



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

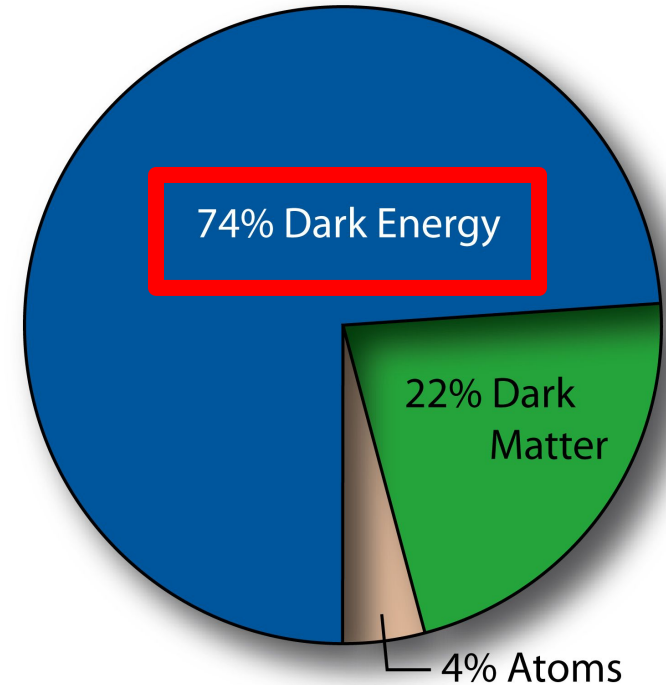
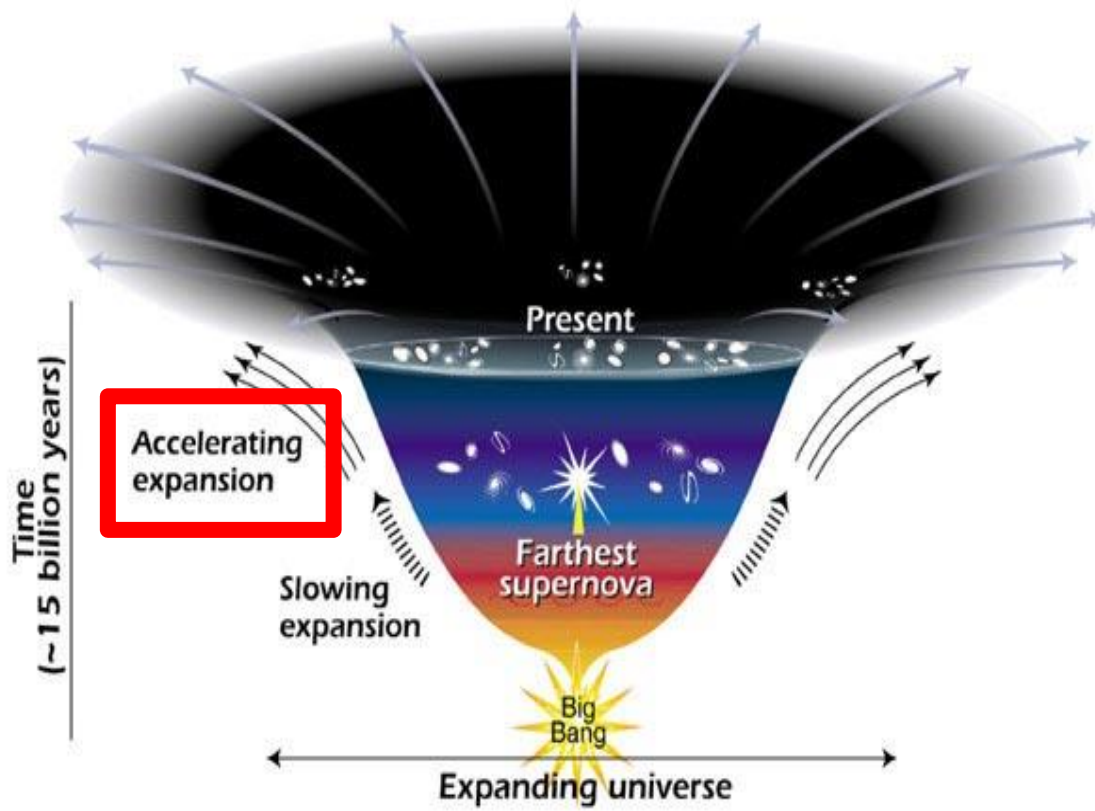


Dark Energy Survey Member Institutions

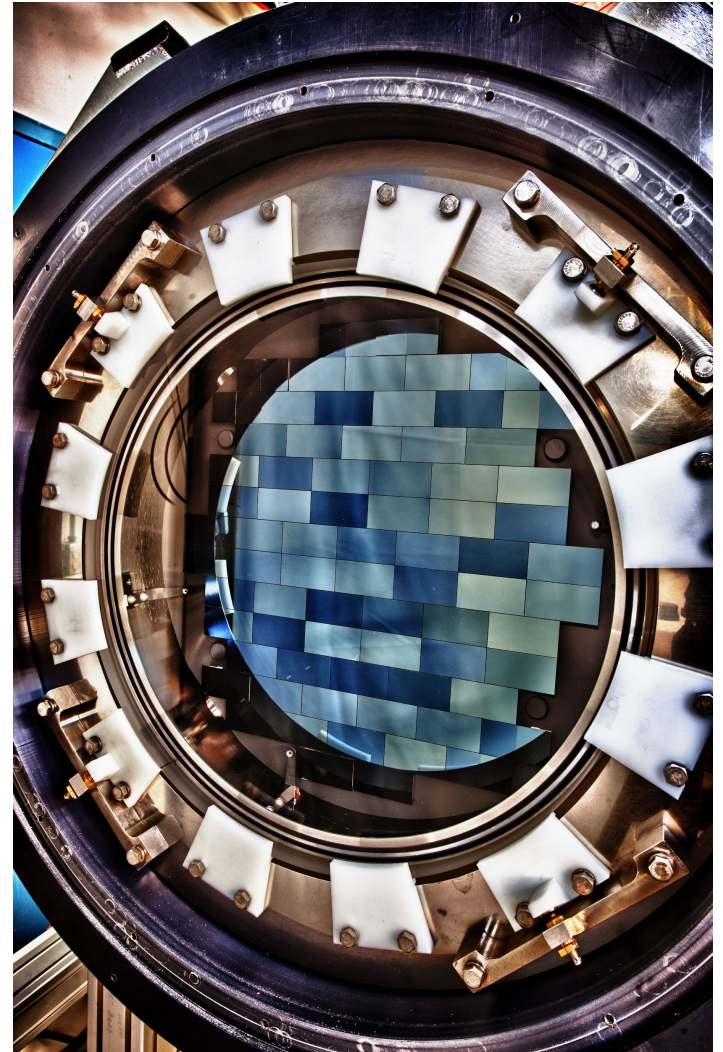
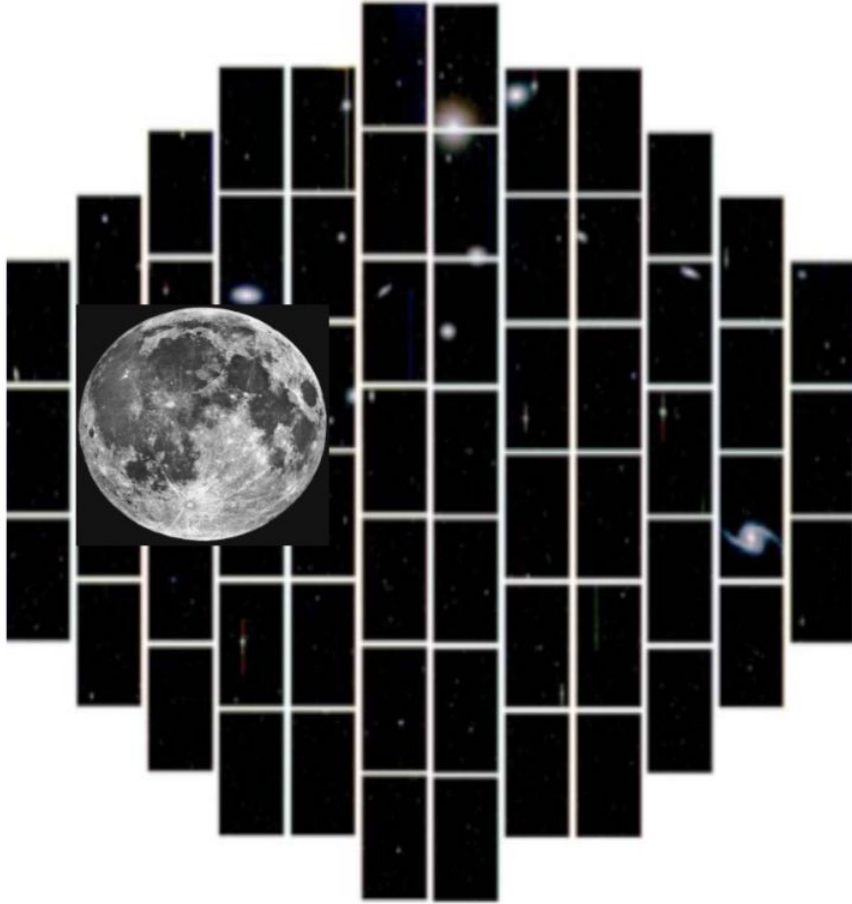
Fermilab, UIUC/NCSA, University of Chicago, LBNL, NOAO, University of Michigan, University of Pennsylvania, Argonne National Laboratory, Ohio State University, Santa-Cruz/SLAC/Stanford Consortium, Texas A&M (+scientists at CMU, Arizona, Brandeis, Wisconsin,...)

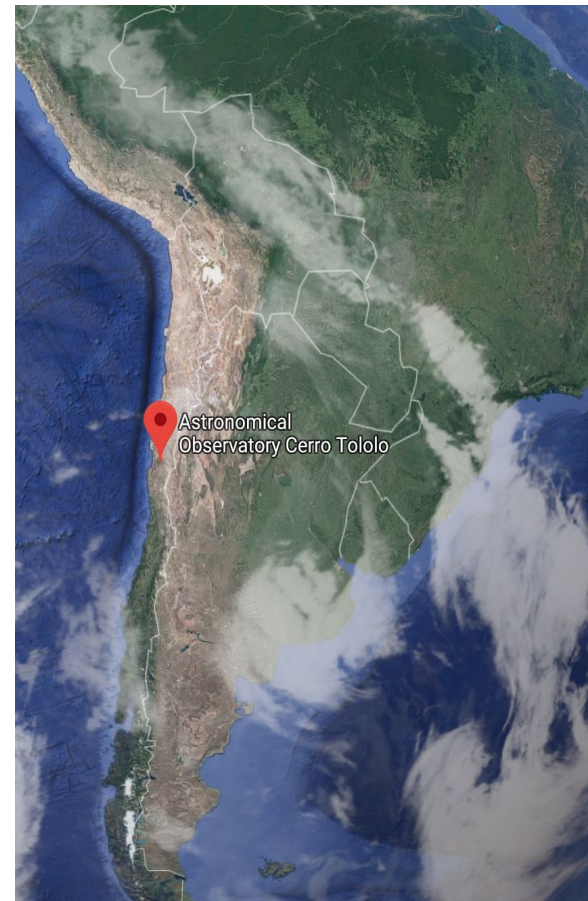


Dark Energy Survey Science Goals

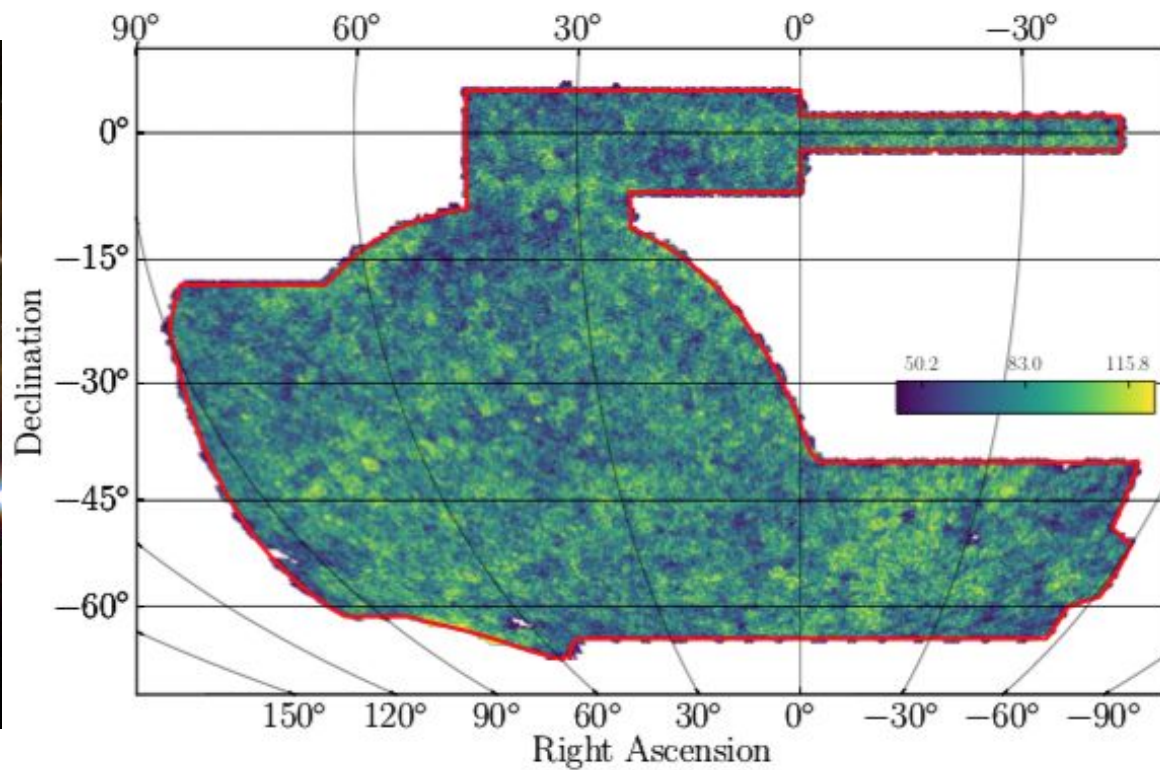


Dark Energy Camera



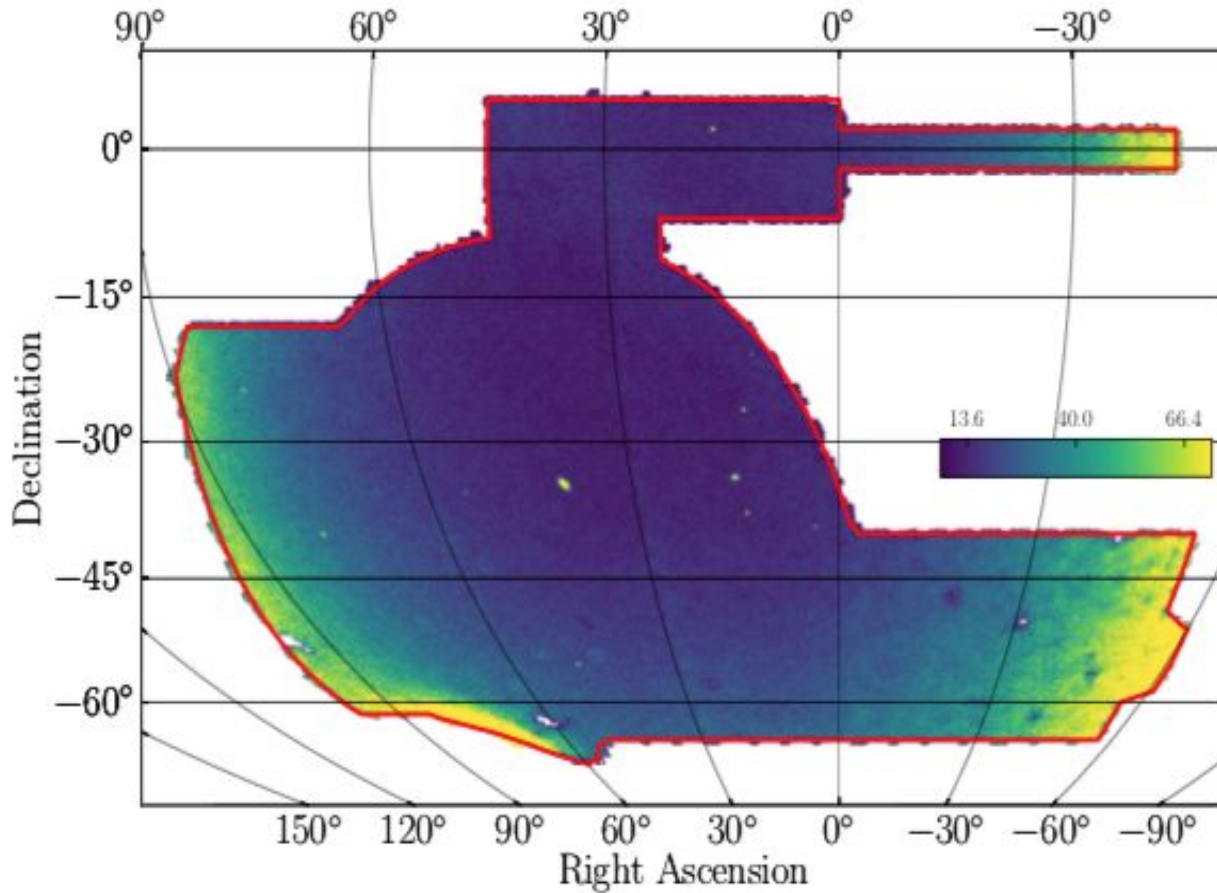


DES Data Release 1: Galaxies

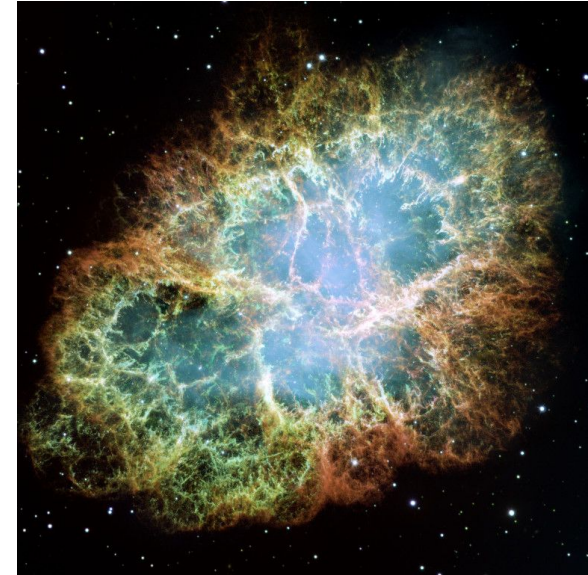


DES Collaboration [1]

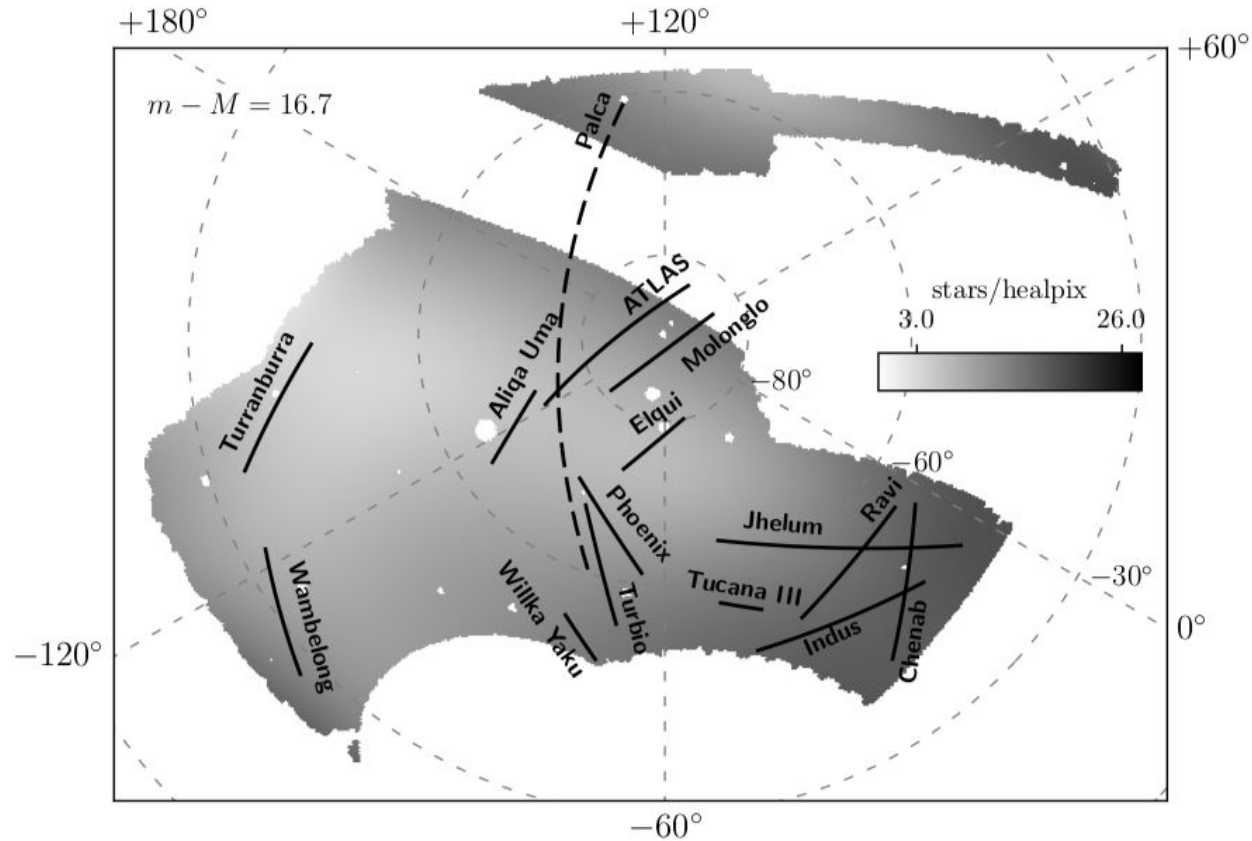
DES Data Release 1: Stars



DES Collaboration [1]

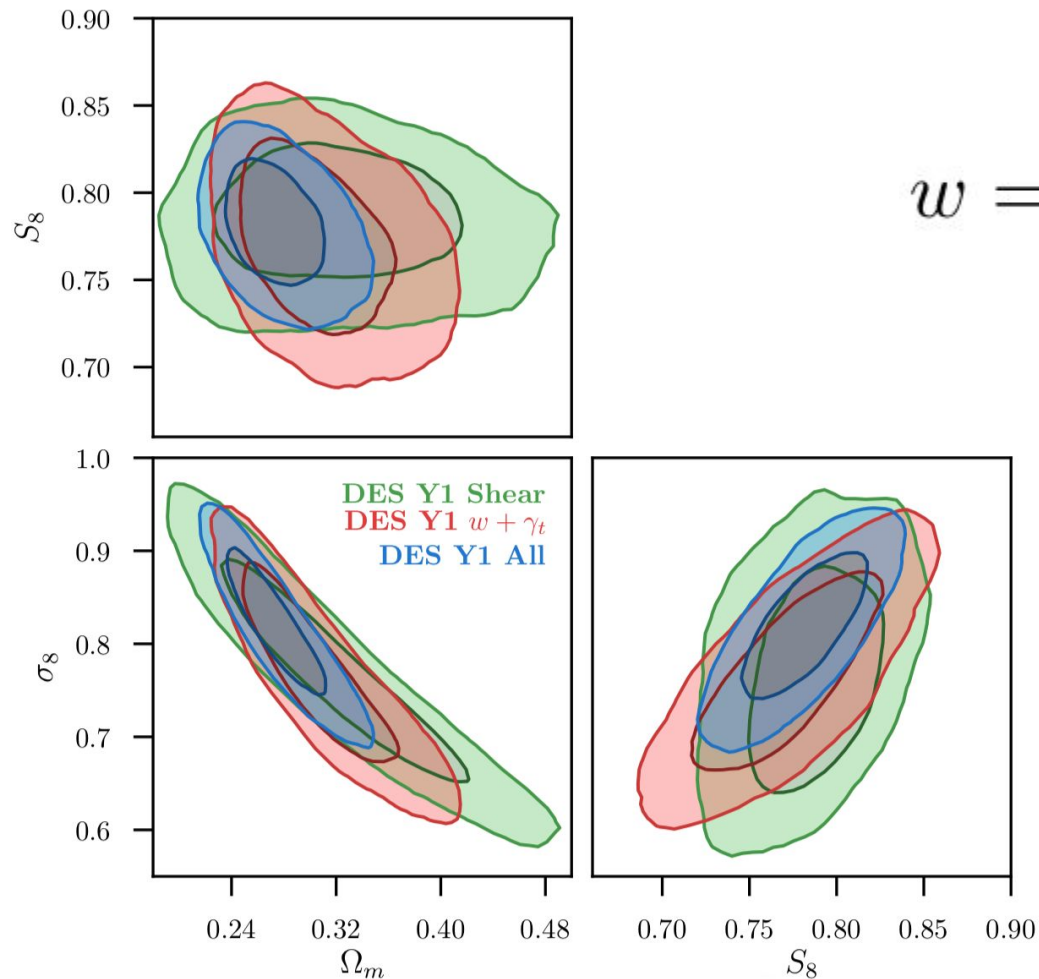


DES DR1 discovered 11 stellar streams



Shipp et al. [2]

DES Y1 constraints on cosmological parameters

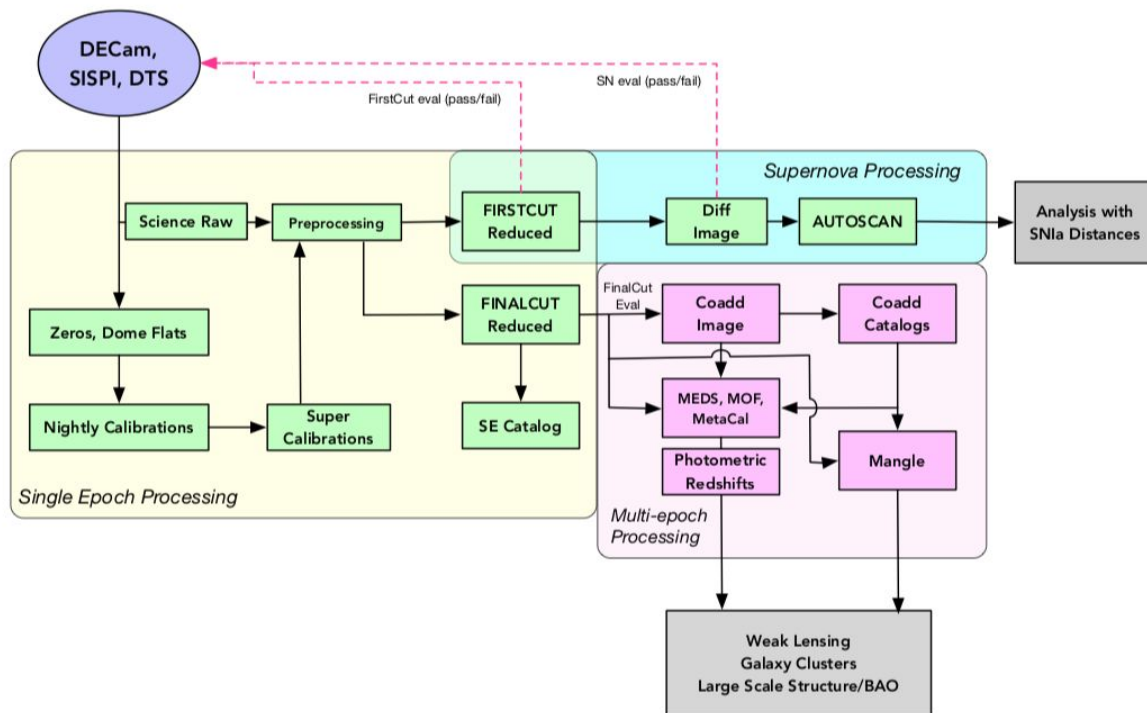


$$w = -1.00^{+0.04}_{-0.05}$$

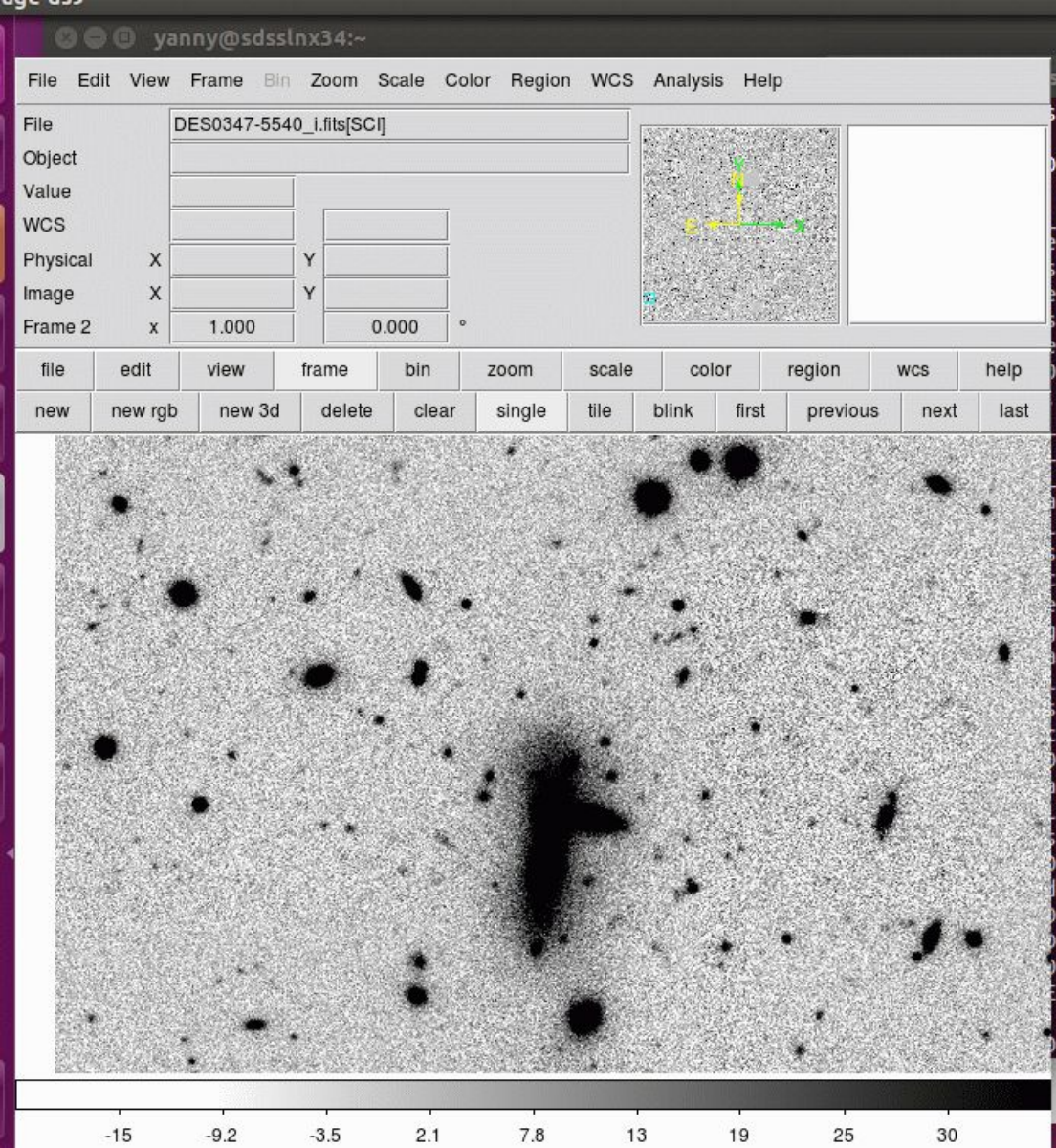
DES Collaboration [3]

Balrog

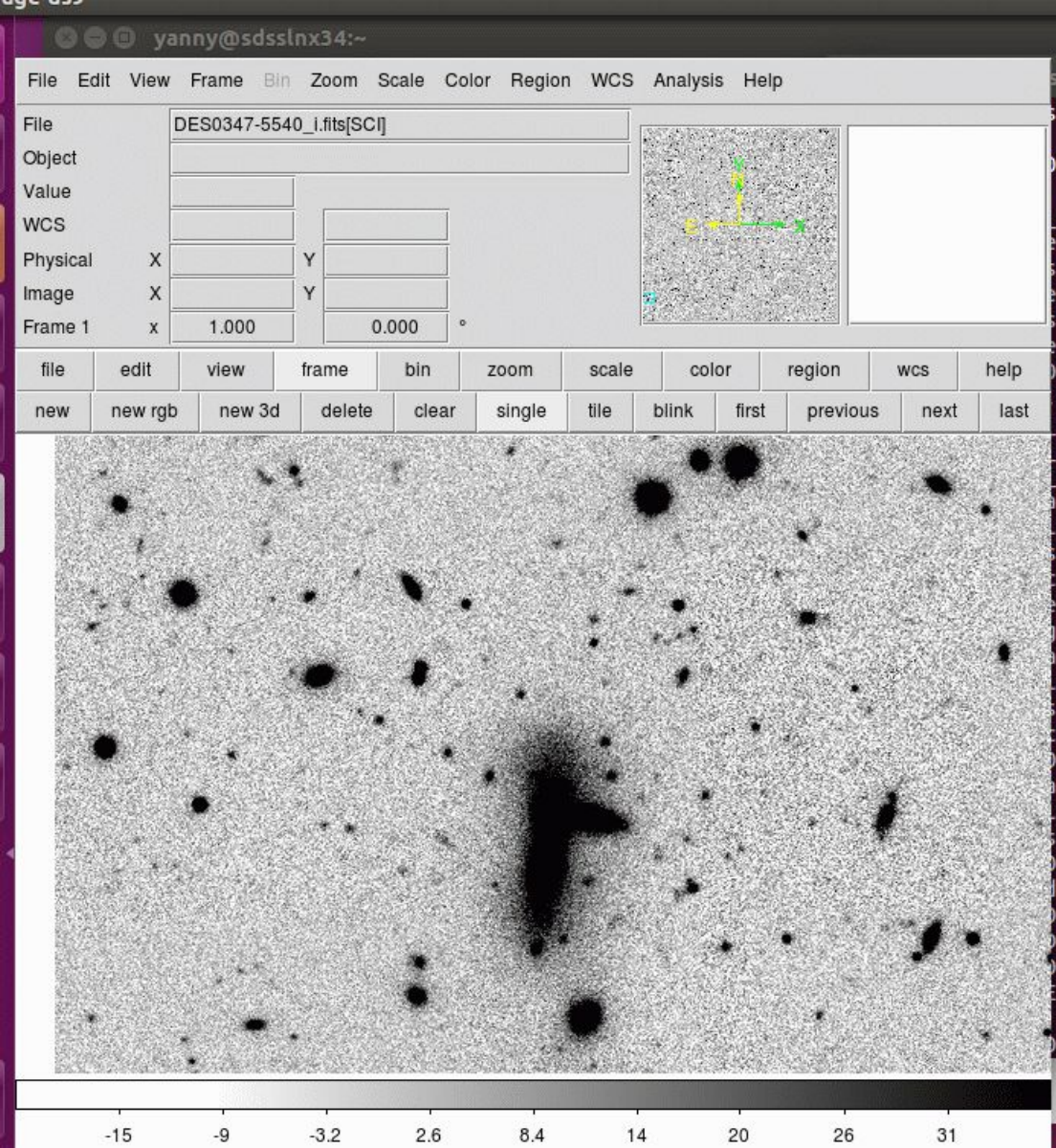
- “*digging too deeply and too greedily into data*”
- Understand systematic biases → useful for **all** DES working groups



DESDM pipeline schematic [4]



Balrog injections



File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help

File DES0347-5540_i.fits[SCI]

Object

Value

WCS

Physical X

Y

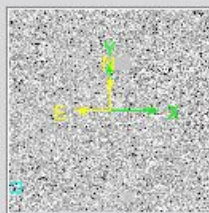
Image X

Y

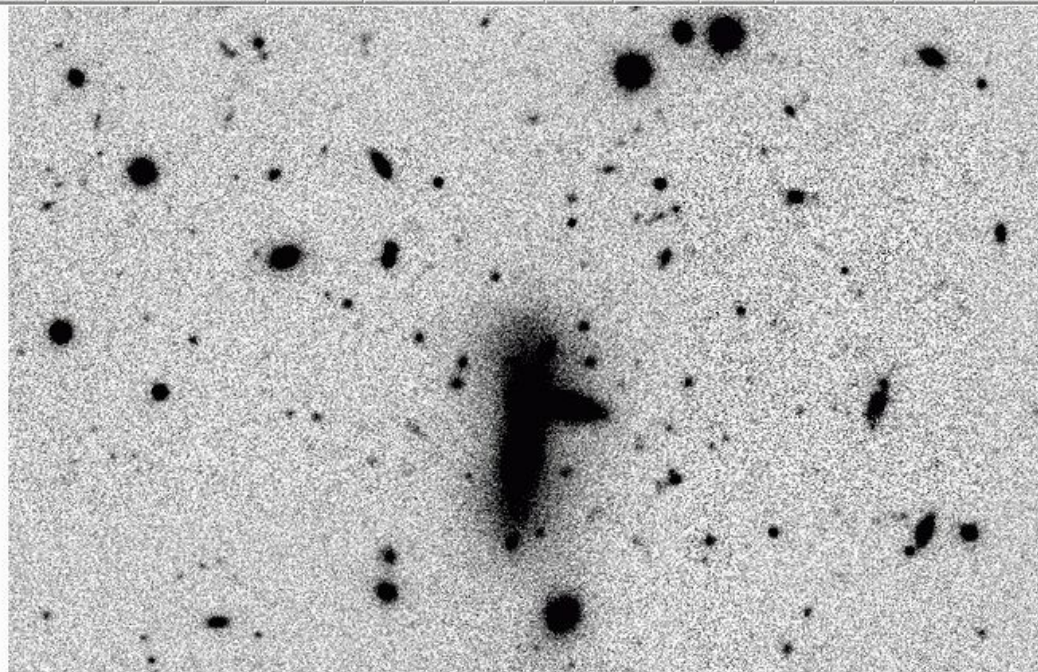
Frame 2 x

1.000

0.000 °



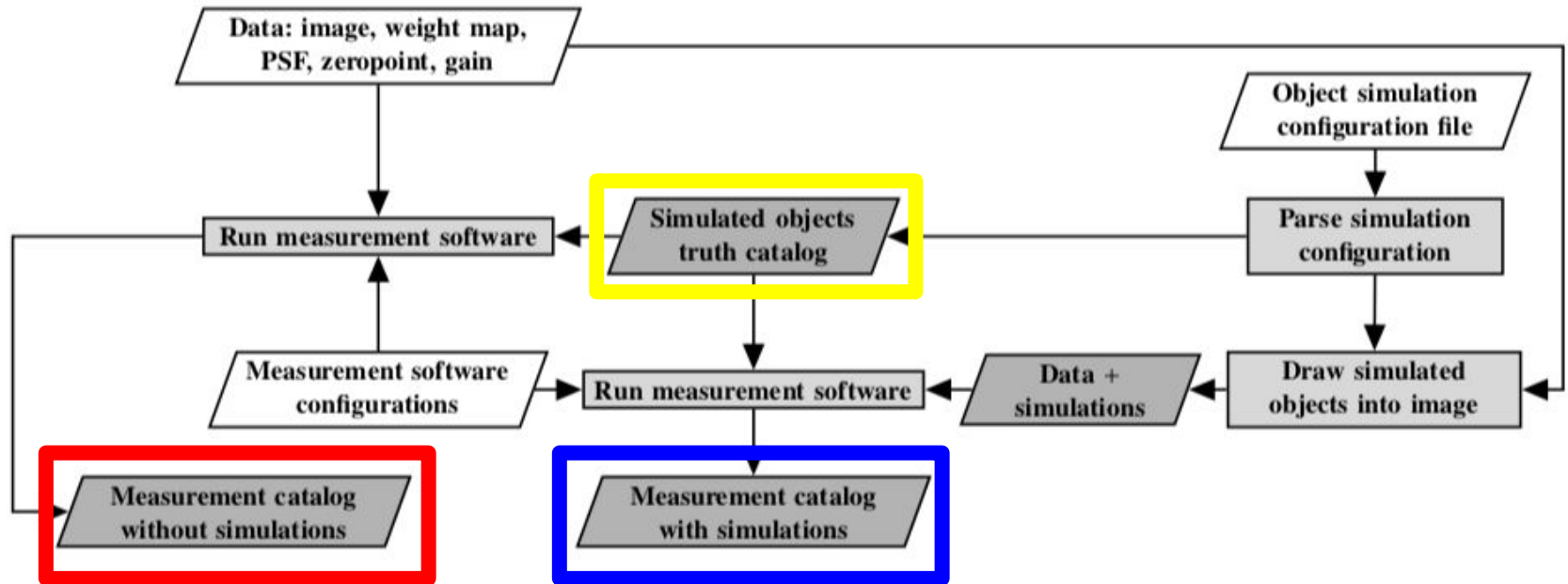
file	edit	view	frame	bin	zoom	scale	color	region	wcs	help	
new	new rgb	new 3d	delete	clear	single	tile	blink	first	previous	next	last



-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



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>

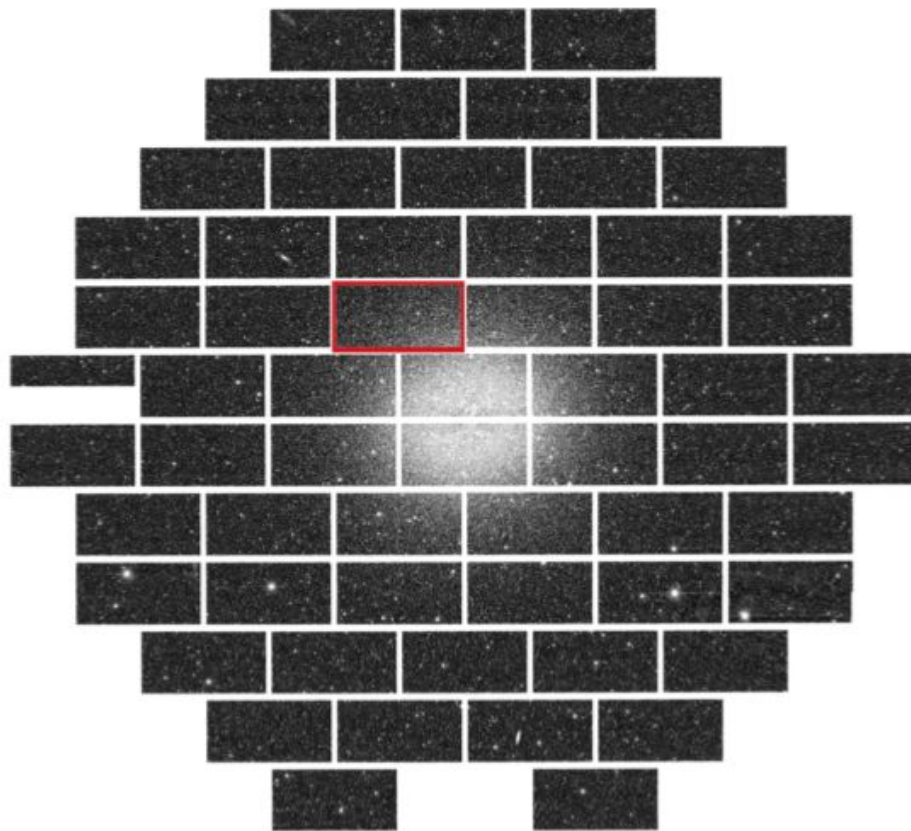
Extra Slides...



Probes

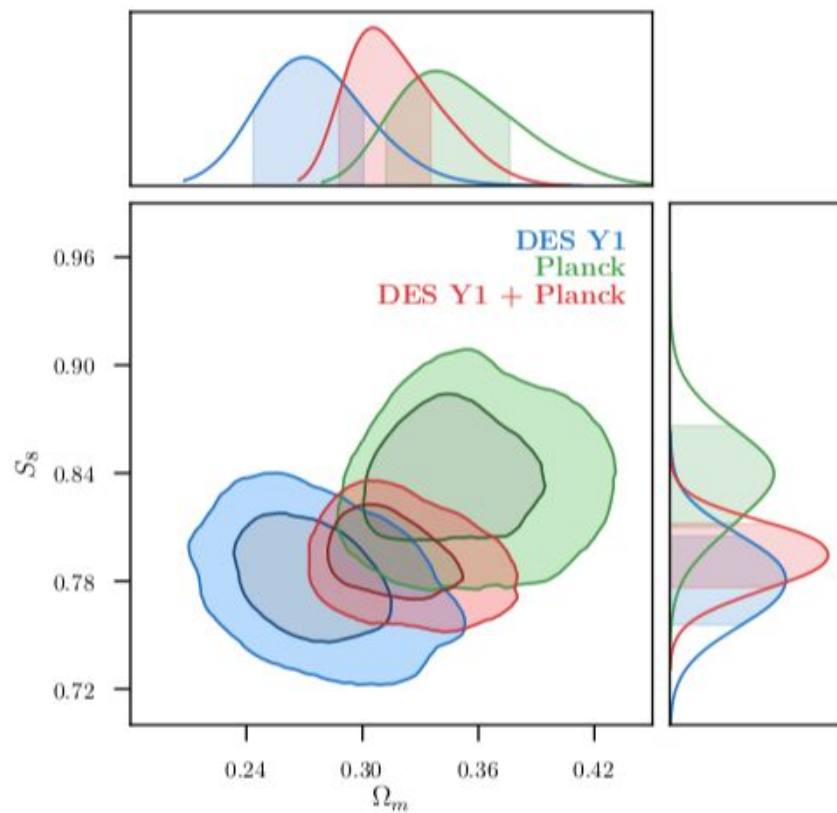
- Supernovae
- Galaxy Clusters
- Gravitational Lensing
- Baryon Acoustic Oscillations

Dark Energy Camera



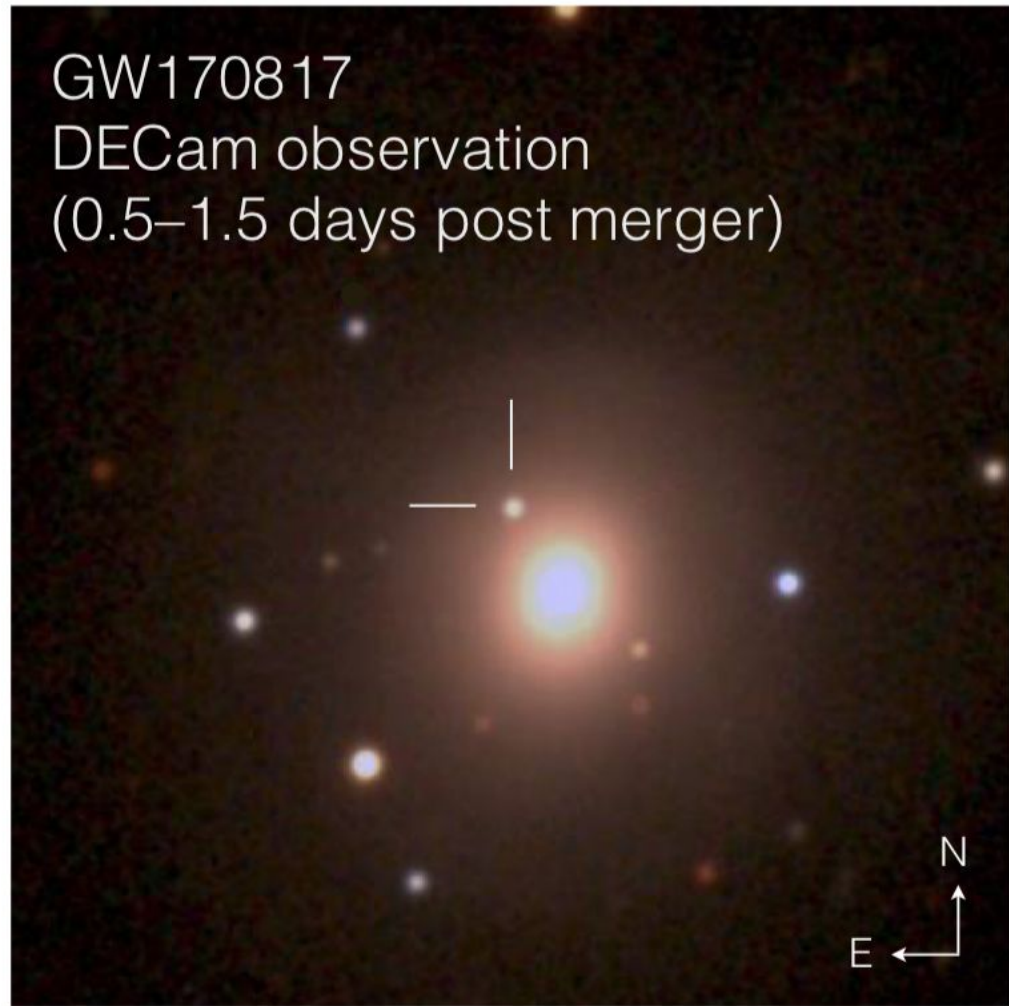
Camera image [1]

DES Y1 comparison to Planck



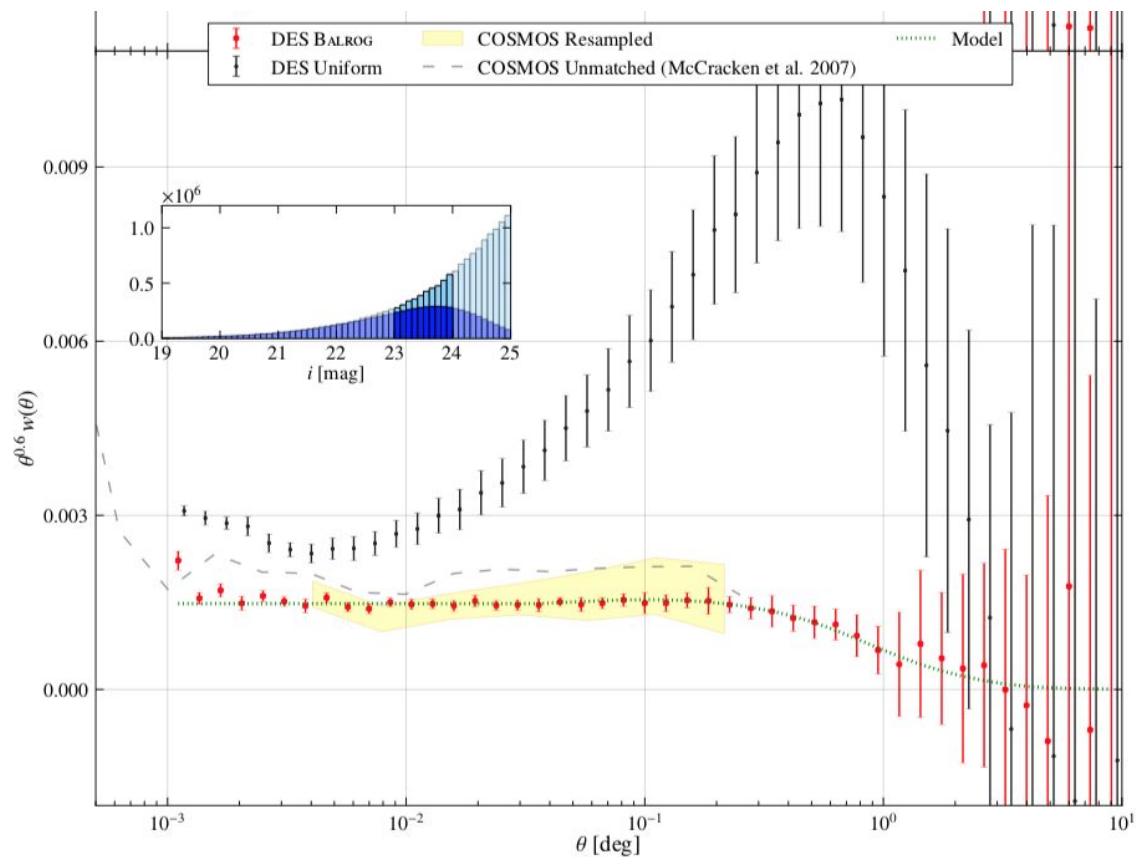
Kilonova

GW170817
DECam observation
(0.5–1.5 days post merger)



<https://arxiv.org/abs/1710.05459>

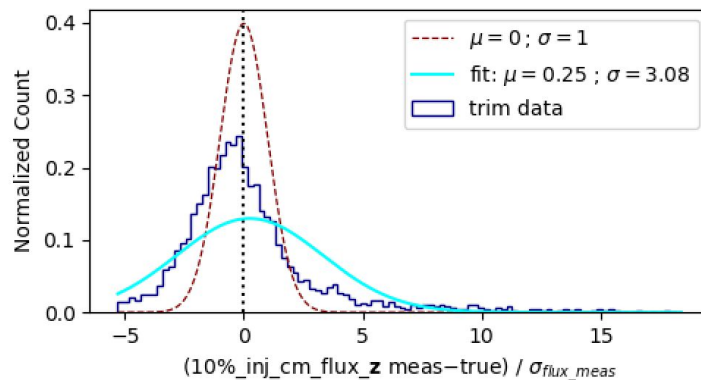
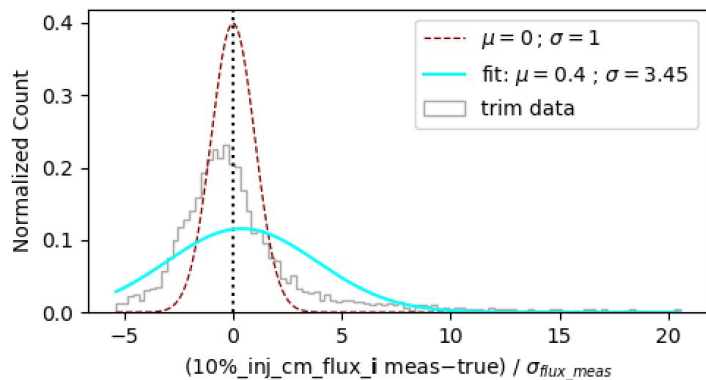
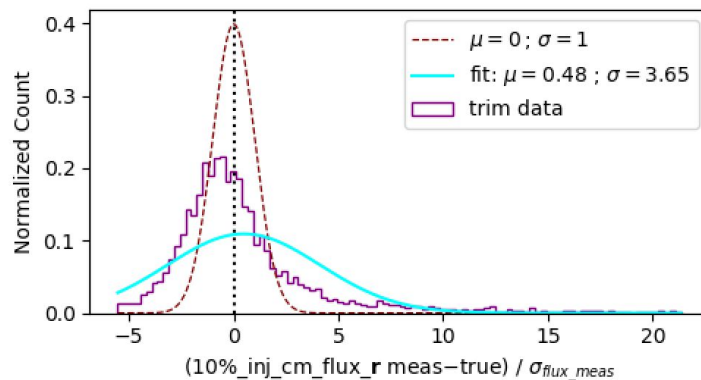
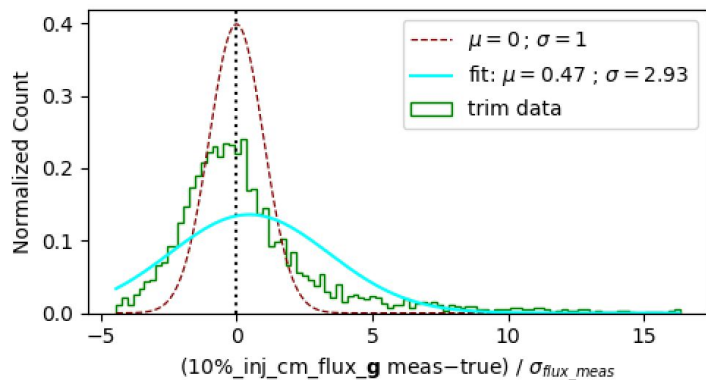
Science Verification Balrog Results



Reference []

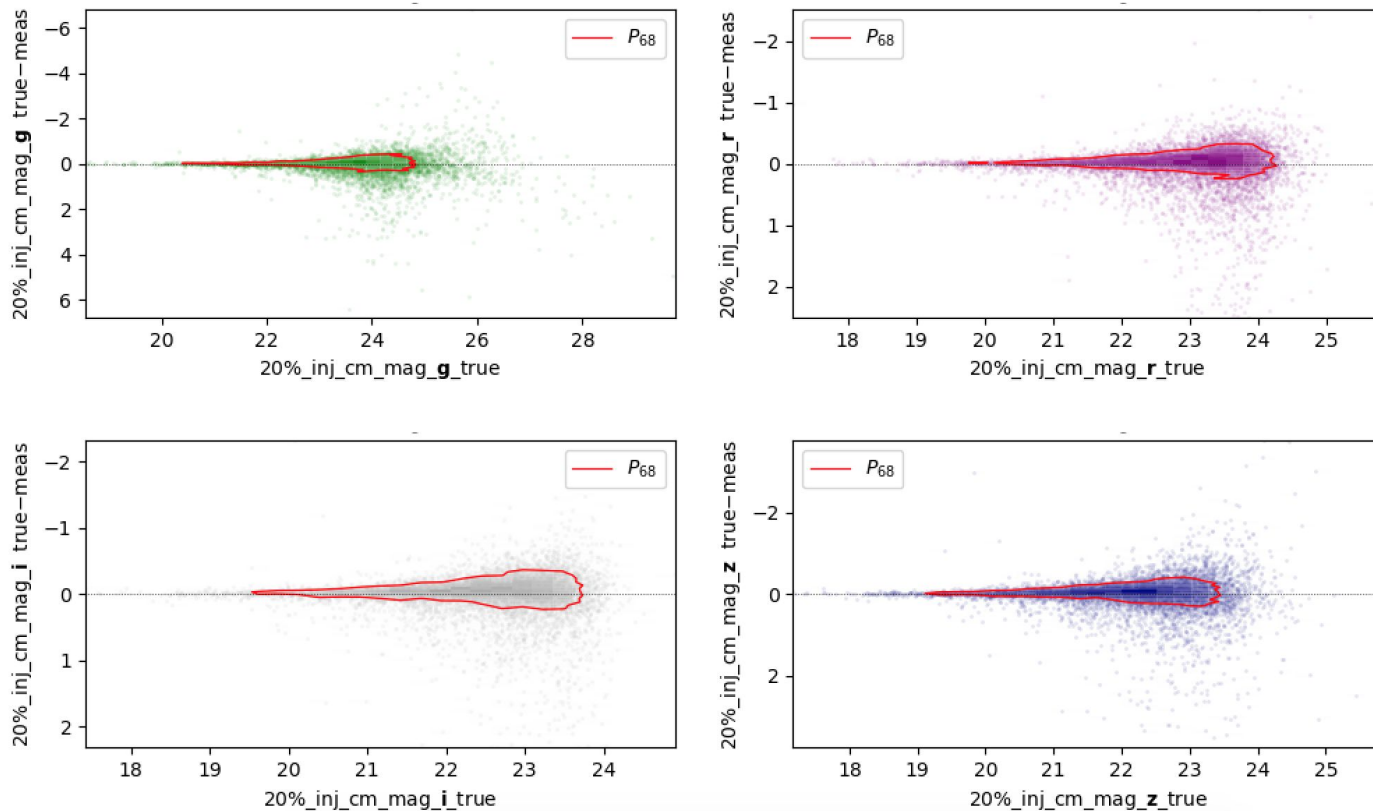
Validating Balrog -- Flux

10% Inj Gal Truth Cat & 10% Inj SOF Cat. Tile: DES0220-0207. Realization: 0.



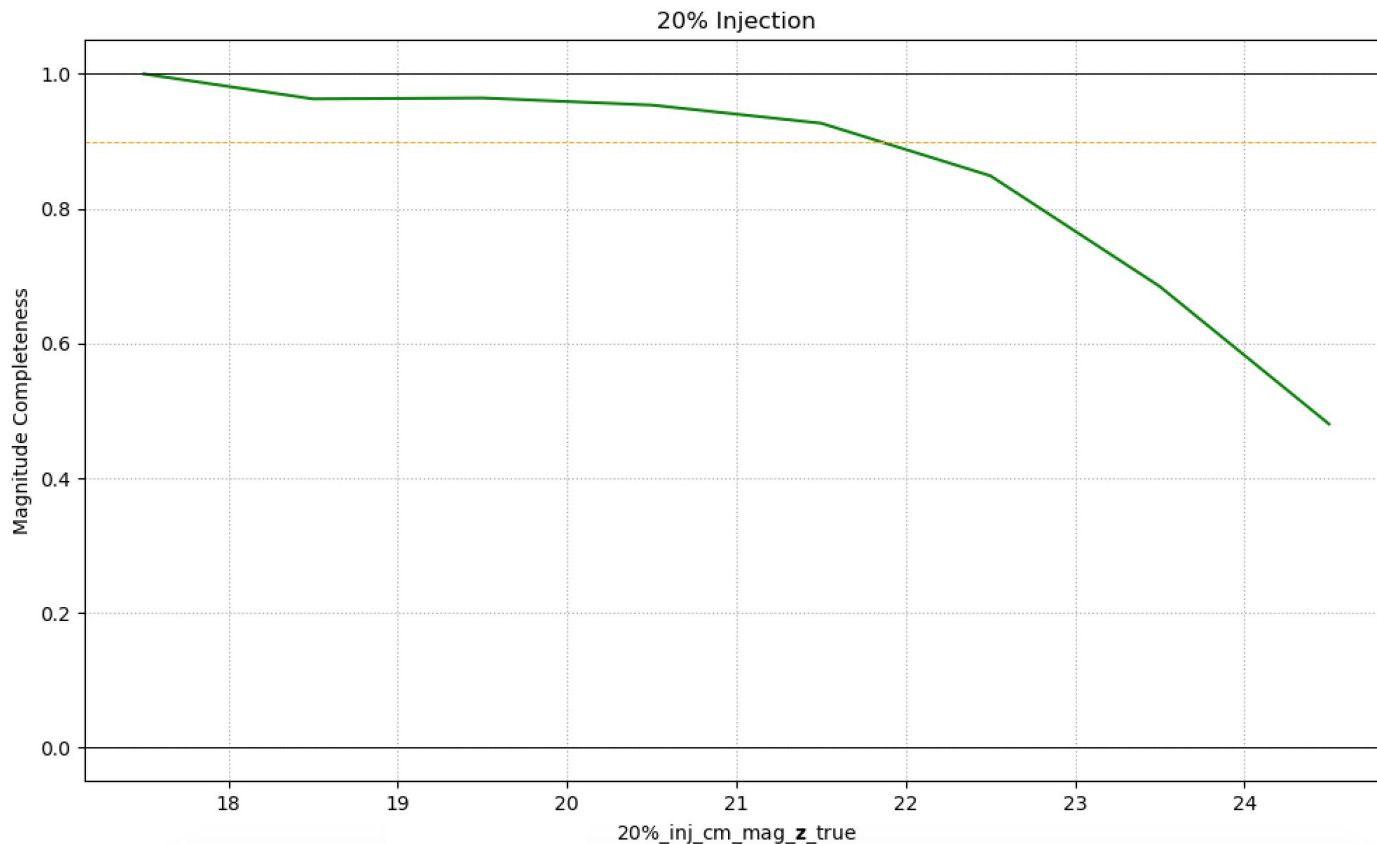
Validating Balrog -- Magnitude

20% Inj Gal Truth Cat & 20% Inj MOF Cat. Tile: DES0102-4914. Realization: 0. Recovered (with flags): 83.17%



Validating Balrog -- Completeness

Inj Gal Truth Cat & Inj MOF Cat. Tile: DES0236+0001. Realization: 0.



Validating Balrog -- Color

20% Inj Gal Truth Cat & 20% Inj MOF Cat. Tile: DES0102-4914. Realization: 0.

