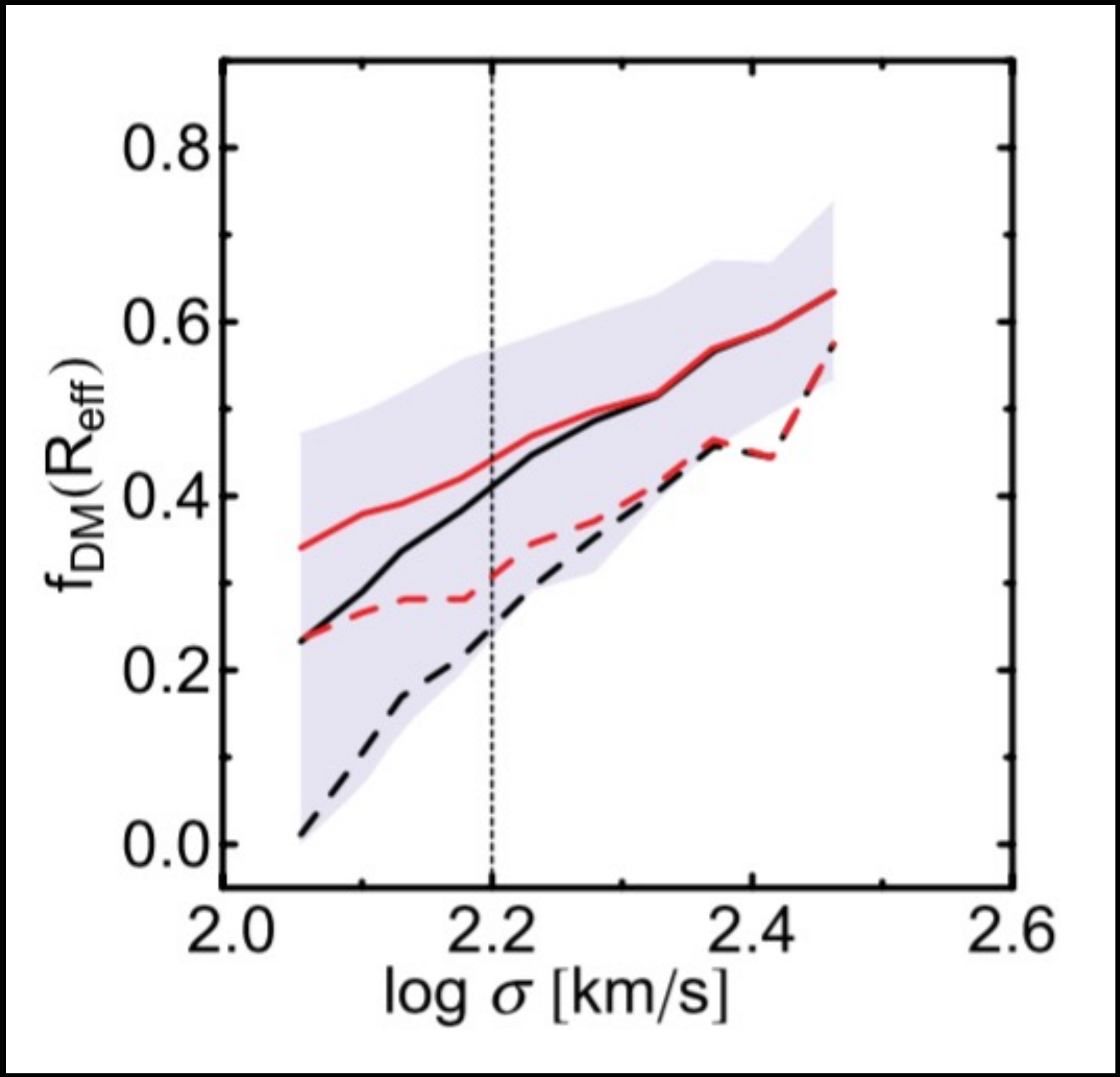
at z = 0

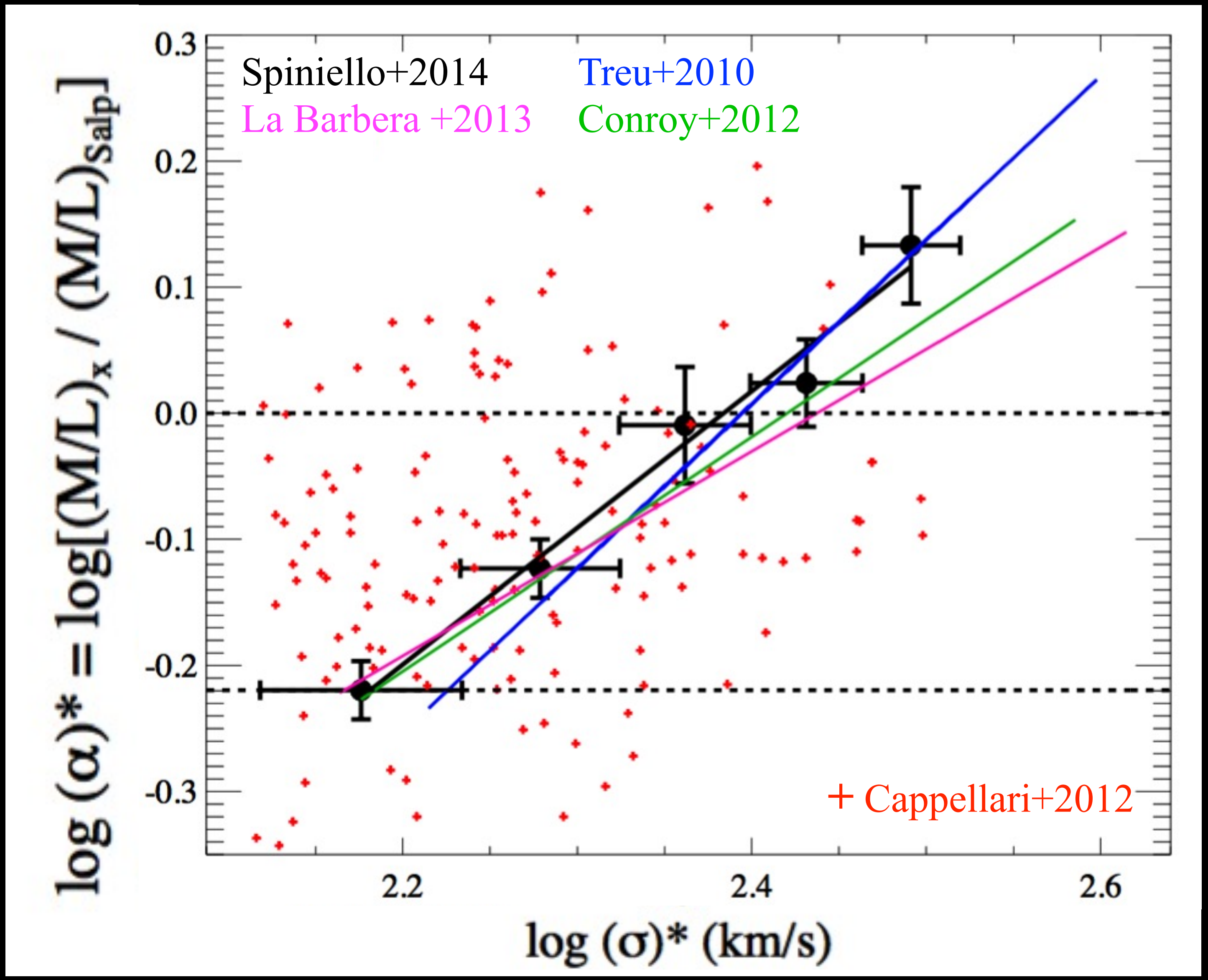
The Mass to Light ratio in massive ETGs increases with increasing mass (velocity dispersion) of the systems



Stellar (crosses) and total (points) M/L in the B- (blue) and V - (red) bands for the SLACS lenses, *Auger et al. 2010*

DARK MATTER FRACTIONS vs IMF





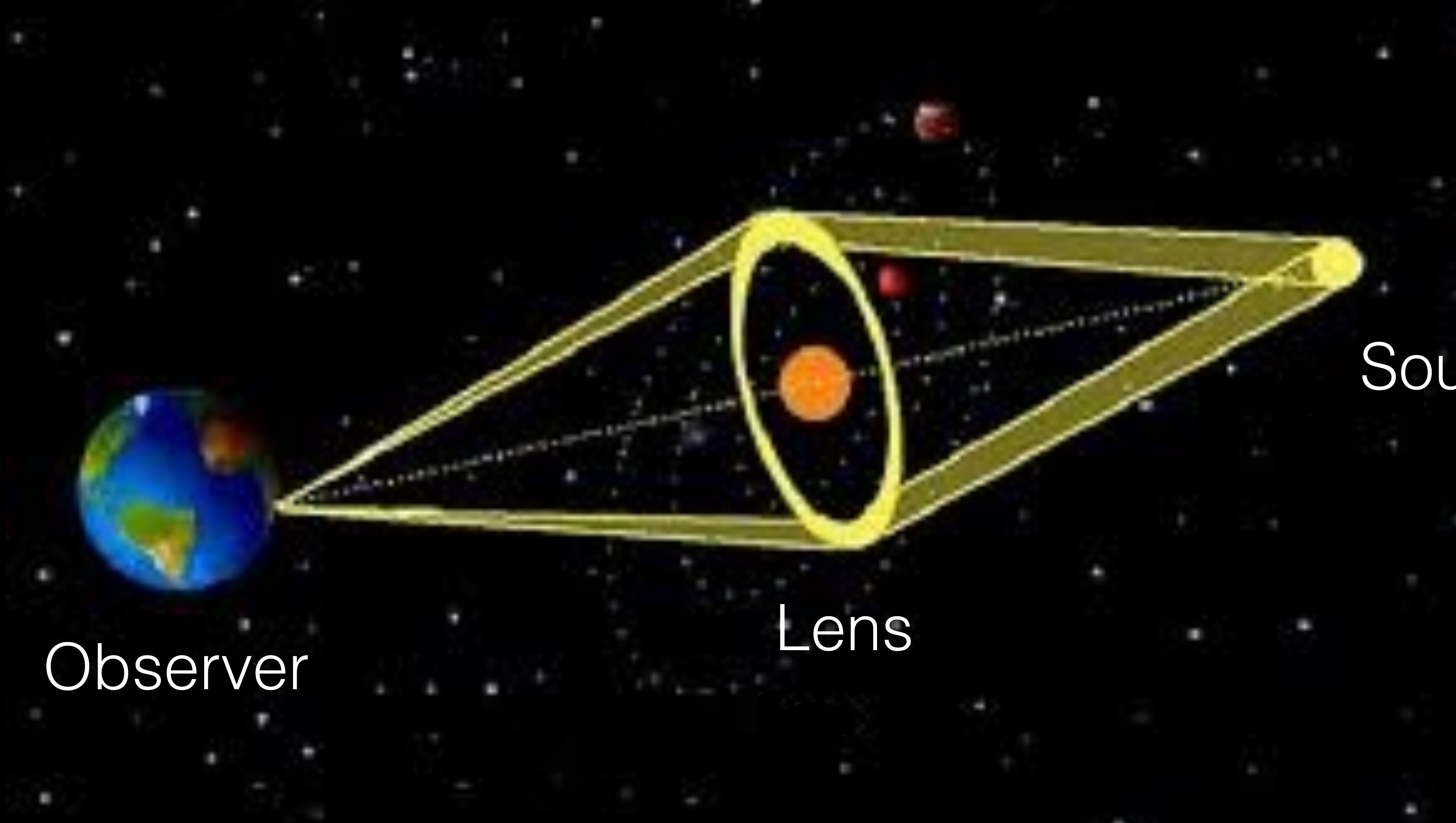
Tortora et al. 2012

Spiniello et al. 2014

The situation is already complicated at z=0…
What happens to higher redshift?

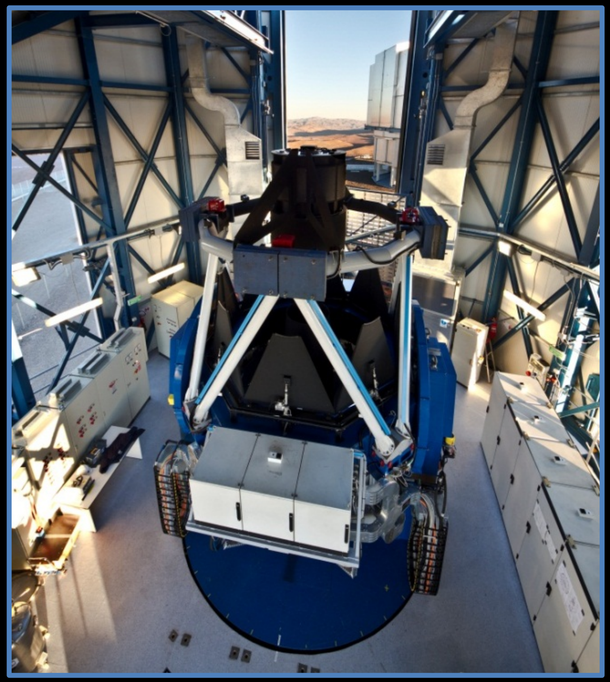
STRONG LENSING IS ONE OF THE MOST ACCURATE WAY TO MEASURE TOTAL MASSES

AND THE ONLY POSSIBLE AT Z > 0



WE NEED MORE LENSES !!!

SEARCH FOR NEW LENSES IN KiDS



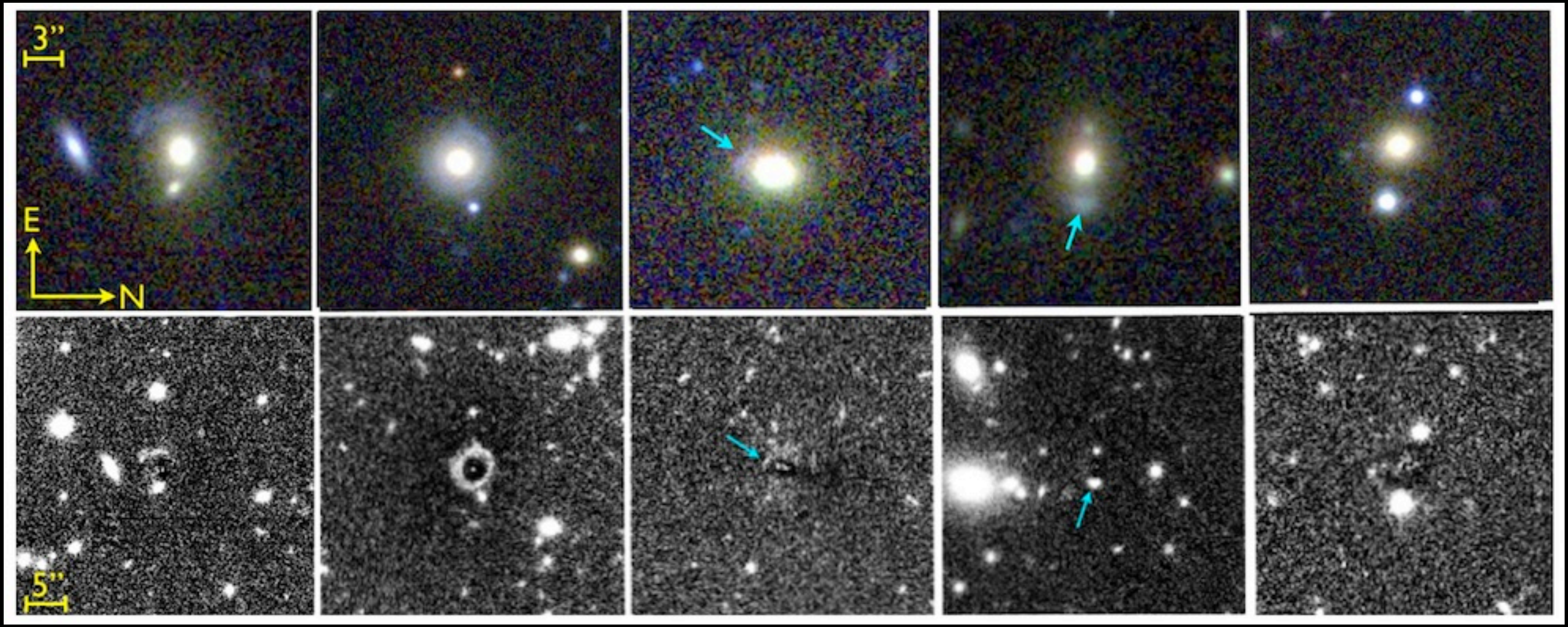
KiDS – Kilo degree survey

de Jong et al. 2015

OmegaCAM on the VLT Survey Telescope

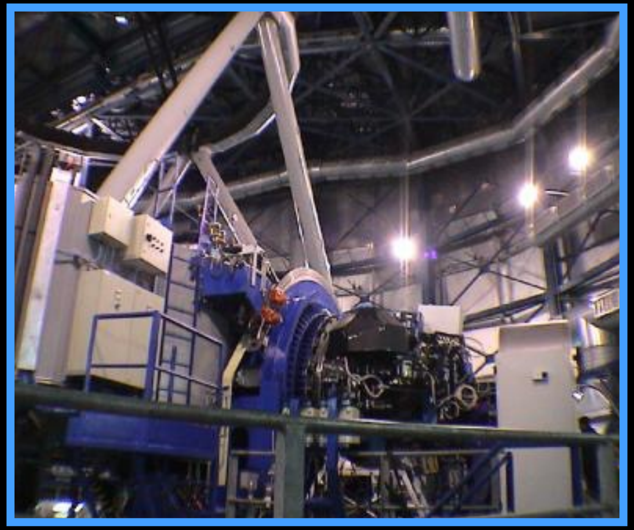
1500 deg^2 in ugri (depth ~25 in r-band – 5sigma 2" ap)

- Active M1 shape control
- Active M2 positioning in 5 dof (hexapod)
- 0.27 Gpixel 1°x1° f.o.v.
- 0.21"/pixel
- Median seeing = 0.7"



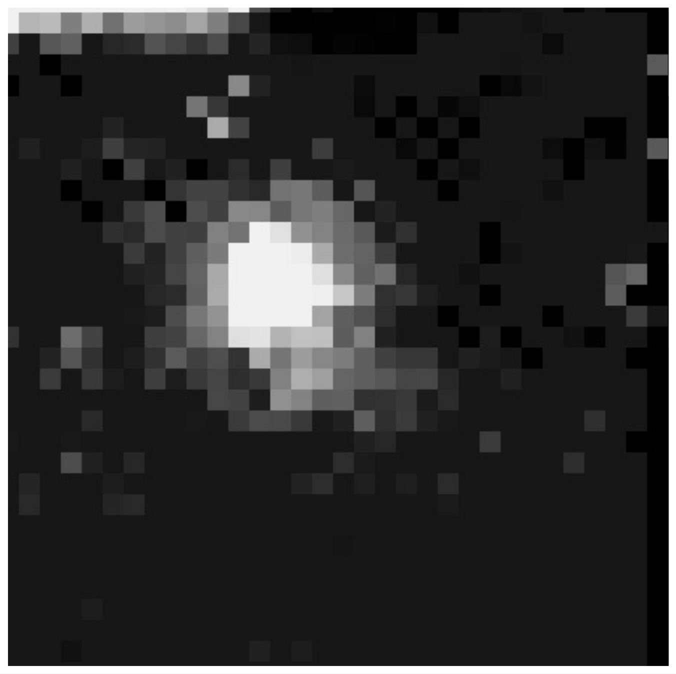
SPECTROSCOPIC FOLLOW UP to confirm the first candidates

VIMOS IFU



IFU Medium Resolution
R=720
Scale: 0.67"/fibre
Field-Of-View (FOV) = 27" x 27"
Wavelength (nm) = 490 - 1015
Dispersion 2.5 AA/px

- First 11 candidates observed
- 1h OB per system (~40 mins on target)
- One lens confirmed (100%)
- One candidate excluded (star)
- Seven ON GOING but very promising
- Two new observed to reduce and analysing

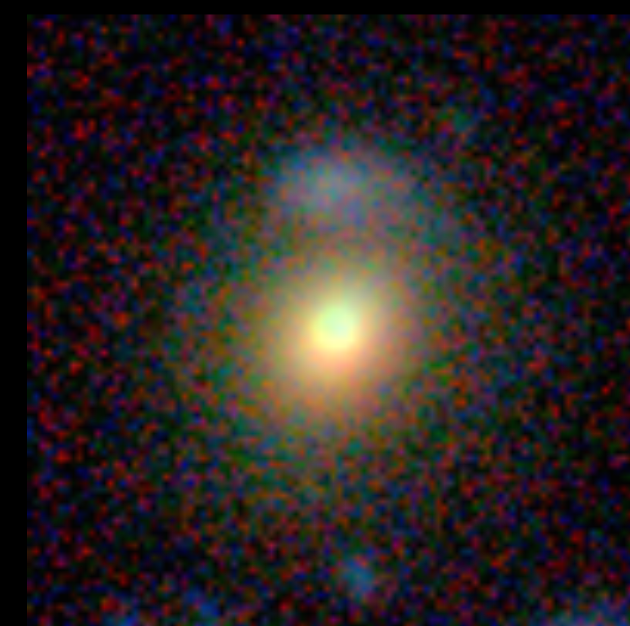


FIRST CANDIDATES:

First KiDS andidates:





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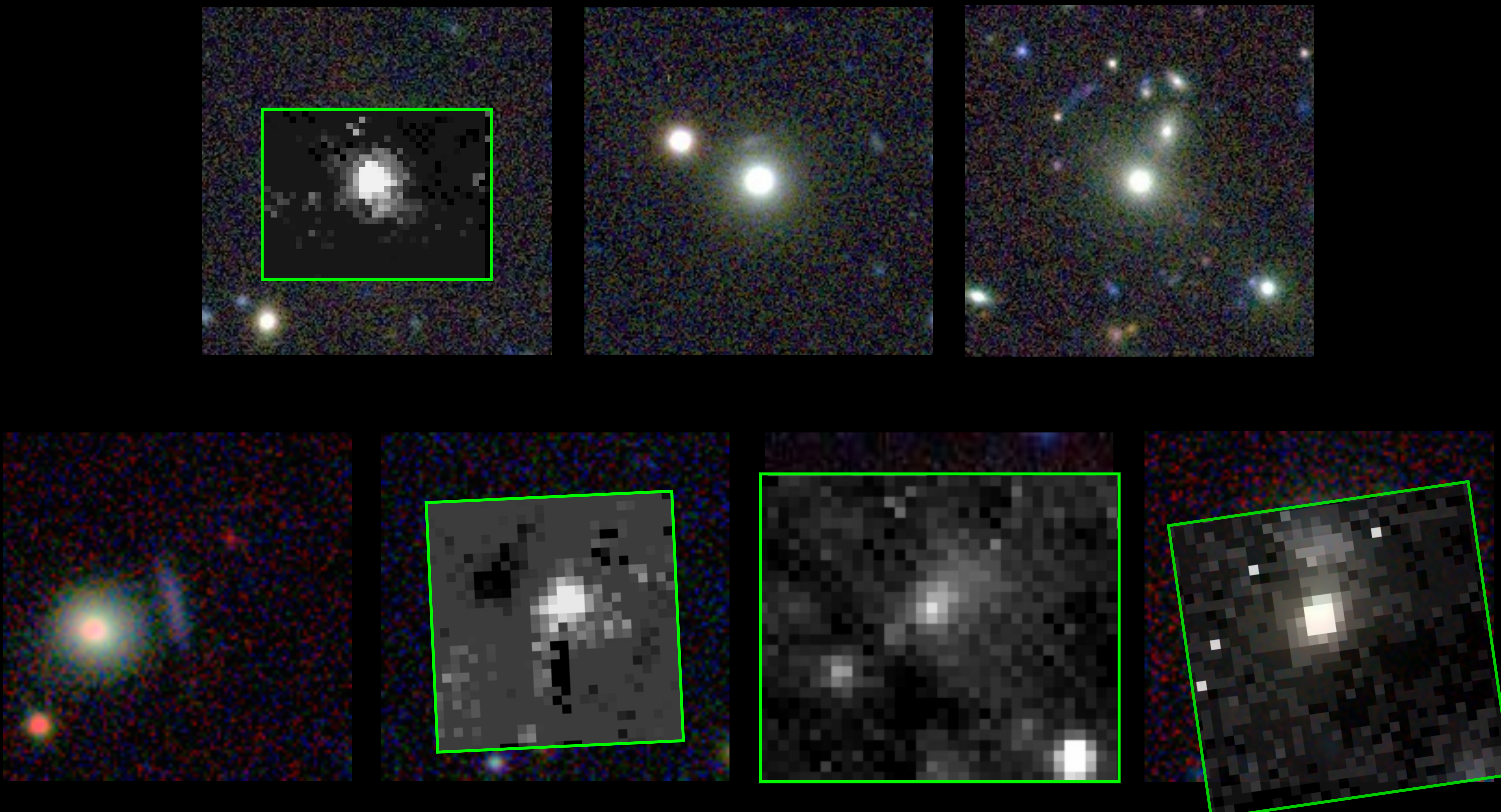

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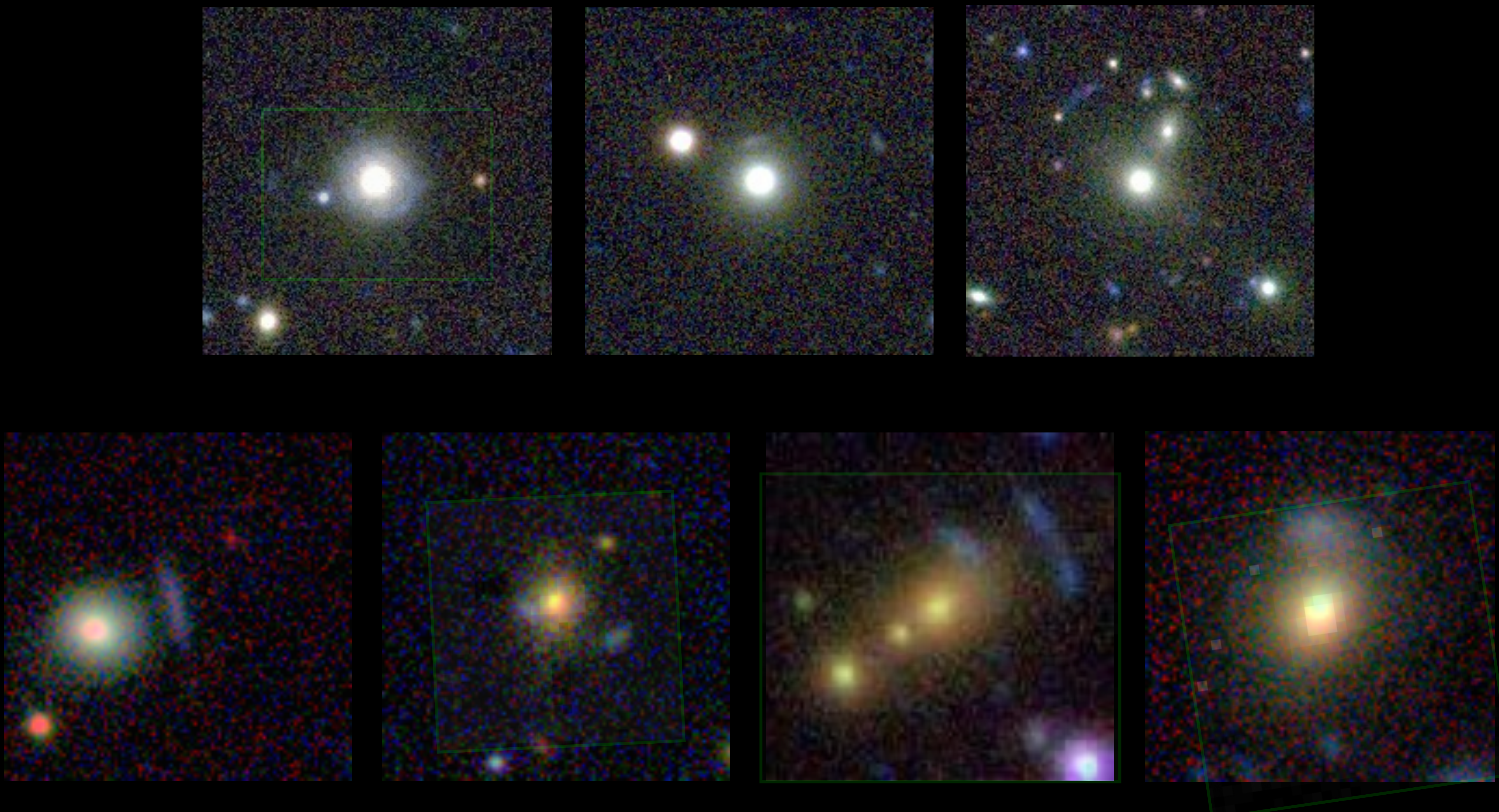

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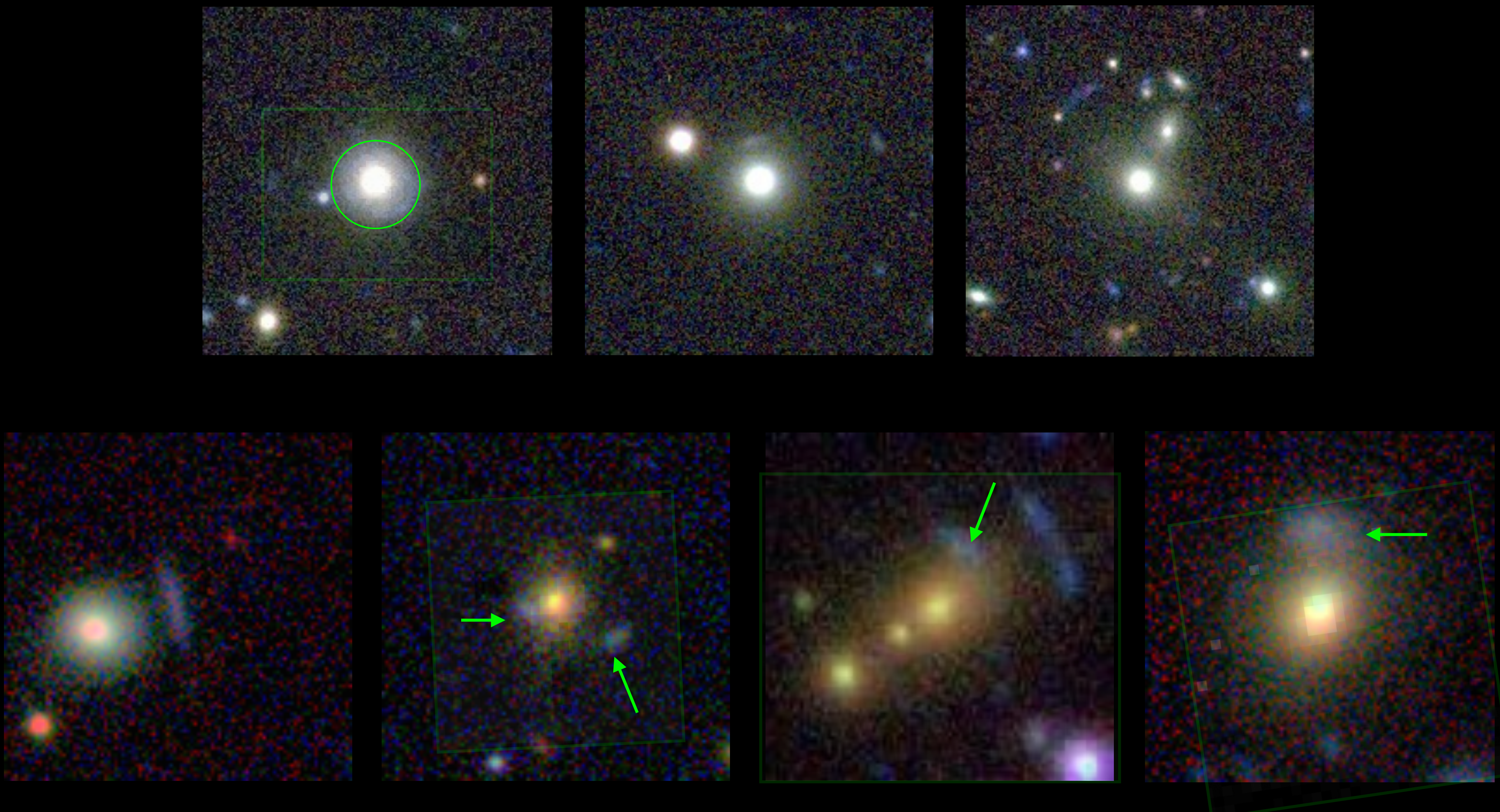

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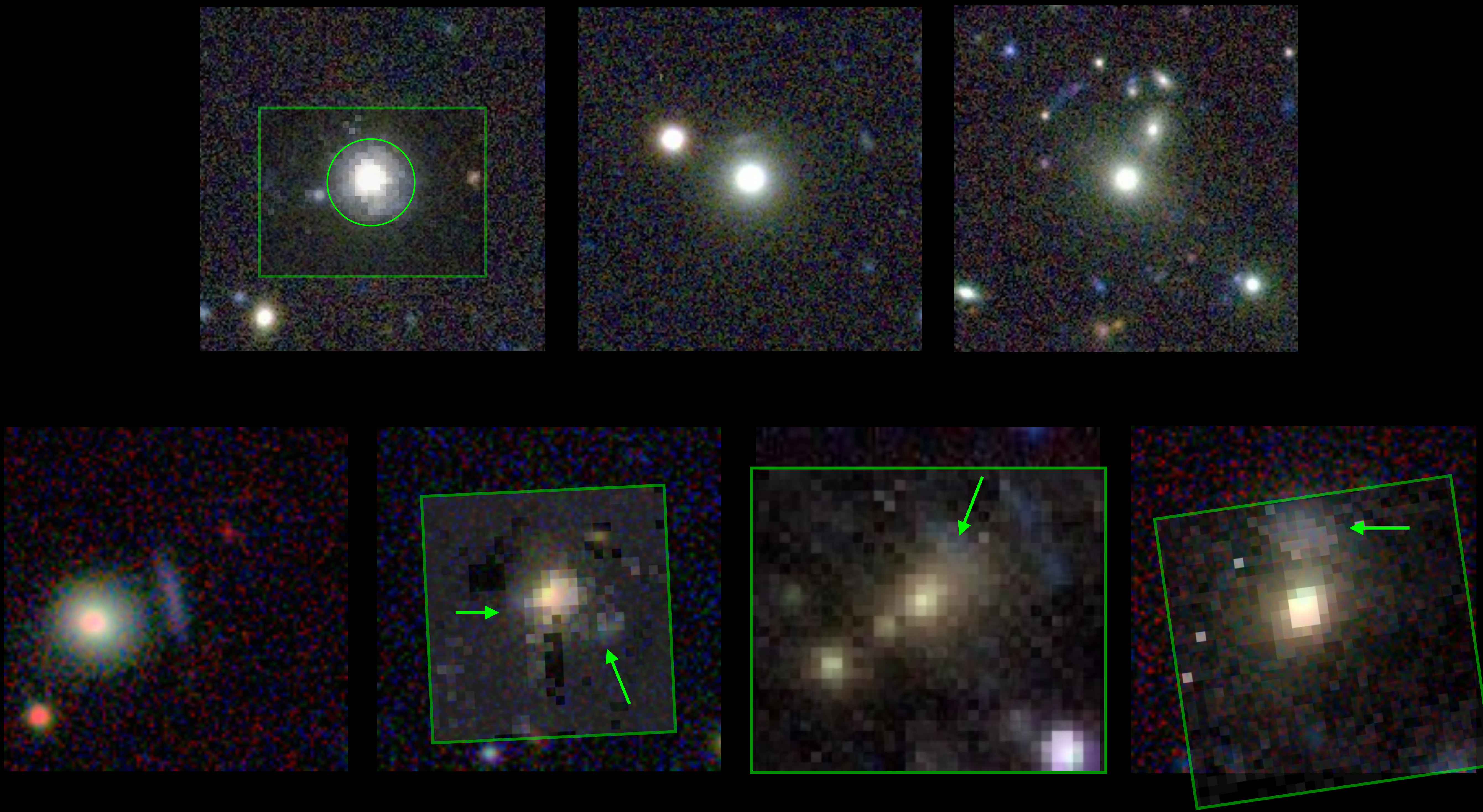

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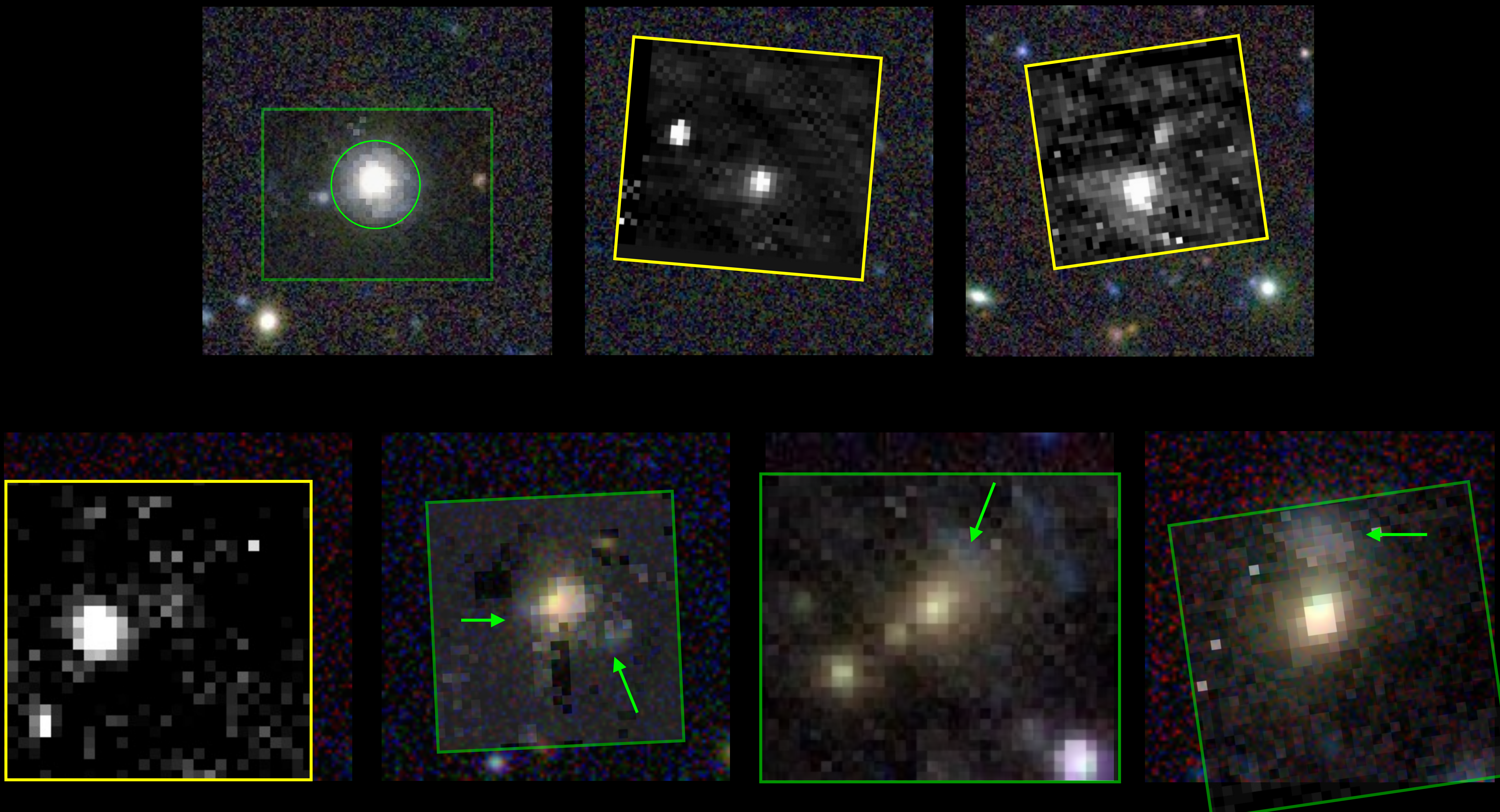
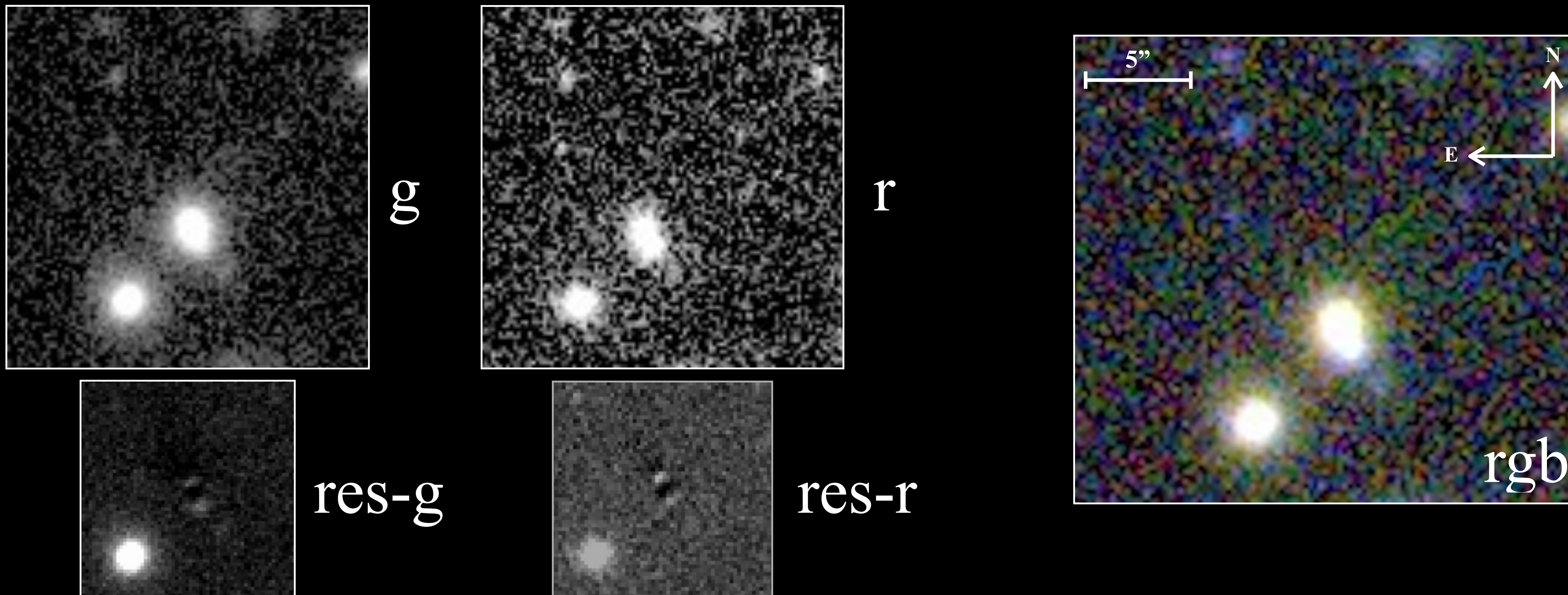


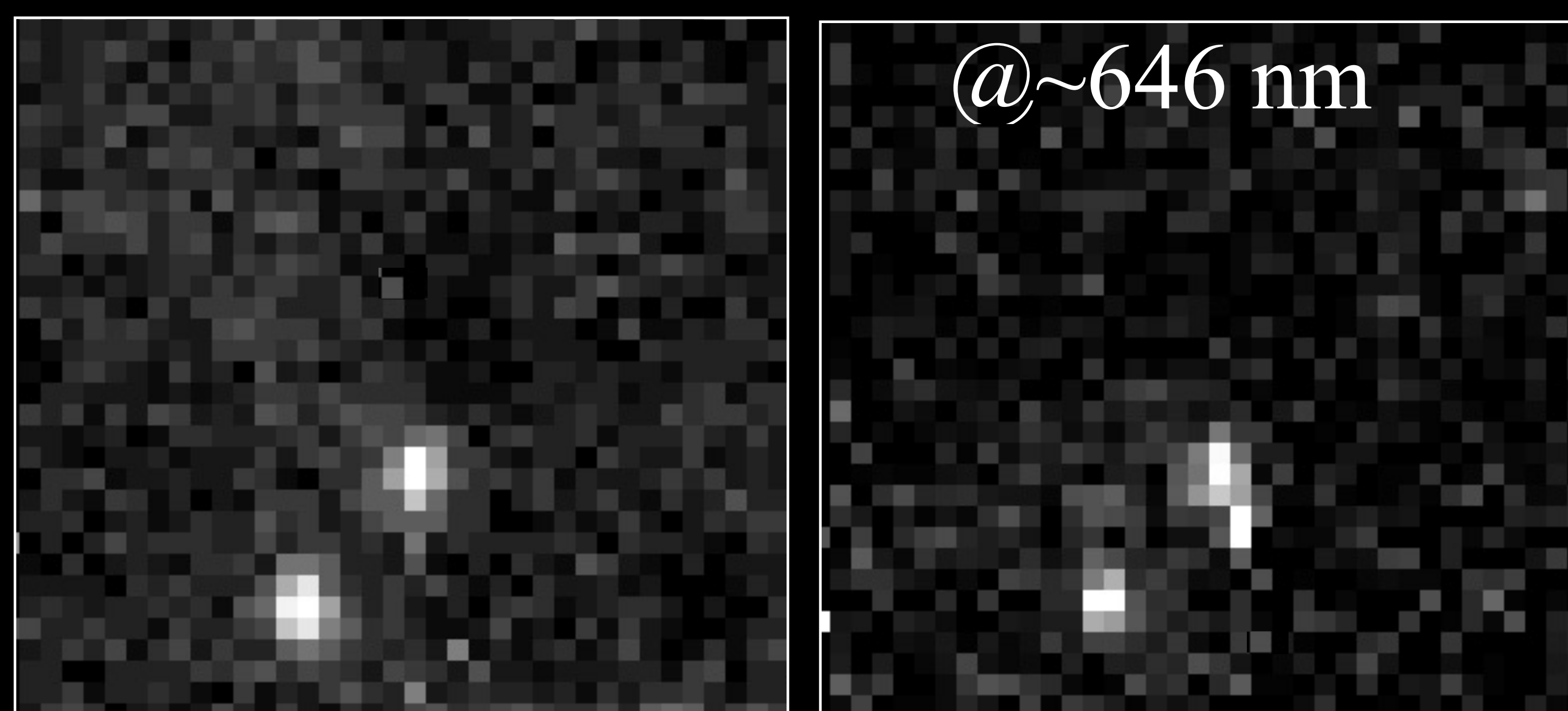
THE FIRST SUPER-COMPACT MASSIVE STRONG LENS

KIDS1748825

KiDS images



VIMOS FoV



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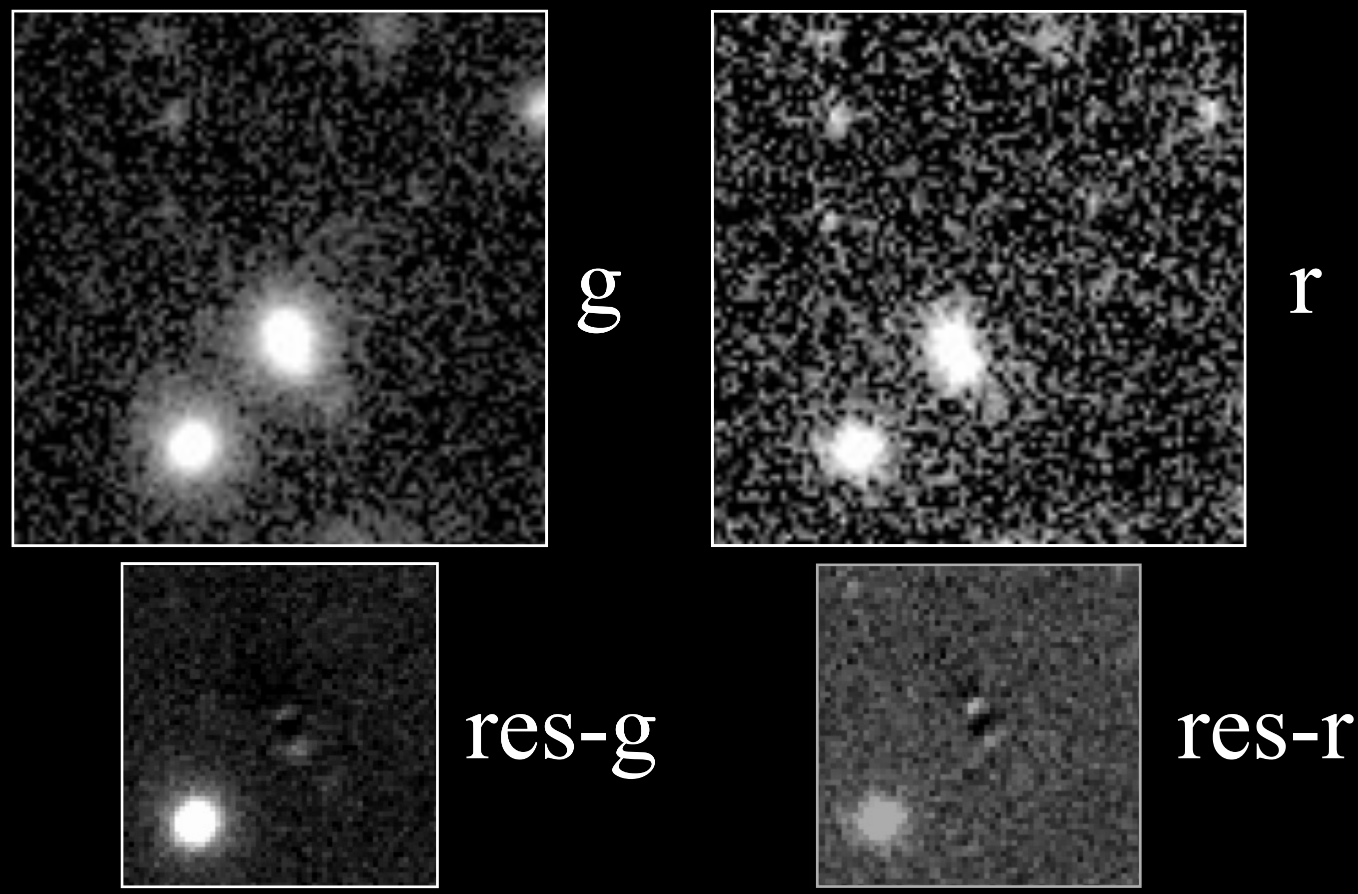

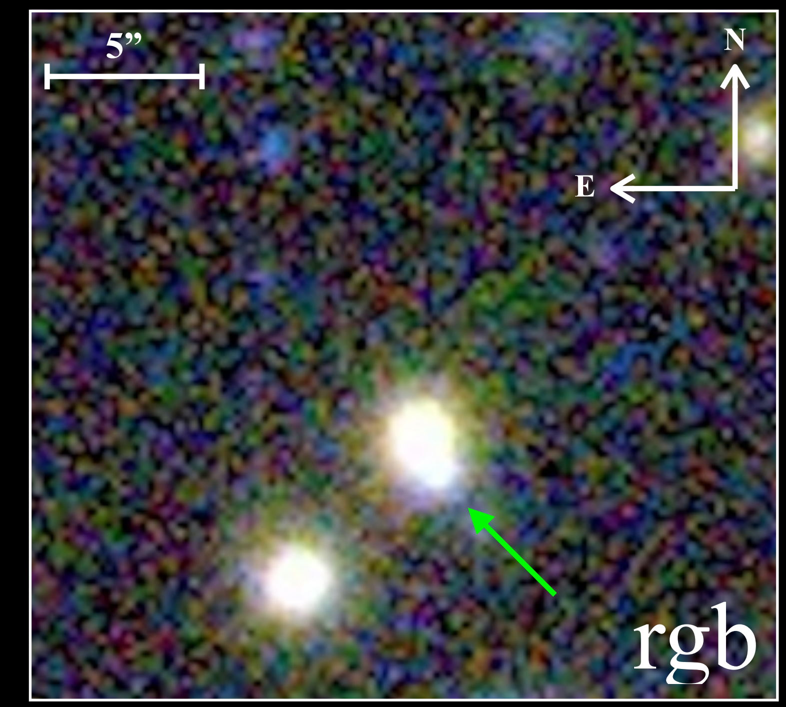

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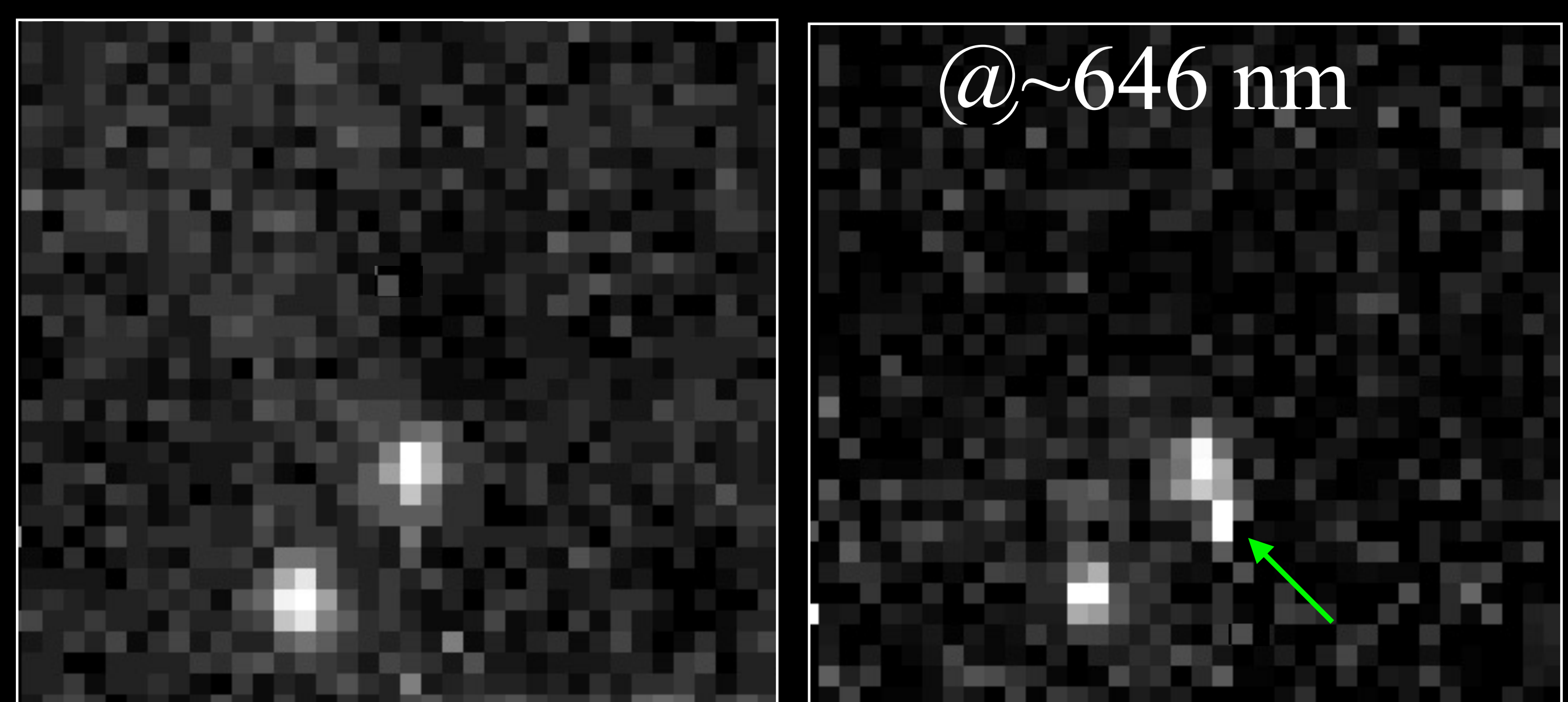
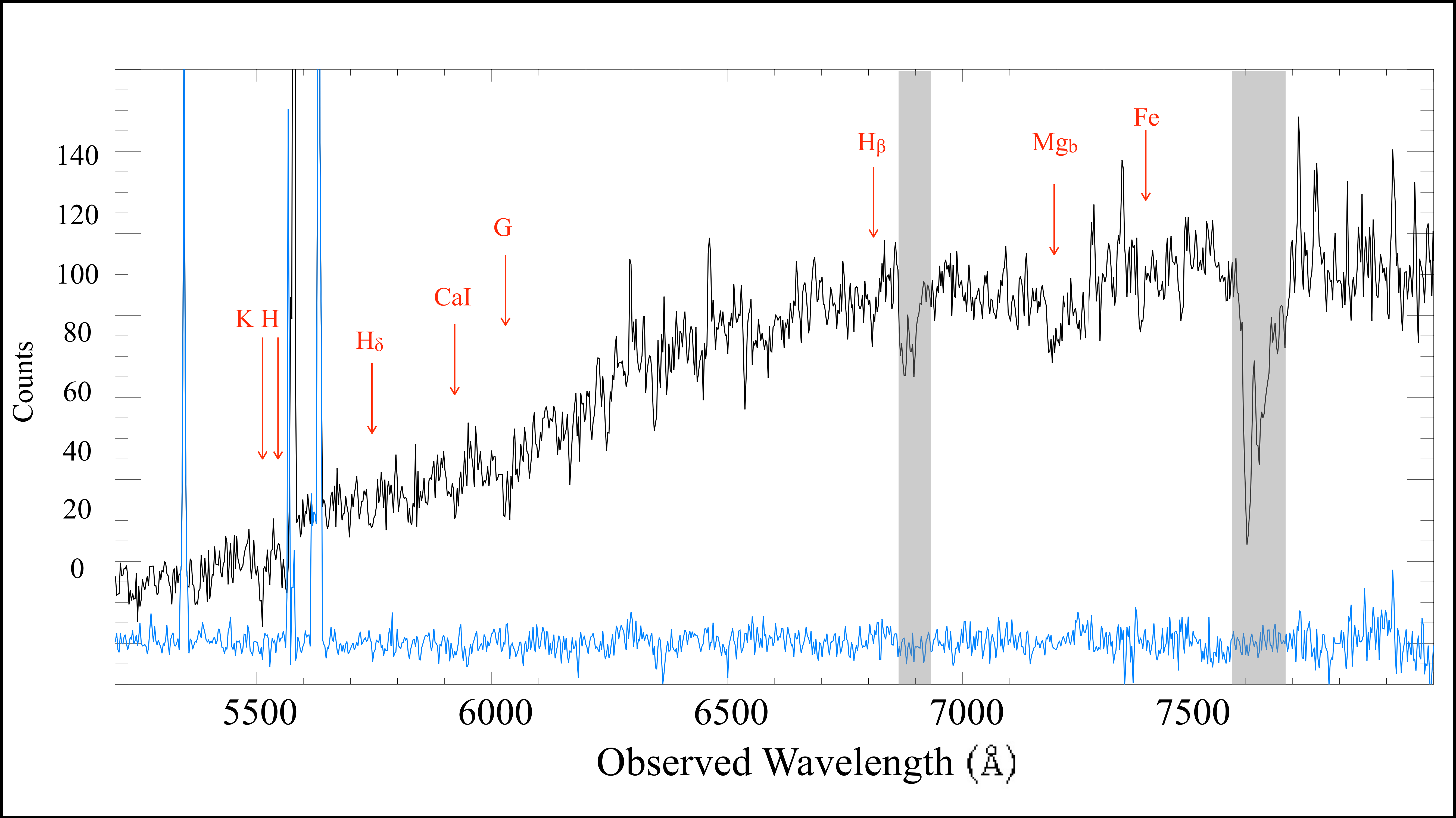


THE LENS



$z = 0.4006$

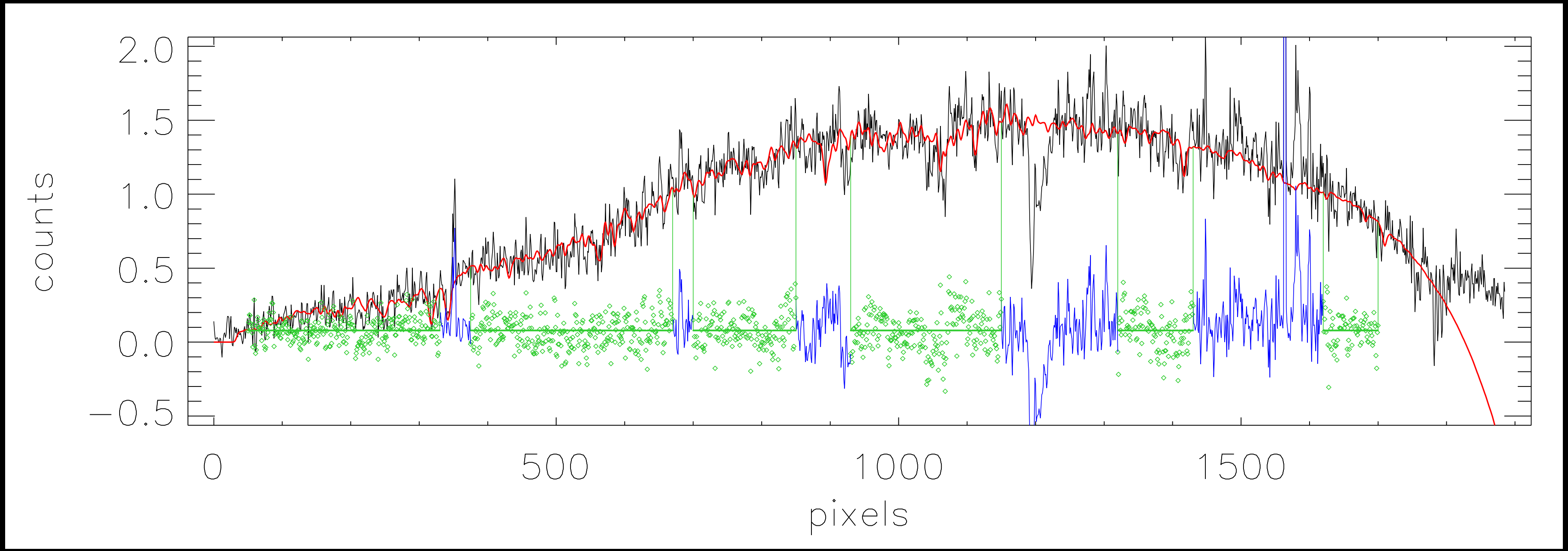
$\sigma_{*} = 227 \pm 15$ Km/s

$R_{eff} \sim 2.5$-3 kpc

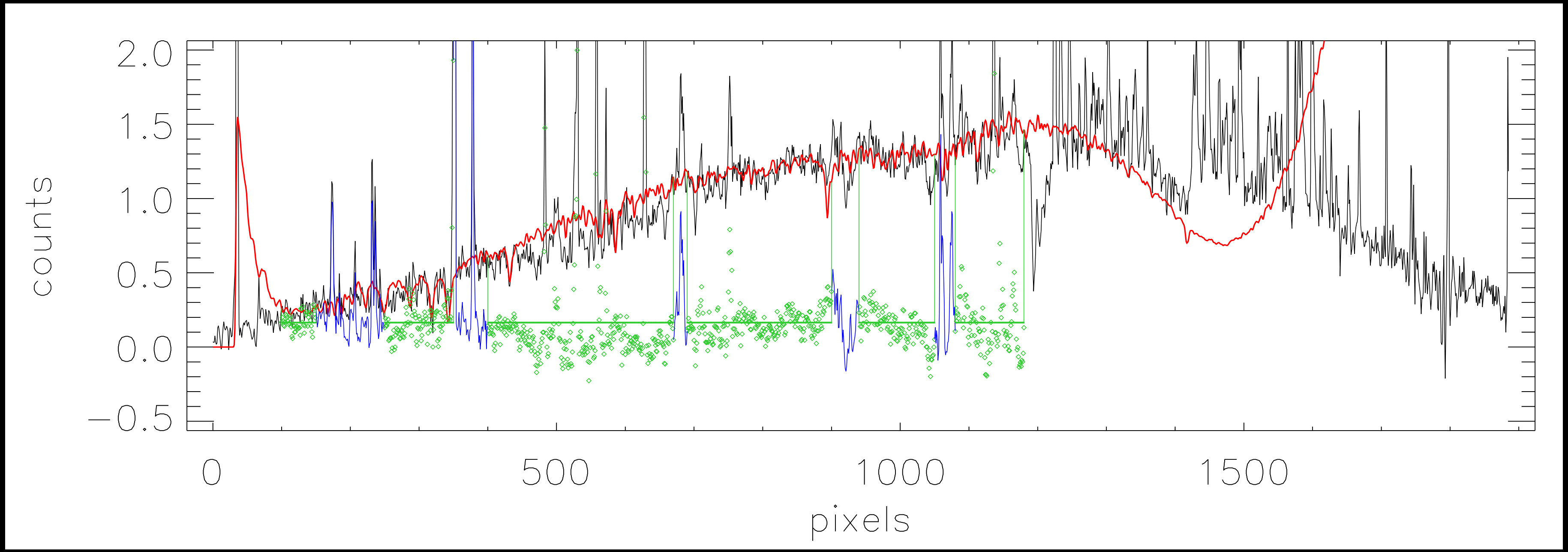
Spatially resolved kinematics with pPXF

(Cappellari & Emsellem, 2004, PASP, 116, 138
Cappellari, 2017, MNRAS, 466, 798)

Radius	Num Spectra	S/N per Å	$\sigma_\star$ ($\mathrm{km\,s^{-1}}$)
$r < 0.33$”	1	38	227 ± 15
0.33” $< r <$ 1.0”	5	20	192 ± 26
1.0” $< r <$ 1.42”	7	10	175 ± 30
1.42” $< r <$ 2.36”	7	7	152 ± 36



Central aperture
r < 0.33”
S/N ~20



Outer ring
1.42” < r < 2.36”
S/N ~5

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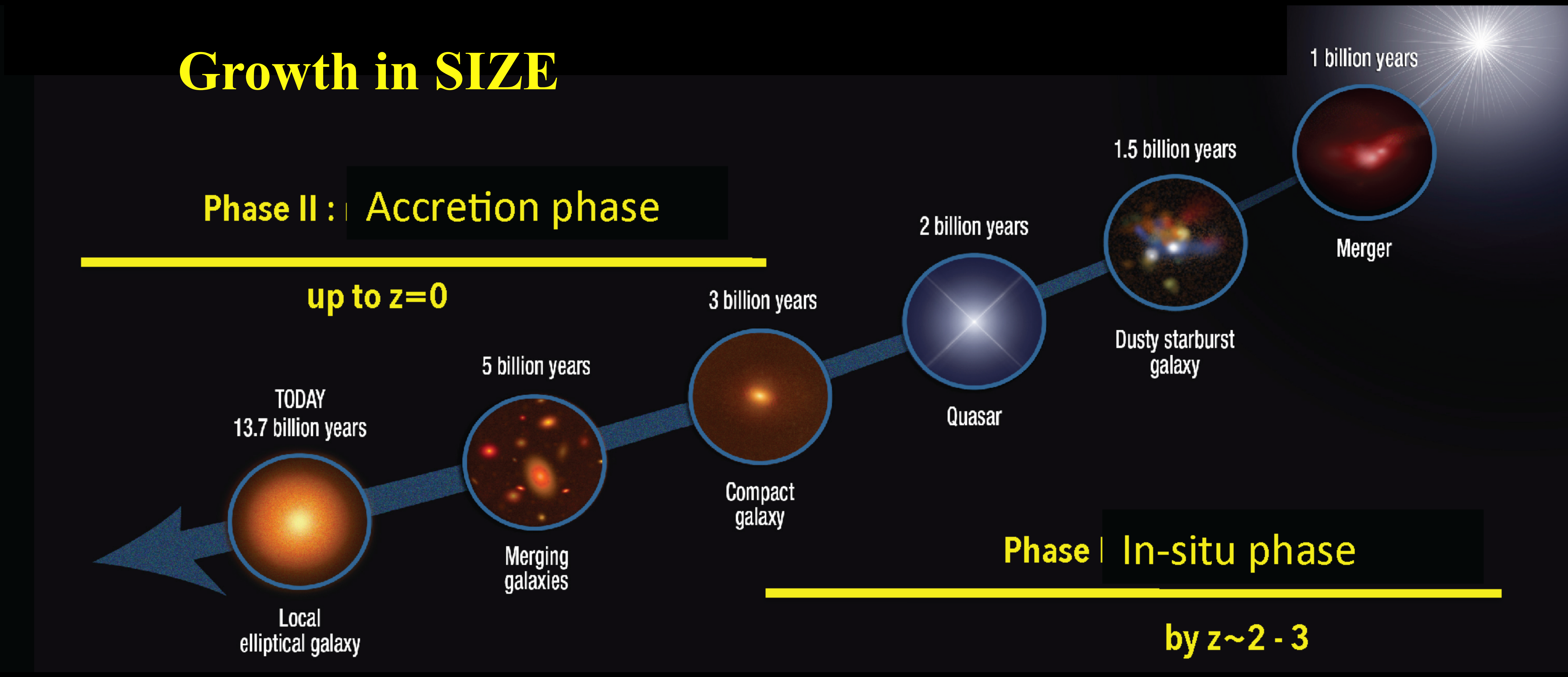

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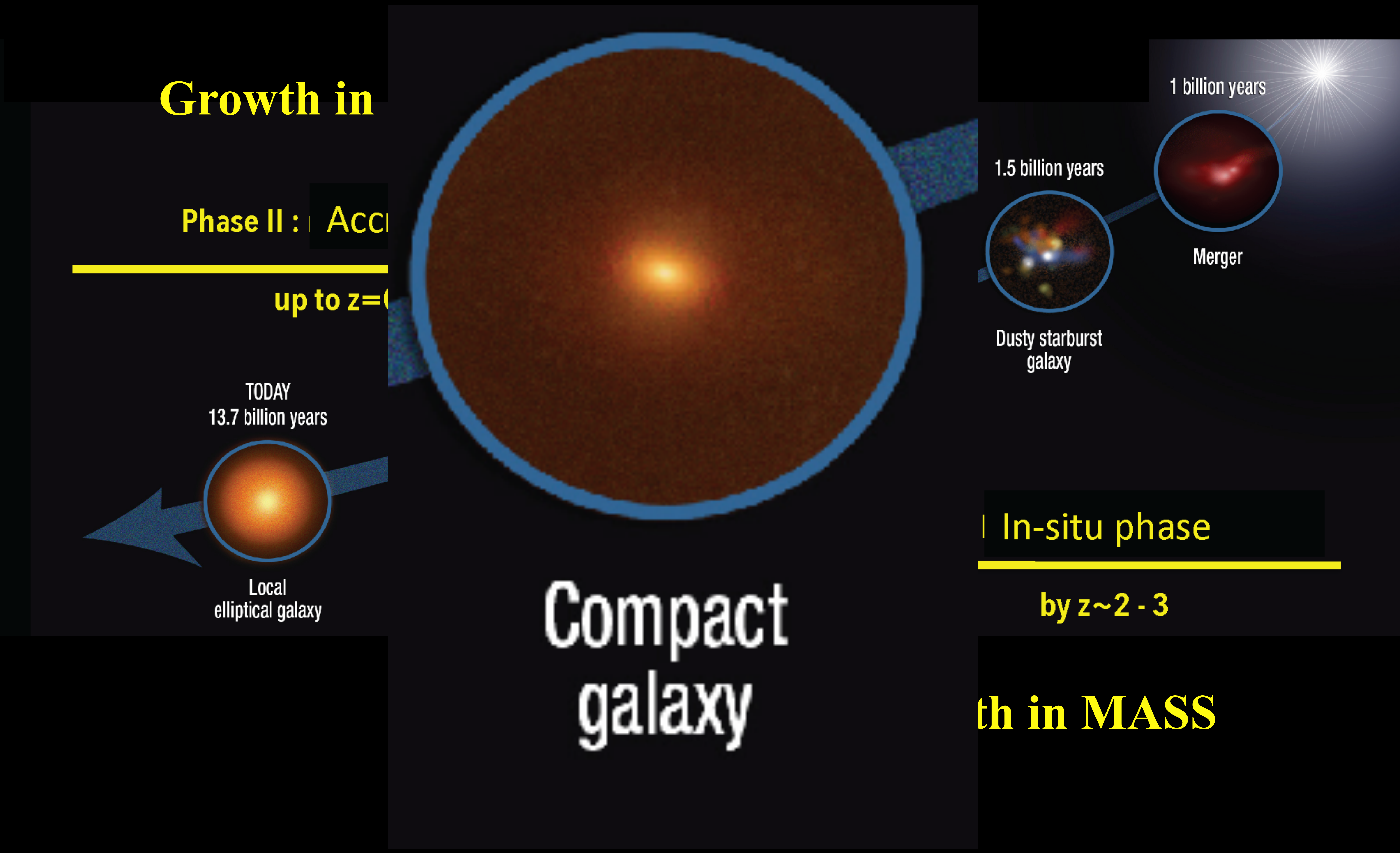


COMPACT MASSIVE GALAXIES

★ **Local counterparts of the high-redshift red nuggets**

(Trujillo et al. 2009, 2014, Poggianti et al. 2013, Tortora et al. 2017)

who somehow missed the channels of galaxy size growth

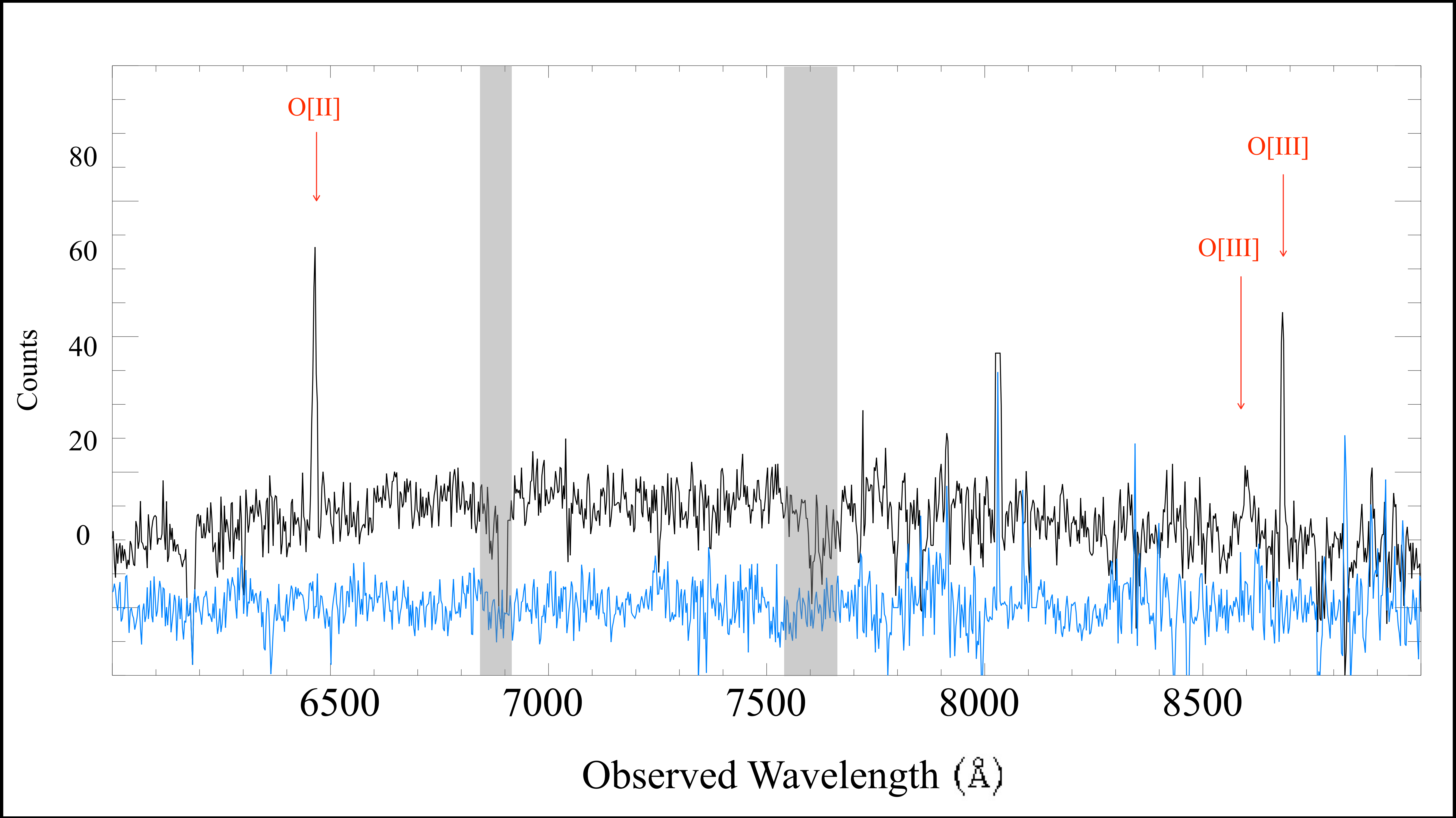
(Daddi et al., 2005, Trujillo et al., 2006)

★ **Unique systems to :**

- understand formation and evolution of structures in the Universe

- test possible galaxy formation scenarios.

THE SOURCE



z = 0.7343 Rein ~ 2.5 Reff

O[II] and O[III] emission lines

LENSING AND DYNAMICAL MODEL

Band	R_{Ein}(lensing)	R_{Ein}(dinamica)	R_{eff}
r	0.47 +/- 0.24	0.71 +/- 0.10	0.72
g	0.67 +/- 0.31	0.54 +/- 0.07	0.59

From lensing:

M_{tot} ($R<R_{Ein}$) = 7.4 x 10^10 M_{sun}

M_{tot} ($R<R_{eff}$) = 1.1 x 10^11 M_{sun}

From dynamics:

(Isotropic model, Chabrier IMF)

M_{tot} ($R<R_{eff}$) = 1.07x 10^11 M_{sun}

M_{star} ($R<R_{eff}$) = 7.645 x 10^10 M_{sun}

f_{DM} ($R<R_{eff}$) = 0.28

ρ_{tot} ($\rho_{star} + \rho_{NFW}$) = -2

CONCLUSIONS

- Early Type Galaxies are not boring ;)
- A detailed understanding of the mass distribution (disentangling luminous from dark) is crucial to test structures formation scenarios
- Lensing and dynamics are unique tools (possibly the only ones that allow to go to higher redshift)
- KiDS will find hundreds of new lenses.
  WE FOUND THE FIRST