DES in 10 minutes

DES in 7 minutes, Balrog in 3 minutes

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Fermilab New Perspectives
June 18, 2018

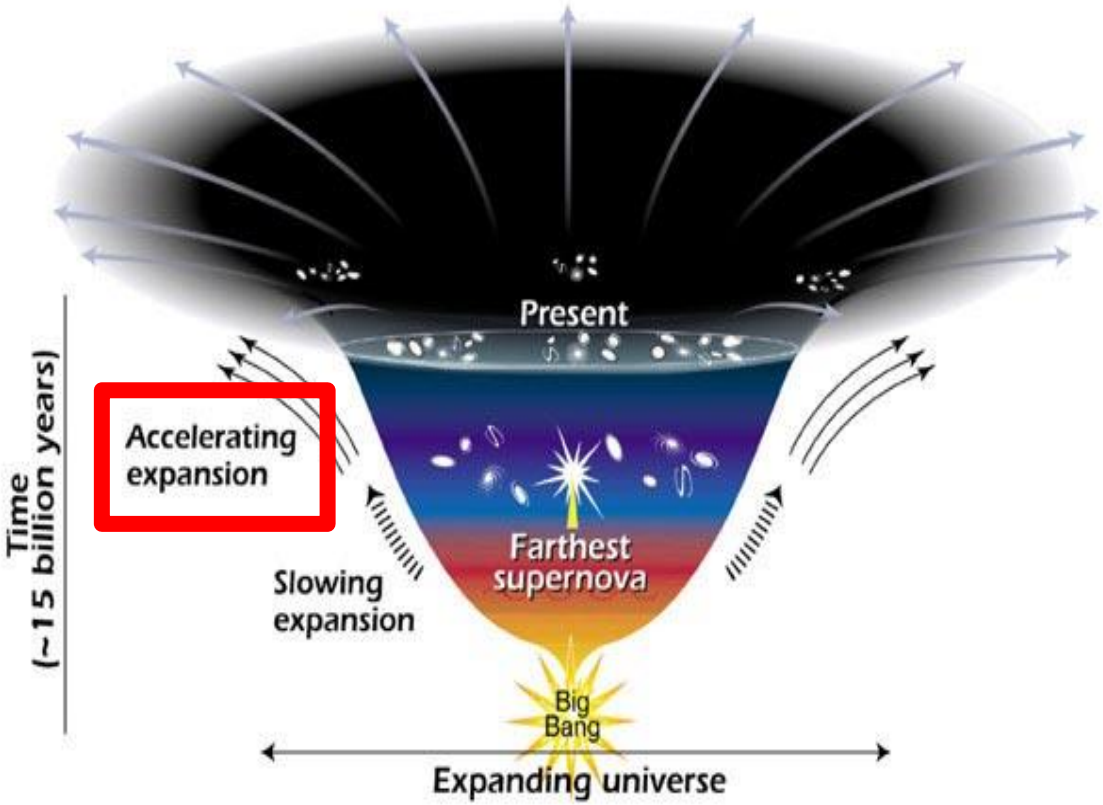
Dark Energy Survey (DES) Collaboration

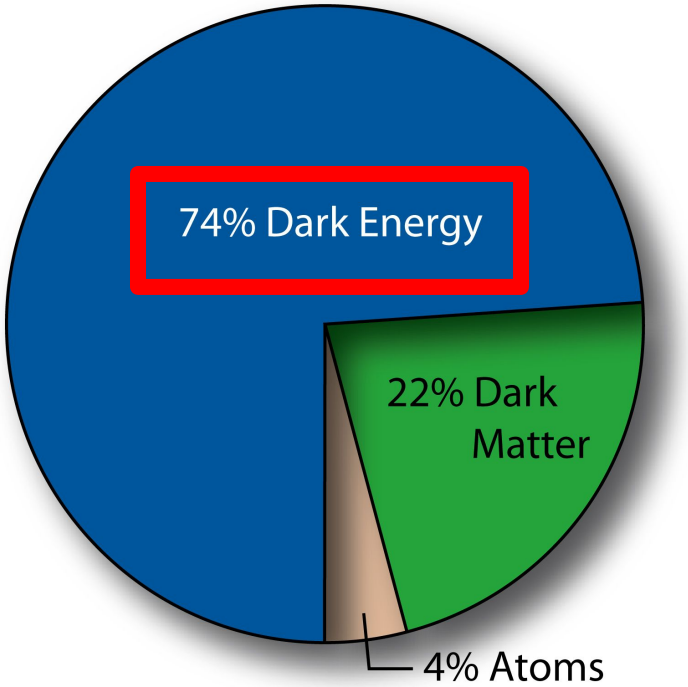
- ~400 collaborators, of which ~70% are students and postdocs

Dark Energy Survey Member Institutions

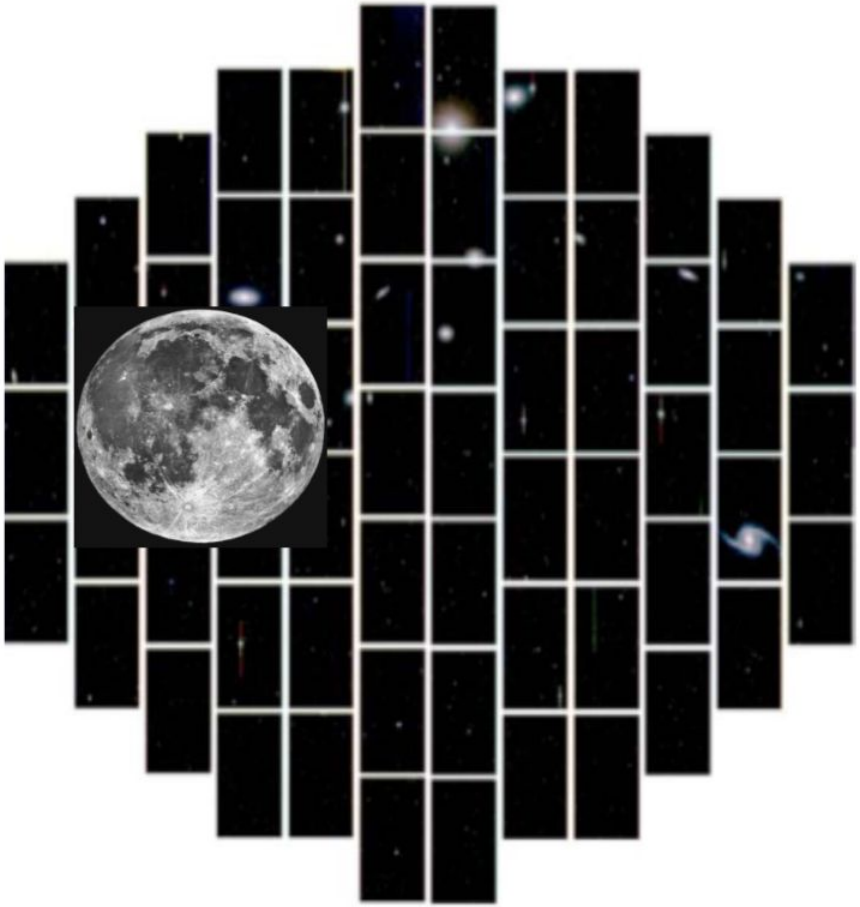
Fermilab, UIUC/NCSA, University of Chicago, LBNL, NOAO, University of Michigan, University of Pennsylvania, Argonne National Laboratory, Ohio State University, Santa-Cruz/SLAC/Stanford Consortium, Texas A&M (+scientists at CMU, Arizona, Brandeis, Wisconsin,…)

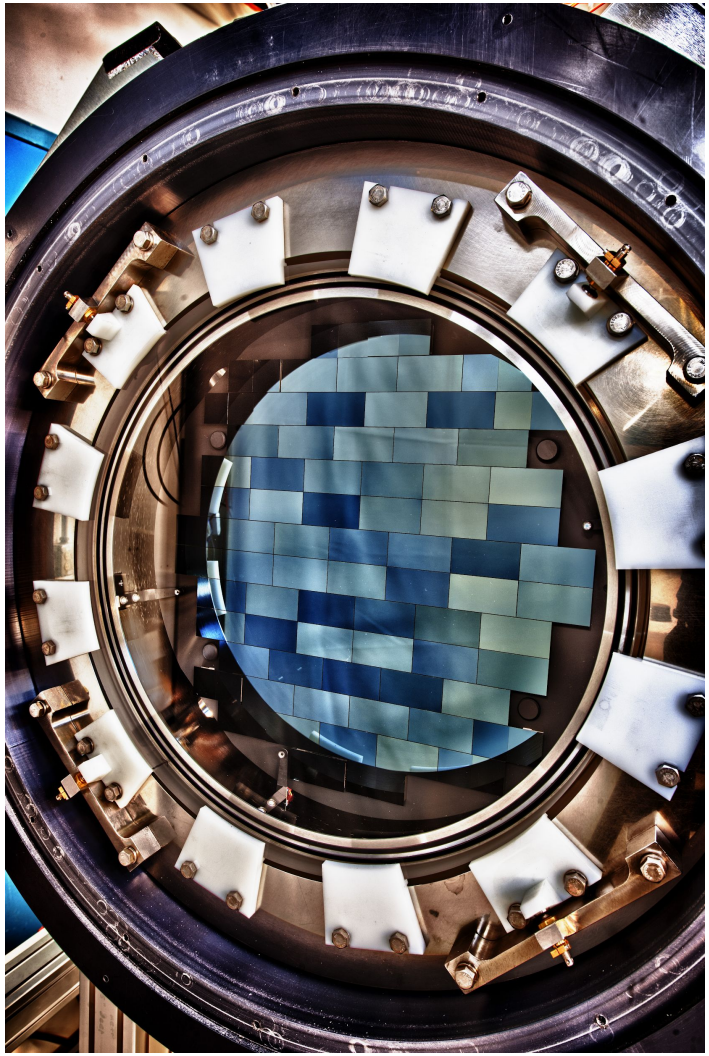
Dark Energy Survey Science Goals

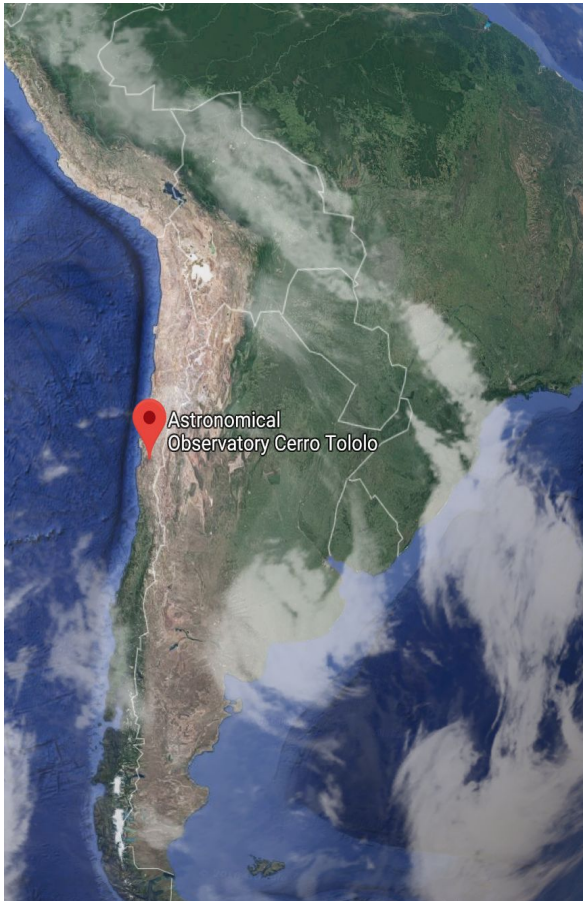




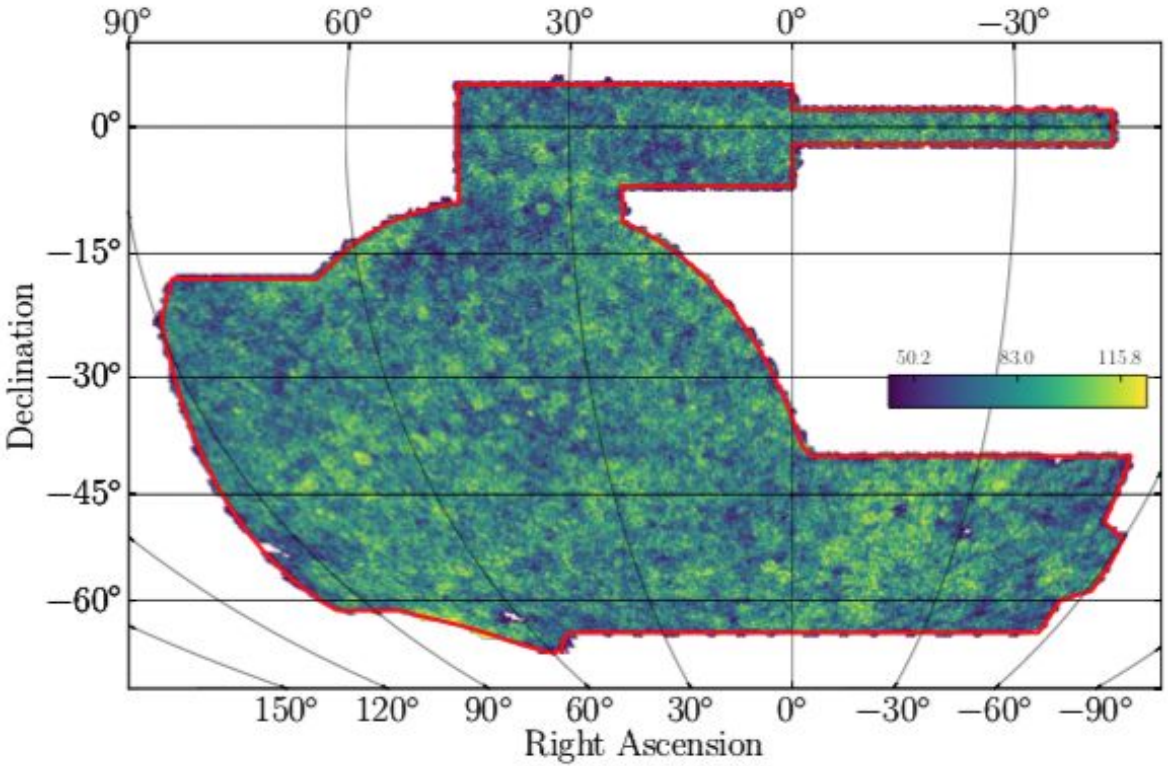
Dark Energy Camera





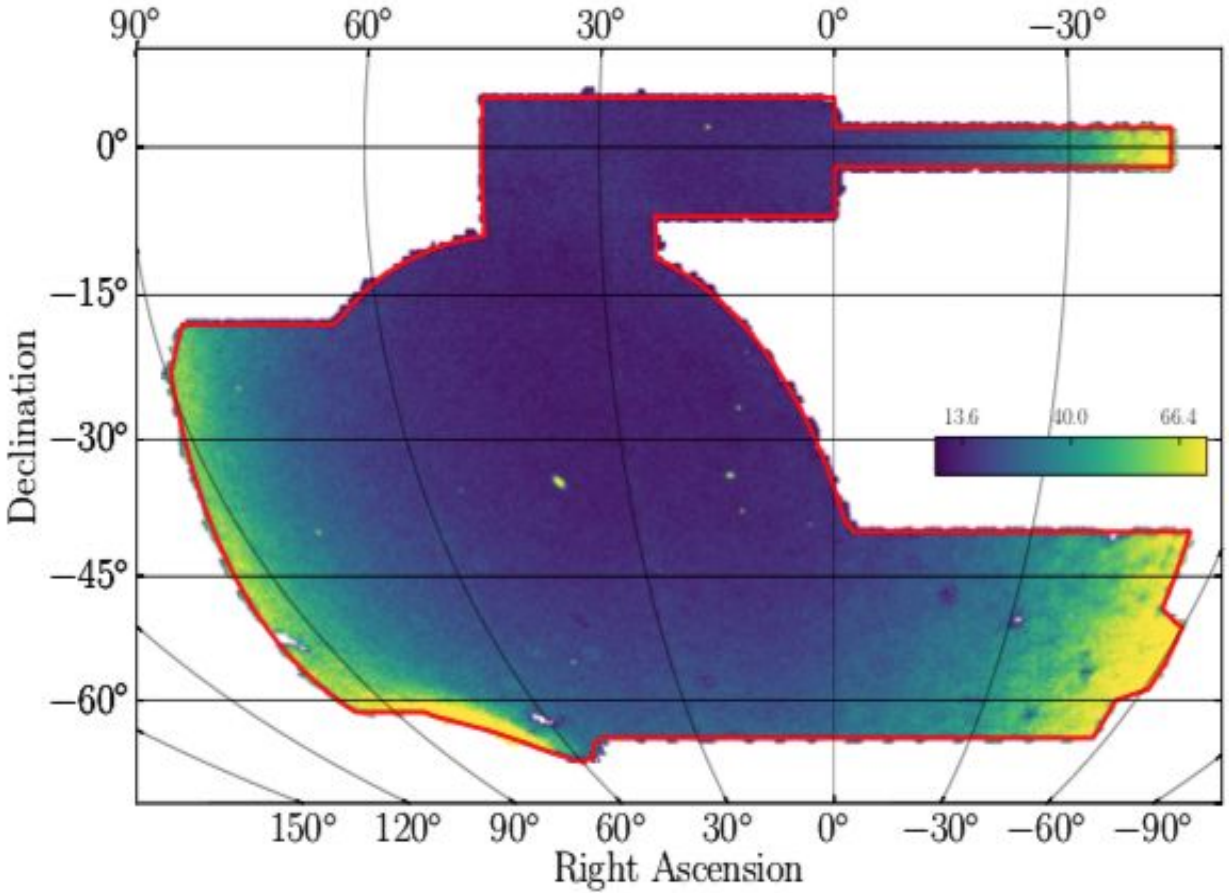

Astronomical
Observatory Cerro Tololo

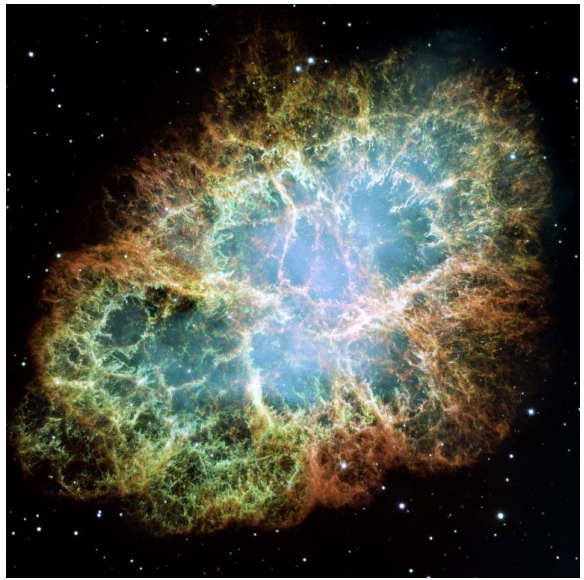
DES Data Release 1: Galaxies



DES Collaboration [1]

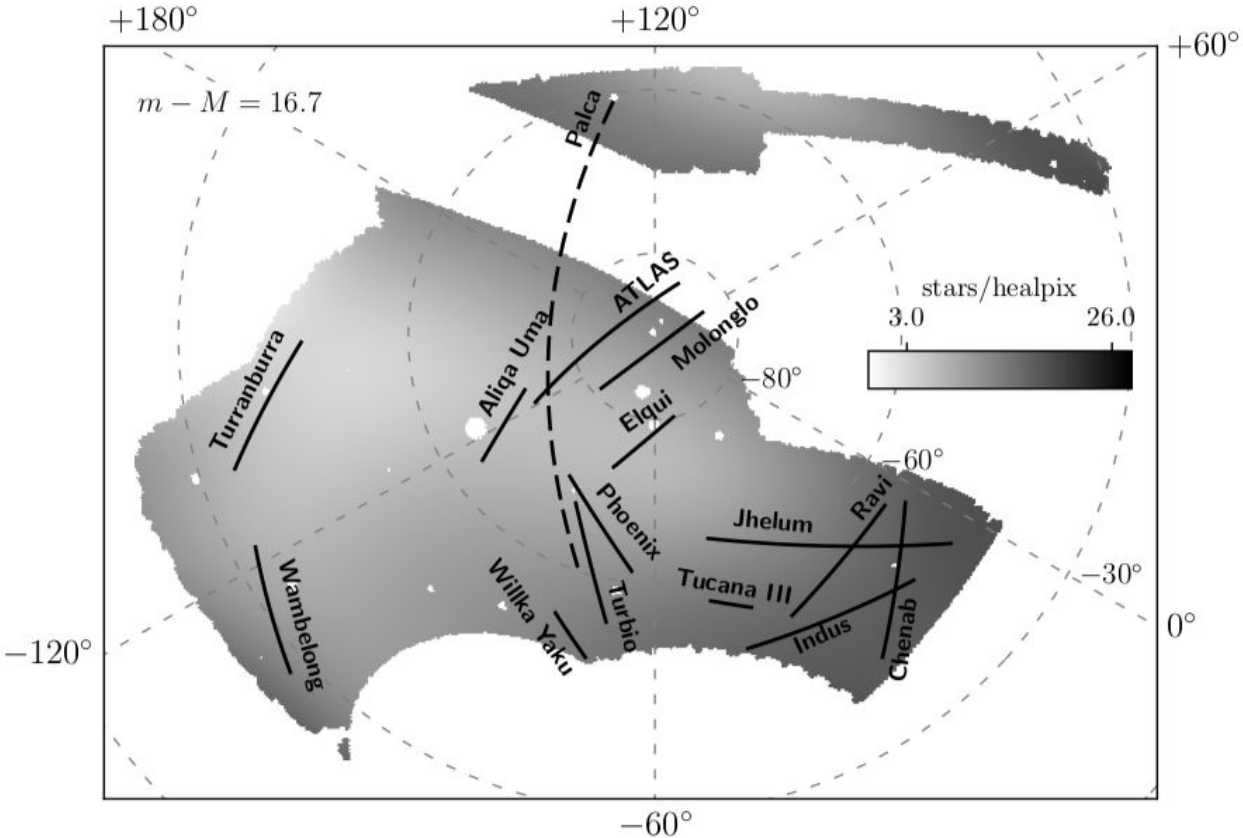
DES Data Release 1: Stars





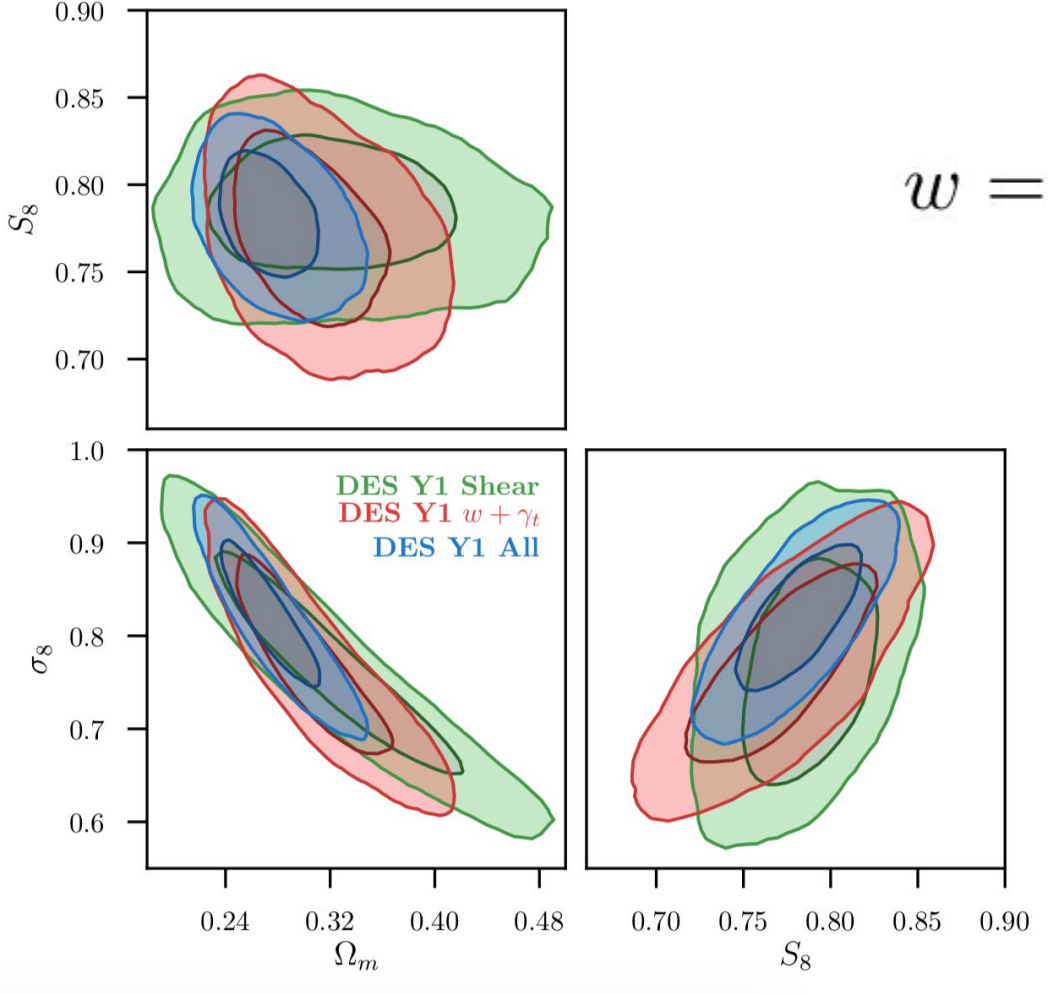
DES Collaboration [1]

DES DR1 discovered 11 stellar streams



Shipp et al. [2]

DES Y1 constraints on cosmological parameters

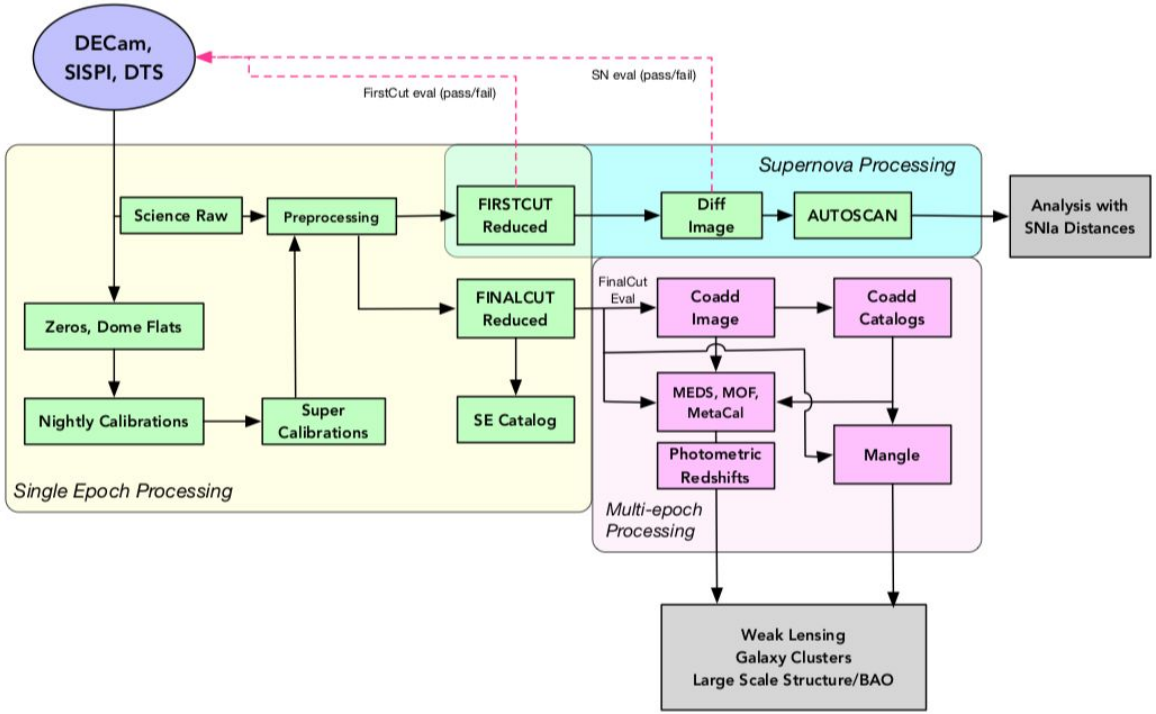


$$w = -1.00^{+0.04}_{-0.05}$$

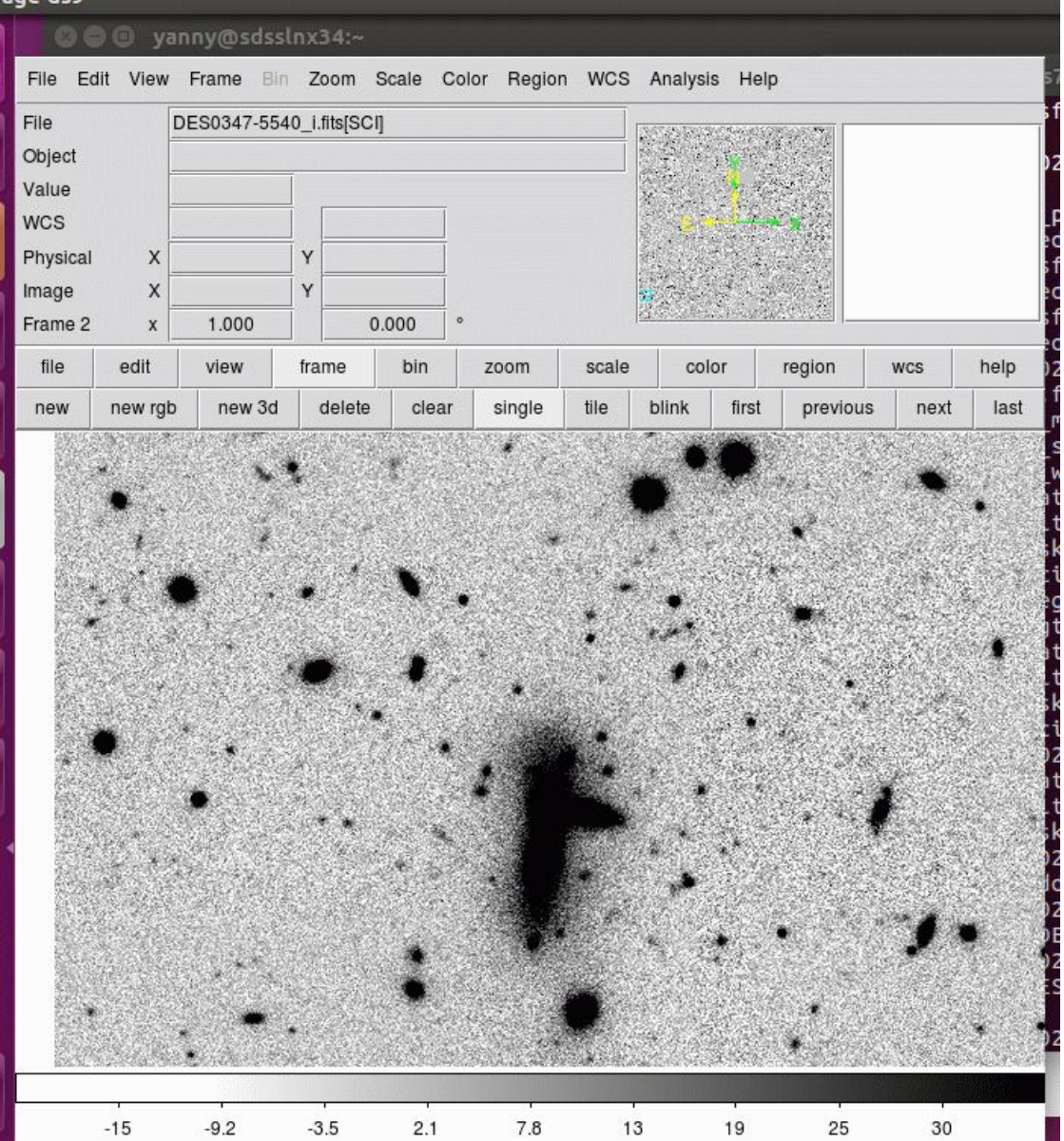
DES Collaboration [3]

Balrog

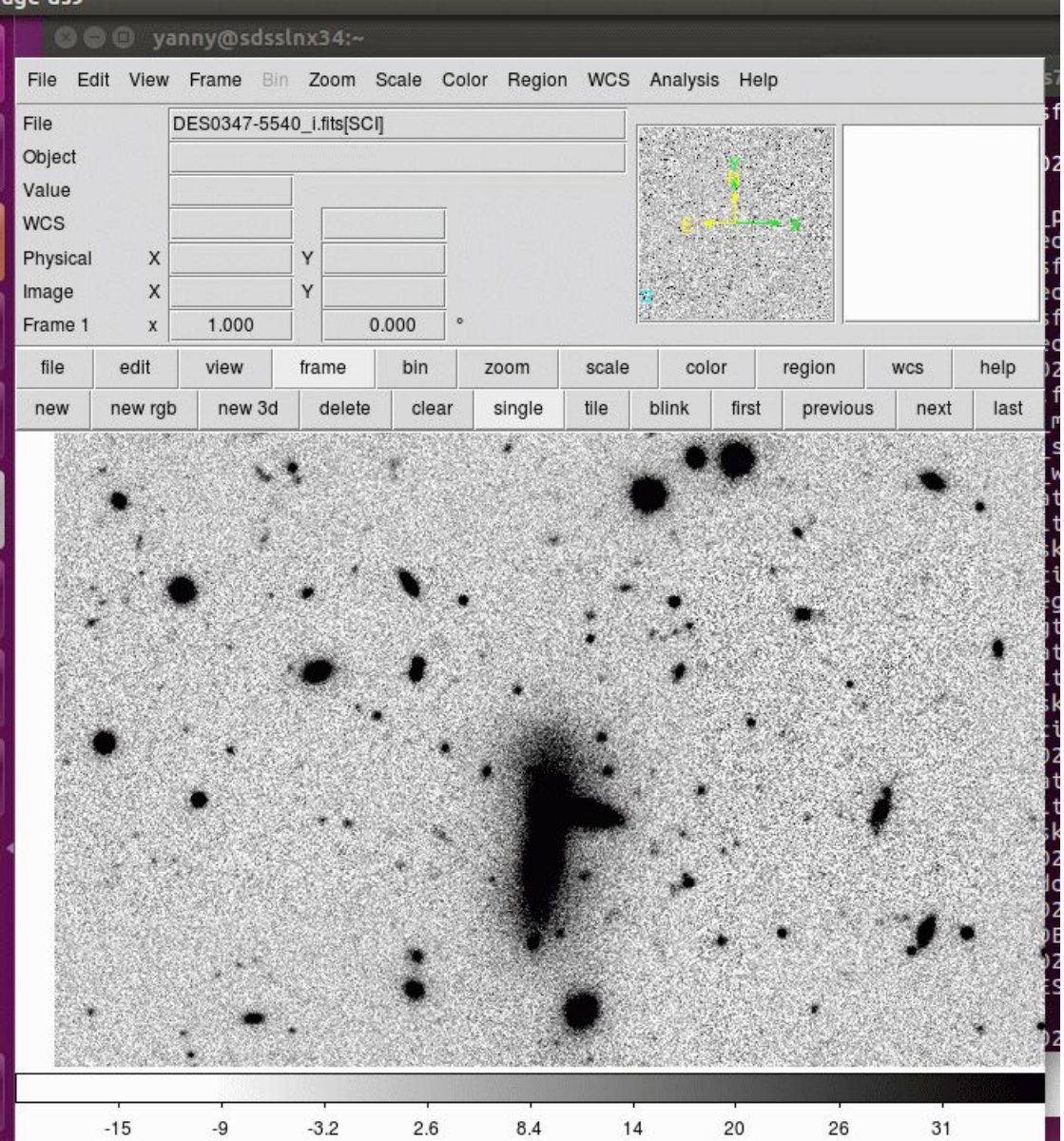
- *"digging too deeply and too greedily into data"*
- Understand systematic biases → useful for **all** DES working groups



DESDM pipeline schematic [4]



Balrog injections


yanny@sdsslnx34:~
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help
File DES0347-5540_i.fits[SCI]
Object
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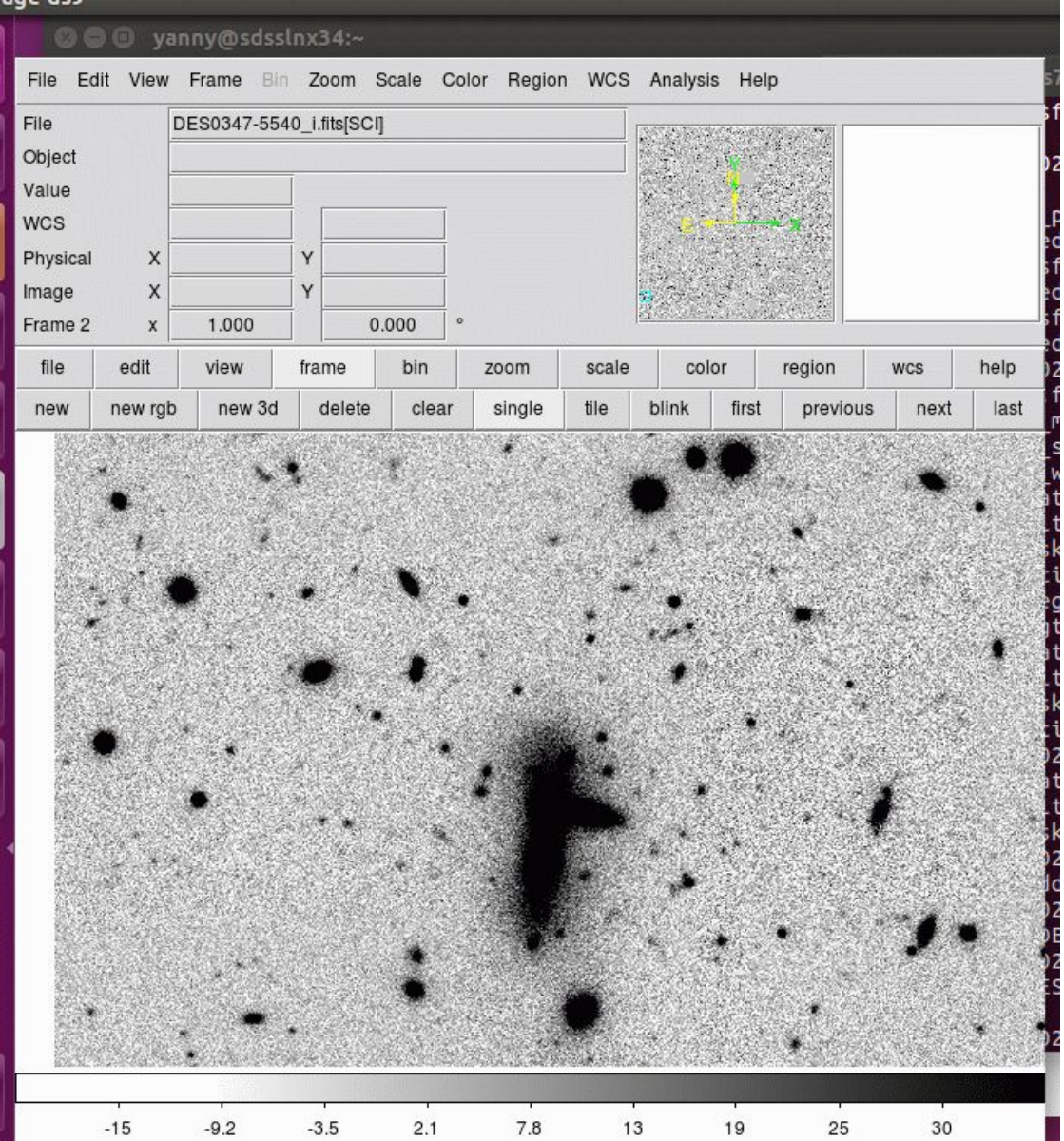
new new rgb new 3d delete clear single tile blink first previous next last
-15 -9 -3.2 2.6 8.4 14 20 26 31


yanny@sdsslnx34:~
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help
File DES0347-5540_i.fits[SCI]
Object
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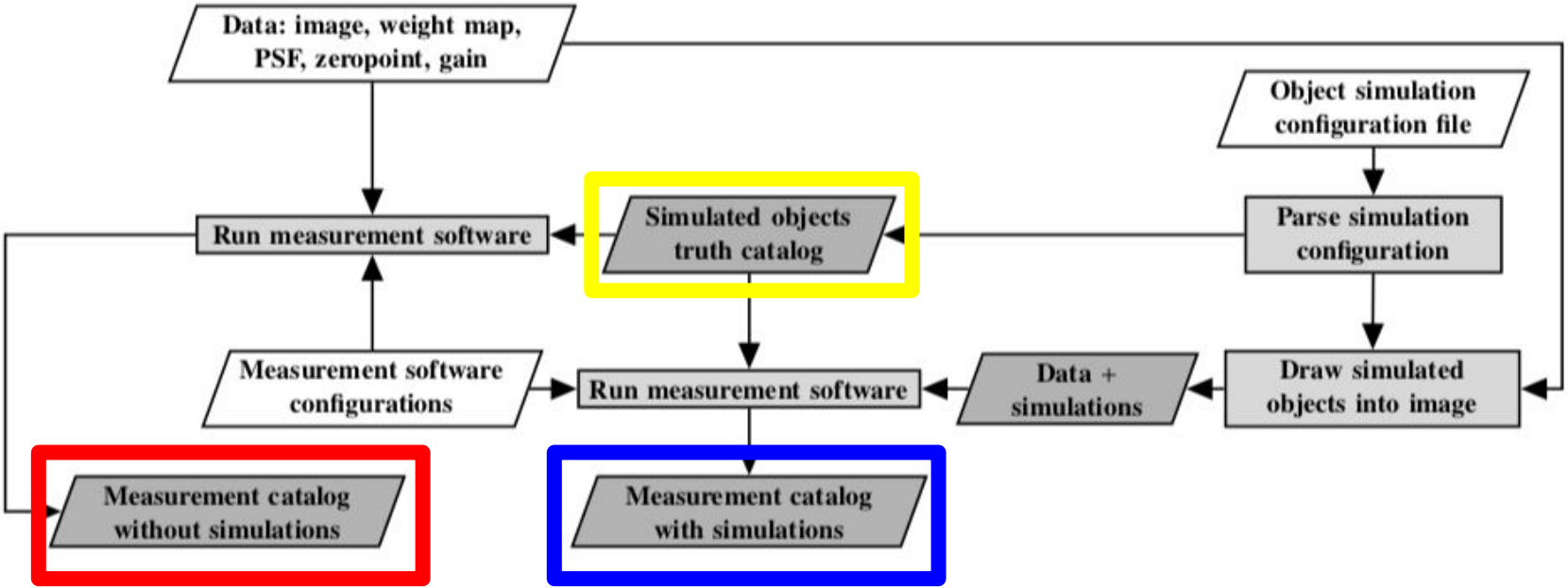
file edit view frame bin zoom scale color region wcs help
new new rgb new 3d delete clear single tile blink first previous next last
-15 -9.2 -3.5 2.1 7.8 13 19 25 30

Balrog validation

- Inject fake objects onto real images. Compare truth, real, and injected catalogs
- Agreement between real & injected and truth & injected?



Balrog overview [5]

Summary

- Tons of science is done with DES data (**much** more than discussed here)
- Balrog has the potential to help DES utilize more of its data

DES Collaboration [4]

Dark Energy Survey Working Groups

- Galaxy Clusters
- Supernovae
- Weak Lensing
- Theory and Combined Probes
- Milky Way
- Strong Lensing
- Large-Scale Structure
- Simulations
- Redshift
- Galaxy Evolution & QSO
- Transients & Moving Objects
- Science Release
- Science Committee

References

[1] https://arxiv.org/abs/1801.03181

[2] https://arxiv.org/abs/1801.03097

[3] https://arxiv.org/abs/1708.01530

[4] https://arxiv.org/abs/1801.03177

[5] https://arxiv.org/abs/1507.08336

Balrog software: https://github.com/sweverett/Balrog-GalSim, https://github.com/emhuff/Balrog

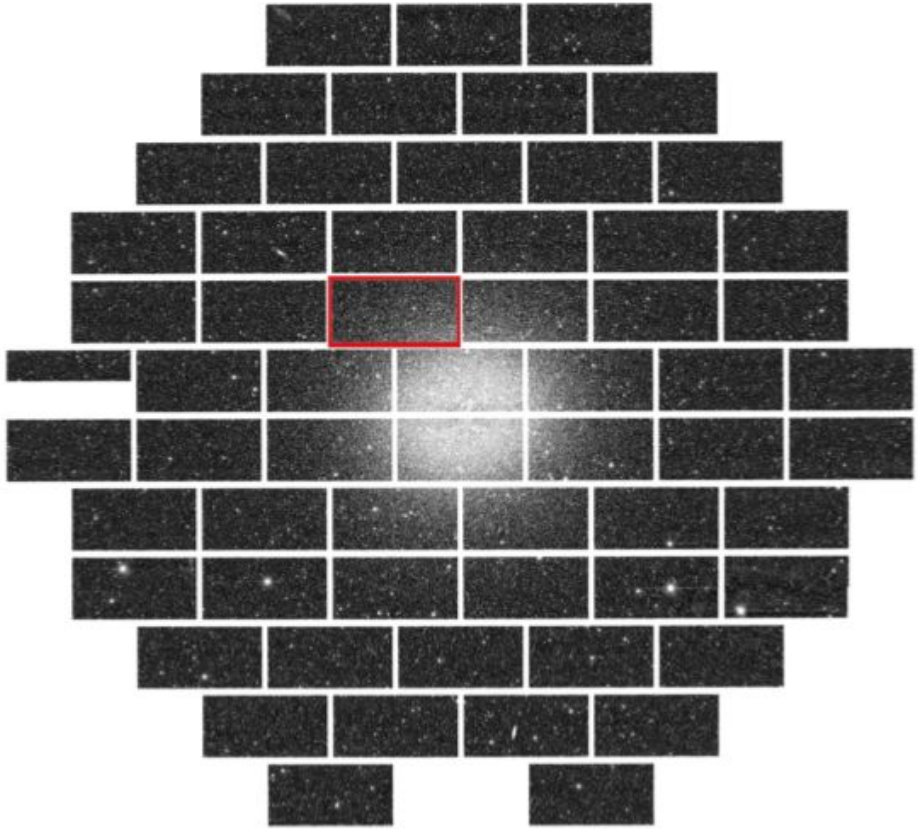
Some validation tests: https://github.com/spletts/BalVal

Extra Slides...

Probes

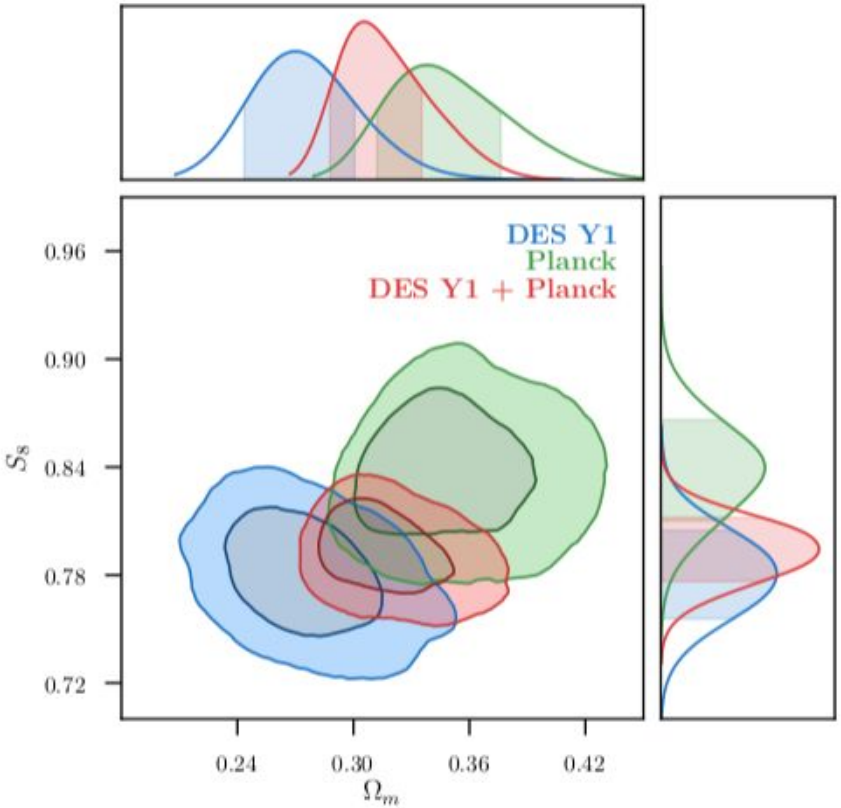
- Supernovae
- Galaxy Clusters
- Gravitational Lensing
- Baryon Acoustic Oscillations

Dark Energy Camera

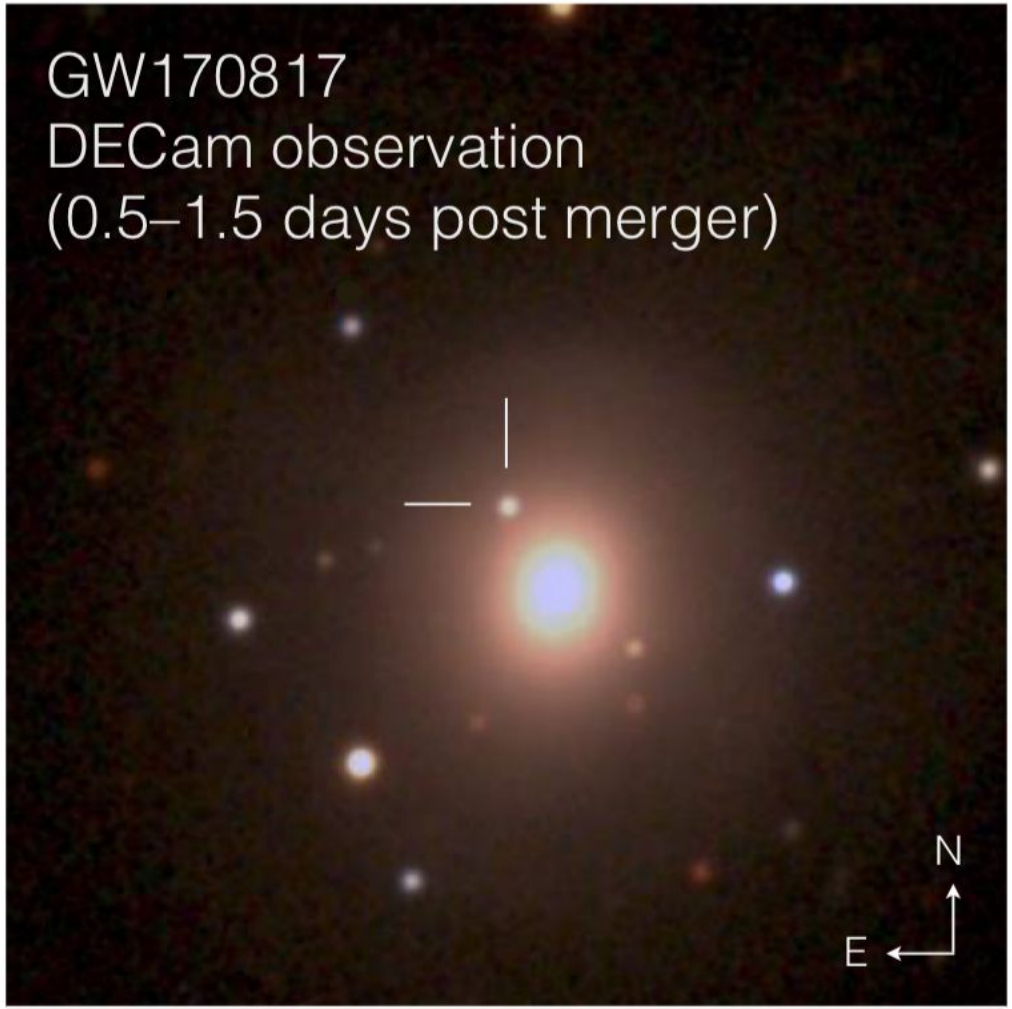


Camera image [1]

DES Y1 comparison to Planck

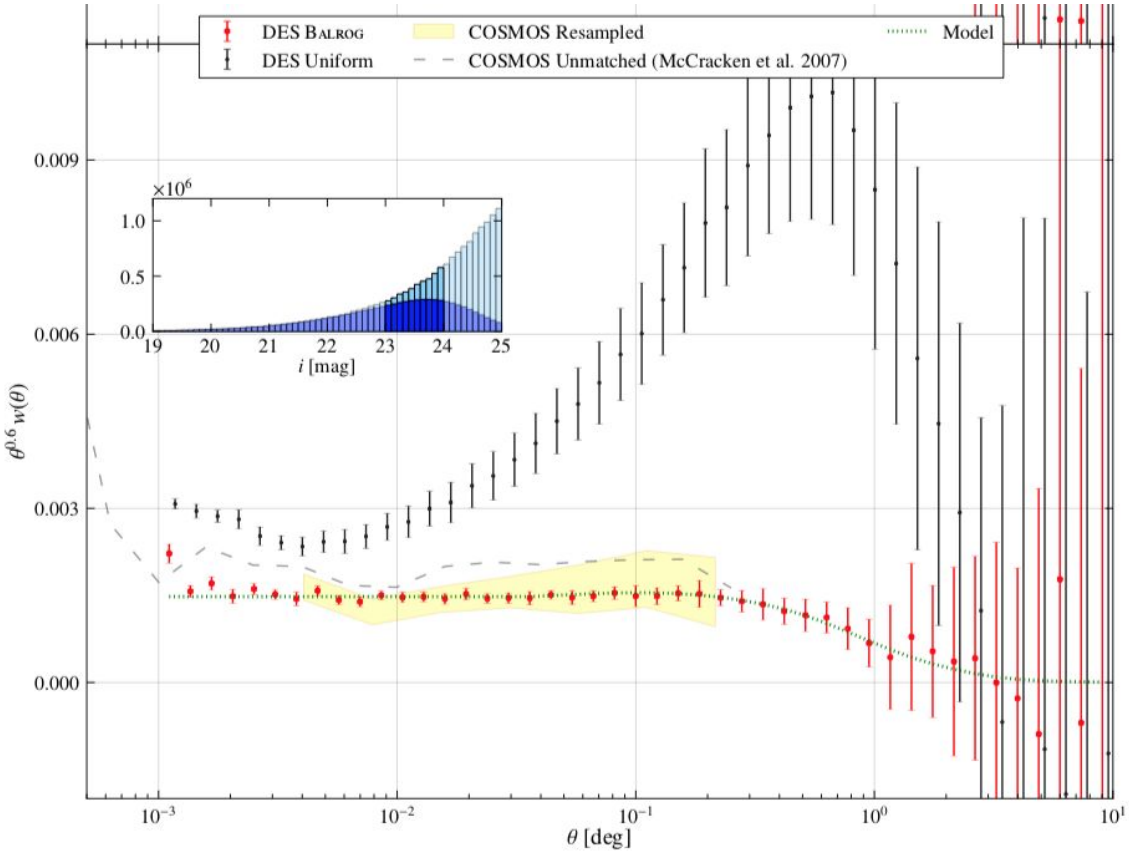


Kilonova



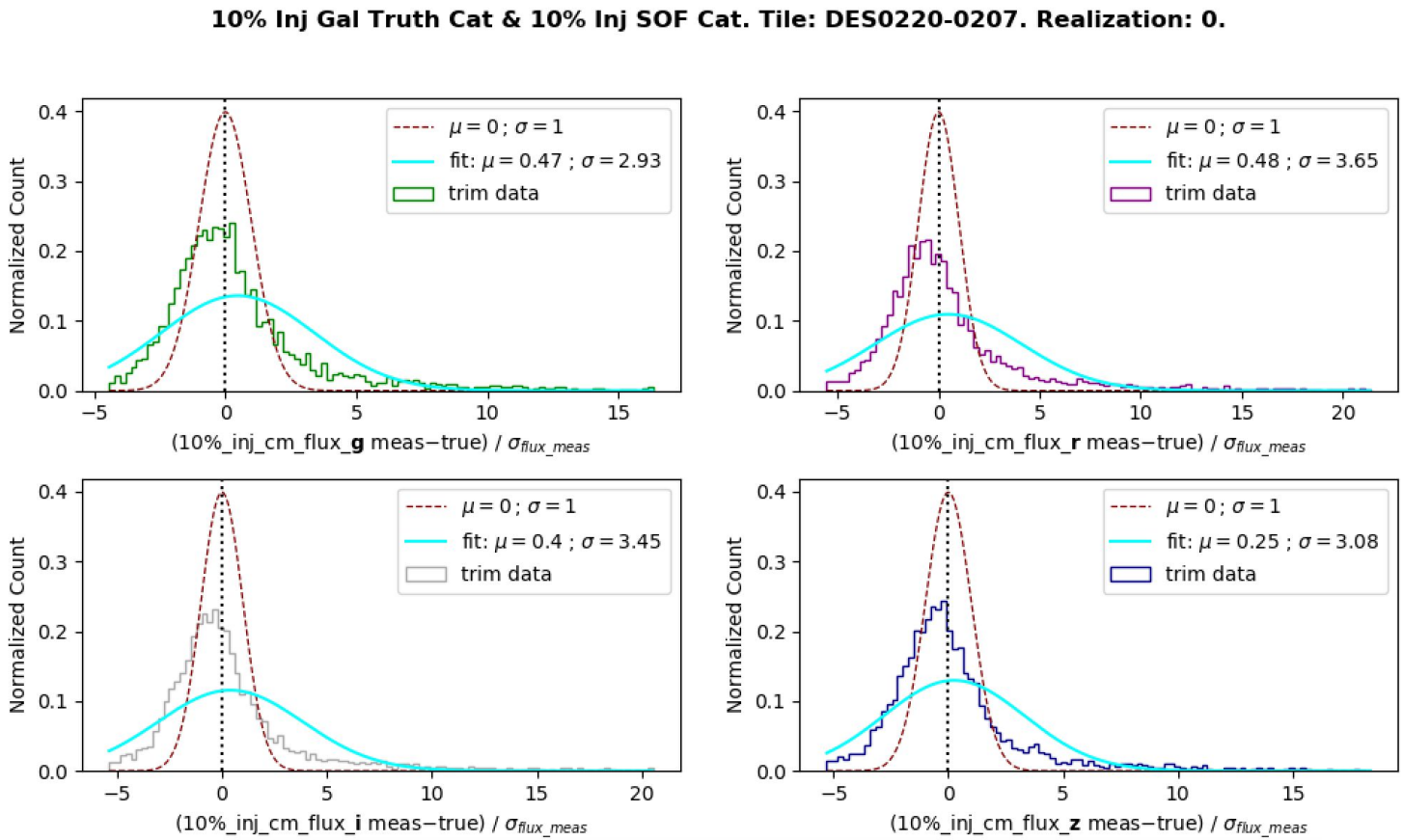
https://arxiv.org/abs/1710.05459

Science Verification Balrog Results

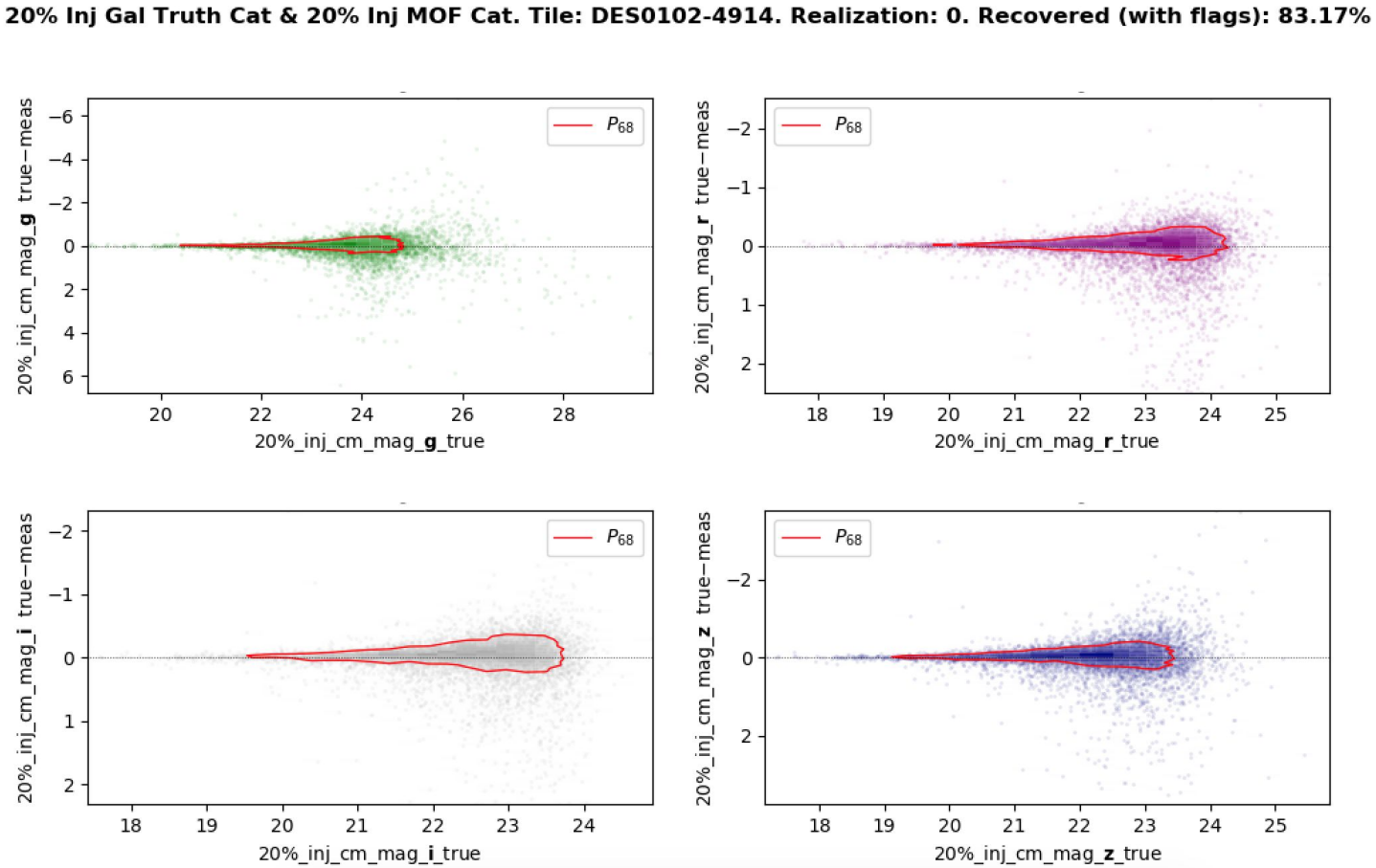


Reference []

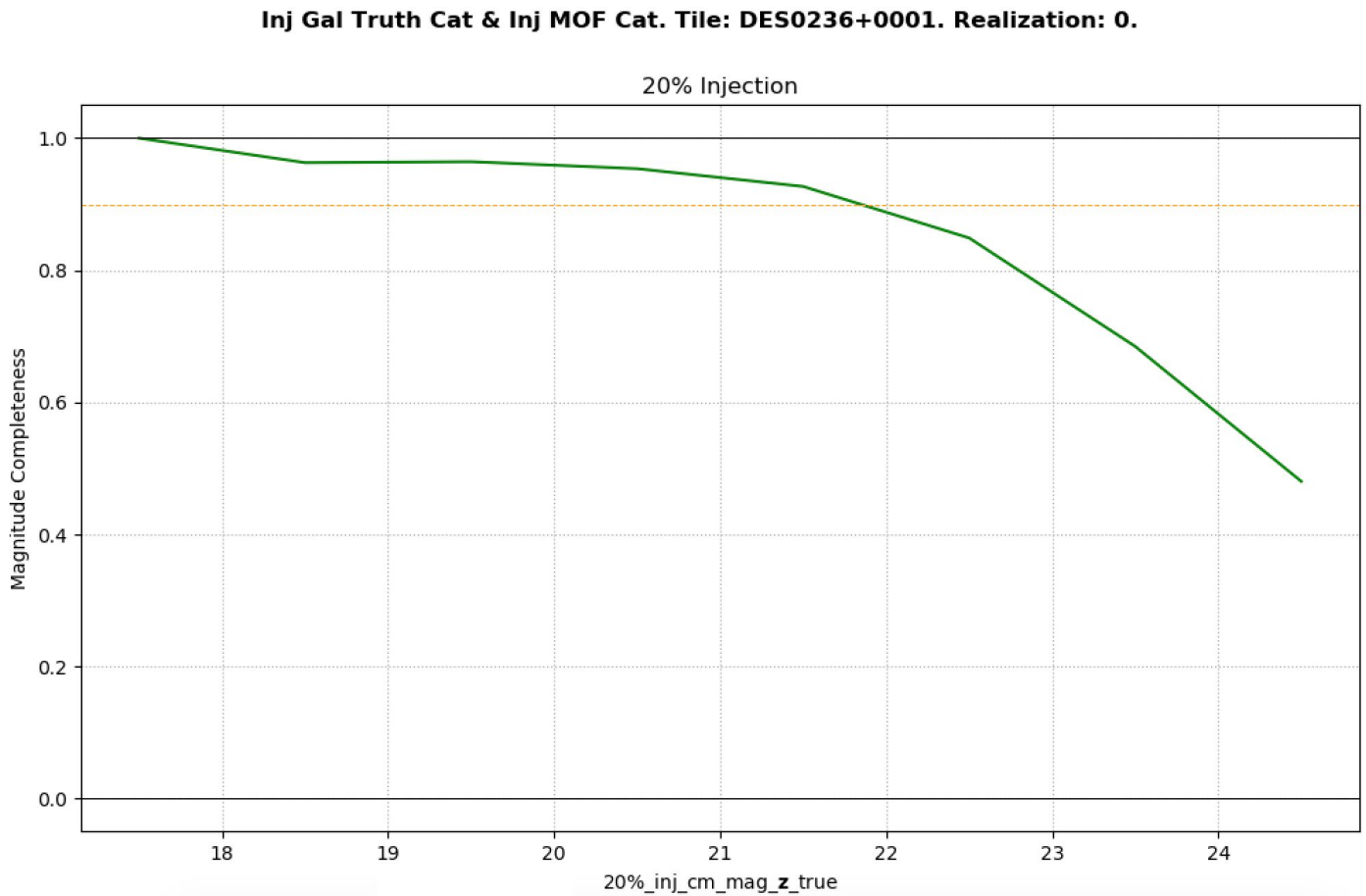
Validating Balrog -- Flux



Validating Balrog -- Magnitude



Validating Balrog -- Completeness



Validating Balrog -- Color