VERA C. RUBIN OBSERVATORY

Synthetic Source Injection Workshop

Future synthetic source processing

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NSF AURA U.S. DEPARTMENT OF ENERGY SLAC CHARLES AND LISA SIMONYI FUND FOR ARTS AND SCIENCES LSST CORPORATION

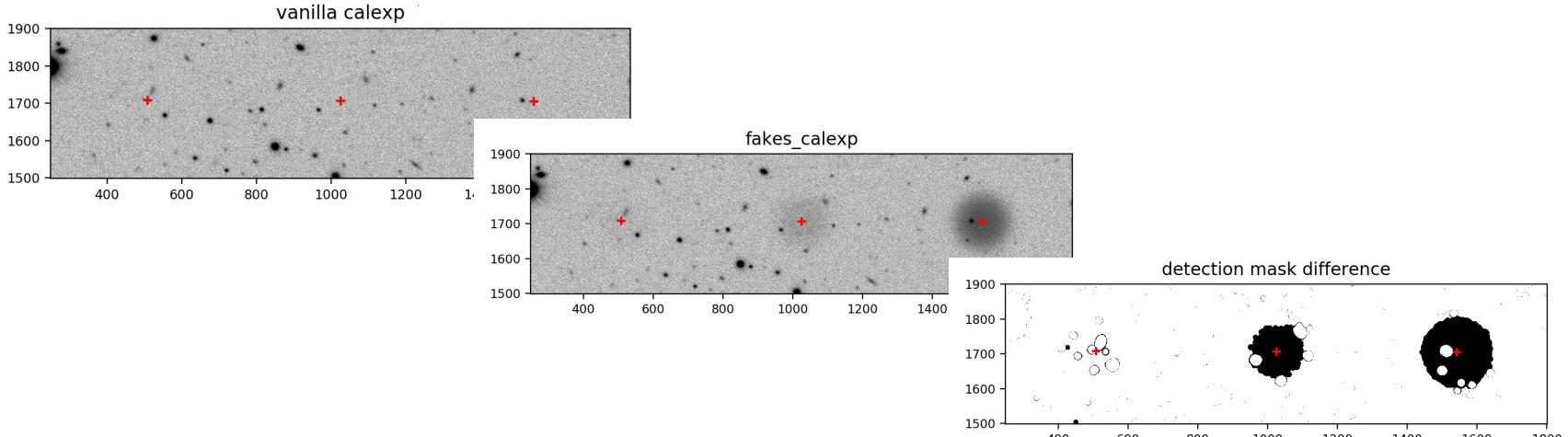
Thurs, June 3, 2021

Top Level Questions

What synthetic datasets do we want to be regularly processing?

What metrics do we want to be tracking?

What analysis plots do we want to be creating?



Proposed Synthetic Datasets: two strands

Regular Bi-Monthly Reprocessing

Designed for metric and performance analysis.

Synthetic Galaxies

Sérsic sources injected at the visit level.
Regular gridded dimension inputs (mag, Re, n).

Synthetic Stars

Point sources injected at the visit level.
As above, gridded dimension inputs.

Synthetic Difference Imaging

???

Irregular Processing (as needed)

Designed to test new pipeline functionality which may impact multiple science use cases.

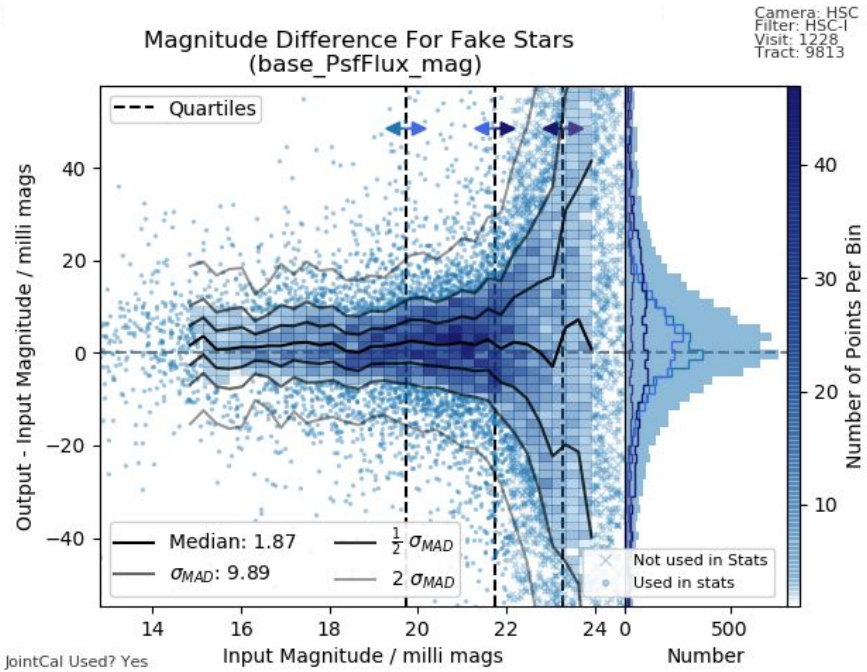
Quasars and AGN

Moving Sources

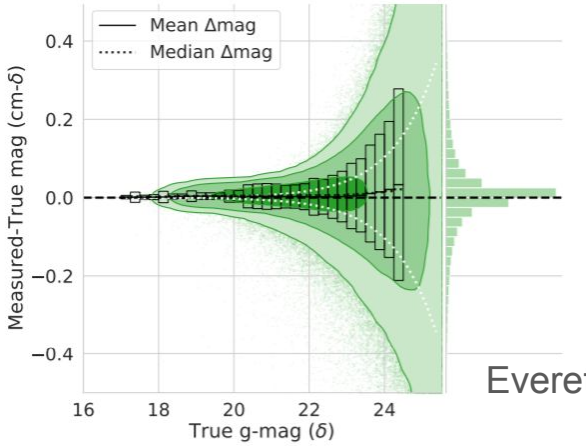
Lensing

LSB Galaxies

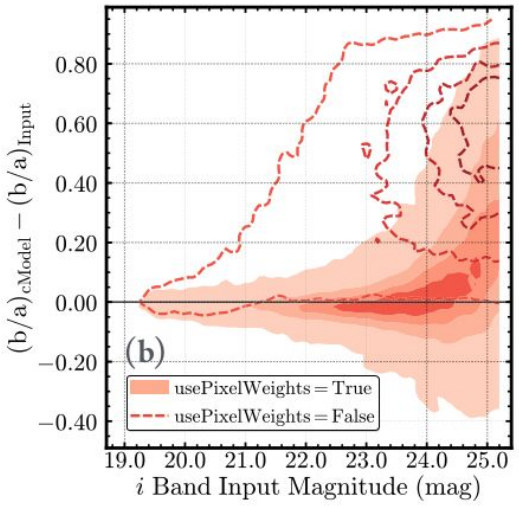
To Track: Trumpet Plots



Rubin DM Team



Everett et al. (submitted)



Huang et al. (2018)

To Track: Recovered Synthetic Number Counts

The total number of injected synthetic sources recovered as a function of magnitude.

As expected, easier to recover bright sources, more difficult to recover fainter sources.

Recent LSST DM results using the RCfakes dataset show that 50% of injected sources are recovered down to a magnitude of m_i=24.27 mag.

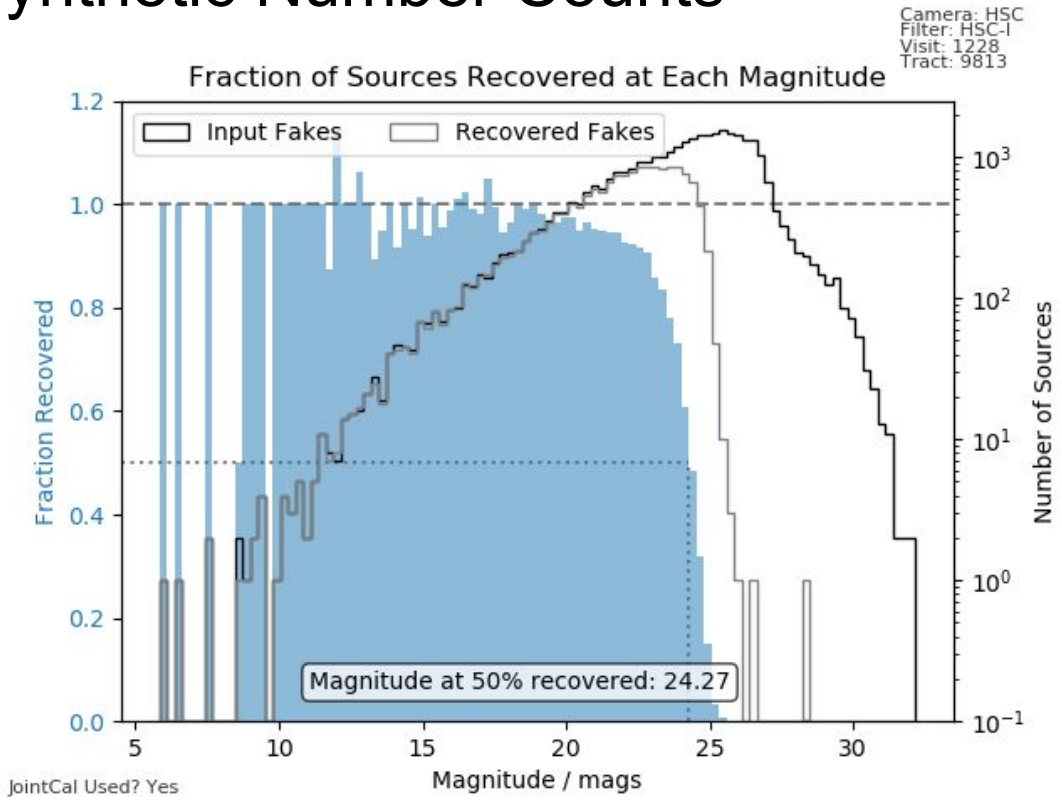
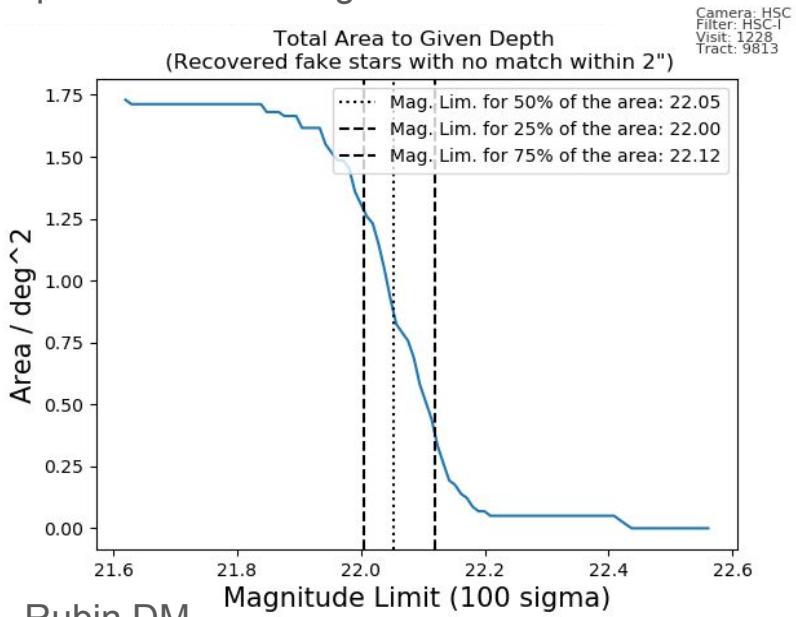


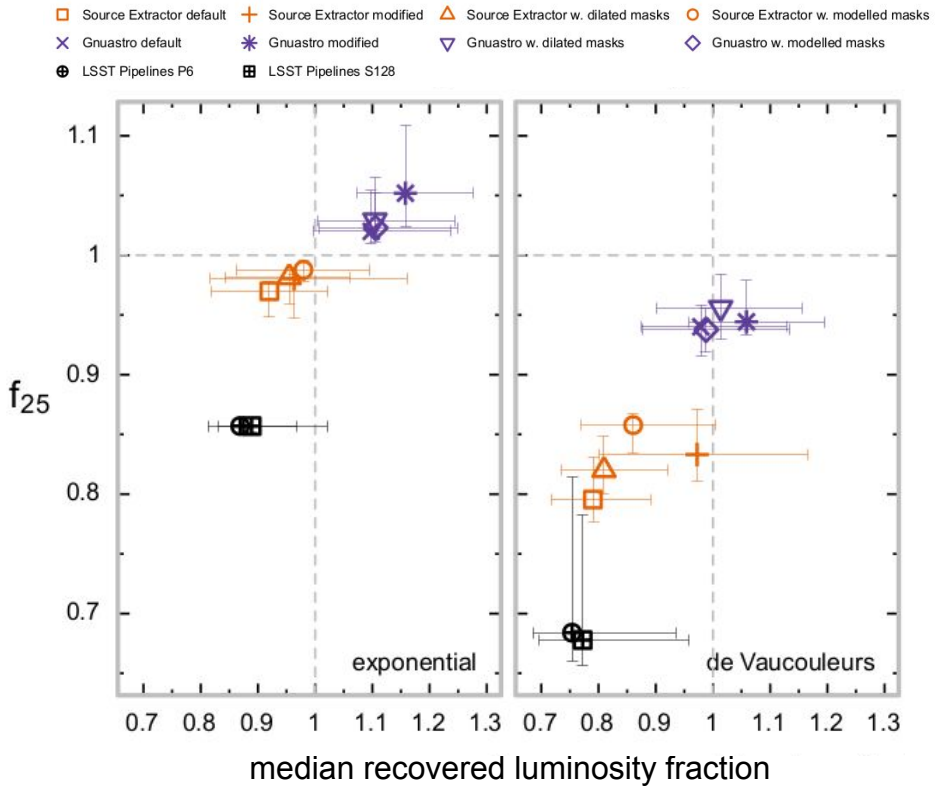
Figure: Rubin DM Team

To Track: Recovered Total Luminosity

The fraction of total input luminosity recovered by output science catalogues.



Rubin DM Team

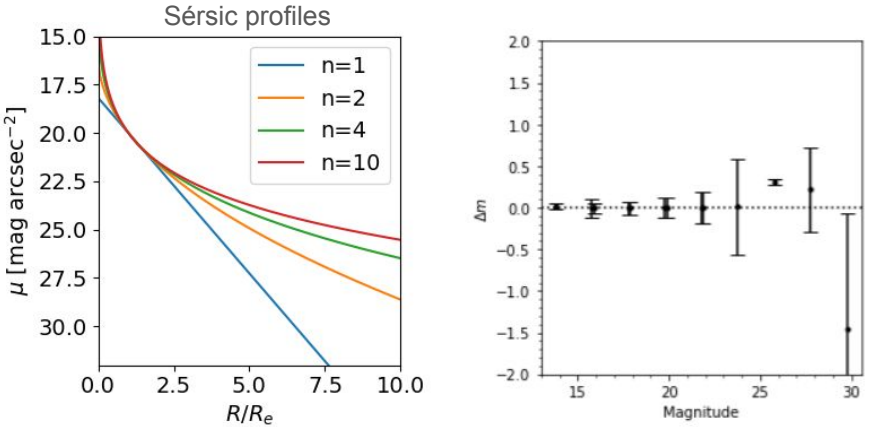


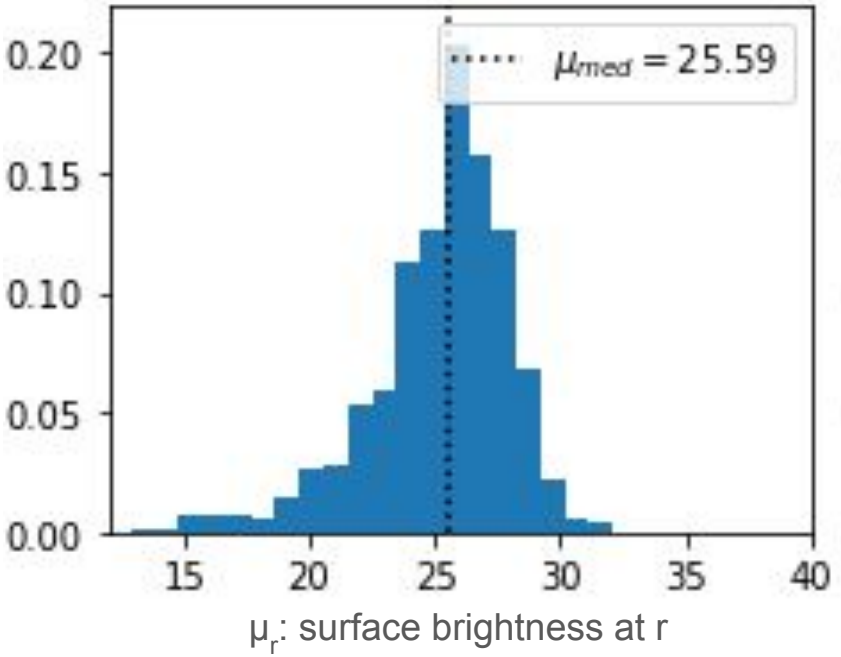
Kelvin, Hasan & Tyson (submitted)

To Track: Surface Brightness 10% Deviation

The surface brightness at which the output profile first begins to deviate from the known Sérsic input by 10%.

LSST:UK LSB results show that this occurs at $\mu_{\Delta 0.1}$~25.6 mag/arcsec^2 in current HSC SSI.





μ_r: surface brightness at r

Figures: Aaron Watkins

To Track: Error Vectors

Figure showing the error vector diagram for 75,000 synthetic Sérsic sources injected into SDSS r-band imaging.

Parameter	Simulated Inputs	Units	Total
m	15, 16, 17, 18, 19, 20	mag	6
r_e	0.5, 1, 2, 4, 8	arcsec	5
n	0.5, 1, 2, 4, 8		5
e	0, 0.2, 0.4, 0.6, 0.8	$1 - b/a$	5

Allows for general trends to be identified for bulk populations, assigning confidence intervals to specific groups.

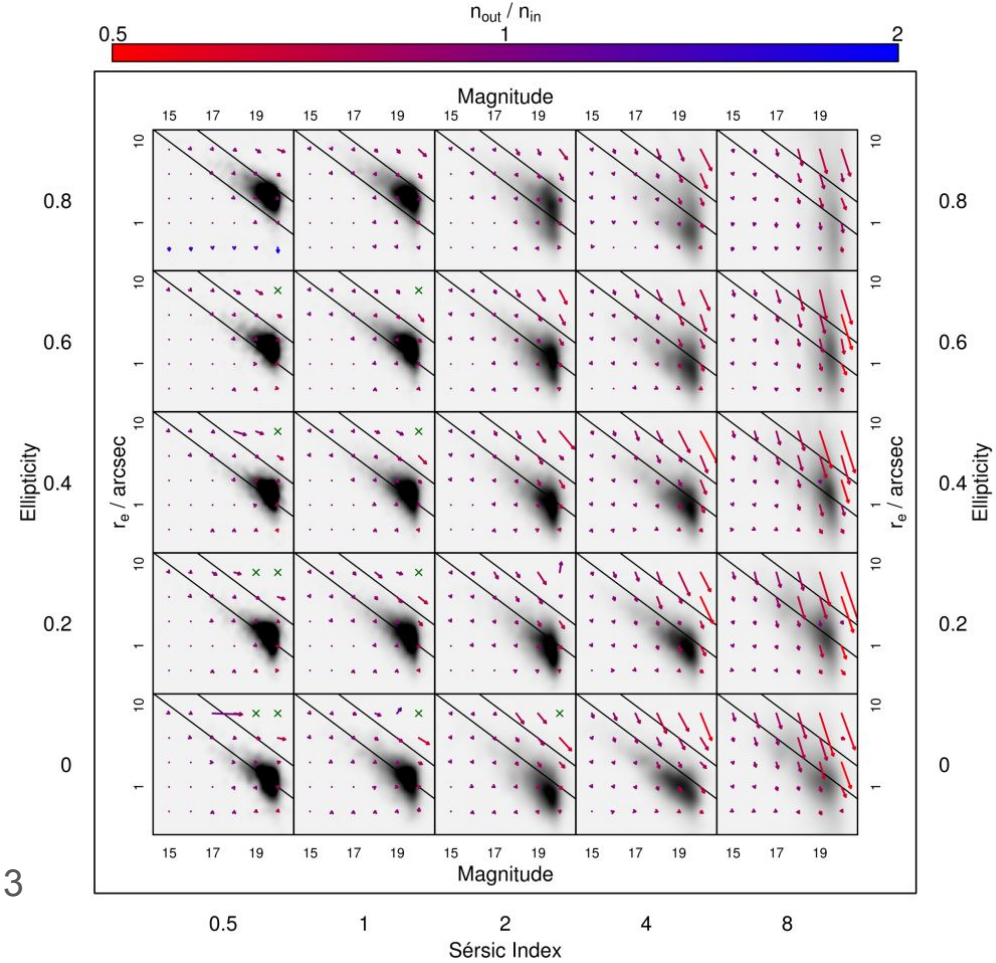
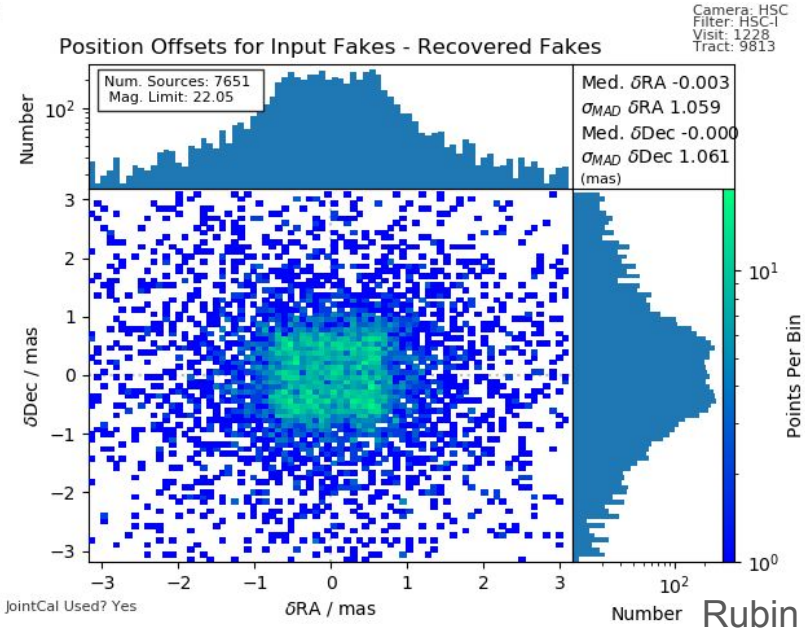


Figure: Kelvin 2013

To Track: Astrometric accuracy

Quantify the difference between known input coordinates and measured outputs.



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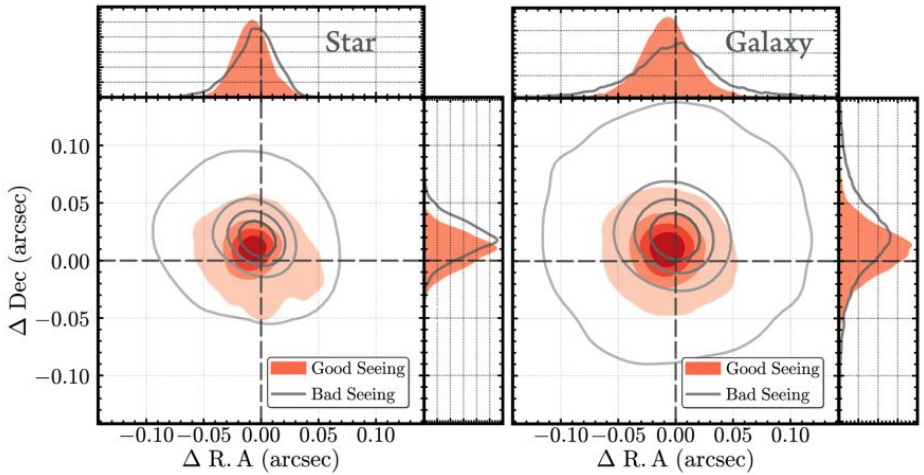
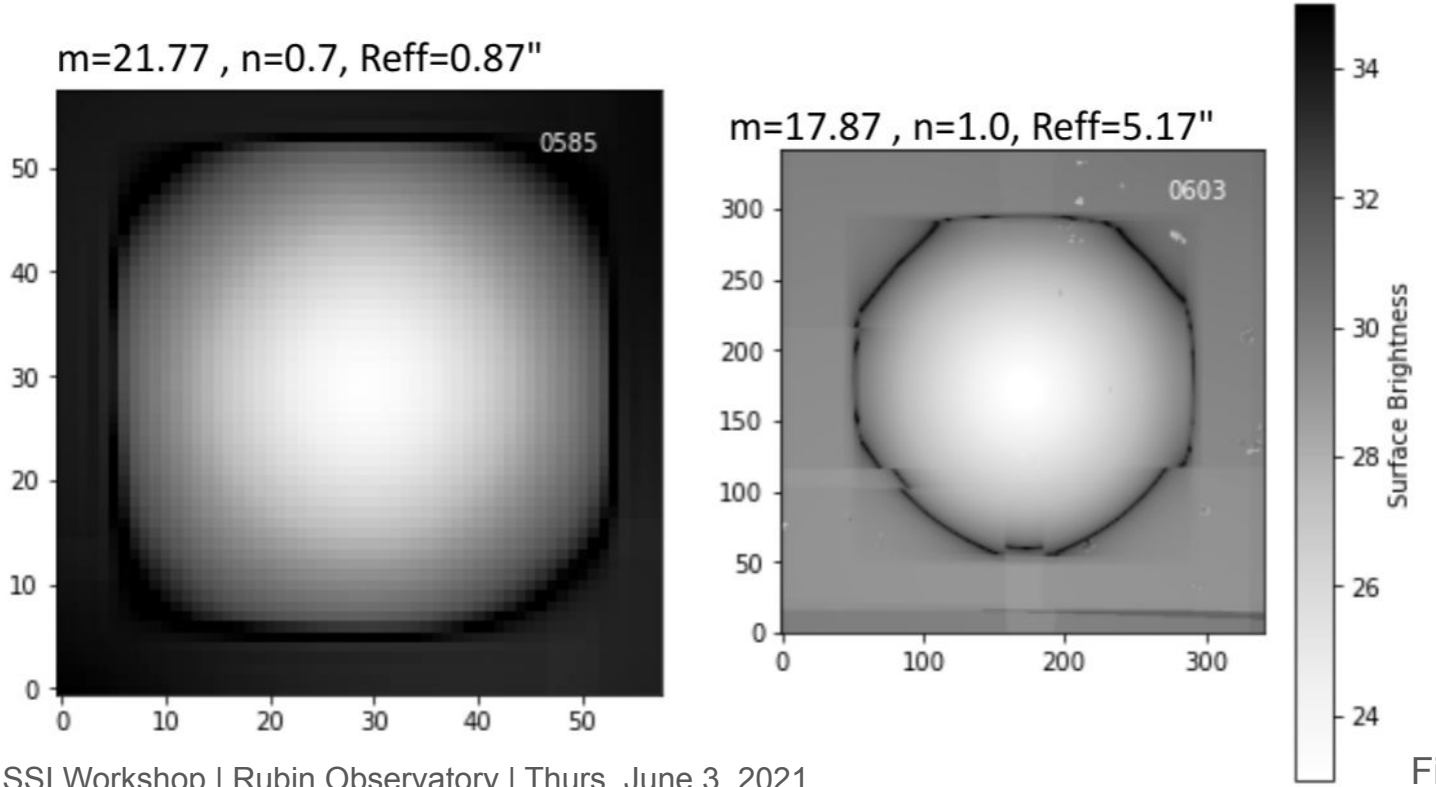


Huang et al. 2018

To Track: Sky Oversubtraction

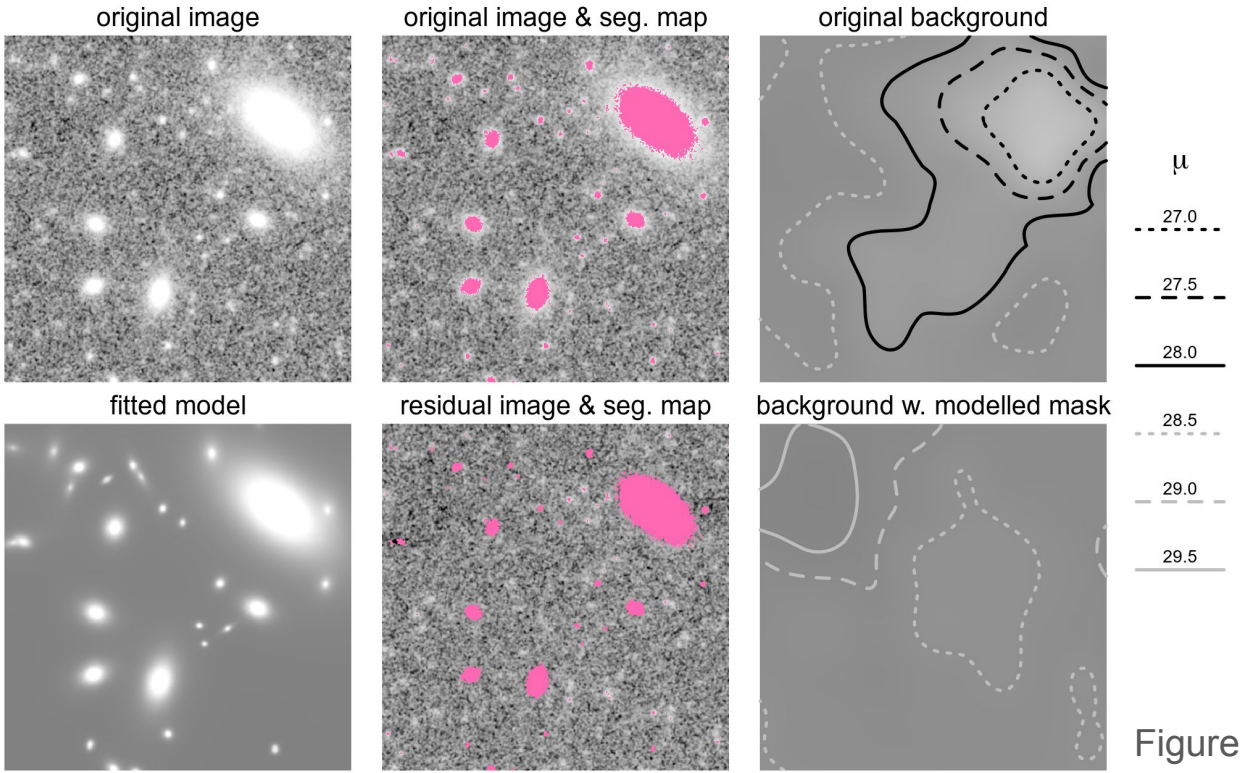


Two Sérsic models after stack sky subtraction.

A known issue since HSC PDR1 → tracking this effect is important in efforts to minimize it.

Figure: Aaron Watkins

To Track: Impact of Sky Subtraction Methodology



SSI outputs are ideal for testing modifications to our current sky subtraction methodologies.

The results shown here working with simulated HSC-like imaging show the impact of using model fits to bright detected sources to aid sky map estimation, more accurately accounting for the flux in the wings of extended sources.

Figure: Kelvin, Hasan & Tyson (submitted)

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Discussion

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