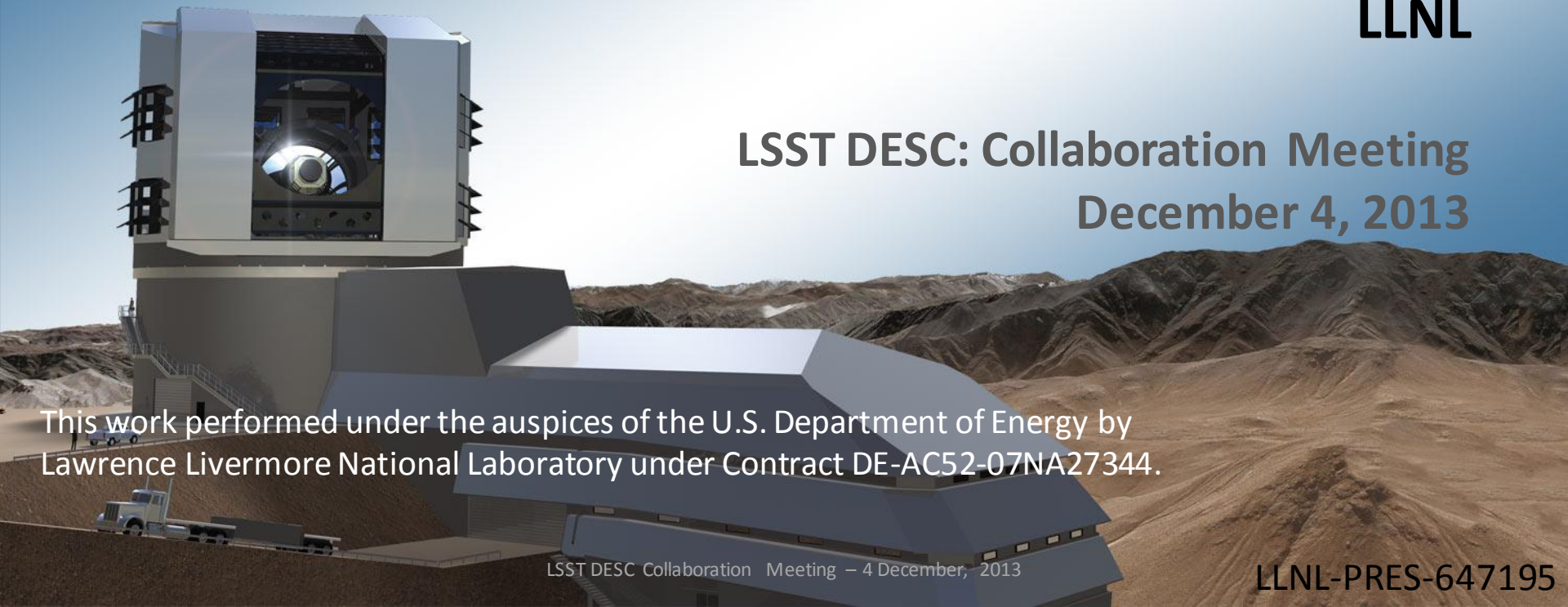
$N_{effective}$ & Bias from Comparison of Space & Ground

Will Dawson
LLNL

LSST DESC: Collaboration Meeting
December 4, 2013



This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

LLNL-PRES-647195

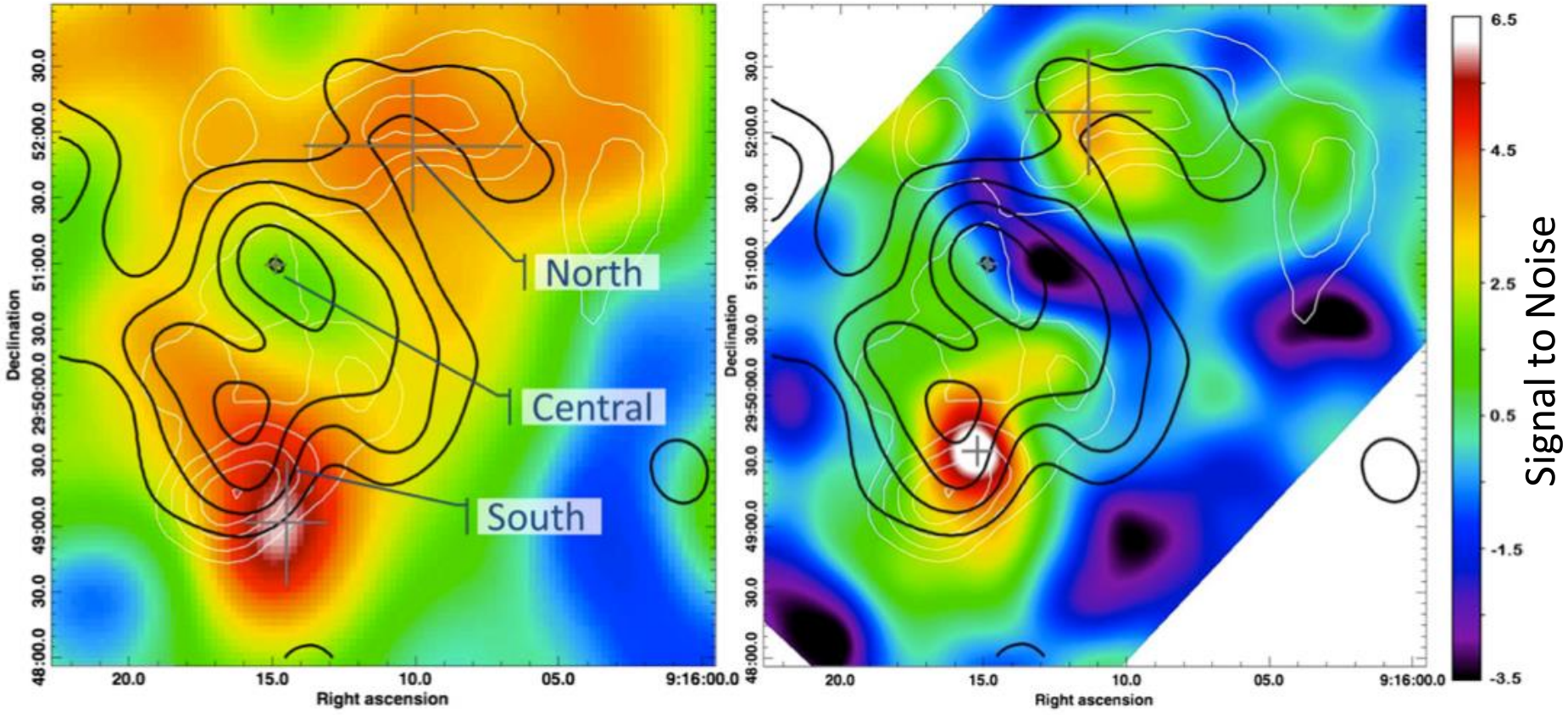
DLSCL J0916.2+2951 a.k.a. Musket Ball Cluster

Dawson et al. 2012

Musket Ball
Weak Lensing S/N Mass Maps

Subaru

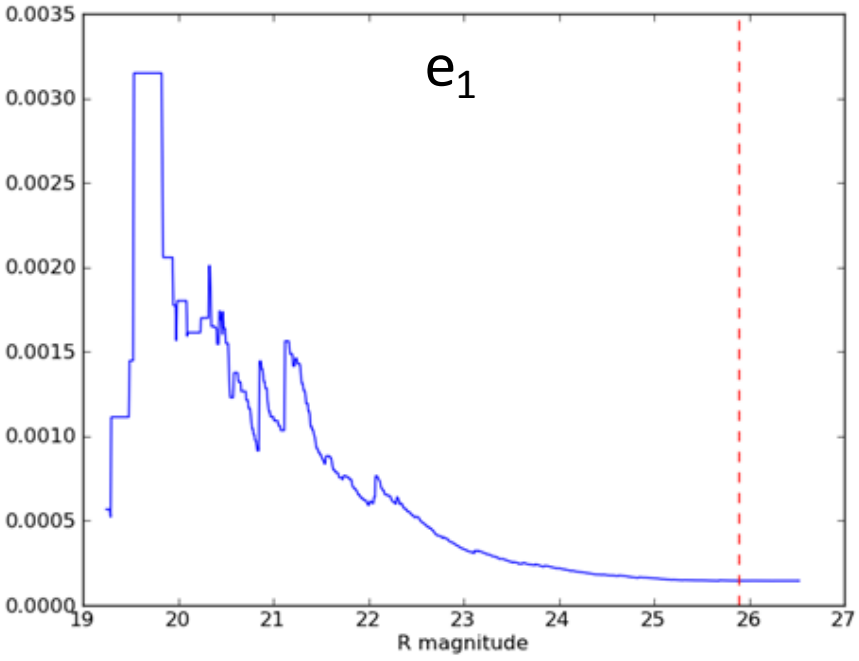
HST

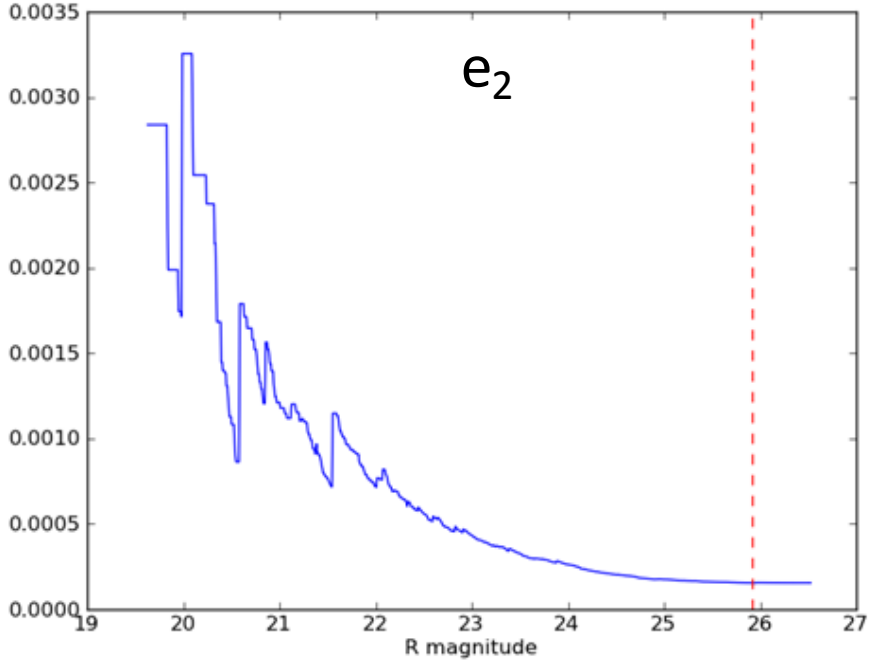


Dawson et al. 2012

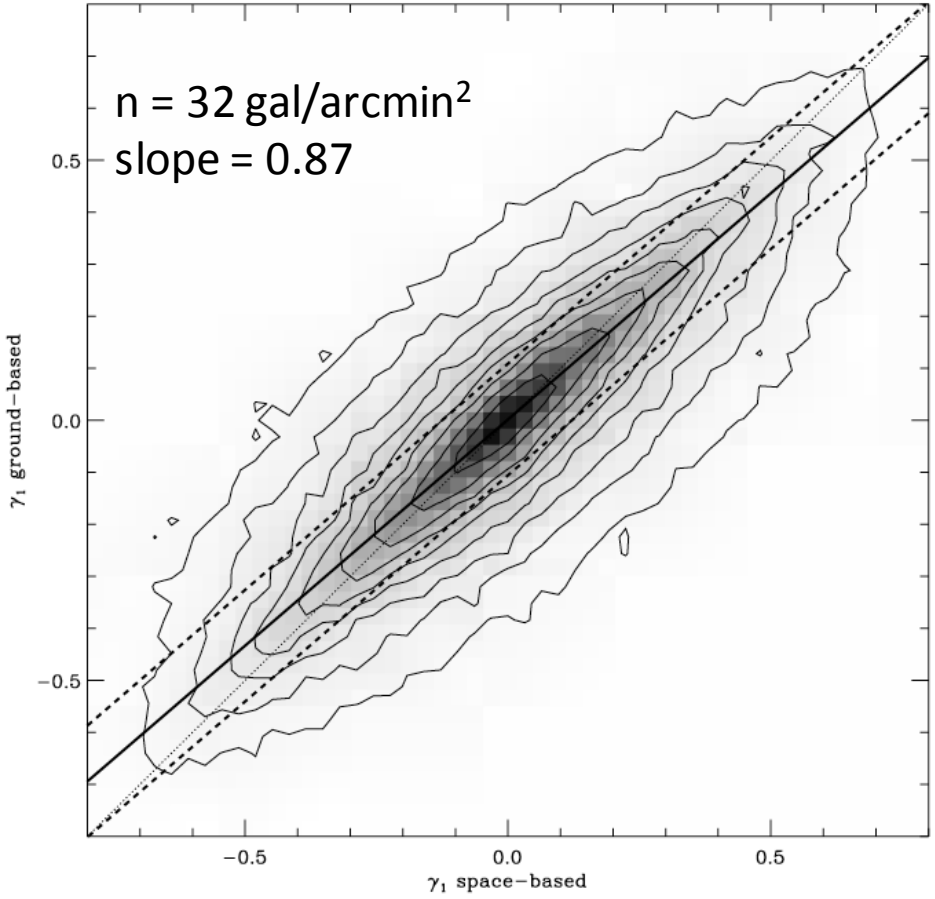
Gains in going faint

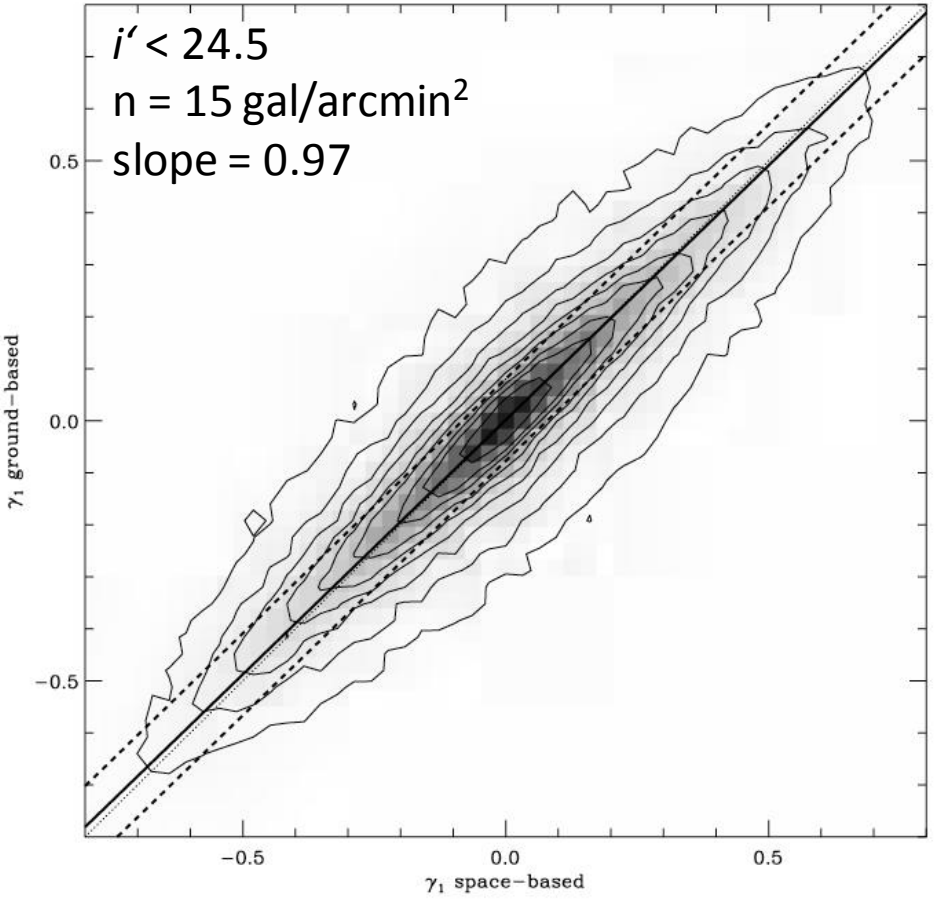
$$\frac{\sigma(e_{Subaru} - e_{HST})}{\sqrt{N}}$$





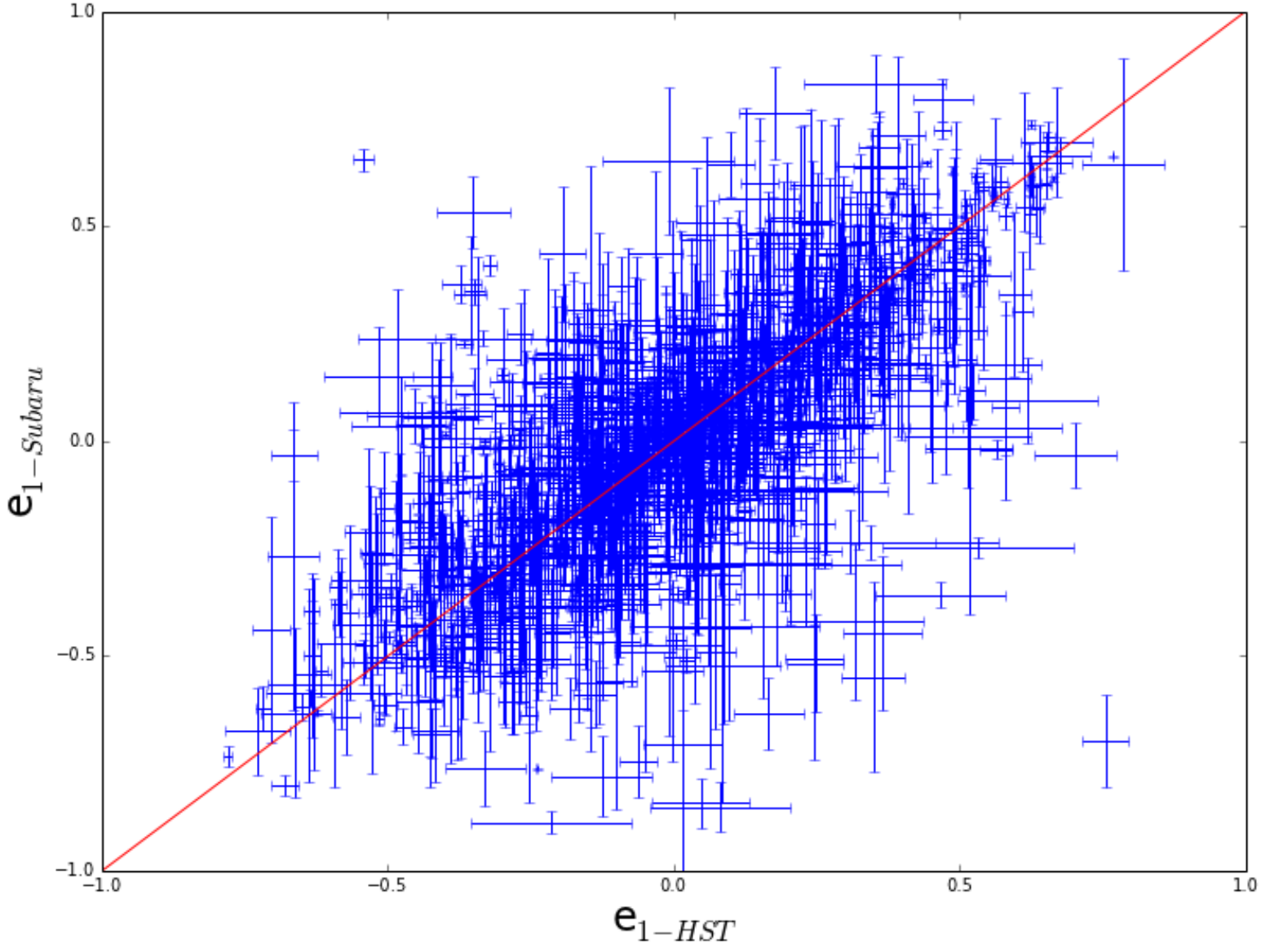
Estimating multiplicative bias with ground and space observations





Kasliwal et al. 2008

HST-Subaru ellipticity comparison

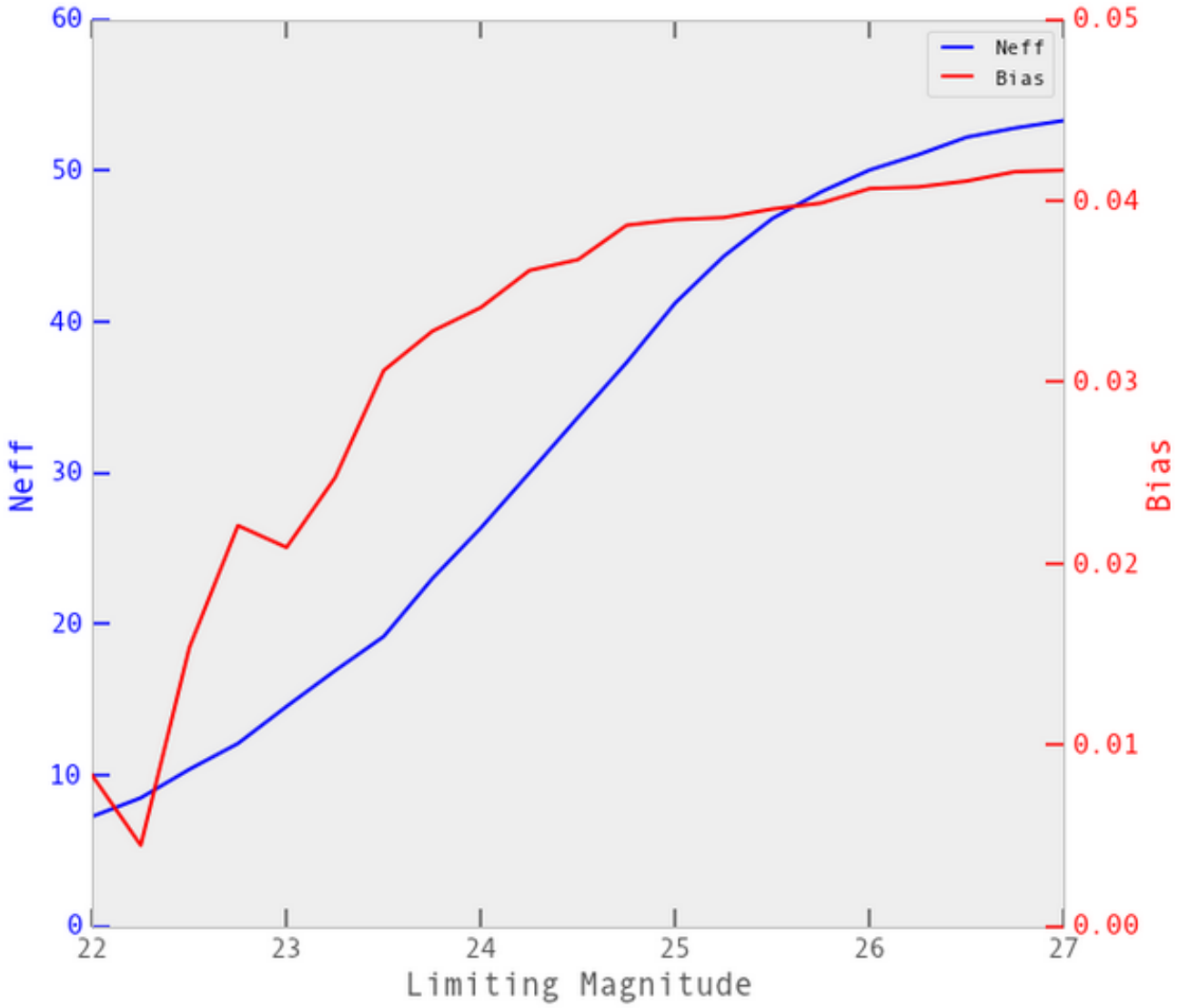


Proposed Study

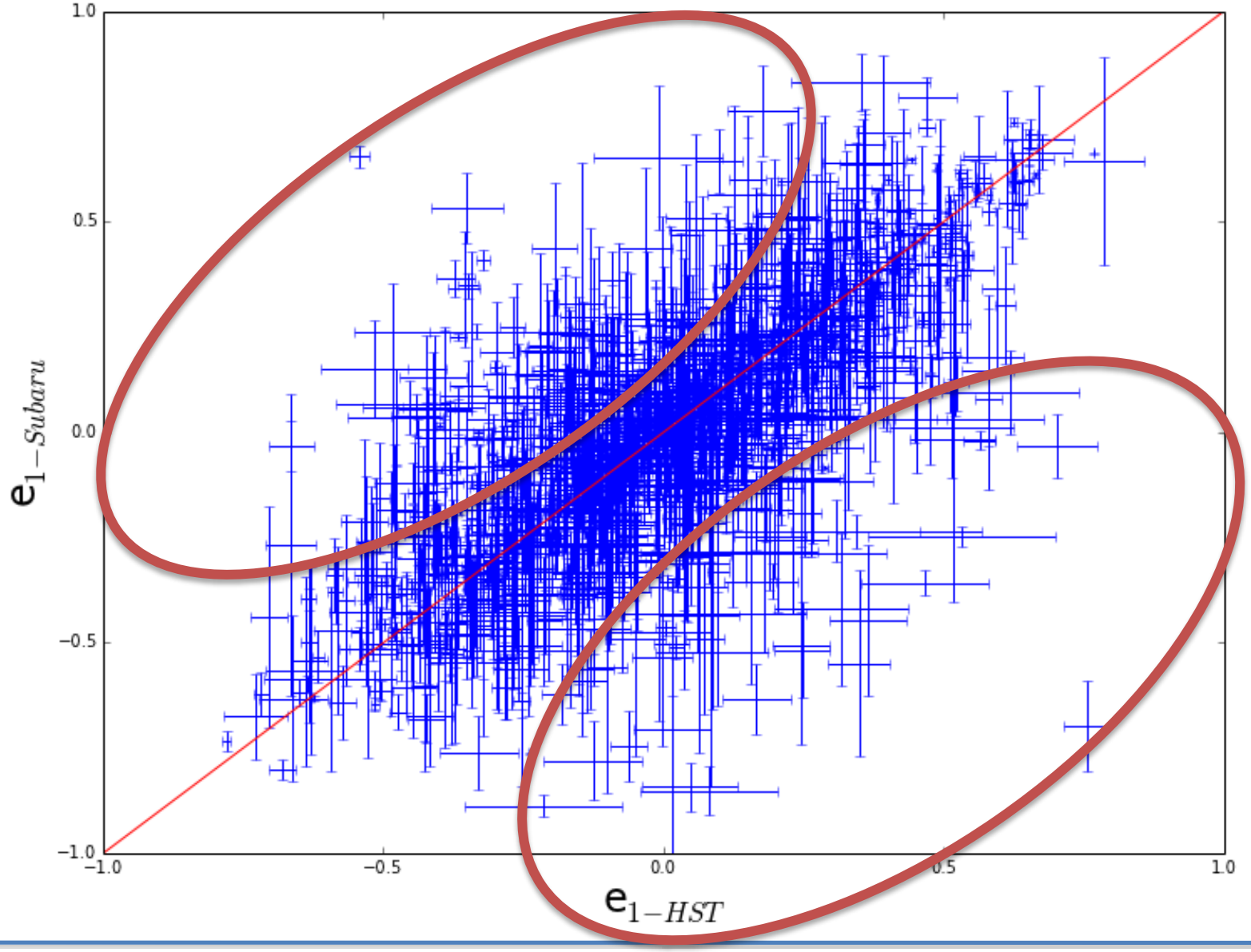
-1

In some ways similar to Kasliwal et al. 2008.

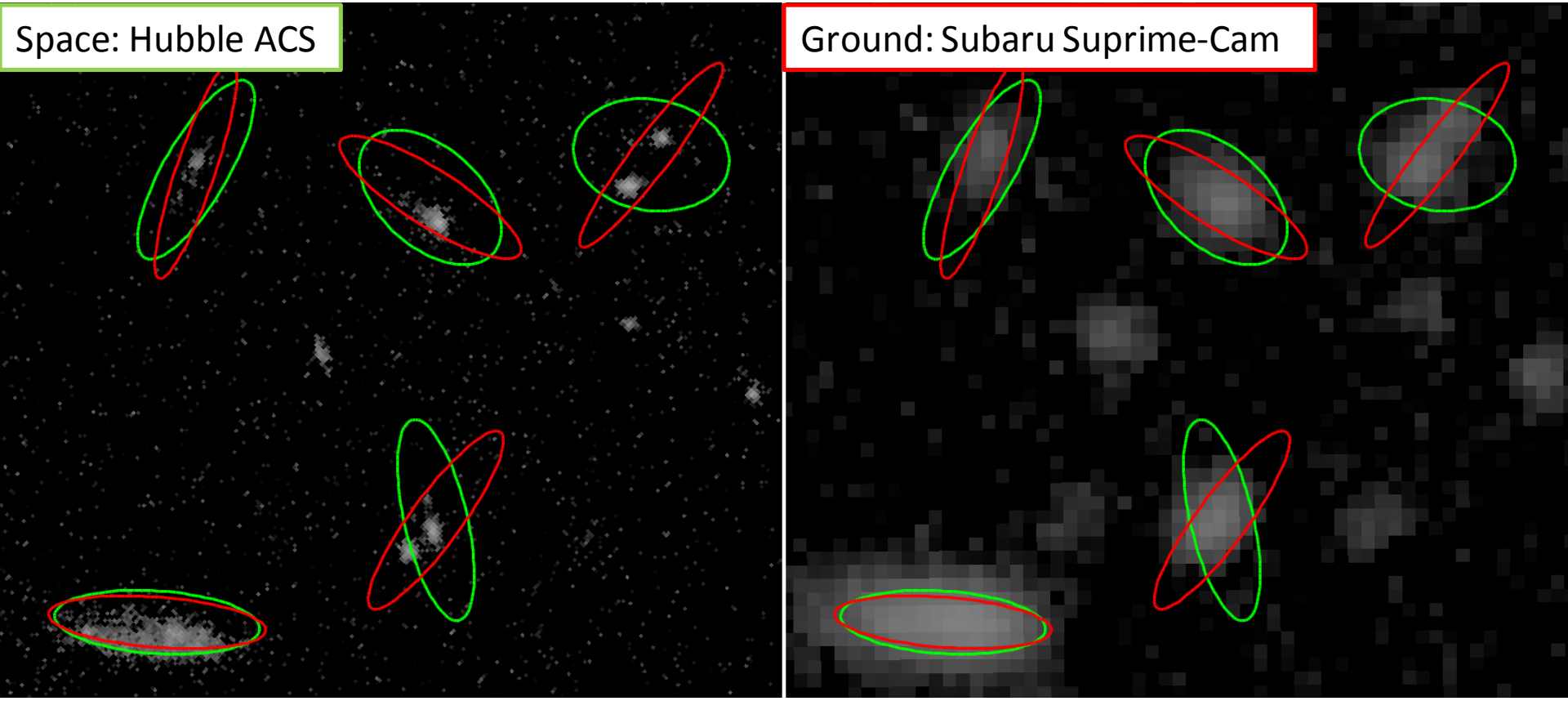
Full Sample Raw Results



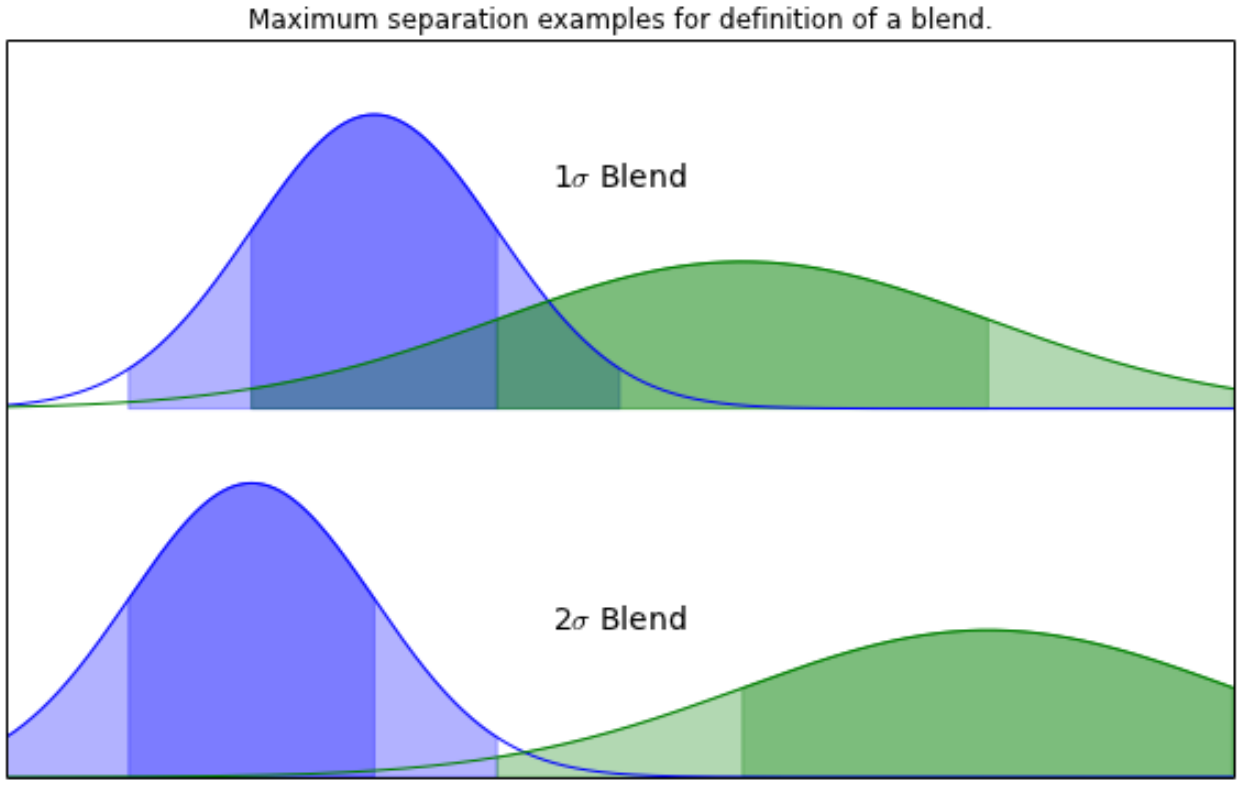
What is causing these outliers?



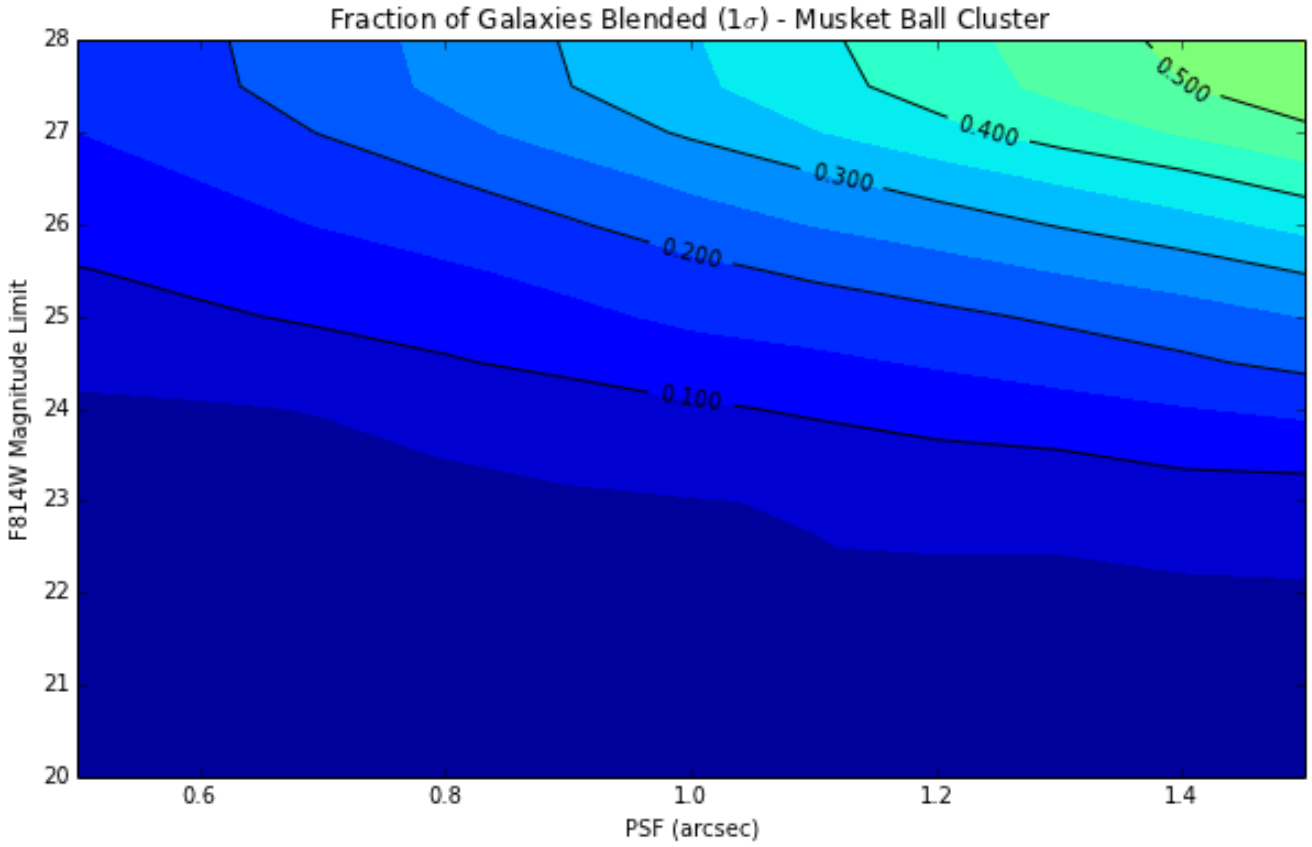
Examples of outliers



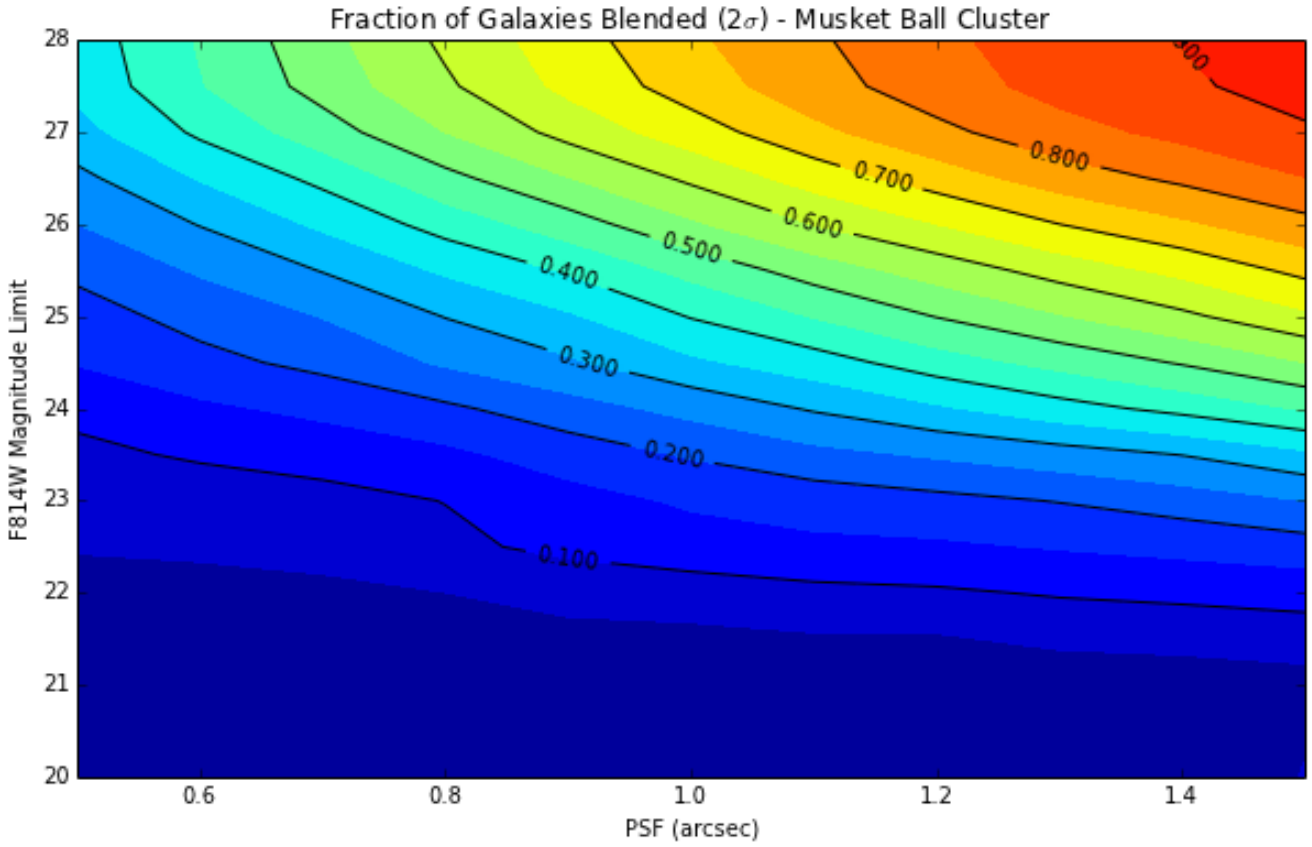
Two definitions of blends considered in this analysis



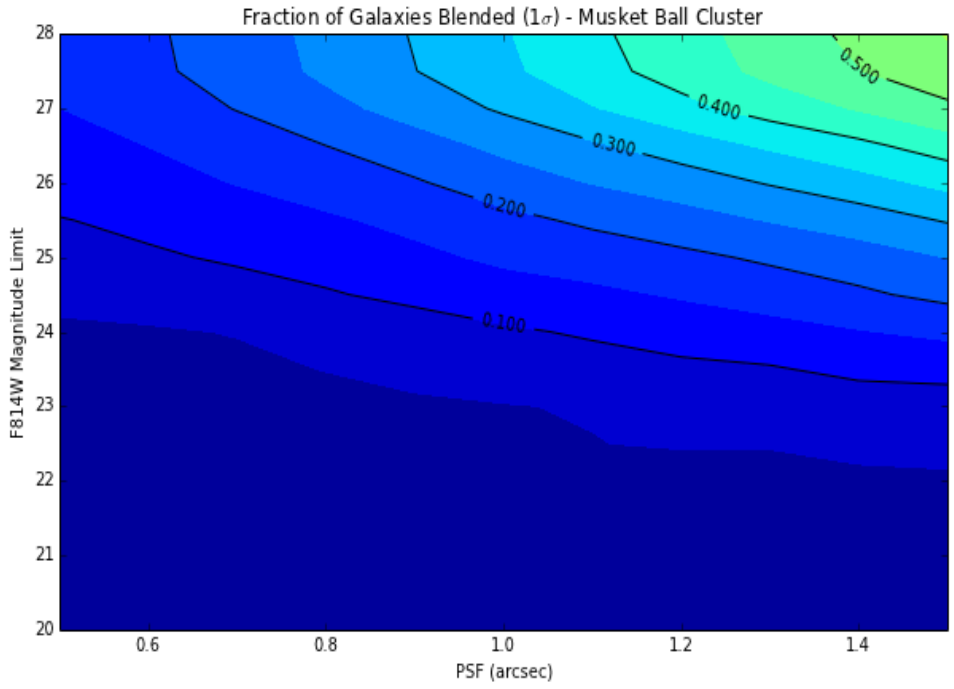
1σ blends
for the Musket Ball Cluster field

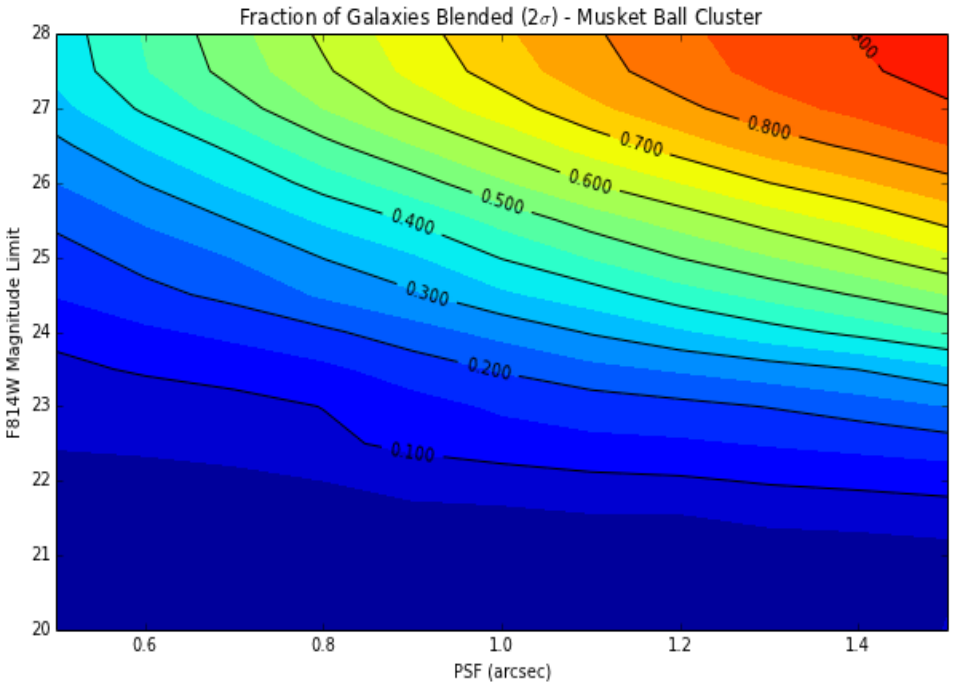


2σ blends
for the Musket Ball Cluster field

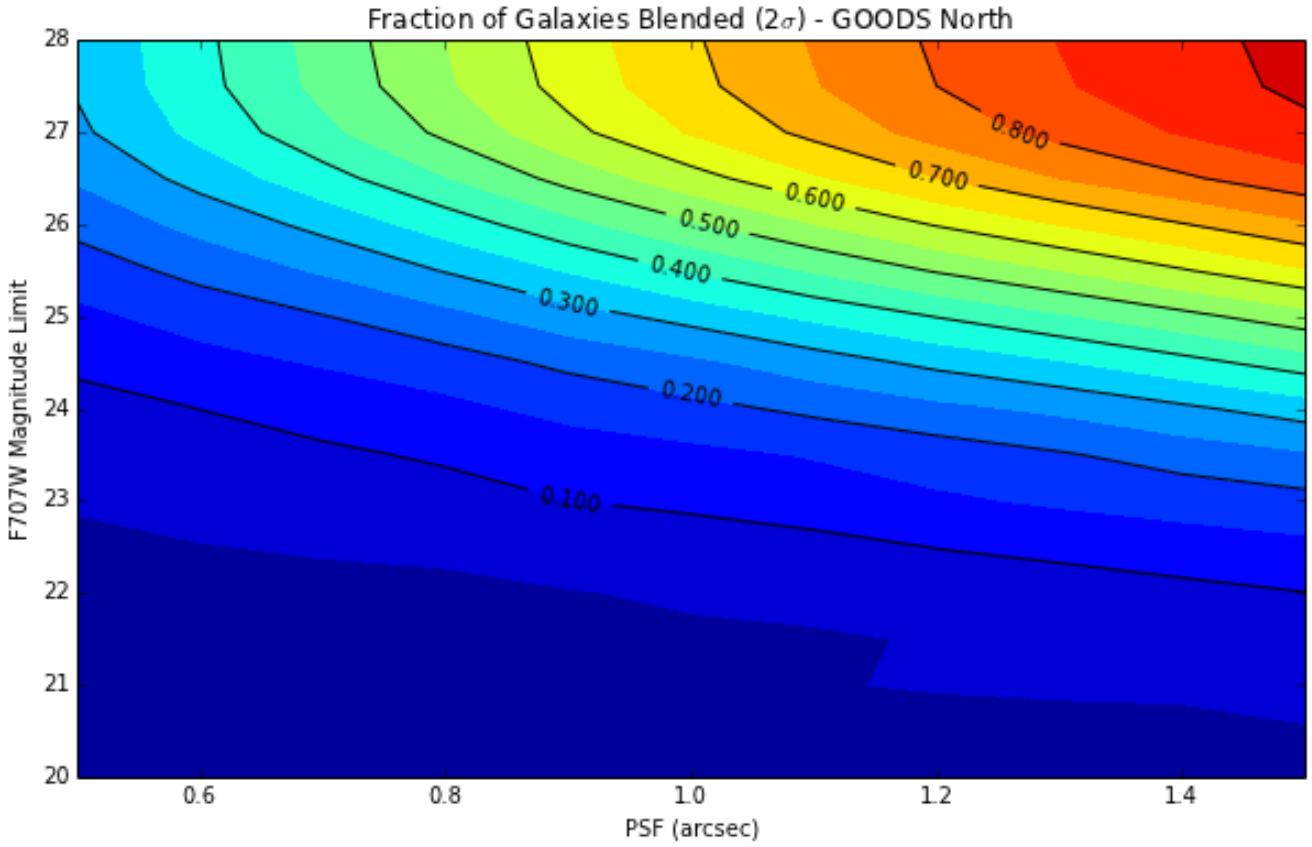


Comparing 1σ and 2σ blends for the Musket Ball Cluster field

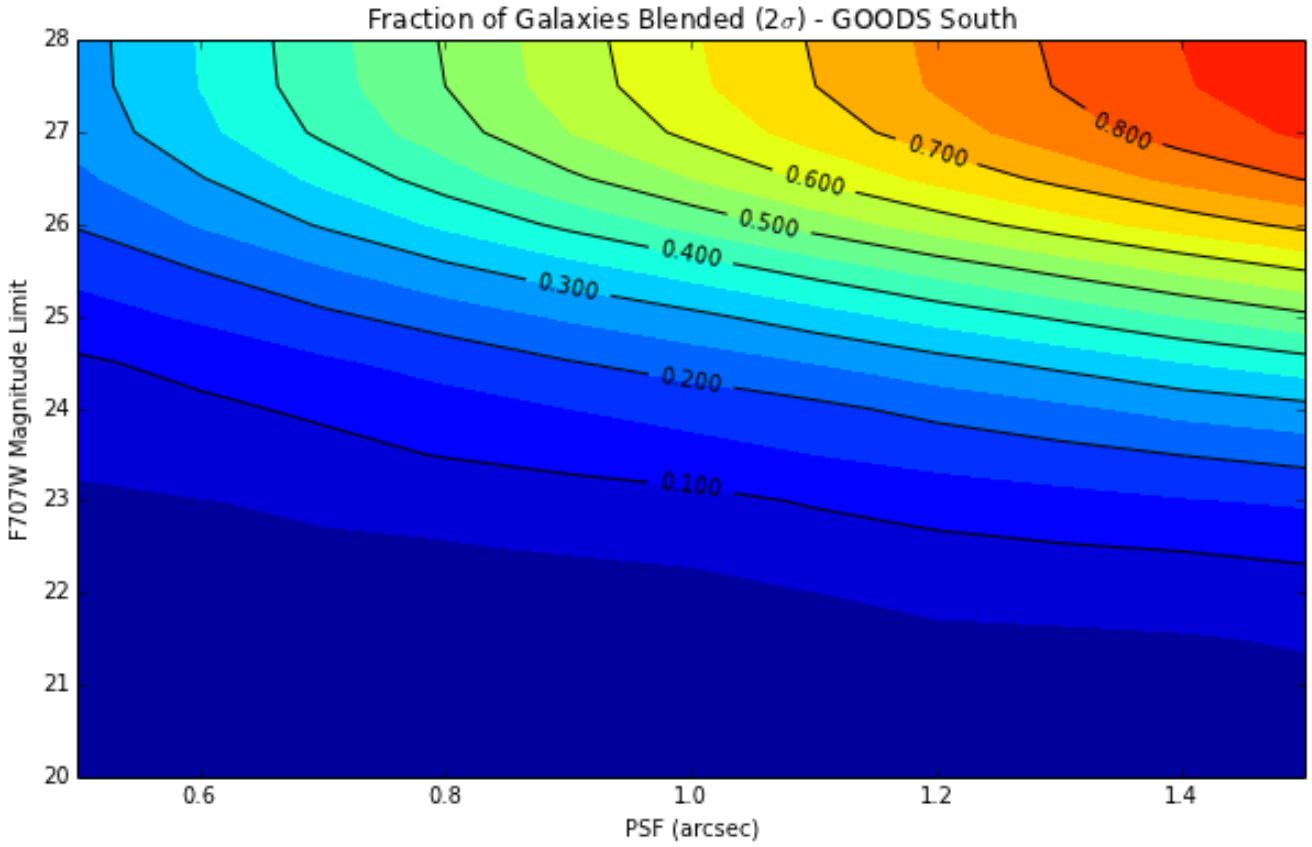




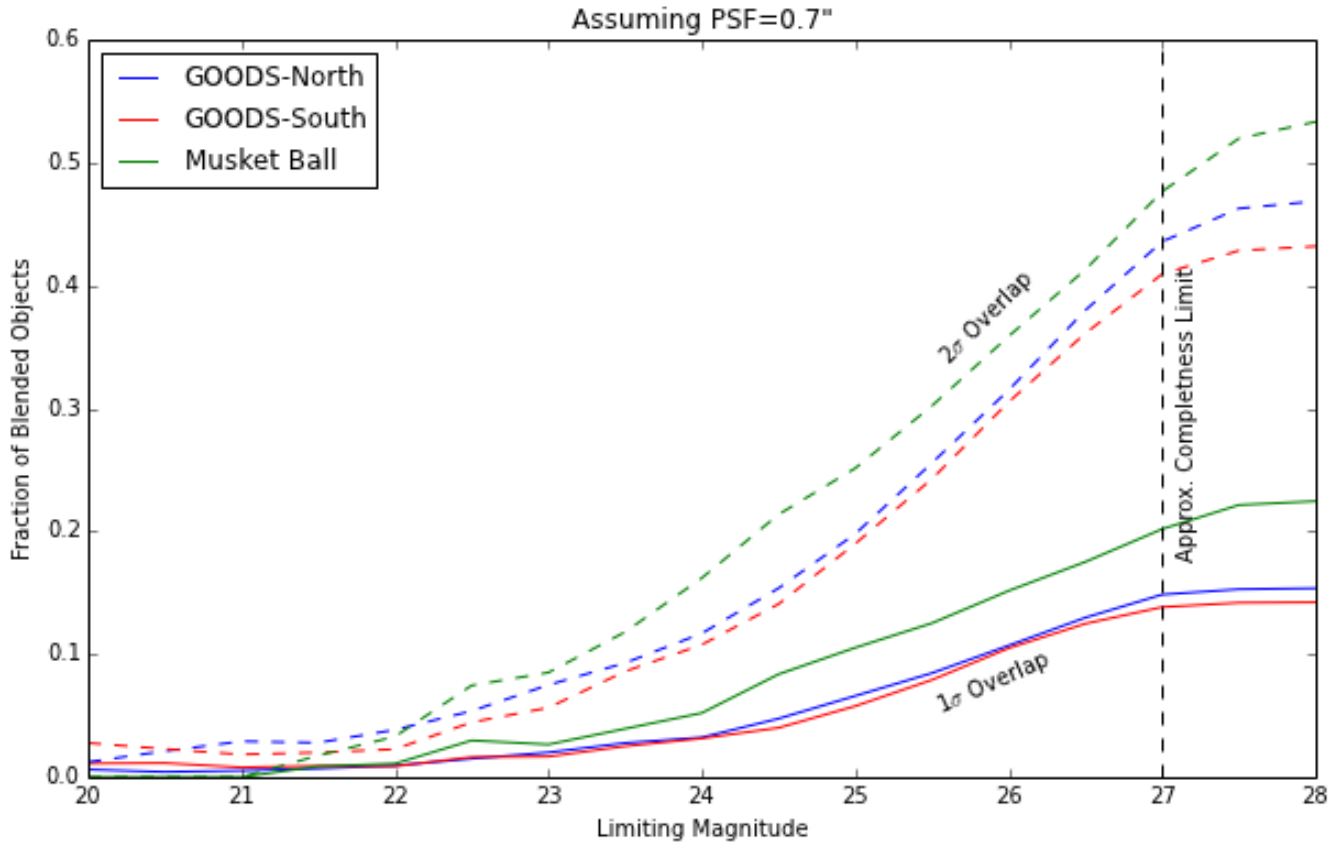
2σ blends
for the GOODS-North field



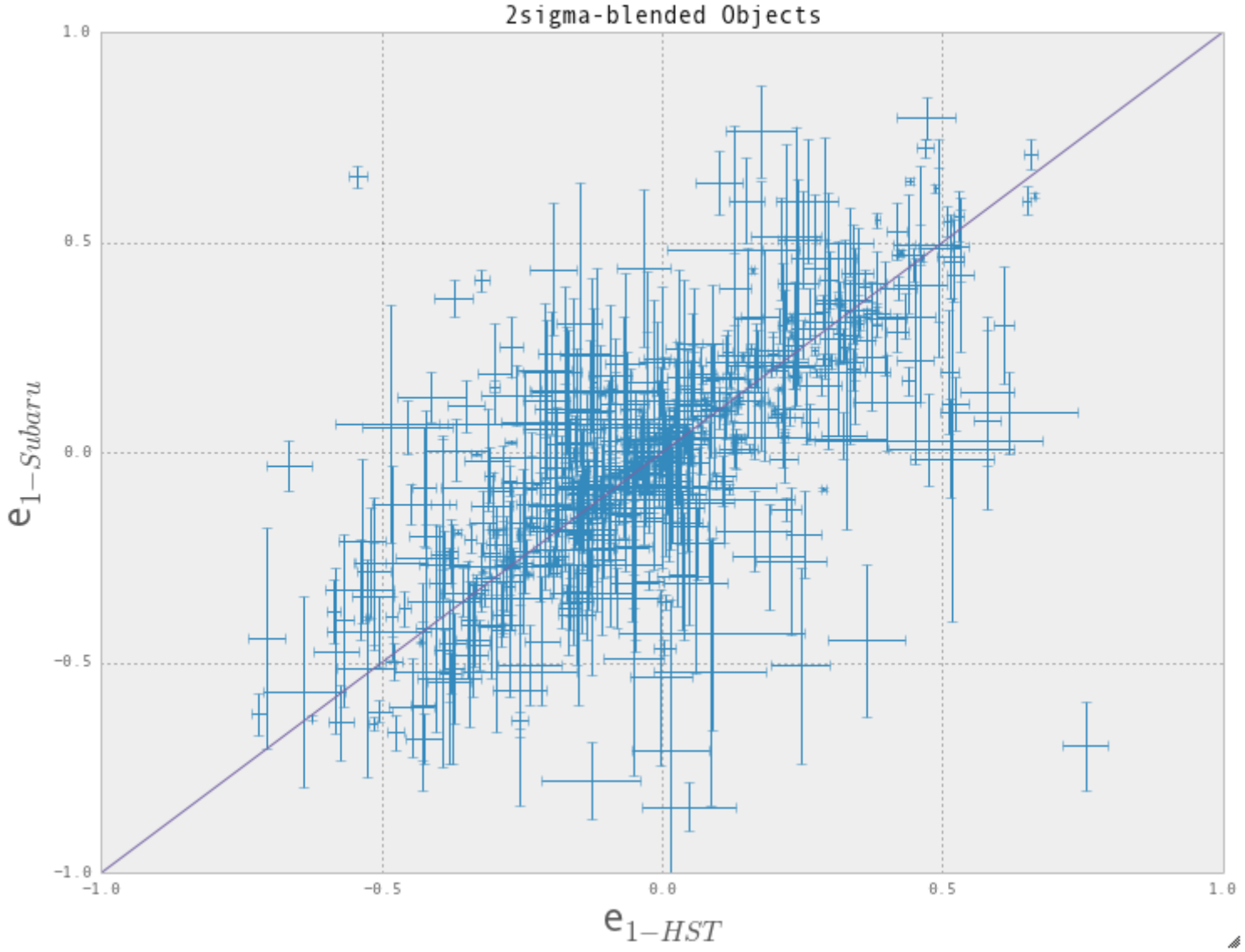
2σ blends for the GOODS-South field



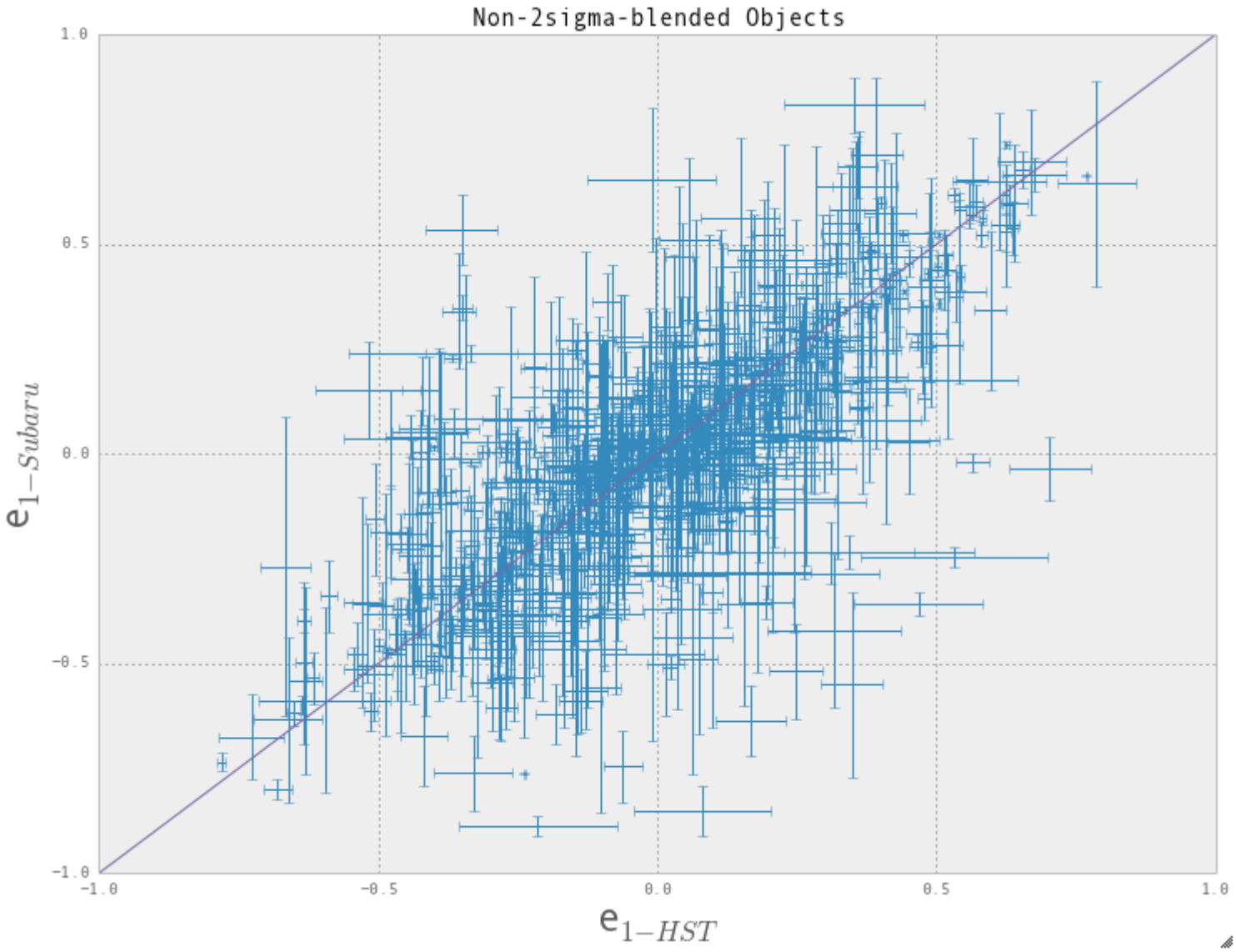
Comparing blend fraction for typical LSST seeing (0.7”)



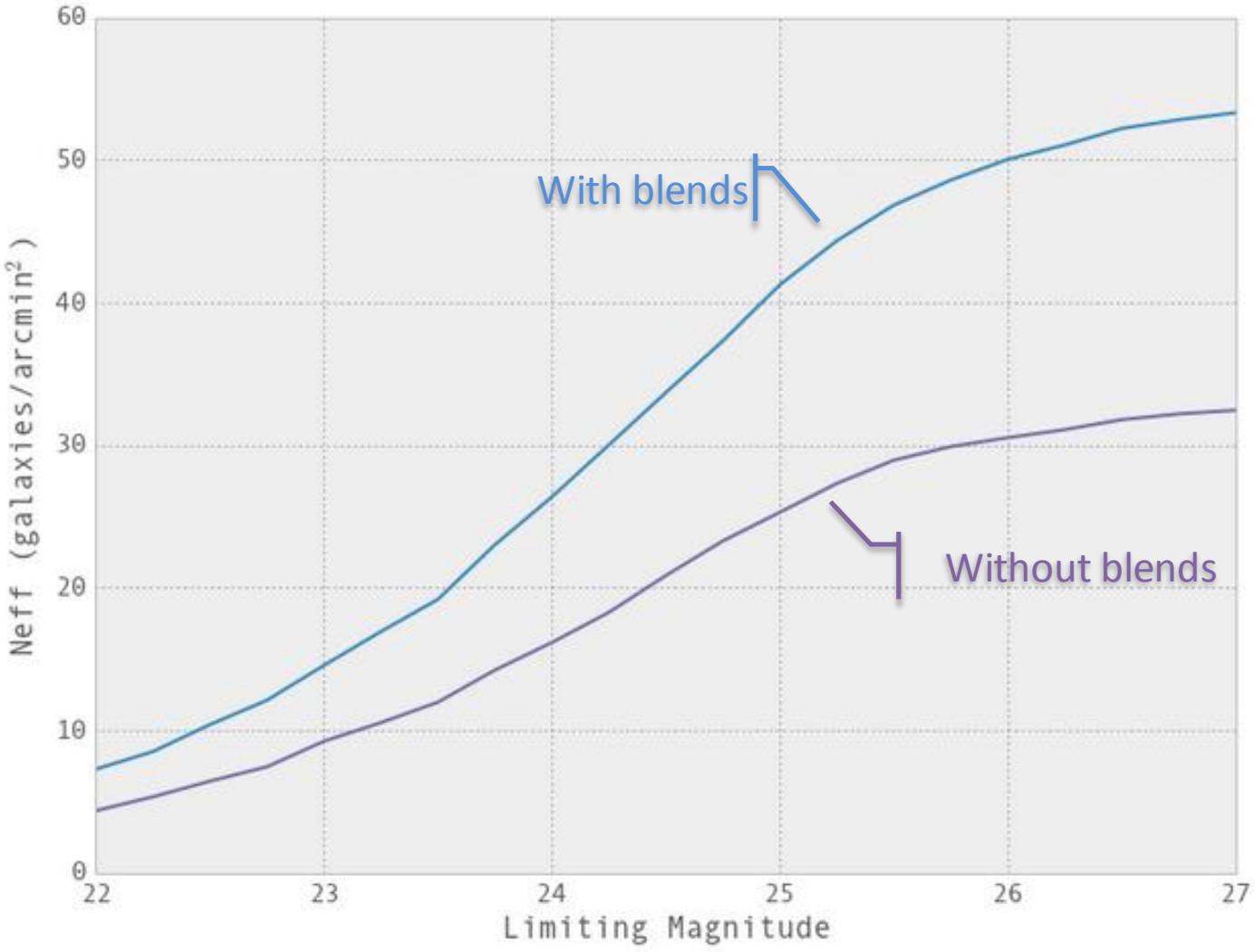
Distribution of the Blended objects



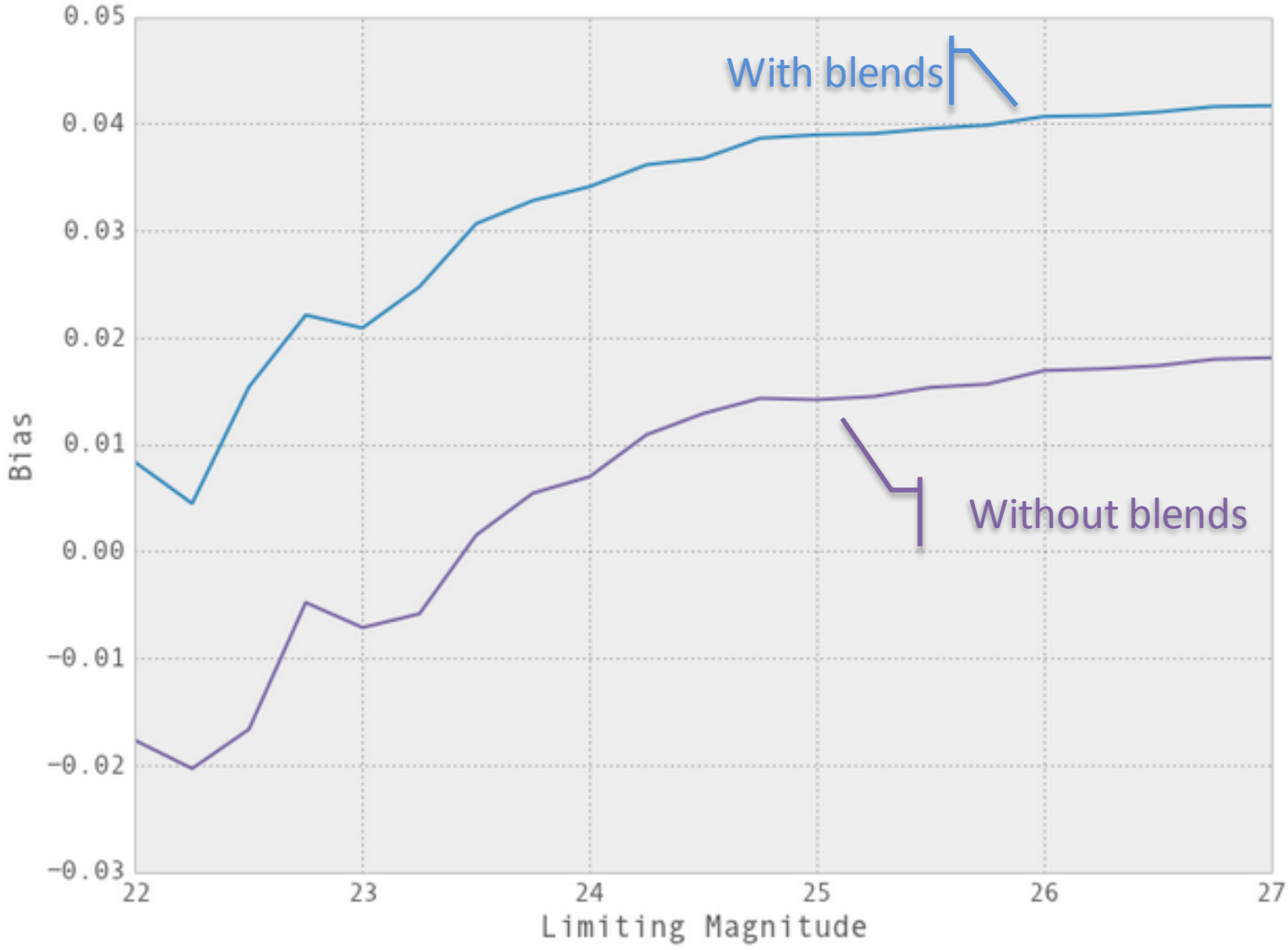
Remaining “Non-blended” Objects



Neff decreases by < ½ despite throwing out ½ galaxies

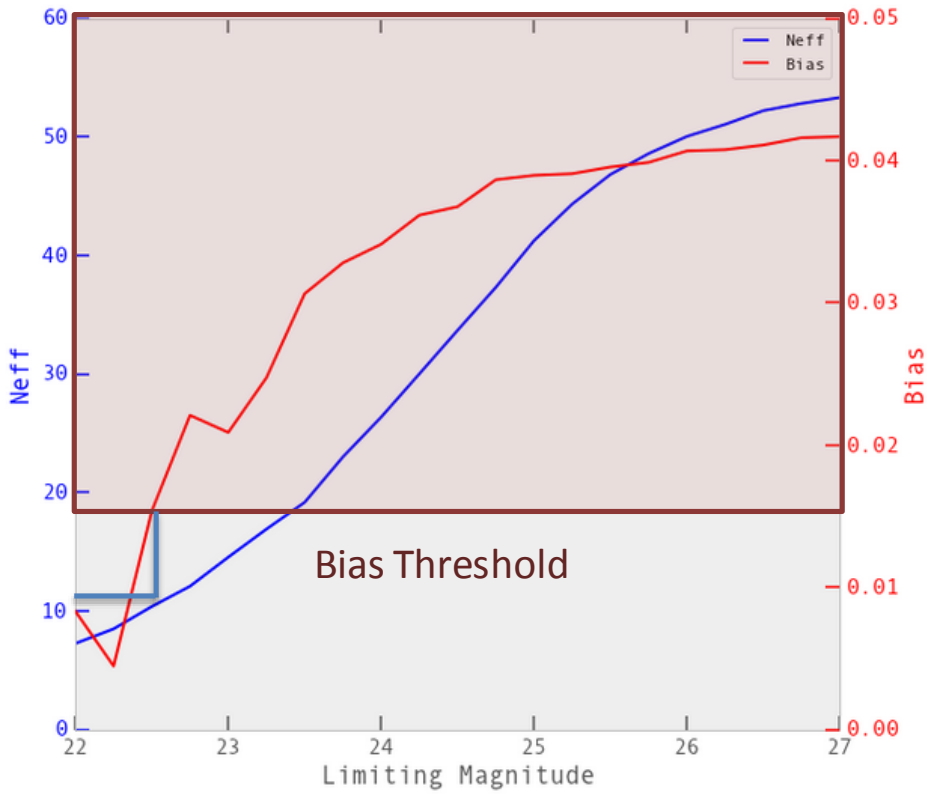


Bias is improved by a factor of ~3

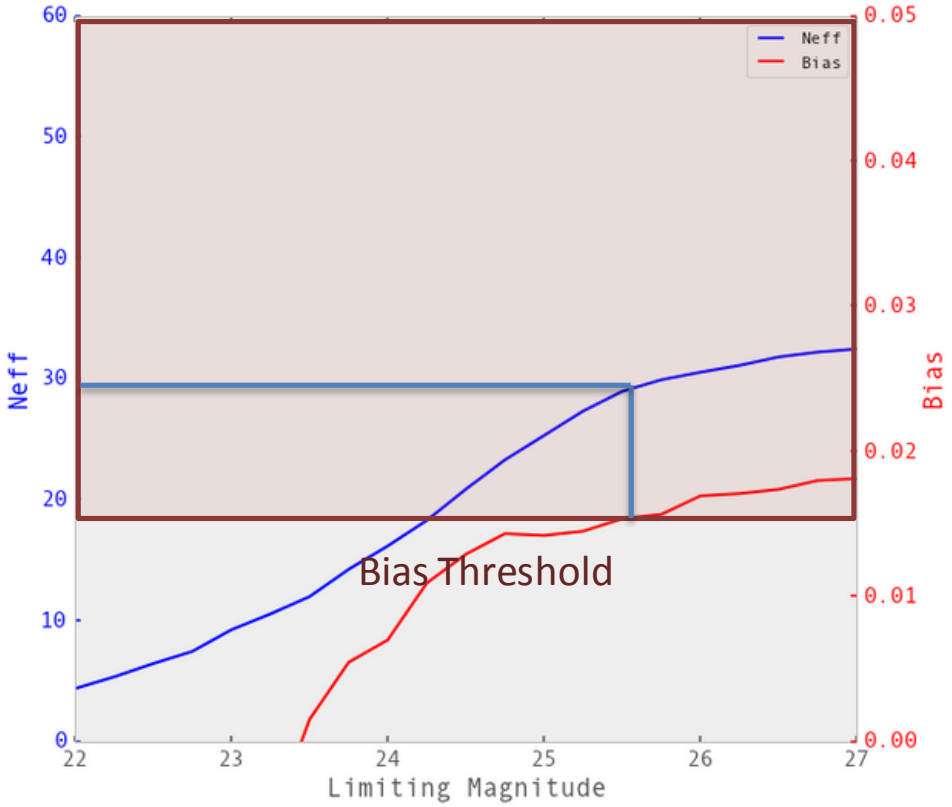


Despite throwing away ½ galaxies due to blending, $N_{effective}$ increases by a factor of 3!

Full Sample

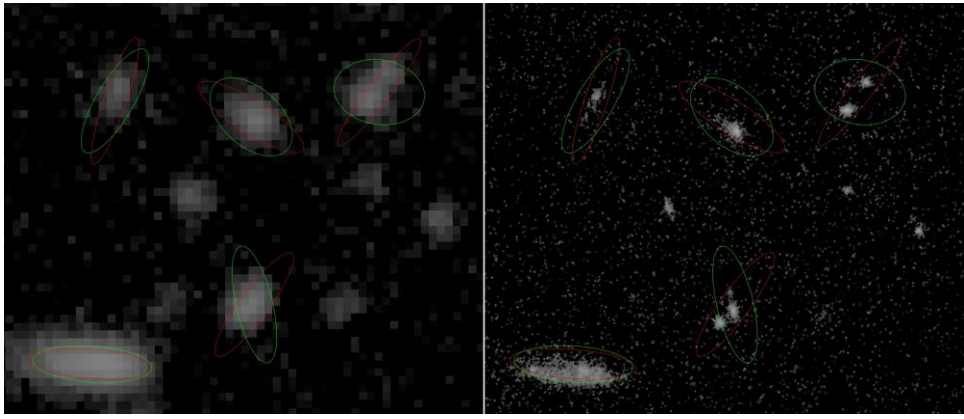


Clean Sample



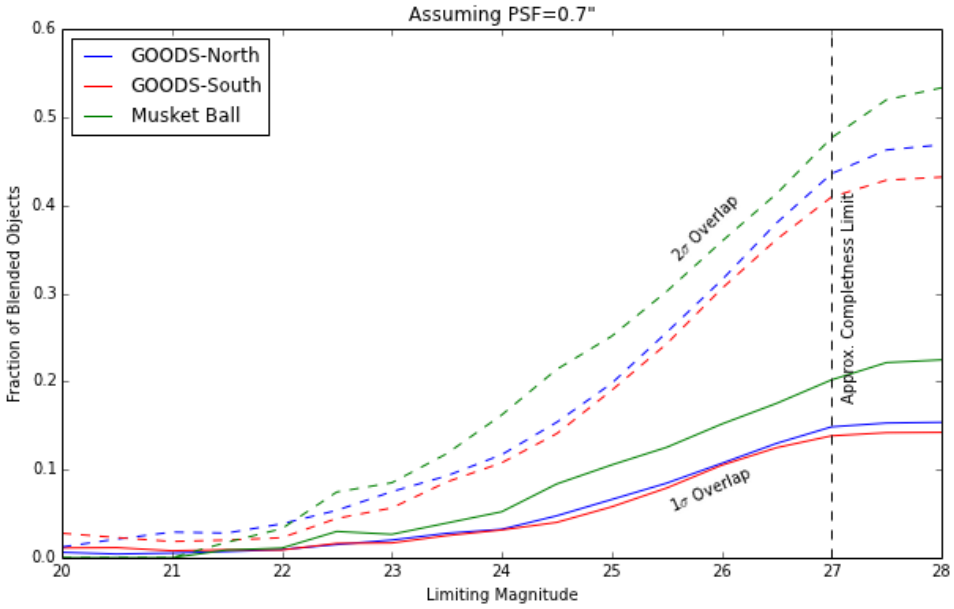
Summary

- Blending is a major source of galaxy shape measurement bias



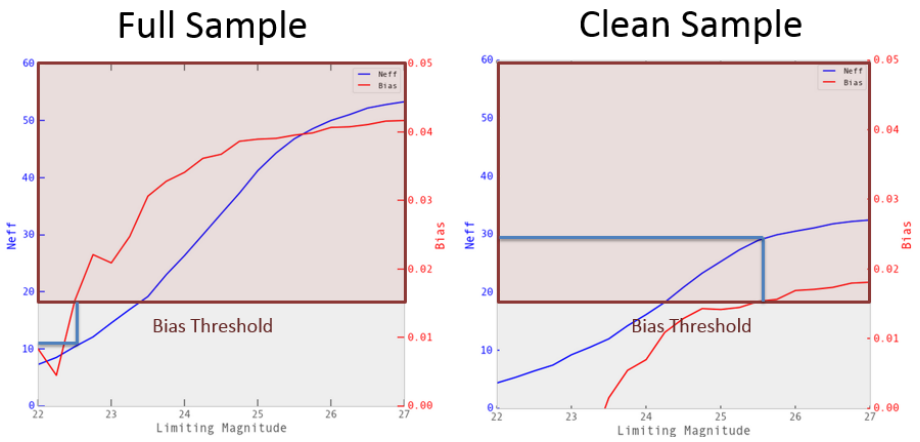
Summary

- Blending is a major source of galaxy shape measurement bias
- Approximately ½ of ground galaxy sample is blended



Summary

- Blending is a major source of galaxy shape measurement bias
- Approximately ½ of ground galaxy sample is blended
- Throwing out this ½ of the sample actually increases the effective number of galaxies by a factor of ~3!

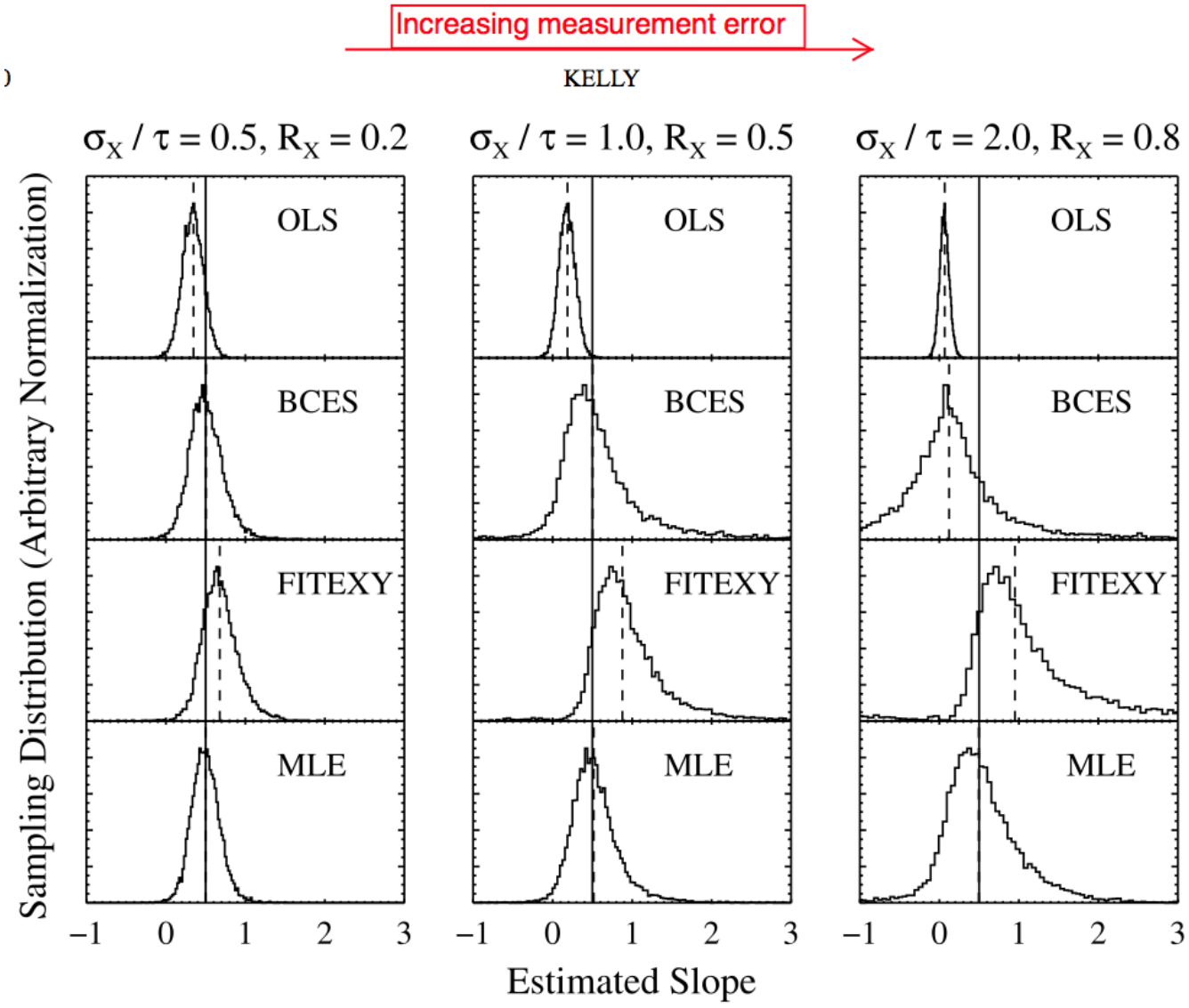


Caution!

Caution

- Bias on the bias
- Ability to flag blends
  - Consider good seeing ground images
- Cross-matching
- Should we believe the results
  - Do we really expect blending to cause a multiplicative bias

Regression Bias on the Slope



Kelly 2007

2013 IEEE INTERNATIONAL WORKSHOP ON MACHINE LEARNING FOR SIGNAL PROCESSING, SEPT. 22–25, 2013, SOUTHAMPTON, UK

BOUNDED GAUSSIAN PROCESS REGRESSION

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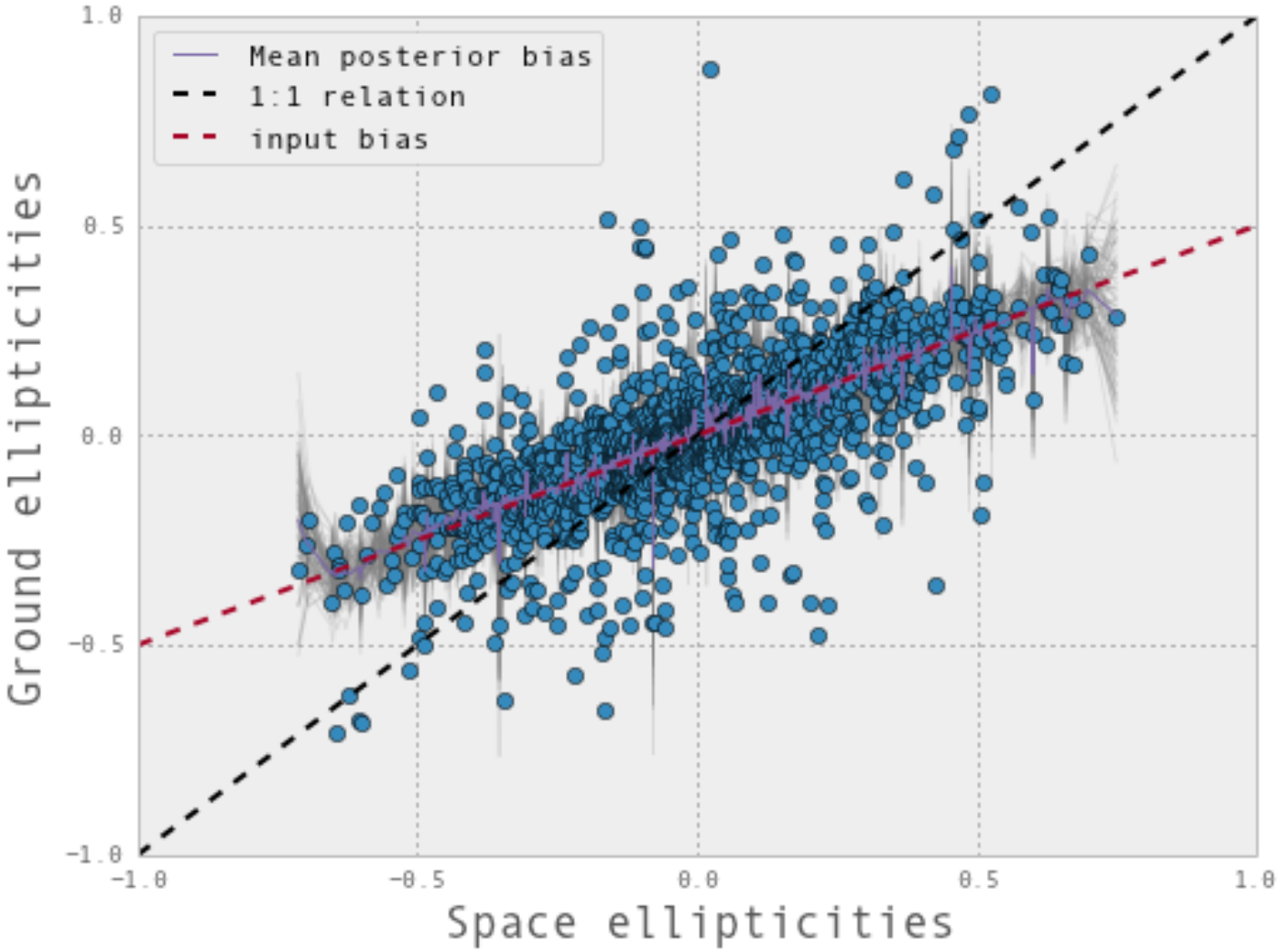
Gaussian Process Modeling



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Probabilistic Cross-matching

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ADVANCES IN SPACE RESEARCH (a COSPAR publication)

www.elsevier.com/locate/asr

Bayesian linking of geosynchronous orbital debris tracks as seen by the Large Synoptic Survey Telescope ☆,☆☆

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Available online 18 November 2011

Caution

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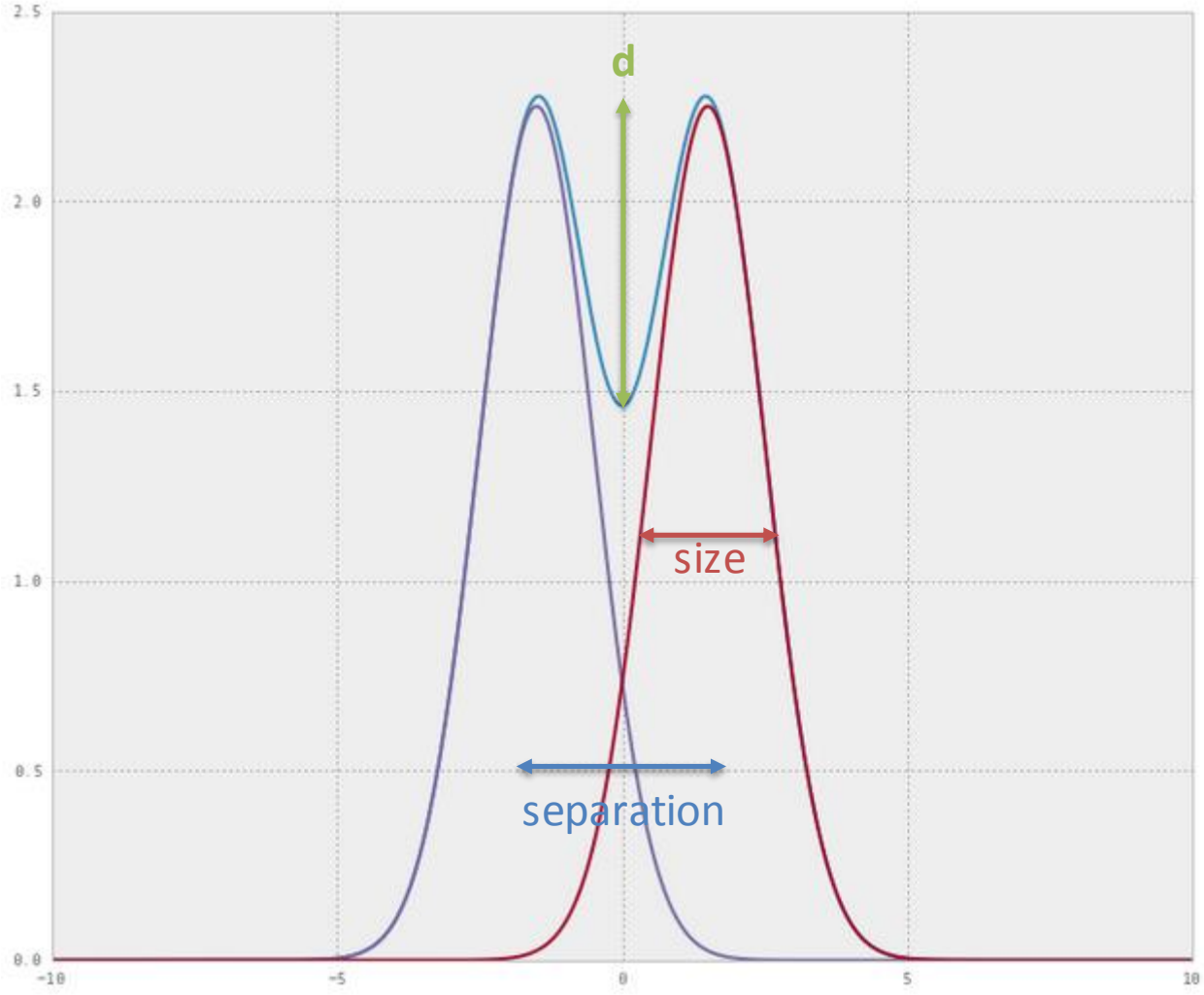
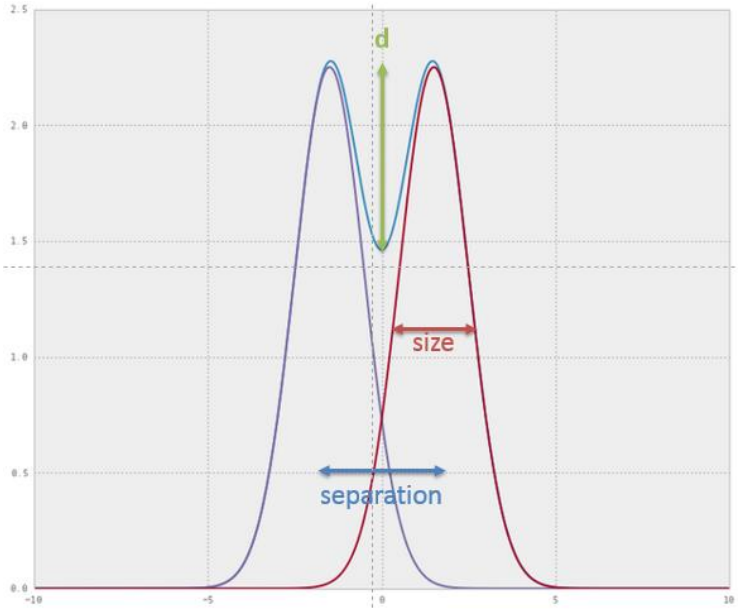
Neff of blends


d
size
separation
2.5
2.0
1.5
1.0
0.5
0.0
-10
-5
0
5
10

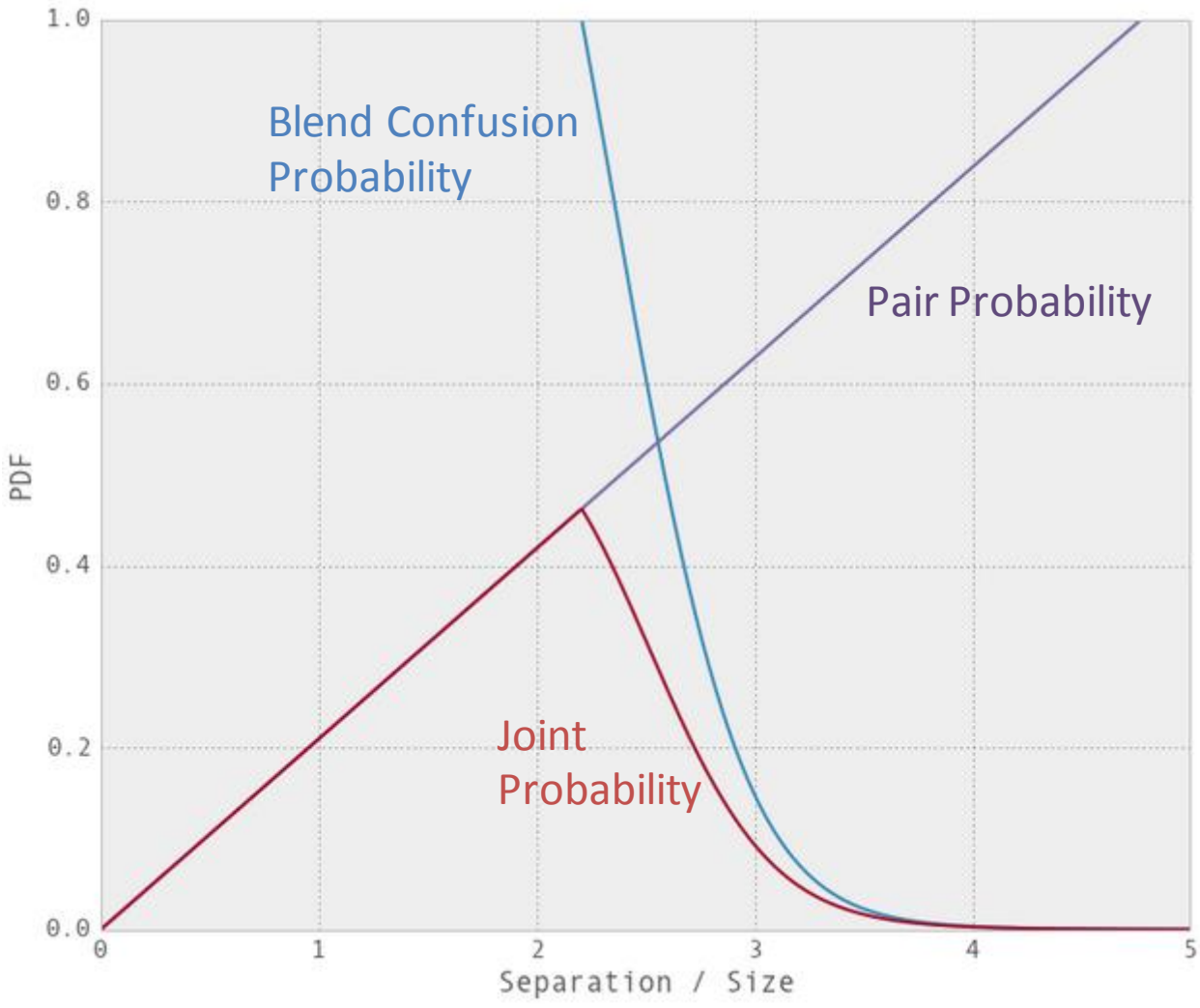
Probabilities

$$p(g_2 @ r) \propto 2\pi r$$

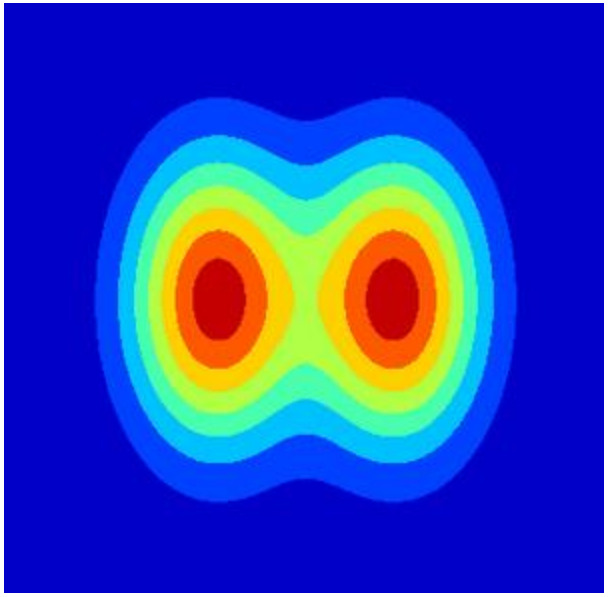
$$\text{prob\_blendflag} = \frac{\text{erf}(d/\sqrt{2})}{2}$$



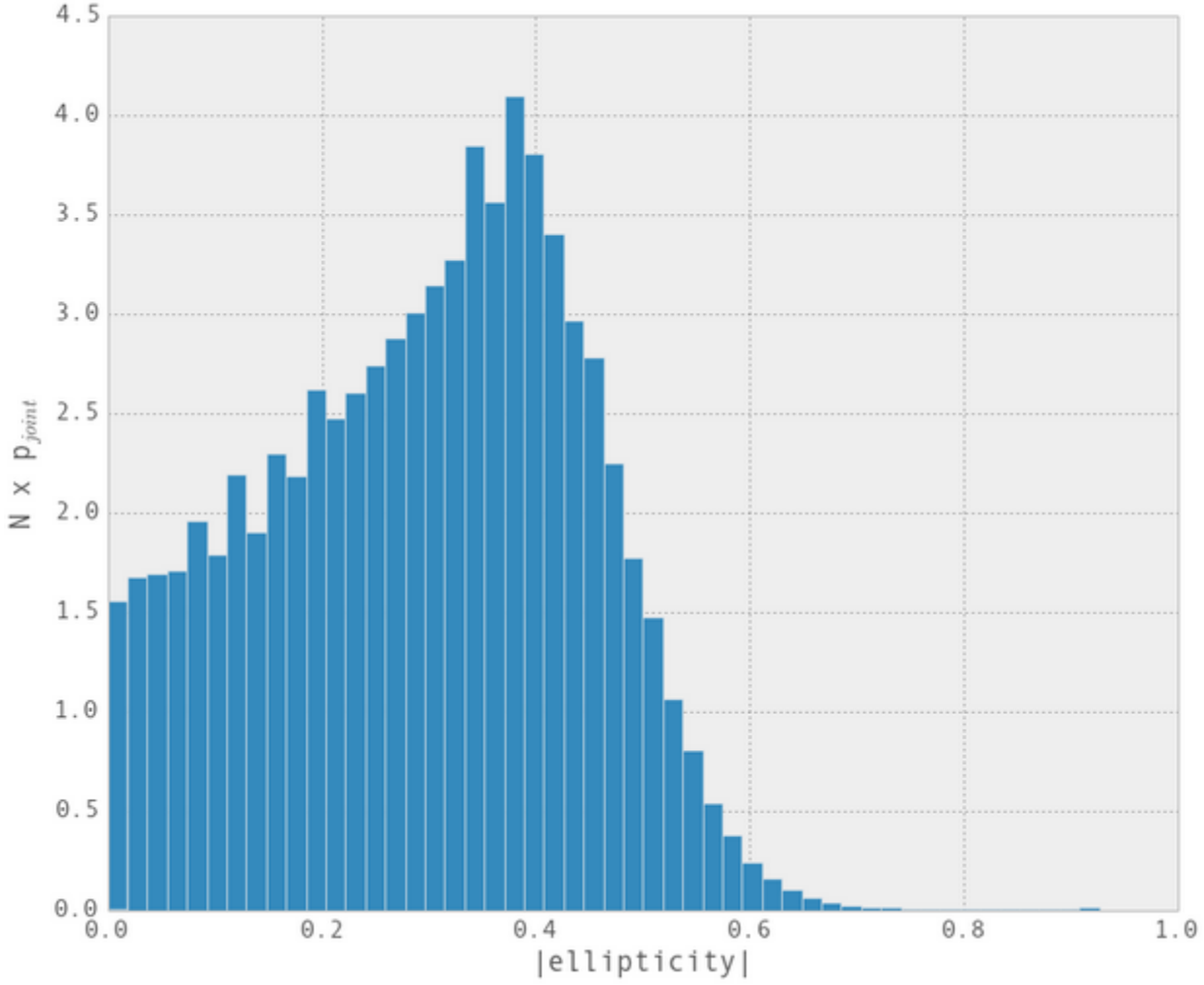
Effective Blending PDF



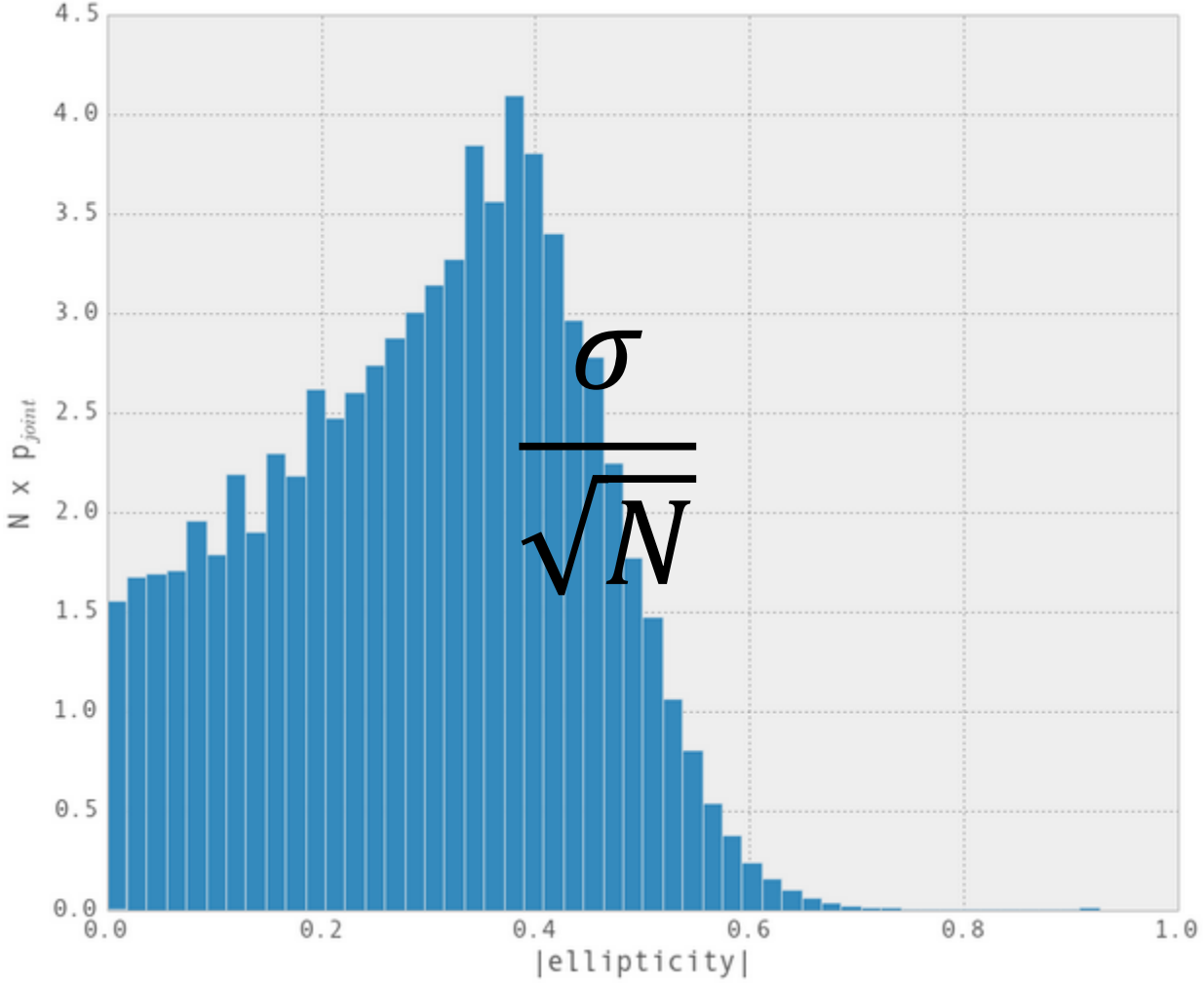
Converting to Ellipticity



Weighted Blending Ellipticity Distribution



A Problem


4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
N x p_joint
0.0
0.2
0.4
0.6
0.8
1.0
|ellipticity|
$\frac{\sigma}{\sqrt{N}}$