Connecting catalogs to image pixels with the Astro Data Archive

Knut Olsen (NOIRLab/CSDC) on behalf of Sean McManus, Steve Pothier, and Pete Peterson
Crowd Sourcing the Sky

- Astro Data Archive inception in 2004
- Imaging data covers >80% of sky
- Billions of astronomical objects in associated catalogs

Animated Sky Coverage Map:
https://www.youtube.com/watch?v=lbRWdOqWrEk
From images to catalogs

- NOIRLab Source Catalog DR2 (Nidever et al. 2020)
- 3.9 billion objects
- 68 billion measurements
astroarchive.noirlab.edu

- Petascale pixel data archive
- Web and API queries
- Astroquery module
- Jupyter notebook examples
Advanced search capabilities

- API with interactive documentation
- Use to access and search any field in file headers

REST API

API description for NSF’s GRI Lab Astro Data Archive. (version 3.8)
Example usage can be found in Jupyter Notebooks.

Discovering Our Universe Together
API image retrieval

```
Out[13]: 'https://astroarchive.noirlab.edu/api/retrieve/84289f753e3155b55955b7d4ffe67c4b?hdus=35'

In [14]:
hd = fits.open(onehduurl)
hd.info()
```

Unique identifier

Filename: /home/pothiers/.astropy/cache/download/url/c4a811d78e3043fd7c834c396c565ff5/contents

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Ver</th>
<th>Type</th>
<th>Cards</th>
<th>Dimensions</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>PRIMARY</td>
<td>1</td>
<td>PrimaryHDU</td>
<td>251</td>
<td>()</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>N4</td>
<td>1</td>
<td>CompImageHDU</td>
<td>127</td>
<td>(2046, 4094)</td>
<td>float32</td>
</tr>
</tbody>
</table>

In Data Lab:  

Discovering Our Universe Together
Making a DES exposure map

Map of effective exposure time depends on atmospheric transparency, PSF FWHM, sky brightness, and commanded exposure time.

This metadata is available at detector level for every image.
Summary

- Astro Data Archive puts a Petabyte+ of pixel data and metadata in your hands
- Is the source of billions of catalog objects and measurements
- Come to NOIRLab Data Services Splinter Session on **Thursday at 4:10 PM** to see Astro Data Archive and other NOIRLab services as an integrated scientific workflow:
  - DES depth map (Astro Data Archive)
  - Discovery of dwarfs and streams in DES catalog data (Astro Data Lab)
  - Discovery of associated variables and transients (ANTARES)
  - Scheduling a followup observation with Gemini (AEON)