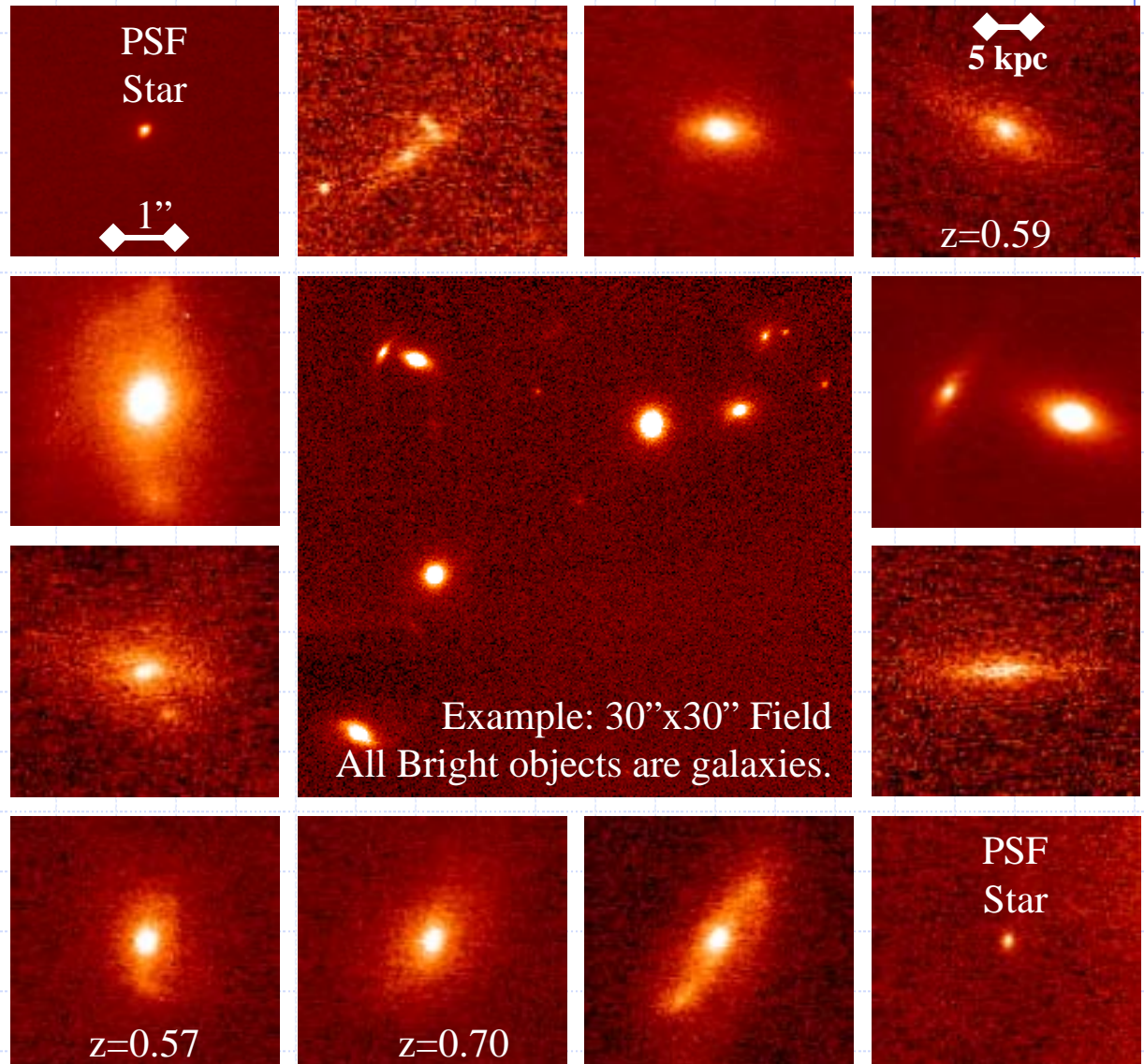
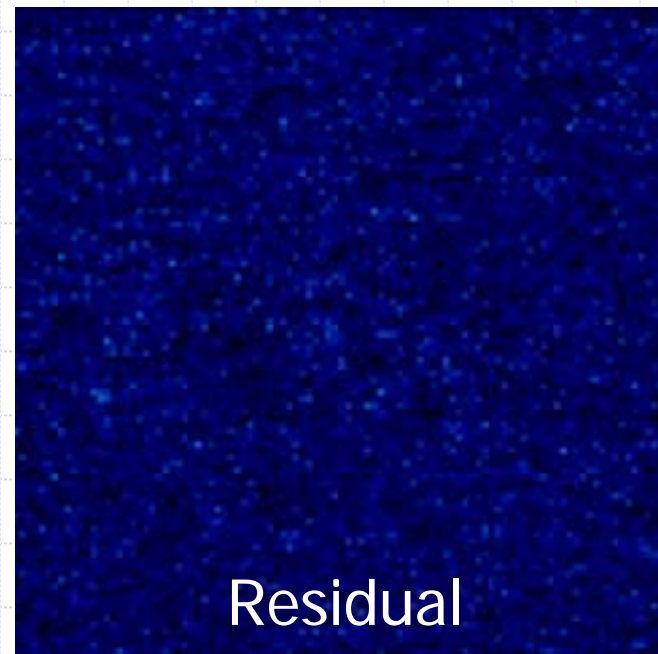
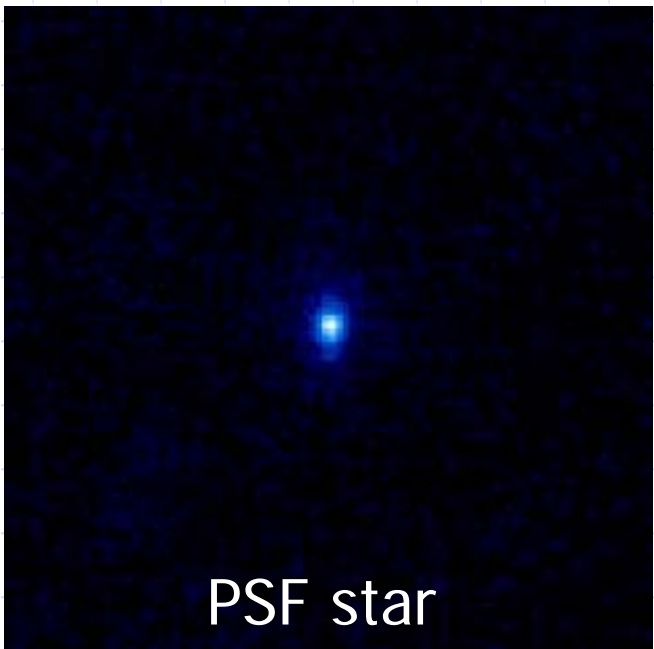
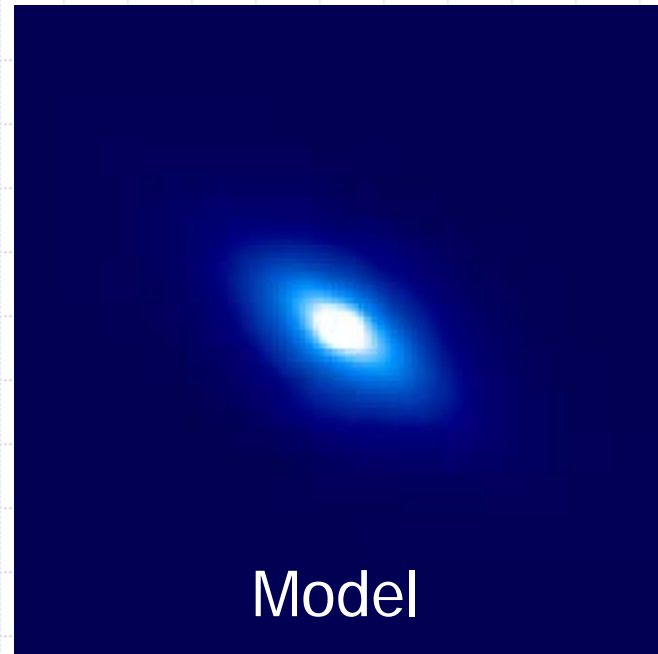
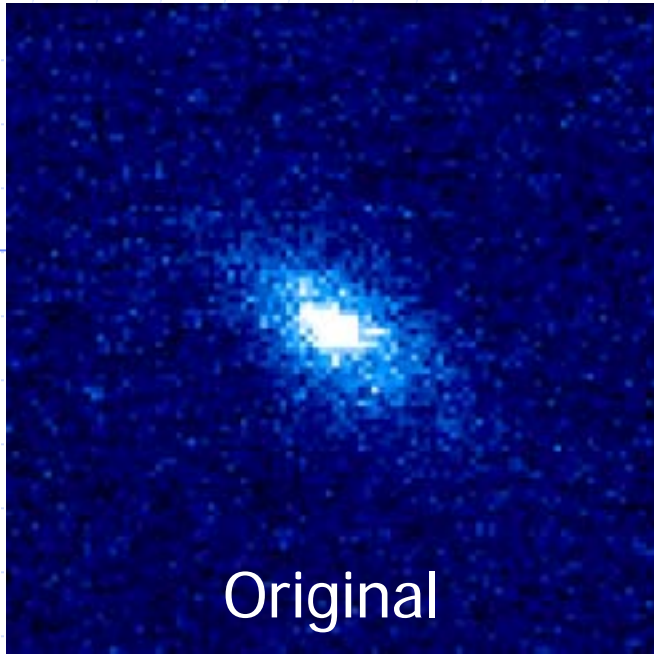
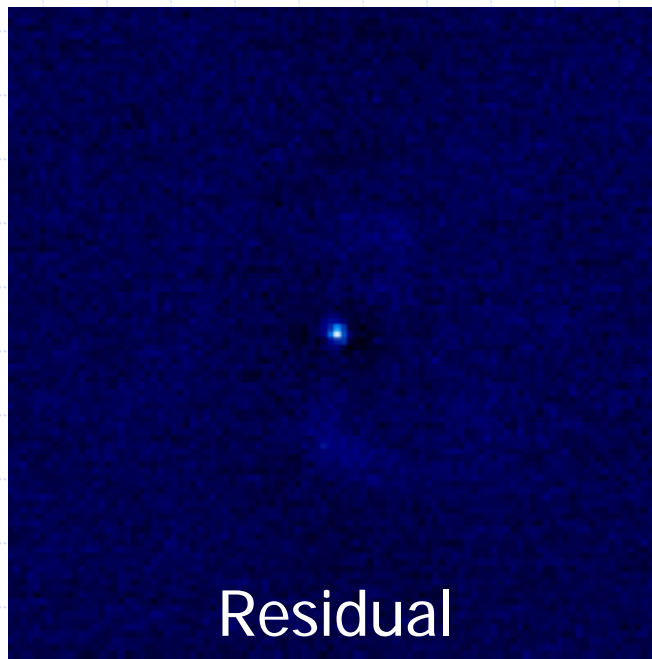
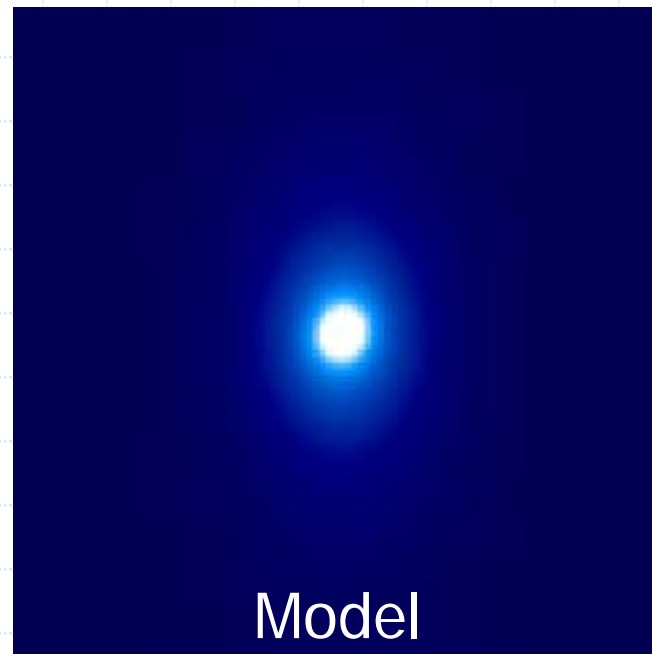
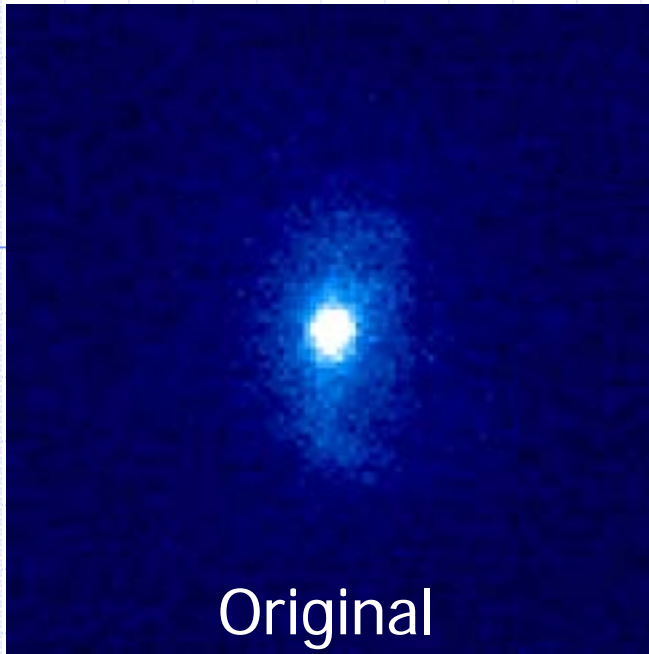


Galaxy Modeling with measured PSFs

With 300 galaxies now and many more expected with CATs, we need fully automated routines for PSF estimation.





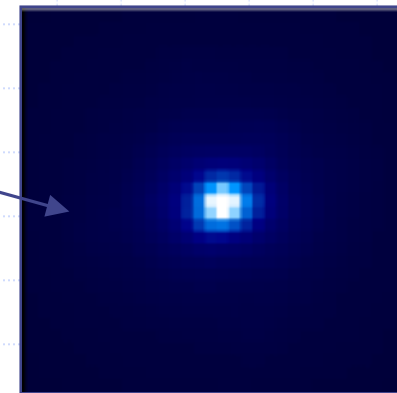
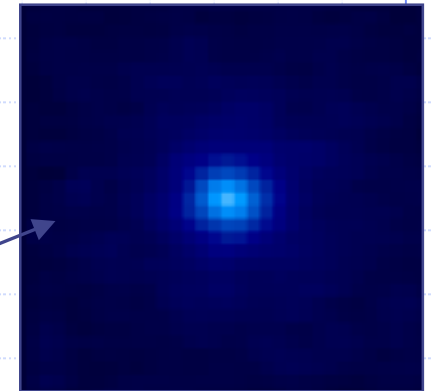
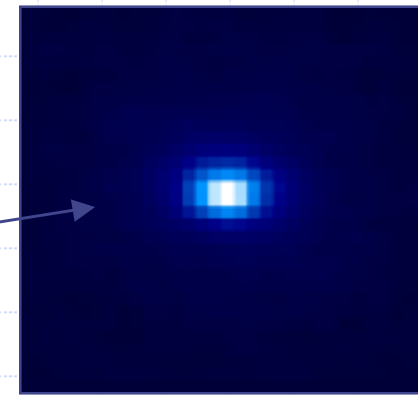
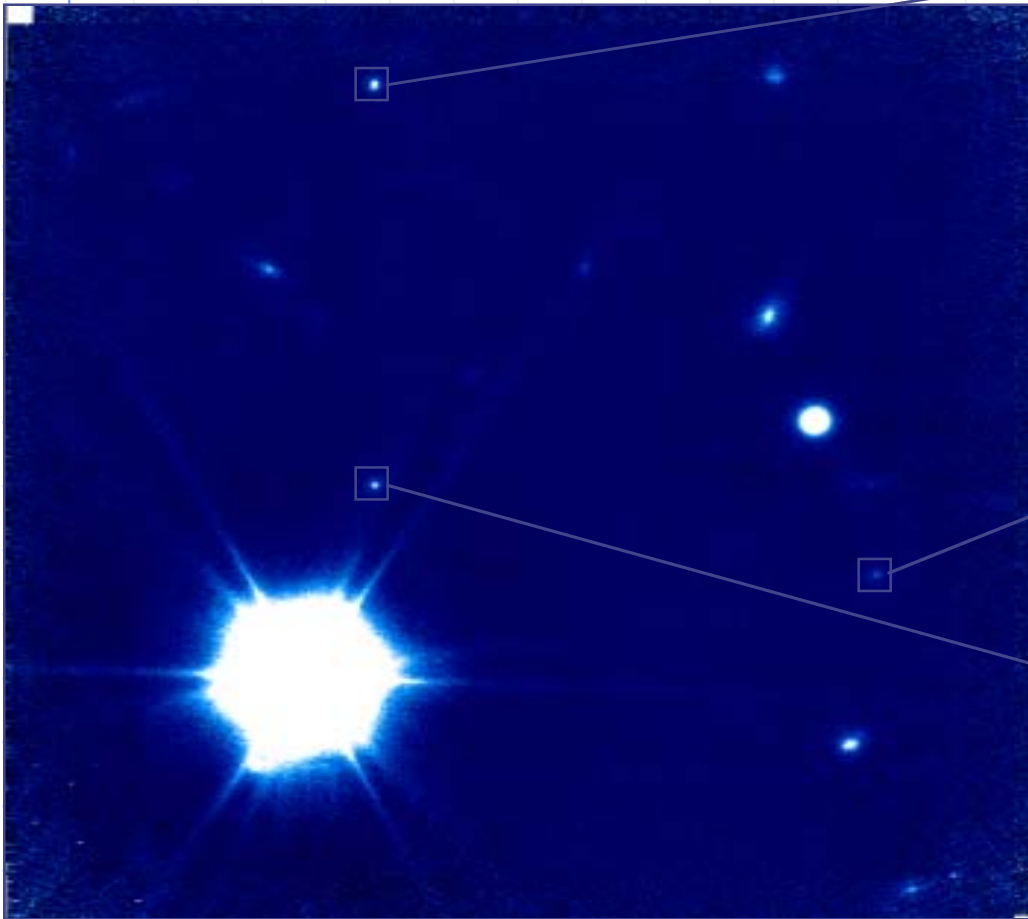


PSF Modelling

- ◆ The spatial and temporal variation of the PSF is a major challenge for all AO observations.
- ◆ We have multiple faint stars ($H \sim 20$ mag) that can provide PSF's as a function of position.
 - After last spring's retreat, we put considerable effort into eigenimage-decomposition (Szalay, Lupton and Lauer) also called Karhunen-Loeve transforms.

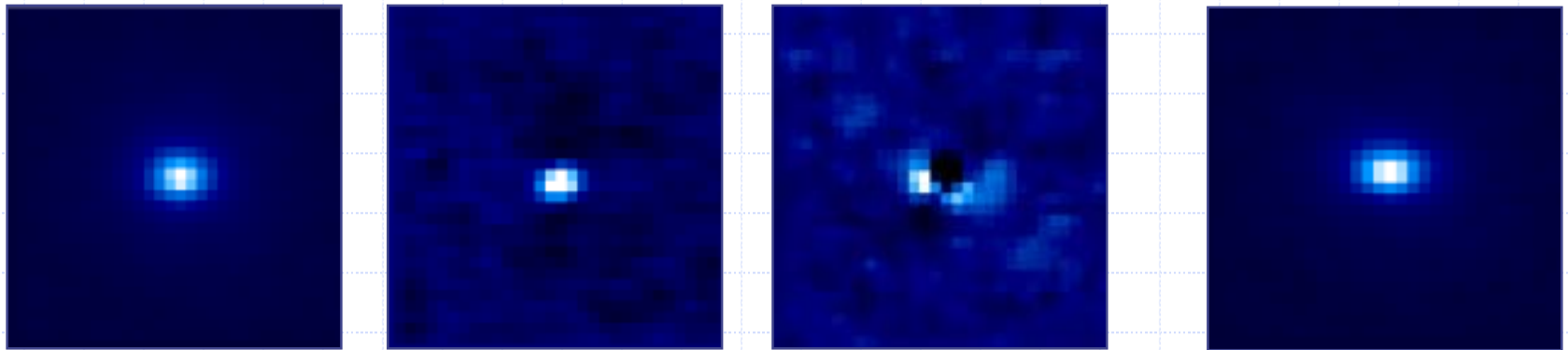
Eigenimage Decomposition

1. Extract and normalize



Eigenimage Decomposition

Rotate to common orientation and decompose.



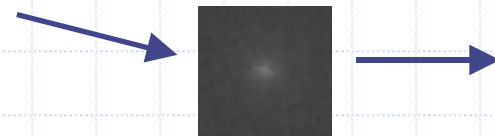
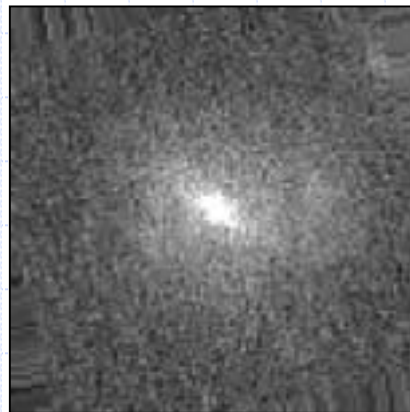
$$0.9 * \text{Eigen}[0] + 0.15 * \text{Eigen}[1] - 0.05 * \text{Eigen}[2] = \text{PSF1}$$

Determine coefficients for all PSF's in the field. Fit these coefficients as a function of guide star separation. For OSIRIS field, interpolate coefficients for its separation and produce broad band OSIRIS PSF.

Main complication has been optical aberration within science camera.
Does not follow same rotational symmetry.

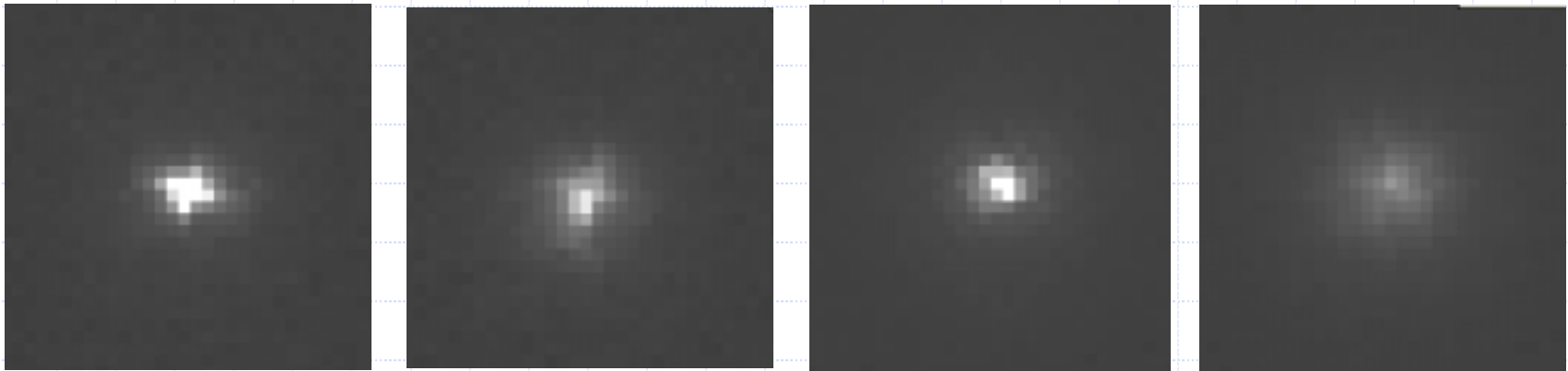
New Idea

- ◆ Use brute force – try many available PSF's – Measure quality of decomposition.

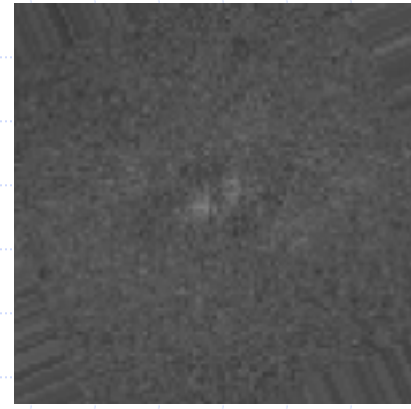
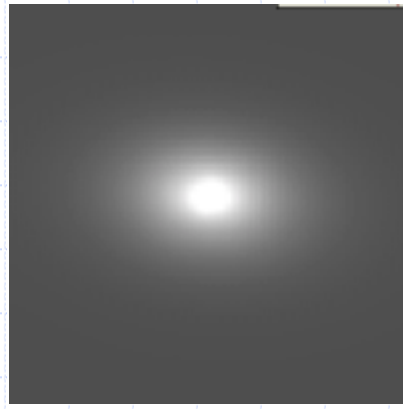
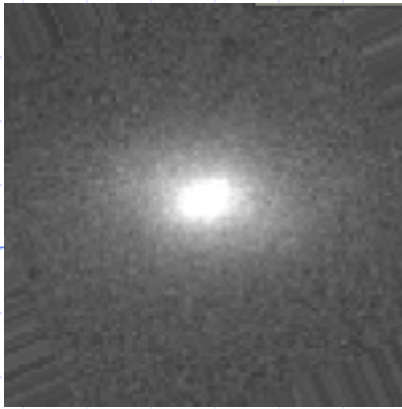


PSF's

- ◆ Produced 18 guide stars from 10 fields.
- ◆ Rotated all to one orientation compared to guidestar.



- ◆ Rotate galaxies to same orientation then fit.
- ◆ Model minimizes total chi-sq
- ◆ Best models selected for best core stdev.



18 Fits:

Inclination	Disk Bright	Disk Size	Bulge Bright	Bulge Size	Error	Core error
53.5003	190.104	11.1314	389.644	0.682095	1.05669	2.21857
54.1585	194.444	10.8209	355.013	0.913645	1.05980	2.06700
55.1474	181.531	11.4735	386.982	0.919668	1.05163	2.03059
55.1719	194.374	10.6031	390.040	1.00626	1.03190	1.66940
52.4252	190.250	11.0529	408.227	0.668925	1.05066	2.13471
52.1665	193.573	10.9710	384.921	0.873845	1.03317	2.02399
54.6499	190.678	10.9095	392.093	1.01154	1.04773	1.93616
57.1725	211.569	10.0332	384.932	0.955084	1.09438	2.31938
56.0203	187.325	10.9798	396.092	0.967714	1.05370	2.13525
55.2594	208.981	10.3518	391.068	0.913072	1.05363	2.16584
53.4764	173.450	11.7516	369.644	1.38914	1.03887	1.73606
60.2977	213.078	9.69238	391.449	1.24506	1.07359	1.95251
54.3004	200.416	10.2924	390.672	1.06921	1.02322	1.75565
54.3028	162.906	11.9061	389.731	1.30411	1.03077	1.97852
61.5792	247.761	8.99976	368.589	1.25295	1.12167	2.14399
61.2849	210.188	9.89913	404.224	1.11851	1.05358	1.96837
55.6387	193.888	10.2703	401.185	1.37815	1.04137	1.83743
69.2949	188.926	9.35825	424.910	1.83028	1.11011	1.90303

Best 5 Fits:

57.5765	190.211	10.4551	395.290	1.33461	1.04909	1.78031	Mean stdev
6.60308	10.2174	0.861170	20.1164	0.327416	0.0348284	0.0910909	

Conclusions

- ◆ True modeling of PSF in NIRC2 fields with only 2-3 stars is problematic due to optical distortion.
- ◆ Brute Force method appears promising.
- ◆ Concern: PSF core shape partially degenerate with Bulge Sersic Index.
- ◆ Need to compare results from multiple nights on same galaxy.
- ◆ Jason Melbourne at UCSC is going to simulate galaxies and test robustness of this technique in measuring parameters and identifying PSF.
- ◆ Routine is time consuming, so any routines to predict PSF range or eliminate candidate PSFs would be useful.