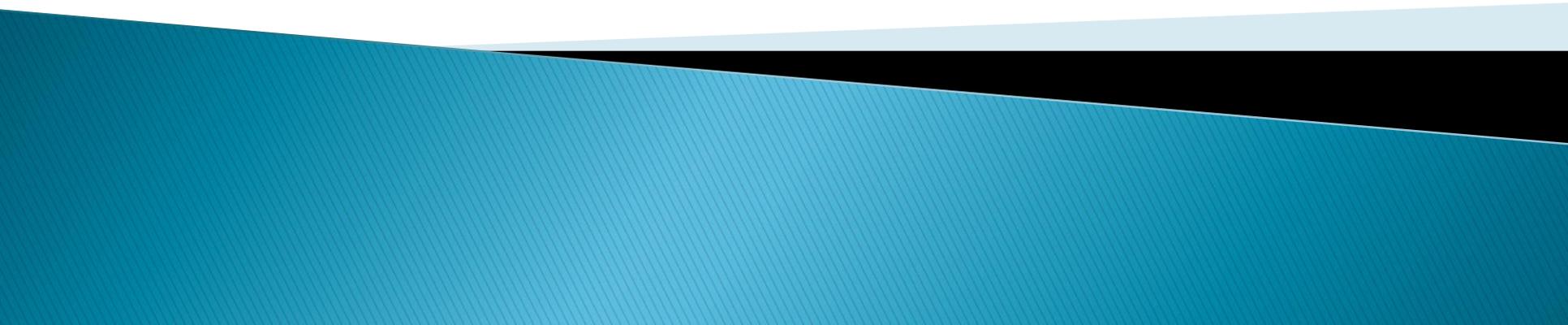


Insertion of Simulated SN into DES Images to Determine Efficiency of Finding SN

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Overview

- ▶ Motivation
- ▶ General Procedure
- ▶ SN – Galaxy Matching
- ▶ Image Calibration
- ▶ SN PSF Calculation
- ▶ Photon Fluctuations
- ▶ Future Work
- ▶ Questions & Answers

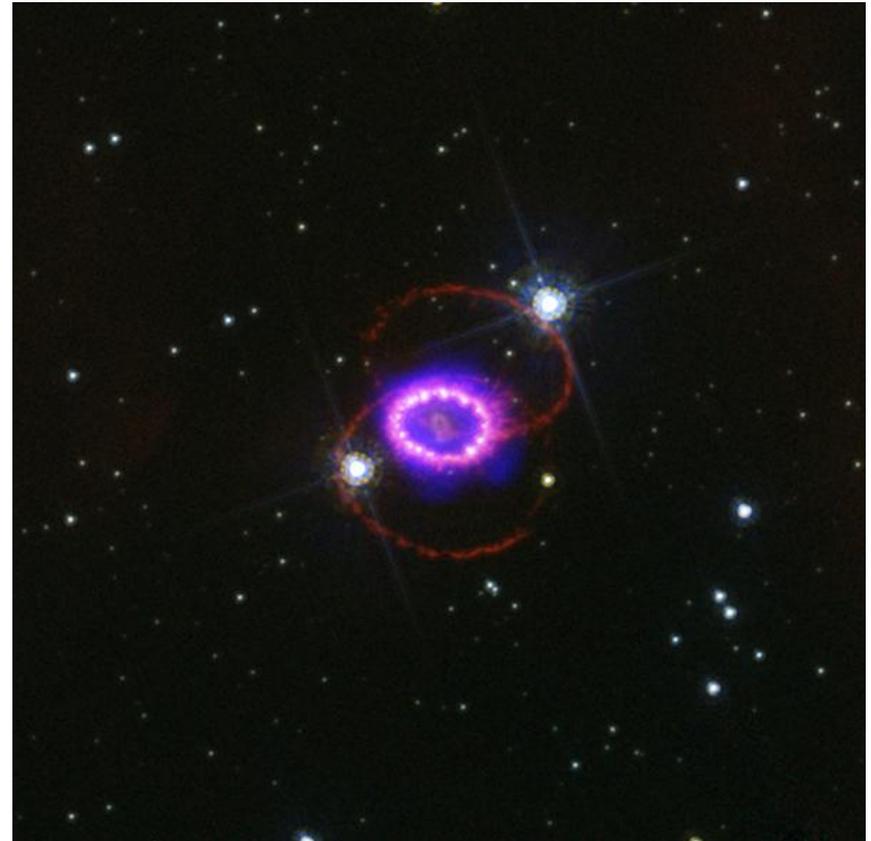


Image from [Chandra X-Ray Observatory](#)

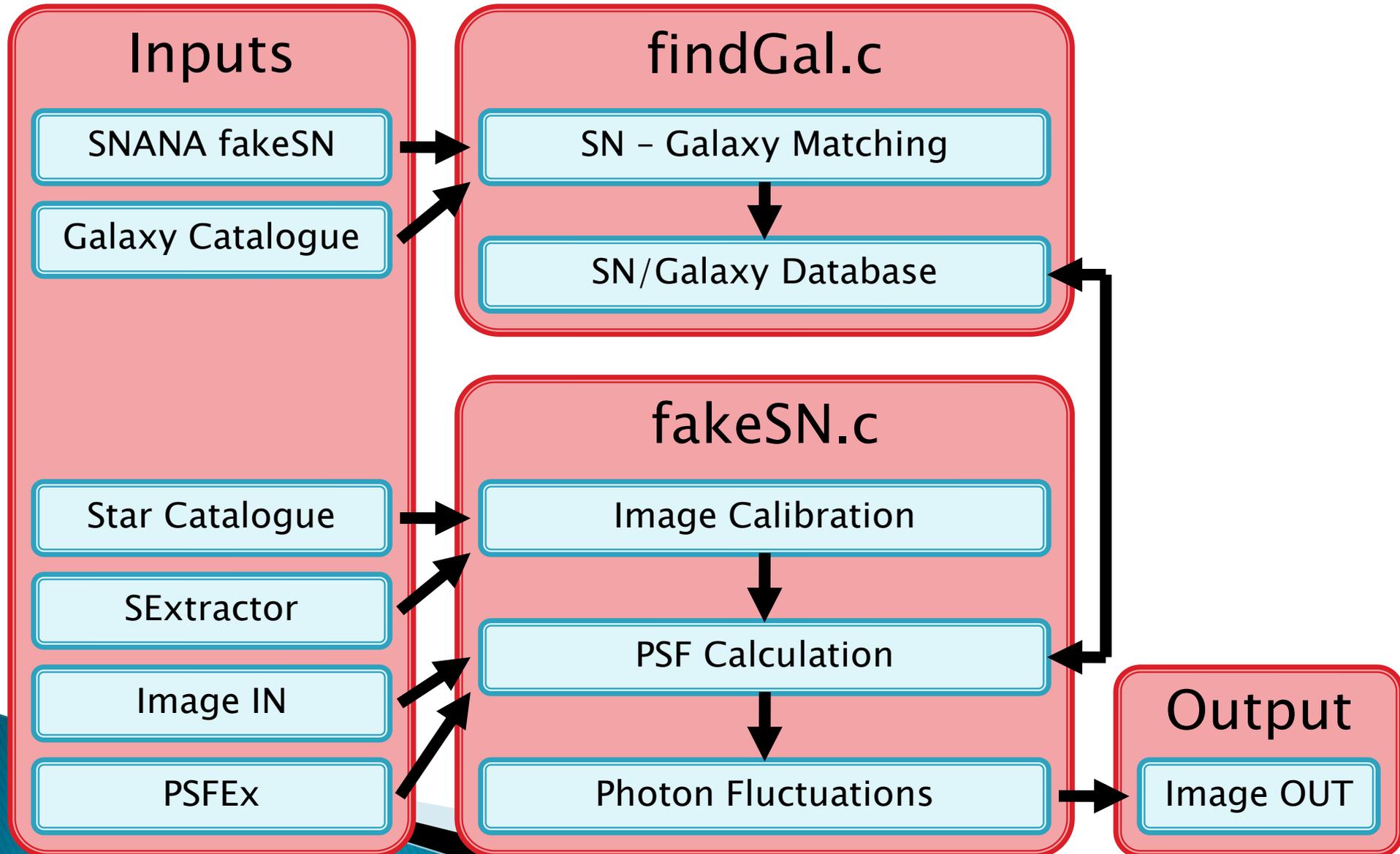
Credit: X-ray: NASA/CXC/PSU/S.Park & D.Burrows.;
Optical: NASA/STScI/CfA/P.Challis

Motivation

- ▶ Simulate SN and catalogue them
- ▶ Insert SN into images in known host galaxies
- ▶ Subsequent image analysis will find a fraction of the simulated SN
- ▶ This fraction determines the efficiency of finding SN

$$\frac{\text{Number fakeSN found}}{\text{Number fakeSN inserted}} = \text{Efficiency}$$

General Procedure

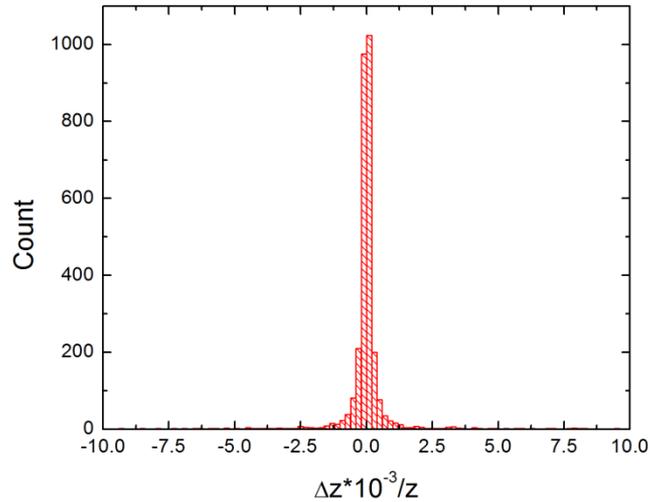


SN – Galaxy Matching

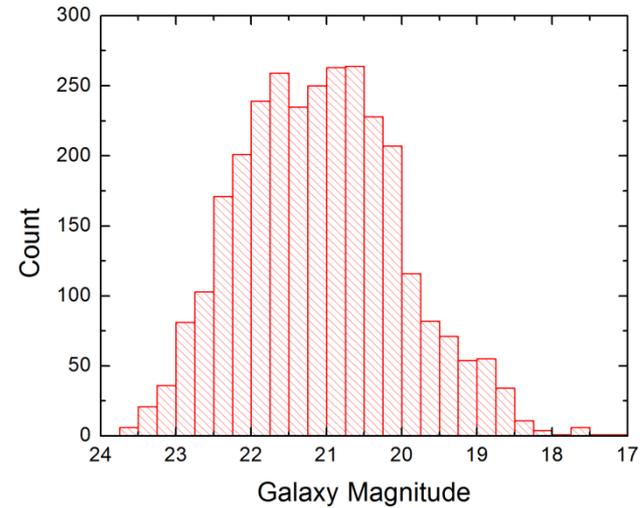
- ▶ SNANA → SN redshift, magnitude
 - ▶ Find 10 galaxies with closest redshift for each SN
 - ▶ Select one galaxy at random with weight given to higher luminosity galaxies
 - ▶ Place SN randomly in galaxy with a Gaussian radial distribution
 - ▶ Enter SN/galaxy info into database
- 

SN - Galaxy Matching

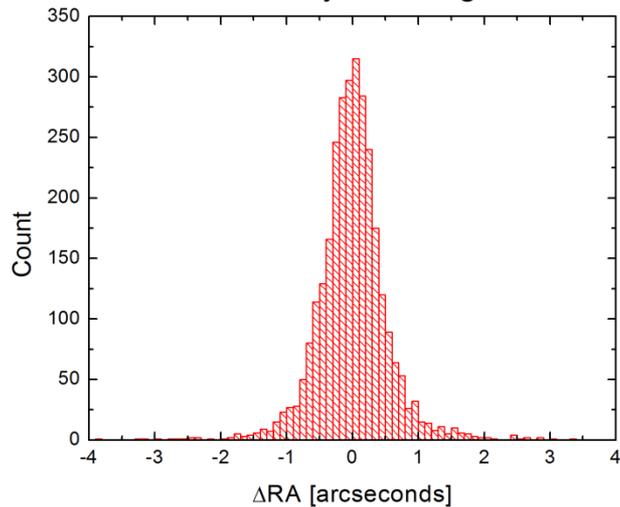
SN - Galaxy Matching: Redshift



SN - Galaxy Matching: Magnitude



SN - Galaxy Matching: RA



SN - Galaxy Matching: Dec

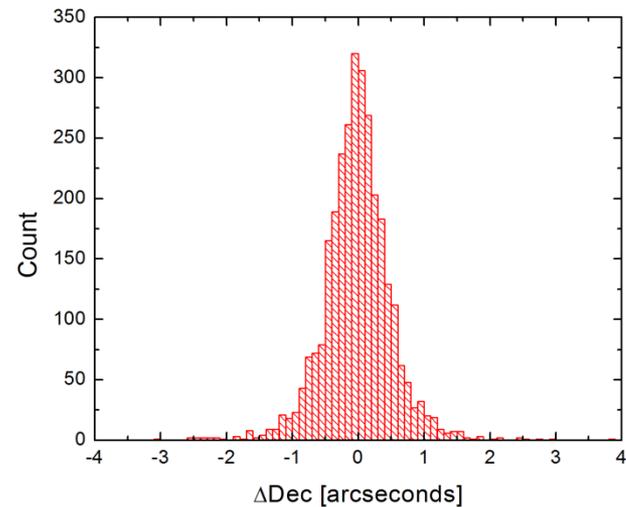
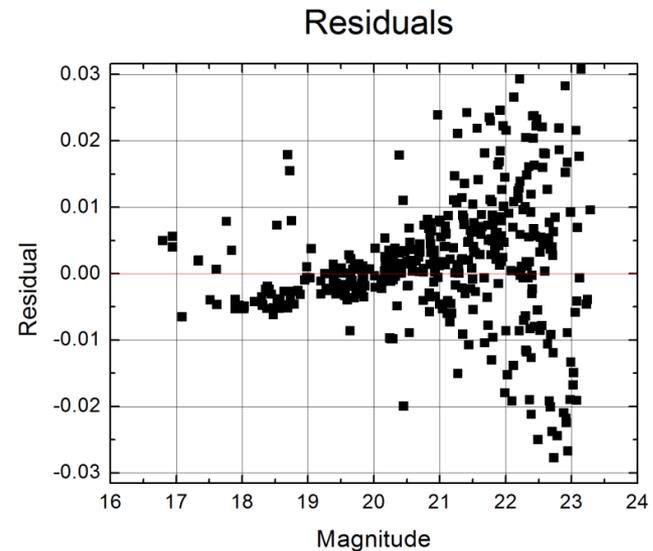
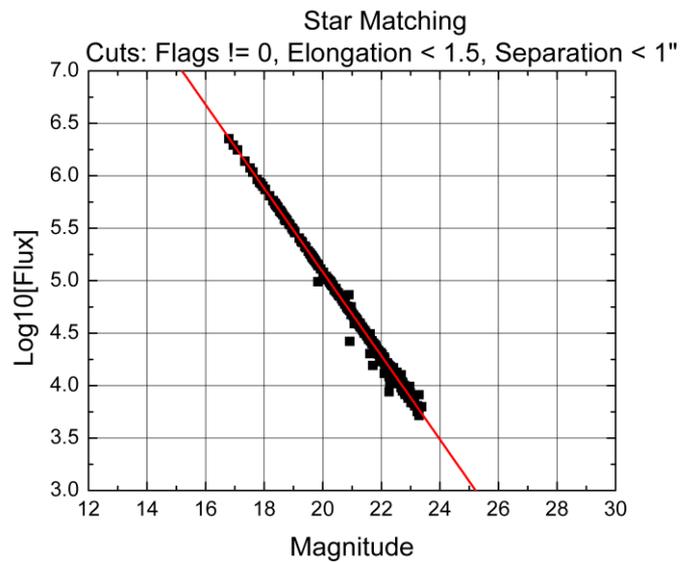
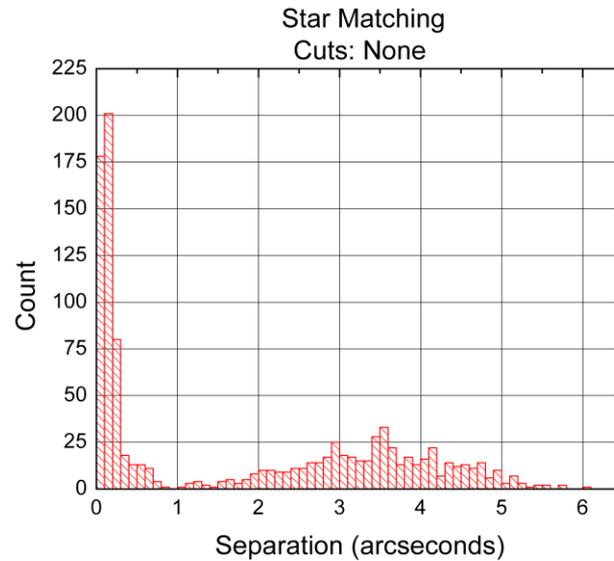


Image Calibration

- ▶ SExtractor → position, flux of every object in the image
- ▶ Find closest star in position from catalogue
- ▶ Reject any matches greater than 1 arcsecond
- ▶ Perform linear fit of $\log_{10}(\text{flux})$ of each object to magnitude of its match
- ▶ Reject outliers
- ▶ Perform fit again
- ▶ Result: $\text{Flux} = \text{Exp}[a + b * \text{Magnitude}]$

Image Calibration



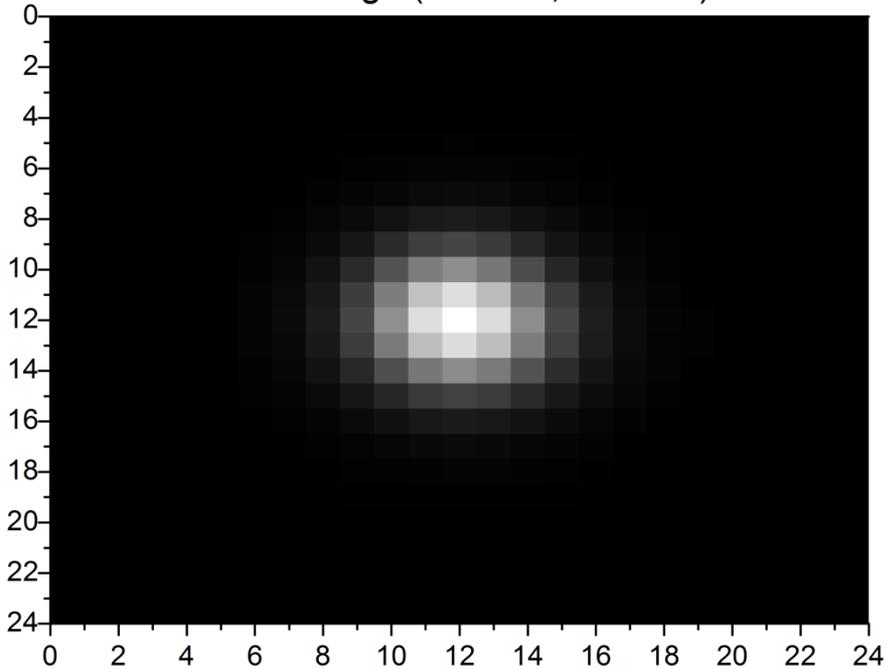
PSF Calculation

- ▶ PSFEx → Computes polynomial to determine PSF at arbitrary location on image
- ▶ Look up SN/galaxies in database and compute image coordinates
- ▶ Compute PSF of SN to determine shape of SN
- ▶ Use image calibration to normalize shape to proper flux:

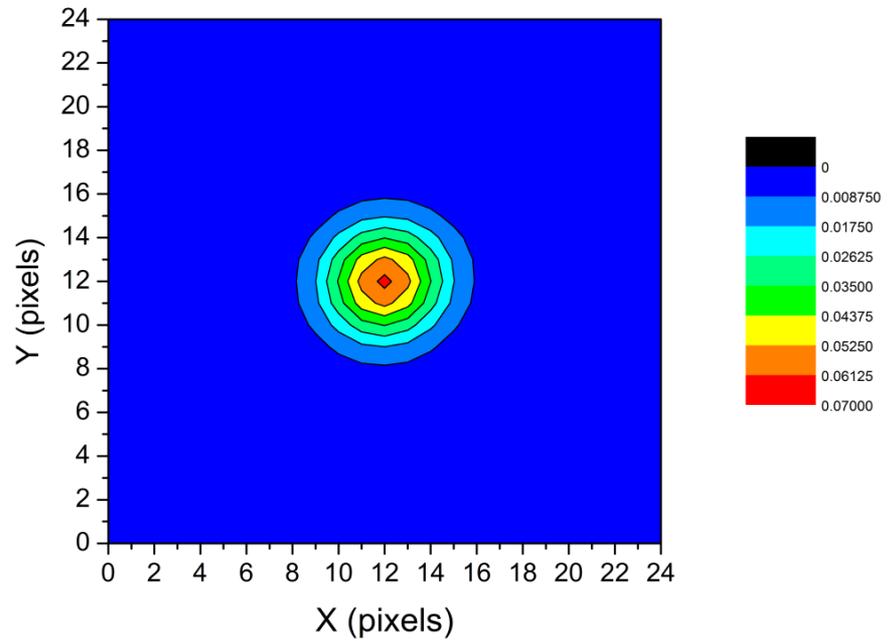
$$\text{Image SN} = \frac{\text{Flux(SN)}}{\text{Flux(PSF)}} (\text{PSF shape}) = \frac{e^{a+b*\text{Magnitude(SN)}}}{\text{Flux(PSF)}} (\text{PSF shape})$$

PSF Calculation

PSF Image (X = 990, Y = 990)



PSF Contour (X = 990, Y = 990)

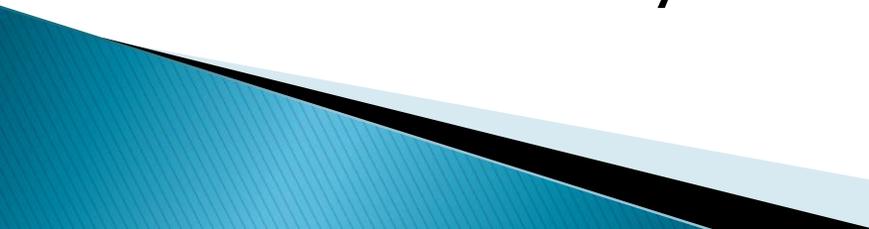


Photon Fluctuations

- ▶ After PSF and normalization, must simulate photon fluctuations
- ▶ Convert each pixel ADC count to number of photons by gain of each pixel
- ▶ Apply Poisson distribution errors to each pixel
- ▶ Convert number of photons back to ADC counts

$$\text{New ADC value} = \frac{\text{Poisson}(\text{Gain} * \text{Old ADC Value})}{\text{Gain}}$$

Current and Future Work

- ▶ Improve linear fitting
 - Include weighting based on magnitude
 - ▶ Incorporate dead pixels
 - ▶ Change distribution of SN within galaxies
 - ▶ PSF rebinning problem
 - PSF pixels are not 1 to 1 with image pixels
 - ▶ Determine gain of pixels
 - Assumed gain=2 right now
 - ▶ Incorporate Oracle database
 - ▶ Run efficiency test on DC5 data
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Questions?

