Crescenzo Tortora

university of groningen

Napoli
Napolitano
La Barbera
D'Ago
Spiniello
Spavone
Getman
Cavuoti
Brescia
Longo
Capaccioli
……..

Groningen
Koopmans
Verdoes Kleijn
Petrillo
Vernardos
Chatterjee
……..

Other institutions
Kuijken
Radovich
……..

Wider Than Before

Deeper Than Before

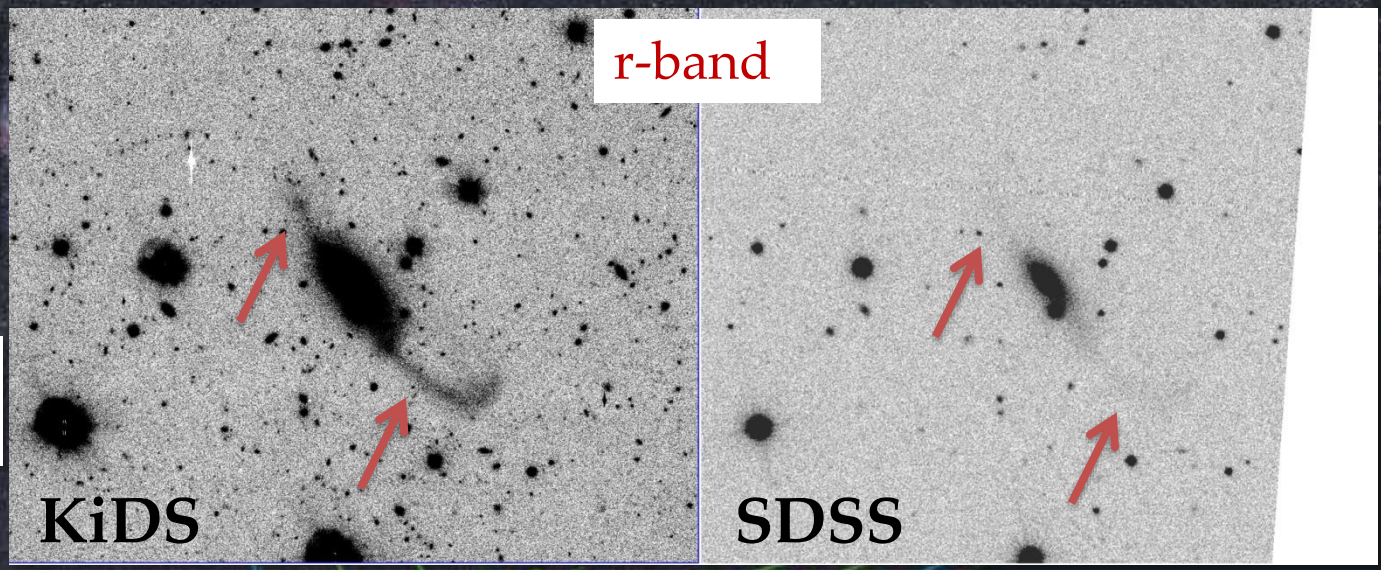
KiDS@VST aims to image 1500 square degrees in 4 optical bands (complemented in the NIR with VIKING@VISTA).

Deeper and with better quality and higher spatial resolution than previous surveys.

KIDS-N
ATLAS-N
KIDS-W2
KIDS-S

Pixel scale **0.2″/pxl**
Seeing **0.7″** (r-band)
Depth **r = 25** (r-band)

Why KiDS?



DR1/2/3 (440

Sources: ~ 60

Galaxies: ~ 22 millions with photo-z

> 3 millions with high-quality photo-z

~ 1 millions with structural parameters

Ultra compact galaxies

Gravitational arcs/rings

Lensed quasars

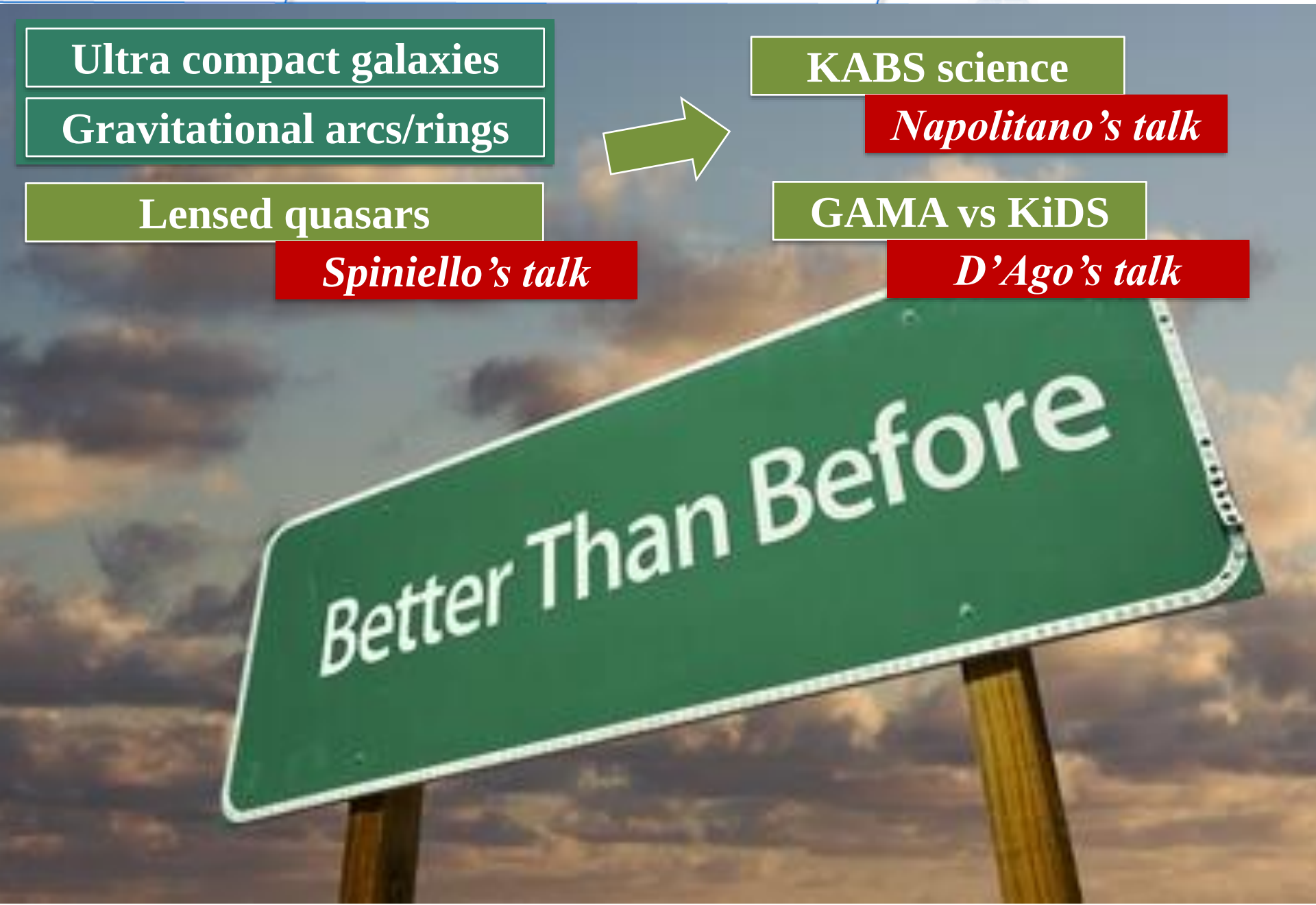
Spiniello's talk

KABS science

Napolitano's talk

GAMA vs KiDS

D'Ago's talk



Towards a census of supercompact massive galaxies in the Kilo Degree Survey

C. Tortora,[1⋆] F. La Barbera,[1] N. R. Napolitano,[1] N. Roy,[1,2] M. Radovich,[3] S. Cavuoti,[1] M. Brescia,[1] G. Longo,[2] F. Getman,[1] M. Capaccioli,[2] A. Grado,[1] K. H. Kuijken,[4] J. T. A. de Jong,[4] J. P. McFarland[5] and E. Puddu[1]

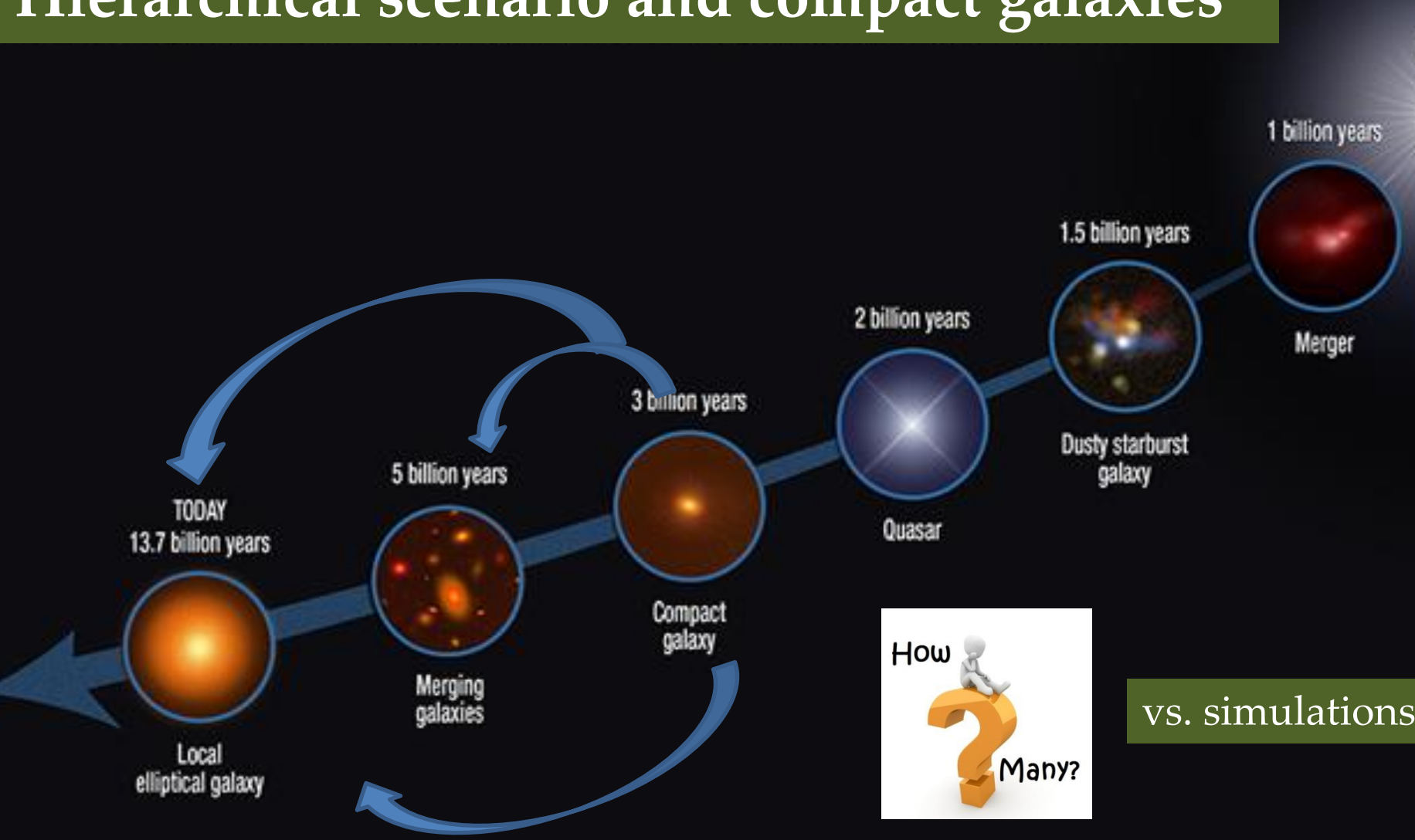
The first sample of spectroscopically confirmed ultra-compact massive galaxies in the Kilo Degree Survey

C. Tortora[1⋆], N.R. Napolitano[2], M. Spavone[2], F. La Barbera[2], G. D'Ago[2], C. Spiniello[2], K. H. Kuijken[3], N. Roy[2,4], M. A. Raj[2], S. Cavuoti[2,4], M. Brescia[2], G. Longo[4], V. Pota[2], C. E. Petrillo[1], M. Radovich[5], F. Getman[2], L.V.E. Koopmans[1], I. Trujillo[6,7], G. Verdoes Kleijn[1], M. Capaccioli[4], A. Grado[2], G. Covone[4], D. Scognamiglio[2], C. Blake[8], K. Glazebrook[8], S. Joudaki[8,9,10], C. Lidman[11], C. Wolf[12]

Better Than Before

The census of ultra-compact massive galaxies

Hierarchical scenario and compact galaxies

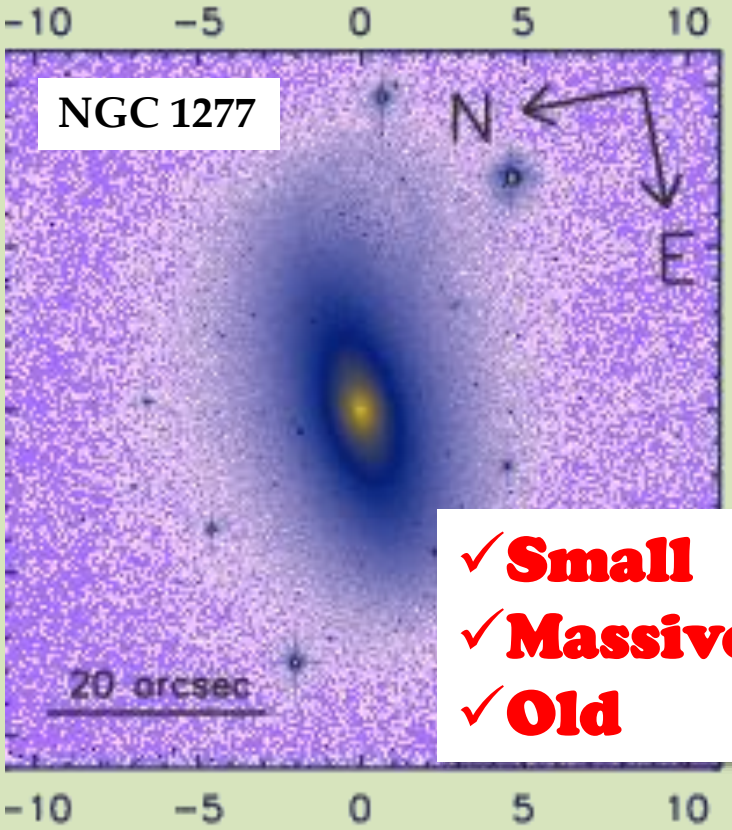


vs. simulations

NASA, ESA, S. Toft, A. Feild

Ultra-compact massive galaxies (UCMGs)

"LOCAL RED NUGGET"



- ✓Small
- ✓Massive
- ✓Old

Trujillo et al. 2014

UCMGs definition

$$R_e < 1.5\,\mathrm{kpc}$$

$$M_\star > 8 \times 10^{10}\, M_\odot$$

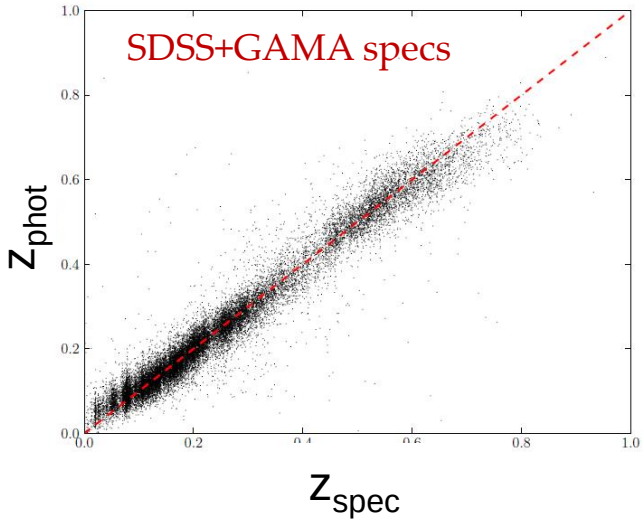
Data analysis

Photo-z

(machine learning, specs to train the network)

scatter ~ 0.03

Cavuoti et al. 2015, 2017



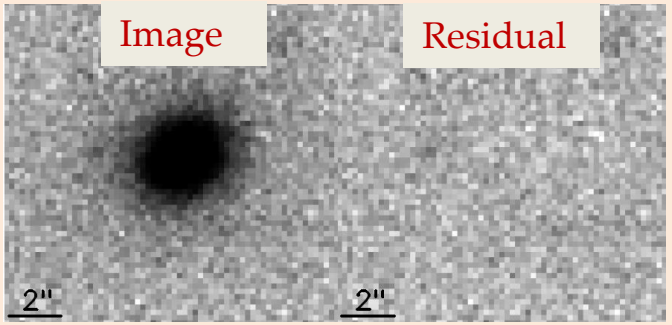
Stellar masses

(SED-fitting, using Lephare program)

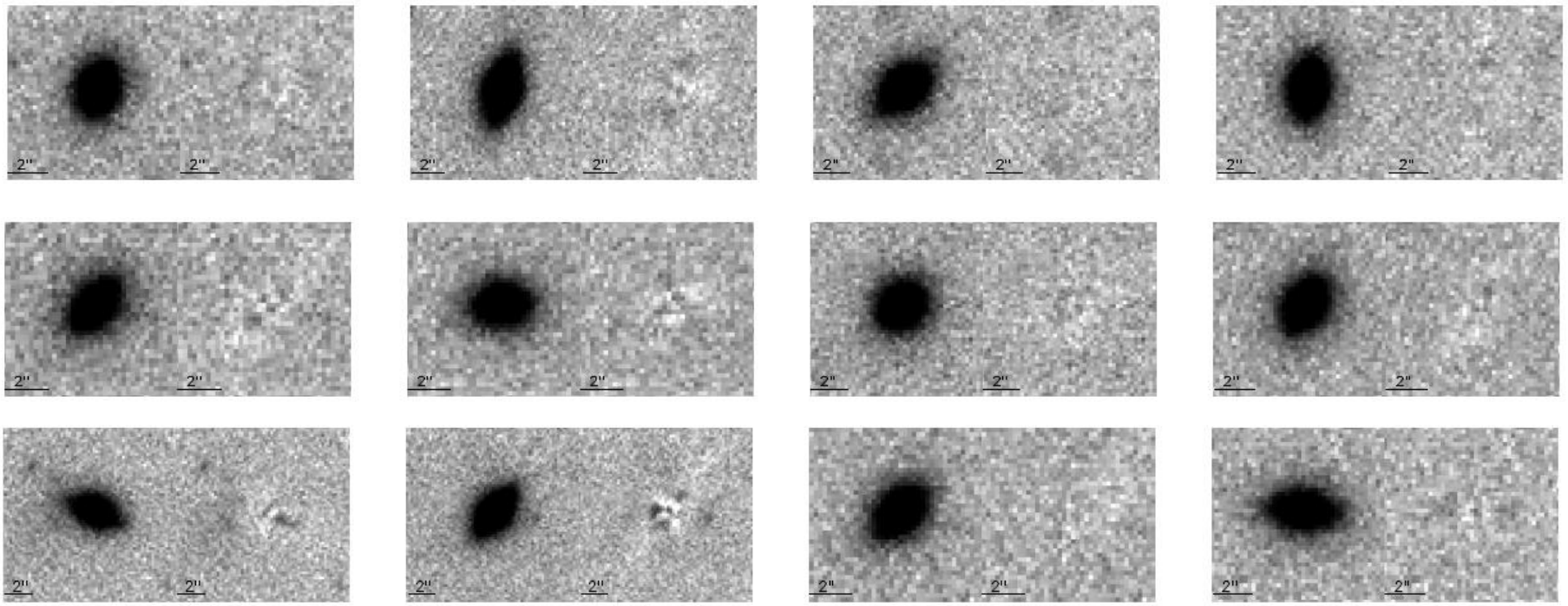
Structural parameters

(2DPHOT, Sérsic fit, modelling the PSF)

La Barbera et al. 2008; Roy et al., MNRAS submitted



Some UCMG candidates

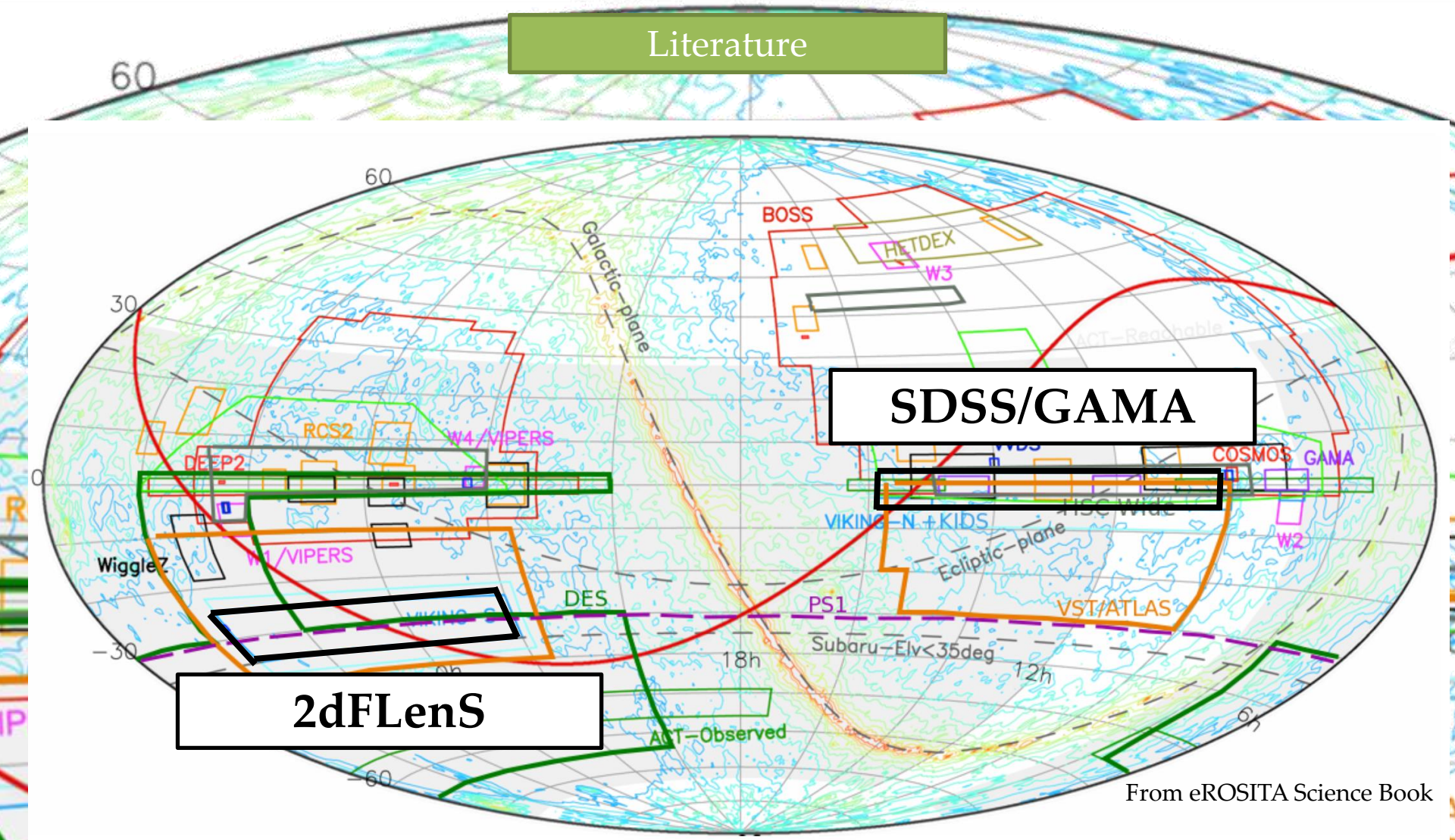


Complete at z < 0.5

Spectroscopic redshifts

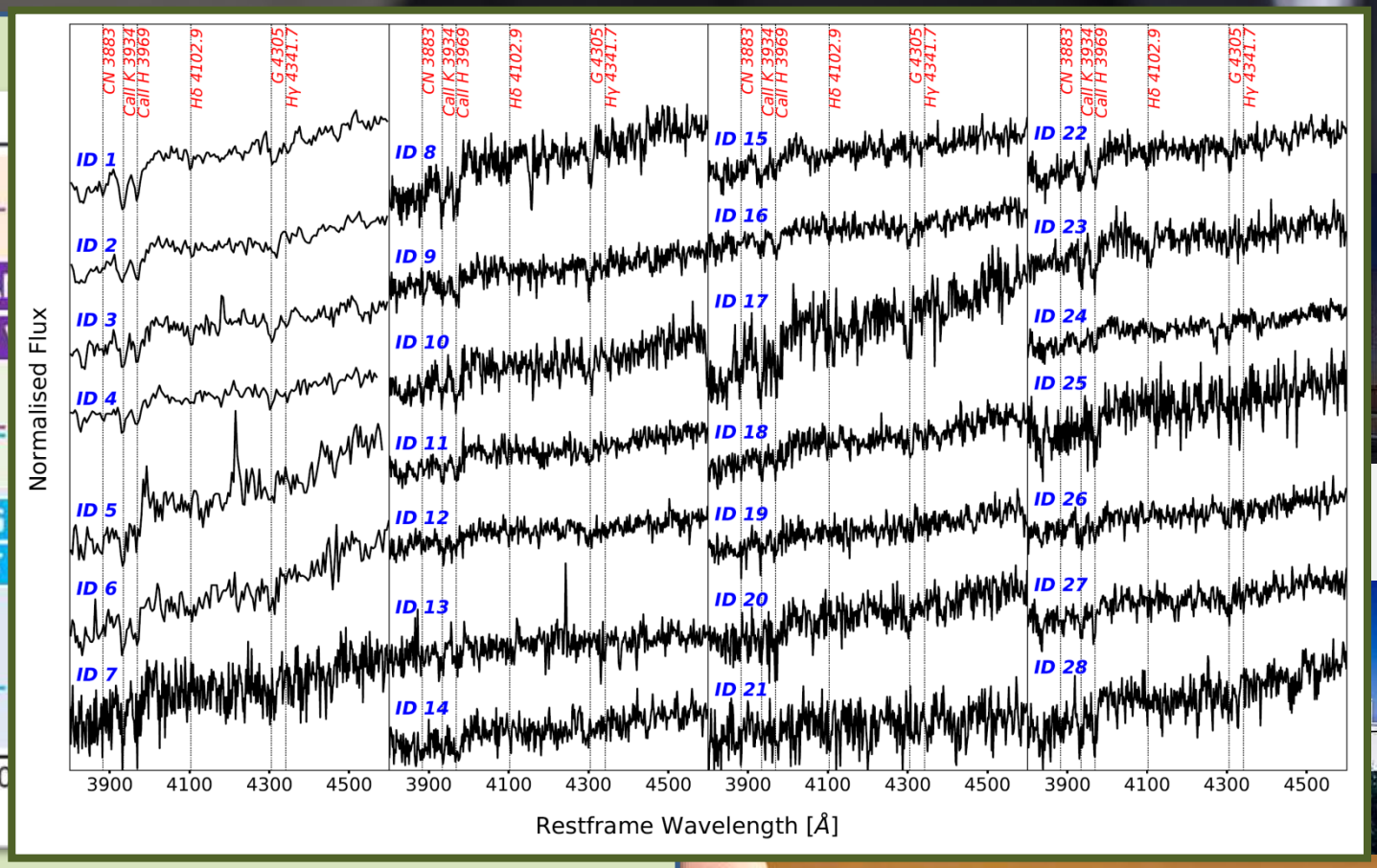
- Literature
- New observations

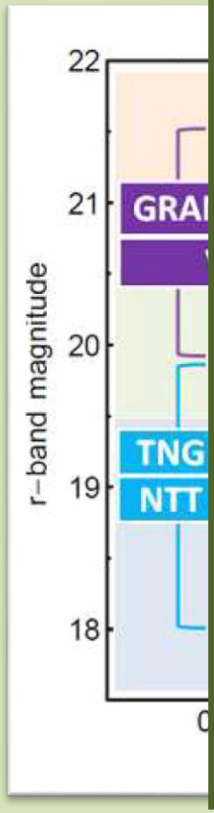
Literature

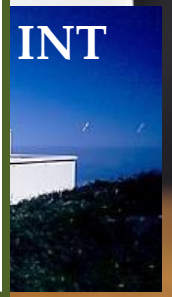


From eROSITA Science Book

New observations







28 observed and reduced (TNG-1st, NTT)

~45 observed and to be reduced (TNG-2nd, INT)

~20 to be observed (TNG-3rd)

Spectroscopic redshifts

TRUE

Literature

New observations

- ✓**Contamination** (false positive)
- ✓**Incompleteness** (false negative)

False Positive

False Negative

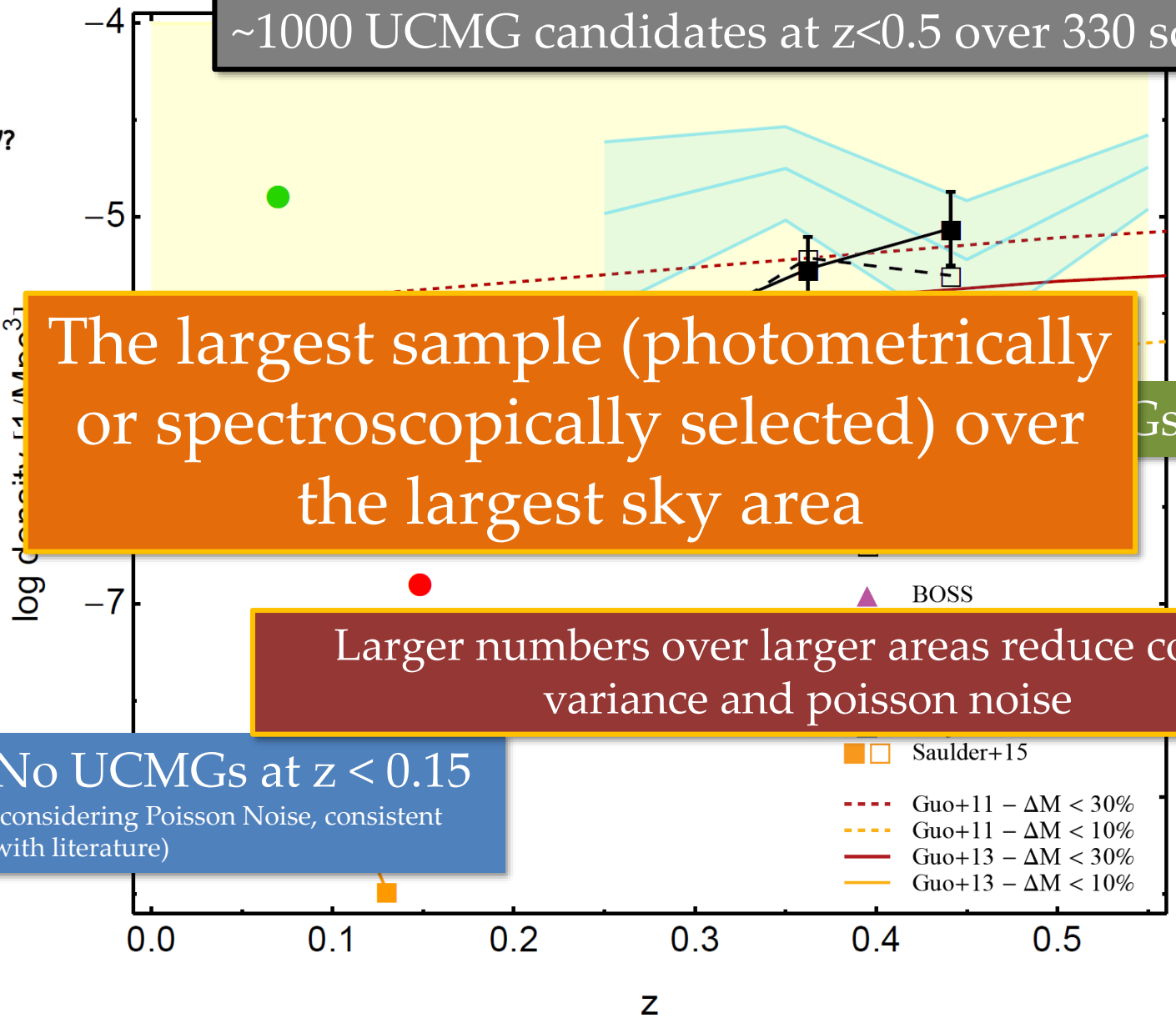
~1000 UCMG candidates at z<0.5 over 330 sq. deg.

The largest sample (photometrically or spectroscopically selected) over the largest sky area

Gs at z=0

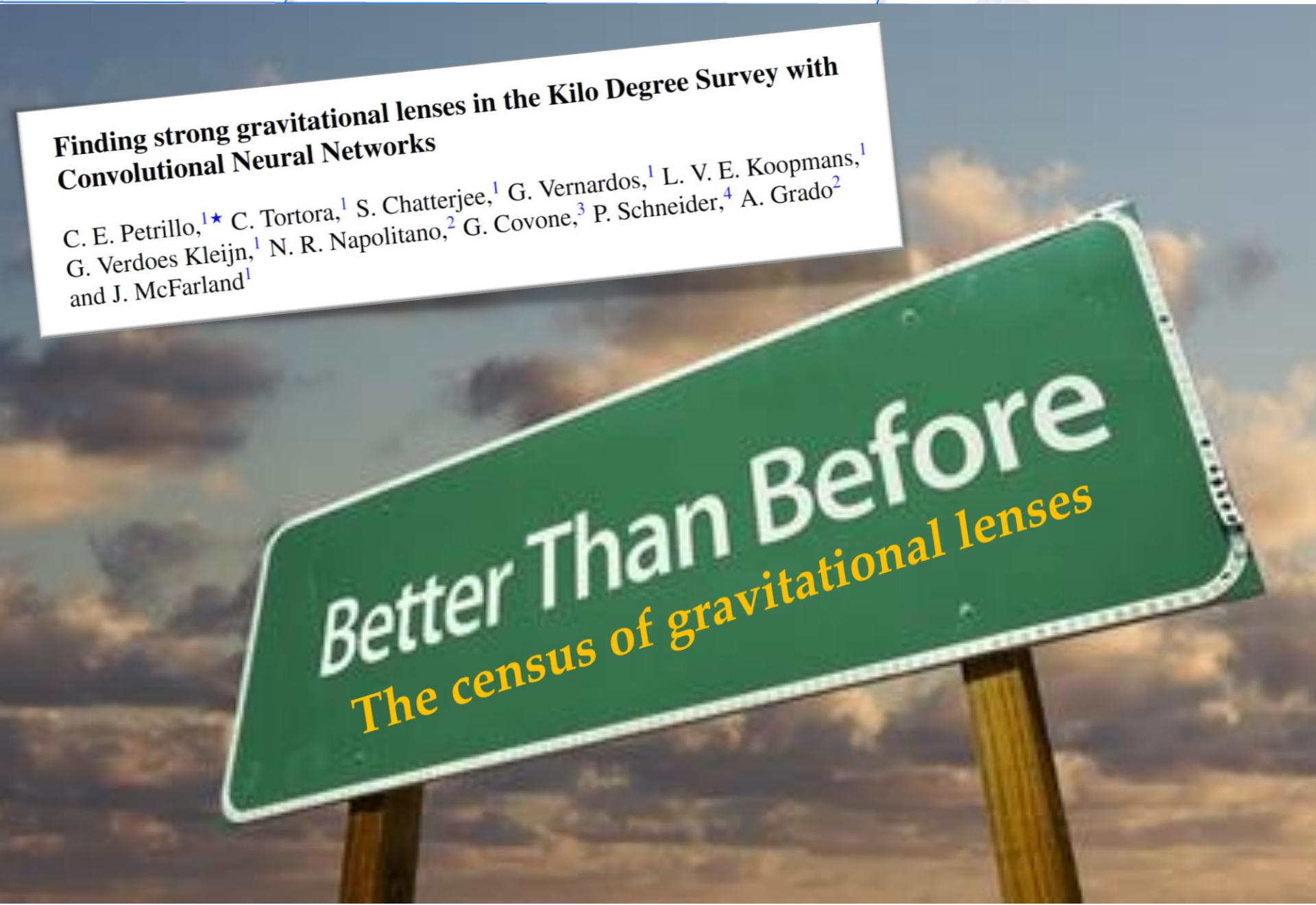
Larger numbers over larger areas reduce cosmic variance and poisson noise

No UCMGs at z < 0.15
(considering Poisson Noise, consistent with literature)

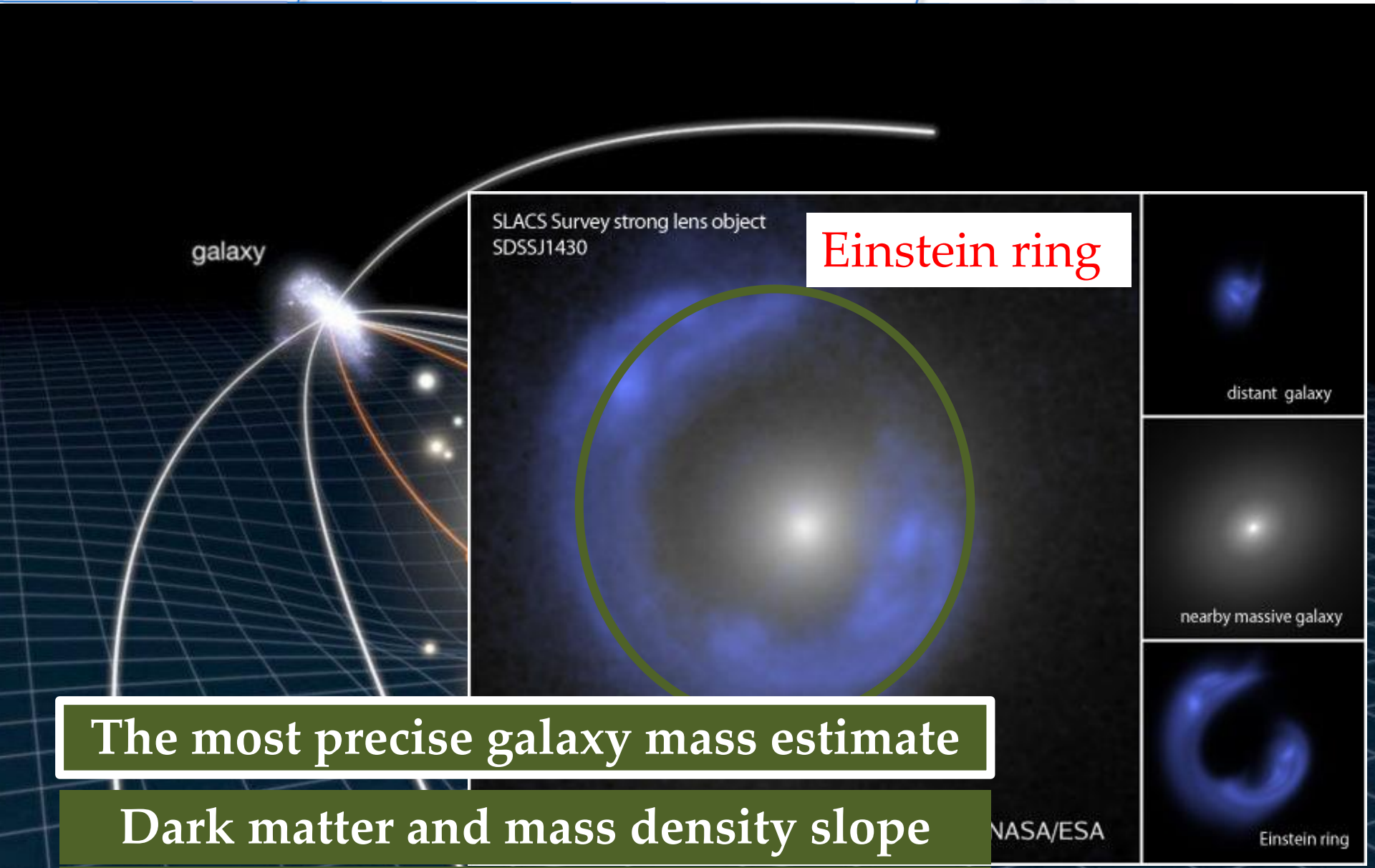


Finding strong gravitational lenses in the Kilo Degree Survey with Convolutional Neural Networks

C. E. Petrillo,[1]★ C. Tortora,[1] S. Chatterjee,[1] G. Vernardos,[1] L. V. E. Koopmans,[1] G. Verdoes Kleijn,[1] N. R. Napolitano,[2] G. Covone,[3] P. Schneider,[4] A. Grado[2] and J. McFarland[1]



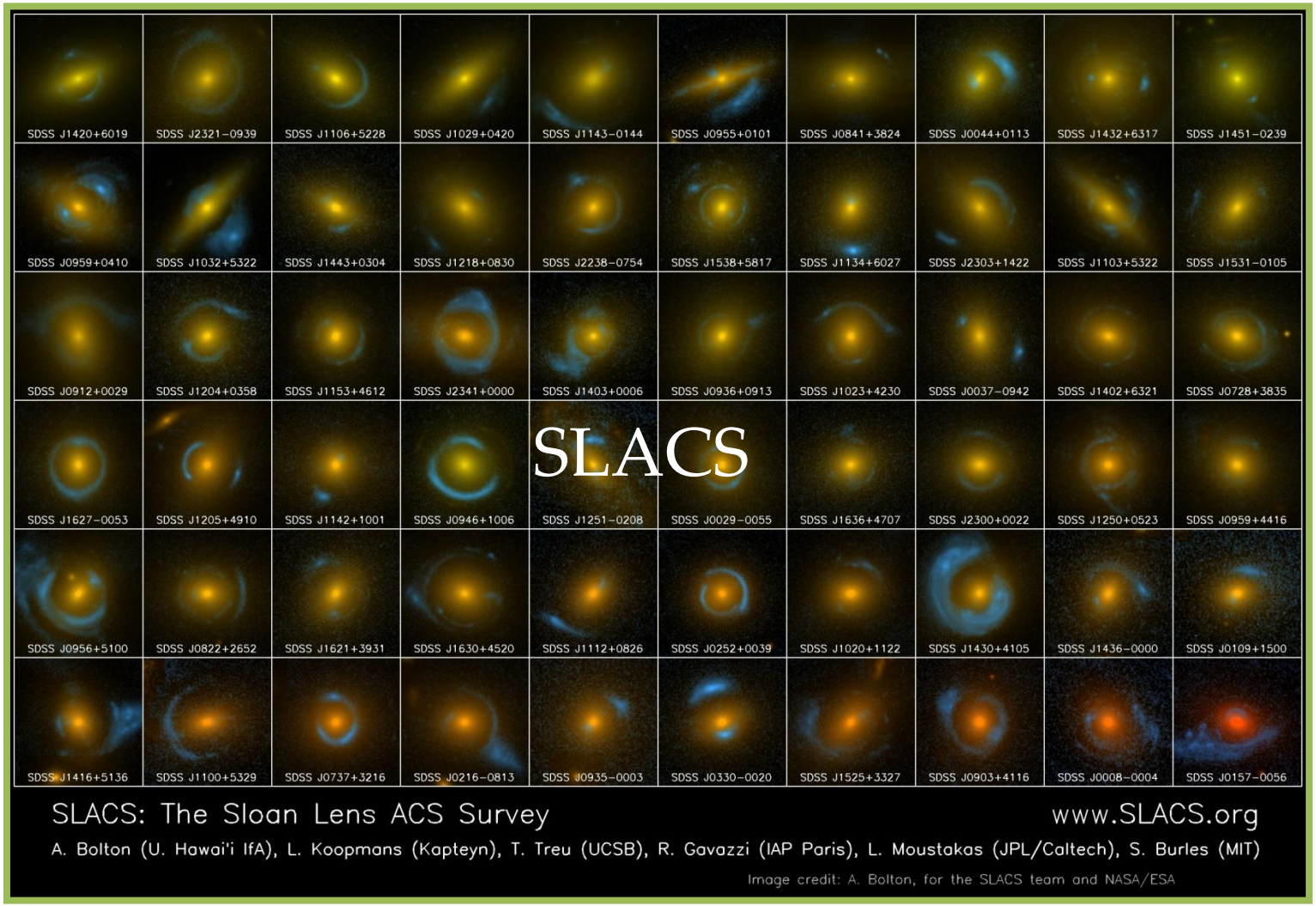
The census of gravitational lenses



The most precise galaxy mass estimate

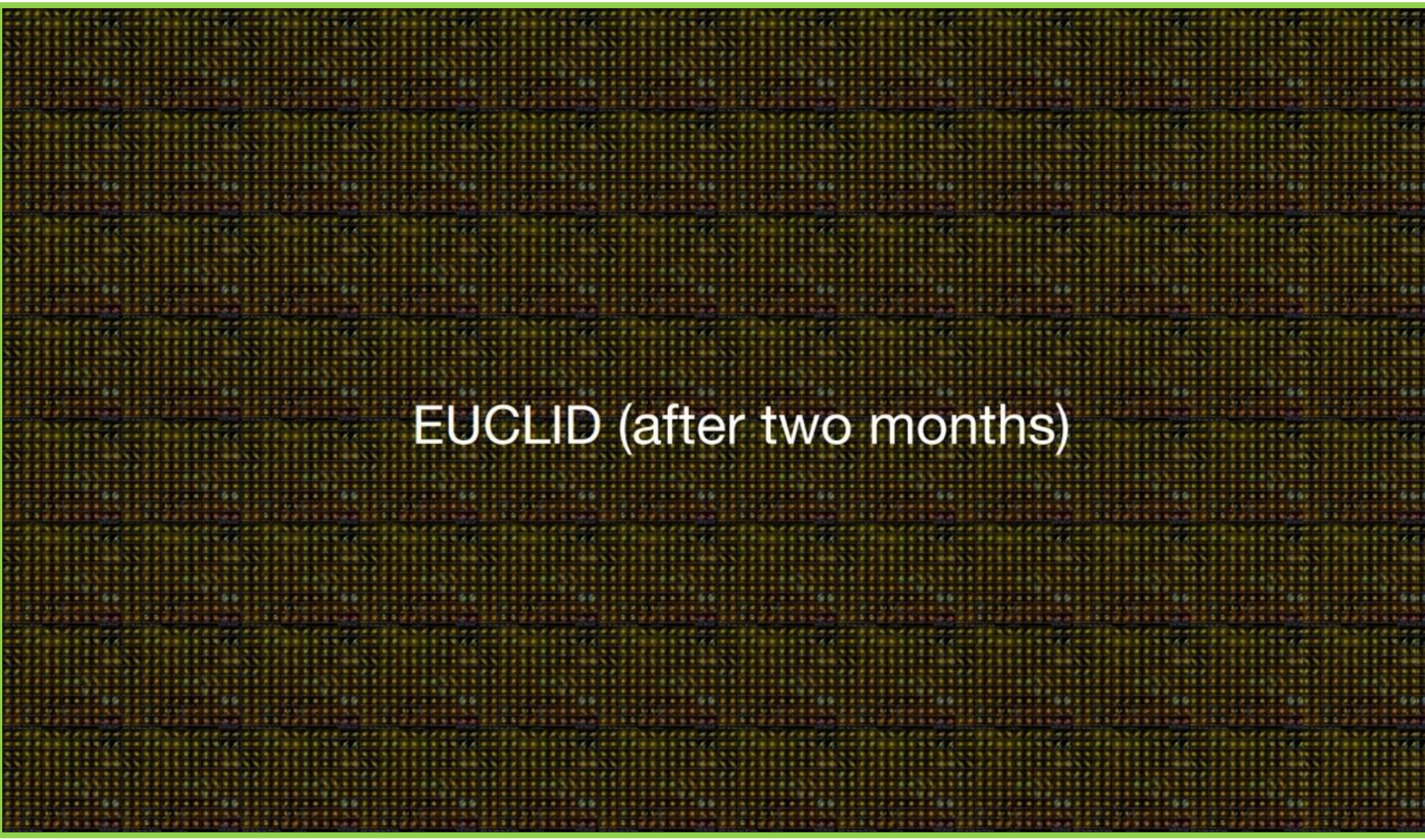
Dark matter and mass density slope

Dark substructures



Now: ~ 600 lenses known

KiDS: ~ 2400 lenses *(Petrillo+17)*


EUCLID (after two months)

Visual inspection

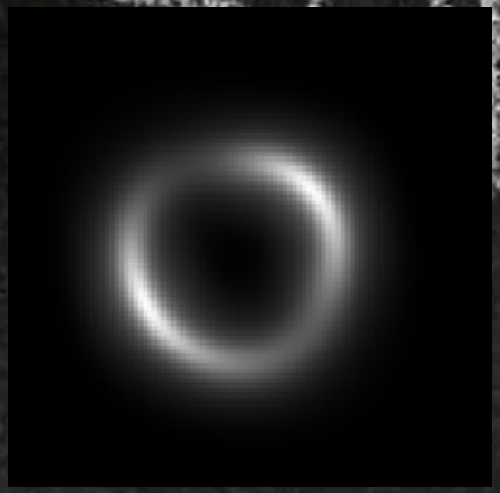
Automated search

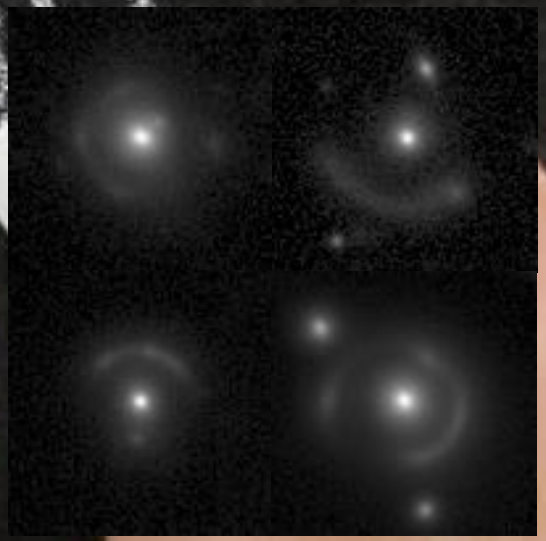
Training sample: an issue

CNNs need large "training set"!

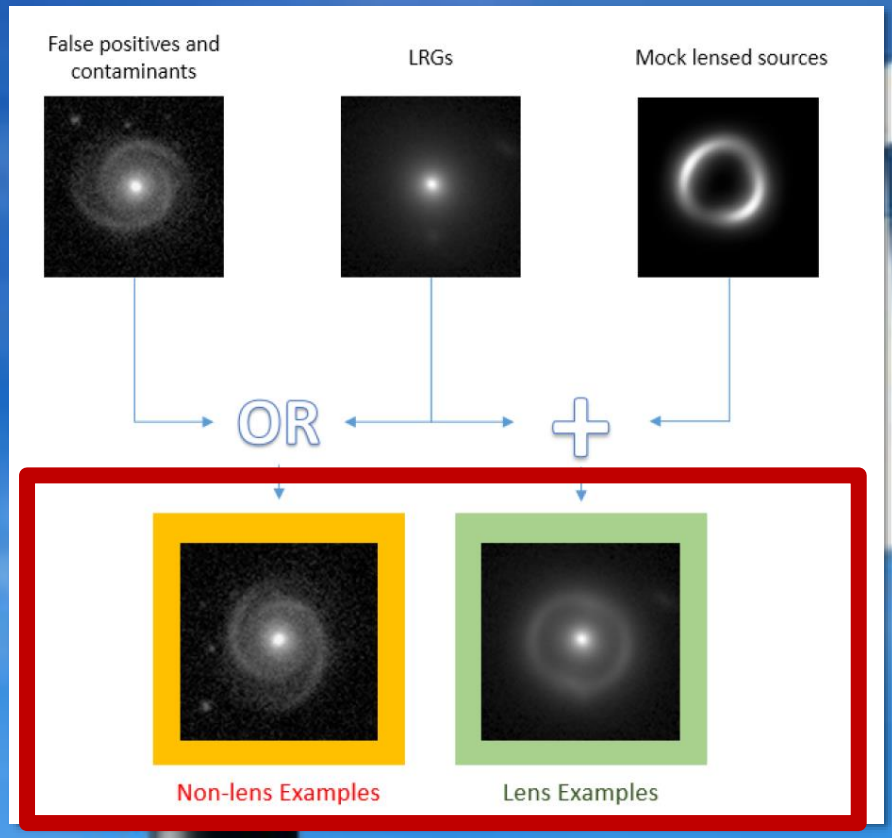
A few hundred of observed gravitational lenses

Mock gravitational lenses



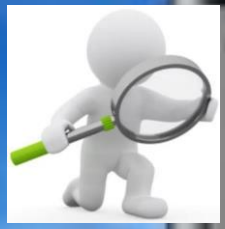


The strategy



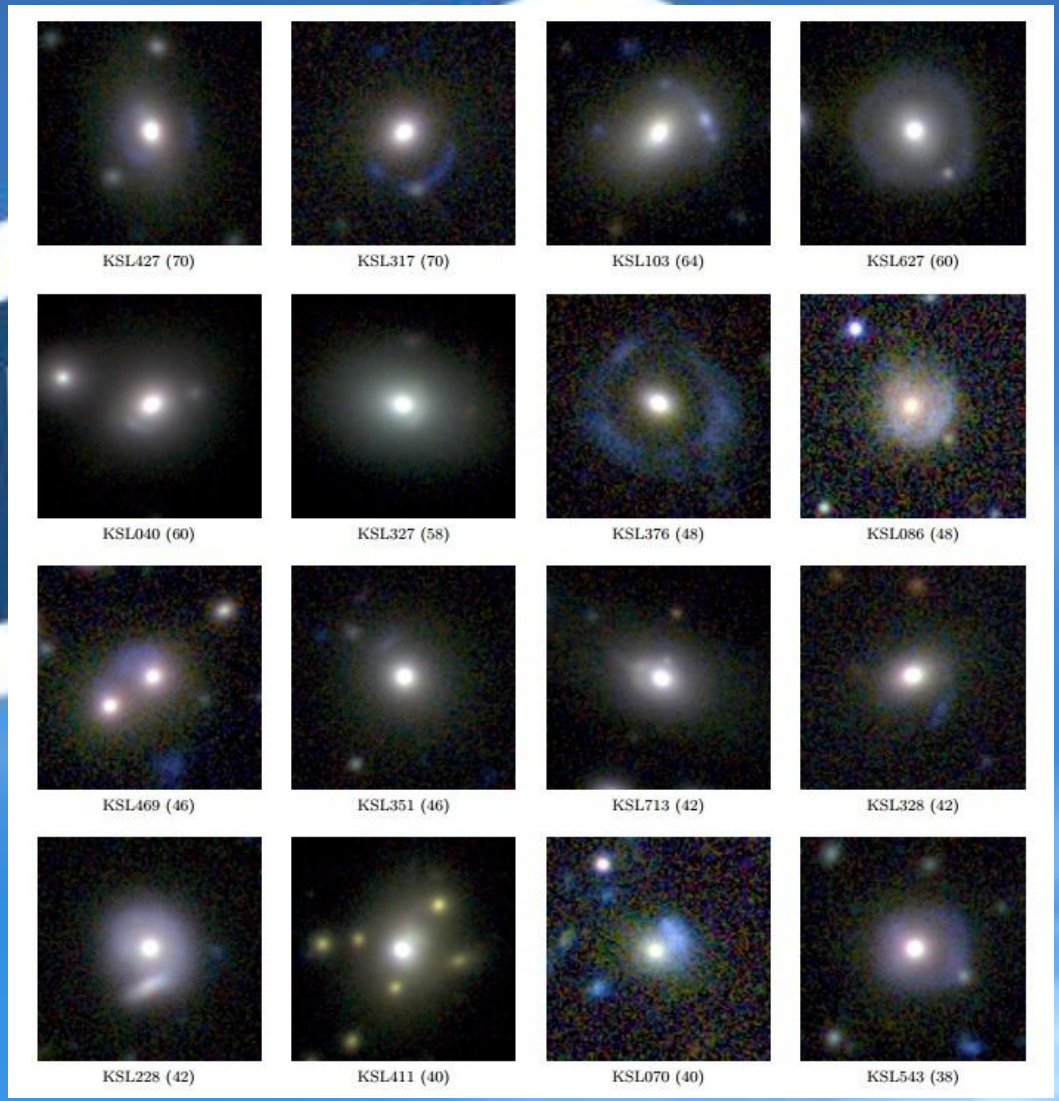
The lens sample

From ~22.000 color selected LRGs in KiDS DR3 (255 sq. deg.), in few minutes the CNN selects **746** lens candidates.



We choose the best **56 lenses** with a joint visual inspection.

Prediction from LensPop (Collett 2015): ~50 LRG lenses in KiDS DR3 with ER>1.4″.



Known lenses

TRUE

J085446-012137

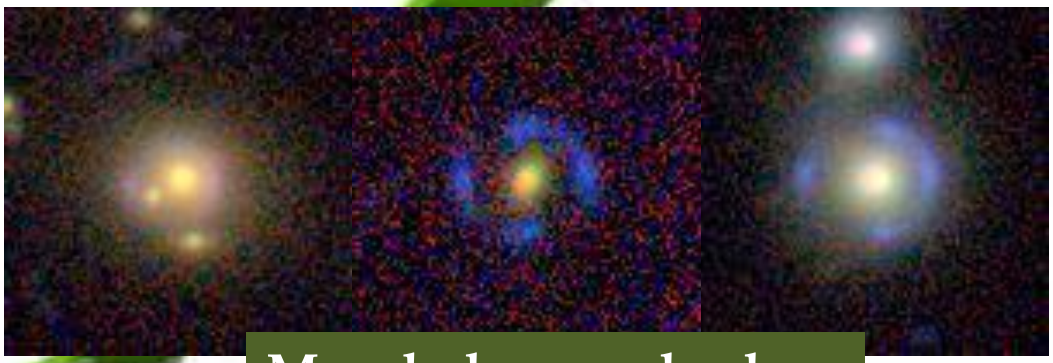
J114330-014427

J1403+0006

FALSE

On-going improvements

Just morphology



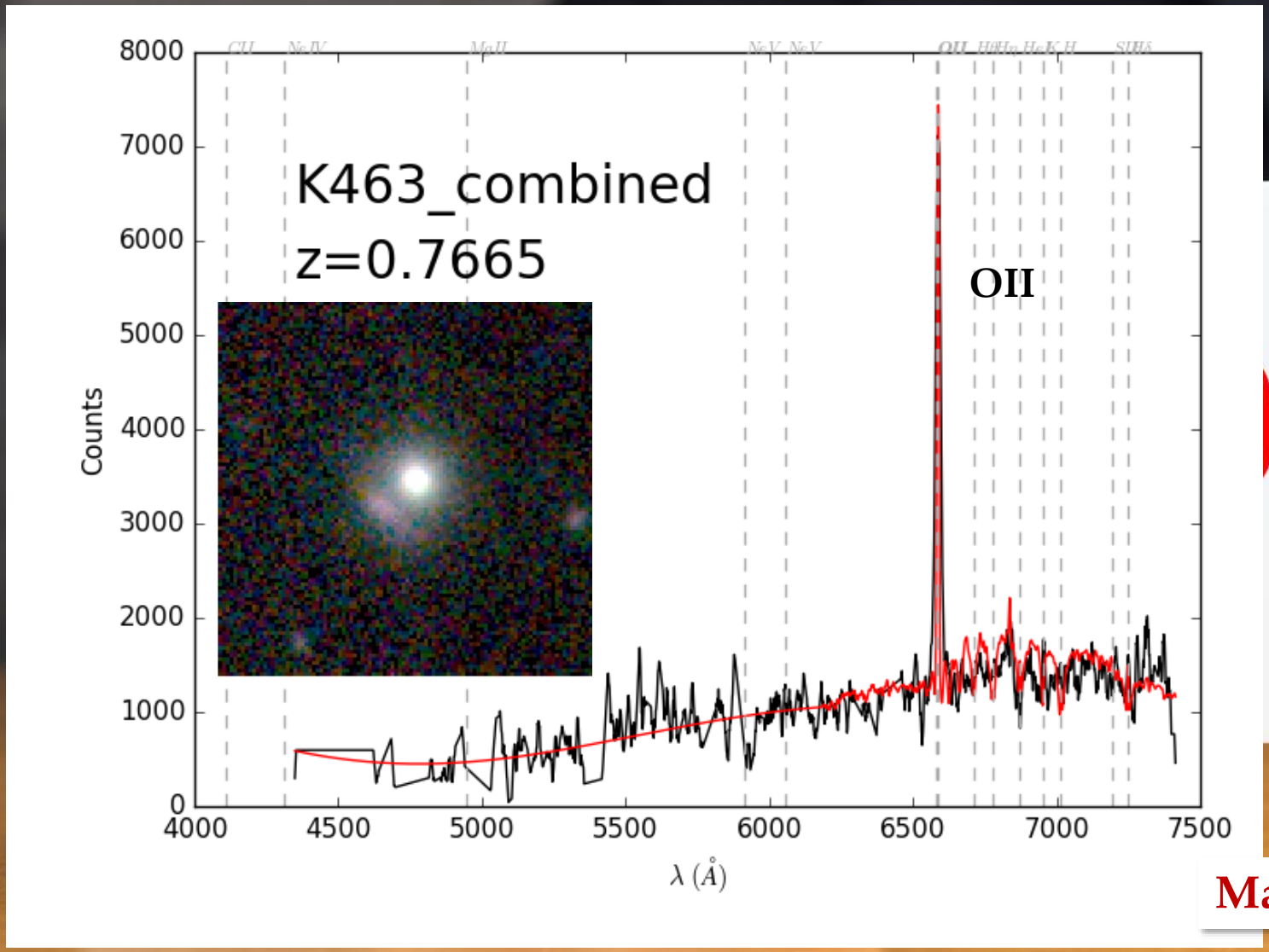
Morphology and colour

- ✓Network architecture
- ✓Sample selection
- ✓Survey area (soon 900 sq. deg.; KiDS-DR4)
- ✓ ……

Some new candidates

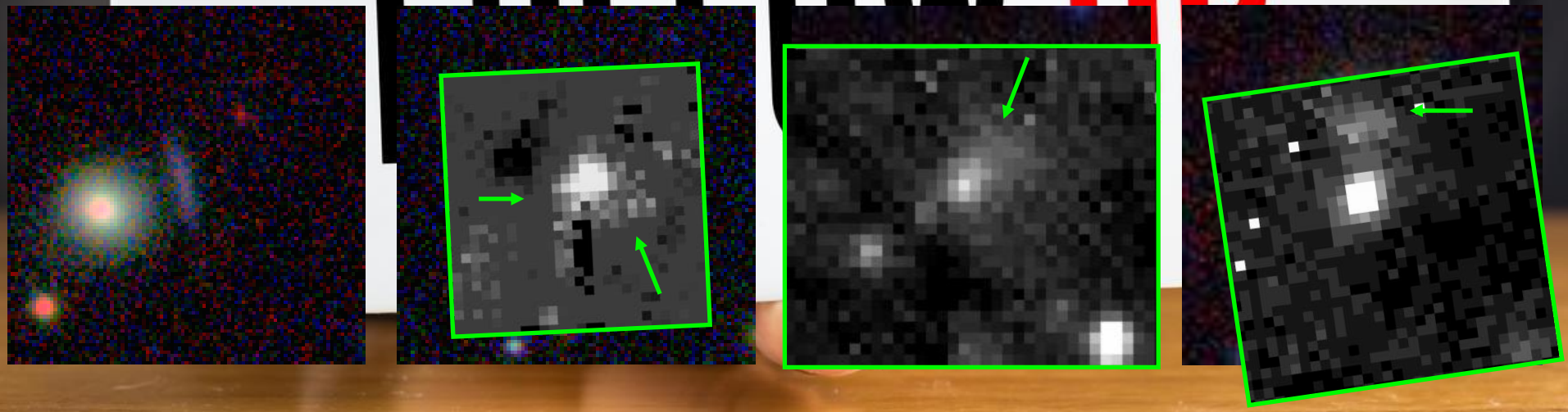
We are putting the basis of the future lens searches

Spectroscopic follow-up (SALT)

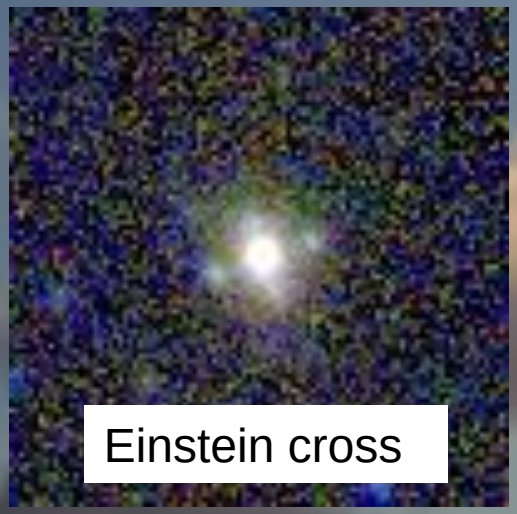


Marchetti's talk

Spectroscopic follow-up (VLT)



Napolitano et al. in prep.; Spiniello et al. in prep.



Einstein cross

Not searched but found by our CNN.

Lensed quasars are rarer (only ~100 known)!

Spiniello's talk

Better Than Before

Rare treasures in the KiDS survey