Pan-STARRS1 data archive home page

Welcome to the starting point for access to data from the Panoramic Survey Telescope and Rapid Response System (Pan-STARRS). This page provides a brief summary of the facilities and data products to guide Pan-STARRS archive users. More complete information is provided on linked pages (see below).

Pan-STARRS is a system for wide-field astronomical imaging developed and operated by the Institute for Astronomy at the University of Hawaii. Pan-STARRS1 (PS1) is the first part of Pan-STARRS to be completed and is the basis for both Data Releases 1 and 2 (DR1 and DR2). The PS1 survey used a 1.8 meter telescope and its 1.4 Gigapixel camera (GPC1; see PS1 GPC1 camera) to image the sky in five broadband filters (g, r, i, z, y). The PS1 Science Consortium funde d the operation of the Pan-STARRS1 telescope, situated at Haleakala Observatories near the summit of Haleakala in Hawaii, for the purposes of astronomical research. The PS1 consortium is made up of astronomers and engineers from 14 institutions from six countries.

The data from PS1 are archived at the Space Telescope Science Institute (STScI) in Baltimore Maryland, and can be accessed through MAST, the Mikulski Archive for Space Telescopes. Additional support for the PS1 public science archive is provided by the Gordon and Betty Moore Foundation.

The web site for Pan-STARRS in Hawaii also describes the project.

Quick links to the MAST PS1 Archive User Interface:

The current PS1 data release is DR2 (2019 January 28.)
Use the following links to jump right to the MAST PS1 Science Archive interfaces and get started using PS1 data!

PS1 Object Catalog Search: http://catalogs.mast.stsci.edu/
PS1 Image Cutout Server: http://ps1images.stsci.edu/cgi-bin/ps1cutouts
PS1 Casjobs SQL Server: http://mastweb.stsci.edu/ps1casjobs

See How to retrieve and use PS1 data for more information on these access mechanisms. Note that all of these allow programmatic scripted access, and there are sample Python Jupyter notebook scripts.

Users of the current PS1 DR2 data should be aware of a few issues and inconsistencies in the data.

- Approximately 4.9 square degrees (0.016% of the survey area) has sources that are missing due to various issues in the database population procedures. These are expected to be filled in eventually.
- The stack positions (raStack, decStack) have considerably larger systematic astrometric errors than the mean epoch positions (raMean, decMean).
- The astrometric and photometric keywords in the image headers are slightly inconsistent with the astrometry and photometry for catalog objects. The catalog quantities are more accurate due to post-image-processing improvements.
- Some images near the celestial pole have registration issues that lead to poor photometry and astrometry.
- There are some astrometry issues at the ~0.5" level near the pole (mostly above 85 deg declination) which have caused problems with the stacking. As a result, both warp and stack images may have incorrect WCS, and in extreme cases double objects may be visible in the stacks. There will also be errors in the stack positions (but not mean epoch positions) in the catalogues.
- FITS image headers use the obsolete PC001001, PC001002, etc., keywords for the WCS. The fluxes have been non-linearly scaled using an asinh transformation. The files also use the tile-compressed image format. The full skycell FITS images do not have a RADESYS keyword, which leads some software (including DS9 v8) to incorrectly interpret the coordinates as being equinox 1950 rather than equinox 2000. The fix is to insert the keyword RADESYS = 'FK5' in the header. The headers also lack the TIMESYS = 'TAI' keyword, which is important if you care about the image observation dates at an accuracy of 30 seconds.

See the PS1 DR2 caveats page for more details.

What data is available in DR1 and in DR2?

The full data processing procedures and data products that result from them are described in PS1 data processing procedures.

PS1 News

- 2024.02.02: Search for moving targets in PS1 images and catalogs
- 2022.06.30: PS1 astrometry updated using Gaia EDR3
- 2021.11.04: Bulk image download Python script
- 2020.06.29: PS1 VO Table Access Protocol information added
- 2020.06.29: Missing data sky regions updated
- 2019.12.11: Easy cross-match using the MAST catalogs API
- 2019.02.25: ForcedMeanObject and ForcedMeanLensing tables available
- 2019.01.28: PS1 Data Release 2
- 2018.10.23: Sample Python notebook for image retrievals
- 2017.03.17: DR1 database update adds 14M object measurements
- 2017.02.02: DR1 database now has 1.5 percent more objects
- 2017.02.02: PS1 sky available in MAST Portal
- 2016.12.21: PS1 DR1 caveats
- 2016.12.21: How to separate stars and galaxies
- 2016.12.21: Catalog search radius limited
- 2016.12.20: Bug in catalog search (fixed)
- 2016.12.19: PS1 Data Release 1

PS1 data products are served in an archive operated by the Space Telescope Science Institute (STScI), in Baltimore, Maryland.

- The PS1 archive includes images and catalogs from several defined surveys, including observations of three quarters of the sky ("3PI Survey," which is available in DR1 and DR2) carried out several times per filter and over a four-year time span. In addition, there were nightly observations of ten smaller fields distributed across the sky (the "Medium Deep Survey," not part of DR1 or DR2).
- The PS1 archive includes a simple image search form for retrieving image cutouts and full images and a catalog search form to search for objects near a sky position. A CasJobs SQL interface allows expert users to craft more sophisticated queries.

The following image and catalog products are available in **DR1:**

- PS1 Stack images, which are co-added images made from the multiple exposures taken over the survey. Stacks provide the best signal-to-noise, and the source catalogs created from the stacks are recommended as a starting point for data analysis.
- PS1 Source extraction and catalogs describes how point-source and extended-object photometry is measured from the PS1 Stack images. These source extractions are made available in DR1.
- Mean values of the point-source and extended-object photometry from the PS1 Warp images will be made available in DR1.

The following image and catalog products are available in **DR2**:

- PS1 Warp images, which are the result of resampling and realigning the camera images into a skycell of the PS1 sky tessellation, a set of common pixel-grid images with simple projections from the sky. Warps are astrometrically and photometrically calibrated.
- Extracted photometry for point sources and extended objects from the PS1 Warp images are available in DR2. The DR2 source database allows users to extract information on any time variation of source photometry or astrometry.
- All data from DR1 are available in DR2 as well. Note that the DR1 database remains available for access.

PS1 data release dates

- PS1 DR1 occurred on December 19, 2016.
- PS1 DR2 occured on January 28, 2019.

PS1 thumbnail sketch

Want a short, succinct summary of PS1, how it was executed and what kinds of data have been produced? Check out the slide deck below. It is now a few months old, and so details should come from these pages, but it presents a good summary of the project.

metcalfe_nam2015.pdf

How to use the PS1 documentation

Papers describing the instrument, survey, and data analysis
PS1 Surveys, Chambers, K.C., et al.
PS1 Data Processing, Magnier, E. A., et al.
PS1 Pixel Processing, Waters, C. Z., et al.
PS1 Source Detection, Magnier, E. A., et al.
PS1 Calibration, Magnier, E. A., et al.
PS1 Database, Flewelling, H. A., et al.

PanSTARRS1 Quick Facts	
Location	Haleakala, Hawaii
Telescope	1.8 m diameter
Field of view	3 degree diameter, 7 square degree FOV
Filters	g, r, i, z, y
Detectors	60 orthogonal transfer arrays
Surveys	3pi Steradian Survey (DR1), Medium Deep Survey (DR2)
Sky coverage	North of declination -30 degree
3pi stack 5 depth	grizy < 23.3, 23.2, 23.1, 22.3, 21.3
Single epoch 5 depth	grizy < 22.0, 21.8, 21.5, 20.9, 19.7
Saturation	12-14 mag, depends on seeing and filter
Median seeing	grizy = 1.31, 1.19, 1.11, 1.07, 1.02 arcsec

You are on the home page of the web pages at STScI created to document and explain PS1 and its data products. This first release of PS1 documentation is intentionally minimal in order to focus on the main issues a potential user of the PS1 dataset will face. Details will be added as time permits and as questions arise from users.

These user information pages for PS1 are intended to be individually focused and broken down into a well-linked tree. They approximate the structure of Wikipedia.

In particular, this structure makes it possible for users to search specifically within the domain of this documentation, reducing false positives significantly. We welcome suggestions and comments that can improve our presentation. Contact archive@stsci.edu with suggestions.

PS1 user information topics

There are five primary informational topics, with links below, that provide further details:

- PS1 The Pan-STARRS1 facilities and hardware
- PS1 Data processing procedures
- PS1 Image data products
- PS1 Source extraction and catalogs
- How to retrieve and use PS1 data
- PS1 Sample queries

How to get help

- Try the FAQ page: PS1 FAQ - Frequently asked questions.
- Contact archive@stsci.edu with questions.

Credit where it is due

Here is the text for acknowledging PS1 in your publications:

> The Pan-STARRS1 Surveys (PS1) and the PS1 public science archive have been made possible through contributions by the Institute for Astronomy, the University of Hawaii, the Pan-STARRS Project Office, the Max-Planck Society and its participating institutes, the Max Planck Institute for Astronomy, Heidelberg and the Max Planck Institute for Extraterrestrial Physics, Garching, The Johns Hopkins University, Durham University, the University of Edinburgh, the Queen's University Belfast, the Harvard-Smithsonian Center for Astrophysics, the Las Cumbres Observatory Global Telescope Network Incorporated, the National Central University of Taiwan, the Space Telescope Science Institute, the National Aeronautics and Space Administration under Grant No. NNX08AR22G issued through the Planetary Science Division of the NASA Science Mission Directorate, the National Science Foundation Grant No. AST-1238877, the University of Maryland, Eotvos Lorand University (ELTE), the Los Alamos National Laboratory, and the Gordon and Betty Moore Foundation.

In addition, please cite the following papers describing the instrument, survey, and data analysis as appropriate:

1. The Pan-STARRS1 Surveys, Chambers, K.C., et al.
2. Pan-STARRS Data Processing System, Magnier, E. A., et al.
3. Pan-STARRS Pixel Processing: Detrending, Warping, Stacking, Waters, C. Z., et al.
4. Pan-STARRS Pixel Analysis: Source Detection and Characterization, Magnier, E. A., et al.
5. Pan-STARRS Photometric and Astrometric Calibration, Magnier, E. A., et al.
6. The Pan-STARRS1 Database and Data Products, Flewelling, H. A., et al.

People and organizations that built and supported PS1

Fourteen organizations in six nations (plus two funding organizations) supported the Pan-STARRS1 survey.

Many individuals contributed to the creation of the Pan-STARRS survey and archive.