# Weak Lensing Mass Reconstructions of High−z EDisCS Clusters with ACS Mosaic Images

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## The EDisCS Sample

The ESO Distant Cluster Survey contains a sample of 20 high−redshift (0.4<z<0.9) galaxy clusters, drawn from the optically selected Las Campanas Distant Cluster Survey. The clusters have been observed with deep VLT/FORS2 optical imaging, NTT/SOFI infrared imaging, wide−field optical imaging with the WFI, and VLT/FORS2 multi−object spectroscopy. In addition, ten of these clusters have have had time scheduled to be observed with ACS mosaics.

Because the EDisCS sample of clusters was drawn from an optically selected catalog, they consist primarily of clusters with lower masses than those found at similar redshifts with X−ray surveys. The number density of clusters massive enough to have been found in a deep X−ray survey (eg. EMSS or ROSAT NEPS) is consistent with the numbers of clusters in the X−ray surveys.

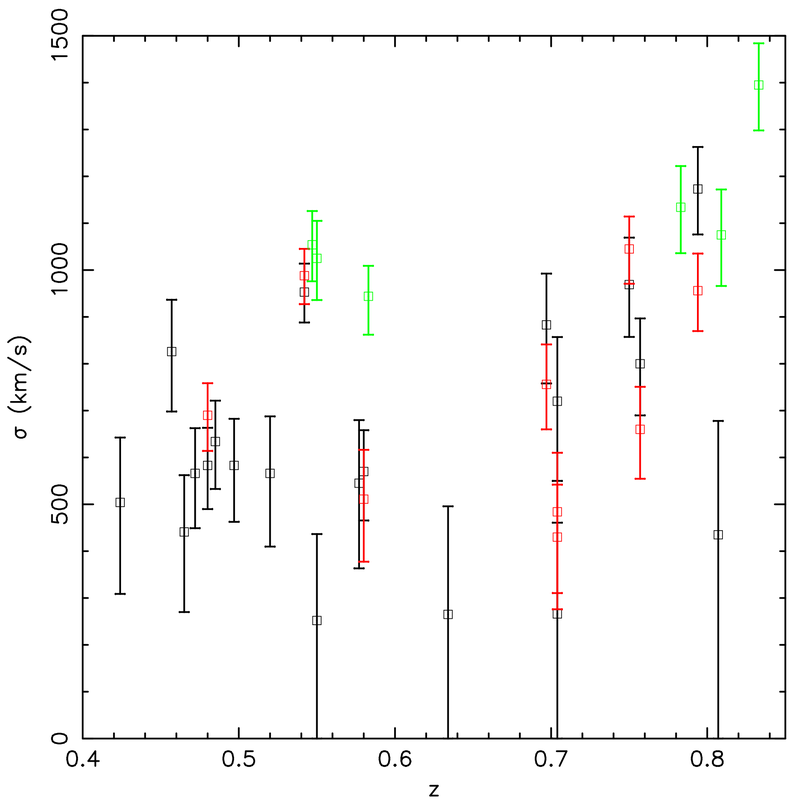
## Image Reduction

For each cluster, we covered a 6.5' x 6.5' field in 8 orbits with the ACS. Each orbit consisted of two CR−split pointings offset to span the 50 pixel interchip gap. The entire area was imaged with 4 one−orbit, overlapping tiles. The cluster center, offset from the region center, was then imaged with an additional 4 orbits. The total exposure time near the cluster center is ~10.2 ks, while in the outer regions it is ~2.04 ks. The resulting 32 images per cluster were reduced on the fly with CALACS v4.3 when they were requested from the archive. We used Mulitdrizzle to remove cosmic rays, undistort the images, and drizzle them into a mosaic. Cross−correlation of undistorted images was used to provide Multidrizzle with precise image offsets. All of the images were taken in the 814 filter.

## Best−Fit Mass Profiles

Best−fit mass profiles were determined by $X^2$ minimization of the azimuthally averaged reduced shear profile of the cluster to integrated SIS reduced shear profiles. Over the radial range used for the fits (100 kpc < r < 700 kpc), the integrated SIS and integrated NFW profiles are indistinguisable within the errors of the shear measurements. The largest source of systematic error in these fits is the mean redshift of the background galaxy population, which we determined by comparison with HDF−S photometric redshift catalogs.

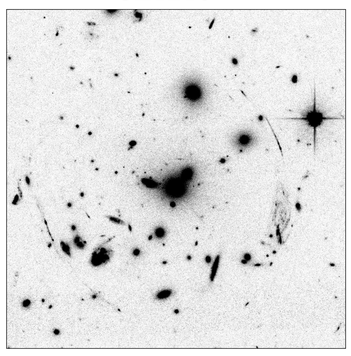
The plot below shows the best−fit SIS velocity dispersion for the clusters vs the cluster redshift. The black points are the 20 clusters in the EDisCS sample, with shears measured from the VLT images. The red points are the EDisCS measurements from the ACS images. The green points are weak lensing measurements from X−ray selected cluster samples (EMSS and ROSAT NEP) for comparison.



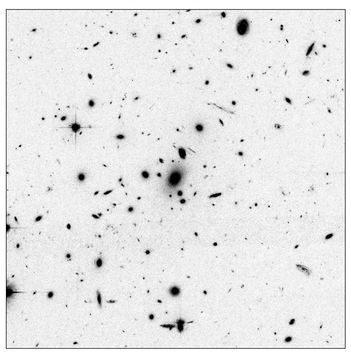

## Strong Lensing

Two of the nine clusters in the ACS sample show signs of strong lensing. CL1216 has a multiple arc system (either 2 arcs of a multiply peaked galaxy, or 4 arcs arranged in 2 almost merging sets). CL1054−12 has two individual arcs at much different radial distance from the central galaxy, and a possible arc at a much larger distance (bottom of the image). No redshifts are known for any of the arcs.

CL1216



CL1054−12



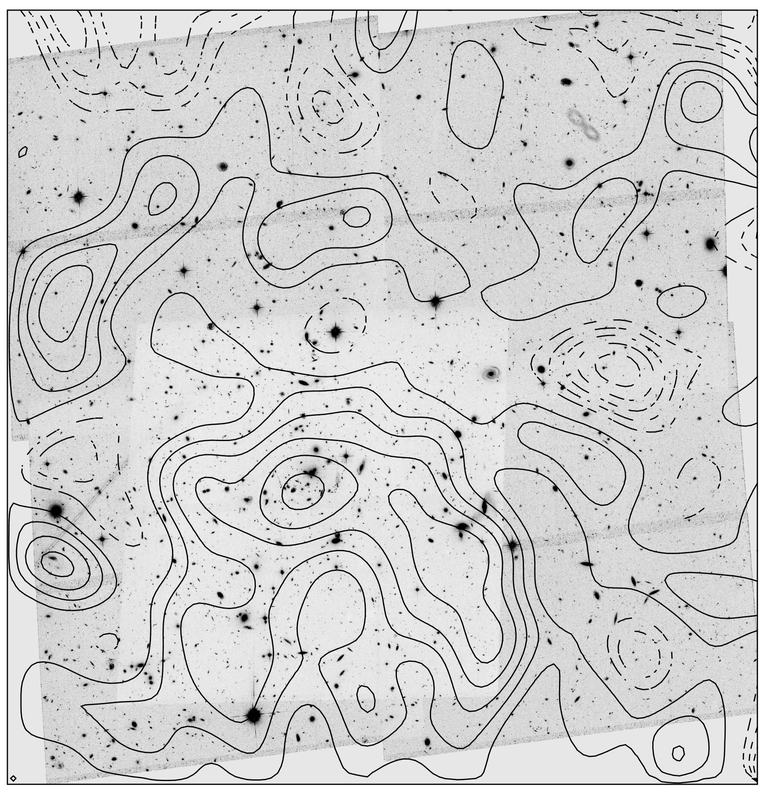
## Creating the Shear Catalogs

Objects were detected in the mosaic images using SExtractor, and had the moments of their surface brightness measured using IMCAT. Galaxies were seperated from stars based on the size of a 50% encircled light radius. The galaxies then had optical colors measured on the VLT/FORS2 images using matched aperture photometry. Background galaxies were selected by cuts in magnitude, size, central surface brightness, and, for the brighter galaxies, color. PSF correction of the galaxy shapes was performed with a variation of the KSB method.

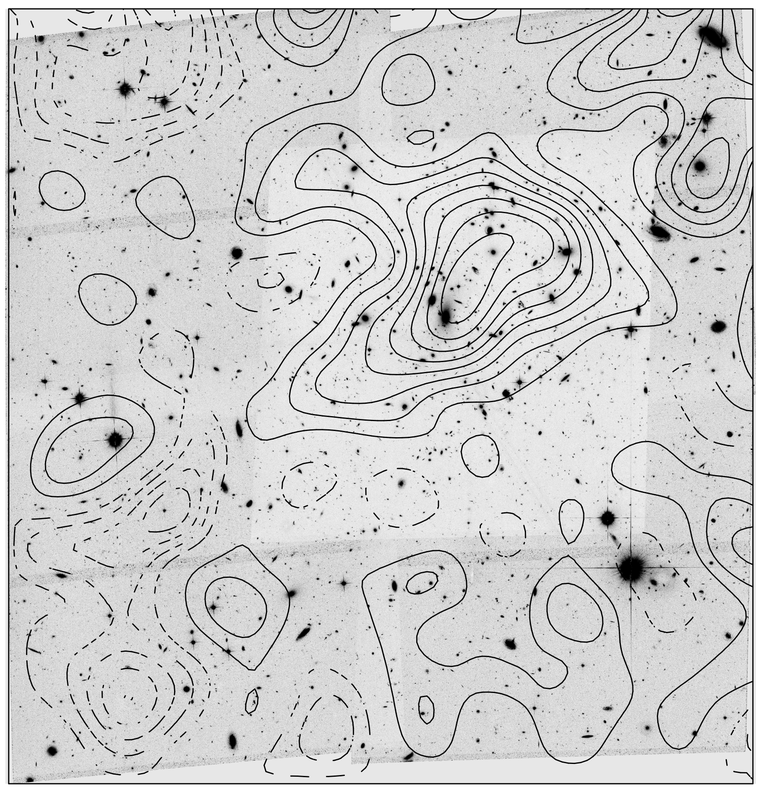
To measure the PSF on the mosaic images, we measured the moments of the surface brightness of all the stars on each individual exposure, after correcting for image distortion but before aligning the images for coaddition. We then binned the stars by exposure date into one month bins, and fit the moments within each bin as a function of image position. The object in each mosaic image was then referenced back to its position on each input image, and the moments of the surface brightness of the psf on the input images at the given positions were averaged to determine the moments of the PSF of the mosaic, which were then used to correct the object's shape.

In the final catalogs were an average of ~90 galaxies/sq. arcmin. in the single orbit portions of the mosaic and ~130 galaxies/sq. arcmin. in the deeper central pointings which were usable as background galaxies for shear measurements. The 1−D rms shear estimator per galaxy was 0.36, which is about 20% higher than typical values from the deep VLT images. This suggests that the additional population of background galaxies observed in the ACS images are intrinsically more elliptical than those also detected in the ground based images.

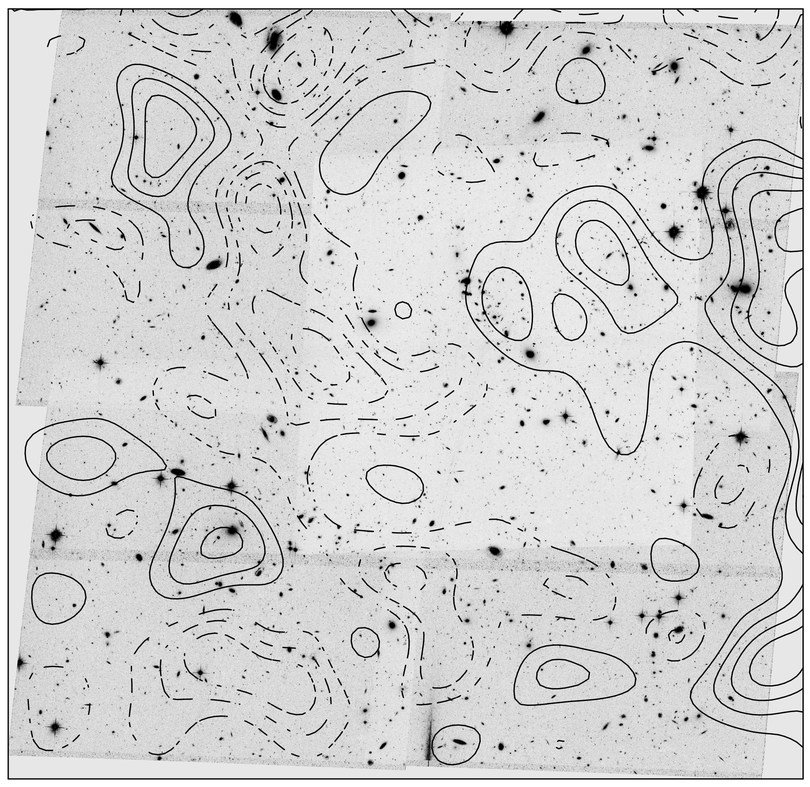
CL1216 (z=0.794)



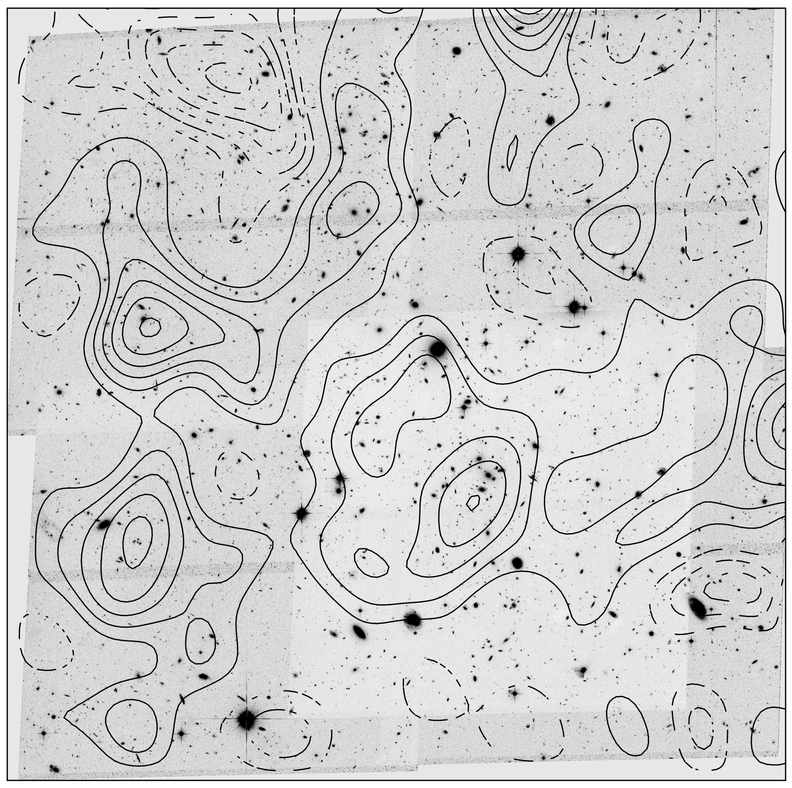
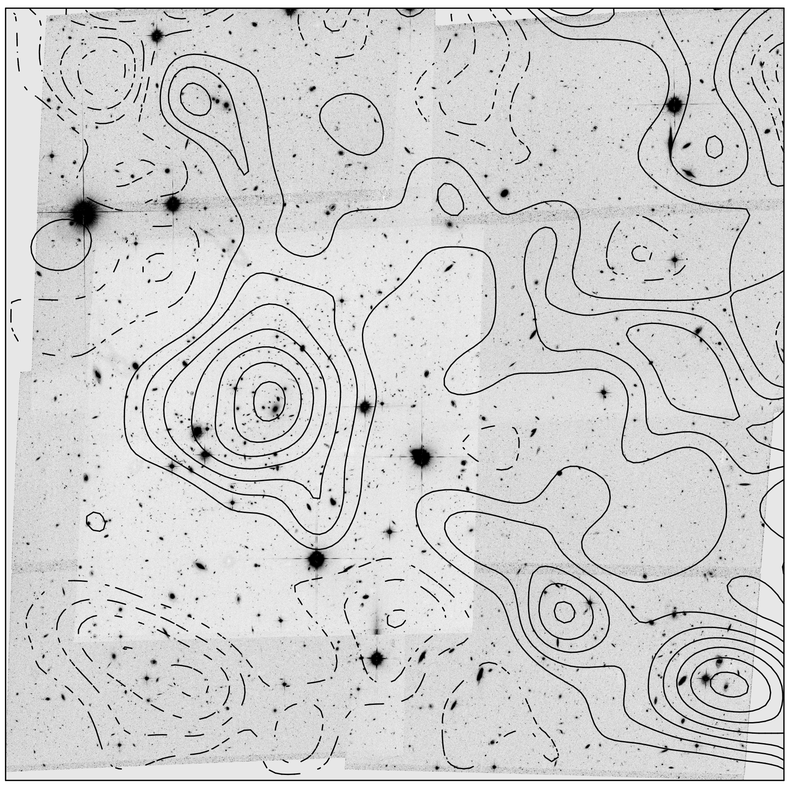
CL1232 (z=0.542)



CL1037 (z=0.580)



CL1054−11 (z=0.697)



CL1054−12 (z=0.750)