

# LineA: astronomical data access interfaces and products

# HELLO

**Ricardo Ogando**

I work at Observatório Nacional and  
Laboratório Interinstitucional de e-Astronomia (LINEA)

You can find me at  [@thespacelink](https://twitter.com/thespacelink) or  
[ogando@linea.gov.br](mailto:ogando@linea.gov.br) (see also Luiz Nicolaci da Costa at  
[Ciberinfraestrutura para la Ciencia](#))

# LineA team



Luiz Nicolaci



Marcos Lima



Martin Huarca



Andrea Nunes



Carlos Azean

Multidisciplinary team spread  
 over different parts of Brazil

Astronomy compels the soul to look upwards and leads us from this world to another - Plato.

# Astronomical data access



- ◇ Observations
- ◇ ~One year proprietary period
- ◇ Static data access interfaces
  - **Raw** products
  - Advanced products: article results, tables...
- ◇ CADC, CDS, IPAC



CADC Home > Advanced Search

## Advanced Search

Search **Results** Error ADQL Help

Search Reset

### Observation Constraints

- ▶ Observation ID
- ▼ P.I. Name  
James Clerk Maxwell Telescope
- ▼ Proposal ID
- ▶ Proposal Title
- ▶ Proposal Keywords
- Science and Calibration data

### Spatial Constraints

- ▼ Target
  - Resolve object name to coordinates
  - Automatic
  - OMC-1
- OR
- Browse... No file selected.
- ▶ Pixel Scale
- Do Spatial Cutout

### Temporal Constraints

- ▶ Observation Date
- ▶ Integration Time
- ▼ Time Span (< 2.0 days)  
<2d

### Spectral Constraints

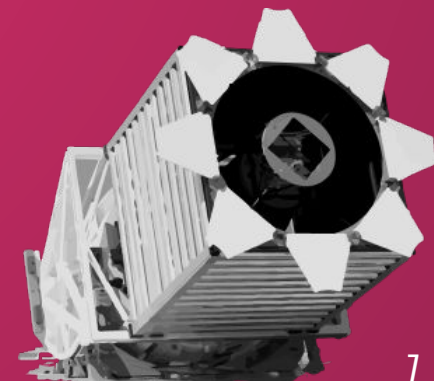
- ▼ Spectral Coverage (8.566E-4..8.690E-4 metres)  
345..350 GHz
- ▶ Spectral Sampling
- ▶ Bandpass Width
- ▶ Rest-frame Spectral Coverage
- Do Spectral Cutout

### Additional Constraints

Band	Collection	Instrument	Filter	Calibration Level	Data Type	Observation Type
All (8)	DAO	All (25)	All (1)	All (3)	All (3)	All (3)
Gamma-ray	DAOPLATES	ACSIS	None	(0) Raw Instrumental	cube	grid
Infrared	FUSE	AOSC		(1) Raw Standard	Other	jiggle
Millimeter	HST	CBE		(2) Calibrated	spectrum	scan
Optical	HSTHLA	DAS				
Radio	IRIS	FTS2-SCUBA-2				
UV	JCMT	HARP-ACSIS				
X-ray	MACHO	IFD				
Unknown	OMM	POL-HARP-ACSIS				
	UKIRT	POL-RXA3-ACSIS				

# Sloan Digital Sky Survey

The most detailed three-dimensional maps of the Universe ever made





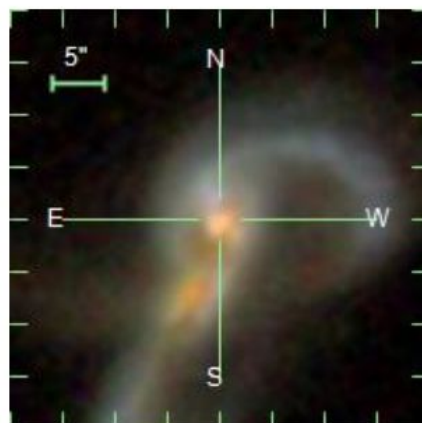
## Summary data for: SDSS J151806.13+424445.0

### Position Data (How do I find it?)

Object ID (objID):	Right ascension (ra):	Declination (dec):
1237662301903192106	229.525575753922	42.7458537608544

### Image Data (What does it look like?)

Preview image (click to go to Navigate tool)



Object Type (type): GALAXY

Magnitudes:

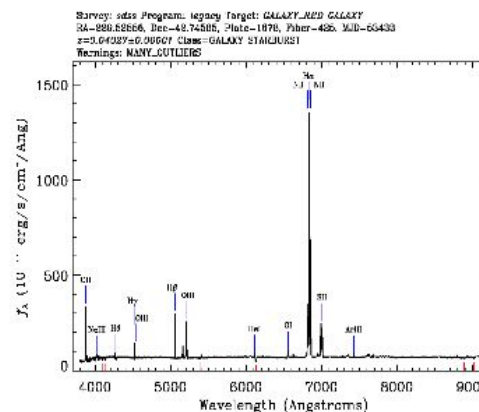
Ultraviolet (u):	16.27 ± 0.01
Green (g):	15.30 ± 0.00
Red (r):	14.76 ± 0.00
Infrared - 7600 Å (i):	14.32 ± 0.00
Infrared - 9100 Å (z):	14.02 ± 0.00

**Caution:** Magnitudes and other data for this object may be unreliable. See the **flags** in the Explore tool summary page for more information.

### Spectrum Data

(What does its spectrum look like?)

Preview spectrum (click for a larger version)



[Interactive spectrum](#)

Spectral classification (Class): GALAXY

Redshift Data:

Redshift (z): 0.04027193

[Get spectrum as CSV](#)

[Get spectrum as FITS](#)

Summary

Explore

Search

Notes

Add to Notes  
Show Notes

Finding Chart

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Help

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Examples


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SciServer







## SDSS Query / CasJobs

---

Help
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Query
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MyDB
Import
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Output
Schema Browser
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Logout

Context
Table (optional)
Task Name

BESTDR14
MyTable\_4
My Query

Samples
Recent
Clear

- Basic SELECT FROM WHERE**
- Galaxies two criteria
- Unclassified spectra
- Galaxies multiple criteria
- Spatial unit vectors
- CVs using colors
- Data subsample
- Low z QSOs by colors
- Velocities and errors
- Using BETWEEN
- Moving asteroids
- Quasars in imaging
- Object counts and logic
- Galaxy star blends
- Stars in specific fields
- Using three tables
- Objects close pairs
- QSOs in spectroscopy
- Errors using flags
- Elliptical galaxies
- Galaxies blue centers
- Diameter limited galaxies
- Extremely red galaxies
- LRG sample
- Galaxies by spectra
- Galaxies by spectra2
- Binary stars colors

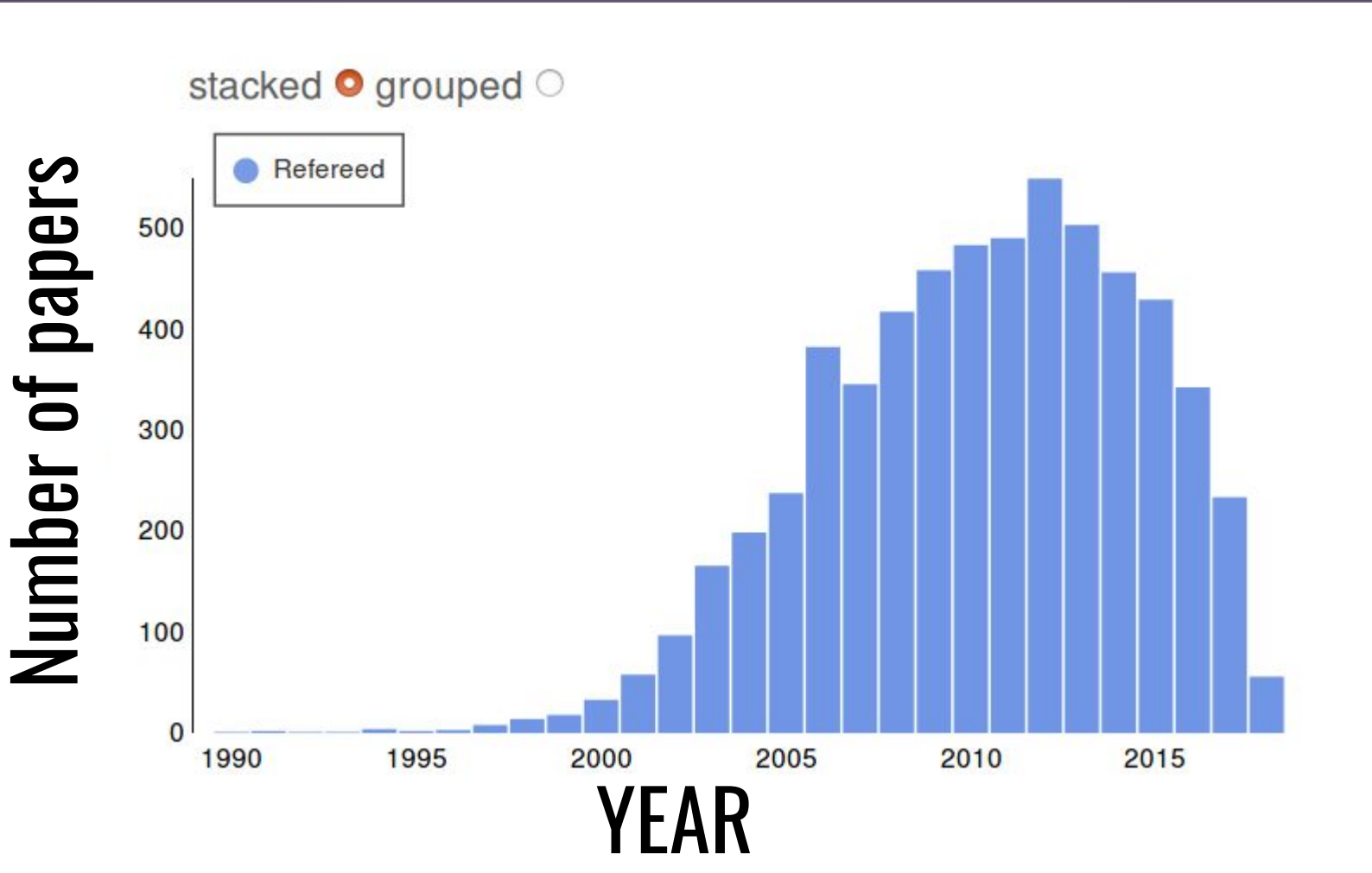
```

-- Galaxies meeting two simple criteria.
-- Find all galaxies brighter than r magnitude 17, where the local
-- extinction is > 0.275. This is a simple query that uses a WHERE clause,
-- but now two conditions that must be met simultaneously.
--
-- Finds 6604 galaxies in under 10 mins on DR2, but beware that increasing
-- the limiting r magnitude will significantly add to the execution time.

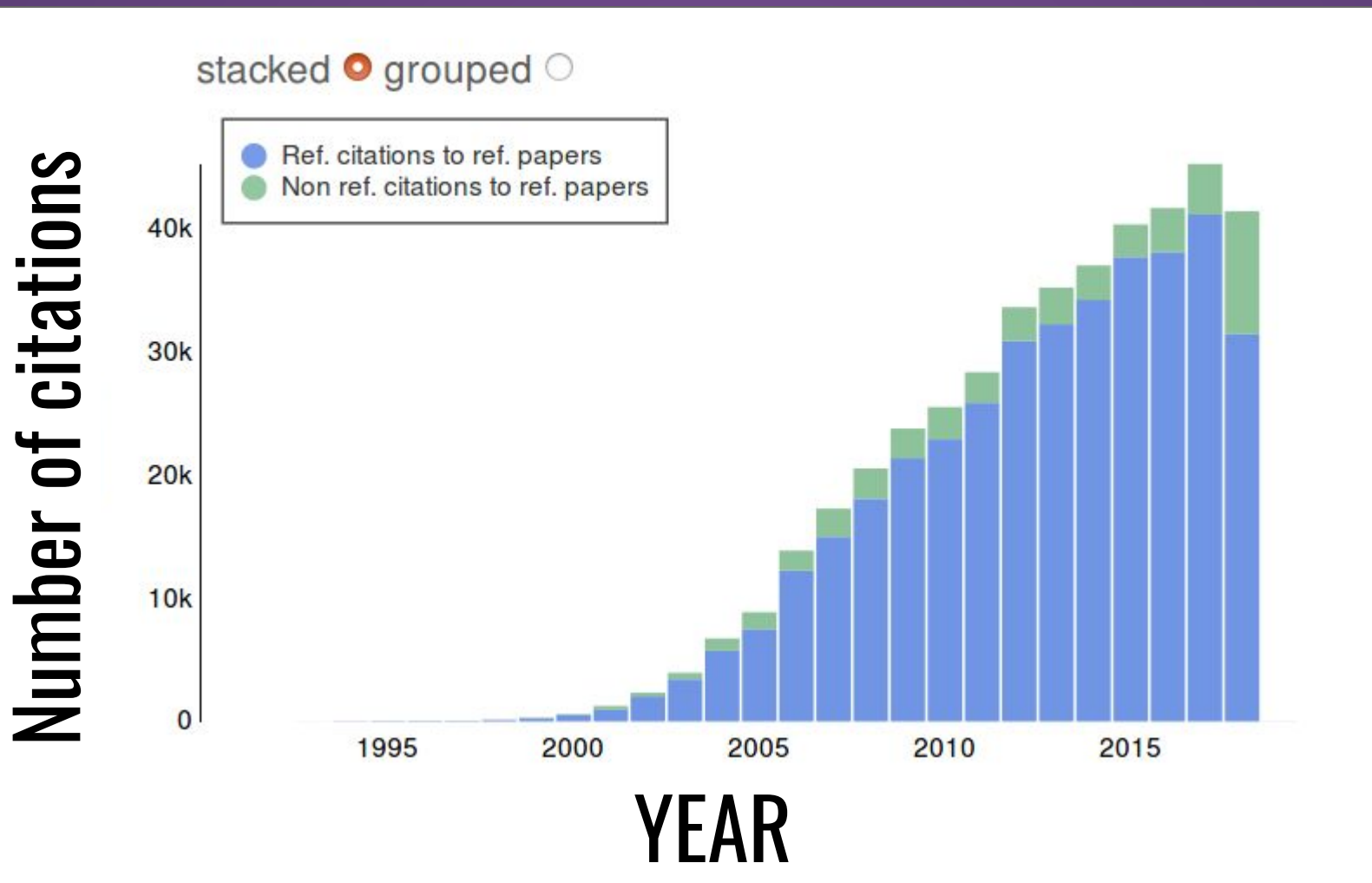
SELECT objID
FROM Galaxy
WHERE
  r < 17 -- r IS NOT dereddened
  and extinction_r > 0.275 -- extinction more than 0.175
                    
```

Gray's law  
20 queries!

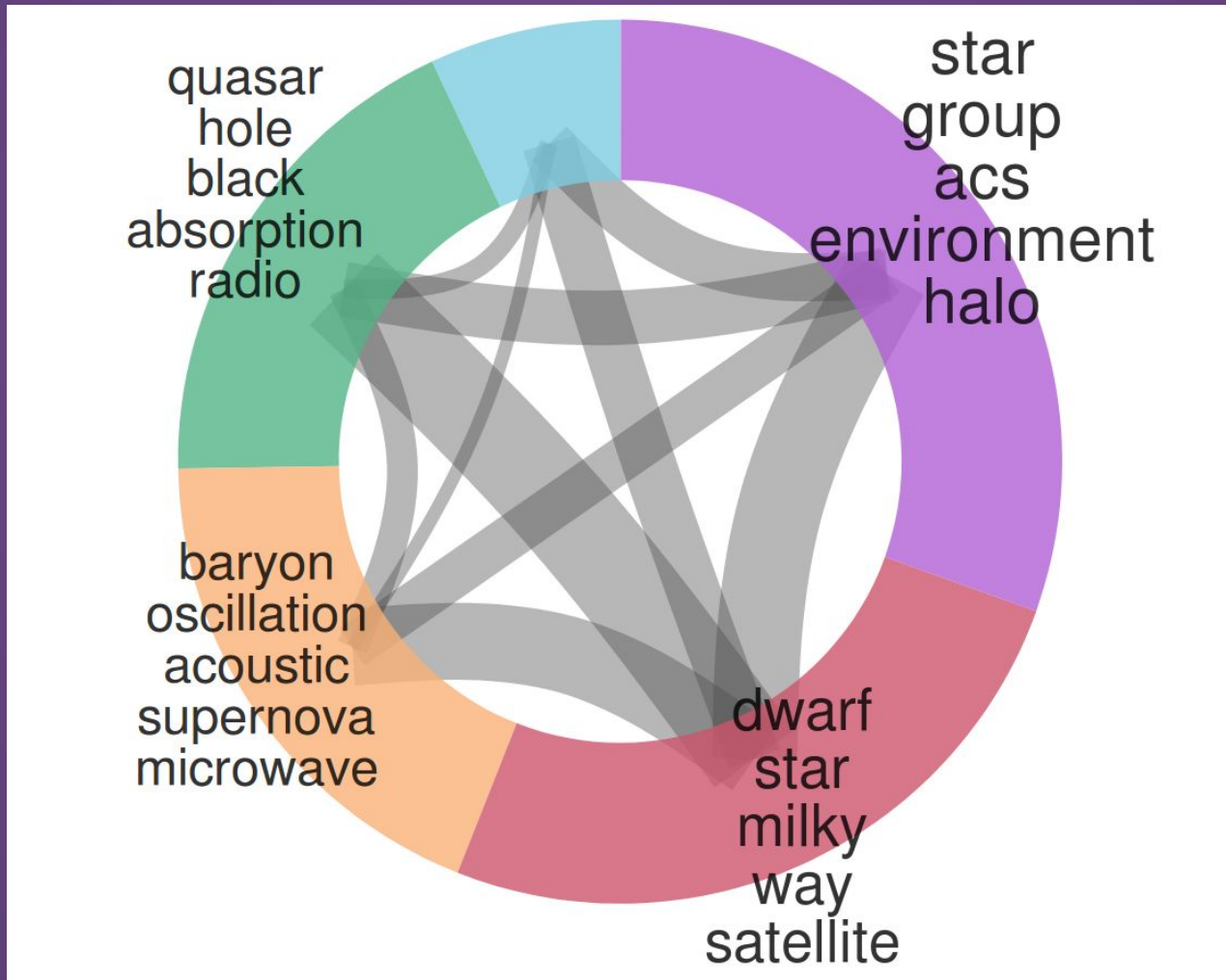
# SDSS high impact: papers



# SDSS high impact: citations



# SDSS high impact: areas



# Universe expansion is accelerated

- Dark Energy (1998)
- Stage 1: Discovery
- Stage 2: Ongoing (SDSS) (10M sources)
- Stage 3: Dark Energy Survey (DES) 2013-2018 (100M sources)
- Stage 4:
  - Large Synoptic Survey Telescope (LSST) 2021-2031 (1B sources)



We have to do better at producing tools to support the whole research cycle — from data capture and data curation to data analysis and data visualization. - Jim Gray, 2007

# LineA interfaces and products



## Science Portals

Interface for scientific analysis in Rio de Janeiro, Brazil



## Quick Reduce

Quality control of DECam images on CTIO, Chile



## Data Release Interface

Interactive maps and catalog query for DES data release at NCSA, USA



## Quick Look Framework

Quality control of DESI 15k spectra/exposure on Kitt Peak, USA

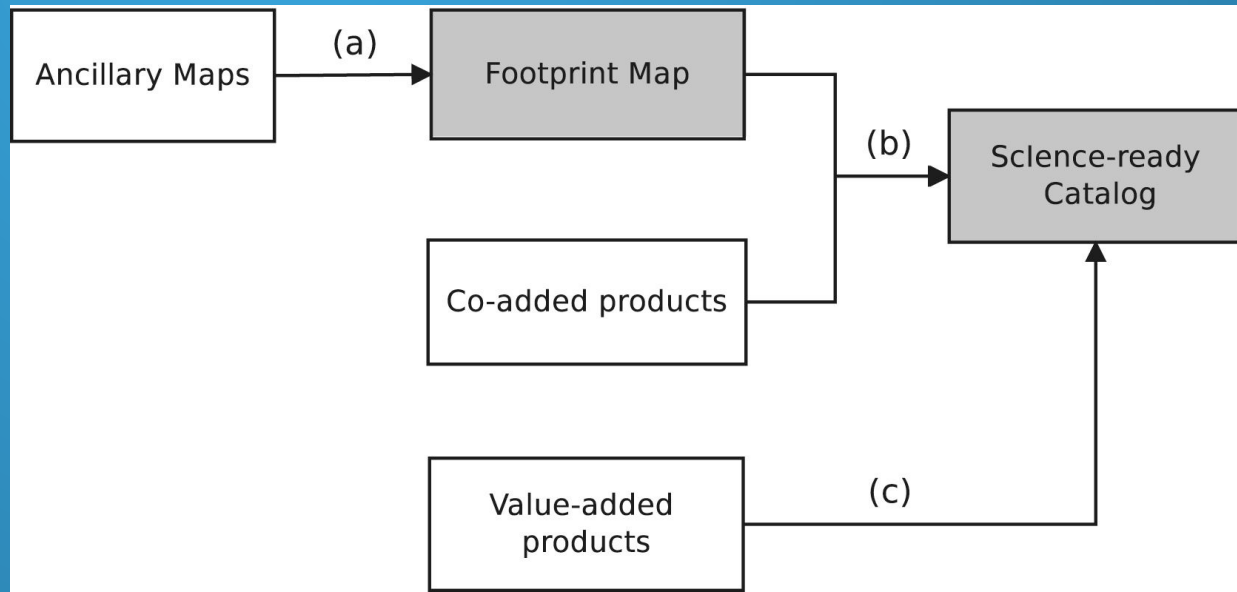


# Science Portals

- Interface to cluster nodes
  - Powered by TurboGears
  - Home-made orchestration + condor
  - XML workflows
  - XML product logs
- Provenance: data and configuration
- Dashboard process management

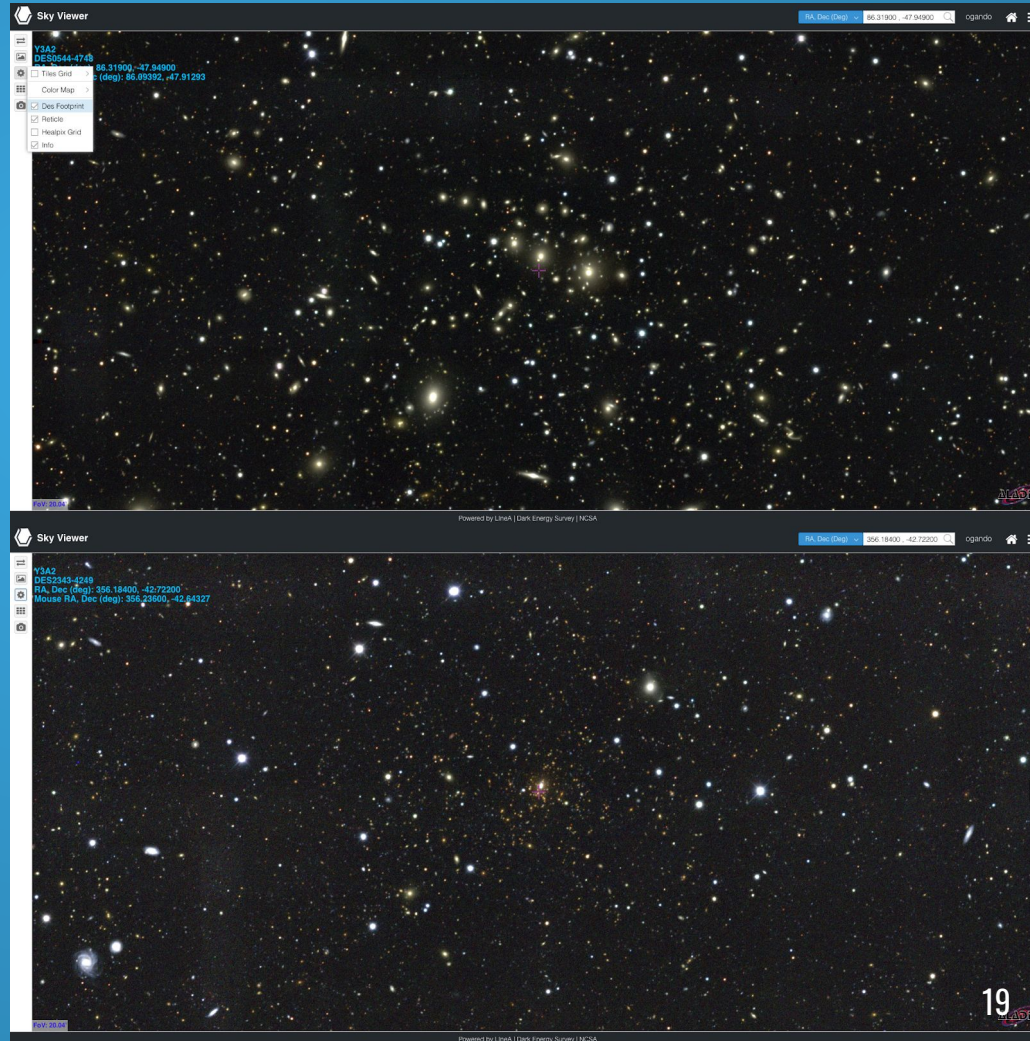
# Science Portals

- End to end process
  - Maps of observational properties
  - Star/Galaxy classification
  - Photometric redshifts (Gschwend et al. 2018)
- Value-added catalogs ([Fausti Neto et al. 2018](#))
- Query builder



# Science Portals

- Value-added catalogs feed several scientific pipelines
- Ex. cluster finding



# Quick Reduce (QR)



DES CTIO Portal

Ricardo Ogando

Welcome to the DES Science Portal at Ctio.

Home My Workspace Pipelines **Quick Reduce** Tools Release Notes Documentation Help

CTIO production environment

November, 2014 (v2.0)

This version of the CTIO portal runs at LIneA test environment. The following services are available:

- a pipeline for producing master calibration frames (under development)
- the **Quick Reduce** tool

The introductory documentation for using Quick Reduce is available at [Documentation > Start-up Guide](#)

Please, report bugs and/or comments to the LIneA IT team using the e-mail [helpdesk@linea.gov.br](mailto:helpdesk@linea.gov.br)

Coordinator: [Luiz Nicolaci da Costa](#)  
 Technical Contact: [Angelo Fausti Neto](#) (Skype: angelofausti)

- Quickly reduce and assess DECam images
- Typical exposure time of 90 s
- Millions of CCDs processed throughout almost 6 years of operation

Portal Analysis Toolkit V2.0

# Quick Reduce (QR)

Image General Properties Requirements

**Quick Navigation**

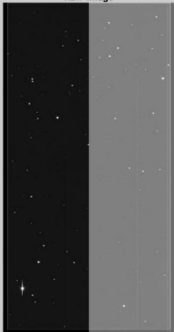
CCDs

Background

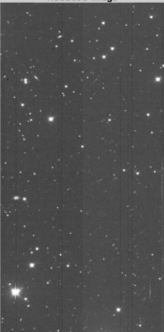
CCDs

Parameter	Value
Bias corrected	Y
Flat corrected	Y
Filter	g
RA	08:05:42
Dec	-29:32:44
l (deg)	300.75
b (deg)	-27.08
Exposure time (s)	80.0
Extinction (mag)	--
HI Column (atoms cm <sup>-2</sup> )	--

Raw Image



Reduced Image

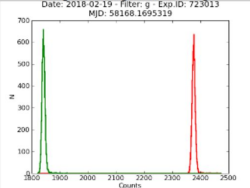


Background

Parameter (reduced Image)	Value
Median of sky background (ADU)	96
RMS of sky background (ADU)	5
Skewness of sky background	0.06

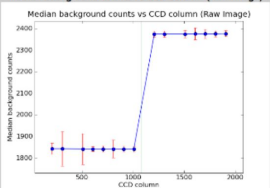
**Background Histogram for Raw Image**

Date: 2018-02-19 Filter: g Exp.ID: 723013  
MJD: 58168.1695319



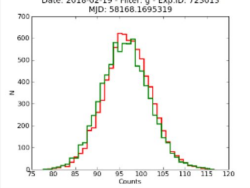
**Median background counts vs CCD column (Raw Image)**

Median background counts vs CCD column (Raw Image)



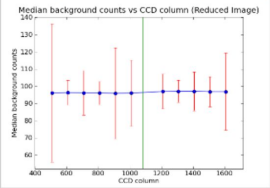
**Background Histogram for Reduced Image**

Date: 2018-02-19 Filter: g Exp.ID: 723013  
MJD: 58168.1695319



**Median background counts vs CCD column (Reduced Image)**

Median background counts vs CCD column (Reduced Image)



Custom  
python data  
reduction  
module

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# Quick Reduce (QR)

## Observing History

From: 2018-02-19 To: 2018-02-19 Submit

Refresh:

## Image Quality Time series

Download data

Please wait...

PSF Sky Background Number Counts Footprint Statistics

Tip: click on the data points to open the corresponding QR process.

### Axis Limits

FWHM max: 2.0

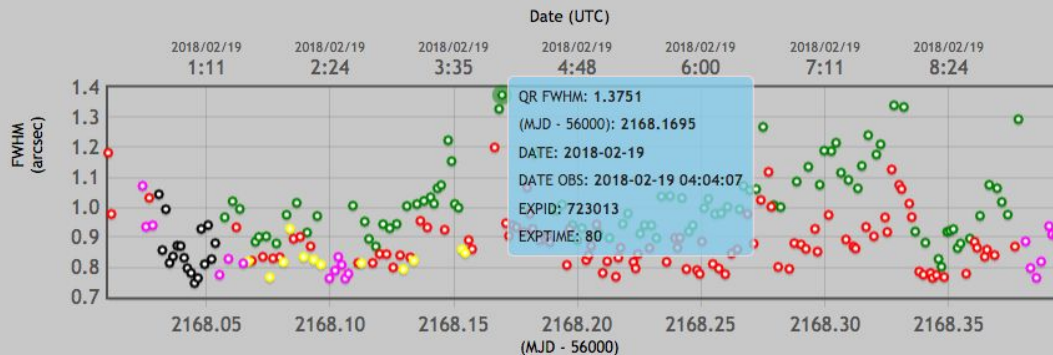
FWHM min: 0.5

Ok

Auto Scale

Zoom Out

Reset



### Filters:

- All
- u
- g
- r
- i
- z
- Y

### Data:

- IH
- DIMM

### Axis Limits

Ellipticity max: 0.2

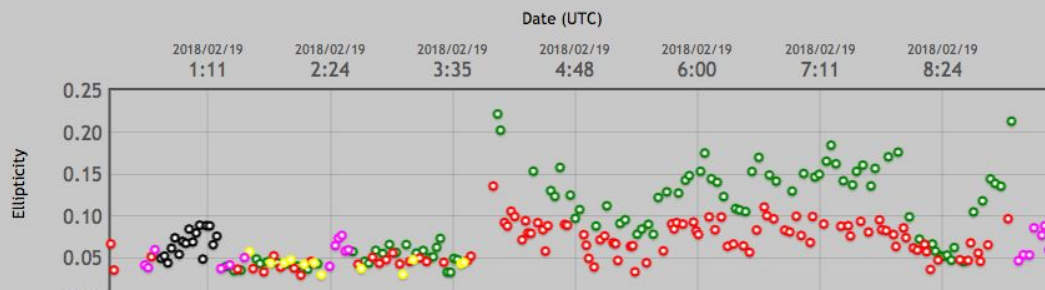
Ellipticity min: 0.0

Ok

Auto Scale

Zoom Out

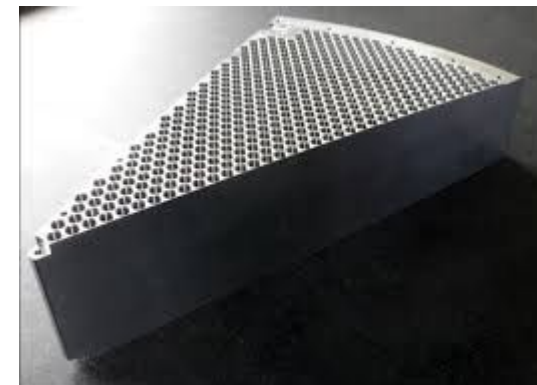
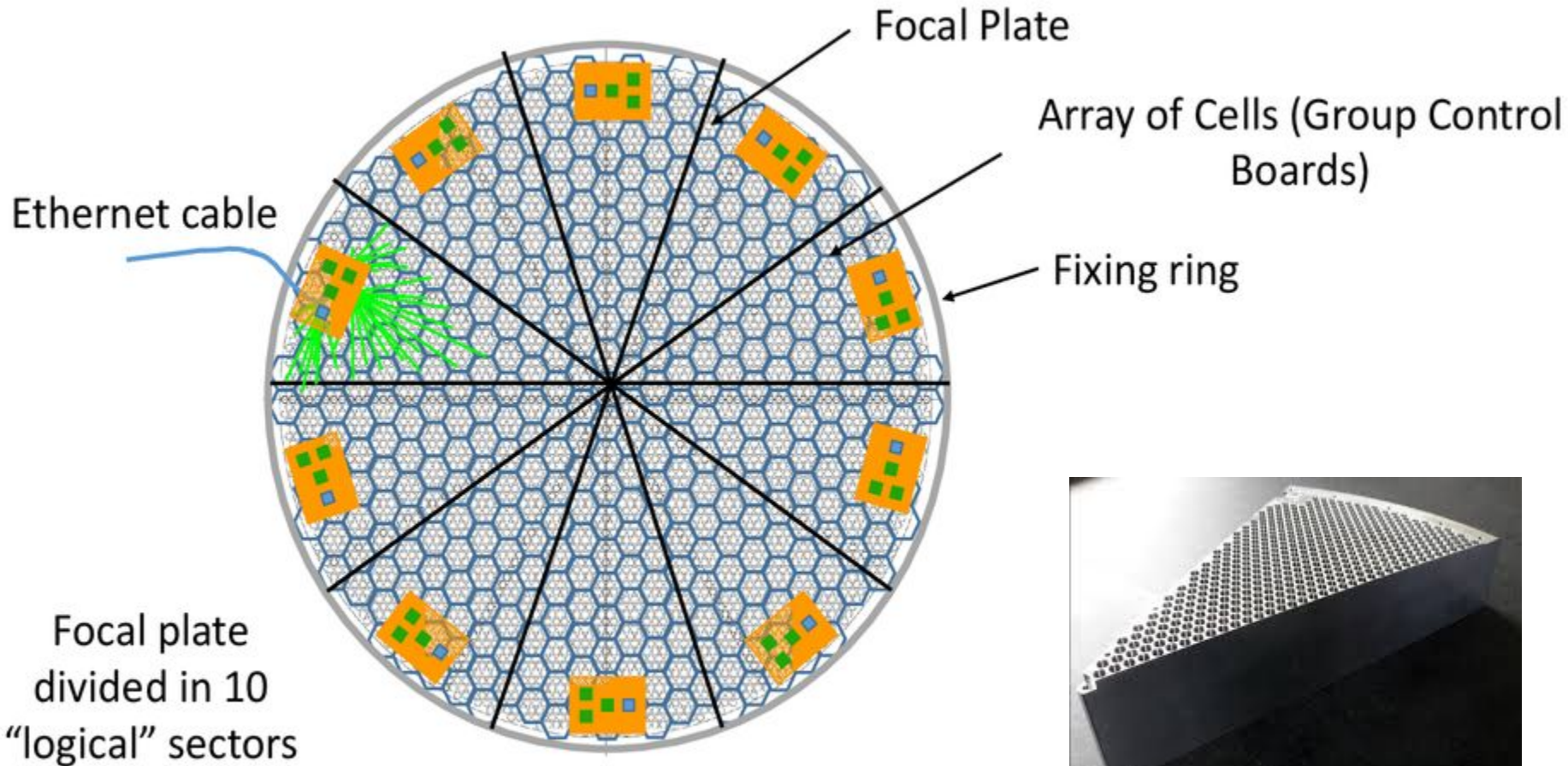
Reset



### Filters:

- All
- u
- g
- r
- i
- z
- Y

# Quick Look Framework (QLF)



5,000 fibers → 15,000 spectra

# Quick Look Framework (QLF)

## DESI Quick Look



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### Pipeline Monitor



Control and monitor the execution of the Quick Look pipeline

### Processing History



List exposures that have been processed

### Observing History



Display time series plots for QA metrics, list of exposures and observed targets for the current night or for a range of nights

### Afternoon Planning



Browse QA results for exposures processed by the offline pipeline at NERSC

### Trend Analysis



Simple plots using quantities stored in the database

### Observing Conditions



Display observing conditions such as atmospheric transparency, seeing, and observing background from the GFA camera

### Survey Reports



Show the overall progress and performance of survey

### Configuration



Configuration of initial settings for execution



# Quick Look Framework (QLF)

DESI Quick Look - Monitor



Status: Not Running

Flavor: science

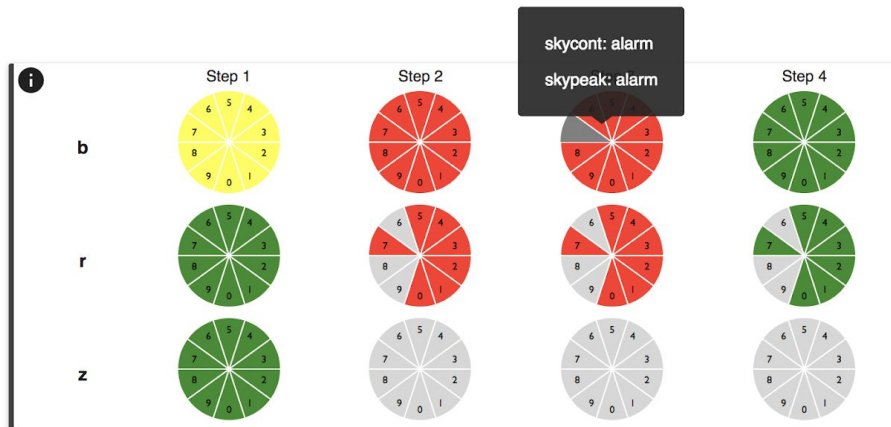
Process Id: 14

Exposure: 3905

MJD: 58773.917

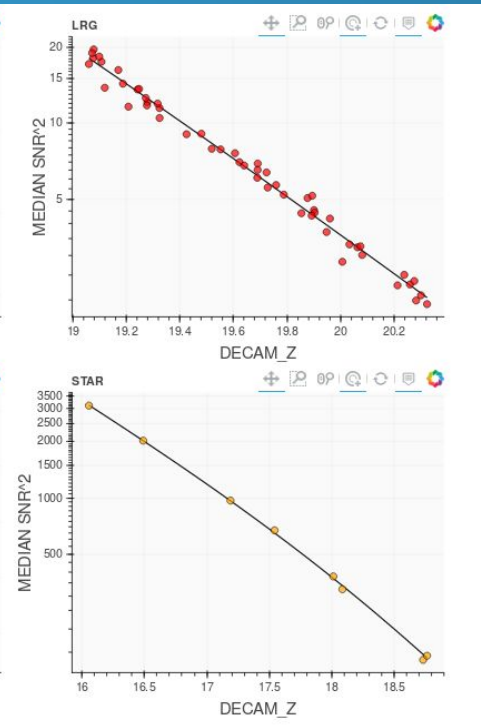
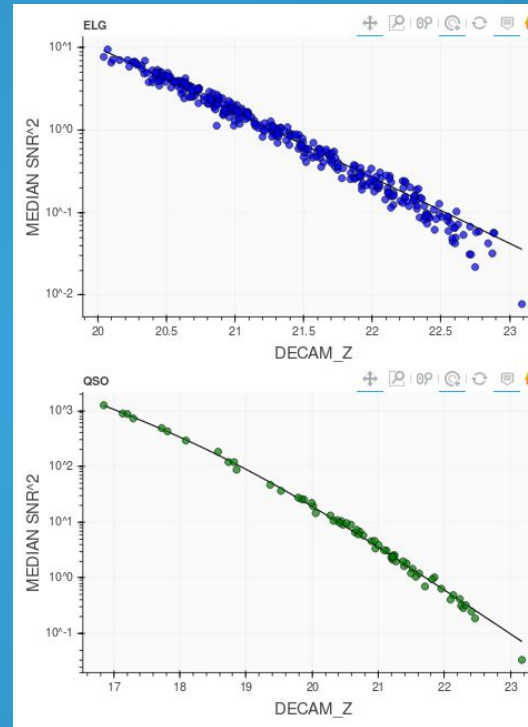
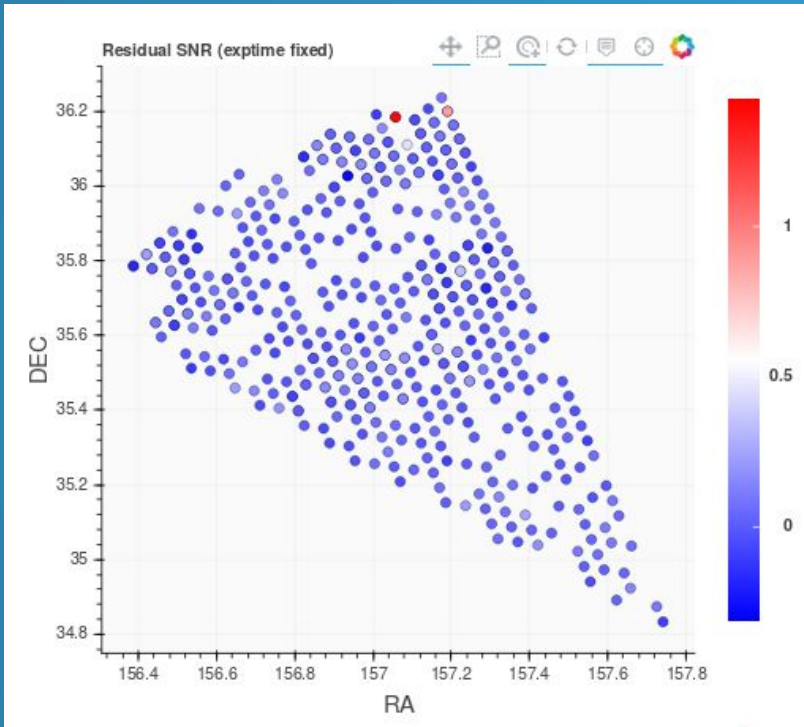
Date: 20191017

START RESET CLEAR DISK



```
2018-09-01 02:58:21 Process 14 aborted.
2018-09-01 02:55:37 Pre Processing ended (0:06:12).
2018-09-01 02:54:35 Check_HDUs ended (0:05:10).
2018-09-01 02:53:44 Sky Subtraction started.
2018-09-01 02:53:41 Fiber Flattening started.
2018-09-01 02:50:06 Spectral Extraction started.
2018-09-01 02:49:25 Pre Processing started.
2018-09-01 02:49:25 Check_HDUs started.
2018-09-01 02:49:21 Exposure 3905 started.
2018-09-01 02:49:21 Process 14
```

# Quick Look Framework (QLF)



Bokeh for interactive drill-down plots

**The DES Bright Arcs Survey: Hundreds of Candidate Strongly Lensed Galaxy Systems from the Dark Energy Survey Science Verification and Year 1 Observations**

H. T. Diehl<sup>1</sup>, E. J. Buckley-Geer<sup>1</sup>, K. A. Lindgren<sup>1</sup>, B. Nord<sup>1</sup>, H. Gaitsch<sup>1</sup>, S. Gaitsch<sup>1</sup>, H. Lin<sup>1</sup>, S. Allam<sup>1</sup>, T. E. Collett<sup>2</sup>, C. Furlanetto<sup>3</sup>, M. S. S. Gill<sup>4</sup>, A. More<sup>5</sup>, J. Nightingale<sup>3</sup>, C. Odden<sup>1,6</sup>, A. Pellico<sup>1</sup>, D. L. Tucker<sup>1</sup>, L. N. da Costa<sup>7,8</sup>, A. Fausti Neto<sup>7</sup>, N. Kuropatkin<sup>1</sup>, M. Soares-Santos<sup>1</sup>, B. Welch<sup>9</sup>, Y. Zhang<sup>1</sup>, J. A. Frieman<sup>1,9</sup>, F. B. Abdalla<sup>10,11</sup>, J. Annis<sup>1</sup>, A. Benoit-Lévy<sup>10,12,13</sup>, E. Bertin<sup>12,13</sup>, D. Brooks<sup>10</sup>, D. L. Burke<sup>1,14</sup>, A. Carnero Rosell<sup>1,8</sup>, M. Carrasco Kind<sup>15,16</sup>, J. Carretero<sup>1,7</sup>, C. E. Cunha<sup>14</sup>, C. B. D'Andrea<sup>18</sup>, S. Desai<sup>19</sup>, J. P. Dietrich<sup>20,21</sup>, A. Drica-Wagner<sup>1</sup>, A. E. Evrard<sup>22,23</sup>, D. A. Finley<sup>1,7,8</sup>, B. Flaugher<sup>1</sup>, J. García-Bellido<sup>24</sup>, D. W. Gerdes<sup>22,23</sup>, D. A. Goldstein<sup>25,26</sup>, D. Gruen<sup>4,14</sup>, R. A. Gruendl<sup>15,16</sup>, J. Gschwend<sup>1</sup>, G. Gutierrez<sup>1</sup>, D. J. James<sup>27,28</sup>, K. Kuehn<sup>29</sup>, S. Kuhlmann<sup>30</sup>, O. Lahav<sup>10</sup>, T. S. Li<sup>1</sup>, M. Lima<sup>7,3</sup>, M. A. G. Maia<sup>7,8</sup>, J. L. Marshall<sup>32</sup>, F. Menanteau<sup>15,16</sup>, R. Miquel<sup>17,33</sup>, R. C. Nichol<sup>2</sup>, P. Nugent<sup>26</sup>, R. L. C. Ogando<sup>7,8</sup>, A. A. Plazas<sup>34</sup>, K. Reil<sup>4</sup>, A. K. Romer<sup>35</sup>, M. Sako<sup>18</sup>, E. Sanchez<sup>36</sup>, B. Santiago<sup>7,37</sup>, V. Scarpine<sup>1</sup>, R. Schindler<sup>4</sup>, M. Schubnell<sup>33</sup>, I. Sevilla-Noarbe<sup>36</sup>, E. Sheldon<sup>7,38</sup>, M. Smith<sup>39</sup>, F. Sobreira<sup>7,40</sup>, E. Suchyta<sup>41</sup>, M. E. C. Swanson<sup>10</sup>, G. Tarle<sup>23</sup>, D. Thomas<sup>2</sup>, and A. R. Walker<sup>28</sup> (DES Collaboration)

**Tile Viewer**

Release: v1.6 (Y1A1\_COADD) Field: SPT

Footprint Tile Mosaic Tile List Favorites Targets Gallery

Redmapper clusters nbule ge 3

Showing targets in the selected release and field.

Mosaic List List (Original Properties)

<p>V1A1_COADD_SPT 0250043-4249 ID: 6724 RA: 12.635 Dec: -42.624</p> <p>Id: RA: 12.6348 Dec: -42.6242</p>	<p>V1A1_COADD_SPT 0250043-4623 ID: 10981 RA: 12.249 Dec: -46.242</p> <p>Id: RA: 12.2493 Dec: -46.2415</p>	<p>V1A1_COADD_SPT 0250052-4153 ID: 2189 RA: 13.389 Dec: -41.506</p> <p>Id: RA: 13.3887 Dec: -41.5061</p>	<p>V1A1_COADD_SPT 0250052-5331 ID: 10987 RA: 13.595 Dec: -53.359</p> <p>Id: RA: 13.5955 Dec: -53.3589</p>	<p>V1A1_COADD_SPT 0250056-5049 ID: 12023 RA: 14.319 Dec: -50.705</p> <p>Id: RA: 14.3185 Dec: -50.7050</p>
<p>V1A1_COADD_SPT 0250057-5057 ID: 6813 RA: 15.036 Dec: -54.694</p> <p>Id: RA: 15.0355 Dec: -54.6935</p>	<p>V1A1_COADD_SPT 0250059-5205 ID: 4204 RA: 15.048 Dec: -52.007</p> <p>Id: RA: 15.0426 Dec: -52.0066</p>	<p>V1A1_COADD_SPT 0250102-5123 ID: 11827 RA: 16.216 Dec: -51.400</p> <p>Id: RA: 16.2163 Dec: -51.4003</p>	<p>V1A1_COADD_SPT 0250103-4457 ID: 4048 RA: 15.799 Dec: -44.616</p> <p>Id: RA: 15.7987 Dec: -44.6163</p>	<p>V1A1_COADD_SPT 0250107-4457 ID: 5108 RA: 15.659 Dec: -44.609</p> <p>Id: RA: 15.6533 Dec: -44.6687</p>

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Displaying 1 - 25 of 478

**Coadd Properties**

Object Id	3116038543
RA (deg)	15.6524
Dec (deg)	-44.6687
l (deg)	296.3809
b (deg)	-72.3172
g	22.88 ± 0.180
r	21.42 ± 0.066

Reject.

Rating: ☆☆☆☆☆

**Figure 2.** Typical page of cutouts as viewed on the Science Portal. The cutouts are 55'' on a side. The Portal displayed 25 cutouts on each page. These were viewed on a computer screen large enough to visualize the details in each system.

# New Science Server @ NCSA\*

Science Server 2 + New Howdy,

## LIneA Science Server

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### News

12/13/2017 - Public Release


New technologies:

- Python 3
- Django
- ExtJS 6
- Aladin
- VisiOmatic


DES first public data release



Sky Viewer [More](#)









Target Viewer [More](#)



User Query [More](#)

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<https://desportal2.cosmology.illinois.edu/dri/apps/home/>

# Sky Viewer

## DES images exploration and validation

DR1  
DES0111-3457  
RA, Dec (deg): 17.84694, -35.29514  
Mouse RA, Dec (deg): 316.51383, 20.37405

Fov: 180°

Powered by LineA | Dark Energy Survey | NCSA

# Sky Viewer

## DES images exploration and validation

Sky Viewer

RA, Dec (Deg) RA (deg), Dec (deg) ogando

Map viewer

Map Type: Systematic Maps

Map Class: NImages

Filter: i

Display Map

RA: -35.29514  
Dec: 38.84712, 11.32195

Fov: 180°

Powered by LineA | Dark Energy Survey | NCSA



# Online image visualization

## Image comparison

Image Viewer

RA, Dec (Deg) RA (deg), Dec (deg) ogando

DR1 - All - DES0257-5414

Image preferences

Invert: OFF

Contrast: 1.7 - +

Color Sat: 2.3 - +

Gamma: 2 - +

JPEG quality: 90 - +

RA, Dec (Deg) 44.59991, -54.0326

Mouse RA, Dec (44.47627, -54.03287)

DR1 - All - DES0257-5414

RA, Dec (Deg) 44.60003, -54.0328

Mouse RA, Dec (44.63676, -53.97375)

50"

50"

# Online image visualization

## Catalog overlay

Image Viewer

RA, Dec (Deg) RA (deg), Dec (deg) ogando

DR1 - All - DES0257-5414

DR1 - All - DES0257-5414

RA, Dec (Deg) 44.59991, -54.0326  
 Mouse RA, Dec (44.47154, -54.02586)

RA, Dec (Deg) 44.60003, -54.0328  
 Mouse RA, Dec (44.54311, -53.97412)

Catalog Overlay

Search by name

- DR1 Main (1074 entries)
- 2MASS All-Sky (52 entries)

Targets

- Objects Catalog
  - Coadd Objects
    - DR1 Main
  - External Catalogs
    - VizieR
      - 2MASS All-Sky
      - SDSS release 9
      - PPMXL
      - ...

Color:

Marker: circle Size: 1.8

Filters

Apply

50"

50"

Powered by LineA | Dark Energy Survey | NCSA



# User query

## Query DES database

Release: DR1

Input Tables

- DR1 Main

External Tables (+)

My Tables (+)

Shared Tables (+)

My Queries (+)

Sample Queries (-)

magnitude limit

**Query Definition**

Name\* : magnitude limit

Description:

SQL Sentence\* : `select RA, DEC, MAG_AUTO_G_DERED from DES_ADMIN.DR1_MAIN where DES_ADMIN.DR1_MAIN.MAG_AUTO_G_DERED < 20 and rownum < 100`

[Check](#) [Preview](#)

Table Content **My JOBS**

dec	mag_auto_...	ra
-59.615191	19.5282707...	325.782713
-59.593984	19.5542869...	326.858598
-60.337994	16.3335685...	318.423702
-60.34427	19.5136470...	319.340188
-60.380532	16.6520538...	318.631498

# THANKS

## ANY QUESTIONS?

You can find me at  @thespacelink  
[ogando@linea.gov.br](mailto:ogando@linea.gov.br)

