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ODI Pipeline, Portal and Archive - Quick Guide

Introduction

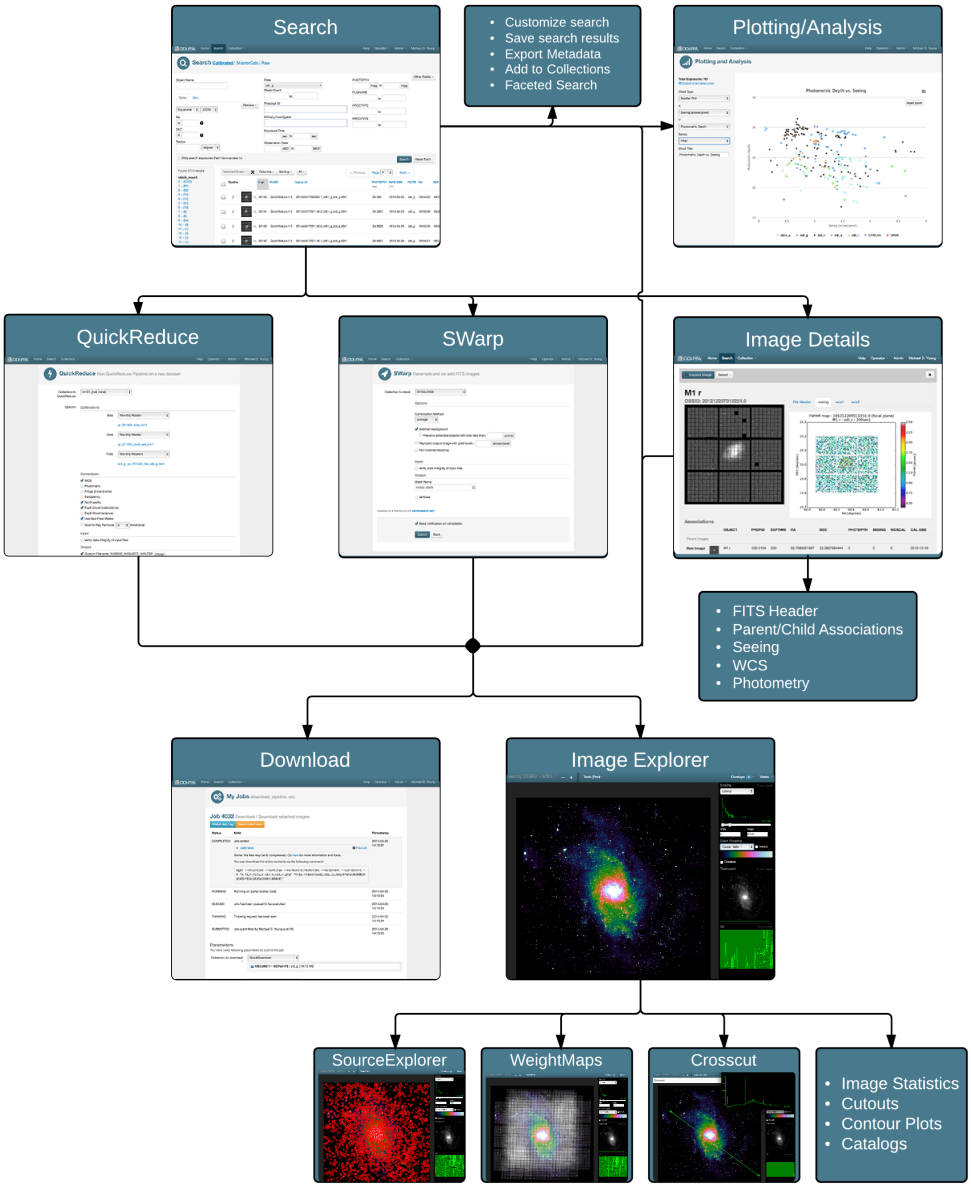
The One Degree Imager (ODI), an optical imager on the WIYN 3.5m telescope at Kitt Peak, Arizona, is designed to deliver atmosphere-limited image quality (<0.4") over a one degree field of view. The ODI Pipeline, Portal, and Archive (ODI-PPA) is a web science gateway that provides astronomers a single point of access to ODI data, and rich computational and visualization capabilities. Its goal is to support scientists in handling complex data sets, and to enhance the WIYN observatory's scientific productivity beyond data acquisition.

ODI-PPA lets astronomers do their science -- while the gateway seamlessly manages the data!

The ODI-PPA portal offers a modern web interface to *search* and *download* data (like traditional archives). It is designed to be a *compute archive* that has several built-in frameworks:

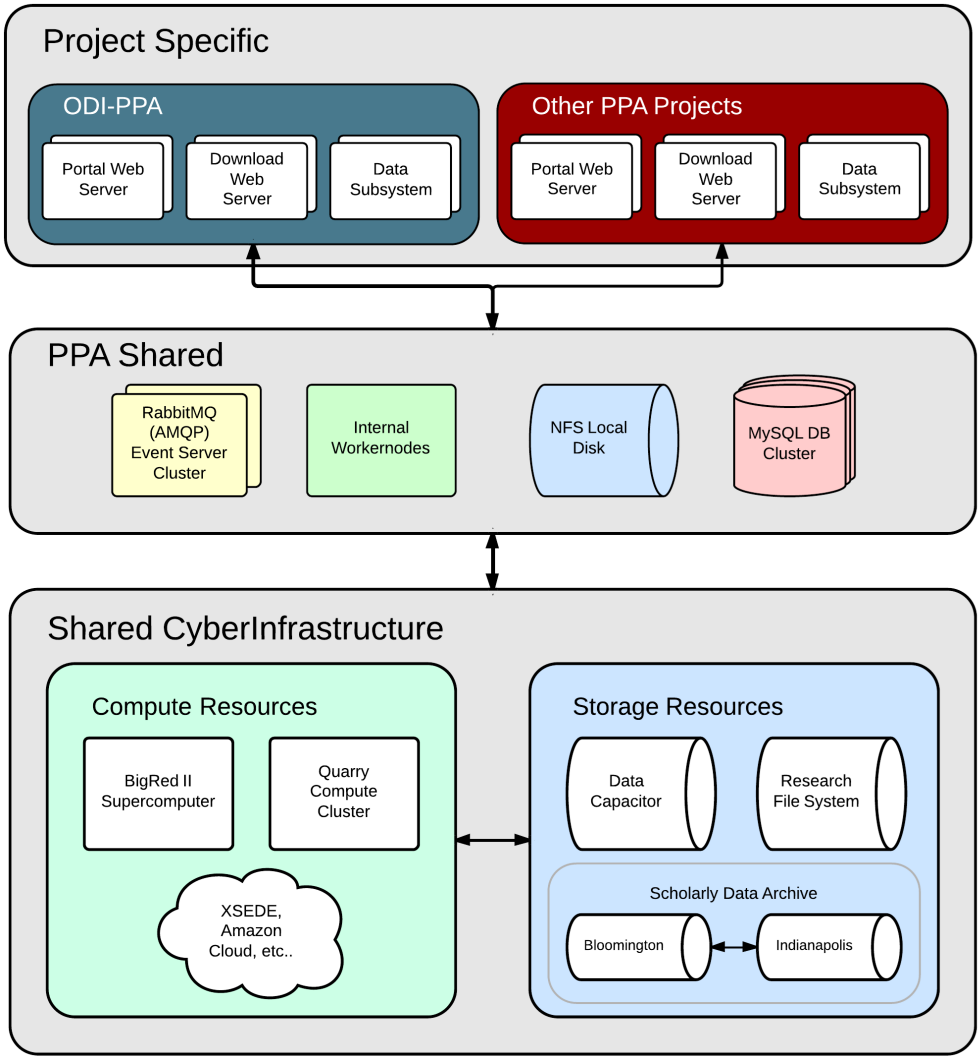
1. *Collections* that allow an astronomer to create logical collations of data products intended for publication, further research, instructional purposes, or to execute data processing tasks
2. *Image Explorer* and *Source Explorer*, which together enable real-time interactive visual analysis of massive astronomical data products in a DS9-style interface within an HTML5 capable web browser, and the visualization of standard catalog and SExtractor-generated source markers and overlays
3. Workflow framework which makes it possible for the PPA administrators to rapidly integrate data processing pipelines on an associated compute cluster, and for users to request such pipelines to be executed on their data via custom user interfaces.
    a. Currently integrated pipelines/libraries include a python based QuickReduce pipeline, SExtractor, an IRAF based calibration pipeline, SWarp, and basic IRAF modules.
4. Association information between data products to help astronomers understand where one or more data products came from – be they from the instrument directly or the output from a data reduction pipeline. These association information are displayed in Collections and while inspecting details about a particular image.

ODI-PPA User Workflow



Brief Technical Description

The ODI-PPA service stack, deployed on Linux servers at Indiana University (IU), is made up of a set of light-weight services tied together by an Advanced Message Queuing Protocol (AMQP) message bus and the web portal. The web front-end is built using the Twitter/Bootstrap and jQuery Javascript libraries while the backend services are written in PHP (using the Zend framework) and Python. A data subsystem handles the archival and file-staging tasks while a core service called Spider is responsible for appropriate handling and redirection of various data products. Several other services invoke and handle registration of new data products, and user-requested pipeline executions. A set of compute nodes – some dedicated and others acquired via request on the petaflop-scale Big Red II supercomputer – handle all data processing requests including operator or user requested pipeline executions, tile generation for use on Image Explorer and Source Explorer, and staging of data in response to download requests.



ODI-PPA leverages CyberInfrastructure Indiana University including the geographically replicated 42 PB Scholarly Data Archive (SDA) tape system for safe archival of data, the 1 Petaflop Cray Big Red II and Karst supercomputers, and the 5 PB Data Capacitor shared file system for temporary staging of data. A set of download servers running Apache HTTP handle all download requests. A replicated MySQL cluster and a RabbitMQ event cluster handle all PPA database and message bus needs respectively.

Getting Started

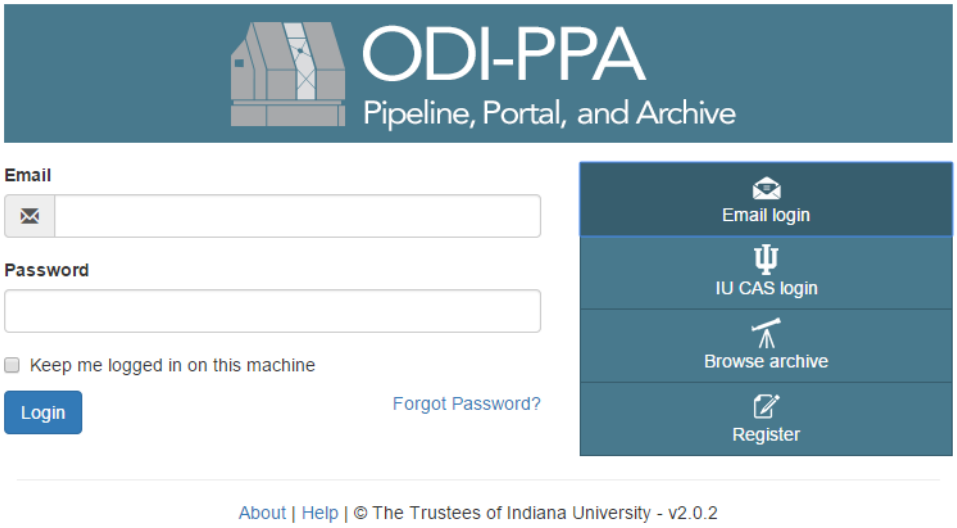
Logging In

Pre-registration of PIs and co-PIs with WIYN Observation Programs: Beginning with the 2013B semester, approved projects and their PIs will be pre-registered on the PPA site. To complete your registration, follow the instructions in the pre-registration email you must have received. Contact the PPA helpdesk if you need any further assistance with this!

Self-Registration: If you are not a PI or co-PI who has not been already pre-registered to PPA, you can create a new user account via the *Register* link on the home page. Enter your name, email, affiliated institution, and a password (8 characters minimum, feedback on password strength provided). You will have to confirm the user registration by clicking on a link you will receive via the email address you used to register.

You can access the ODI-PPA portal at http://portal.odi.iu.edu. Most users would likely use the email address + password combination via the

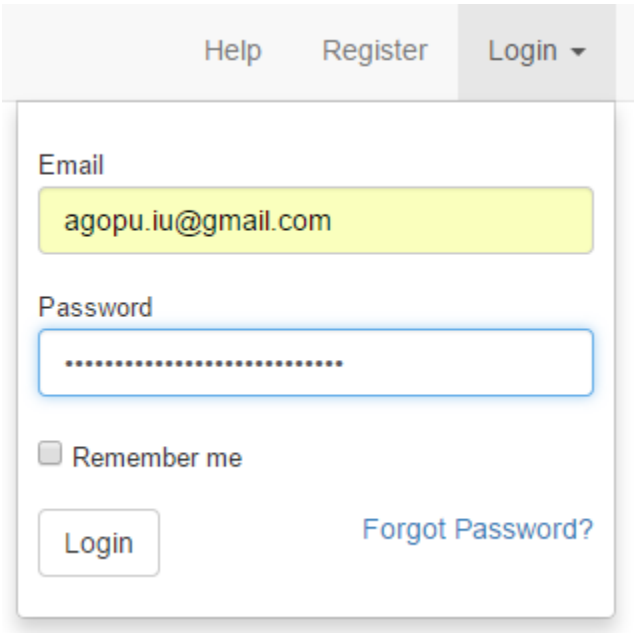
Email Login button. If you have forgotten your password, you can use the *Forgot Password?* option to reset it.



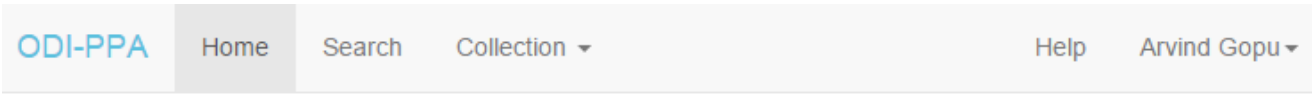
Single Sign On: If the email address you used to register is an @iu.edu or @indiana.edu based one, then you can click on the button like the one shown below, and use the IU CAS single sign on process to login to ODI-PPA (without having to remember yet another username/password!)

OpenID/Google ID/Other Single Sign On: ODI-PPA has the ability to allow authentication via any Open ID provider (for example, one's Google ID) if a user maps their account to one such OpenID (or an administrator does it on their behalf). Contact the ODI-PPA Help Desk if you would like to request any such Open ID provider to be added to the list of providers supported.

If you are browsing the archive (for example, if you clicked on the Browse Archive button in the landing page shown above) then you can click on the Login menu item, and then enter your username and password. If you have forgotten your password, you can use the *Forgot Password?* optio n to reset it.



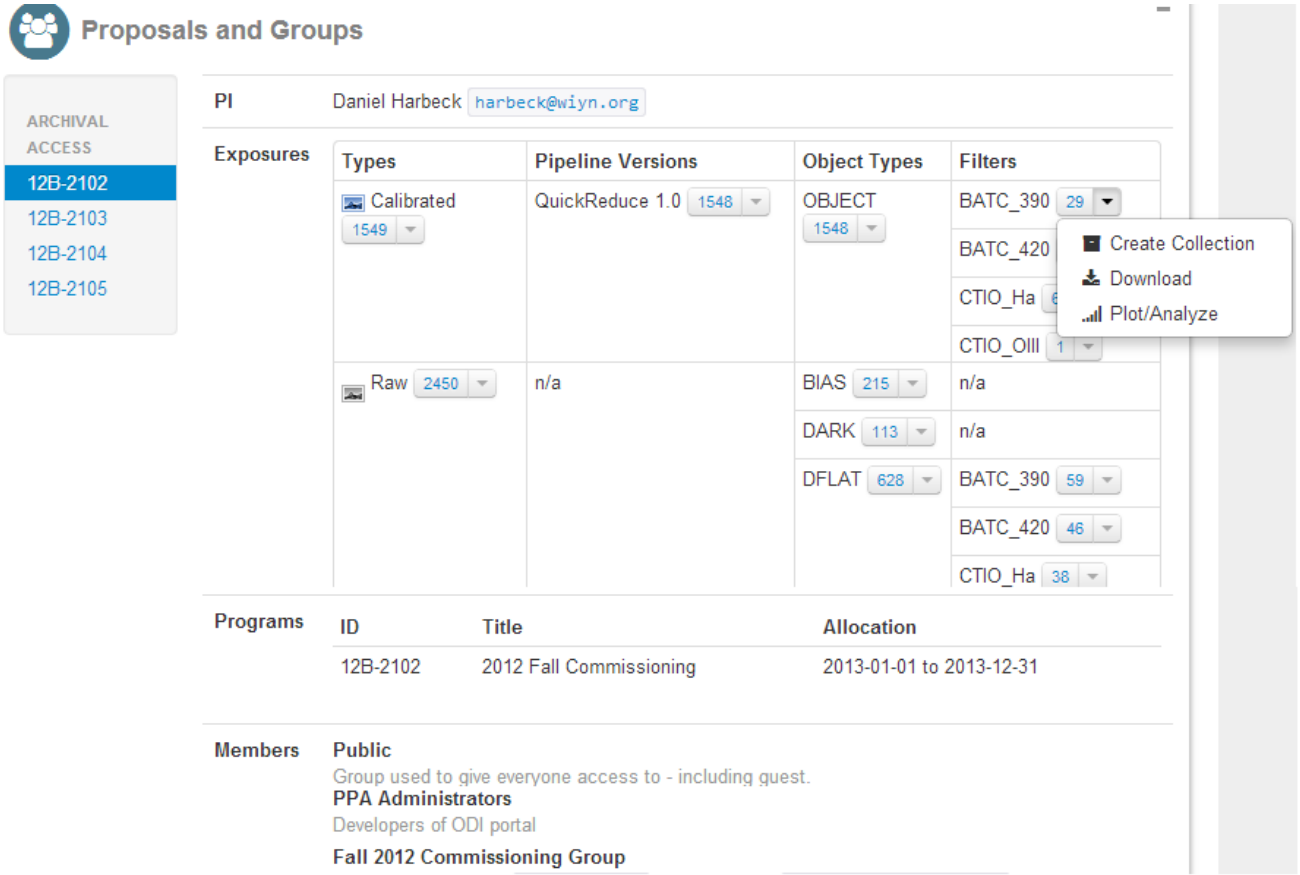
Once logged in, all pages on PPA are designed to have a consistent navigation menu bar at the top of the screen which currently includes *Home* (takes you back to *your Dashboard*), *Search*, *Collections* (and sub-menus to create, view, manipulate, or execute Tier 2 workflow tasks on a collection), *Help*, and the <*username*> menu item (for access to *user profile settings*, *My Jobs* listing, and the ODI *Proposal* listing). Additionally, PPA operators and administrators will get an *Operator* and *Admin* menu items respectively.



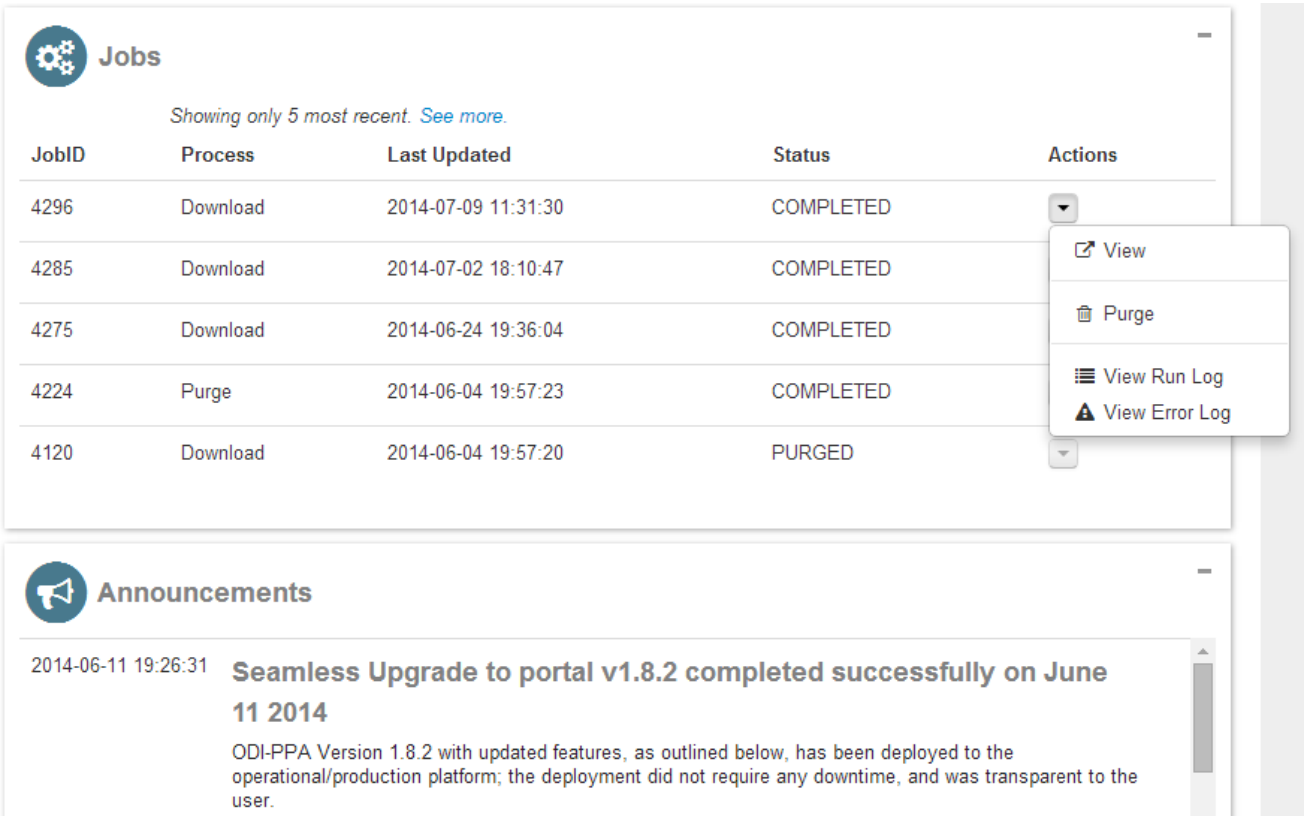
Personal Dashboard

When you login, you will be taken to *your personal Dashboard*. Currently the dashboard has three sections as listed below. You can choose to close or re-open each section per your preference via the ***+/-*** icons on the top right of each section; your choice is stored to your user profile, and remembered the next time you login to PPA.

- ***Proposals* section:** Displays a list of various WIYN observing proposals you may be PI or co-PI on, and proposals that are non-proprietary and accessible as part of the public archive. Details are shown for a selected proposal including PI, exposure listing, associated observing runs/programs, and the groups of people that have access to the data (including PPA admins and operators).
  - In the exposure listing, the calibrated data products produced by the *QuickReduce* pipeline (also referred to as QR, and indicated by
    
) or *NOAO calibration* pipeline (also referred to as *AuCaP*, and indicated by
    
    ), and raw data from the instrument are demarcated as are exposures by data type (bias, darks, flats, science objects) and by filter (if applicable).
  - Clicking on the numeric values shown before the drop down sub-menu next to each data product type or pipeline version or the like will take you to the Search interface with appropriate parameters pre-filled out. For example, clicking on the 1548 next to the OBJECT listing on the first row on the screenshot below will populate the *Calibrated* search form with the the OBSTYPE Object and other appropriate field values for PROPID, etc.
  - The dropdown submenu items allow you to create a collection of the relevant images, download them, or to analyze them directly using PPA Charts!



- ***My Jobs* section:** Displays a short list of Tier 2 jobs including download that you may have executed previously. You can jump to the job's details by clicking on it, inspect the status of that job, and perform other actions related to each job. The My Jobs option via the top level <Username> menu will show you all the jobs you have executed in the past.
- ***Announcements* section:** Displays recent announcements posted by the PPA administrators with information about new releases for updates, bug fixes, etc., and any planned or unexpected outages.



Tip on PROPID Identification: if you do not know the Proposal ID for your observing program or don't see it listed on your dashboard, you can locate it in one of the following ways:

1. Go to the KPNO/WIYN telescope schedule online (http://www.noao.edu/kpno/forms/tel_sched/) and locate your observing run. The “P#” to the left of your name in the appropriate night is your proposal number.
2. Go to the <username> menu item in the upper-right hand corner on the black bar, and from the drop-down menu, choose Proposal/Programs. This will list all observing programs, roughly in chronological order. Search for your program by clicking on the Proposal IDs.

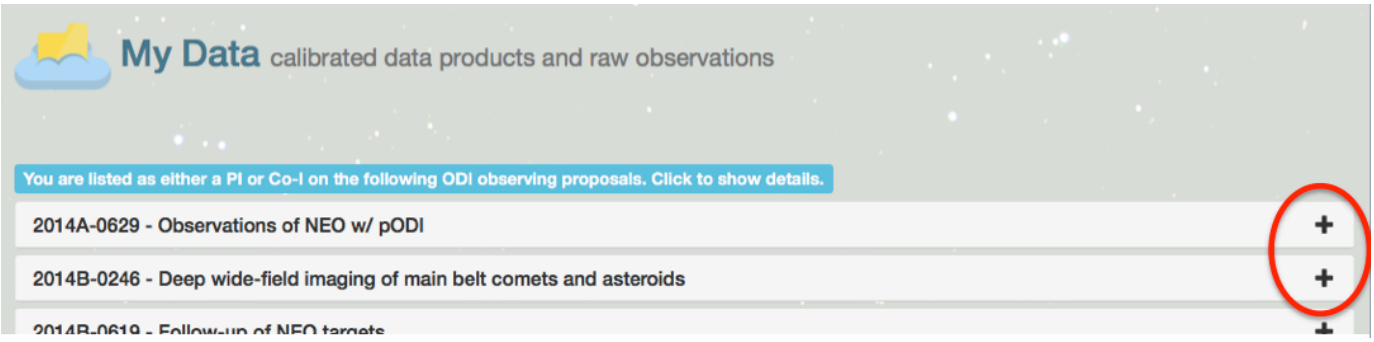
Downloading Walkthrough ("Give me my data!")

Under Construction!

The *fastest way* to access your calibrated data is to click on the 'My Data' icon on the splash page:

You will see a list of observing programs in which you are listed as a PI or Co-I.

Click the '+' icon next to the program with the data you wish to download.



To download all the data from your program, click the Download icon. In the following screen, click the 'Submit' button to begin the download process:

Allow the process to run... this may take between a few seconds up to a couple hours depending on the size of the request and how recently the data was taken.

When the process is complete you will see the following message, along with a link to download a tar ball with your data, or view a file list. Note that files are .fz compressed. The download screen provides a link to the tools necessary to uncompress the data.

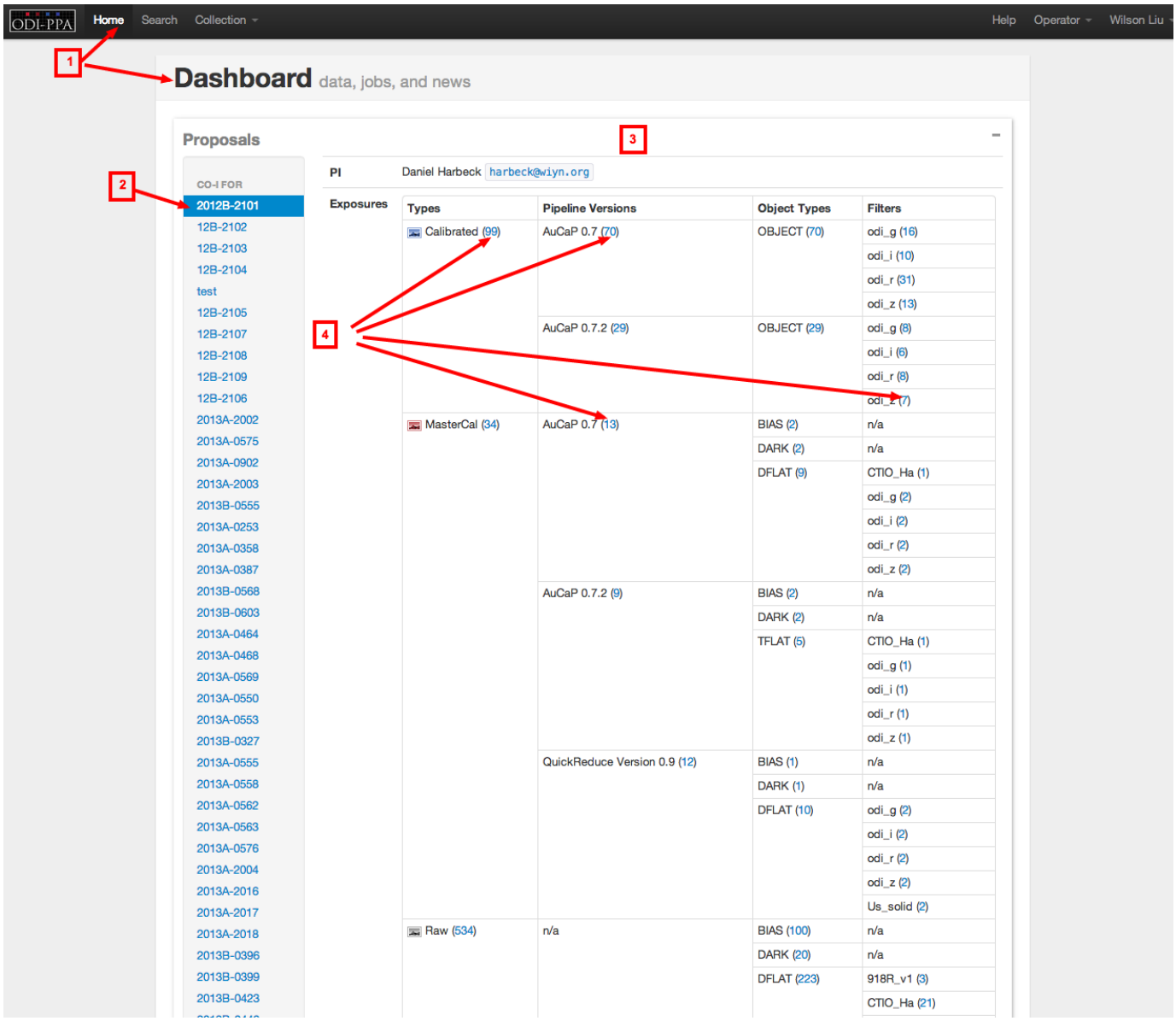
The Following section refers to an deprecated version of the PPA and is no longer applicable.

NOTE: In order to access your data, you must be registered on the ODI-PPA portal! More information on registration is available here.

The Home Page and Dashboard

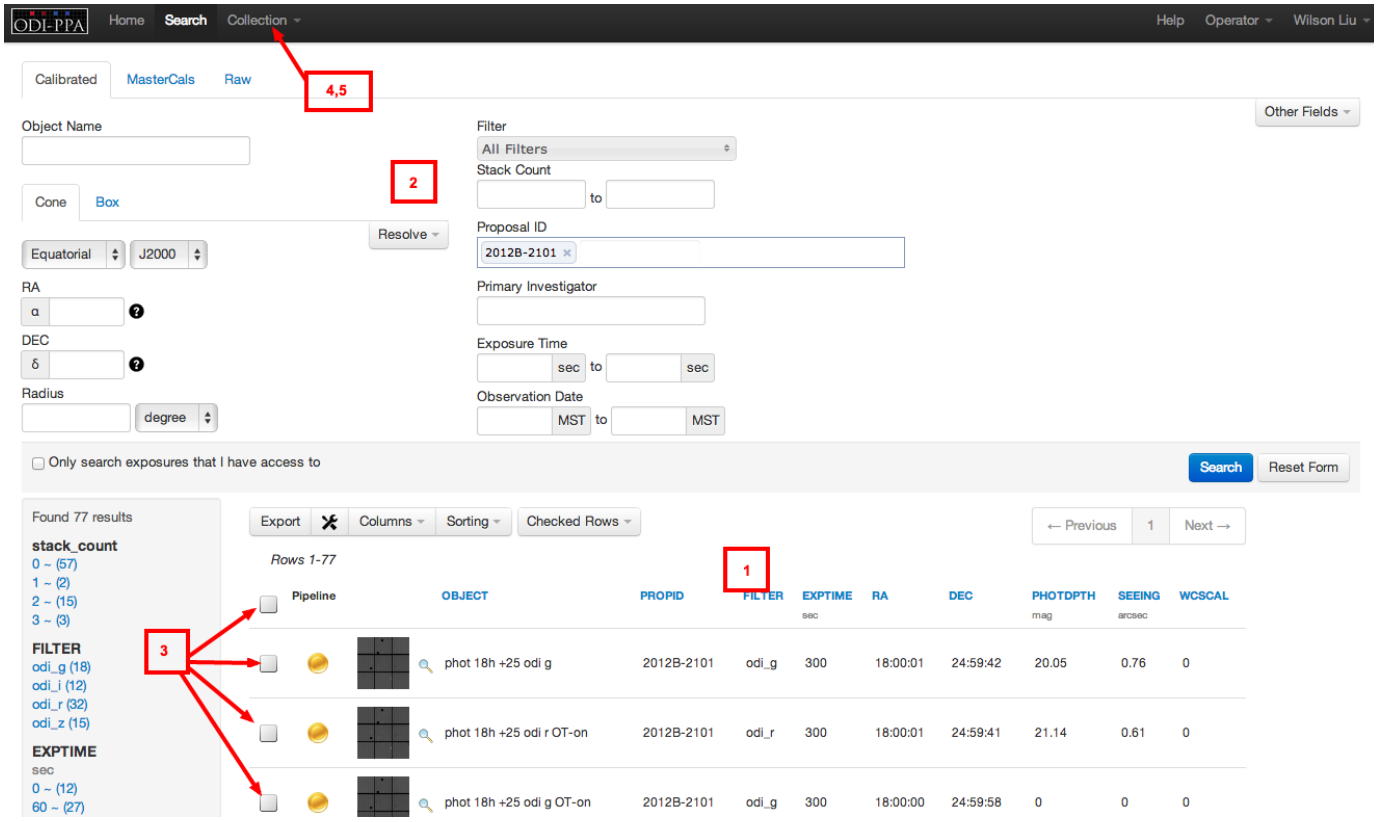
1. After you log in, you will be taken to the Home screen, which contains the Dashboard. The first section of the dashboard contains a summary of your data.
2. On the left side of the screen, there is a vertical bar which contains the Program IDs for the data you have access to. Select the appropriate Program containing the data you wish to download.

3. To the right, you will see a summary of all the data taken under your observing program. The data are subdivided into Calibrated (science data), MasterCal (pipeline processed calibration frames), and Raw (unprocessed frames; science and calibration data). The data are further subdivided by the pipeline and version used to process them, as well as the filter used to take the data.
4. The number next to each type of data shows the number of exposures.
5. Click on the Search link in the black bar at the top of the page.



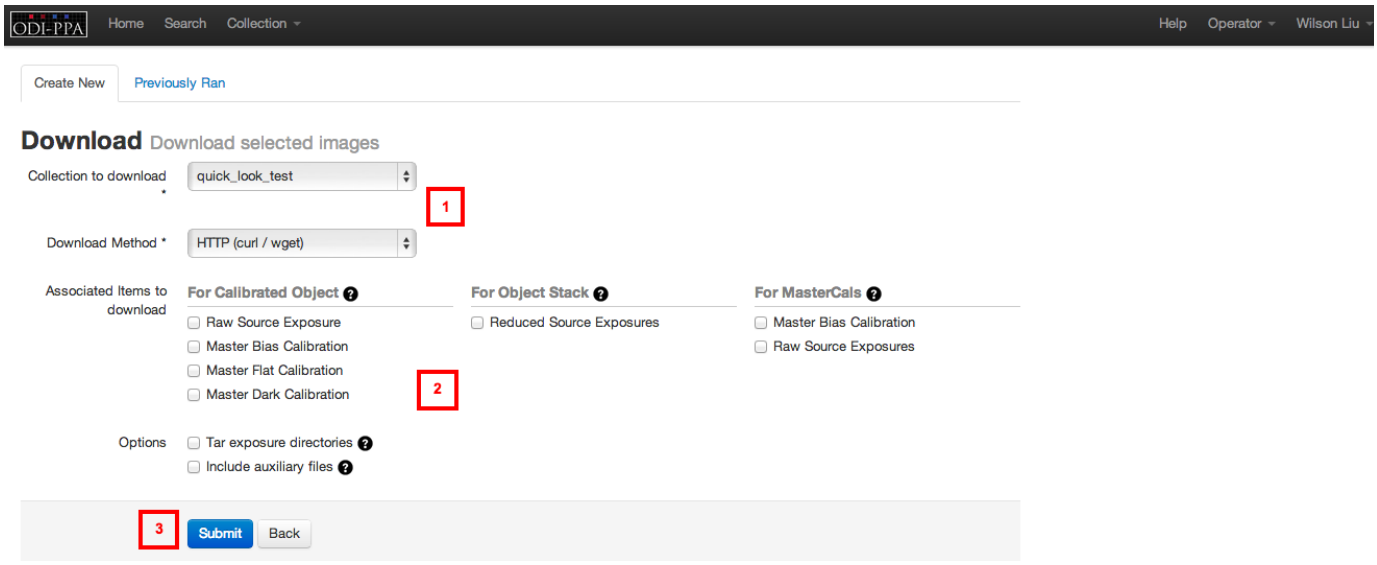
The Search Page and Collections

1. After you click on the Search link, you will be taken to the Search page.
2. In order to access your data, enter the Proposal ID and/or Primary Investigator of your program in the appropriate field.
3. When the specific data you wish to download appears in the search results, you can select the any of the exposures by checking the box at the beginning of the row, or all of the exposures by checking the box at the top of the search results.
4. To download these data, you need to create a Collection (like a folder) and add the exposures to the Collection. Choose the Collection menu at the top of the page. From the drop-down menu, select Create New Collection. This will open a pop-up window for you to name your collection. Press the blue Create button.
5. To add the exposures to the Collection: click the 'Checked Rows' button at the top of the search results. From the drop down menu, select the collection you just created.
6. After you create your collection, open the Collection menu again and place your cursor over the appropriate collection. This will open a side menu with a list of actions for the collection. Select Download.

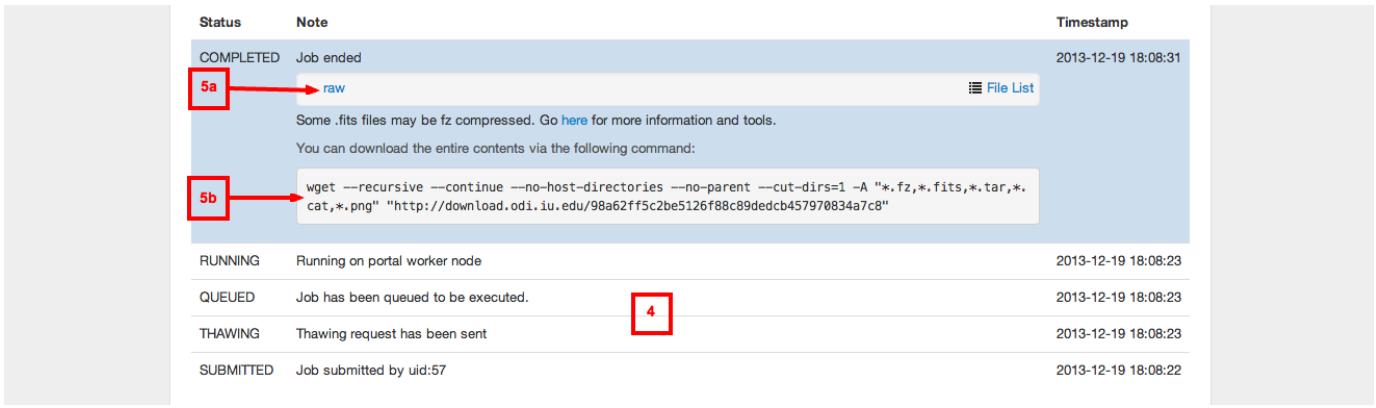


The Download Page

1. In the Download Screen, you will see two drop down menus at the top. The first will be pre-filled with the collection you chose to download in the Search page. The second allows you to select a download method, with HTTP as the default.
2. Below, you can select options to include associated (calibration, raw) and auxiliary (exposure and data quality maps) files with your download, or tar your output directories.
3. After you have selected any options, click the blue Submit button.
4. The job will run and the status of the job will update occasionally.
5. When the job is complete, you will receive a download box at the top of the page. There are two ways to retrieve your data.
    a. Click on the blue links for “calibrated,” “raw,” or “mastercal” images. This will take you to a index of files which you can download using your browser.
    b. Copy/paste the command provided in a terminal window. This will save all the images in your download job into your current working directory, organized into subdirectories



...when the job is complete:



The default format for a single pODI exposure is a ***directory*** (named after the exposure ID). Each OTA will have 2 fits files (one calibrated image, and one calibrated/resampled image), resulting in 26 images. For calibrated science images, the fits files have been flattened so that all cells are contained in one extension. For calibrations and raw images, each fits file is actually an MEF, with 64 extensions, one for each cell in the OTA. For a more thorough explanation of the filenaming convention, see the Data Description section of the Quick Guide.

QuickReduce Version Guide

Version 2.4 (implemented August 2017) :

More information coming soon.

Version 2.3 (implemented February 2017) :

1) Version 2.3 consists predominantly of infrastructure improvements to include the deployment of long-lived calibration products (such as fringe maps) part of the QuickReduce distribution. Calibration products are defined in the mastercals/ directory and its subdirectories of the distribution. Some of the larger calibration files (those too large to host on github) will be downloaded from an URL defined in the mastercals/ configuration files.

2) There is fix to a bug introduced in version 2.2 where the header keyword RADESYS was set incorrectly defined as '"ICRS"' (using triple quotes instead of single quotes), causing issues with the usability of the WCS solution in the image header. Also included is a change to the definition of the WCS CTYPE keyword from TAN to TPV for improved compatibility with iraf post-processing workflows. Lastly the swarpstack function will now define the RA and DEC keywords in image stacks.

3) Minor internal bug fixes. Reduced images should be unaffected by these changes.

Version 2.2 (implemented December 2016) :

!!!!***Warning [Feb 16 2017]:*** **A revised WCS template was introduced in version 2.2. Unfortunately, the new WCS template introduced contained a bug, where the header keywords RADESYS, CTYPE1, and CTYPE2 were populated incorrectly. This error is corrected as of quick reduce version 2.3.**

If your data has been processed by QuickReduce v2.2 (as indicated by the header keyword GITBRNCH, please contact the PPA team for instructions on how to either: 1) fix the keywords in your data, or 2) reprocess your data.

1) WCS calibration is now done using the Gaia catalog (previously 2MASS). Astrometric precision and accuracy are greatly improved.

2) Where available, SDSS DR13 is used for photometric calibration.

Version 2.1 (implemented October 2016) :

First QuickReduce deployment from Github. This release is primarily a technical release to improve robustness of pipeline operation. Impact on actual scientific data products is minimal compared to the previous version (2.0).

1) Various internal improvements for debugging and logging

2) New header keywords added:

GITBRNCH- QuickReduce version/branch name

GITCOMIT- Code revision commit hash (allows pull of exact version- for advanced github users)

3) Enables comparison of MasterCals with fiducial references (for Pipeline Operator)

4) Improved fringe template generation and fringe removal

5) Improved SExtractor catalog generation

Version 2.0 (July 2015; previous data reprocessed) :

1) Improved pupil ghost template

2) Improved WCS calibration, in particular in denser fields or for narrow-band exposures

3) Stacking improvements: Added illumination correction generation and application; more flexible photometric zeropoints; background normalization

4) Reduction log included in image headers

5) Support for twilight flats in creating mastercals

6) Improved cross-talk correction

Sub-versions to v2.0: These are relatively minor changes implemented in the pipeline, but data taken previous to their release were not reprocessed:

Version 2.0.5 (July 2016)

1) 5x6 fringe templates implemented in i- and z-band

Version 2.0.4 (June 2016)

1) New pupil ghost template and scaling for improved removal of pupil ghost from flat fields

2) New bad pixel mask which includes more regions affected by hot/dead pixels

3) Added support for a new narrow band filter, odi_NB695

Version 2.0.3 (May 2016)

1) Reworked internal communication to improve stability inside PPA (no changes to science functionality)

2) Improved stray-light mitigation during mastercal flat-field generation

Version 2.0.2 (Feb 2016)

1) u-band support
2) Stacking Improvements: Minimized memory demands, support for improved cleaning and rejection of guide-OTAs and broken cells

Version 2.0.1 (Nov 2015)

1) Added support to handle TFLATs and DFLATs simultaneously but separately

Version 1.1 (implemented May 2014; previous data reprocessed; final release for pODI data):

1) Illumination correction added

2) Photometric zeropoint plots and maps added to data products

3) When SDSS coverage is not available, the Pan-STARRs IPPRef catalog is used.

4) PSF shape calculations and diagnostic plots added

5) Persistency masking improvements

6) New WCS algorithm

7) Improvements to exposure scaling when stacking

QuickReduce Version 1.0

An upper-level flow description of the functionality in the QuickReduce pipeline is as follows:

1) Pixels affected by persistency and trailing are masked as non-usable. A catalog of saturated pixels is created

2) Defective cells are masked out. A cell is defined as the 512x512 pixel subsection, 64 of which comprise an OTA.

3) Cross-talk between cells in the same row is corrected.

4) Static bad pixels are masked out.

5) Overscan levels are calculated and subtracted for each cell.

6) Bias and dark-current are subtracted.

7) Non-linearity is corrected.

8) All cells in an OTA are collected into a monolithic frame.

9) Cosmic rays are identified and removed.

10) Fringe affects are removed in the i' and z' bands, using a template.

11) Sources are extracted and a catalog is created for each OTA, using SorceExtractor.

12) Astrometric calibration is performed using 2MASS as the astrometric reference catalog.

13) Source photometry is matched to SDSS, where available, and photometric zeropoints are calculated.

14) Output images, metadata, FITS tables, and diagnostic plots are created.

QuickReduce also includes support for stacking of ODI exposures using SWarp. For a more detailed description of any/all of these steps, please refer to:

Kotulla and Harbeck (ref.)

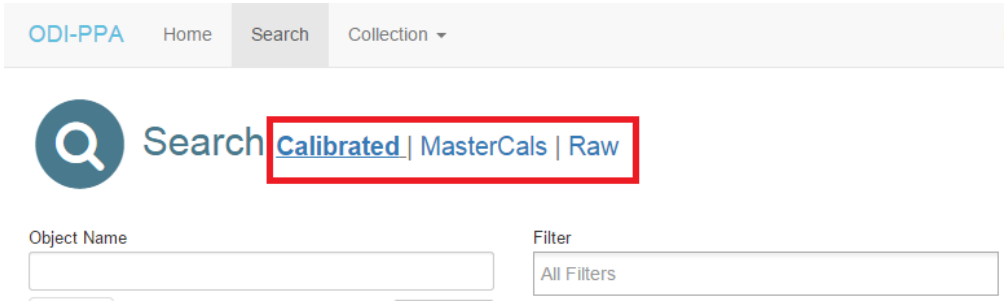
Search Menu

- Search Form (Parameters)
  - Typical Search Options/Parameters
  - Advanced Search Options/Parameters
- Search Results
  - Customizing Search Results
  - Faceted Search (Rapidly Prune Search Results)
  - Search Results (Actions)
  - Image Details Page

Search Form (Parameters)

Search is one of the top menu items on the portal. Three tabs on the top left of this screen allow you to search for a specific data products.

- *Calibrated:* Science exposures produced by the *NOAO calibration* pipeline (often referred to as *AuCaP*) or the *QuickReduce* pipeline.
- *MasterCals:* Master Calibrations (bias, dark, and flat-field) images created from the raw calibration frames by *AuCaP*or the *QuickReduce* pipeline.
- *Raw:* Raw science and calibration frames taken on the instrument.

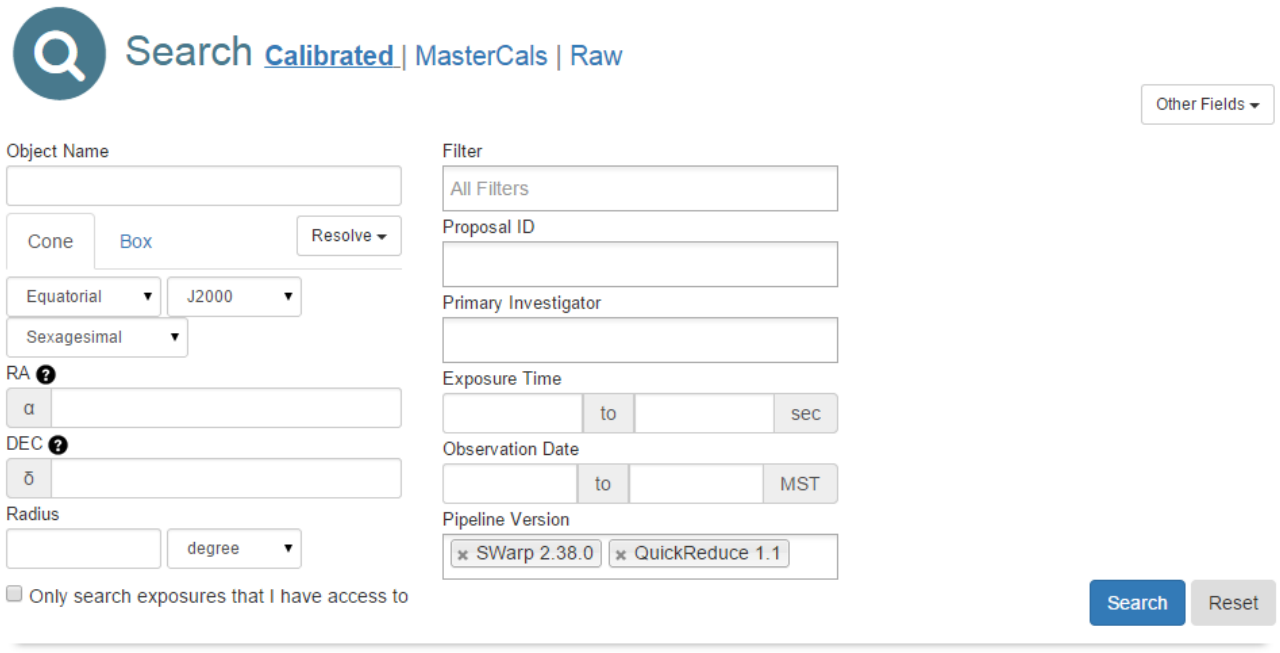


The *Search* form corresponding to each tab is typically split into three sections: the left most section lists options and parameters common to all data products; the middle section lists options and parameters appropriate to only the specific data products; and the right most section lists additional search parameters that can be added in by users for advanced searches (more on this in the Advanced Search section below).

Typical Search Options/Parameters

The list below describes various search options and paramters in the *Calibrated* Search form.

- *Object Name:* Allows you to search by the OBJECT name you chose to input while taking the data.
- Position Search: Allows RA/DEC based searches.
  - *Resolve* (drop down box to the right of the coordinate selection): When you click this button a text field will appear where you can enter the name of an astronomical object (e.g., alpha Lyr, NGC 2024). Clicking the *Resolve* button will use the VizieR service to automatically populate the RA and DEC search fields. This is a good way to search for frames that contain a certain object, but may not be named in the image OBJECT keyword.
  - *Cone/Box Tabs:* Two sub-tabs allow you to select the type of positional search. For *Cone*, the user defines a RA, dec, and radius for the search; for *Box,* the user defines ranges for RA and dec. Beneath the Cone/Box sub-tabs, you can select the coordinate system (Equatorial, Galactic, or Ecliptic) and epoch (J2000, B1950).
- *Only search exposures that I have access to:* Allows you to filter out exposures you do not have access to. All ODI metadata are public, leaving this option unchecked allows you to search for exposures you may not have permissions to download or perform other actions on but want to get an idea of what data products may become available in the future once the PI proprietary time period is over.



- PI observation proposal/program related parameters
  - *Proposal ID* (also referred to as PROPID): Auto-complete field allows you to look for data within specific WIYN observation proposal(s).
  - *Primary Investigator*: Auto-complete field allows you to look for data associated with specific PI(s).
- *Filter, Exposure Time, and Observation Date* are self-explanatory fields.
- *Pipeline Version:* Auto-complete field allows you to look for data products produced only by certain pipelines and pipeline versions. This field defaults to operator set version numbers for the various pipelines integrated into PPA.
- Search Actions
  - *Search* button: Triggers a search using all your selected options parameter values. The *Reset Form* button allows you reset the form to its default state.
  - *Reset* button: Clears all the user-entered search fields.

The *MasterCals* and *Raw* search forms are similar to the Calibrated search form except:

- Position Search options including the *Resolve* drop-down and the *Cone/Box* sub-tabs are not applicable to, and therefore not displayed on the *MasterCal* search form.
- *Stack Count* paramter is not applicable to, and therefore not displayedon the *Raw* search form.

Advanced Search Options/Parameters

The *Other Fields* drop-down option on the right most section of each search tab allows you to perform advanced searches by adding additional search options/parameters most of which are based on header keyword values stored in the PPA database.

Other Fields

Instrument

- [ ] AIRMASS
- [ ] DITHALL
- [ ] DITHERN
- [ ] GAIN
- [ ] IMAGESWV
- [ ] IMGLEVEL
- [ ] OVLEVEL
- [ ] PHOTCLAM
- [ ] PHOTFWHM
- [ ] RDNOISE
- [ ] ZD

Date/Time

- [ ] MJD-OBS

WCS

- [ ] CRPIX1
- [ ] CRPIX2
- [ ] CRVAL1
- [ ] CRVAL2
- [ ] WCS2_DA
- [ ] WCS2_DDE
- [ ] WCS2_DRA
- [ ] WCSCAL
- [ ] WCSXRMS
- [ ] WCSYRMS
- [ ] WCS_NSRC
- [ ] WCS_RMS
- [ ] WCS_SIG

Target

- [ ] TARGDEC
- [ ] TARGRA

Pipeline

- [ ] MAGZERO
- [x] PHOTDPTH
- [ ] PLPROCID
- [ ] PLQNAME
- [ ] PROCTYPE
- [ ] PRODTYPE
- [x] SEEING
- [ ] SKYMAG

Misc

- [ ] PRTLUSER
- [ ] comment
- [x] id
- [ ] size

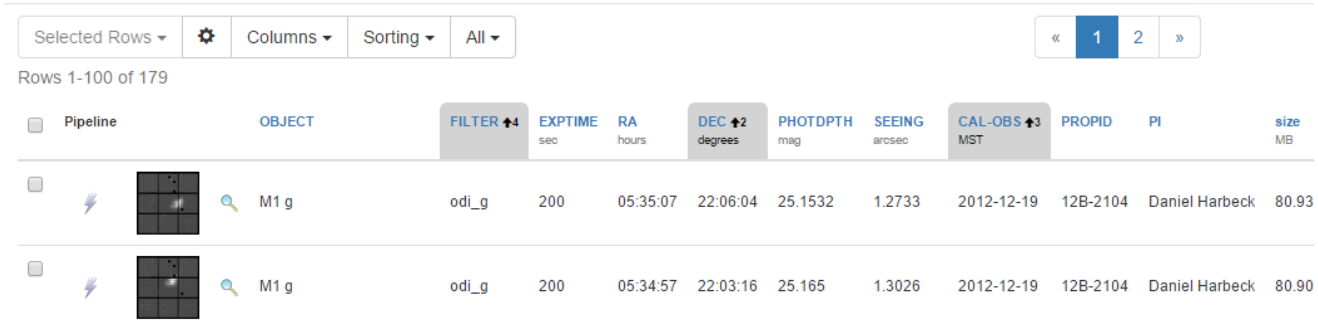
Done

1. Any searches performed with these additional parameters can be bookmarked for future reference or repeat searches.
2. However, the additional fields are not persistent: reloading the search form using the browser refresh button or opening a new search window will present a default search form with no additional search options you may have used previously.

Search Results

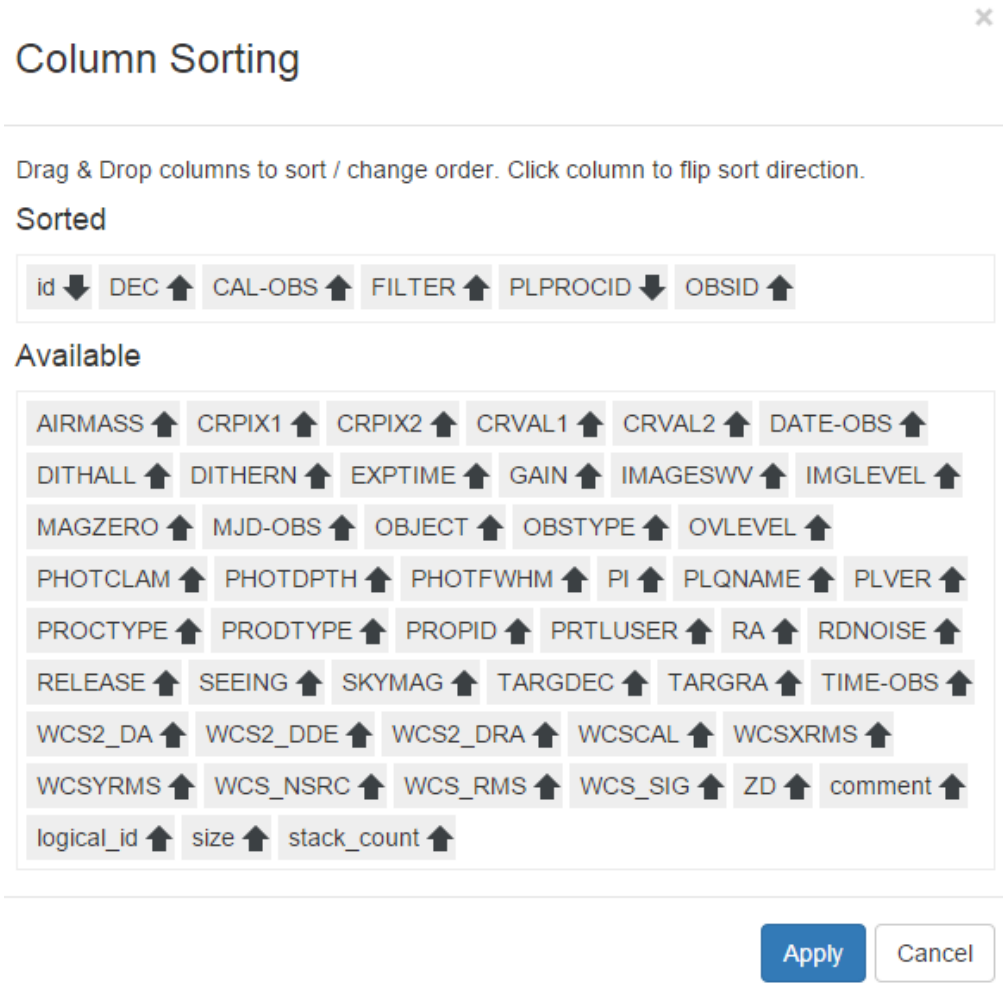
The search results are displayed below the search form.

- Mousing-over any search column header causes a a tool-tip containing a description of that keyword to be displayed.
- For each exposure displayed: A thumbnail, and typical keywords and their respective value for each exposure are shown; tthe list of columns can be adjusted - see below.
- For *Calibrated* data products, the
  
  and
  
  icons indicate data products produced by AuCaP and QuickReduce pipelines respectively.
- For exposures to which you do not have full access, a
  
  icon is displayed indicating you can only view the metadata (header keyword values) for those exposures still under proprietary data access, and that you cannot download or analyze the exposure in Image Explorer.
- For exposures to which you have full access, a
  
  icon lets you open the exposure on Image Explorer for further visual analysis.



Customizing Search Results

The set of buttons above the search results listing allows you to format and perform actions on the search results.



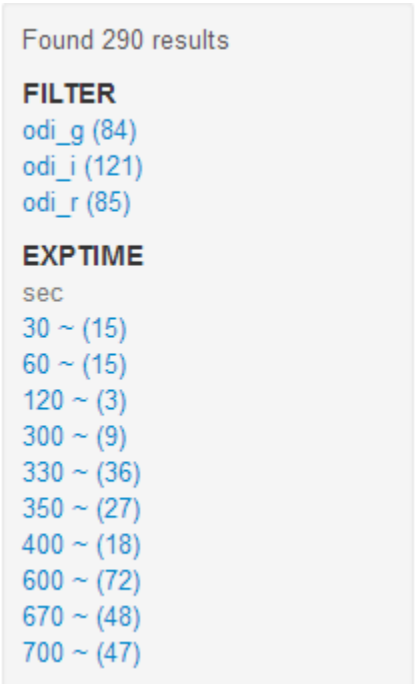
- *Selected Rows:* Allows you to add images to an existing or new collection, or to download them directly.
- *Settings icon*
  : Allows you to format the physical appearance of the output table, including number of entries per page, selection/deselection of thumbnail display, and the spacing of the rows.
- *Columns:* Allows you to customize the list of columns shown in the search results, and their ordering from left to right. To include a column, drag the desired keyword from the “Available” section on the bottom to a preferred location (left to right) within the “Displayed” section on the top. There is also an option to revert to the default view.
- *Sorting:* Allows you to recursively sort the search results using any of the available keywords. To sort by a keyword, drag it from the “Available” section on the bottom to a preferred location (left to right) within the “Sorted” section on the top. You can choose to sort each field in ascending or descending order by clicking on the arrow next to the keyword.

- *All*: Allows you analyze or export as a CSV file, the entire search result set (including ones in preceding or subsequent search results pages).

> NOTE: Sorting on a keyword will *not* automatically include that column in the search results, you will have to add the keyword using the "*Columns"* option.

Faceted Search (Rapidly Prune Search Results)

A "*Faceted Search"* or "amazon-style" selection feature is available, located as a vertical bar on the left side of the screen. To apply a filter to the search output, simply click the appropriate link in the faceted search section. The example shows Obstype, Filter and Exptime facets that you can choose to help narrow your search quickly. NOTE: you can get a larger set of results for the facets by searching on a blank target box to list all available data



Search Results (Actions)

Beyond viewing and analyzing individual exposures, the primary way of downloading or executing Tier 2 workflows on multiple exposures is via *Collections.* You will need to create one or more collections first via the *Collections* menu. Then you can select one or more exposures using the individual check-box on each result row or using the select all check-box which selects all exposures displayed on the current page; and then you can add the selected images to a Collection, via the *Checked Rows* option. Once you have added exposures to a collection, you can analyze the content of that collection or perform further actions via the *Collections* menu and its sub-menus or by going into an individual collection.

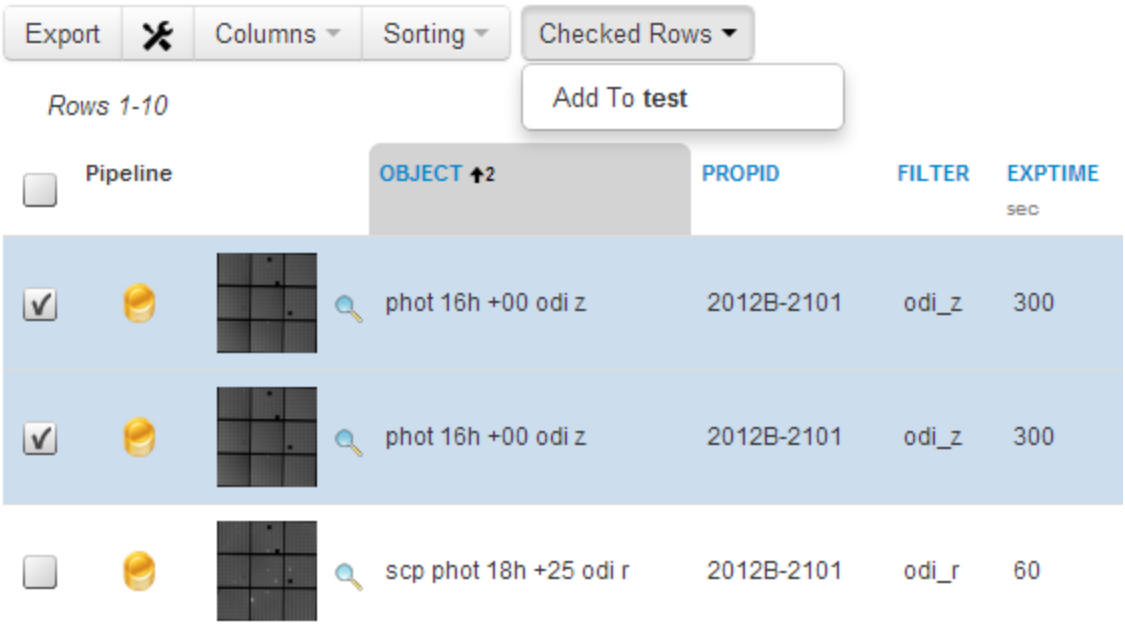
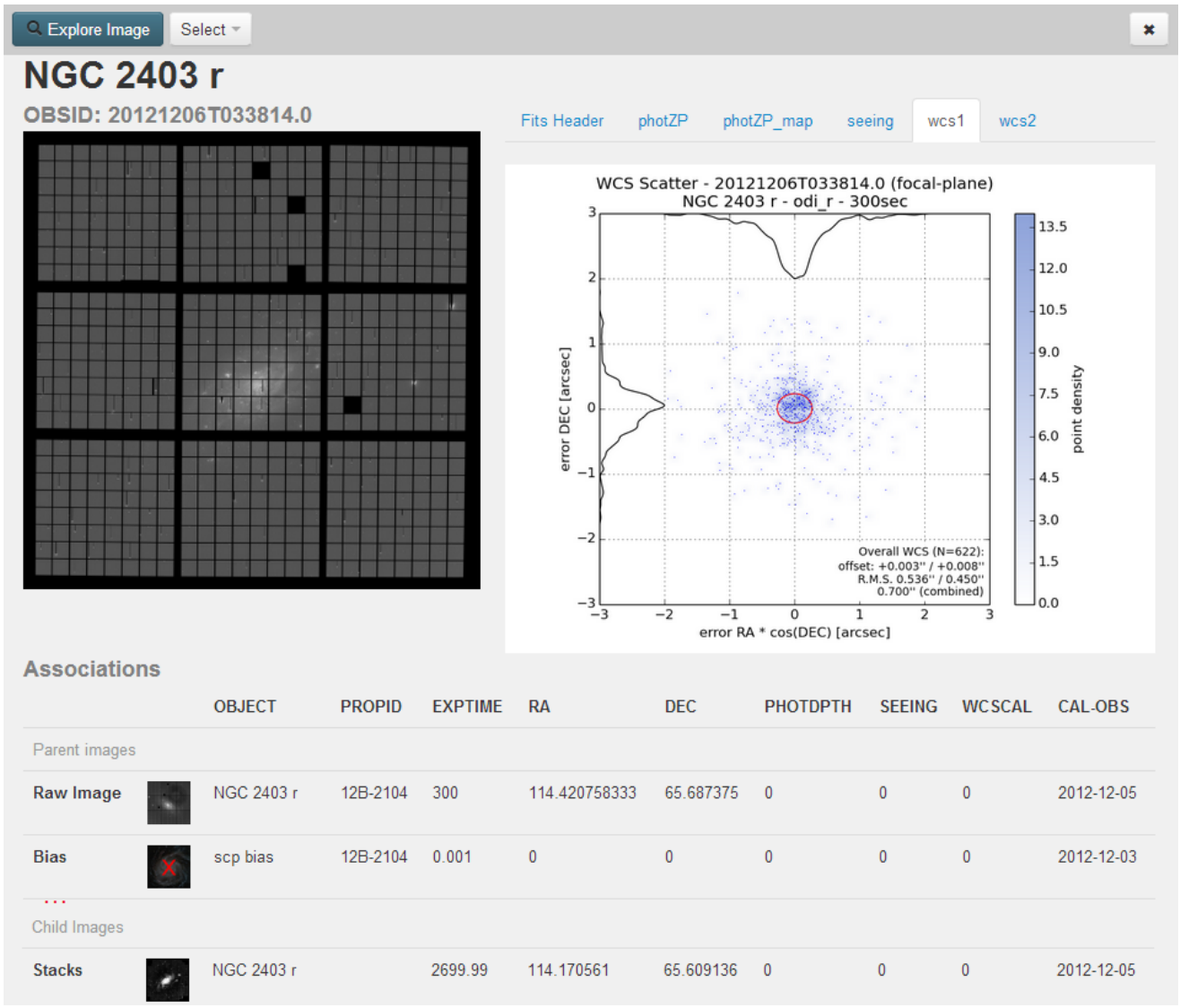


Image Details Page

Clicking on a search result (row) will take you to an Image Details page which lists:

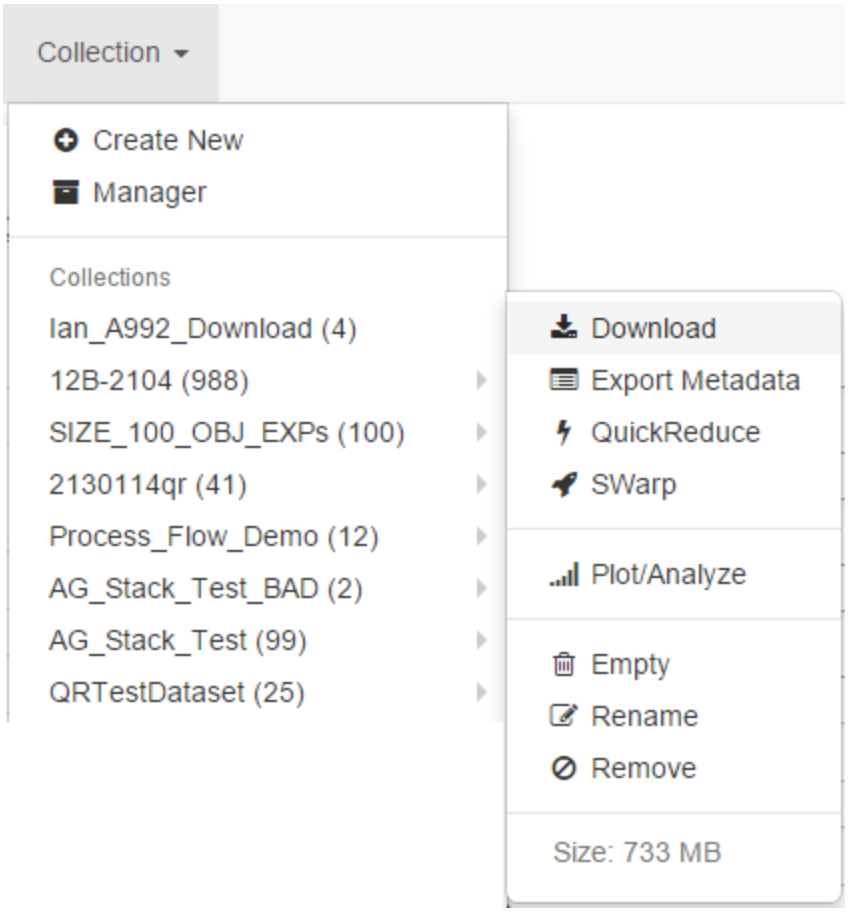
- A larger thumbnail (compared to the ones shown on the search results).
- (If applicable) A list of associated – both parent and child – data products. For example, a calibrated science exposure are associated with raw and master calibrations while a stack is associated with a set of calibrated science exposures used to produce it.
- The area to the right of the thumbnail displays several tabs (as applicable) including the FITS header (from the main extension), and Quality Assurance plots produced by a pipeline (for example, the QR pipeline)
- Options including the ability to open Image Explorer to analyze the image further and to add the image to one or more collections.



Collections

Collections are a way to organize and save a group of related images, and *are necessary to download your data* or to execute Tier 2 workflow jobs. Collections are associated with a user's personal account (unless manually deleted), and are retained up on your logging out or closing your browser.

- The interface to manage your collections is accessible via the Collections menu option (which also offers various sub-menu options for each collection).



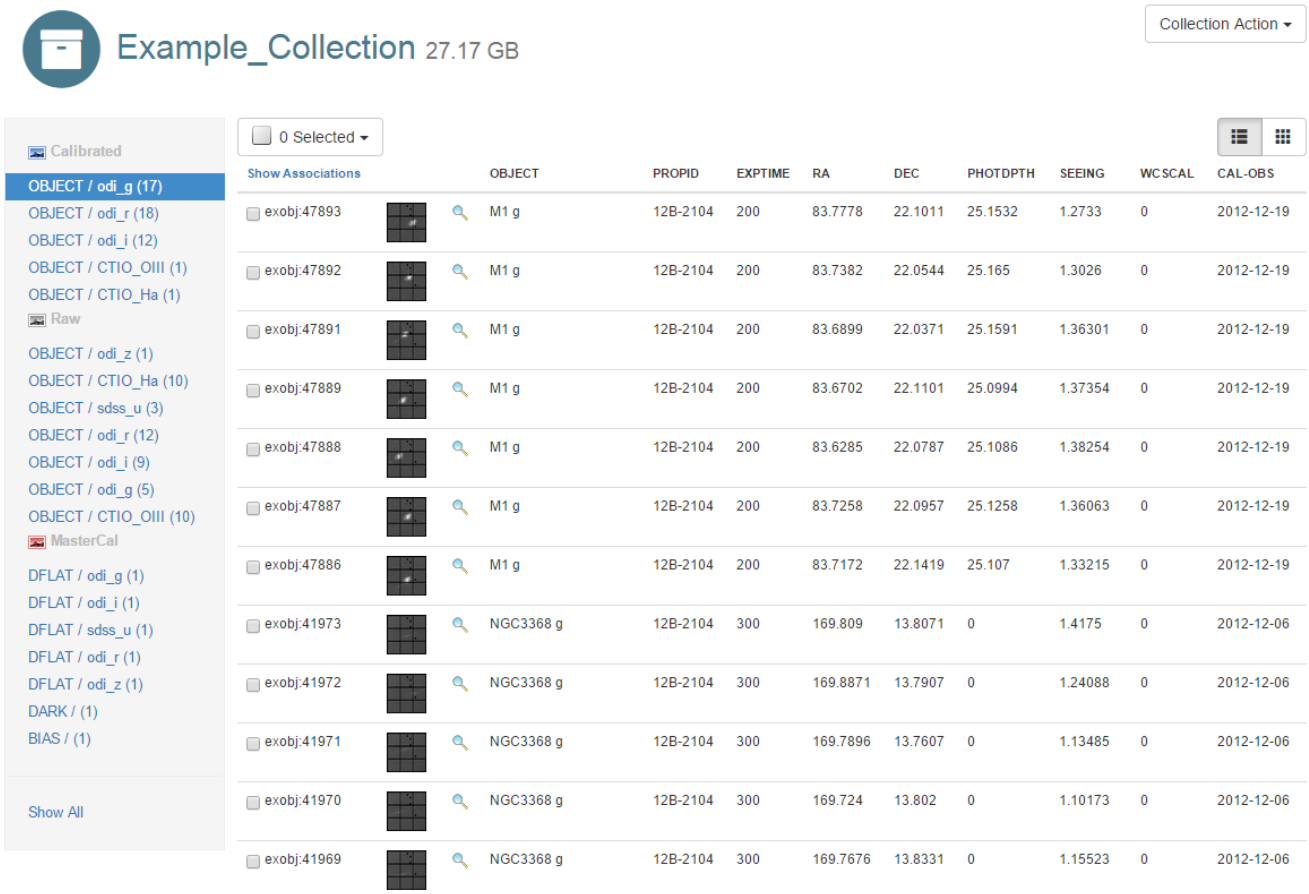
- The approximate size of the contents of the collection is shown for your convenience, as are options to go the details of the Collection.
- You can execute Tier 2 jobs including Download, QuickReduce pipeline, Stacking (SWarp), or use the *Export Metadata* option to download a Comma Separated Values (CSV) file listing typical metadata header values for the content of your collection.
- The Plot/Analyze option allows you to generate custom plots and charts based on the content of the Collection.
- The *Empty*, *Rename*, and *Remove* options are self-explanatory.

> Other Tier 2 workflow options will show up on this sub-menu as and when they are available.

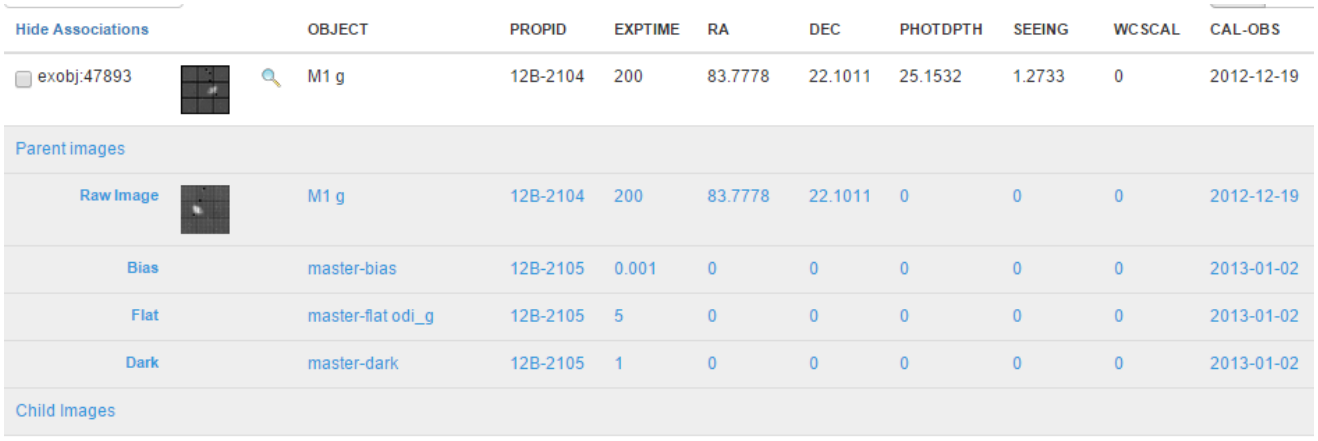
Individual Collection Details View

Clicking on an individual collection from the Collections menu opens up a detailed view of the collection.

- The name and size of the collection are shown on the top, as are counts of different kinds of data products (Raw, Calibrated, MasterCals)
- The content of a collection are grouped on the left hand side by data product type (Raw, Calibrated, MasterCals), then by image type (bias, dark, flats, science objects), and then by filter.
    - For the currently selected group of exposures causes detailed metadata, a thumbnail, and Quality Assurance information for each exposure within that sub-group to be displayed.
- Clicking on individual exposures in the listing takes you to the Exposure Details page, while the icon lets you open up the image in Image Explore for further analysis.



- Clicking on the Show Associations option causes information about associated data products to be displayed for each individual exposure. In the screenshot shown below, for a calibrated science exposure, its source raw exposure and the master calibrations applied to it are displayed.



- You can click on one or more check-boxes for the individual exposures if you need to move them to a different collection or remove them altogether.
    - *Image Type based selection checkboxes*: You can select all images of a given type (e.g., science, raw, calibration, etc.) by clicking on the selection menu in the upper-left corner of the page.
- The Collection Action drop-down menu on the top right of the Collection Details page allows you to begin the Download process (or other Tier 2 workflow processes).

Add images to a collection on Search interface

- Search for the exposures of interest on the *Search* page.
- Select one or more images from your search results by clicking the checkboxes at the beginning of each row in the search results table.
- Click the *Selected Rows* button, and then from the drop down list of collections, select the collection to which you would like to add the

images. The count on that collection, under the *Collection* menu, should reflect your attempt add exposures.

Data Guides - Raw / QuickReduce

Data Guide - Raw Data

WARNING: THIS PAGE IS STILL UNDER CONSTRUCTION

ODI Raw images

Raw data from ODI is sent automatically to the archive at Indiana University immediately after it is read out. After ingestion and tile generation (which creates thumbnail previews of the image), it is available for download by the user (see Download Walkthrough).

If you wish, you may download the raw data (both science and calibrations) from the archive and perform your own data processing. The components of the data pipeline are written in Python and available, along with some documentation, at:

http://members.galev.org/rkotulla/research/podi-pipeline/

Keep in mind, that this method is provided 'as-is' for the convenience of the user, without warranty, express or implied, and no additional support can be expected.

The file structure of the raw data is both large and inconvenient, and is a result of the OTA nature of the instrument's focal plane. Each exposure is divided into thirty separate FITS files with the filename format:

*ayyyymmdd*T*hhmmss.n.xy*.fits.fz

where *a* is a type character:

'o' for a science object

'f' for a dome flat

't' for a twilight flat

'd' for a dark frame

'b' for a bias frame

n is the number of the exposure in a dither sequence (defaults to 1 for a single, non-dithered exposure)

and *xy* is the location of the particular OTA on the focal plane.

Each FITS file is further subdivided into 64 image extensions (one for each cell on the OTA). Images must be opened as a mosaic of images in order to display the entire OTA on one image (e.g., in DS9, File -> Open other... -> Open Mosaic IRAF).

Files are sent in .fz (FPACK) format, which is a compression type optimized for .fits files. Information and tools for uncompressing the data can be found at:

http://heasarc.gsfc.nasa.gov/fitsio/fpack/

Each image is over 1.5GB uncompressed, so make sure you have the disk space before you download/unpack!

When downloaded, each ODI image readout is stored in an individual directory.

Auxiliary Data (*NOT YET AVAILABLE*)

By checking the appropriate box in the Download screen (see Downloading section), one can include the following files in their download:

- Pre-images, videos and guide star telemetry data, image PNGs
- Video
- Catalog
- Data Quality (DQ) Maps
- Bad Pix Map, static calibrations (e.g., cross-talk coefficients)
- Variance

Data Guide - QuickReduce Data Products (pODI and 5x6 ODI)

WARNING: THIS PAGE IS STILL UNDER CONSTRUCTION

Overview

QuickReduce (hereafter QR) is an end-to-end data reduction pipeline for ODI. The pipeline calibrates the raw data into science-quality products, and also adds the required metadata to the FITS headers in the frames. See the QuickReduce Version Guide for more details.

When to expect your data

The calibrated data for your run will be available about 1 to 2 weeks after the last ODI night in a given calendar month. You will receive an email when your data is available through the PPA.

Master Calibrations (Mastercals)

A set of master calibration images (hereafter, mastercals) are produced per month, and used to detrend and remove instrumental signatures from all exposures taken in a given calendar run. A master bias, dark, and flat for each filter used during the month are created for each month. It is necessary to create the mastercals using a large number of single calibration exposures to remove short term variations and pattern noise (in the case of biases and darks).

When the pipeline operator or user initiates a QR run through the PPA, the system will automatically choose the mastercals nearest in time to the science exposures being processed.

These mastercals are created using the through the PPA by the pipeline operator, and are generally run after all ODI observing during a calendar month is completed. Mastercals are available to download through the PPA by searching the archive under the Mastercal choice in the Search menu (see Search Page help)

Calibrated Images

The file format of a image that has been processed by QR is as follows:

*yyyymmdd*T*hhmmss.n_(object name)_(filter).(procID)*.fits

The timestamp and dither position *n* are retained from the raw data filename. This is followed by the *object name* and *filter* used in the exposure, which are self-explanatory. This is followed by the *procID*, which is a unique identifier created during image processing. It can be used to track the original processing run that created the calibrated image.

Like the raw exposures, images are provided in .fz format (see above for details).

All calibrated image files have added metadata associated with them, written by QR. These are in the form of additional keywords in the image header, as well as data tables written as FITS extensions. To access these tables you can use the pyfits package or a table/catalog application such as Topcat. The contents of the data tables are:

1: 2MASS source catalog for the image region

2: ODI catalog of extracted sources

3: ODI + 2MASS catalog of matched sources for astrometric calibration

4: ODI + SDSS catalog of matched sources for photometric calibration

5: Sky levels for ODI sources in the image

6: File associations for the calibrated images (e.g., bad pix masks, raw files, etc.)

Important note: For the odi_g filter, significant color terms are added to the Table 4 SDSS catalog magnitudes, to account for bandpass differences. Thus, the SDSS magnitudes reported (and used in the zero point calculation) will be different than those extracted directly from the SDSS catalog.

2015-08-24

QR updated to SVN Rev 1504 (podi5x6 development branch)

New/Improved features:

- **NEW:** Reduction logs in the FITS header, giving details on what reduction steps were completed successfully, not selected, or failed during execution. These header entries can be viewed as part of the FITS header from the "Details" page of each frame.

  This is what to look for, at the very end of the FITS header of the primary extension (this is what is shown in PPA:)

- **IMPROVED:** WCS solution for some cases for which QR before accepted a wrong, yet apparently sufficiently good solution (Thanks to Steven Janowiecki and Daniel Harbeck for reporting this problem)
- **IMPROVED:** Algorithm to compute the pupilghost template from its constituent frames (this will aid the upcoming removal of the pupilghost signature in calibration and science frames).

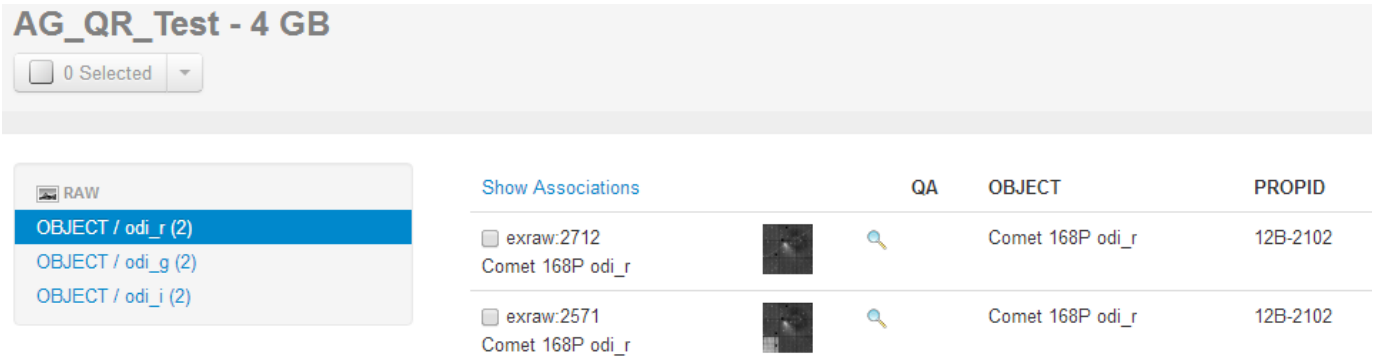
User Executed Functions - QuickReduce and Stacking

Execute QuickReduce pipeline on your Raw Data

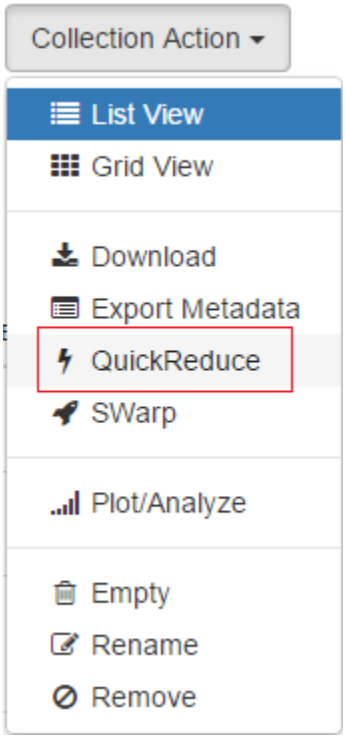
Preparing data for reduction with QR:

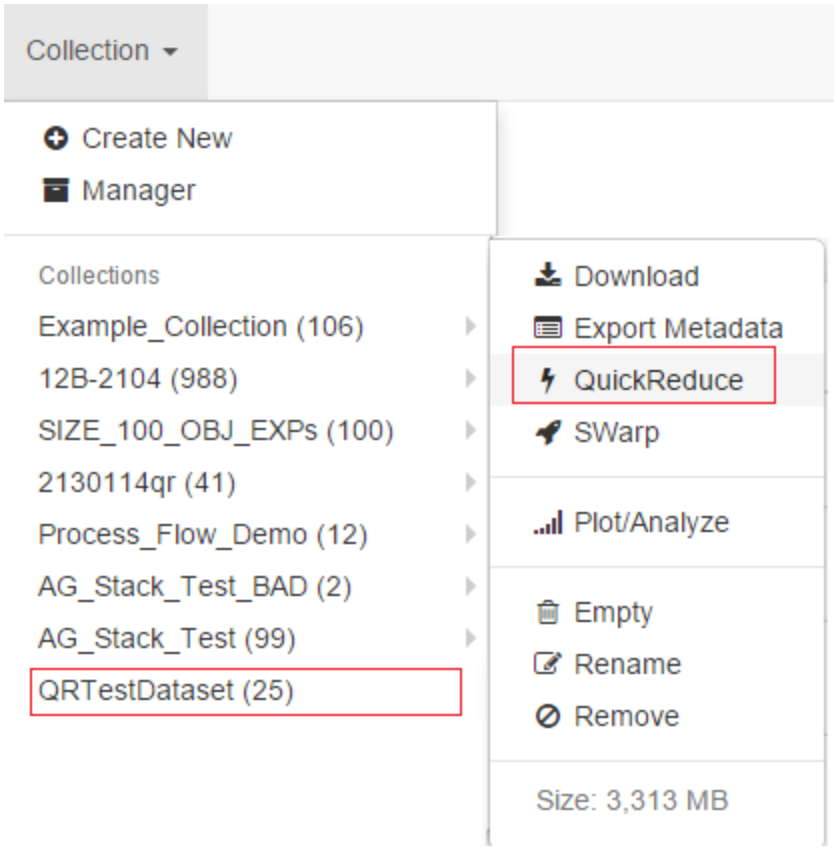
Create a collection of the raw images you would like to reduce using the QuickReduce pipeline.

In the example screenshot, there are two raw images each of Comet 168P in the r, g, and i bands within a collection called 'AG_QR_Test'.



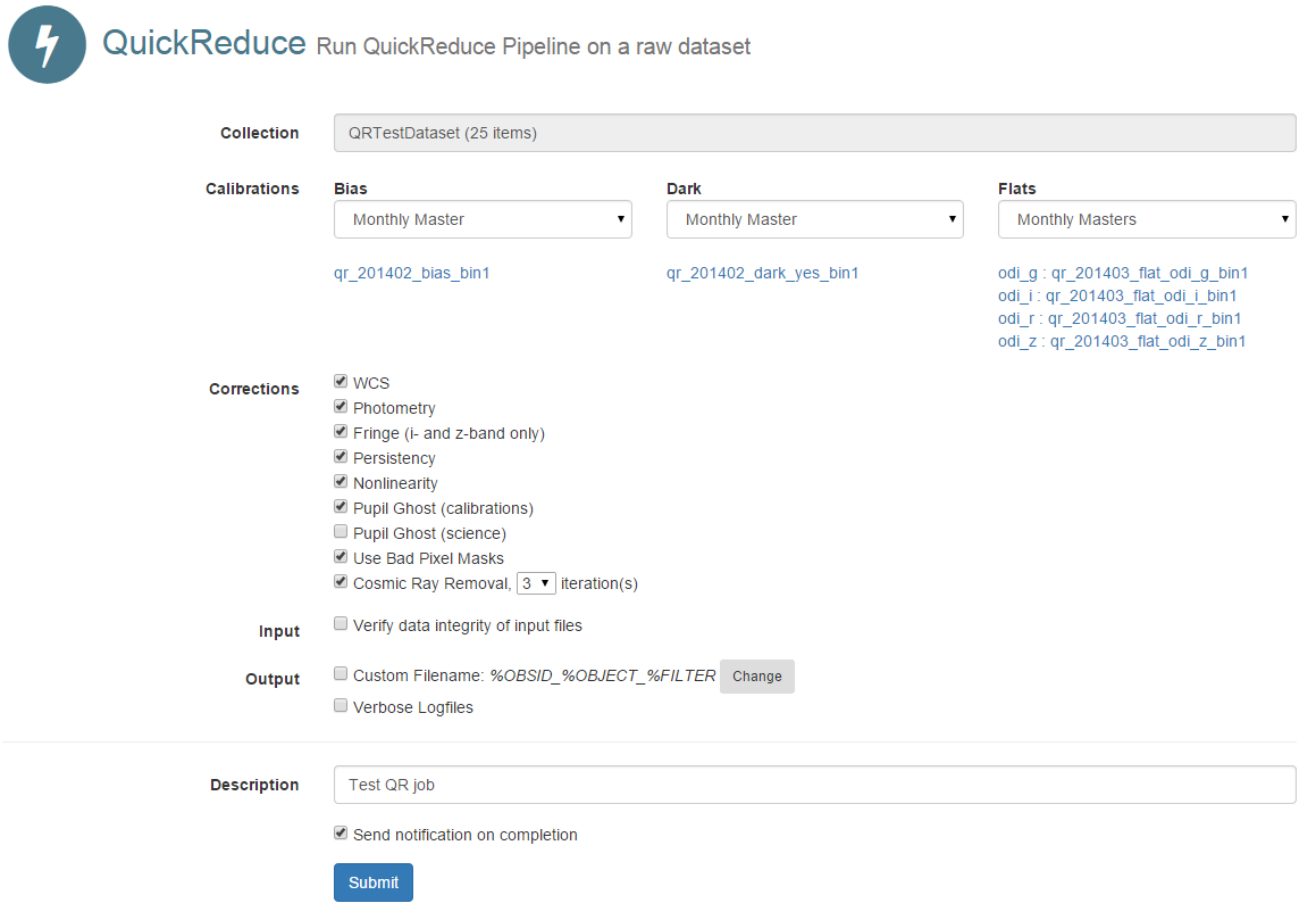
Once you are satisfied with the content of the collection, navigate to the QuickReduce pipeline submission form via the Collections menu or via the Collection Actions drop-down within the collection





Configuring your QR job

In the QuickReduce pipeline submission form, you can select the master calibrations to be applied on your raw data, and the various corrections that you would like to be performed. Note that. currently, only monthly master calibrations are available (unless you want a certain master calibration to not be applied at all), other master calibration options will be available in Spring 2014.

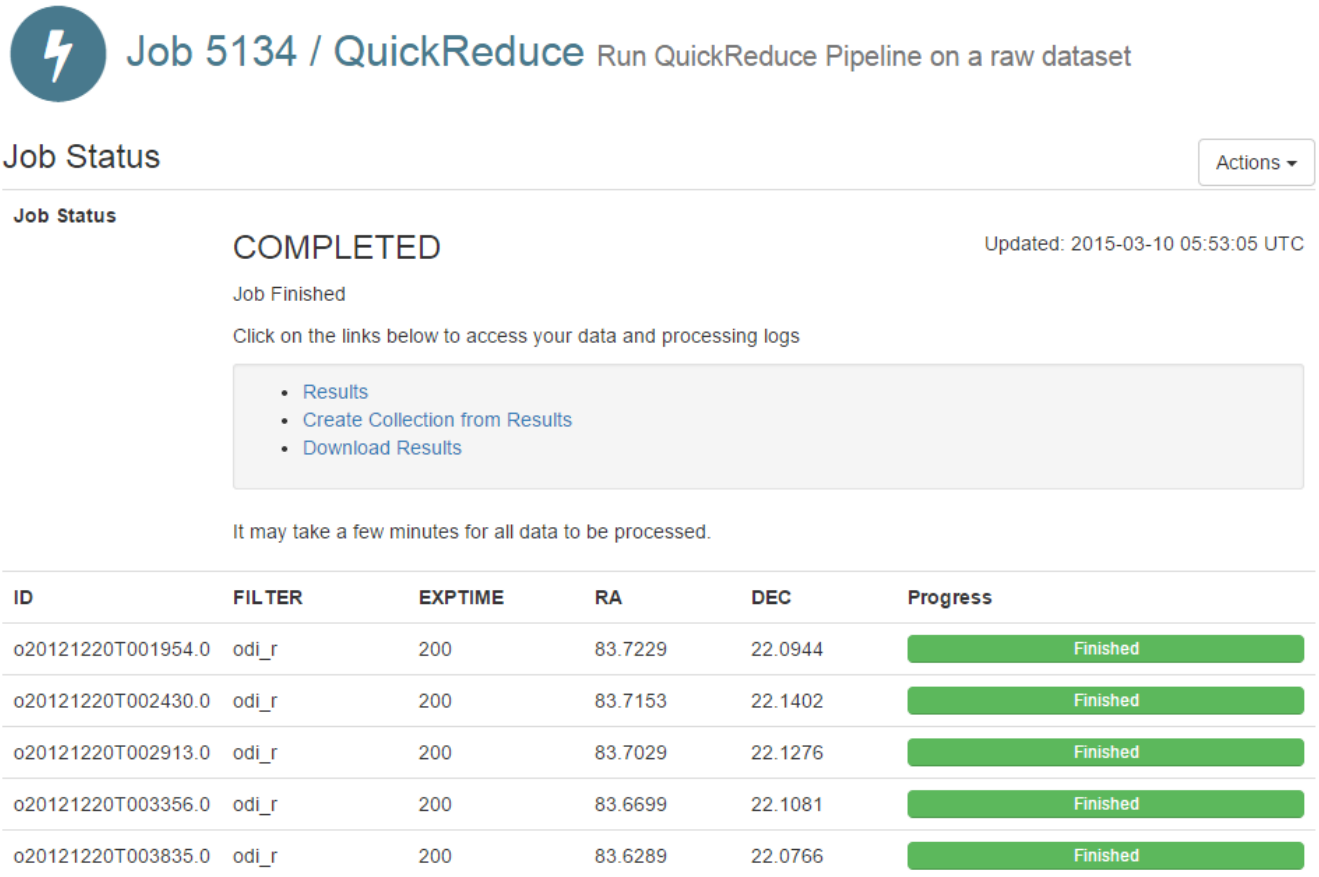


This is what the following options will do:

- **WCS:**
  Correct the world-coordinate solution (shift, rotation, distortion) such that ODI sources are properly aligned with reference sources (highly recommended)
- **Photometry:**
  Calculate photometric zeropoints by comparing the ODI source catalog with SDSS (or PanSTARRS, coming soon). Recommended (highly recommended)
- **Fringe:**
  Remove the fringing by subtracting an appropriately scaled template (recommended for odi-i and odi-z band data, in particular for extended sources)
- **Persistency:**
  Mask out all pixel (columns) likely affected by saturation in the current frame (look for upward streaks starting from saturated stars) as well as persistency caused by saturated stars in earlier exposures. If activated this option helps produce better looking and higher quality stacks. Typically recommended, unless you have a lot of saturated sources
- **Non-linearity:**
  Correct for non-linearity effects in the readout gain of each cell. Highly recommended to produce truly flat backgrounds.
- **Pupilghost (calibrations):**
  Remove the pupilghost contribution from flat-fields. Note: This currently only works for dome-flats with filters installed in level 2 (XXX lookup which filters this is XXX). Does not work on filters from level 1 & 3. Recommended within limitations.
- **Pupilghost (science):**
  This is a mostly experimental feature, in principle removing the pupilghost from the science frames. However, we still lack a proper template for each level. Currently NOT recommended.
- **Use Bad Pixel mask:**
  Apply static bad pixel masks. This trims each cell and removes large-scale defects from several cells. Recommended for most, sufficiently dithered exposures; typically not recommended for sparse dither coverage.
- **Cosmic Ray Removal:**
  Remove single and multi-pixel cosmic ray hits using the LACosmic algorithm. Adds some processing time, but is highly recommended, in particular for projects interested in faint, small-scale features (e.g. stars). 3-4 iterations is sufficient to remove essentially all cosmics.
- **Verify data:**
  Typically not required, unless you experience issues during processing.
- **Verbose logfiles:**
  Mostly for error tracking, not typically useful to the average user.

Submitting your QR job

Once you click on the Submit button, a new job is created for your dataset and using the options you selected. As per with any other workflow job on ODI-PPA, the data is staged off the Scholarly Data Archive (tape archive library) if necessary, and then the job is queued to be executed on a compute node associated with the PPA system (typically on IU's BigRed II supercomputer or Quarry cluster). Once the job execution starts on the compute node, status updates are presented as they become available. Typically, it takes 1-4 minutes per image depending on the corrections you request.



You do not have to wait until the job completes, you can close the job window, and revisit it later via the My Jobs menu item (or via a bookmarked URL).

Once your QR Job is completed

When the job finishes, the output data are archived, and ingested into *your* user account. The QuickReduce.log link on the job status page shows the various steps that were executed on your raw dataset (including possible error conditions that may have come up.) The QuickReduce Results link takes you to a search page on which you can access the output dataset.

Export | Columns | Sorting | Checked Rows

Rows 1-6

Pipeline		id	OBJECT	PROPID	FILTER	EXPTIME sec	RA	DEC	PHOTDPTH mag	SEEING arcsec
		22194	Comet 168P odi_g	12B-2102	odi_g	300	23:40:08	36:21:43	23.8337	3.92949
		22193	Comet 168P odi_g	12B-2102	odi_g	300	23:40:08	36:21:46	24.1476	3.35844
		22192	Comet 168P odi_i	12B-2102	odi_i	300	23:40:09	36:21:49	23.5708	3.43335
		22191	Comet 168P odi_i	12B-2102	odi_i	300	23:40:08	36:21:50	23.6953	3.25068
		22190	Comet 168P odi_r	12B-2102	odi_r	300	23:40:11	36:21:40	24.2599	3.50035
		22189	Comet 168P odi_r	12B-2102	odi_r	100	23:40:10	36:21:53	24.4332	1.45699

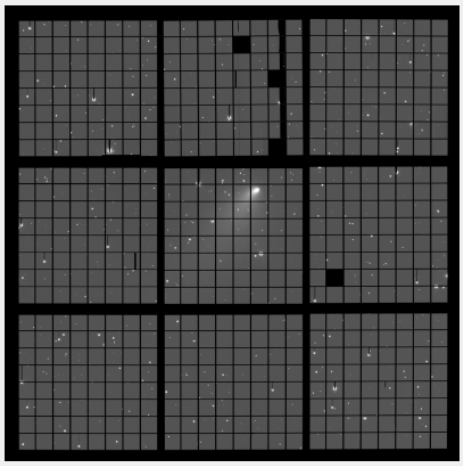
Exploring the results

From the search results page, you can perform common ODI-PPA operations including looking at metadata and Quality Assurance plots via the Image Details page, opening up an image in Image Explore for visual analysis, and creating a collection to analyze or or to download a set of images.

Explore Image | Select

Comet 168P odi_r

OBSID: 20121101T184524.0



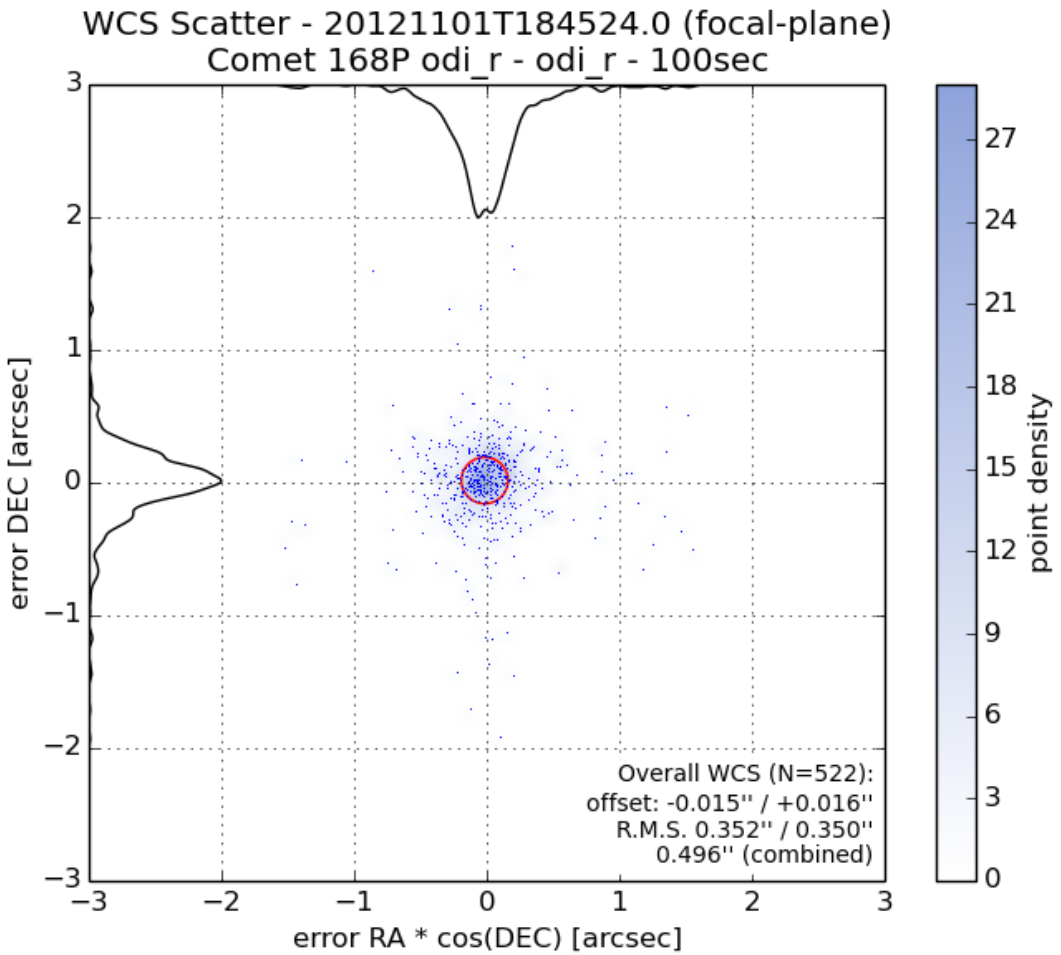
Fits Header | photZP | photZP_map | seeing | wcs1 | w

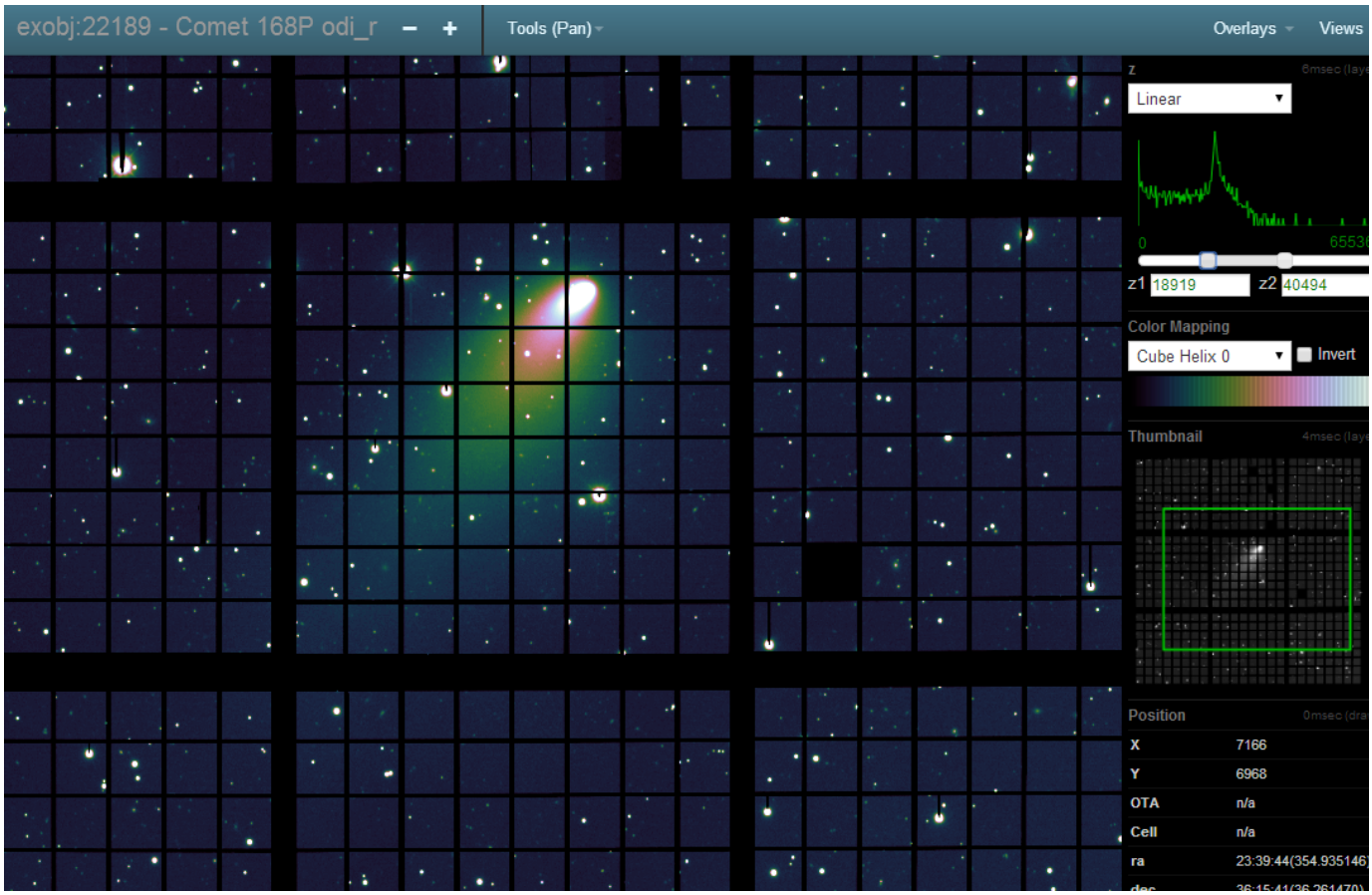
XTENSION	'IMAGE '	/ Image exten
BITPIX		-32 / array data
NAXIS		2 / number of a
NAXIS1		4096
NAXIS2		4096
PCOUNT		0 / number of p
GCOUNT		1 / number of g
QPIPESVN	'exported'	/ QuickReduce
EXTNAME	'OTA33.SCI'	
OTA		33 / OTA designa
FPPOS	'xy33 '	/ position of
PIXSIZE1		12.0 / pixel size
PIXSIZE2		12.0 / pixel size
IMTM1_1		1.0 / IMage Trans

Associations

		OBJECT	PROPID	EXPTIME	RA	DEC
Parent images						
Raw Image		Comet 168P odi_r	12B-2102	100	355.041483333	36.3646638889
Bias		bias	12B-2102	0.001	0	0
Flat		domeflat r	12B-2102	4	0	0
Dark		dark	12B-2102	300	0	0

Fits Header | photZP | photZP_map | seeing | wcs1 | wcs2

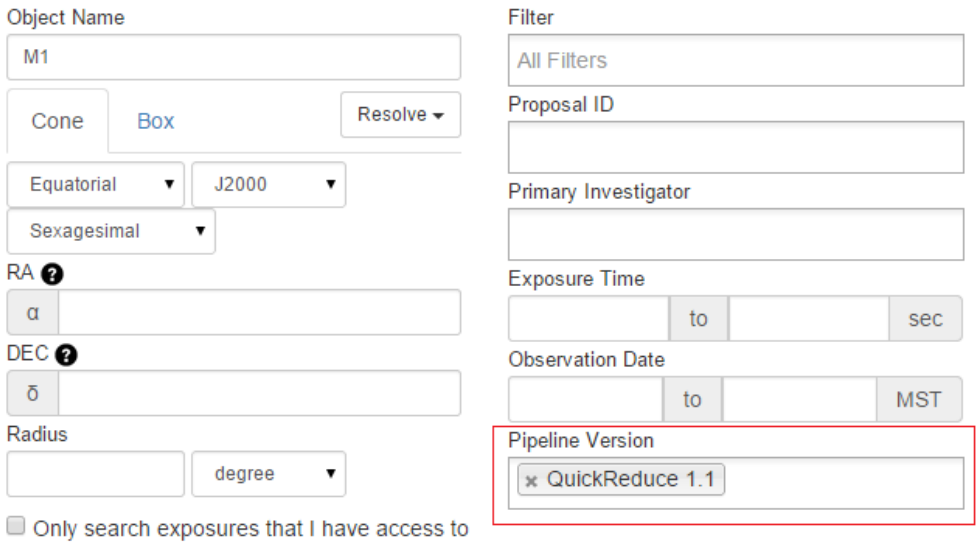




Stack Images using PPA Stack (currently integrated with SWarp)

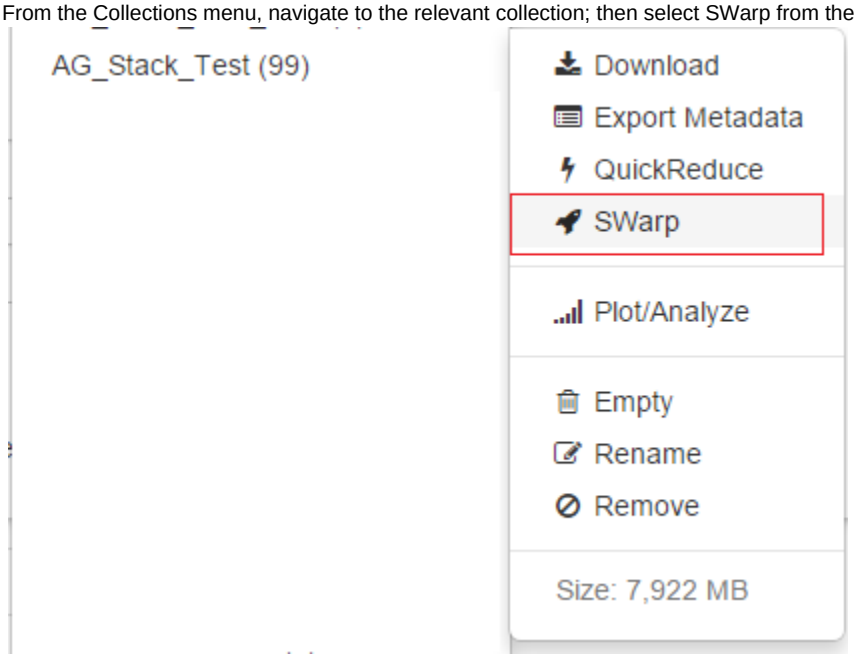
PPA Stack is a generic stacking user interface designed to enable users to stack their images (usually but not necessarily dither patterns). Currently, SWarp is integrated into PPA Stack, though support for this feature is limited. Also, currently the feature only allows you to build stacks on QuickReduce pipeline data products

1. On the *Calibrated Search* page, search for QuickReduce pipeline data products, along with any other relevant search fields. Typically you would want to search for images of the same object/similar coordinates (dither sequences or the like) you would like to stack. These could be based on your PROPID or PI name or OBJECT keyword values or using coordinates obtained via the name resolver or other criteria.

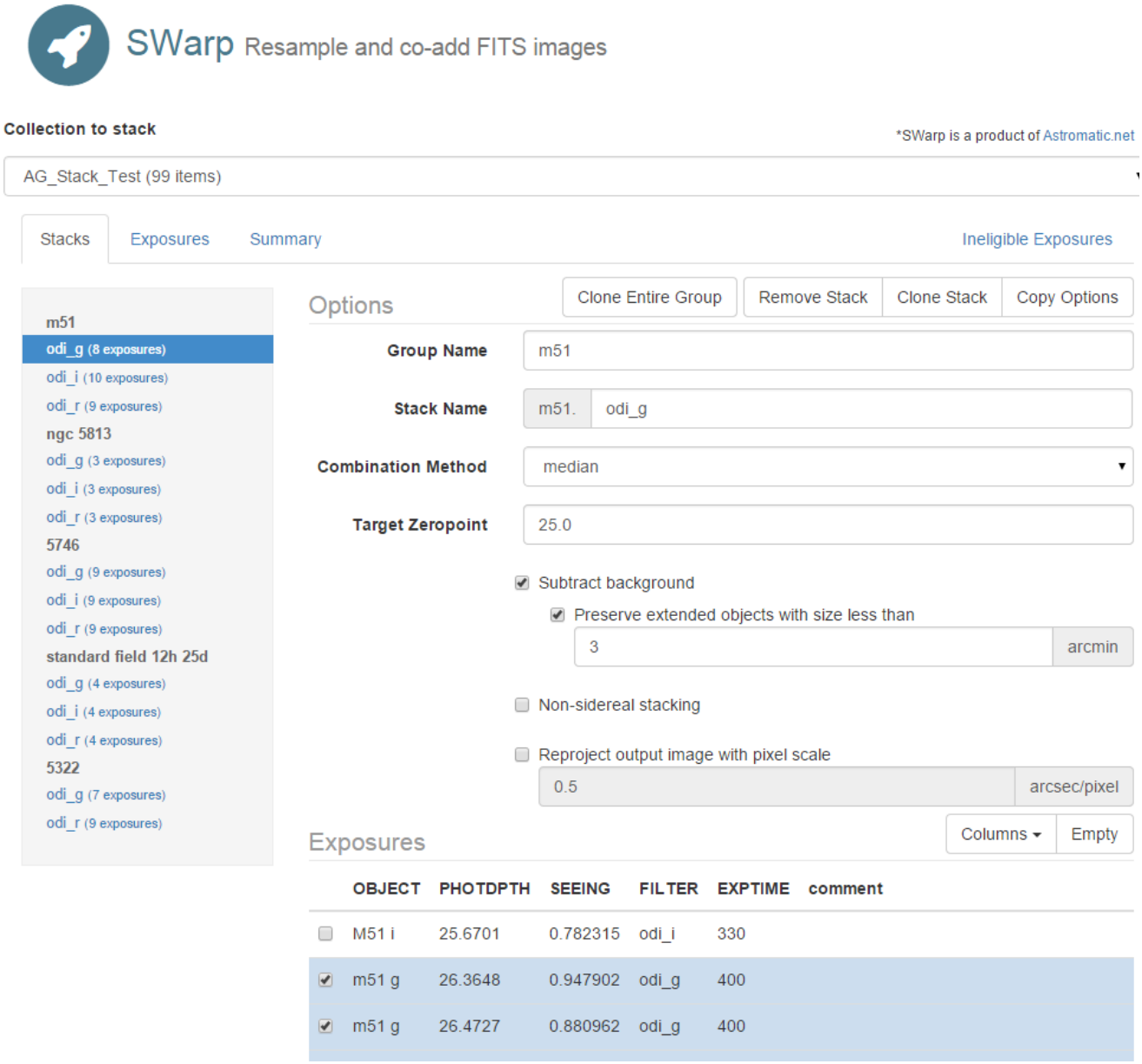


a. An alternative to steps 1 and 2 is to search for QuickReduce dataproducts from your *dashboard* by clicking on the appropriate numeric value.

2. Select and add the images from your search result (or from the dashboard) into a collection. Create a new collection, if necessary.
3. From the Collections menu, navigate to the relevant collection; then select SWarp from the sub-menu for that collection.



4. The PPA-Stack user interface will attempt to heuristically group your images into *various stacks to be produced* (based on pointing, and filter).



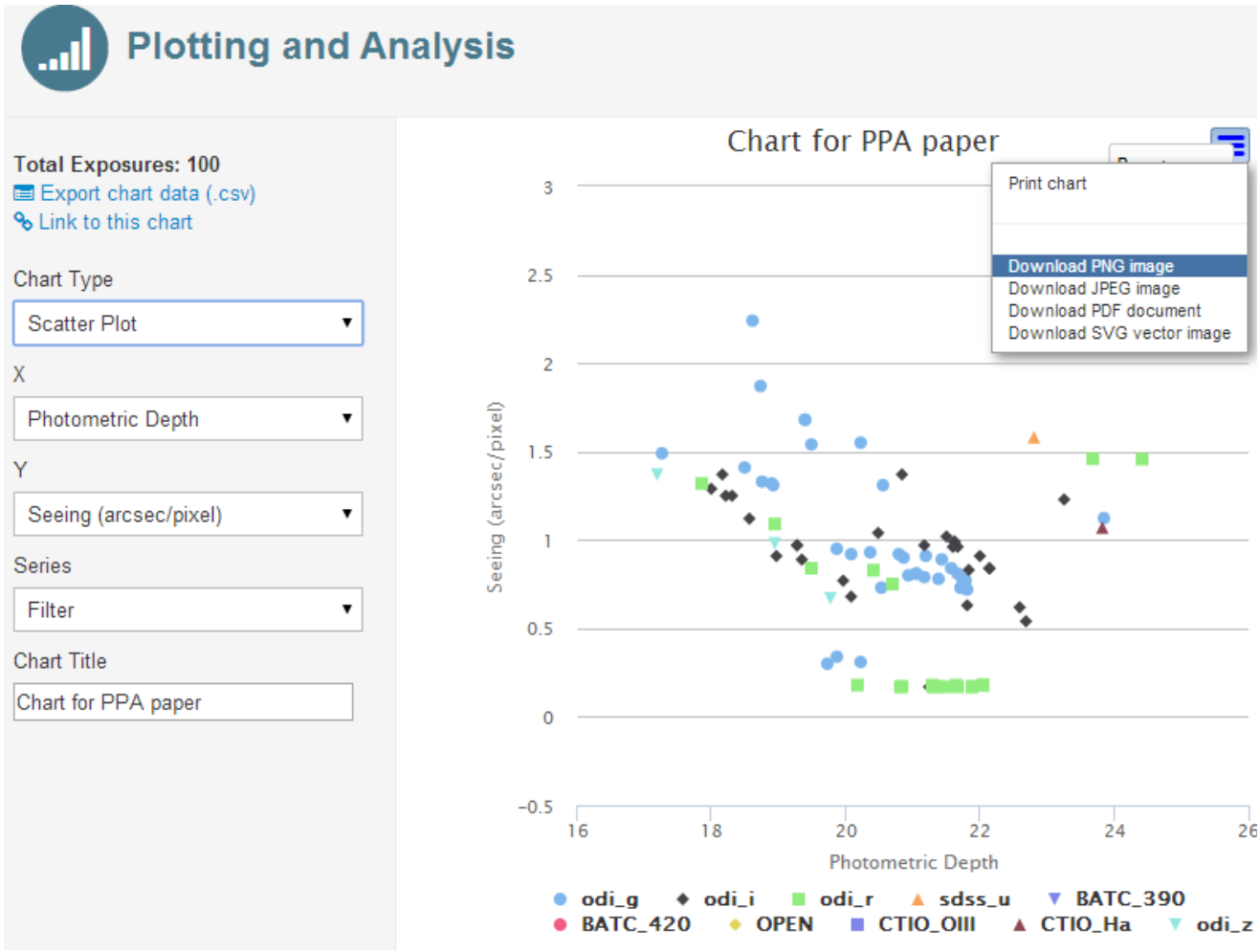
Modify this as appropriate, and edit the parameter values you'd like to pass on to SWarp for each stack, and then hit *Submit*. At this point, a job should get submitted, and queued up for execution. Resources are limited, and sometimes when many similar jobs are running, you may need to wait but typically, your job should begin executing shortly.

Status	Note	Timestamp
COMPLETED	Job ended • AG_Stack_Test File List • SWarp.log Some .fits files may be fz compressed. Go here for more information and tools. You can download the entire contents via the following command: `wget --recursive --continue --no-host-directories --no-parent --cut-dirs=1 -A "*.fz,*.fits,*.tar,*.cat,*.png" "http://download.odi.iu.edu/d0560c369f4a354279c2df3405ae337c5298f9e1"`	2014-03-14 15:22:10
COMPRESSING	Compressing output...	2014-03-14 15:22:06
SUCCESS	Output file found!	2014-03-14 15:22:06
PROCESSING	Calling SWarp	2014-03-14 15:19:33
PREP	Found 9 stackable exposures	2014-03-14 15:19:33
SCANNING	Looking for stackable exposures	2014-03-14 15:18:09
RUNNING	Running on portal worker node	2014-03-14 15:18:03
QUEUED	Job has been queued to be executed.	2014-03-14 15:18:03
THAWING	Thawing request has been sent	2014-03-14 15:18:03
SUBMITTED	Job submitted by Arvind Gopu (Admin) (uid:25)	2014-03-14 15:18:03

When the job completes – and this should usually take around 4-6 minutes for a 9-point dither stack -- you can navigate to the data product list, inspect individual images using Image Explorer, or download the stacked images.

PPA Charts - Custom Plotting and Analysis

The PPA Charts feature allows astronomers to quickly and dynamically plot various metadata/header values from various pages on the portal. Currently available header keywords (for use as X or Y axis) include: Photometric Depth and Zeropoint, Seeing, RA, DEC, Detector gain, Airmass, Exposure time, and Observation Date (including MJD-OBS). PPA Charts is based on the Highcharts [17] and AngularJS [18] libraries, and can easily be extended with additional metadata header fields based on user feedback and requests. From within the PPA Charts interface, users can zoom in to a certain region within a currently displayed plot by drawing a box using their mouse; they can also reset back to the default zoom level.



Exporting plots: Users can easily print a chart or export it in various formats including PNG, JPEG, PDF, SVG vector for use publications, etc.; they can even add a custom title to the plot before they export it. Users can also export the metadata values associated with a plot as a CSV file.

Bookmarking plots: Each plot can also be bookmarked for future reference in cases where, for example, a user is attempting to inspect a certain parameter set over time.

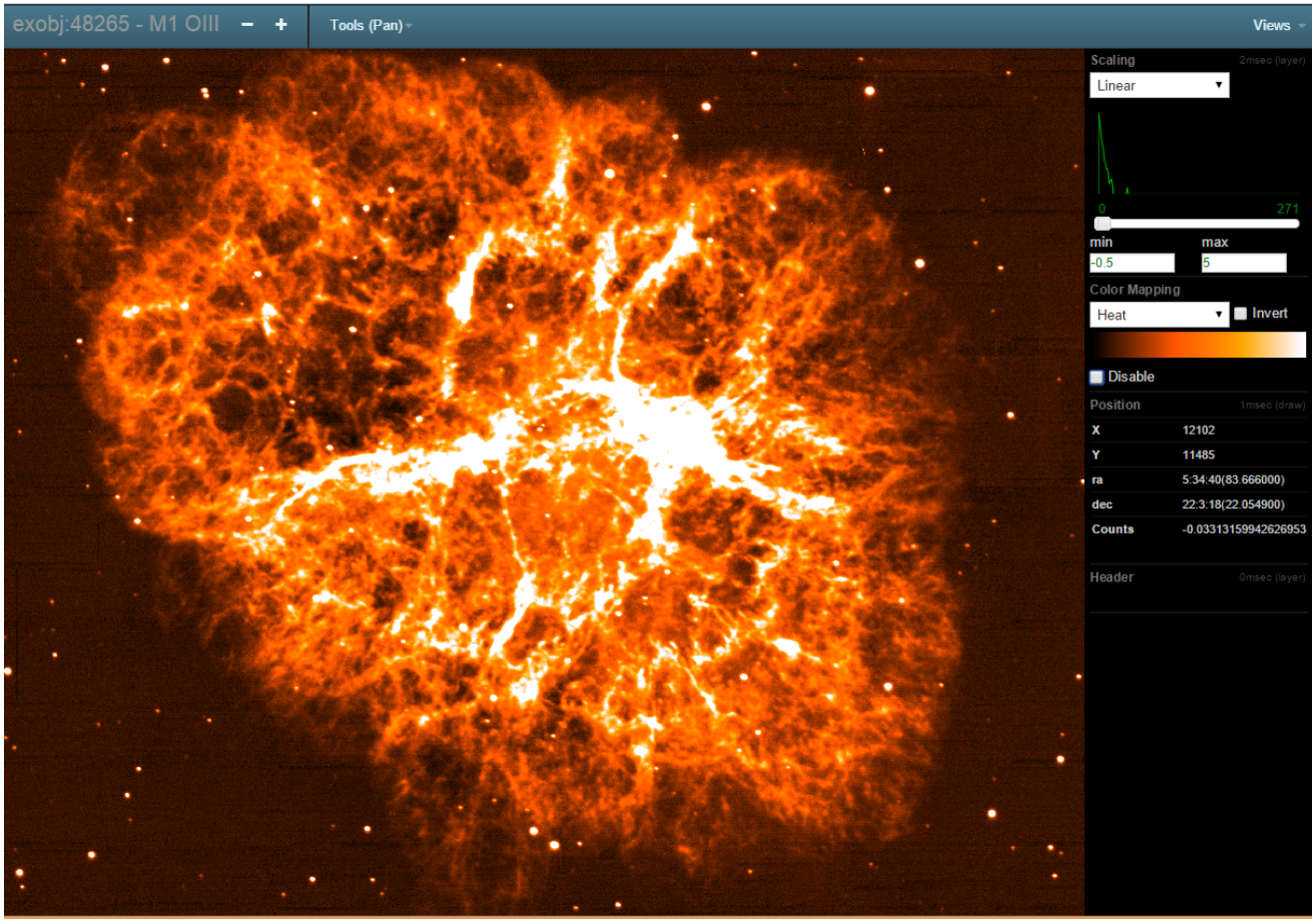
PPA Chart Demo Video

|

Image Explorer

Most astronomical archives present a static, resolution-reduced image of a data product as the only way of judging data quality via visual inspection. While this is sufficient for basic pruning of datasets, you are still required to download the actual dataset to fully vet its value for a science goal. The PPA Image Explorer allows you to visually analyze your data in real time from within any common Web browser capable of rendering the HTML5 canvas, without having to download several GB of data. The basic features of Image Explorer are modeled on the commonly used desktop application SAOImage ds9 including:

- Pan, zoom in/out
- Change the contrast
- Adjust the intensity scaling
- Add color maps



Tools

Image Explorer goes beyond the basic visual inspection of pre-generated tiled PNG images by letting you execute integrated tools on the PNG or the underlying FITS image. These tools include:

- *Cutout*: A box appears to drag-select the region you desire. Cutout button on bottom right will pop up a Process window (Process: Task spawned off) and report status of cutting out. Once complete, click on link to download the FITS file to your local disk.
- *Crosscut*: A line appears to drag-select start/end point for the cut on the image. Once these are chosen, a pop-up window with selected line-cut. Displays normalized intensities. Right-Click on mouse on the graph will produce a .png file for saving locally.
- *Image Statistics (imstat)*: Selecting Imstat will show a Toolbox Icon. Click to select parameters. Click *Submit*. A Process window appears. Once the Job is complete, click on the link to display the image statistics.

Source Catalog Overlay

Image Explorer includes a complementary Source Explorer tool that lets you overlay source catalog information over your astronomy image. You can generate the sources using SourceExtractor (executed on the underlying FITS image using nodes on IU supercomputers), or query an existing commonly used source catalog for information based on your image's RA/DEC, or you can upload your own source catalog information.

Reference URLs & Acknowledgements

References

This page lists a few frequently referenced URLs:

- ODI-PPA Web Portal: http://portal.odi.iu.edu
- Support Help Desk: odi-ppa-help@googlegroups.com

- ODI-PPA Publications: http://ppa.iu.edu/publications
- ODI-PPA Project Website: http://odi.iu.edu/

- This User Guide: https://help.odi.iu.edu/display/help/ODI+Pipeline%2C+Portal+and+Archive+-+Quick+Guide
  - **Printable User Guide: http://bit.ly/13ZUbrB**
- ODI observing manuals and procedures: http://www.wiyn.org/ODI/Observe/wiynodiobserve.html

Acknowledgements

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