



# Science User Interface and Tools: Status

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On Behalf of the SUIT Team at IPAC

**LSST2016** PROJECT AND COMMUNITY  
**WORKSHOP**  
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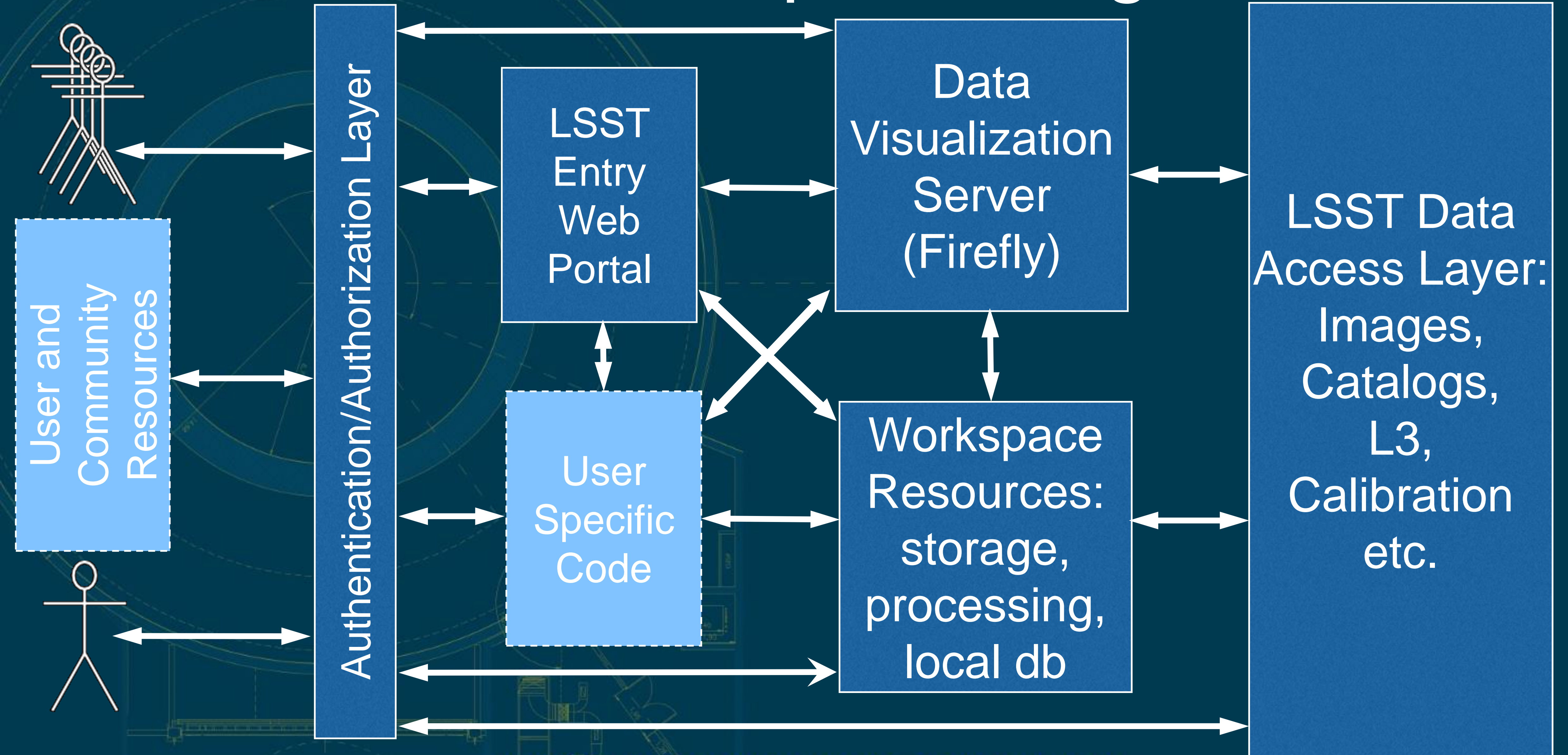
# Purpose of the SUIT

- Enable access to the LSST data products
- Enable visualization and exploration of the LSST data
- Provide an interface to Level 3 facilities enabling added-value processing and analysis close to the data"

# Philosophy of the SUIT

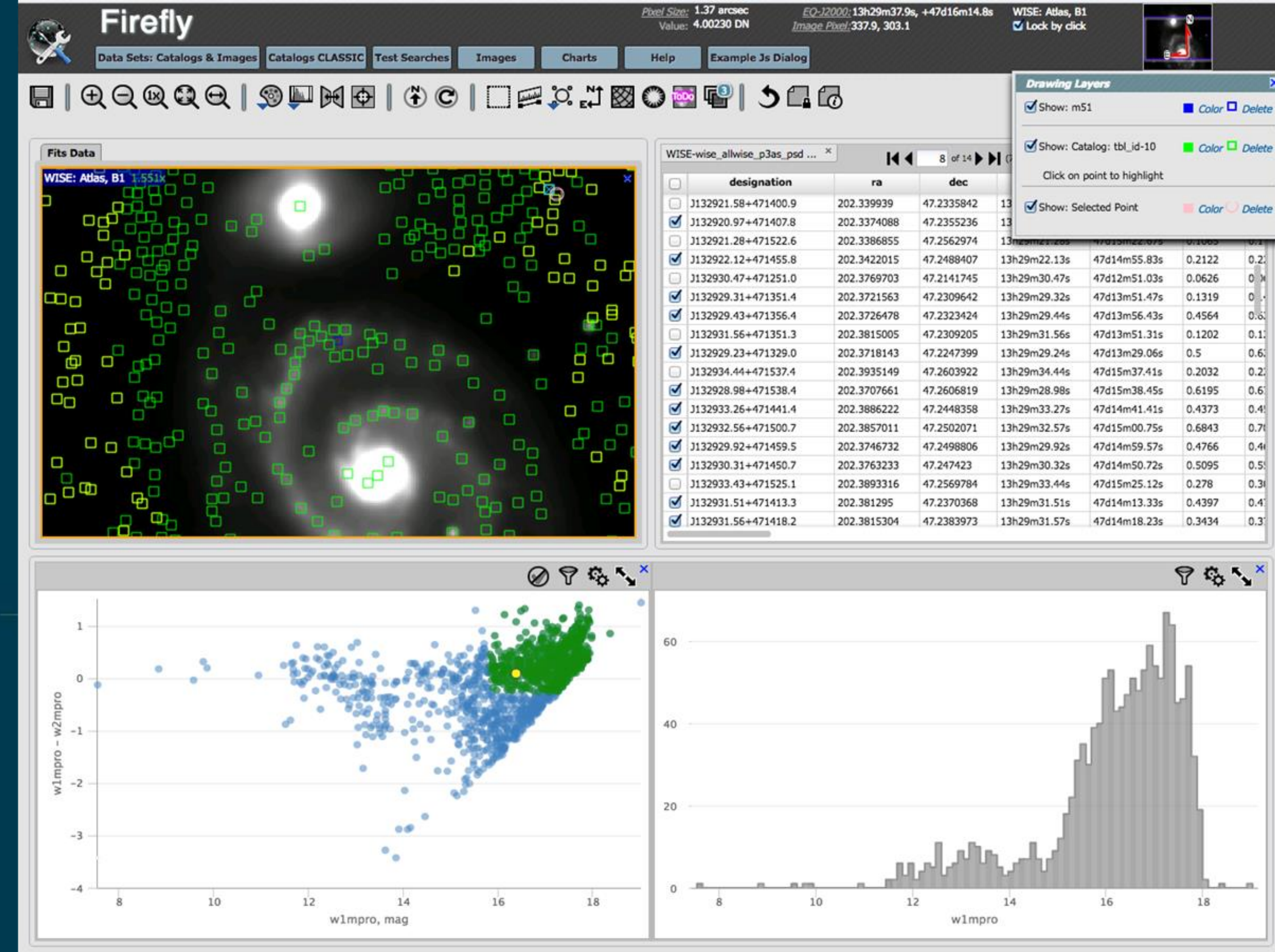
- The SUIT needs to be simple enough to engage the novice and general users while flexible enough to meet the needs of the experienced users
- DM will build a environment that fulfills the needs of the general user (e.g., portal and workspace, searching, image visualization, table manipulation, plotting, etc.)
- Components usable by others to build tools that meet their own special needs
- Enable creativity and flexibility
- SUIT is a portal, a set of tools, a workspace, and a toolkit of JS and Python APIs – all designed to mate the user with the data.

# User Oriented Conceptual Diagram



# What is Firefly ?

- Image and Data visualization suite
- Client – Server architecture
- Data are maintained on server
- Enables fast display on client side
- Unified data model (brushing & linking: images, tables, plots, histograms)
- Modular components (images, tables, plots, histograms)
- Operational in Infrared Science Archive at IPAC



# Visualization & Python

- We've made the first steps in the integration of the Firefly visualization components with Python
- Enables complex processing and analysis beyond the visualization tools: Creativity and Flexibility
- Callable from a Python command-line prompt or from within a Jupyter Notebook
- Computational capabilities of the SUIT extensible by providing for standard ways to invoke Python code in response to GUI actions.
- Currently in the prototype stage to inform the requirements, the design and architecture, and the development plan

# Python Command & Firefly

```

IPython: data/lsst — python — python.app ~/anaconda/envs/ffwidget27/bin/ipython — 80x43
In [36]: print('show the table in the browser')
show the table in the browser

In [37]: fc.showTable(g_srcs, isCatalog=True)
Out[37]: {u'success': True}

In [38]:
  
```

**Firefly**
Pixel Size: EQ-J2000: Image Pixel:  Lock by click

Data Sets: Catalogs & Images
Catalogs CLASSIC
Test Searches
Images
Charts
Help
Example Js

<input type="checkbox"/>	flags	id	coord_ra
<input checked="" type="checkbox"/>	True .. False	427962647745396737	6.135943686
<input type="checkbox"/>	False .. False	427962647745396738	6.13596862426
<input type="checkbox"/>	False .. False	427962647745396739	6.13593785718
<input type="checkbox"/>	True .. False	427962647745396740	6.13594354633
<input type="checkbox"/>	True .. False	427962647745396741	6.13595492472
<input type="checkbox"/>	False .. False	427962647745396742	6.13594371709
<input type="checkbox"/>	True .. False	427962647745396743	6.13595657387
<input type="checkbox"/>	False .. False	427962647745396744	6.135961684
<input type="checkbox"/>	True .. False	427962647745396745	6.13597286742
<input type="checkbox"/>	False .. False	427962647745396746	6.13597405848
<input type="checkbox"/>	True .. False	427962647745396747	6.13599212438
<input type="checkbox"/>	False .. False	427962647745396748	6.13598718268

# Jupyter Notebook Widget

The ArchiveImage widget displays an image retrieved from an IRSA query. In this experimental version, it is a 'k' image from 2MASS centered on M31..

```
In [6]: iv = ArchiveImage(width='400px', height='400px', GridOn=True)
```

The ArchiveTable widget displays a catalog retrieved from an IRSA query. In this experimental version, it is a WISE catalog.

```
In [7]: tv = ArchiveTable(width='600px', height='400px')
```

```
In [8]: ipywidgets.HBox([iv,tv])
```

The screenshot shows a Jupyter Notebook widget with two main components:

- 2mass from service 1x:** A grayscale astronomical image of the M31 galaxy. A grid of green squares is overlaid on the image, representing the positions of stars in the catalog. A bright star is visible in the center. Time stamps are shown in the bottom left: +41d18m0.0s, +41d16m0.0s, and +41d14m0.0s.
- wise\_allwise\_p3as\_psd:** A table of astronomical data with columns: designation, ra, dec, clon, clat, and sigra. The table contains 20 rows of data.

	designation	ra	dec	clon	clat	sigra
<input type="checkbox"/>	J004302.11+411658.2	10.75882	41.28284	00h43m02.12s	41d16m58.22s	0.1646
<input type="checkbox"/>	J004259.53+411654.0	10.7480704	41.2816839	00h42m59.54s	41d16m54.06s	0.1059
<input type="checkbox"/>	J004256.73+411638.3	10.7364019	41.2773059	00h42m56.74s	41d16m38.30s	0.1298
<input type="checkbox"/>	J004257.09+411619.7	10.7378976	41.2721435	00h42m57.10s	41d16m19.72s	0.125
<input type="checkbox"/>	J004301.09+411611.5	10.75458	41.26988	00h43m01.10s	41d16m11.57s	0.093
<input type="checkbox"/>	J004259.07+411642.4	10.746133	41.2784448	00h42m59.07s	41d16m42.40s	0.0923
<input type="checkbox"/>	J004259.86+411606.6	10.7494393	41.2685167	00h42m59.87s	41d16m06.66s	0.1297
<input type="checkbox"/>	J004251.62+411606.8	10.7150945	41.2685667	00h42m51.62s	41d16m06.84s	0.0703
<input type="checkbox"/>	J004252.53+411541.6	10.7188801	41.2615757	00h42m52.53s	41d15m41.67s	0.0868
<input type="checkbox"/>	J004253.85+411536.5	10.7244122	41.2601478	00h42m53.86s	41d15m36.53s	0.0855
<input type="checkbox"/>	J004257.26+411553.7	10.7385866	41.2649191	00h42m57.26s	41d15m53.71s	0.0802
<input type="checkbox"/>	J004303.97+411927.4	10.7665735	41.3242852	00h43m03.98s	41d19m27.43s	0.1632
<input type="checkbox"/>	J004301.29+411951.5	10.75539	41.33099	00h43m01.29s	41d19m51.56s	0.1923
<input type="checkbox"/>	J004302.49+411935.6	10.7604088	41.3265762	00h43m02.50s	41d19m35.67s	0.2631
<input type="checkbox"/>	J004252.51+411928.8	10.7188148	41.3246809	00h42m52.52s	41d19m28.85s	0.1451
<input type="checkbox"/>	J004251.05+411919.2	10.7127087	41.322022	00h42m51.05s	41d19m19.28s	0.138
<input type="checkbox"/>	J004251.00+411917.1	10.7123205	41.3227561	00h42m51.00s	41d19m17.10s	0.1440



# Firefly & Python Data Sharing

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```

```
In [8]: ipywidgets.HBox([iv, tv])
```

```
In [12]: tv.filters
```

```
Out[12]: u'dec > 41.26'
```

Retrieve the filtered table from the widget as an Astropy table.

```
In [13]: mytable = tv.selection()
```

```
In [14]: mytable
```

```
Out[14]: <Table masked=True length=315>
```

designation	ra	dec	clon	clat	sigra	...	...	...	...	...	...
	deg	deg			arcsec	...	...	...	...	...	...
str19	float64	float64	str12	str12	float64	float64	float64	float64	float64	float64	float64
J004302.11+411658.2	10.75882	41.28284	00h43m02.12s	41d16m58.22s	0.1646	0.1243	-0.0255	10.979	0.047	23.3	29.74
J004259.53+411654.0	10.7480704	41.2816839	00h42m59.54s	41d16m54.06s	0.1059	0.0928	-0.0191	11.33	0.04	27.4	35.49
J004256.73+411638.3	10.7364019	41.2773059	00h42m56.74s	41d16m38.30s	0.1298	0.0944	-0.026	11.247	0.044	24.5	30.36
J004257.09+411619.7	10.7378976	41.2721435	00h42m57.10s	41d16m19.72s	0.125	0.1307	-0.0335	11.269	0.053	20.5	16.76
J004301.09+411611.5	10.75458	41.26988	00h43m01.10s	41d16m11.57s	0.093	0.0708	-0.02	9.887	0.033	33.2	72.91
J004259.07+411642.4	10.746133	41.2784448	00h42m59.07s	41d16m42.40s	0.0923	0.0875	-0.0238	10.197	0.034	31.8	70.3
J004259.86+411606.6	10.7494393	41.2685167	00h42m59.87s	41d16m06.66s	0.1297	...	...	...	...	...	...
J004251.62+411606.8	10.7150945	41.2685667	00h42m51.62s	41d16m06.84s	0.0703	...	...	...	...	...	...
J004252.53+411541.6	10.7188801	41.2615757	00h42m52.53s	41d15m41.67s	0.0868	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...

The screenshot shows a Jupyter Notebook interface with two widgets side-by-side. The left widget, titled '2mass from service', displays a grayscale image of the galaxy M31 with green square markers overlaid on it. The right widget, titled 'wise\_allwise\_p3as\_psd', displays a table of WISE catalog data with columns for designation, ra, dec, clon, clat, and sigra. The table is scrollable and shows 315 rows of data.

# Image Mask Viewer

- Firefly Python API
- LSST image: mask plane taken from data
  - Detected (red)
  - Crosstalk (green)
  - Edge (blue)
  - Intrap (yellow)
- User control
  - Color
  - Transparency
  - Visibility

```
[17]: file= '/Users/roby/dev/validation_data_hsc/DATA/00533/HSC-R/corr/CORR-0903338-025.fits'
status = fc.show_fits(file, 'pmask', MultiImageIdx='0')
status = fc.add_mask(5, 1, 'pmask', 'maskid1')
status = fc.add_mask(10, 1, 'pmask', 'maskid2')
status = fc.add_mask(4, 1, 'pmask', 'maskid3')
status = fc.add_mask(2, 1, 'pmask', 'maskid4')
```

# Guiding Development with A Prototype Data Access Center

- Enable an end-to-end integration of (initially) the Data Access, SUIT, and Middleware/Infrastructure components of DM into a cooperating system.
- Enable operational and scaling tests of the above.
- Expose the Data Access (e.g., database query) and SUIT components to a very limited science user community for early feedback on the design and implementation.
- This is an engineering facility and not intended to be a full production-level data archive service
  - Services may go up and down
  - Code and functionality will change

# PDAC Deployments



- 2016/2017: Version 1
  - SDSS Stripe 82 data
  - Web portal and API data access
- 2017: Version 2
  - WISE time domain data (100 Billion rows)
  - Workspace environment
- 2018: Version 3
  - Inclusion of even larger public datasets (e.g., maybe PanSTARRS)
  - LSST processed data
  - Improved and increased SUIT functionality
- 2019: Version 4
  - Support for Commission and analysis of commissioning data
  - Transitioning over to operational DAC for 2020/2021 support of science verification and operations

*Versions 2, 3, 4 are tentative scenarios, not defined plans; more details will become available pending conclusion of DM replan*

# PDAC Access Policy (LDM-482)

- Project team members who specifically request it and receive approval from DM management, after consultation with the teams building and operating the components.
- Astronomers with LSST data rights not employed by the project ("external users"), who submit an application substantively describing investigations they wish to perform, including a description of how they plan to provide technical and usability feedback to the project, and expressing their understanding that the PDAC is not a production system. The PDAC will initially only be able to accommodate a small number of external users

# Summary

- SUIT effort will deliver a web-based user interface allowing the community to visualize, explore, process, and analyze the LSST data, as well as advanced visualization components enabling close-to-the-data analysis in Level 3.
- Strong Python and visualization connection
- Integrated workspace and portal environments
- Python and JS APIs for user customization
- Incremental development and integration and testing through PDAC

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0004252.53+411541.6	10.7188801	41.2615757	00h42m52.53s	41d15m41.67s	0.0868
0004253.85+411536.5	10.7244122	41.2601478	00h42m53.86s	41d15m36.53s	0.0855
0004257.26+411553.7	10.7385866	41.2649191	00h42m57.26s	41d15m53.71s	0.0802
0004303.97+411927.4	10.7665735	41.3242852	00h43m03.98s	41d19m27.43s	0.1632
0004301.29+411951.5	10.75539	41.33099	00h43m01.29s	41d19m51.56s	0.1923
0004302.49+411935.6	10.7604088	41.3265762	00h43m02.50s	41d19m35.67s	0.2631
0004252.51+411928.8	10.7188148	41.3246809	00h42m52.52s	41d19m28.85s	0.1451
0004251.05+411919.2	10.7127087	41.322022	00h42m51.05s	41d19m19.28s	0.138

Firefly

Data Set: Catalogs & Images Catalogs CLASSIC Test Searches Images Charts Help Example 3x Dialog

Tiled View

Drawing Layers

- bit # 5 - MP\_DETECTED over Color Delete
- bit # 10 - MP\_CROSSHAIR over Color Delete
- bit # 4 - MP\_EDGE Color Delete
- bit # 2 - MP\_INTRP Color Delete

Color Picker

[17]: file= '/Users/roby/dev/validation\_data\_hsc/DATA/00533/HSC-R/corr/CORR-0903338-025.fits'

```
status = fc.show_fits(file, 'pmask', MultiImageIdx='0')
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status = fc.add_mask(10, 1, 'pmask', 'maskid2')
status = fc.add_mask(4, 1, 'pmask', 'maskid3')
status = fc.add_mask(2, 1, 'pmask', 'maskid4')
```