Weak-Lensing Mass Calibration of the CODEX clusters

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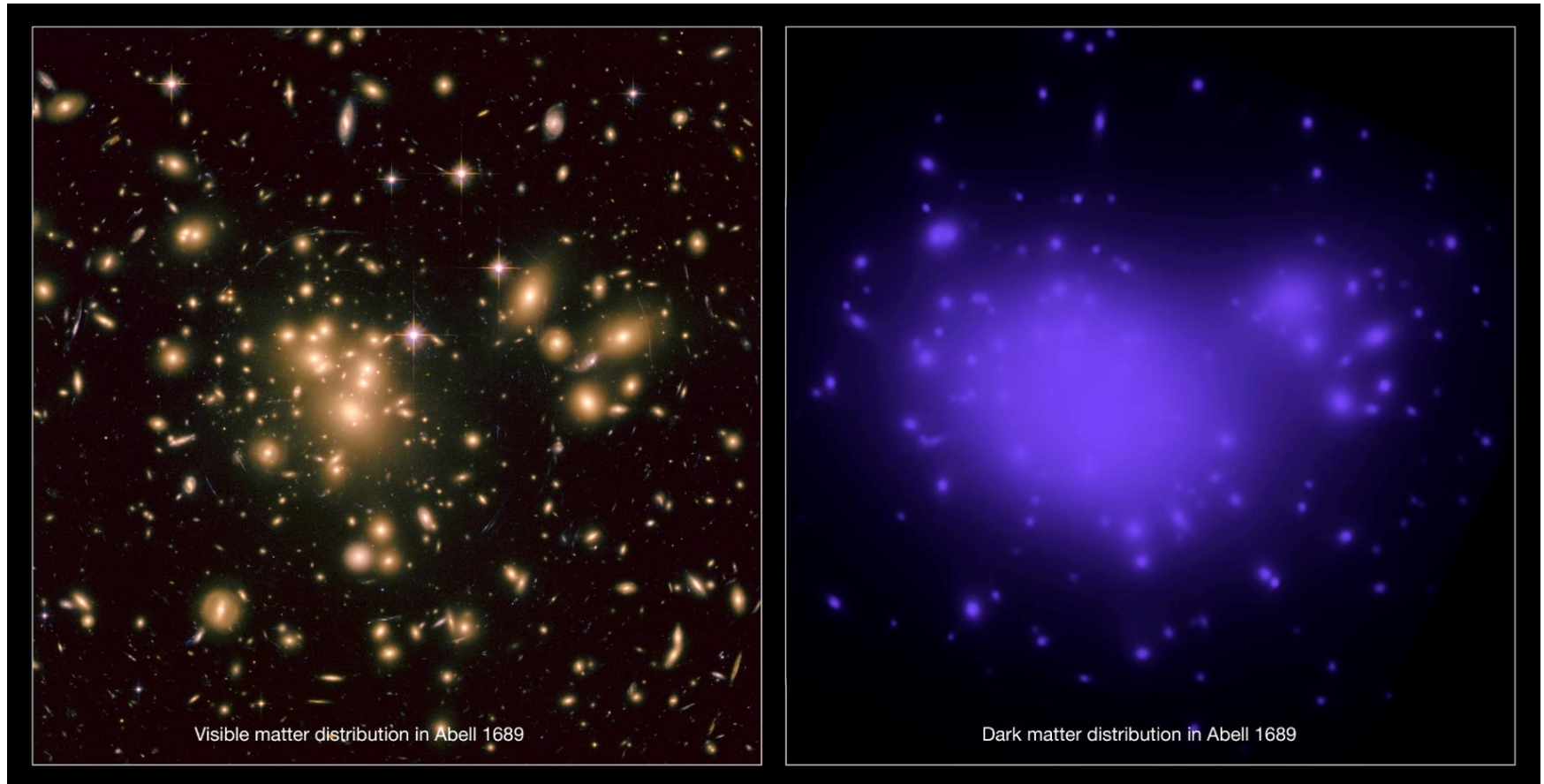Aix-Marseille Université, France

Outline

- Introduction and Objectives

- Data Analysis
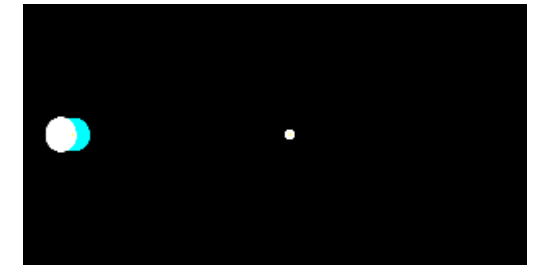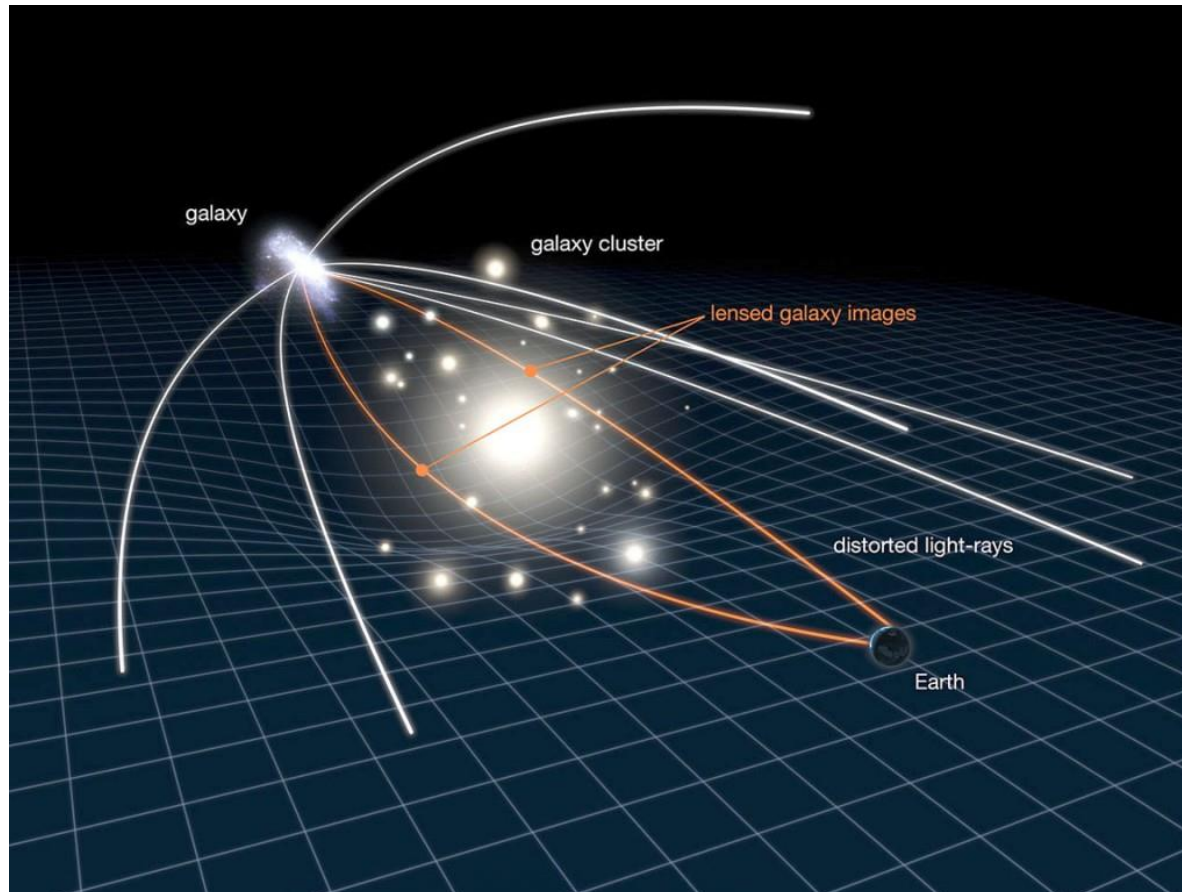
- Preliminary results

- Summary and Discussion

Objective of the Research

- To investigate the total mass of galaxy clusters and compare the weak lensing mass with the dynamical mass

- To study the scaling relation for the CODEX clusters, for example

  - cluster mass and richness

  - cluster mass and X-ray luminosity

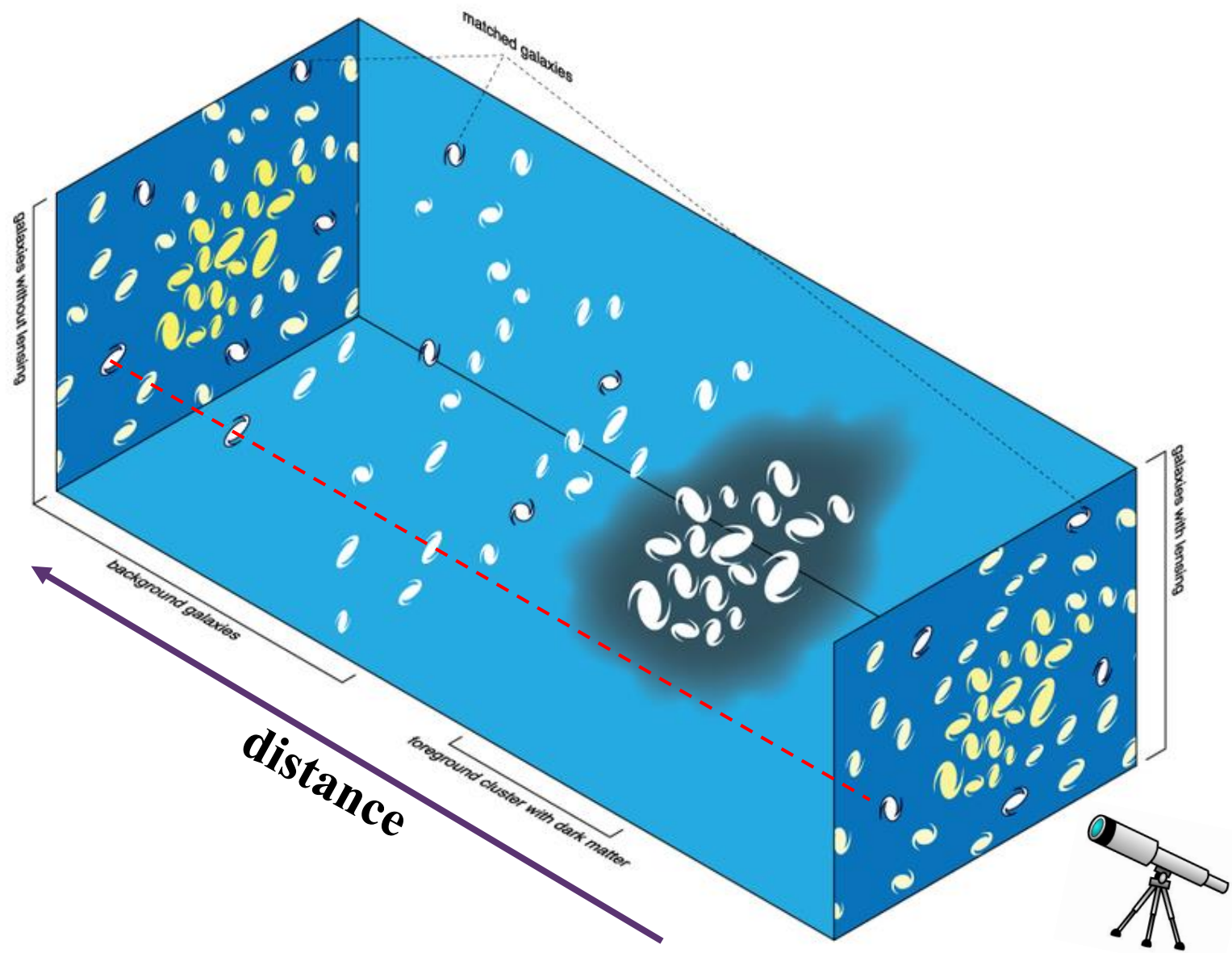- To constrain the cosmological parameter

Galaxy Cluster

Credit: NASA, ESA, E. Jullo (JPL/LAM), P. Natarajan (Yale) and J-P. Kneib (LAM).

Gravitational Lensing

LRG 3-757

Abell 2218

Credit: ESA/Hubble and NASA, G. Mikaberidze

matched galaxies

galaxies without lensing

galaxies with lensing

background galaxies

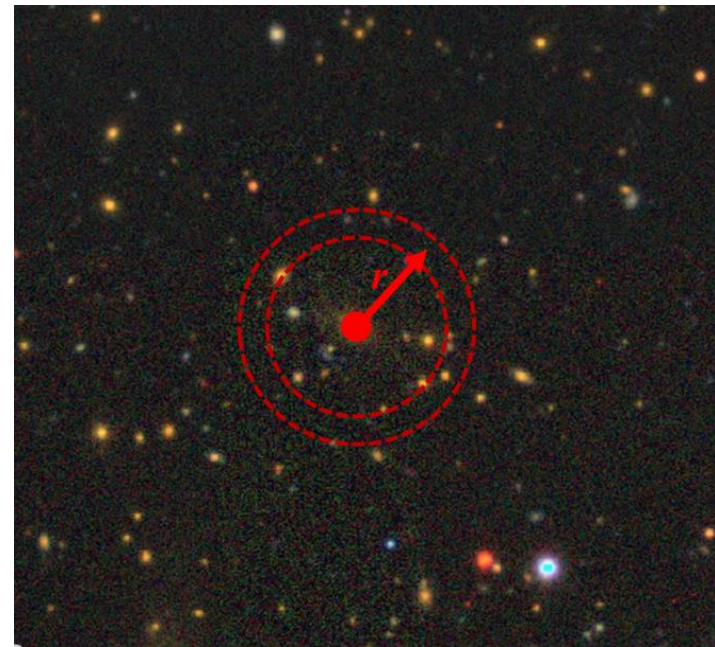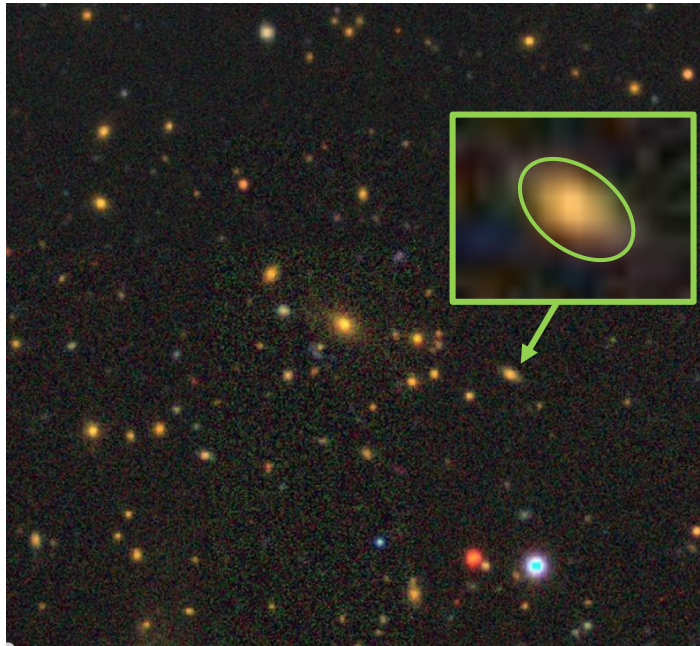foreground cluster with dark matter

distance

Credit: Michael Sachs (2008)
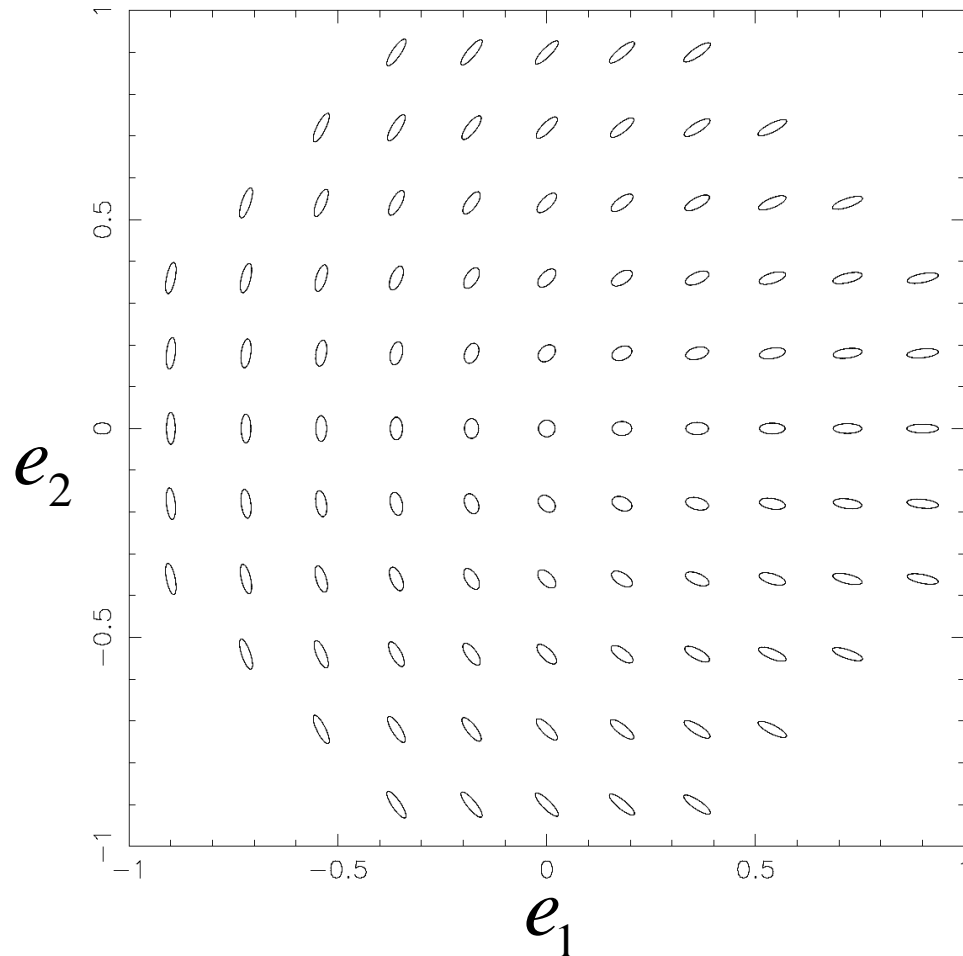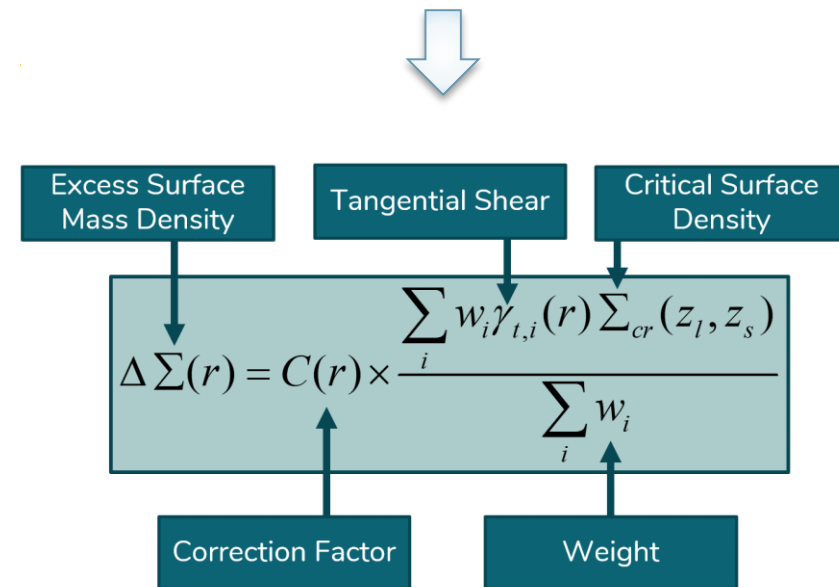
Figure 1: (left) the images from the DECaLS, (right) the cluster position (red dotted) and annular region at the radius r from the cluster center.
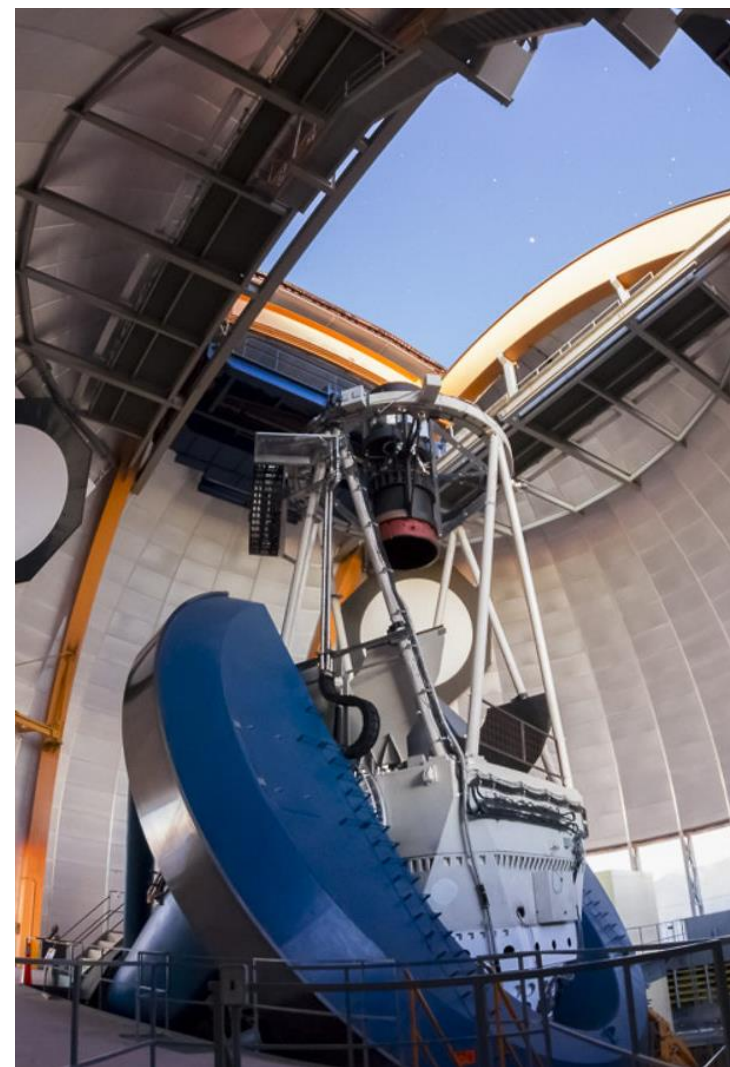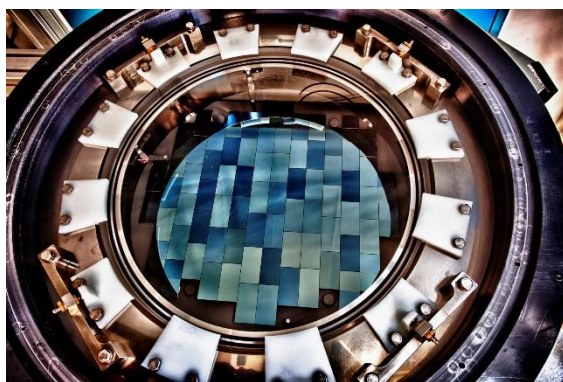
$$\gamma_t = -[e_1 \cos(2\theta) + e_2 \sin(2\theta)]$$

Excess Surface Mass Density

Tangential Shear

Critical Surface Density

$$\Delta\Sigma(r) = C(r) \times \frac{\sum_i w_i \gamma_{t,i}(r) \Sigma_{cr}(z_l, z_s)}{\sum_i w_i}$$
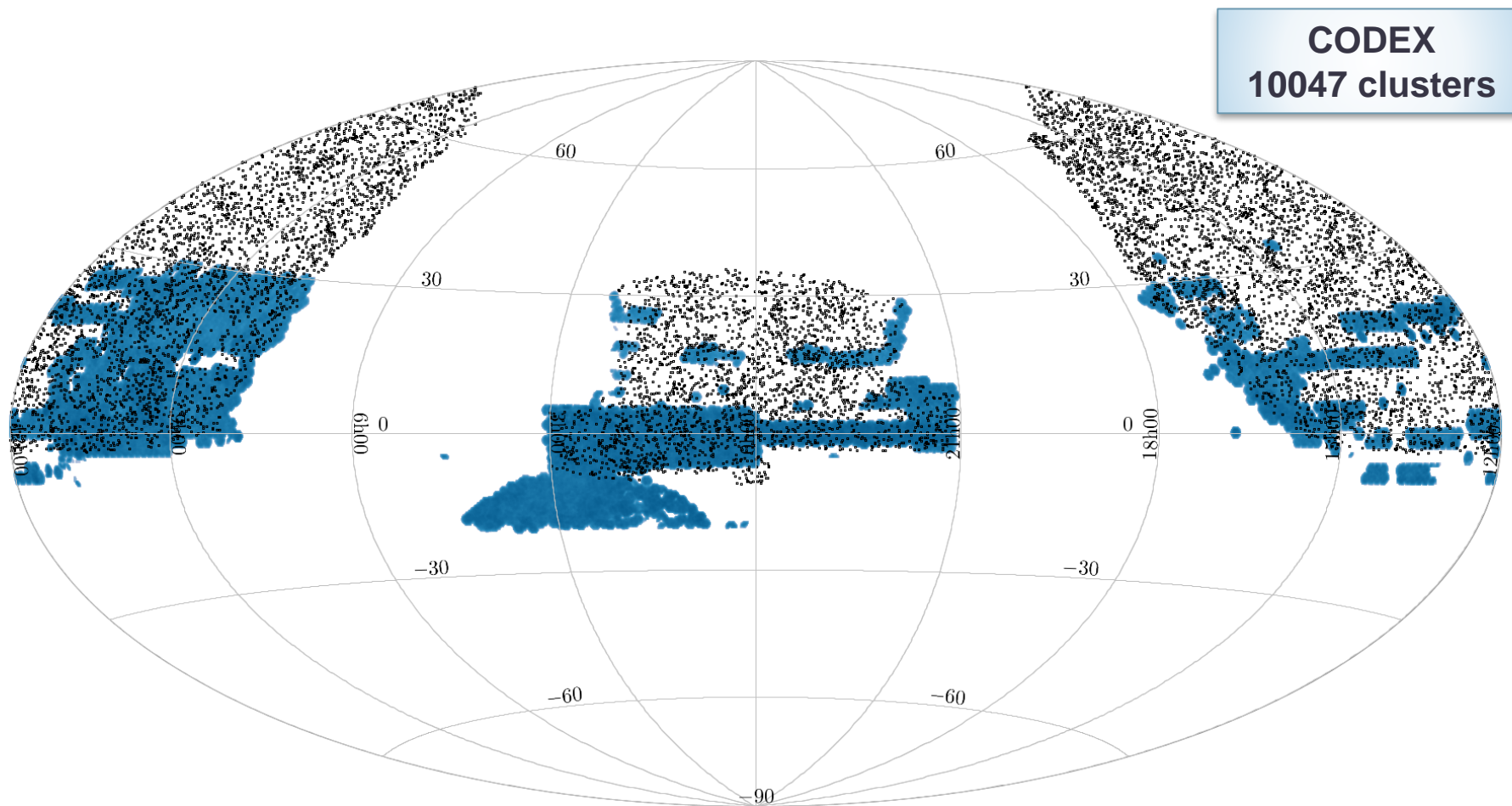
Correction Factor

Weight

Figure 2 : the example of equivalent ellipse for the background galaxies can be defined by two ellipticities

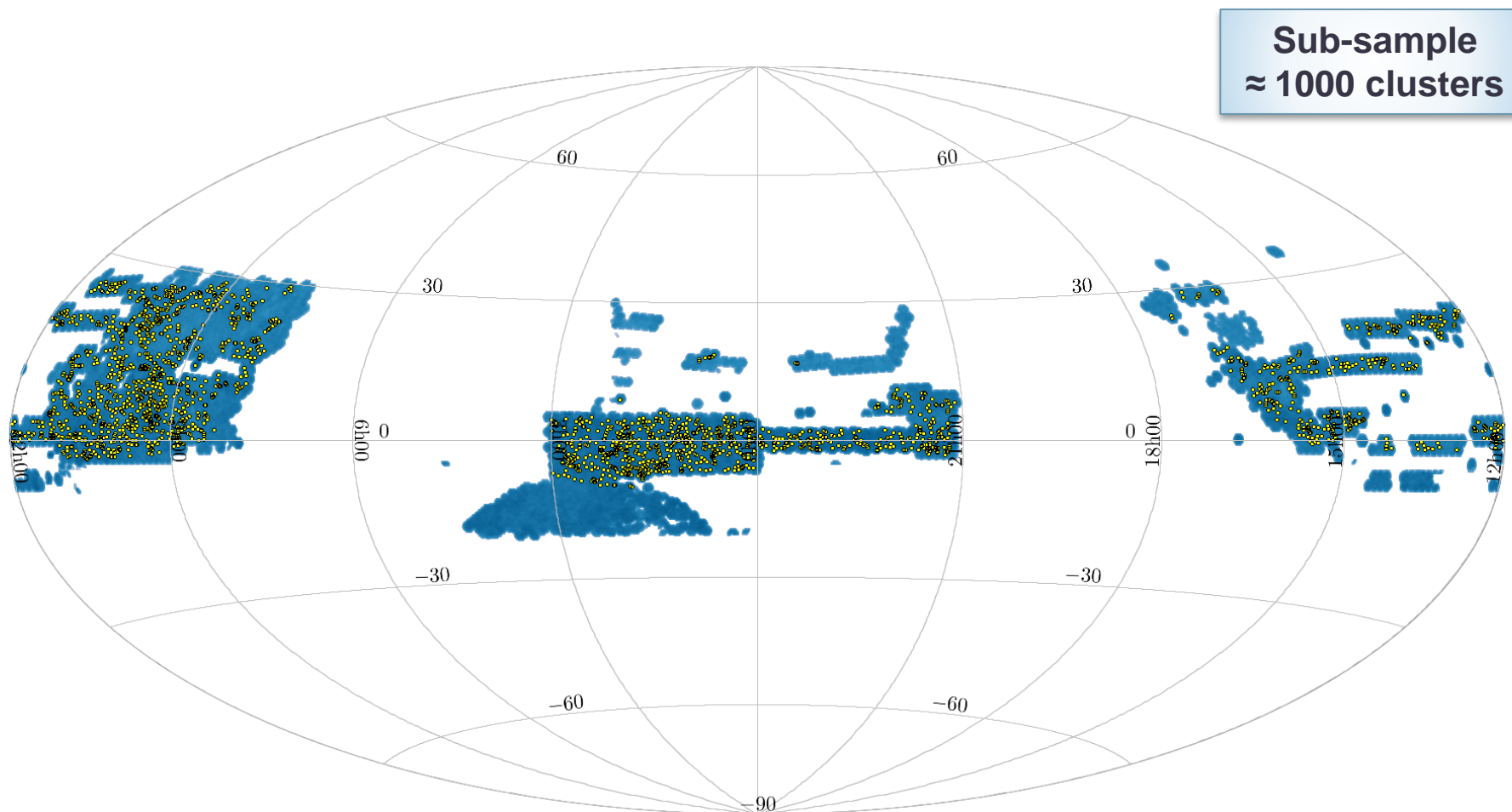**Figure 3** : The Blanco 4m telescope located at the Cerro Tololo Inter-American Observatory (CTIO) in Chile
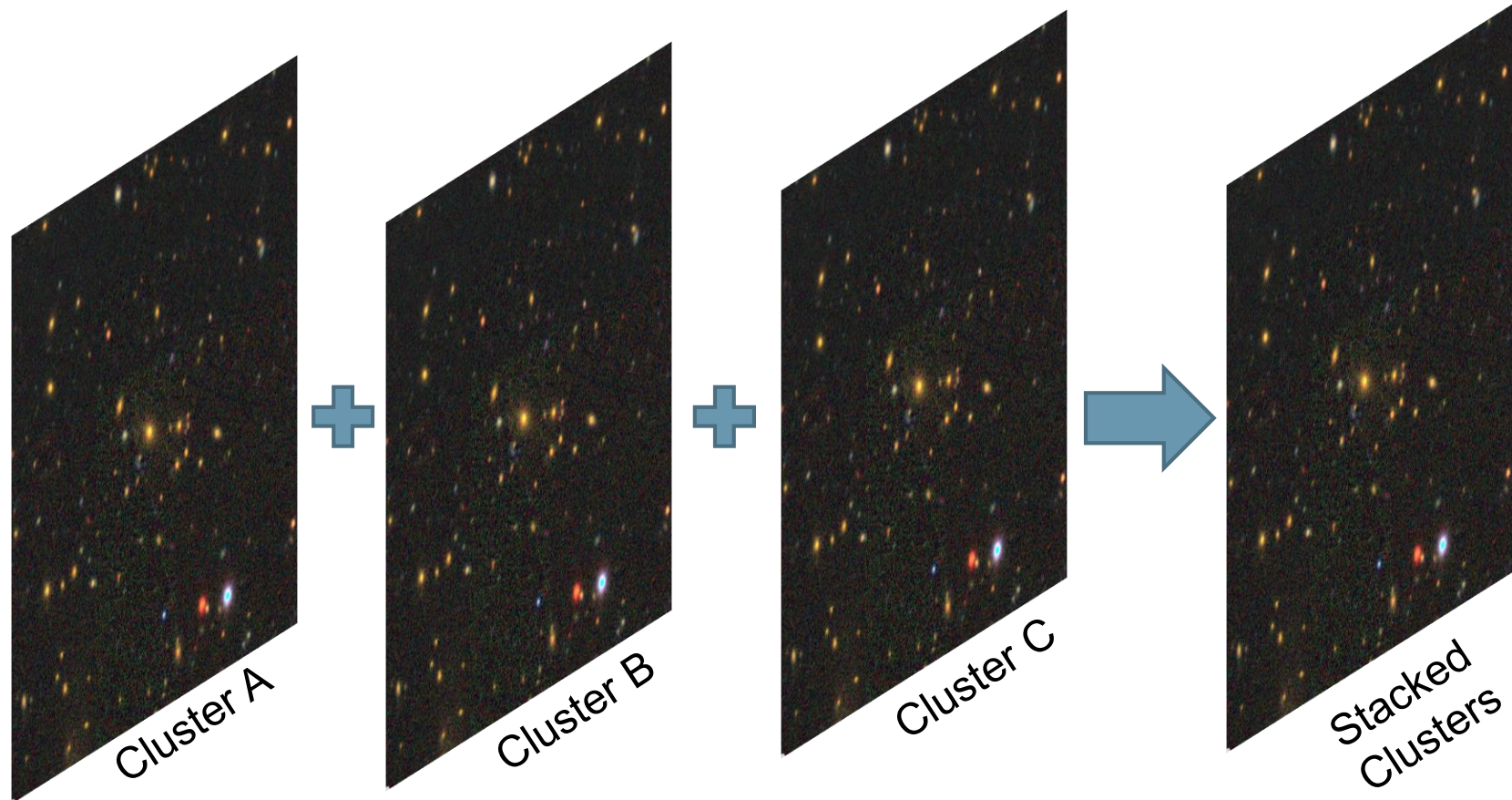
**CODEX
10047 clusters**

Figure 4 : The position of the DECaLS objects (DR3; blue shaded area) and
COnstrain Dark Energy with X-ray galaxy clusters (CODEX)
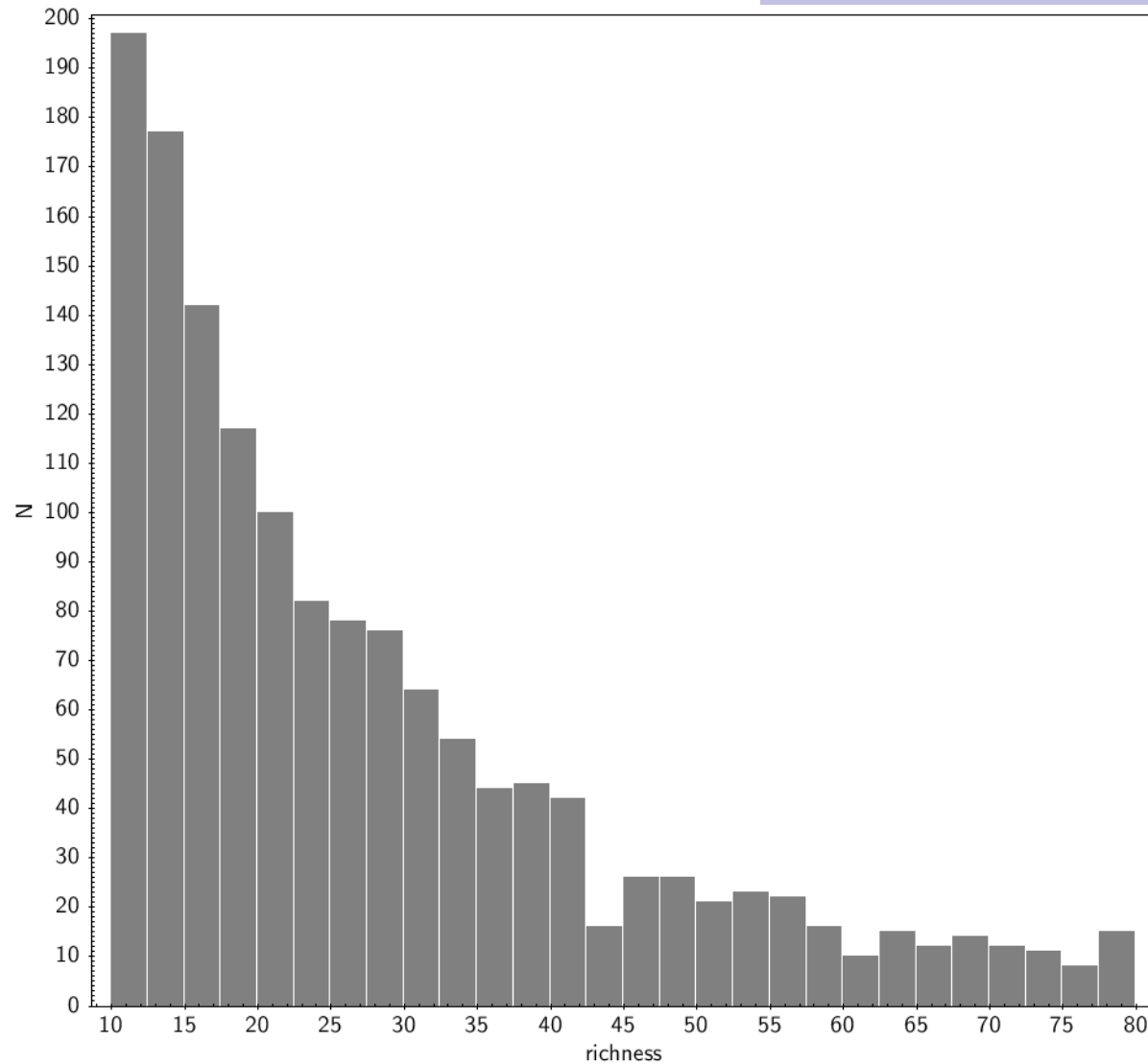cluster catalog (DR14; black dotted).

file : cluster_statistics_2016-11-08-DR14.fits

Sub-sample ≈ 1000 clusters

Figure 5 : The position of the DECaLS objects (DR3, blue shaded) and the CODEX clusters for weak lensing analysis (yellow).

file : cluster_statistics_2016-11-08-DR14.fits

Stacking Technique

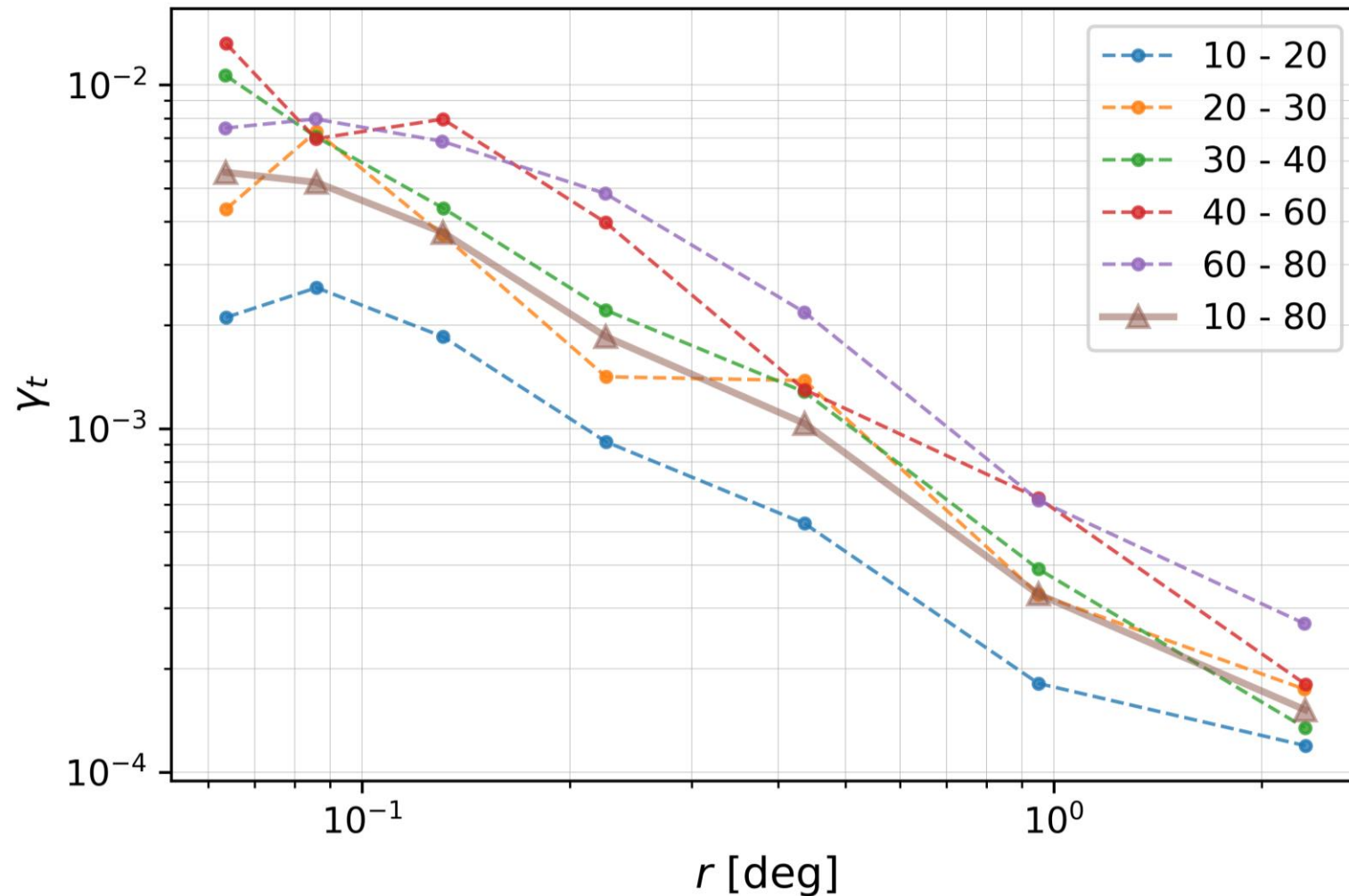

Cluster A + Cluster B + Cluster C → Stacked Clusters

$$\gamma_{t,A}(r) + \gamma_{t,B}(r) + \gamma_{t,C}(r) \rightarrow \overline{\gamma}_{t,stack}(r)$$
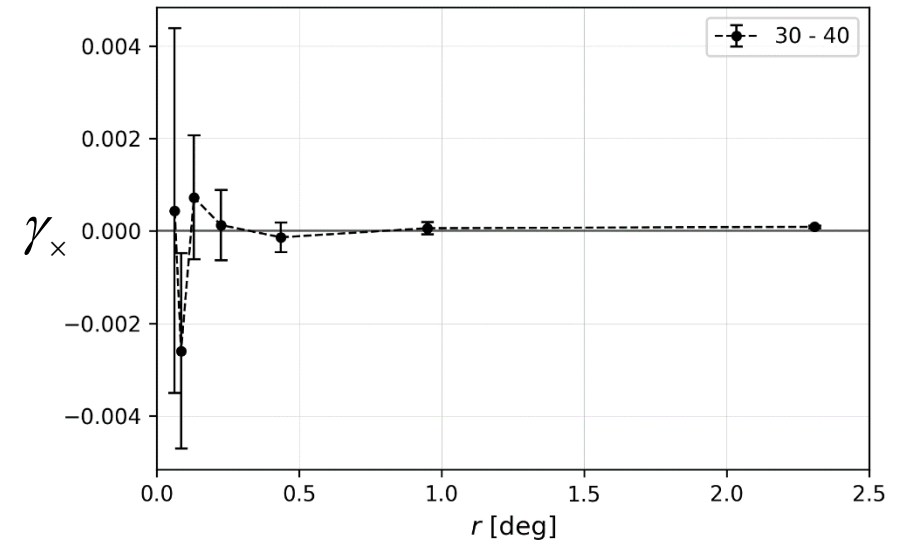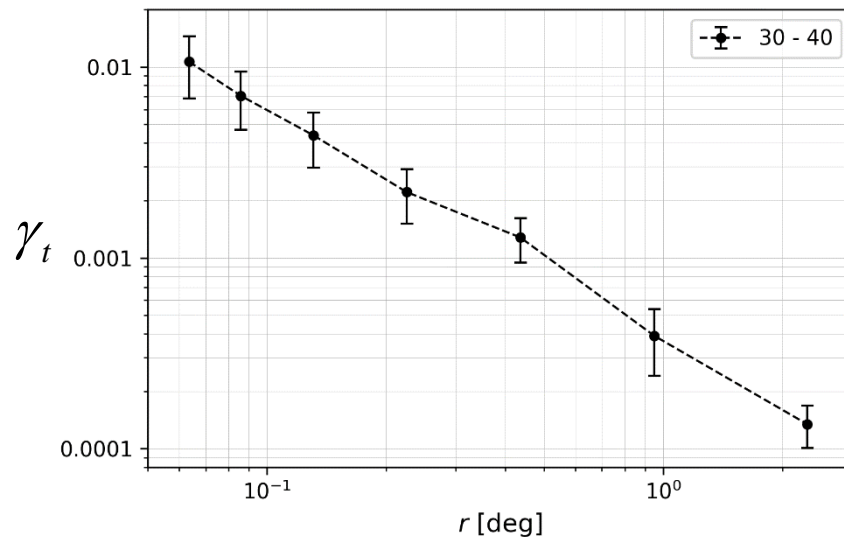
Figure 6 : The number of cluster in each optical richness bins from the CODEX catalog
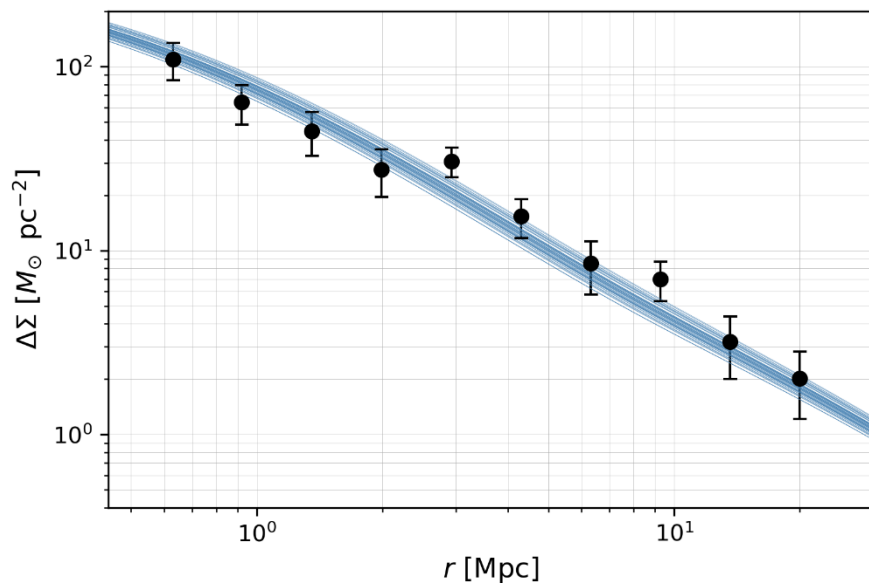
Figure 7 : The tangential shear profile of the CODEX clusters from the weak gravitational lensing
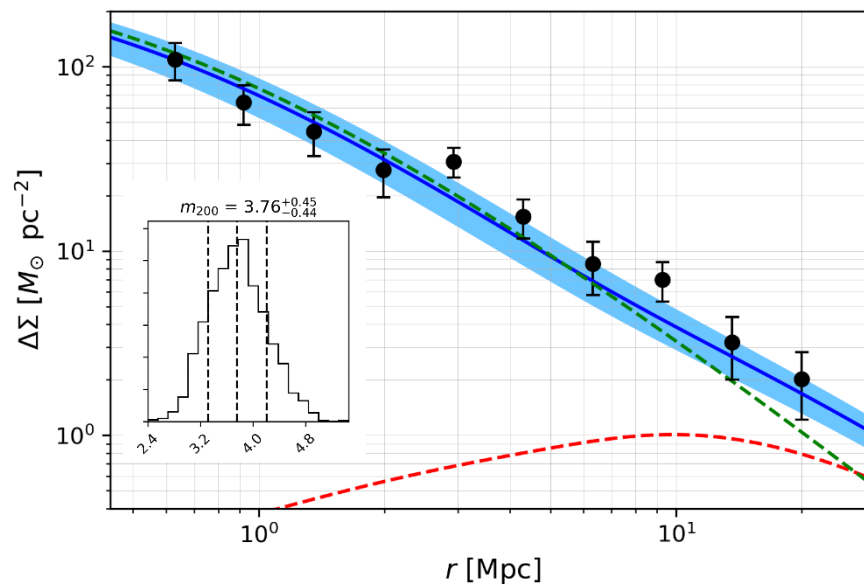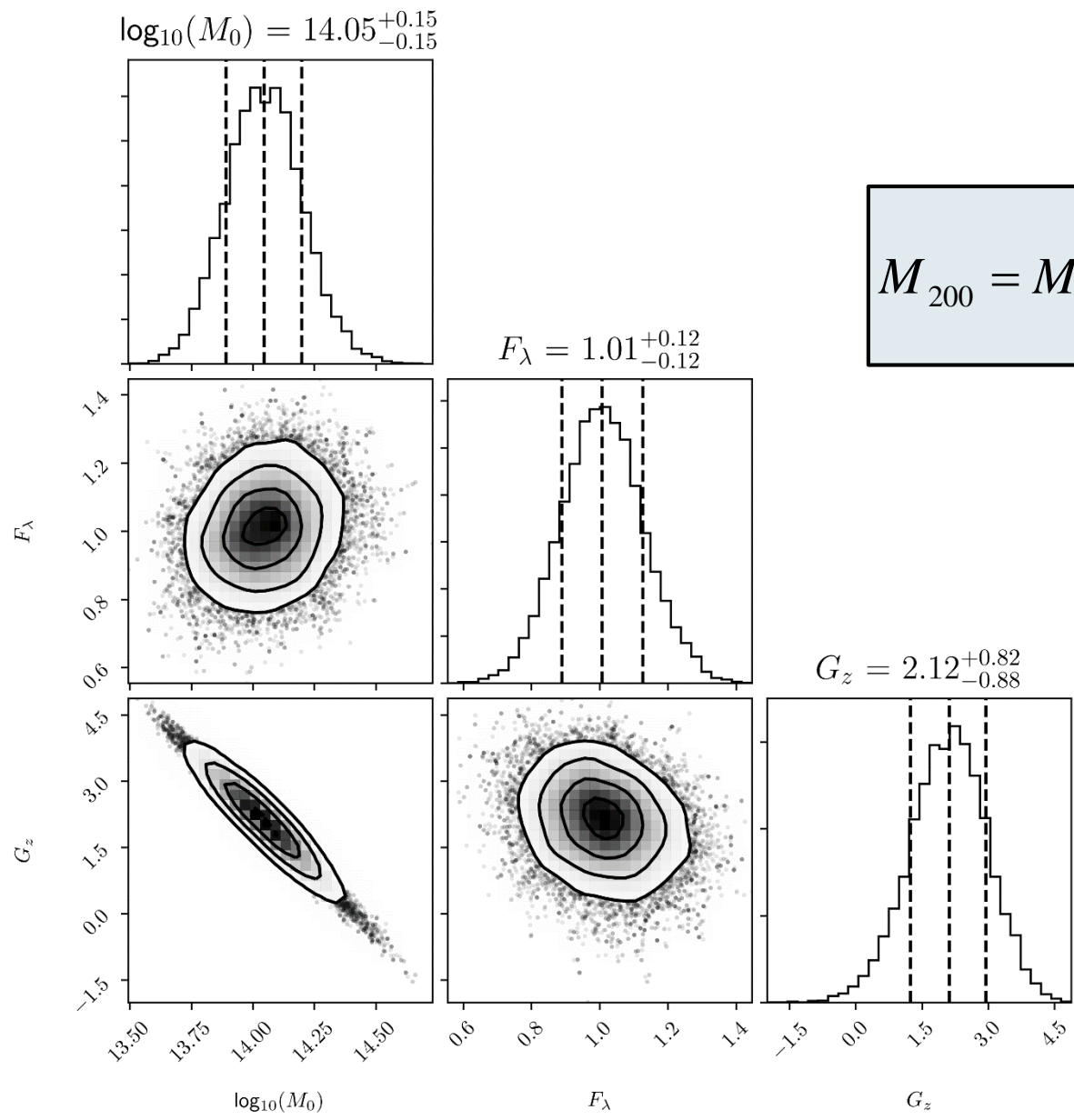
$$\lambda = 30 - 40$$

Figure 8 : The tangential and cross shear profile
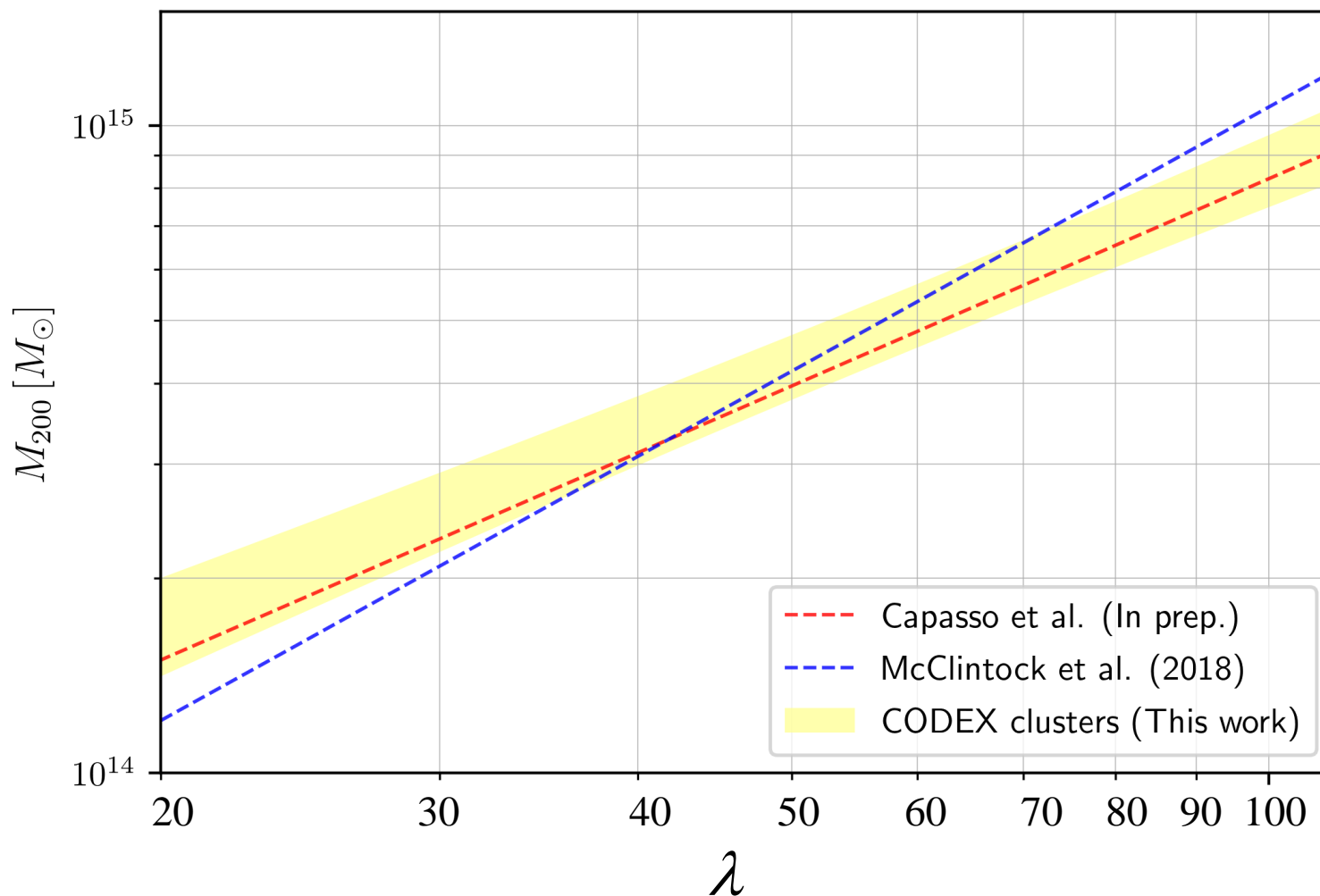of the CODEX clusters within the richness range 30 - 40.

The lensing signal from the sub-sample CODEX cluster with 100 sampling models from the MCMC.

The lensing signal from the sub-sample CODEX cluster with two halo terms (green and red dotted line)

$$M_{200} = M_0 \times \left(\frac{\lambda}{\lambda_0} \right)^{F_\lambda} \times \left(\frac{1+z}{1+z_0} \right)^{G_z}$$

Figure 9 : Best fit model for the M-λ relation, compared to other measurement.

Summary

- We create the sub-sample of the CODEX cluster for the Weak Lensing analysis using the DECaLS

- We compute the tangential shear profile and calculate the cluster mass in each richness bins

- We estimate the mass-richness relation of the CODEX cluster