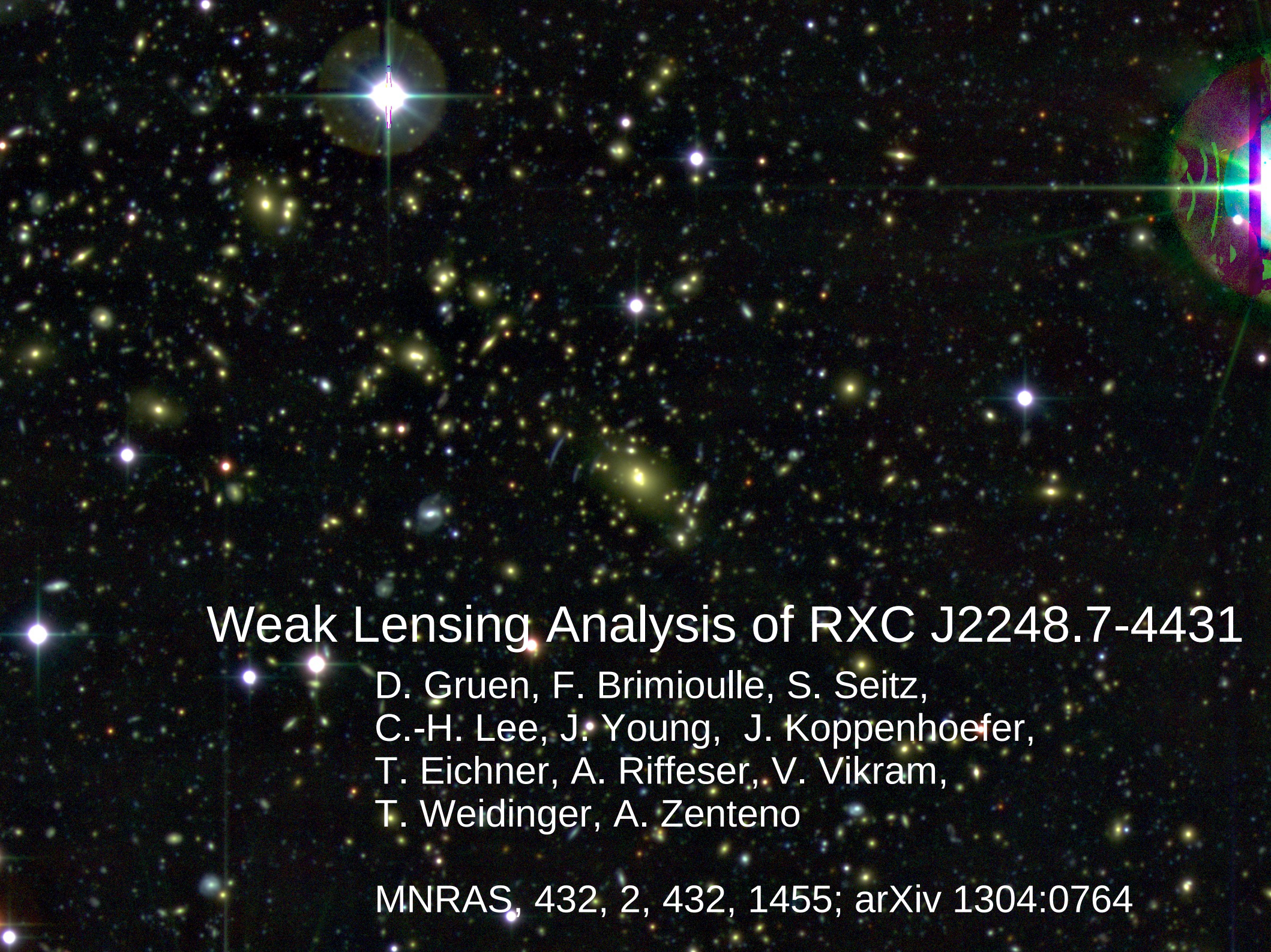


Weak Lensing Analysis of RXC J2248.7-4431

D. Gruen, F. Brimioulle, S. Seitz,
C.-H. Lee, J. Young, J. Koppenhoefer,
T. Eichner, A. Riffeser, V. Vikram,
T. Weidinger, A. Zenteno

MNRAS, 432, 2, 432, 1455; arXiv 1304:0764

Why YOU should care about 2248

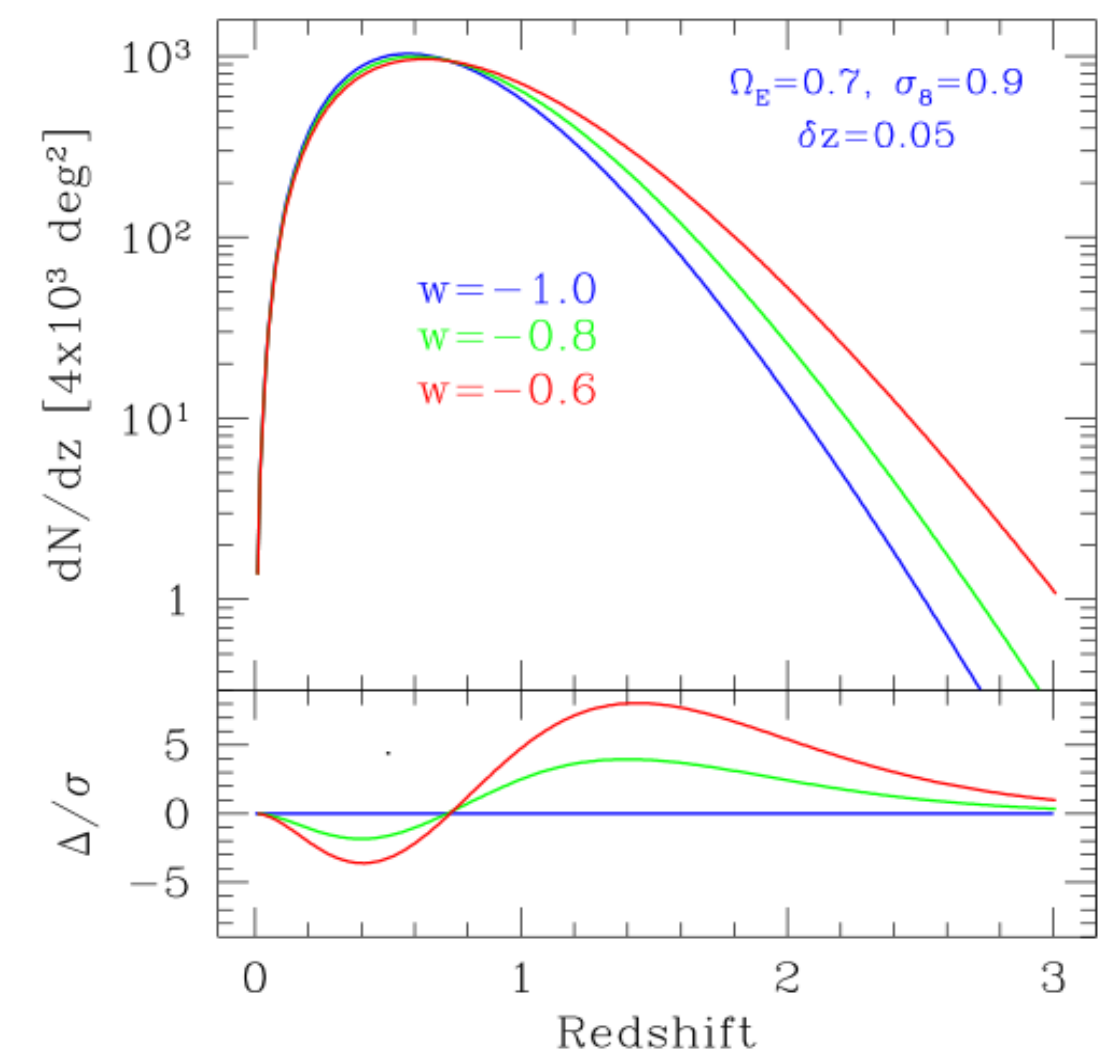
- This is one of the big ones
  - very large X-ray and SZ signal
  - multiple 10^15 Msol from WL
- This is one of the best-covered clusters
  - 50h WFI UBVRIZ; HST from CLASH and FF
  - large spectroscopic programmes
  - X-ray from XMM-Newton and Chandra
  - SZ from SPT and Planck
- This is not just about lensing
  - Cluster member photometry and morphology
  - Magnified background galaxies (Monna+ in prep)
  - Cluster physics and mass tracer comparison

Contents

- Introduction: Cluster Weak Lensing
- Data: Observations, Data Reduction, Photometry, Shape Measurement
- Weak Lensing Analysis
- Summary

Introduction: Galaxy Clusters

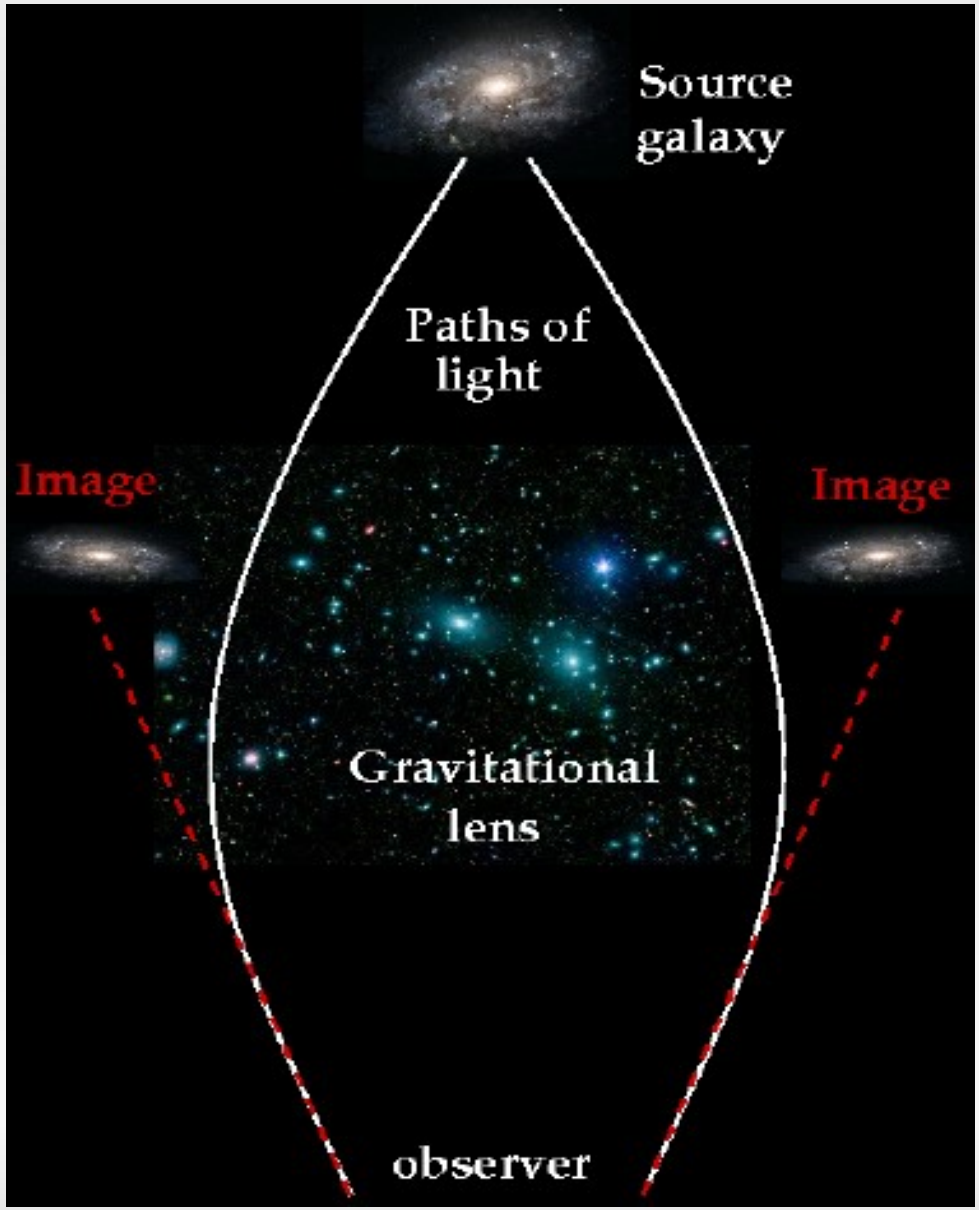
- Most massive objects to have formed in the universe today
- Scale: 10^14-10^15 Msol, Mpc
- Contents: Dark Matter, Gas, Stars
- Where Dark Matter and Dark Energy meet
- What's the mass?



Source: Mohr+ 2005

Introduction: Weak Lensing

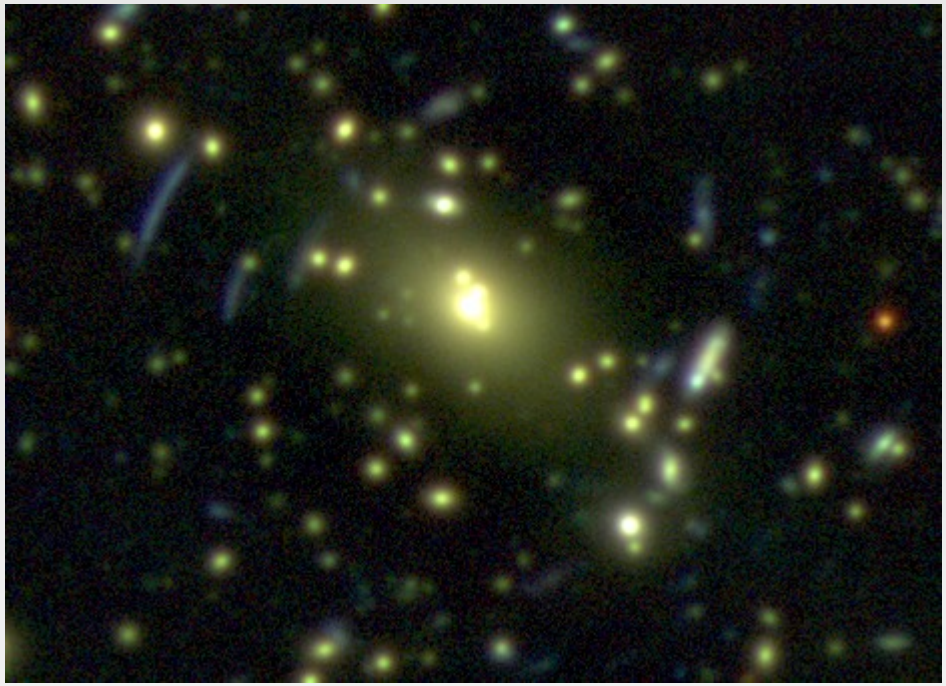
- Mass bends space-time
- Strong effect: multiple images



Source: galileospendulum.org

Introduction: Weak Lensing

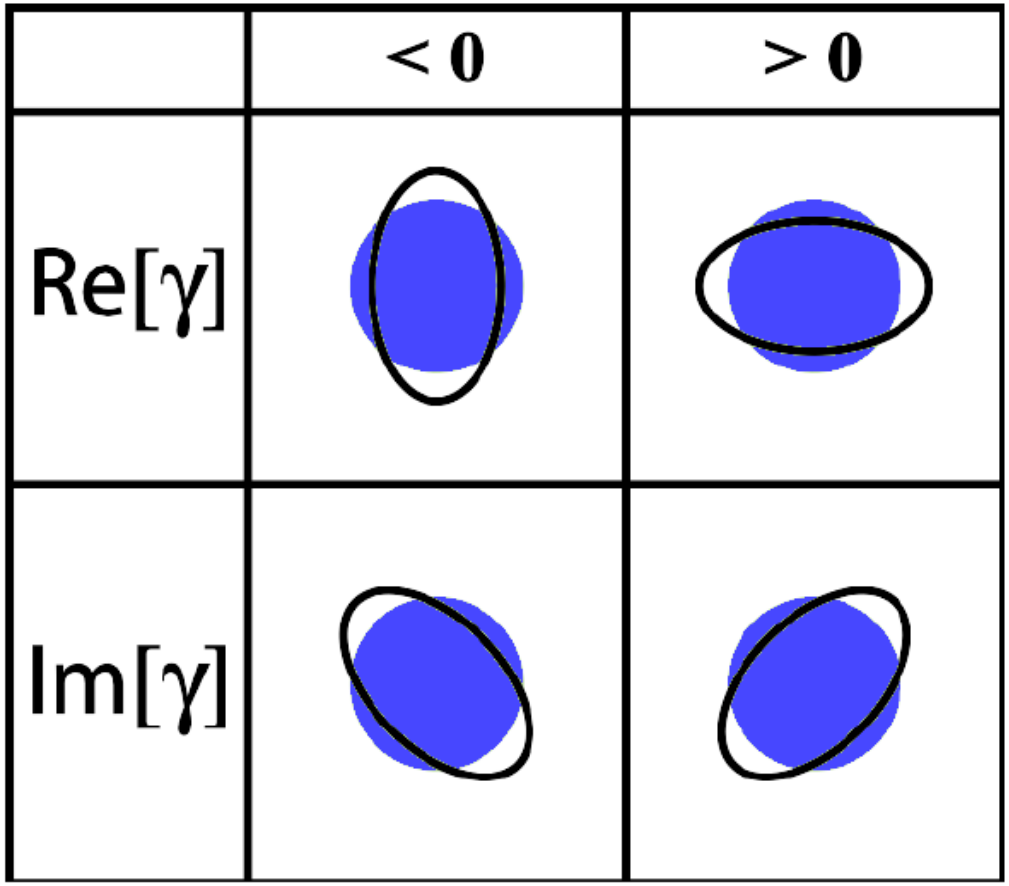
- Mass bends space-time
- Strong effect: multiple images



Source: galileospendulum.org

Introduction: Weak Lensing

- Mass bends space-time
- Strong effect: multiple images
- Weak effect: distortion of shapes
- tangential distortion ~ overdensity

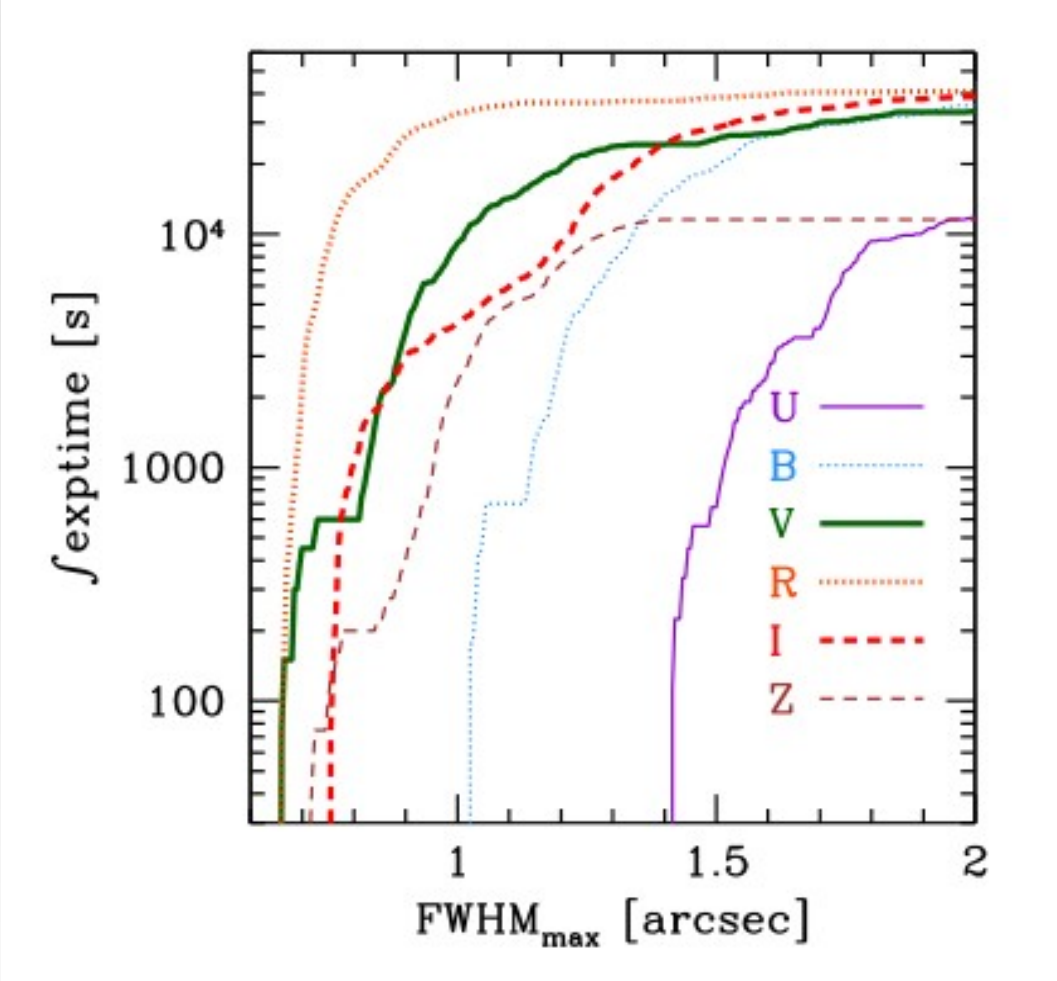


$$\gamma_t(\theta) = \langle \kappa(\theta') \rangle_{\theta' < \theta} - \kappa(\theta)$$

Source: galileospendulum.org

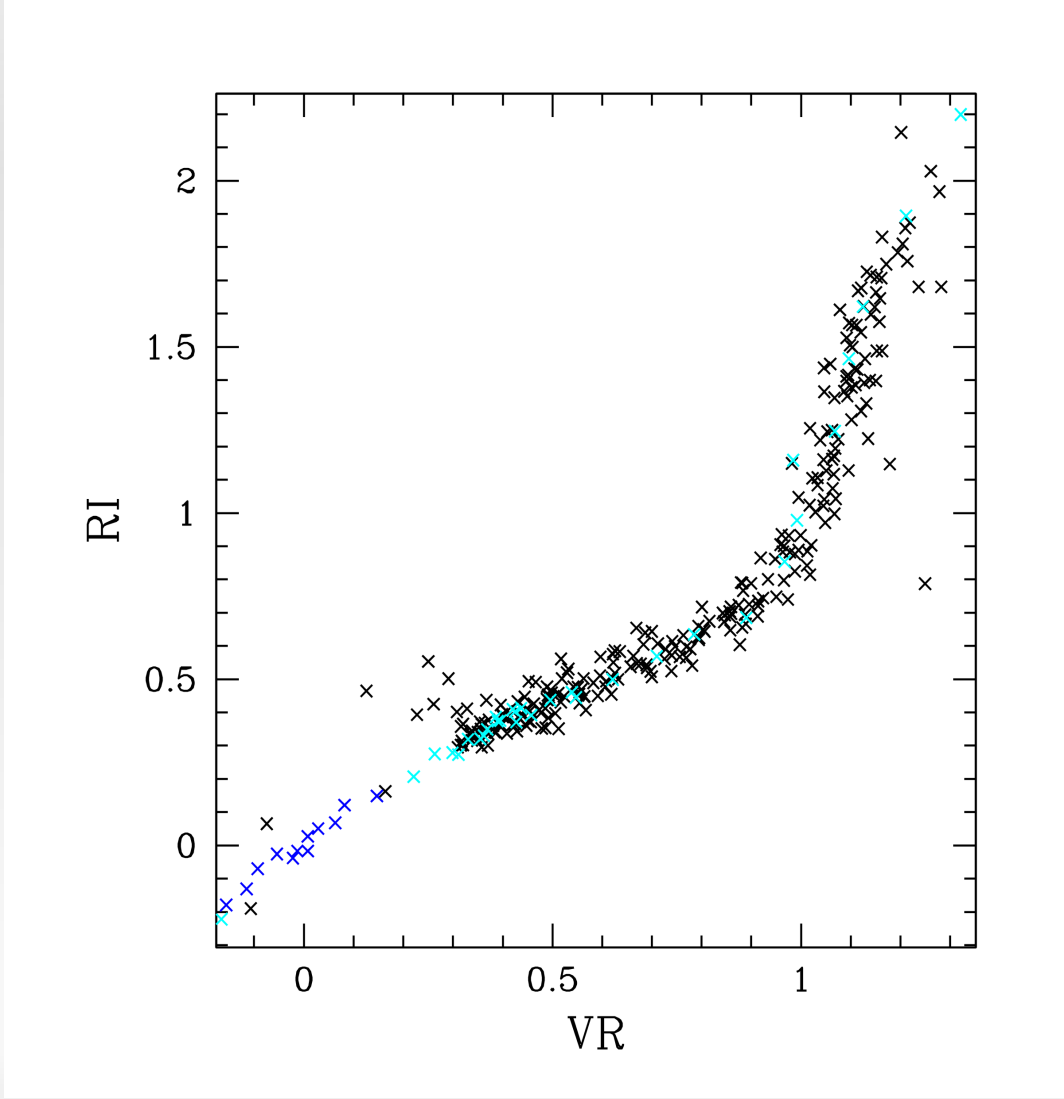
Data: Observations

- WFI on MPG/ESO-2.2m Telescope, La Silla
- ~50h exposure time
- excellent seeing in R, the primary lensing band
- 6 filters from U to Z allow accurate photometric redshifts



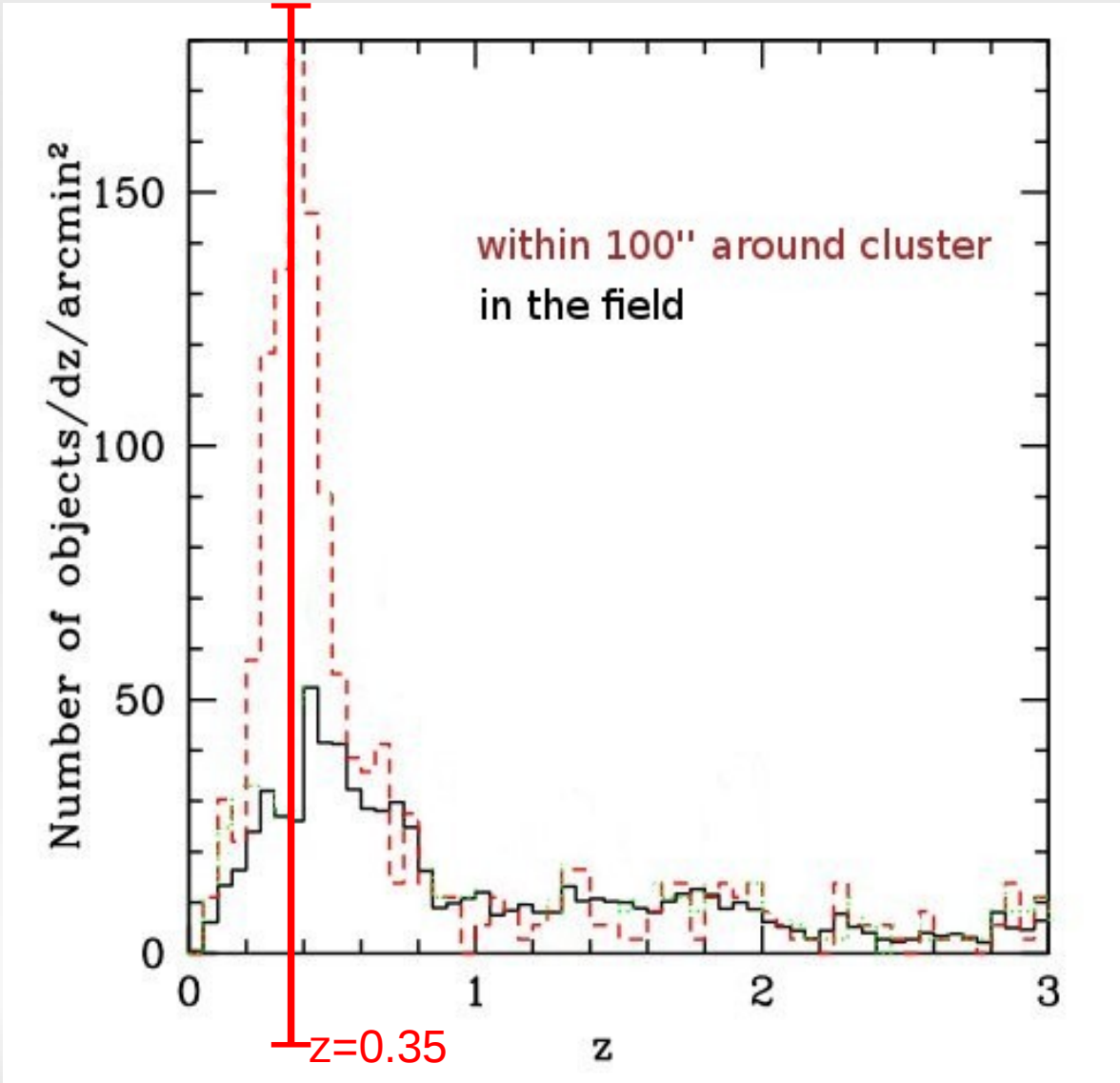
Data: Photometry

- Standard star observations in R band in photometric nights
- UBVIZ matched by stellar color-color locus
- Comparison with B, V zeropoint from standard stars: 0.02mag accuracy



Data: Photometric Redshifts

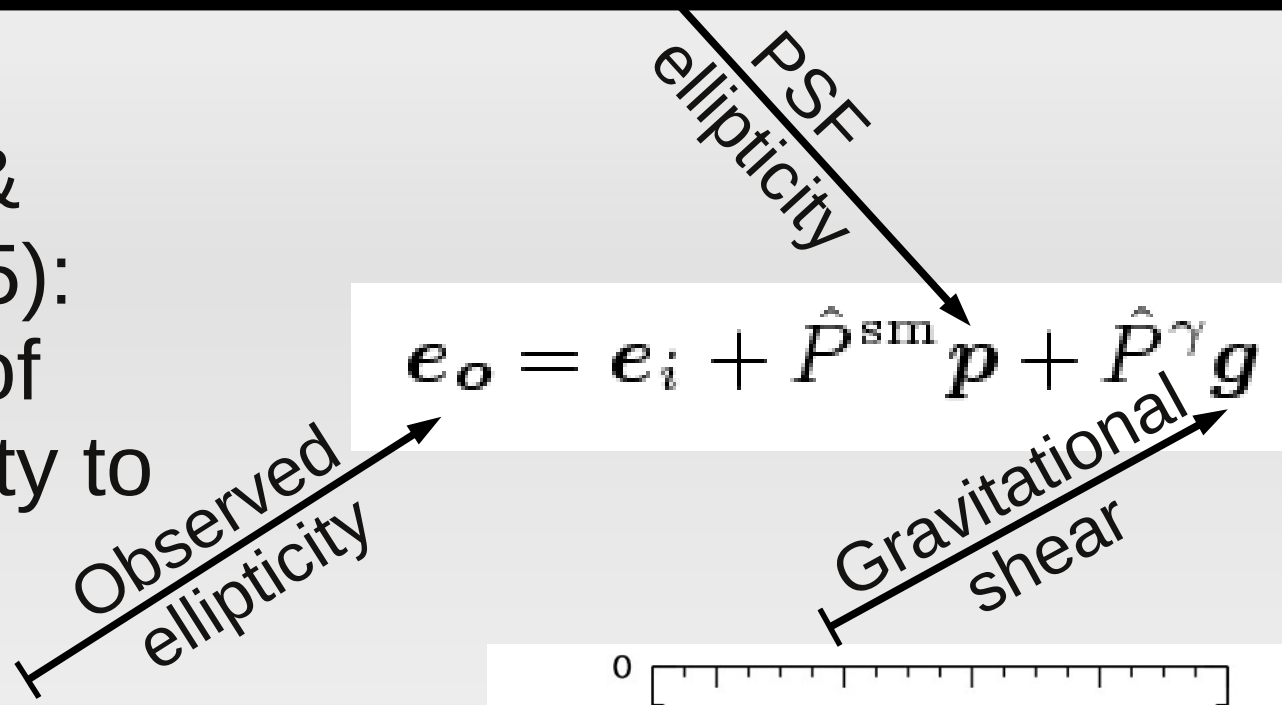
- Degrade images from different bands to same seeing
- Measure aperture fluxes for colors
- Fit redshifted galaxy SED templates to get redshift, luminosity



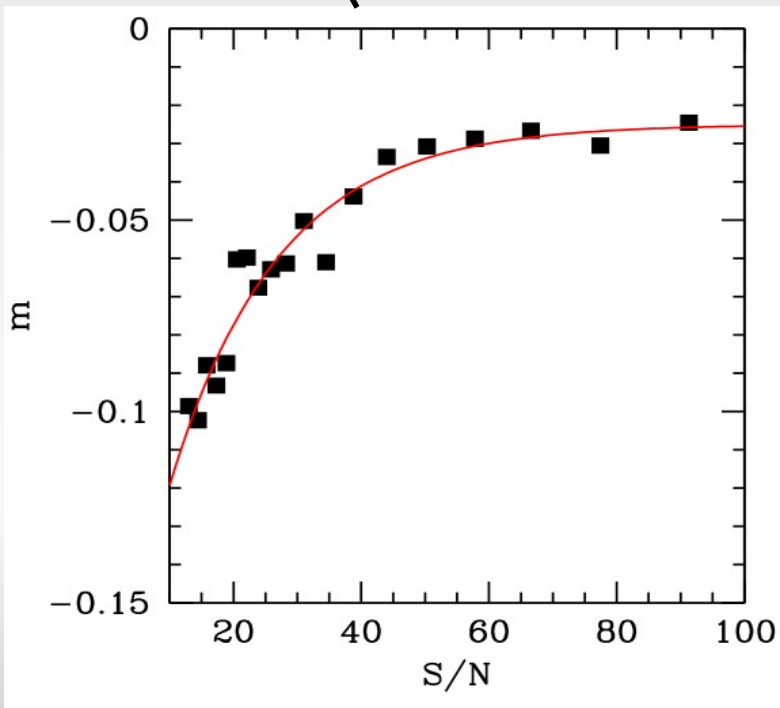
Source: Fabrice Brimioulle

Data: Shape measurement

- Kaiser, Squires & Broadhurst (1995): linear response of observed ellipticity to shear and PSF

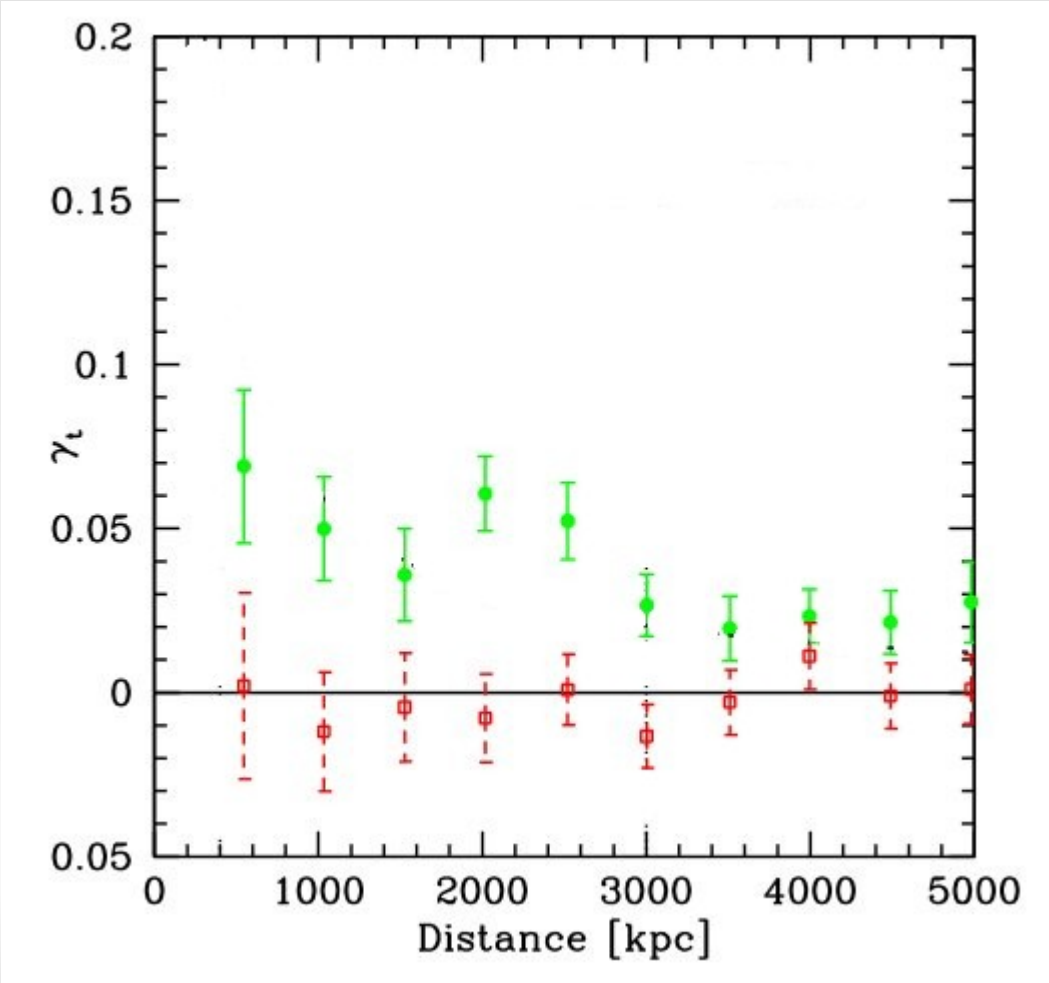


- Details of PSF model, noise bias more tricky



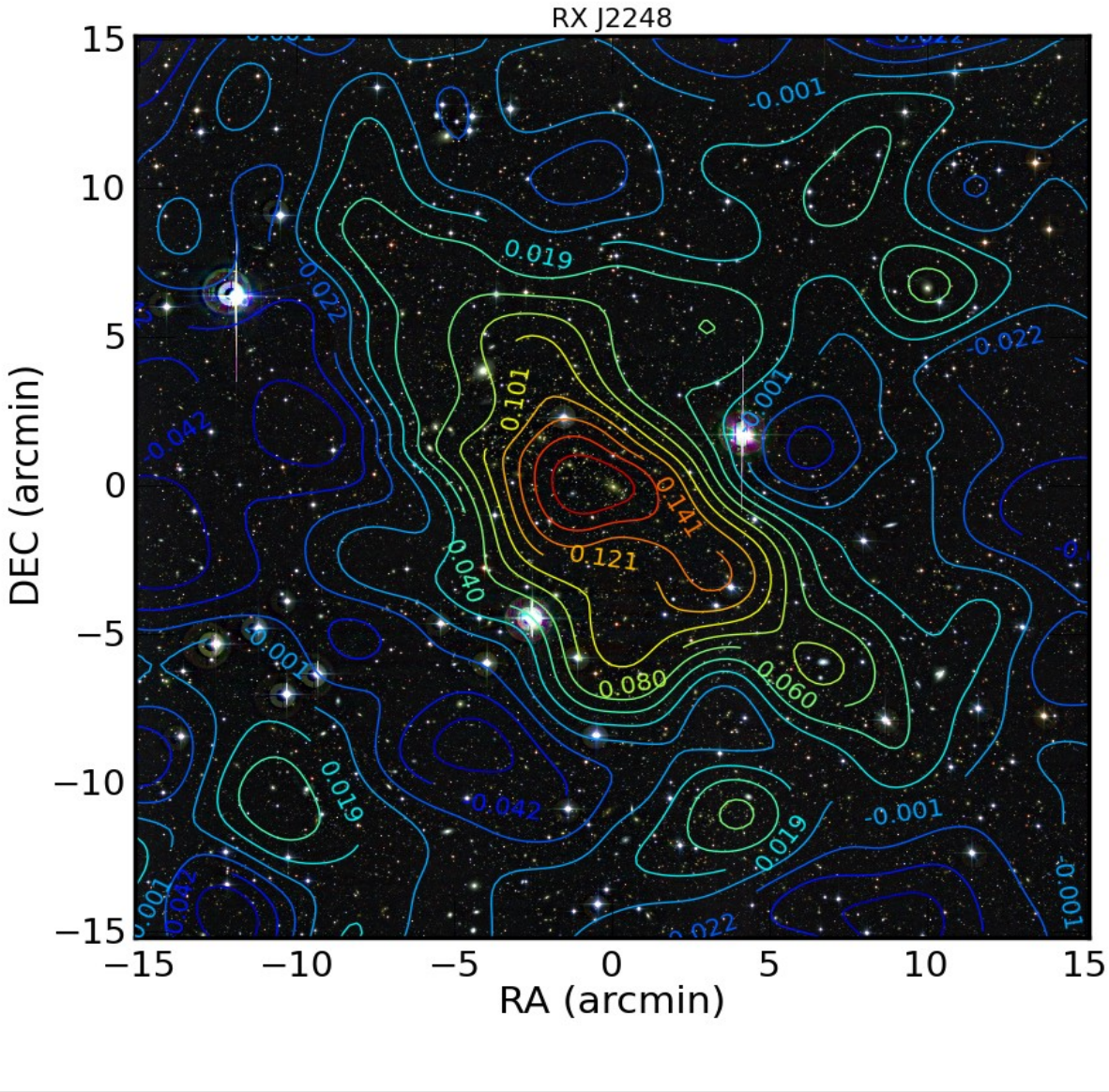
Weak Lensing Analysis: shear

- remember: tangential shear = overdensity



Weak Lensing Analysis: density

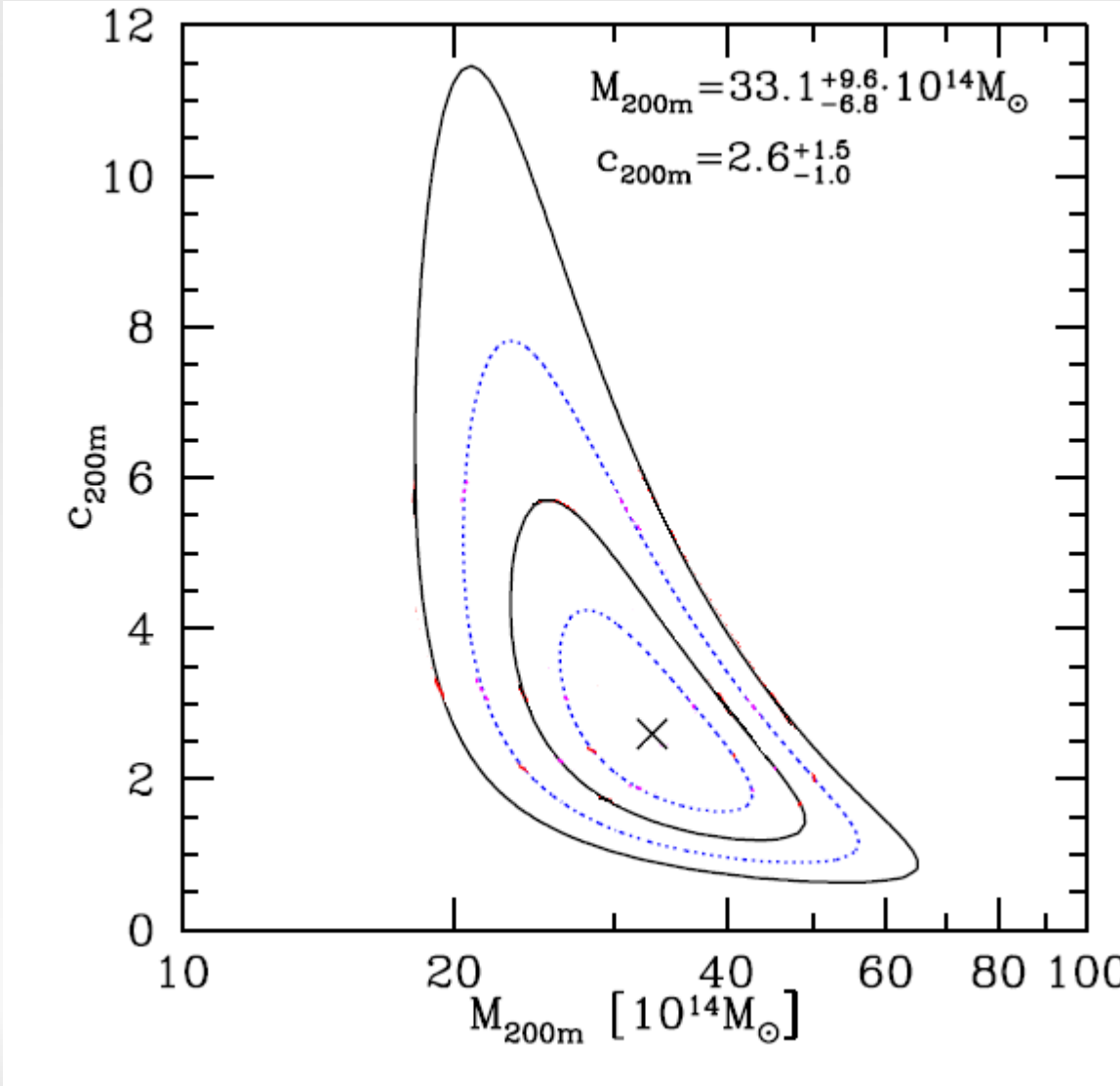
Shear can be 'inverted' to surface density (Kaiser & Squires 1993)



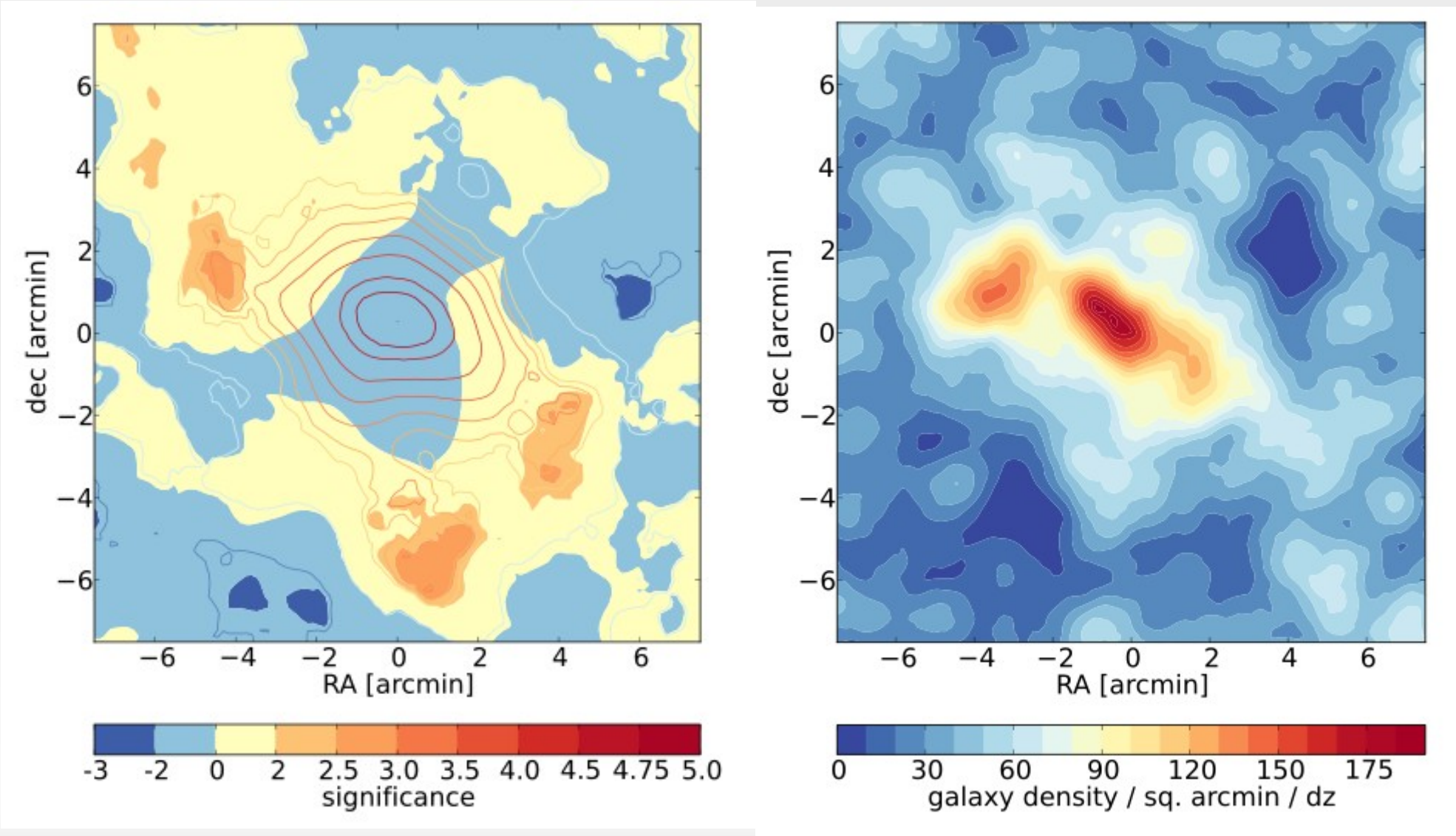
Source: Vinu Vikram

Weak Lensing Analysis: profile

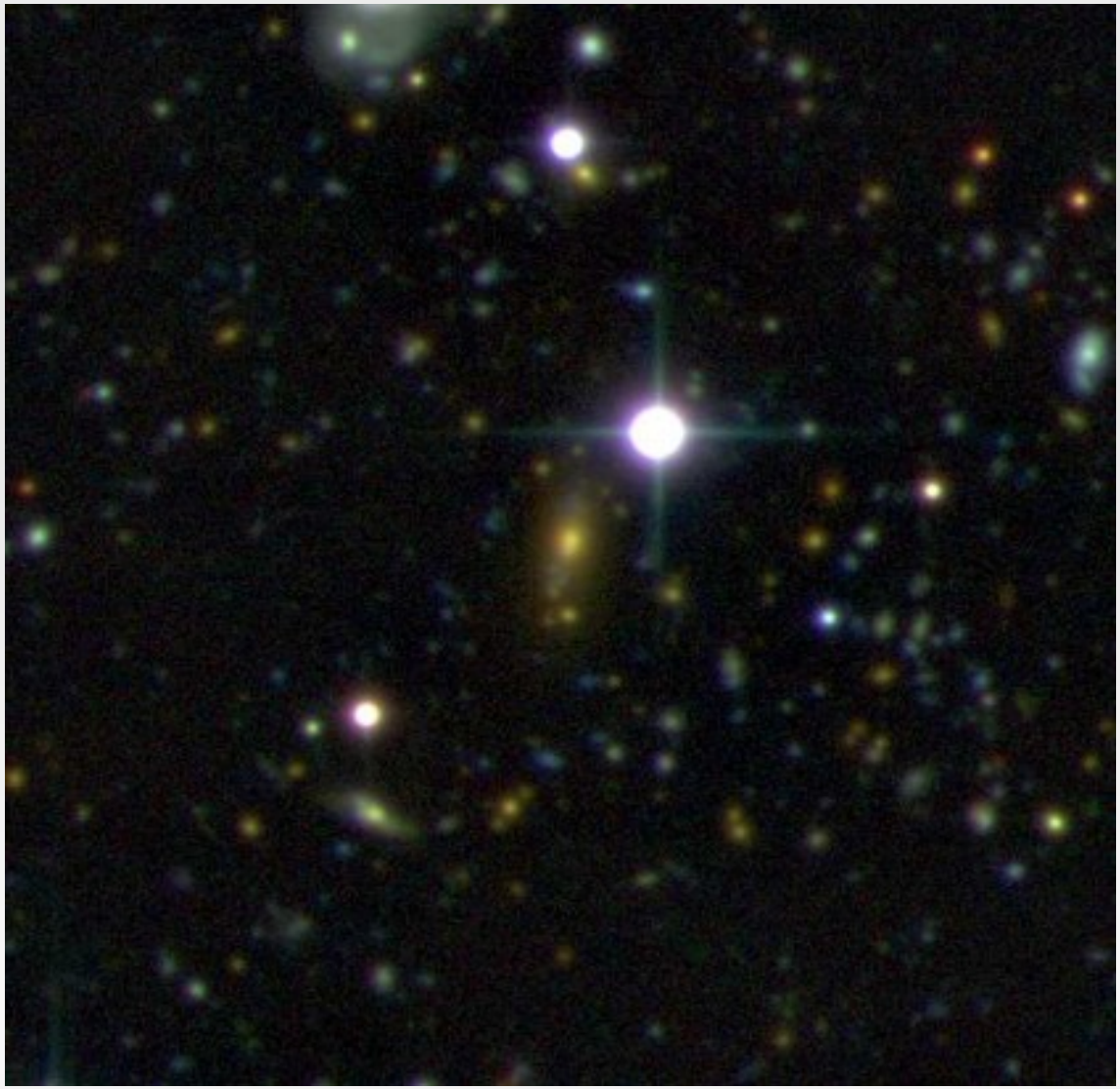
- Dark Matter haloes follow Navarro, Frenk & White (NFW) profile
- $$\rho_{\rm NFW}(r) = \frac{\rho_0}{(r/r_s)\cdot(1+r/r_s)^2}$$
- Fit two parameters (Mass+concentration) to shear
- Agreement with SZ, X-ray; disagreement with kinematic mass (Gomez+2012)



There is more in the data...



There is more in the data...



discovery of
z~0.6 cluster

Summary

- First WL analysis for one of the most prominent multi-probe detected clusters
- Agreement with X-ray and SZ – slight contrast with kinematic mass of Gomez+2012
- Much more to be learned about this and 9 more clusters: stay tuned