

Galaxy Clusters Survey for Cosmology and Galaxy Evolution

Ian Dell'Antonio

Cosmology/Fundamental physics key project proposal

Imagine this at 3-5x resolution!

Why?: Low- z clusters are being studied w/ground based telescopes ($z < 0.2$) and/or HST ($0.2 < z < 0.5$). Equivalent datasets don't exist at higher z . JWST will extend studies to high- z , but not get to the same **physical** resolution for these clusters.

What: Surveying 100 galaxy clusters with $0.5 < z < 2.5$:

50 with $0.5 < z < 1$: Mass scale Calibration; cosmology via SL(and WL?) tomography; high- z lensed galaxies, faint cluster galaxy populations

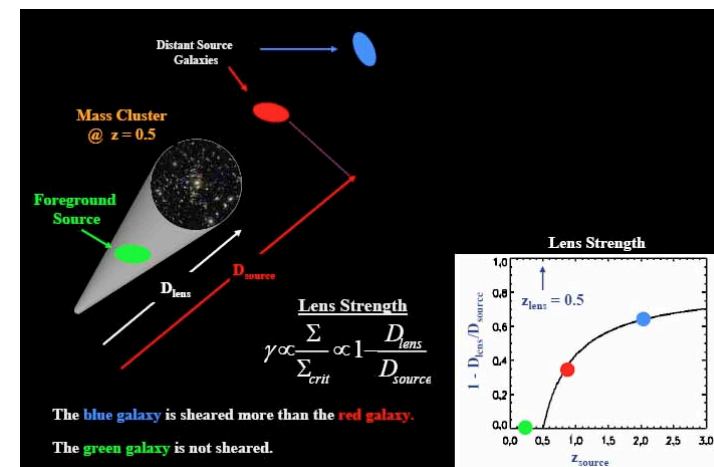
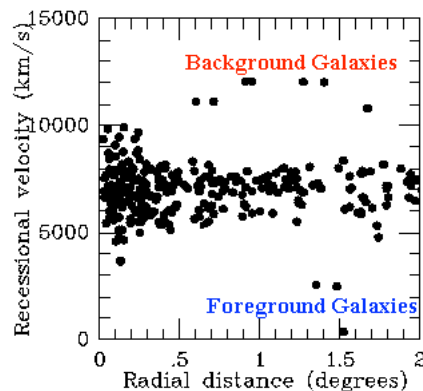
50 with $z > 1$ (out to $z = 2.5 + ?$): masses of high z clusters, evolution of brighter galaxy populations, evolution of cluster merging.

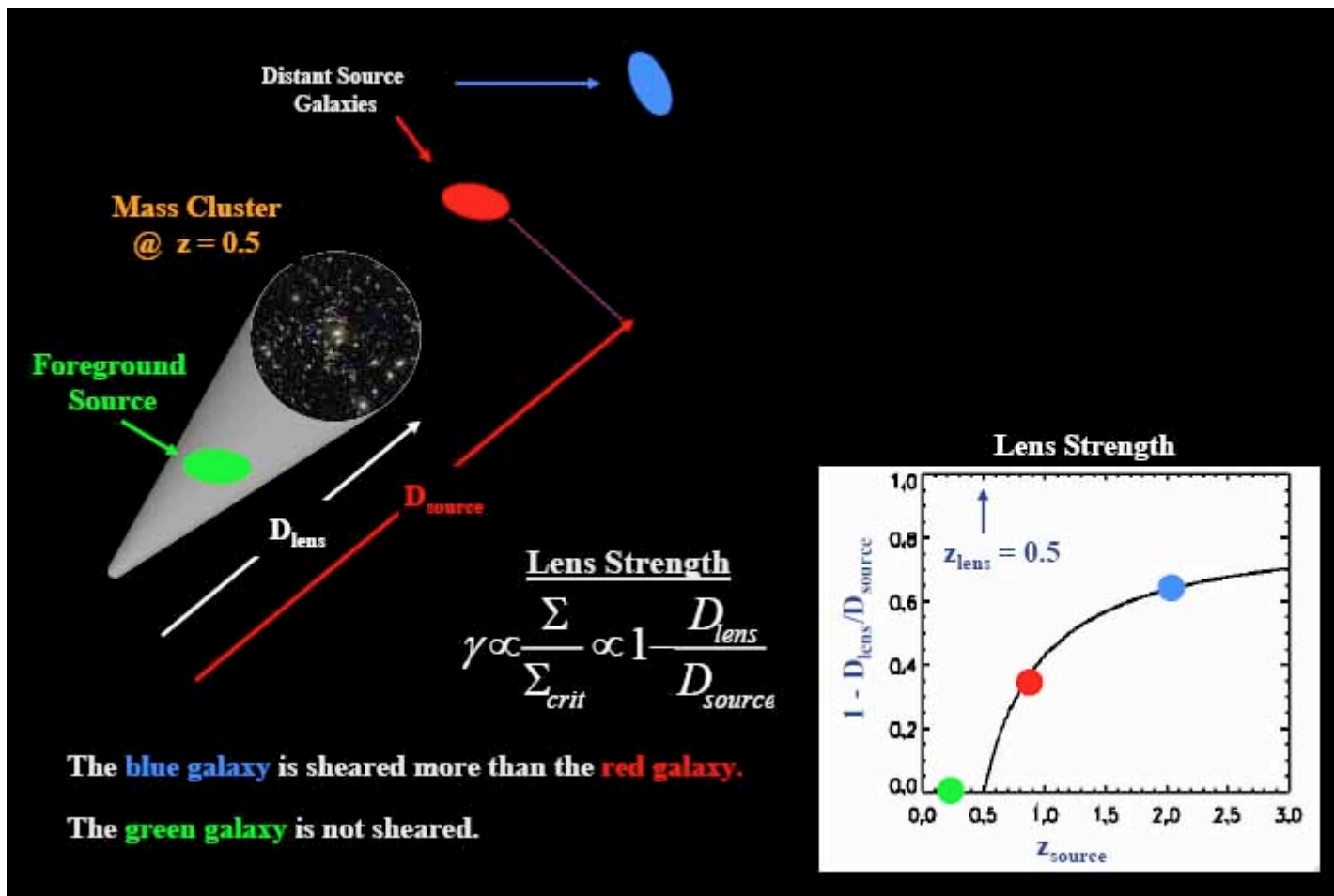
A Legacy survey—the “golden cluster” sample covering the entire redshift range of cluster formation



The science

- Tomographic measurements of SL(+WL?) to make an independent cosmological measurement—relies on resolution to increase number of “arcs” and spectroscopic redshifts to improve mass model.
- Calibration of cluster mass scale (at $z > 0.5$)—SL+WL+ background redshift measurements of clusters spanning mass/redshift to remove systematic uncertainties in LSST/WFIRST dark energy measurements.
- Mass measurements via WL+SL of $z \gg 1$ clusters where the mass-observable relations will not work.
- Spectroscopy of cluster members—kinematics (masses), star formation, and (for the central galaxies) resolved spectroscopy (via IRIS IFU)
- High- z lensed galaxies (resolve individual SFR, find higher z galaxies, increase the $M > 10$ area by factors 10-20x over Frontier Fields.





The Instruments.

IRIS—35"x35" FOV—200 kpc across at $z=0.5$

-- 6x the HST ACS resolution at 1 micron, $\sim 3x$ at Ks (relative to F606W). 120 minutes will give $S/N > 10$ detections of $K \sim 29$ galaxies; $\sim 2-6$ hours/cluster. $\sim 20-60$ nights.

IRMS-- ~ 50 multiplex IR spectroscopy of lensed galaxies AND faint cluster members. 2-3 pointings/cluster. 1-2 clusters/night— (~ 50 nights) Subsample? How much of this science will be done by JWST?

WFOS: star forming galaxy redshifts behind clusters— calibrate mass scale for WFIRST/LSST clusters. $\sim 10-20$ nights.

Supporting data

Planck/eROSITA/Spitzer (cluster selection)

LSST/WFIRST/EUCLID/HSC (weak lensing shear measurements, optical, NIR photometry, wide field context)

VLT/Keck/Gemini (brighter galaxy spectroscopy)

JWST (wider field, deeper spectroscopy)

ALMA/eVLA/SKA– gas, star formation, kinematic WL.

+?

Legacy value

Largest sample of lensed galaxies w/uniform reduction.

Clusters uniformly observed (and analyzed the same way)

Collection of other datasets will be basis for more and more studies

Cadence of observations may allow other science (lensed supernovae?)

Legacy Requirements

Good pipeline software (and a way to contribute improvements back to observatory)

Uniform data archive with reduced data

A large and diverse enough collaboration