The Dark Energy Survey
Public Data Release 1

Matias Carrasco Kind (NCSA/UIUC)

https://des.ncsa.illinois.edu/

June 19th, 2018 - Data Visualization and Exploration in the LSST Era @ NCSA
DES is designed to improve our understanding of cosmic acceleration and the nature of dark energy using four complementary probes of the expansion history and growth of cosmic structure.

... and like other cosmic surveys, the DES data enable a wide range of additional science ranging from the Solar System to the high-redshift Universe.

(highlighted in talks throughout this session)

See also The Dark Energy Survey: more than dark energy - an overview

DES Collaboration, arXiv:1601.00329
The Survey

Dark Energy Survey (DES)
Wide-field Survey: 5000 deg$^2$, 10 visits in each of grizY
Target S/N = 10 coadd depth ~24 mag
Supernova Survey: 27 deg$^2$, observed at weekly cadence

Dark Energy Camera (DECam)
(Flaugher, B. et al. 2015)
570 Mpix camera on
Blanco 4-m telescope at CTIO
3 deg$^2$ field of view, 62 science CCDs
The Collaboration

The Dark Energy Survey Collaboration

~500 Scientists

Credit: Judit Prat (IFAE)
Wide-field Survey Y1-Y3

DES DR1 is based on the first three years of wide-field survey

Typically 3-5 overlapping exposures in each of the grizY bands in each part of the footprint

Observe in riz bands during periods of best seeing
Delivered PSF FWHM ~ 0.9 arcsec
Astrometric and Photometric Precision

Median astrometric residuals vs. Gaia ~ 151 mas

Median photometric uniformity vs. Gaia ~ 7 mmag
Object Classification: Stars

Tune selection according to science case:

Benchmark stellar sample:
~80M objects
>90% efficiency, <3% contamination for $i < 22.5$ mag
Tune selection according to science case:

Benchmark galaxy sample: 
~310M objects 
>99% efficiency, <3% contamination for $i < 22.5$ mag
### DES DR1 Summary Statistics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations (3 years of operations)</td>
<td>345 distinct nights from Aug 2013 to Feb 2016</td>
</tr>
<tr>
<td>Number of DECam Exposures</td>
<td>~39,000</td>
</tr>
<tr>
<td>Sky Coverage in grizY</td>
<td>5186 deg²</td>
</tr>
<tr>
<td>Delivered Seeing (FWHM)</td>
<td>$g = 1.21, r = 0.96, i = 0.88, z = 0.84, Y = 0.90$ arcsec</td>
</tr>
<tr>
<td>Coadd Astrometric Precision (vs Gaia)</td>
<td>151 mas</td>
</tr>
<tr>
<td>Coadd Photometric Precision</td>
<td>$&lt; 1 %$ in grizY</td>
</tr>
<tr>
<td>Coadd depth (S/N = 10 in 1.95” Aperture)</td>
<td>$g = 24.3, r = 24.1, i = 23.4, z = 22.7, Y = 21.4$ mag</td>
</tr>
<tr>
<td>Distinct Coadd Objects in 10,338 tiles</td>
<td>~400M: ~310M galaxies and ~80M stars after basic quality cuts</td>
</tr>
<tr>
<td></td>
<td>~ 35,000 clusters @ z~1</td>
</tr>
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</table>

Largest photometric dataset to date at the achieved depth and photometric precision
**DES DR1 Products and Services**

- **Catalogs**: Year 3 Catalogs based on SExtractor
- **Images**: Year 3 Coadd images, Y1-Y2-Y3 Single-epoch calibrated images
- **Bulk Data Access**: Coadd tile-based image and catalog files
- **Interfaces**: SQL Web Client, File access, Cutout server, Image exploration, Landing release page, Jupyter Notebooks, Science Portal, NOAO Data Lab
- **Documentation**: DR1 paper (tonight), Web documentation, Table Schemas, Interface and software, DR1 Standard Bandpasses
- **Software**: Main components of pipeline on Github. Minimal usage information
- **Support**: Limited collaboration support (similar to SV) and institutional (NCSA, NOAO, LIneA) support for tools
# DES DR1 Data Access

**Three complementary web-based platforms:** [https://des.ncsa.illinois.edu/releases/dr1/dr1-access](https://des.ncsa.illinois.edu/releases/dr1/dr1-access)

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## DR1 Data Access

If you'd like to access the images and catalogs from DES DR1, please use the complementary set of tools created by a collaborative effort between NCSA, NOAO, and LineA. These tools allow the users to access, obtain, visualize, and explore DES DR1 products.

When using DES data and/or DES access tools please consider the notes in the [Acknowledgement](https://des.ncsa.illinois.edu/releases/dr1/dr1-access) page.

Click on the logos below to start exploring DES data tools. Follow the links below to learn more about each tool and their functionalities.

- [NCSA DESaccess](https://des.ncsa.illinois.edu/releases/dr1/dr1-access)
- [NOAO DataLab](https://des.ncsa.illinois.edu/releases/dr1/dr1-access)
- [LineA Science Server](https://des.ncsa.illinois.edu/releases/dr1/dr1-access)
DES DR1 Data Access

Interactive Sky Viewer

SQL Web Client with example queries and schema browser

Jupyter Notebooks and computing environment
DES DR1 Data Access

NCSA DESaccess Deployment

Ingress Controller

Kubernetes Nodes

File Server

GPFS Filesystem

Oracle DB
DES DR1 Data Access

NCSA DES Labs JupyterHub
Thanks!

https://des.ncsa.illinois.edu/

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DR1 Release Scientist
Distribution of depth corresponding to signal-to-noise = 10 for a 2” aperture

Detection Completeness vs. CFHTLenS
(Erben et al. 2013)
The Processing Pipelines @ NCSA

Full details of DESDM processing pipeline in Morganson et al. 2018

https://github.com/DarkEnergySurvey
Extra Slides

570 Mpix camera, 3 deg$^2$ field of view

DES uses 5 broadband optical and near-IR filters
Typically 3-5 overlapping exposures in each of the grizY bands in each part of the footprint

Statistical uncertainty of coadd zeropoints in the i-band estimated from the FGCM photometric calibration
It is recommended to use **SPREAD_MODEL** over **CLASS_STAR** for star-galaxy separation.