ODI and lensing by clusters of galaxies

What can ODI do for me?

AAS Meeting #214   Session 241.04
Meeting within a Meeting: "Science with the WIYN One Degree Imager"
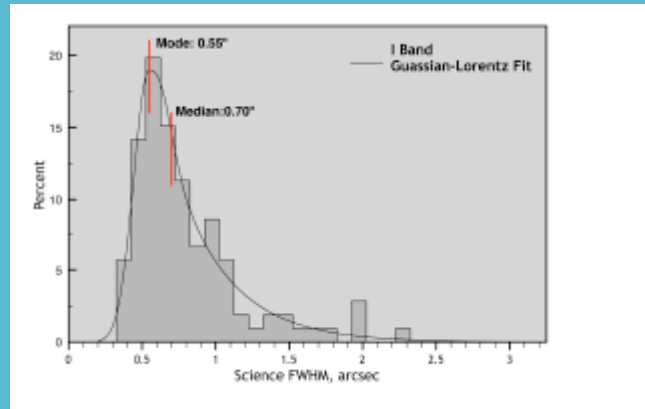
6/10/2009

Image Quality—Seeing matters!

The WIYN telescope already delivers good image quality with the current optical imagers such as Mini-MOSAIC.
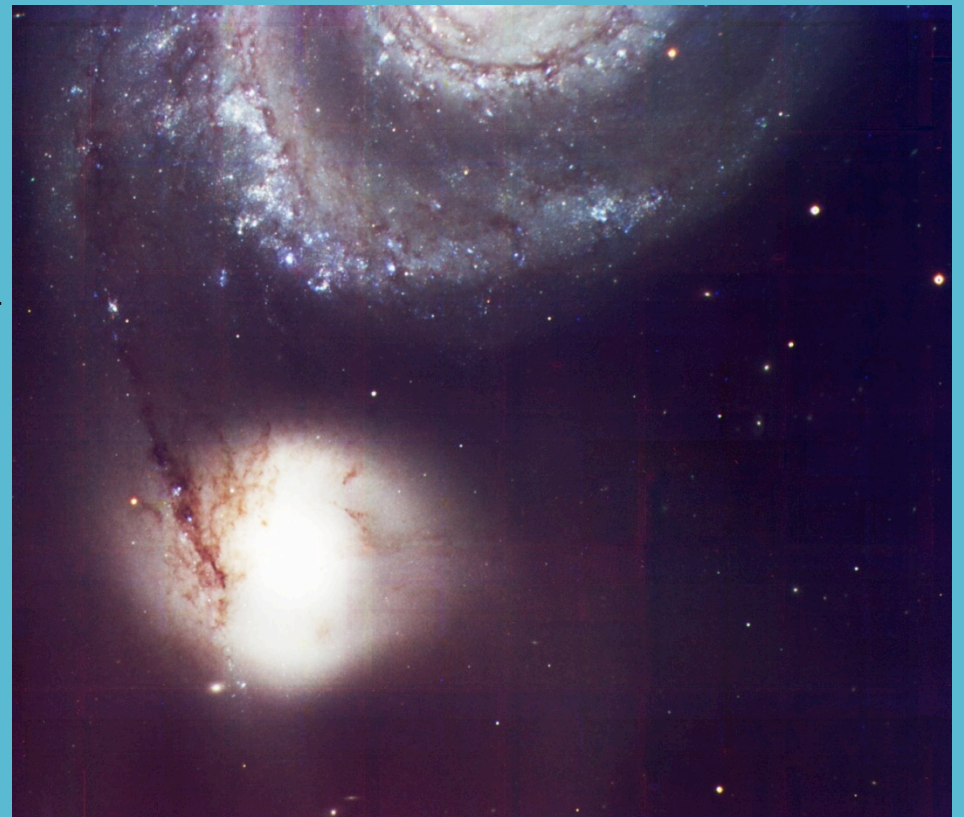
The experience of the past years with the OPTIC and QUOTA OT cameras on WIYN suggests that ~0.1" improvement in median seeing conditions can be obtained via OT guiding. (more improvement in worse seeing)

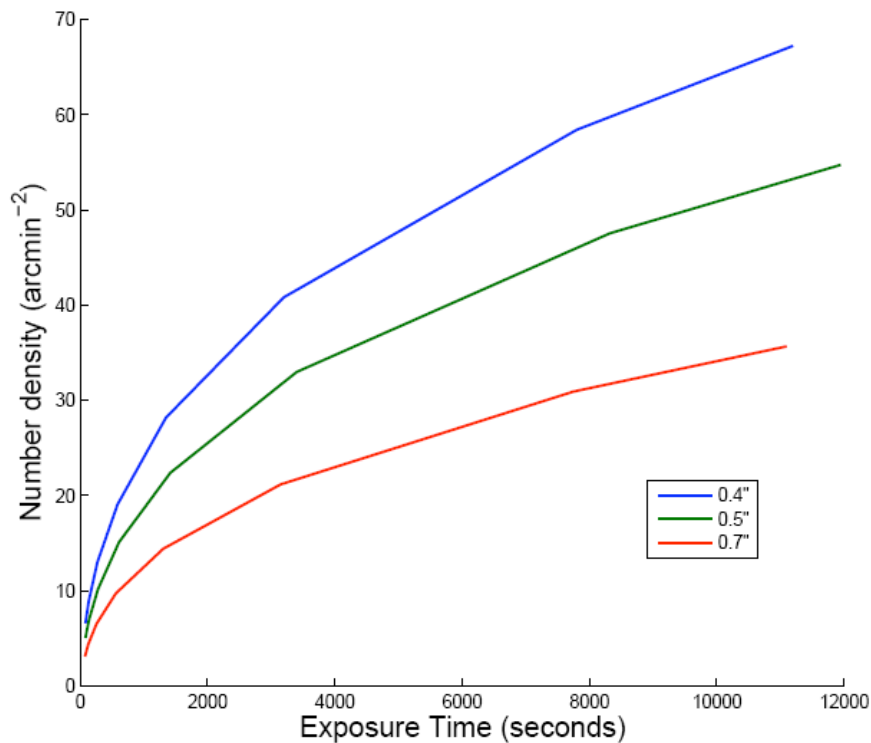ODI will "routinely" (~40% of the time) deliver images with <0.5" FWHM in the redder bands (i' and z').

FWHM distribution of 106 OPTIC I exposures (from WIYN DIQ report)

Multi-color deep exposure from WIYN—FWHM is 0.45"!

The bottom line—density of resolved galaxies

Number of resolved galaxies per unit exposure time as a function of seeing (based on COSMOS ACS size distribution and ODI sensitivity)—credit R. Cook (Brown)

Compare with~20 for Deep Lens Survey
And ~10 for Dark Energy Survey

The ability to detect and characterize the mass distribution in **individual** clusters depends most sensitively on the density of resolved galaxies.

ODI has the potential to be the ideal machine to study large (>>10) samples of intermediate mass clusters of galaxies:
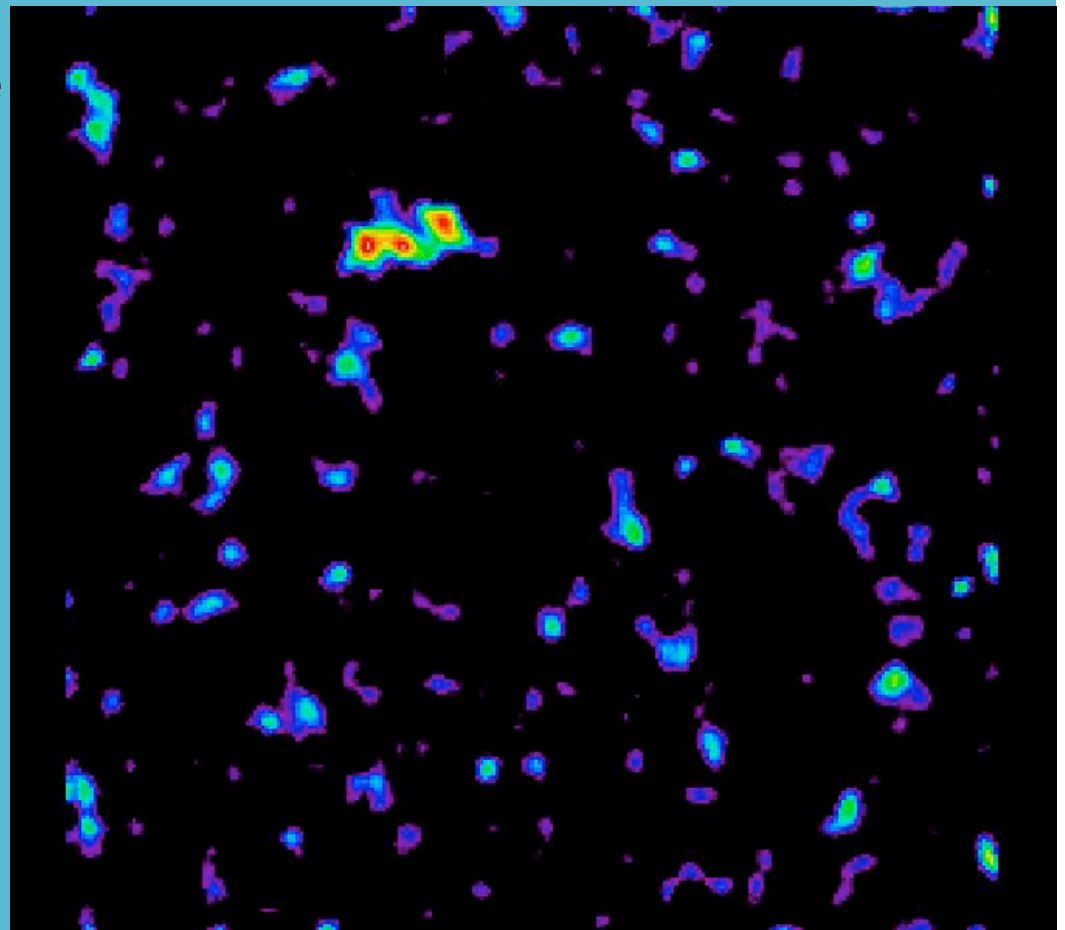
HST/ACS is inefficient because of the need to mosaic the fields…

An example of a project (there are many more)

Many upcoming surveys plan to use "stacks" of clusters to measure the WL signal as a normalization of mass-observable relations.
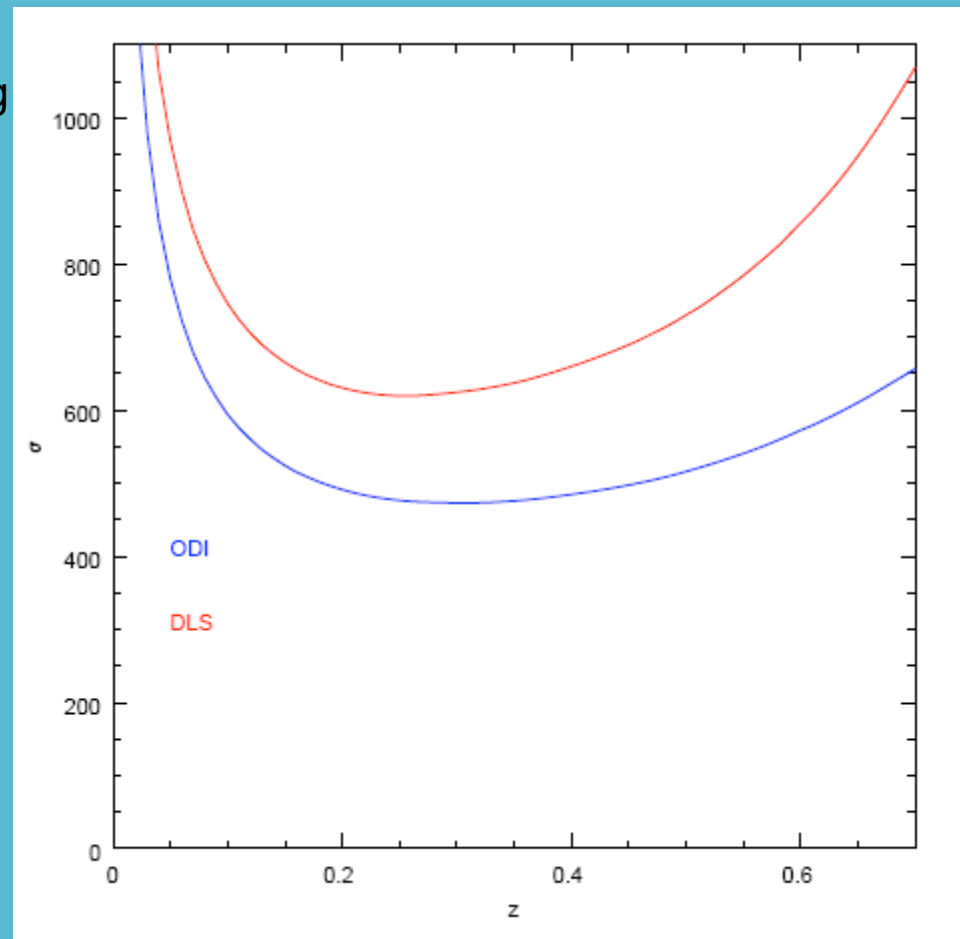
ODI is the one public instrument that can detect the individual clusters to be stacked.

DLS map of F2—4 ODI fields to 1/3 ODI depth…

Sensitivity versus redshift…

- ODI opens the possibility of detecting more abundant low-mass clusters (although confusion of structures along the LOS will be more of a problem)
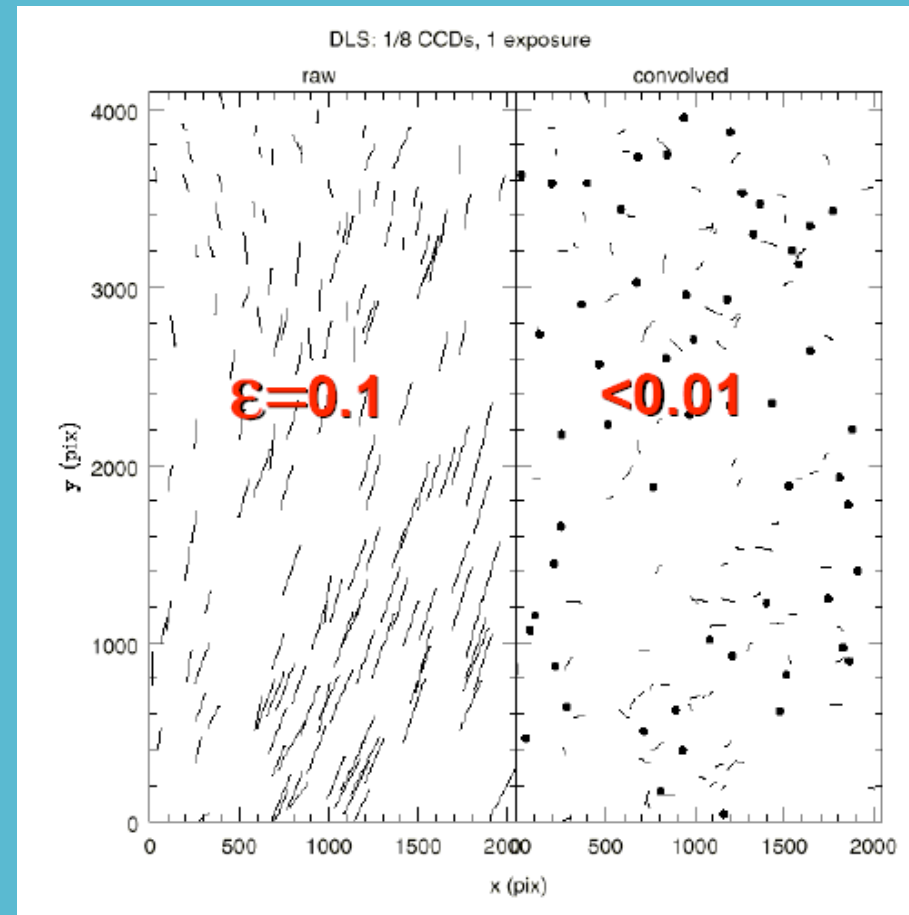- Can use ODI to study mass substructure in high-mass clusters.

Unresolved questions.

- OT guiding alters the PSF shapes—this can introduce systematic errors in the weak lensing reconstruction. Three questions are currently being investigated:

1) What is the induced ellipticity and how does it vary exposure-by-exposure it both local and coherent OT guided mode?

2) How smooth is the spatial variation of OT-induced ellipticity?

3) What is the lower limit of the ellipticity error on ~arcminute scales in the case of many exposures?

(Very) preliminary results suggest that the spatial variations of the induced PSF are relatively smooth (possibly depending on the algorithm for OT guiding). <1% induced ellipticities can be achieved --Cluster weak lensing can be done.

Not yet clear whether <0.1% level can be reached—perhaps not a cosmic shear machine?

DLS: 1/8 CCDs, 1 exposure
raw   convolved

$\varepsilon=0.1$ <0.01

y (pix)
x (pix)

Can this be done for OT arrays?