

# Shear Measurement at UC Davis

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# Software

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- SExtractor for detection
- Ellipto for shape measurements
- Custom software (by David Wittman) for circularization and analysis

# Software: Measuring Shapes

- SExtractor:
  - moments within a limiting isophote
  - Intensity weighting only
  - $I_{ij} = \sum I_{ij} / \sum I$
- KSB:
  - weights by circular gaussian
  - $w = e^{-r^2/2\sigma}$  ;  $I_{ij} = \sum w I_{ij} / \sum w I$

# Software: Measuring Shapes

- Ellipto (adaptive moments, Smith Ph.D. thesis):

- iteratively weights by elliptical gaussian

- $w = e^{-\rho^2/2\sigma}$  ;  $I_{ij} = \sum w I_{ij} / \sum w I$

where  $\rho$ : radius in elliptical coordinates

- Starting from Sextractor's  $I_{xx}$ ,  $I_{yy}$ ,  $I_{xy}$ :

$$\left. \begin{array}{l} \sigma^2 = I_{xx} + I_{yy} \\ \theta = 0.5 \tan^{-1}(2I_{xy}/(I_{xx} - I_{yy})) \end{array} \right\} \rightarrow w \rightarrow I_{xx}, I_{yy}, I_{xy}, \sigma^2, \theta \rightarrow w \rightarrow \dots$$

# Software: Measuring Shapes

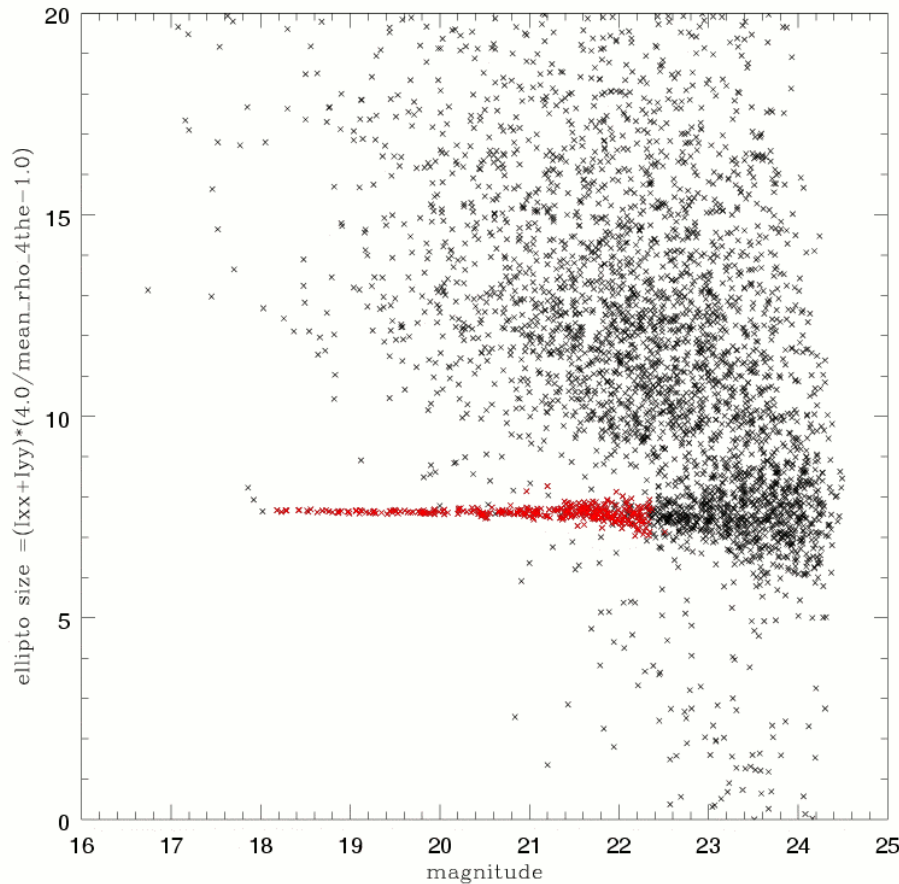
- Ellipto Errorcodes:
  - ✓ 0 *no error*
  - ✗ 1 *negative moments*
  - ✗ 2 *edge object*
  - ✗ 4 *centroid shift*
  - ✗ 8 *ellipticity convergence failure*
  - ✗ 16 *centroid convergence failure*
  - ✗ 32 *ill-conditioned matrix*
  - ✗ 64 *too big*

# Data Analysis

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- (1) First Detection and Measurement: Star Selection
- (2) Circularization
- (3) Final Detection and Shape Measurement
- (4) Seeing correction
- (5)  $e_i \rightarrow \gamma_i$
- (6) Results and Lessons

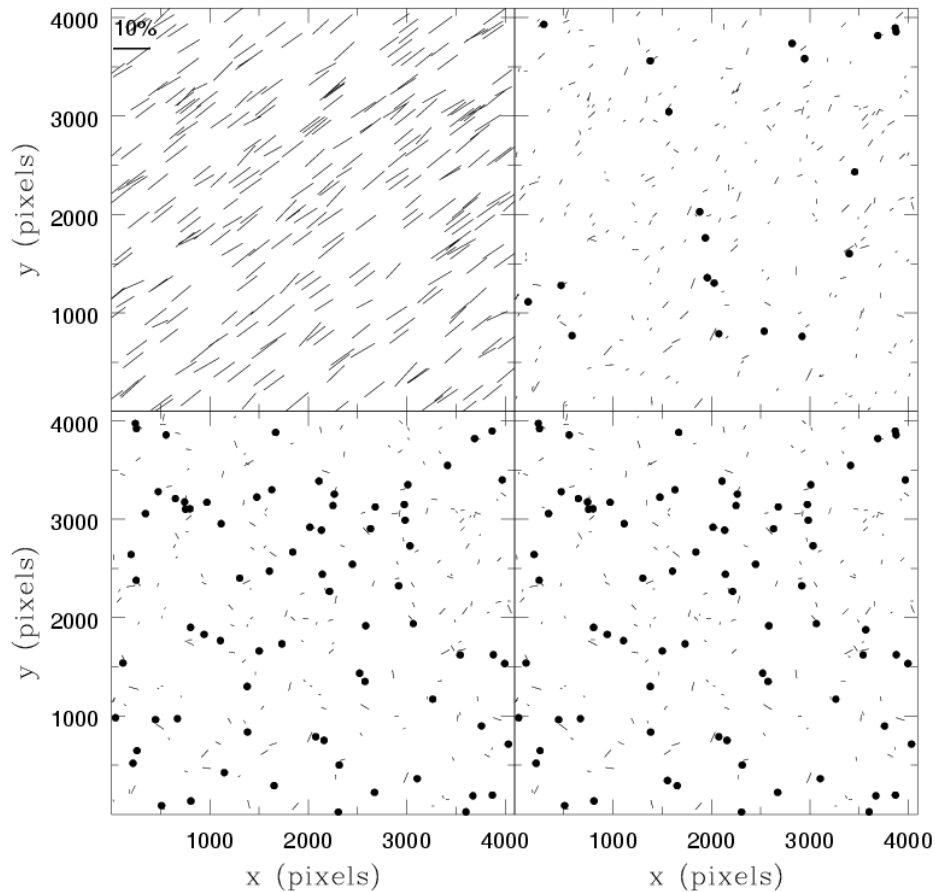
# (1) Star Selection



← Ellipto size makes the stellar locus nice and flat

$$\text{size} = (I_{xx}+I_{yy})(4.0/\langle \rho^4 \rangle - 1)$$

## (2) Circularization



(a) 2<sup>nd</sup> order polynomial fit to stellar  $I_{xx}$ ,  $I_{yy}$ ,  $I_{xy}$

(b) Convolution with a 3x3 kernel

Back to (a)



## (2) Circularization

Niteration	$\overline{I_{xx}-I_{yy}}$	rms	$\overline{I_{xy}}$	rms	$\overline{I_{xx}+I_{yy}}$	rms
0	0.1159	0.055	0.1969	0.029	6.15	0.069
1	-0.0060	0.055	0.0250	0.029	6.59	0.067
2	-0.0002	0.055	0.0014	0.028	6.66	0.062
3	-0.0005	0.055	-0.0002	0.028	6.67	0.059

*nstars* ~ 270

# (3) Detection and Shape Measurement

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Detection: SExtractor

Shape Measurement: Ellipto

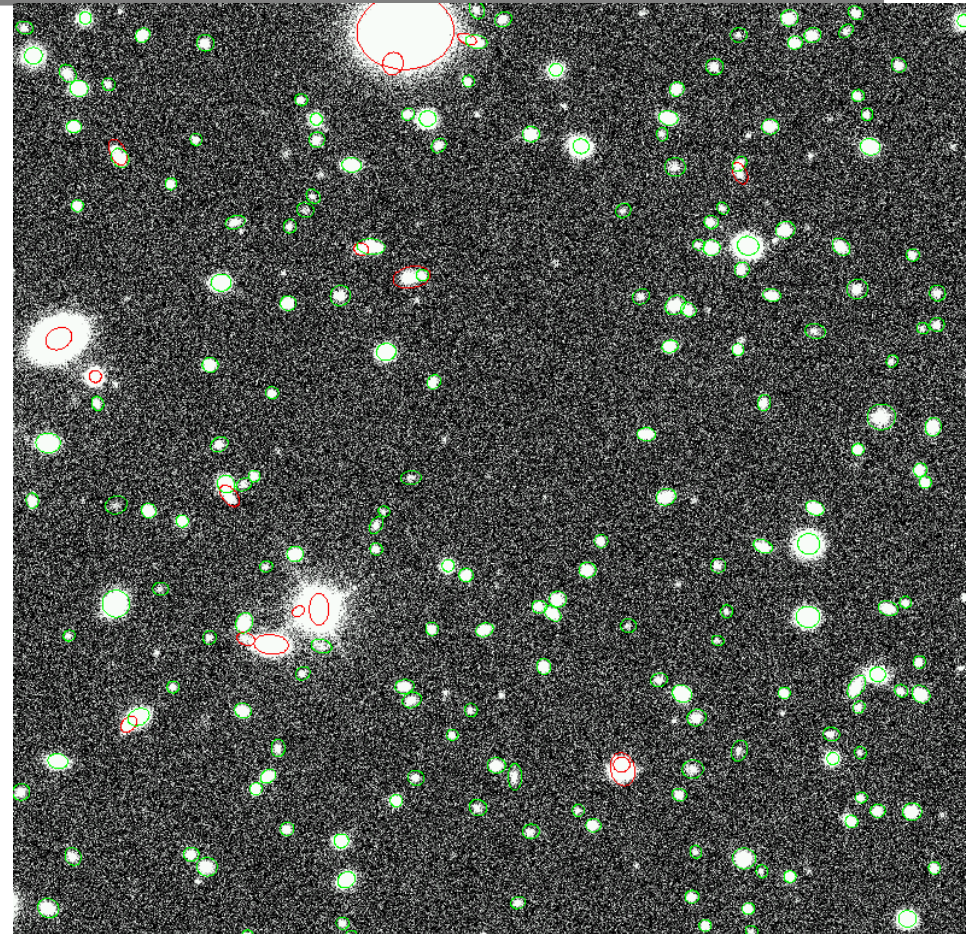
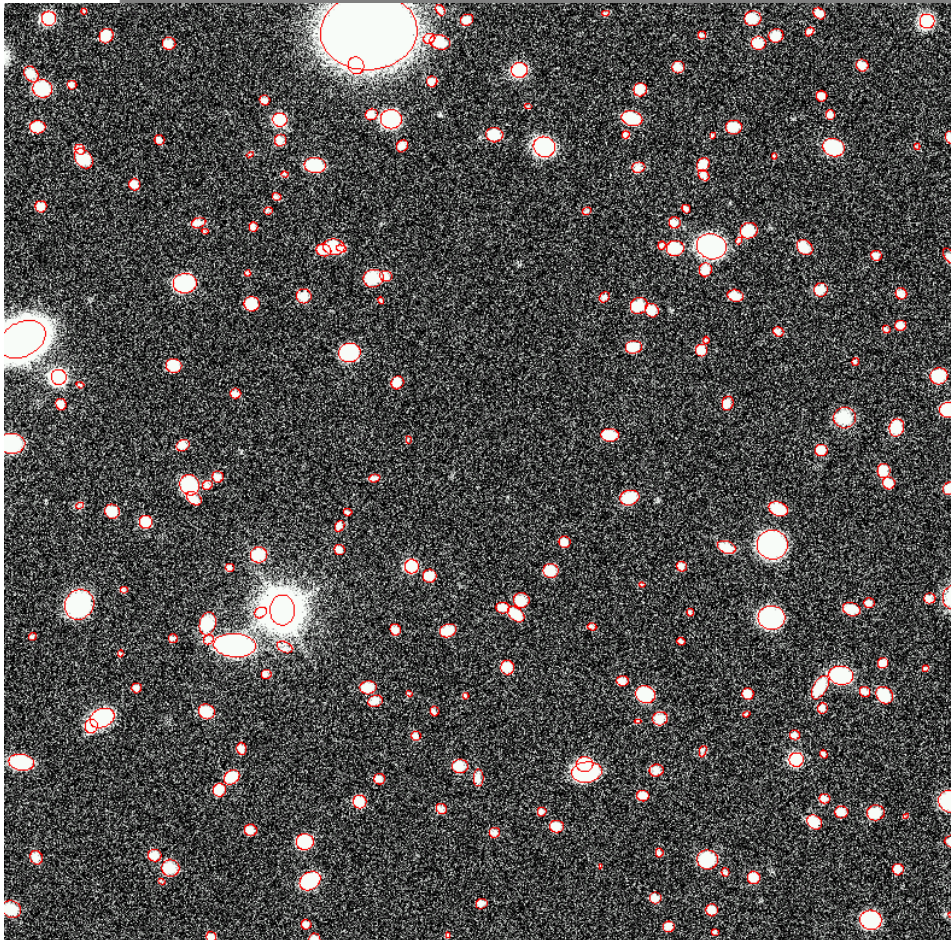
Clean-up:

ellipto errcodee = 0

mag > 19

ellipe < 0.6

# (3) Detection and Shape Measurement



07/25/2005

Slide

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## (4) Seeing Correction of BJ02

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$$e_{\text{true}} = \frac{e_{\text{obs}}}{(1 - \text{size}_{\text{psf}} / \text{size}_{\text{obj}})}$$

Exclude objects with  $\text{size} < 1.2 \text{ size}_{\text{psf}}$

## (5) From Ellipticity to Shear

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$$\gamma_i = \frac{e_i}{2(1-\langle e^2 \rangle)}$$

$$\langle e^2 \rangle^{1/2} \simeq 0.32$$

$$\gamma_i = 1.7952e_i$$

## (6) Results and Lessons

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Level of junk: 0%

Star contamination: 4%

probably not as high in deep dataset  
easily minimized by more conservative size cut

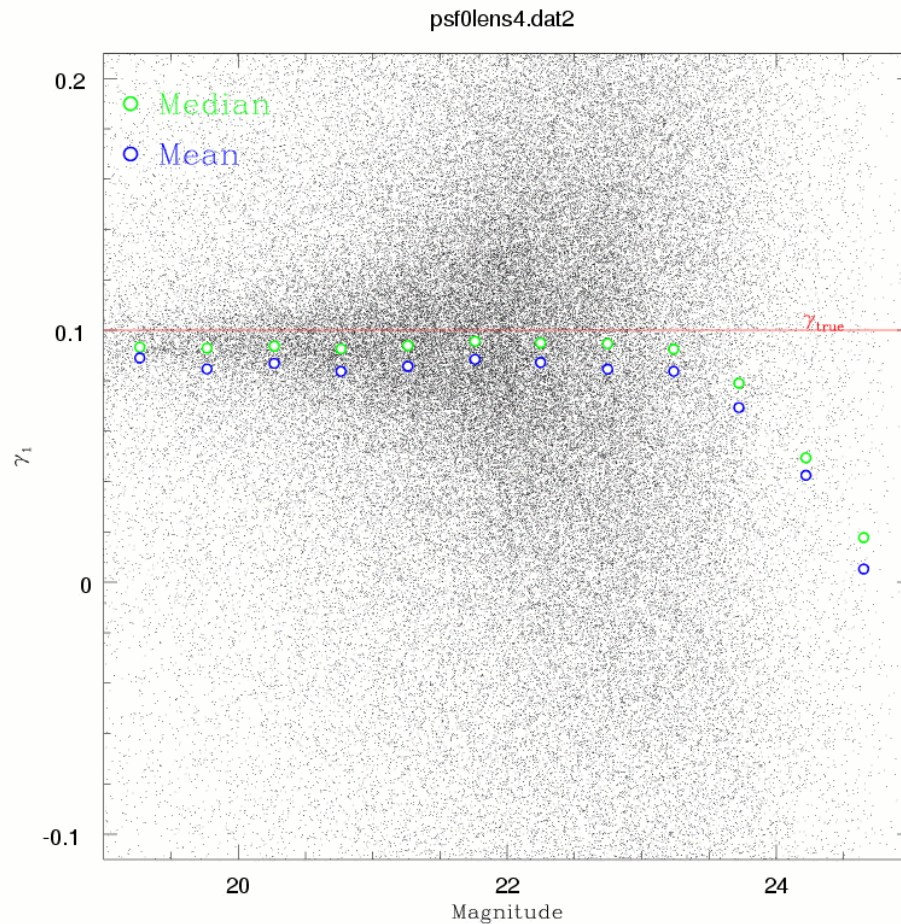
S/N: pretty good (even without weights!)

Object Selection: 1.5% bias towards less sheared object (cut at ellipticity  $<0.6$ ?)

Underestimate shear by  $\sim 16\%$  for all lenses

significantly better for bright objects – cut on object S/N? de-weight it?  
median or 3-sigma clipping are much closer to true shear (?)

# (6) Results and Lessons



Cut or de-weight the faint biased objects will improve results by 4%  
Median or 3-sigma clipping are much closer to true shear (?)

# (6) Results and Lessons

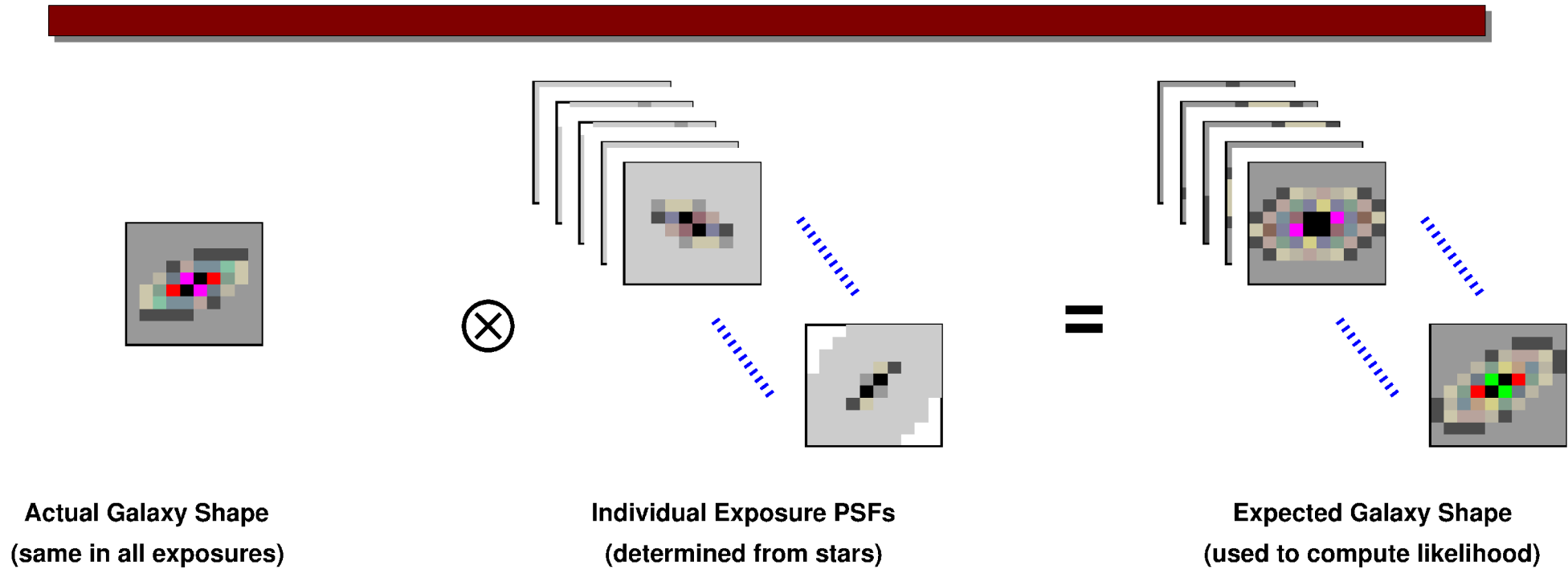
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## BIAS Budget

✓ Stellar Contamination	-4%
? Selection	-1.5%
✓ Faint Objects	-4%
? Unknown	-6.5%



# New at UCD



*Chris Roat and David Wittman*