



MAST
Users
Group
Meeting

December
15-16,
2016

Hubble Legacy Archive and Hubble Source Catalog

Lee Quick, Brad Whitmore, Rick White

Current Team:

HLA/HSC: Tamás Budavári, Michael Dulude,
Anton Koekemoer, Steve Lubow, Brian McLean,
Lee Quick, Armin Rest, Rick White, Brad Whitmore,
Geoff Wallace, Leonardo Ubeda



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Content

- What is the HLA
- What is the HSC
- Highlights from the past year
- Additions to the system
- How the systems are integrated and growing
- Metrics
- Schedule and future plans



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Hubble Legacy Archive goals

1. Process HST data to produce higher-level, science-ready data products: combined images, mosaics, source lists
 - Based on software developed for data analysis (e.g., Astrodrizzle)
2. Develop advanced web interfaces to the archive using next-generation browser technology
 - Portal is replacing the HLA interface (will return to this topic at the end)

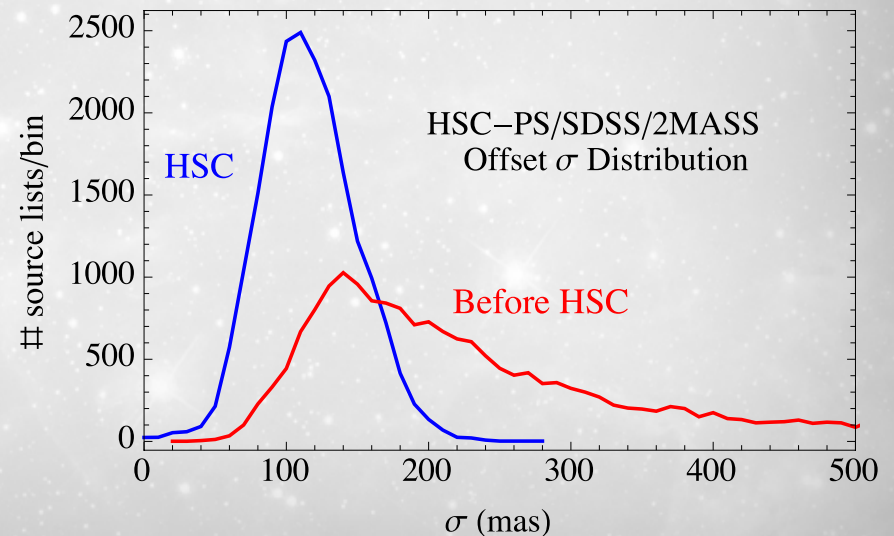
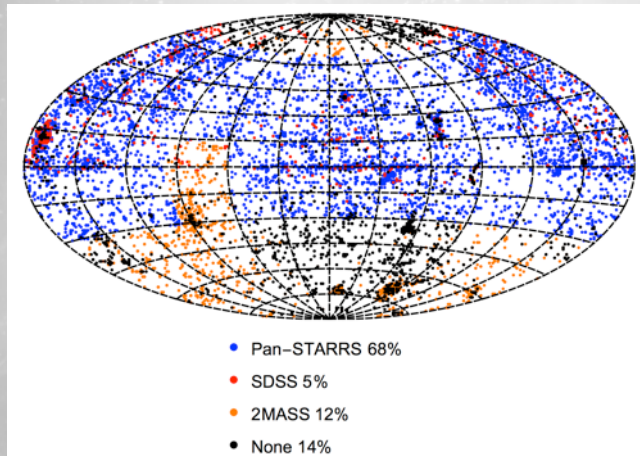


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Hubble Source Catalog

1. Combines tens of thousands of SourceExtractor HLA source lists into a single master catalog. Uses matching algorithm from Budavari and Lubow 2012.
2. Includes WFPC2, ACS/WFC, and WFC3.
3. Absolute astrometry is good to ~ 100 mas (calibrated using PanSTARRS and 2MASS). This can eventually be improved to ~ 10 mas using Gaia observations).

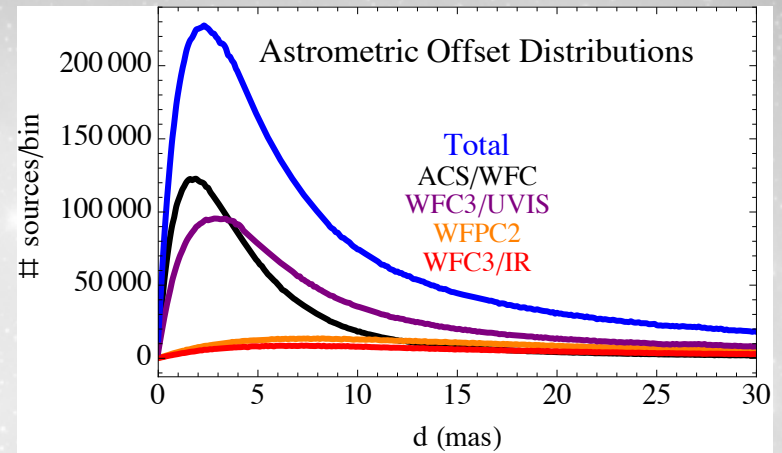




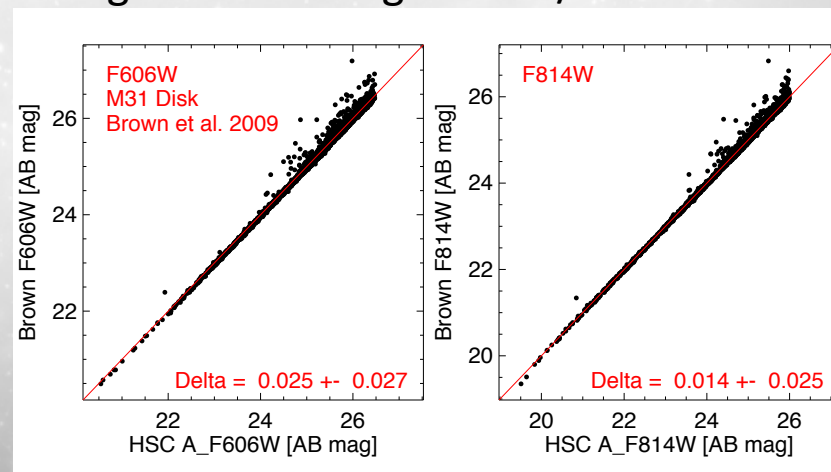
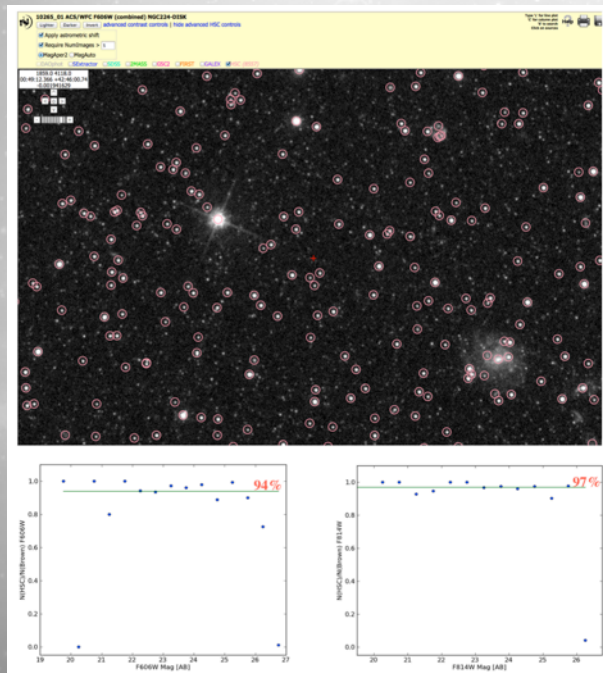
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Hubble Source Catalog

4. Relative astrometry good to better than ~ 10 mas; ~ 2 mas is the peak of the distribution.



5. Photometry (aperture) typically good to 0.10 mag and 0.02 mag when S/N is sufficient.



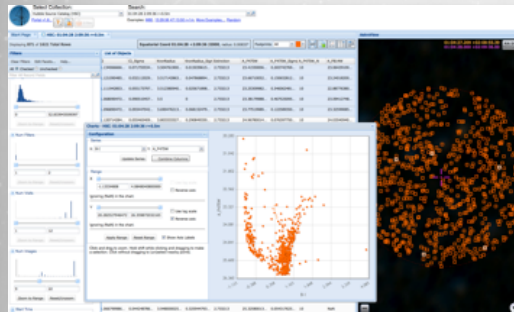
HSC archive.stsci.edu/hst/hsc 5



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6. The MAST Portal is our primary interface, but we also have a CasJobs interface (similar to SDSS) for larger and more complex queries, and a simple HSC search form for special cases and scripted queries.



```

Home Help Tools Query History MyDB Import Groups Output Profile Queues Logout whitmore
Context Table (optional) Task Name
HSC MyTable My Query
Samples Record Clear [x] [y] [z] [g] [i] [r] [z] [s] Syntax Plan Quick Submit
SEARCH
MATCHA, MATCHB, MATCHID, CI, W2_F606W, W2_F814W, V_2=W2_F606W - W2_F814W
FROM
SearchNumber2004a[187,706,12,391,500,0]
where CI > 1.05 and CI < 1.5
and (W2_F606W - W2_F814W) > 0.0 and (W2_F606W - W2_F814W) < 1.0
and num_images > 50
order by matchid

925 rows(s)
MATCHA MATCHB MATCHID CI W2_F606W W2_F814W V_2
117.2200234832 12.361428379636 2498897 1.30243330305 22.2612965138753 22.379090936279 0.445897420247395
187.73072329293 12.3609009798223 2498897 1.4526415113993 24.388463382161 23.955607285254 0.432862399690754
187.697171146073 12.364720217239 2498894 1.3601536962589 23.705452864601 23.315400123962 0.39074516293807
187.690215313199 12.3609009798223 2498897 1.392911296461 23.792003387612 23.4023002181768 0.30480035561236
187.730963090517 12.365281413182 2498869 1.32493149571949 23.188599725439 22.522800445556 0.665796279927227
187.693894248742 12.3609009798223 2498897 1.3902650517912 23.730981225241 23.32816839988 0.600298126392194
187.702657627719 12.3661171871274 2498876 1.4061273704829 23.575990008714 23.2437902099947 0.3257959107664
    
```

7. A range of “documents” and learning aids are available (e.g., FAQ, use cases, videos, journal article - Whitmore et al. (2016) - “Version 1 of the HSC.

A Hubble Source Catalog (HSC) Use Case

Example #3: Using the Discovery Portal to search for Variable Objects in the HSC
(Time Variability in the dwarf irregular galaxy IC 1613)

GOAL: This tutorial shows you how to use the [MAST Discovery Portal](#) to search for variable objects in the HSC.

SCIENCE CASE: The science case is searching for variable objects (i.e. in the irregular galaxy IC 1613; Bernard et al. 2010, Apr 712, 1259).

WHITMORE ET AL. 2016

Version 1 of the Hubble Source Catalog

Whitmore, A., Whitmore, B., Kuerst, J., Davis, B., ... (2016)

The Hubble Source Catalog is designed to help astronomers search for the Hubble Space Telescope (HST) ...

ABSTRACT

The Hubble Source Catalog is designed to help astronomers search for the Hubble Space Telescope (HST) ...

INTRODUCTION

The Hubble Space Telescope (HST) has been in orbit for the past 35 years. In that time it has observed ...

CONCLUSIONS

The Hubble Source Catalog is a valuable resource for astronomers ...

HSC archive.stsci.edu/hst/hsc



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HLA/HSC Highlights for 2016

September 2016

HSC 2.0

- Four additional years of ACS source lists. All ACS source lists go deeper than version 1
- One additional year of WFC3 source lists
- Cross-matching between HSC sources and spectroscopic COS, FOS, GHRs and ACS grism observations

HLA 9.1

- All new ACS and WFC3 source lists (for data public on June 2015)
- Much faster overlays (e.g., “visible area” only option)
- Gaia overlays

MAST Portal 2.7

- New Advanced Search interface
- HSC spectral results page and crossmatching available
- Number of sources displayed has increased from 10K to 50K

HSC CasJobs 2

- Include both HSC versions 1 and 2 (and supporting tables)



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Future HLA/HSC additions: Photometry on Demand (POD)

- Photometry on Demand is an HSC-related tool designed to provide an easy and flexible way for users to obtain “fine-tuned” photometry for the specific datasets, and science needs, they are interested in.
 - In development now (Armin Rest)
- Potential HSC users may not be able to use the “general usage” source lists employed by the HLA.
- Examples are that they might want/need:
 - PSF-fitting photometry for crowded regions,
 - deeper limiting magnitudes,
 - better time resolution

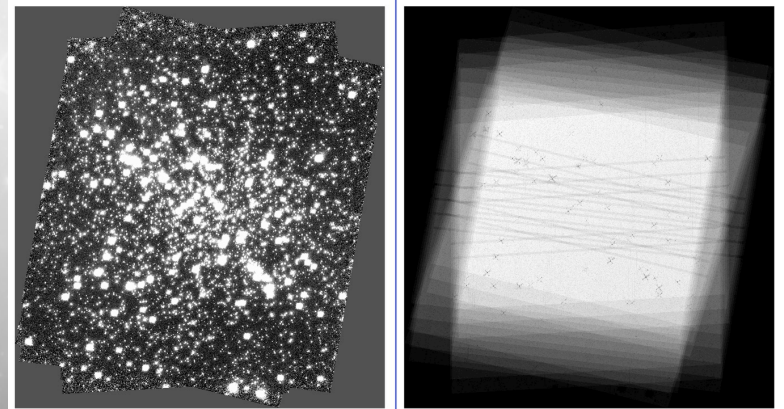


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Future HLA/HSC additions: Super Mosaics

- A project to make “super mosaics” using HLA data has begun, under the leadership of Anton Koekemoer
- A test mosaic in the globular cluster M4 developed using the offsets between the images as determined by the HSC.
- Quality is good - HSC offsets will be sufficient for making mosaics





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Future HLA/HSC additions: Hubble Catalog of Variables (HCV)

- We encourage the development of value-added products such as “The Hubble Catalog of Variables”, a 3-year ESA program to use the HSC to find variable stars.
http://archive.stsci.edu/archive_news/2016/07-Jul/index.html#article4
- PI = Alceste Bonanos – based at the University of Athens
- The group will validate the candidates using a wide variety of different algorithms (Sokolovsky et al. 2016).
- The HCV will be ingested into the MAST archives in the spring of 2018.

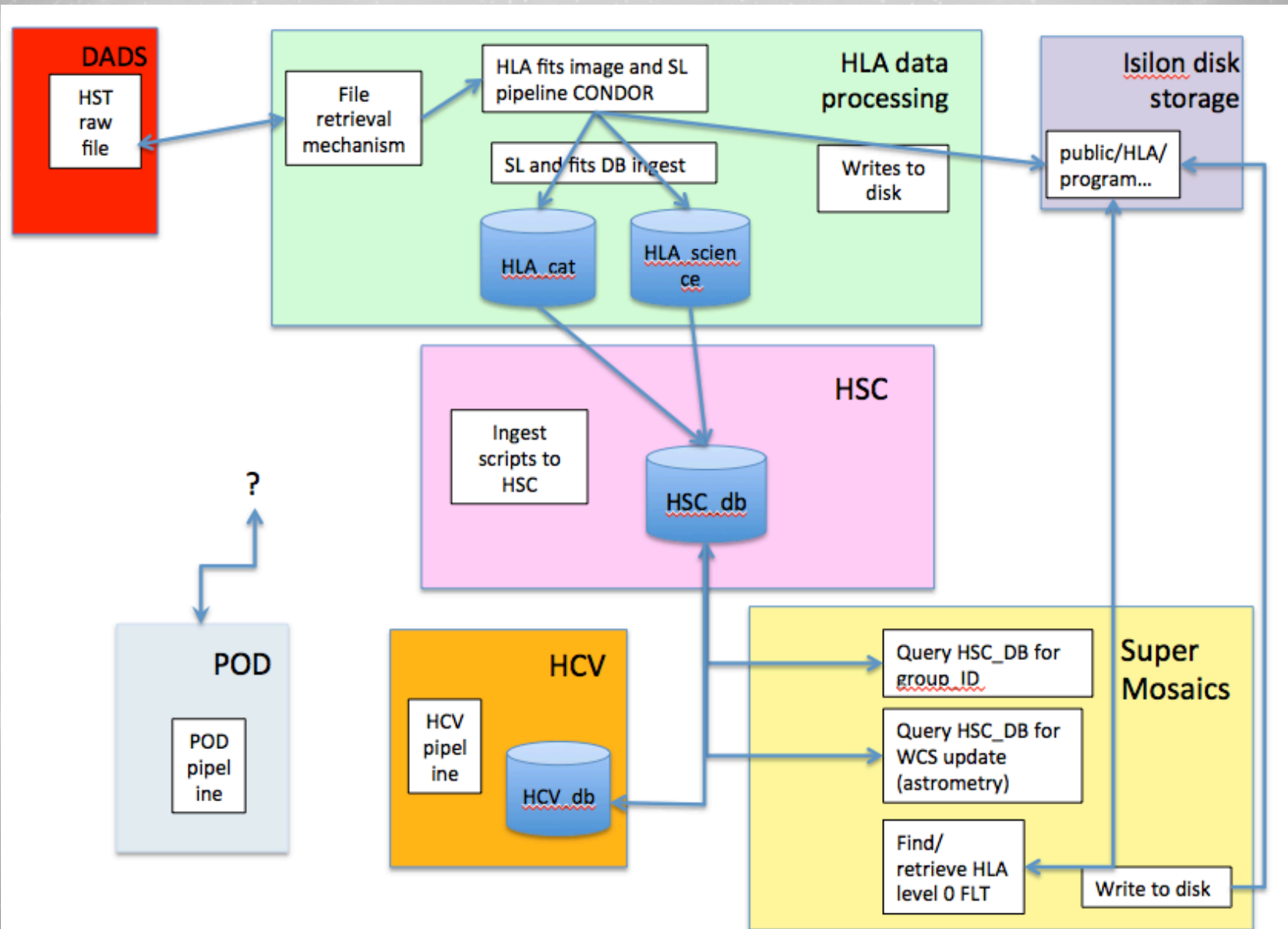


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HLA/HSC system design



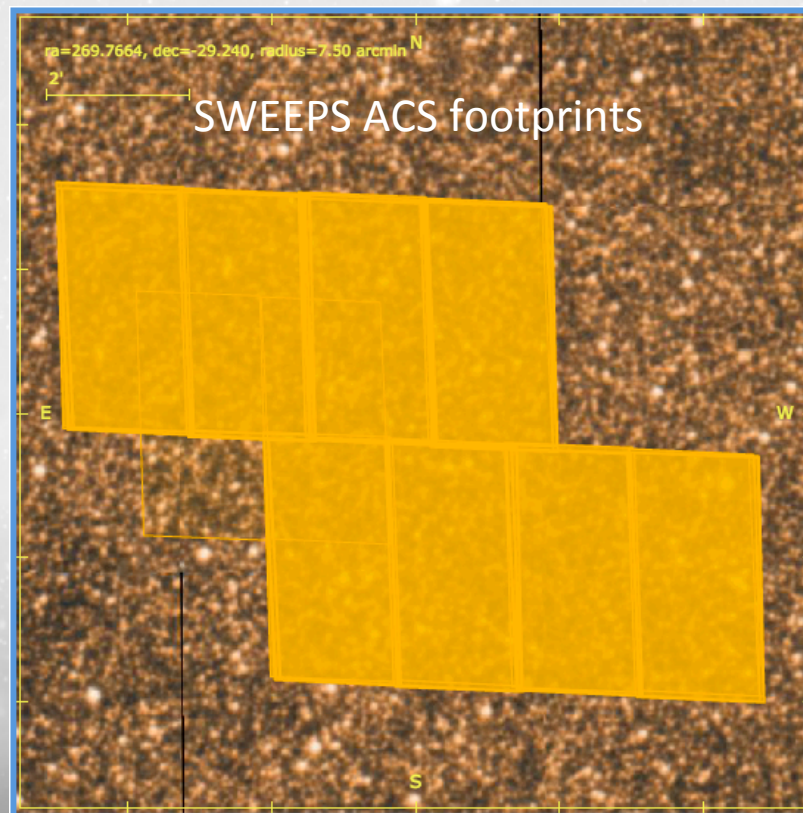


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Future HLA/HSC additions: Astrometry

- HSC absolute astrometry will be inserted into the headers of HLA images (Spring 2017)
- Relative astrometry is excellent in SWEEPS field

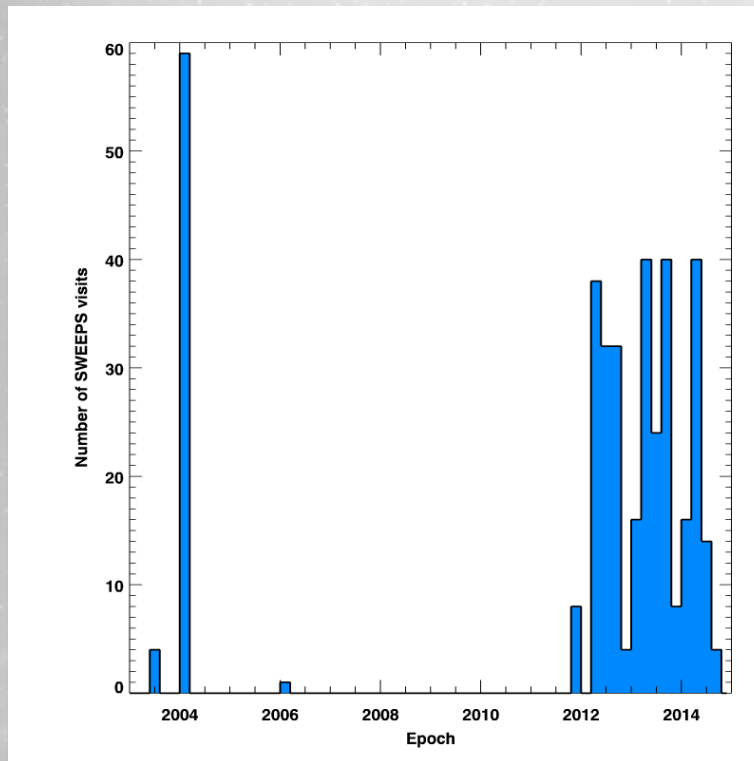




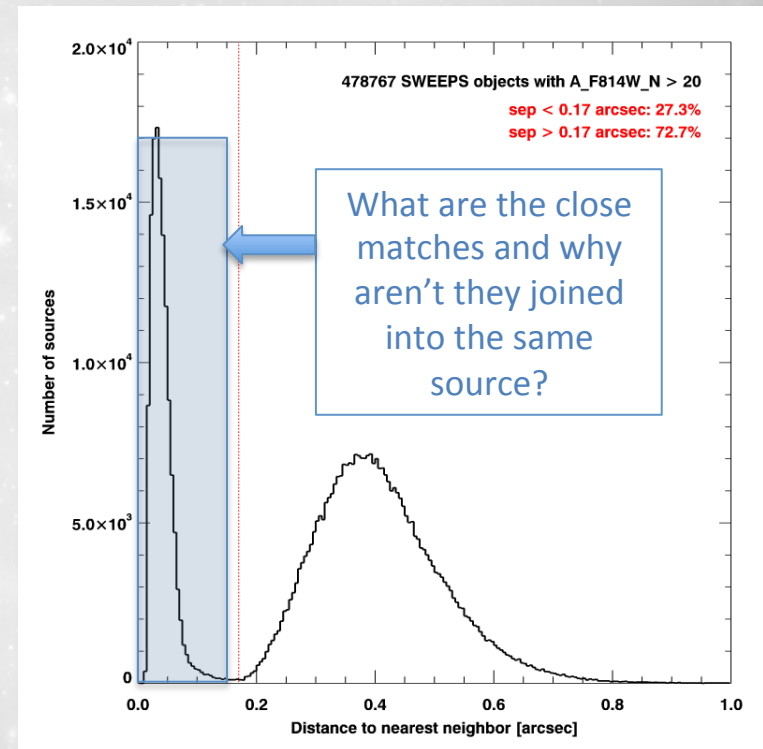
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HLA/HSC additions – Astrometry



SWEEPS field: a decade of observations



Distance to nearest neighbor in the HSC



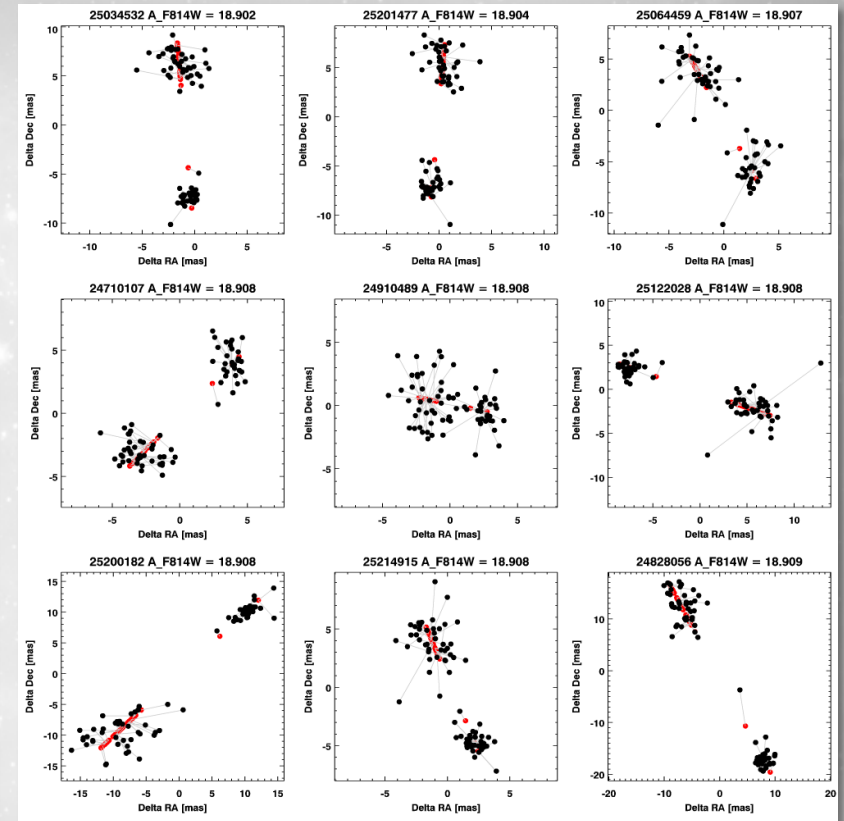
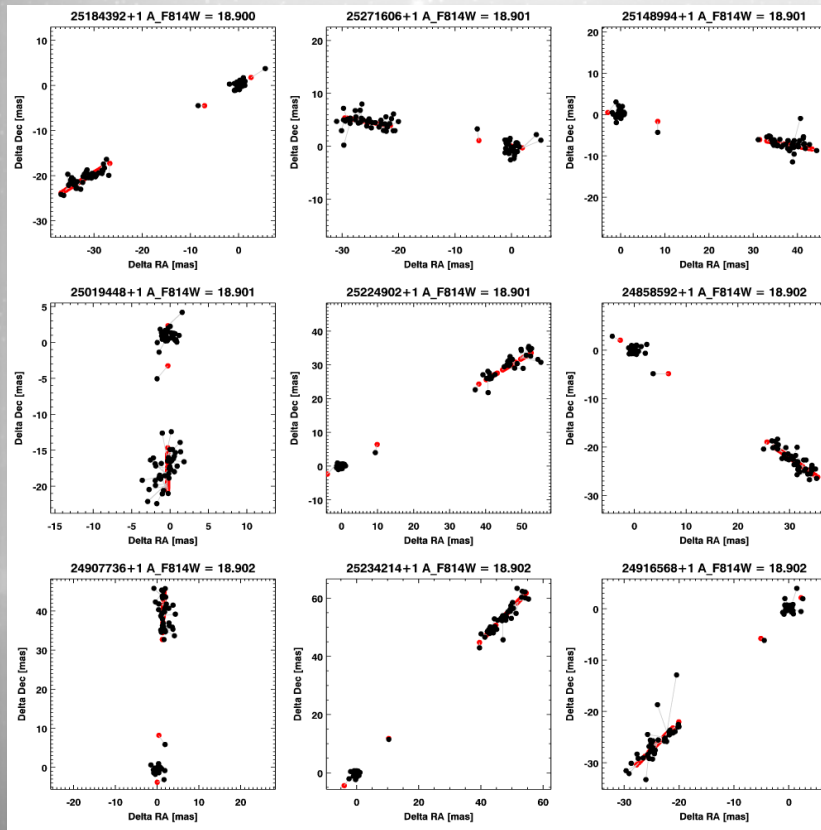
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HLA/HSC additions – Astrometry

Answer: Proper motion!

9 objects fainter than 18.9
that have close neighbors



Objects that are not split
also have proper motions

Next version of the HSC
will include proper motion
measurements.



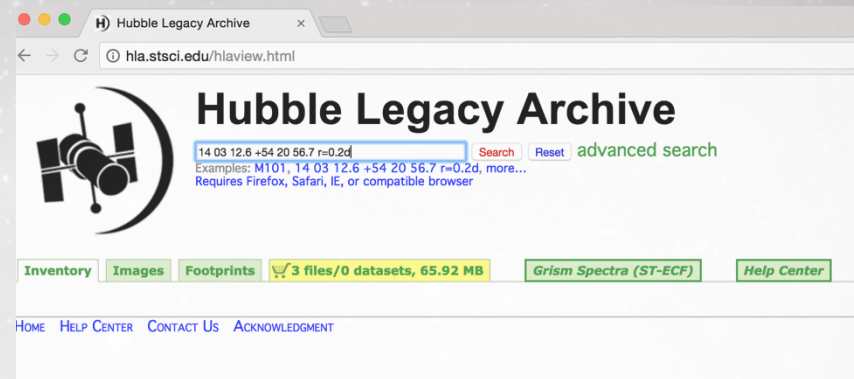
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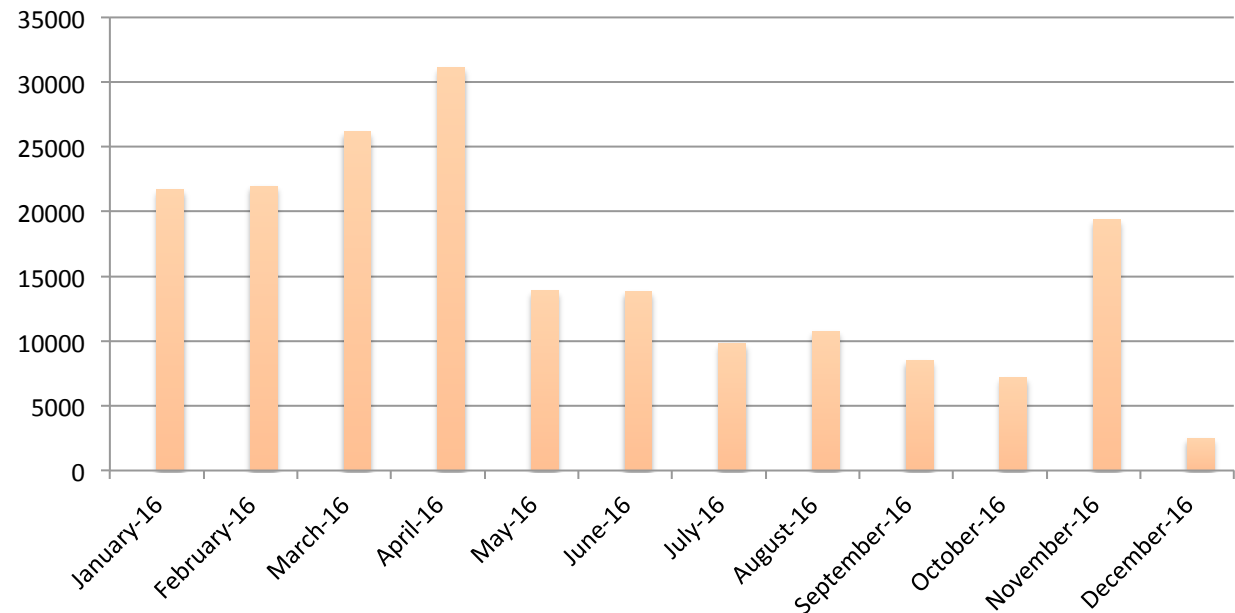
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HLA/HSC metrics

- HLA only
- hla.stsci.edu



Number of
searches
per month





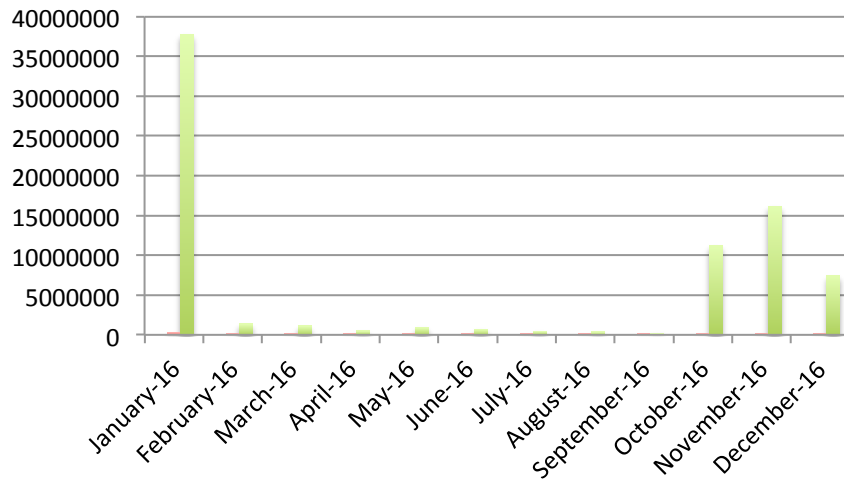
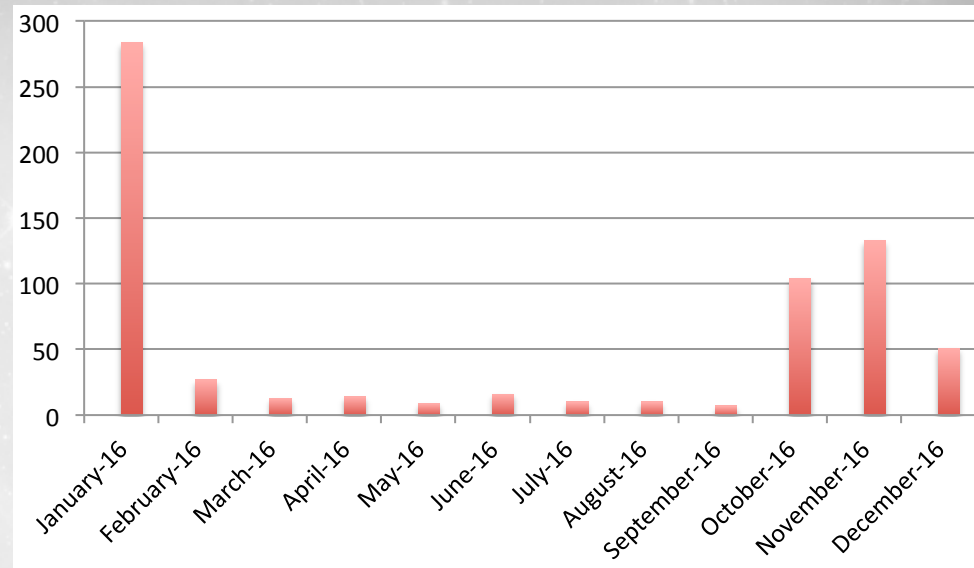
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HLA metrics

Total
downloads
file size GB



Total number
of files
downloaded



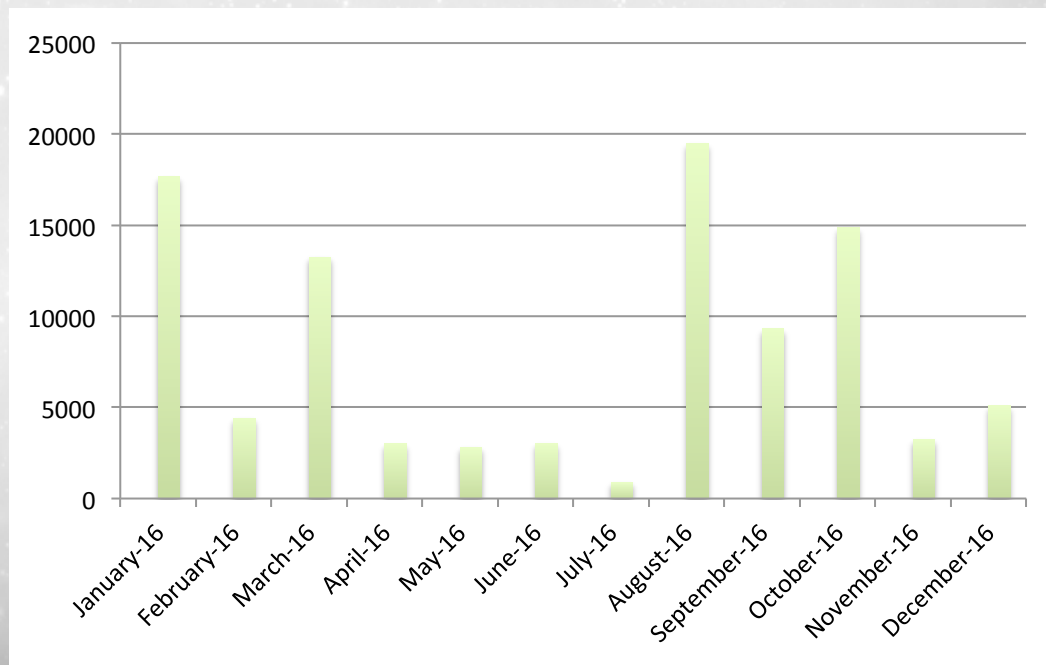
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HSC metrics

- Forms view
- archive.stsci.edu/hst/hsc

Number of
queries using
MAST forms





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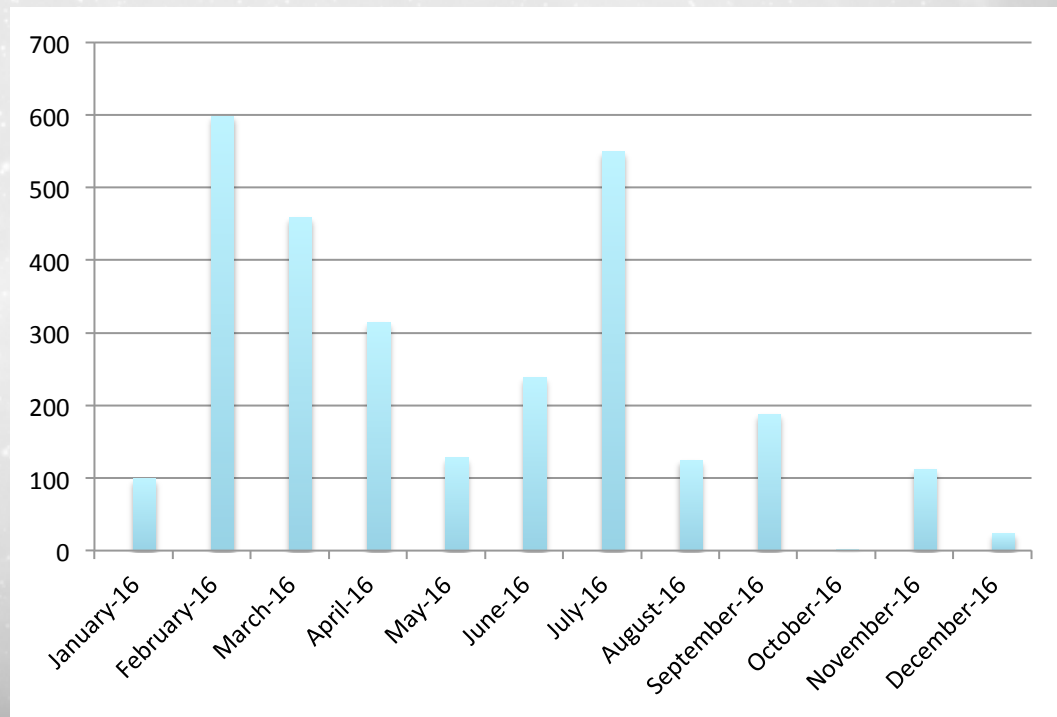
HSC metrics

- Casjobs
- mastweb.stsci.edu/hcasjobs/

```
SearchNumber2Catalog(187,754,12,391,500,0)
where C2 > 2.55 and C2 < 3.2
and (W2_F606W - W2_F814W) > 0.0 and (W2_F606W - W2_F814W) < 1.0
and multiimage > 0;
order by matchID
```

MatchID	MatchIDC2	MatchIDC1	W2_F606W	W2_F814W	V_S	
187.7280954832	12.3614283870636	3498807	1.3024333303061	22.2612965138793	22.26109926279	0.450897420247995
187.730277219395	12.3600000979882	3498827	1.4536451133983	24.388463382161	23.955600738254	0.43286299690754
187.68773146072	12.364702017329	3498864	1.3601238802892	23.706140386002	23.254601223962	0.38014816263867
187.69625352199	12.36000594991	3498867	1.302811296481	23.7973003387451	23.4922003051758	0.39400032669336
187.730063090517	12.36281411382	3498869	1.3248144971949	23.1880967254039	22.522804452666	0.665796279927227
187.69502474974	12.363900206152	3498878	1.304656617913	23.720063320241	21.125883008468	0.68026817392524
187.702602637719	12.366117871274	3498878	1.40061273574829	23.5733990006714	23.2437992095647	0.32979679157666

Number of
successful
queries
using
Casjobs

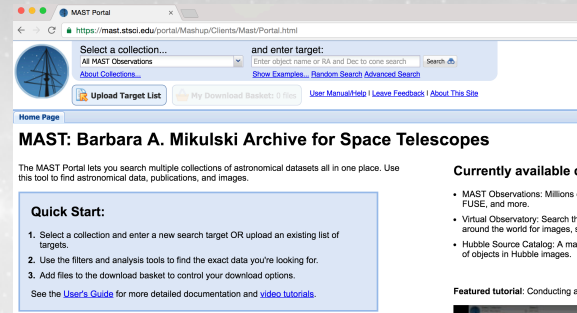




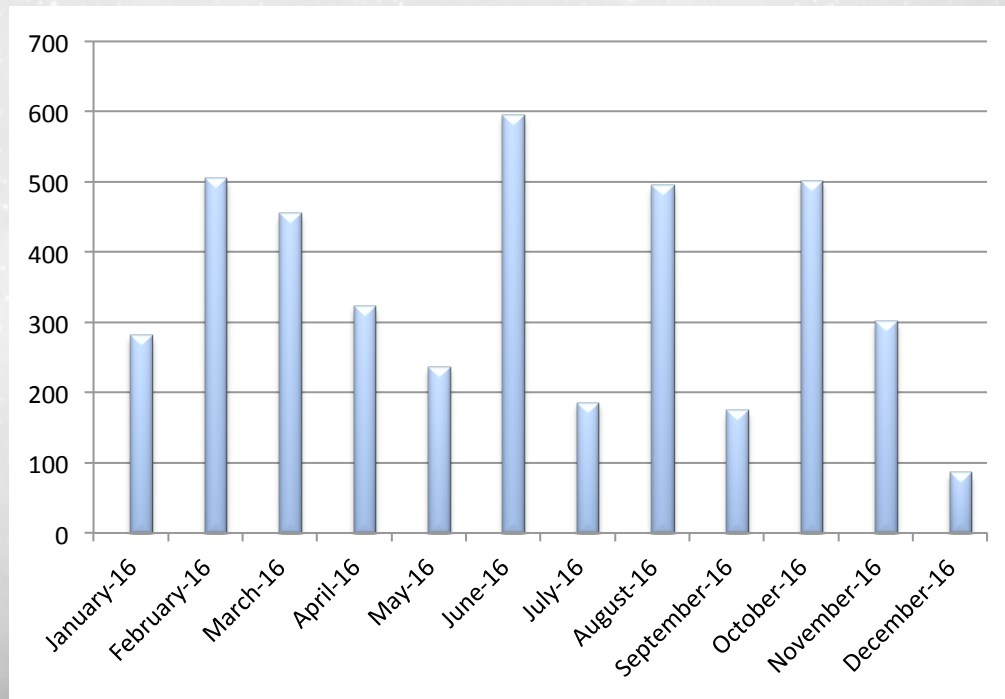
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HSC metrics

- MAST Portal
- mast.stsci.edu



Number of
queries to the
HSC database
via the MAST
Portal





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HLA/HSC schedule

- HLA WFPC2 study (January 2017)
 - We currently archive CADC-generated products
 - Source lists quality could be improved
- HLA DR 9.3 (March 2017)
 - Corrected WFC3 CTE
- HLA DR 10 (August 2017)
 - Super Mosaics
- HSC v3 (September 2017)
 - Improvements to proper motion, plate scale, edge effects, bright stars
 - WFPC2 (possible)
 - WFC3 CTE
 - Additional spectroscopic cross-matching (STIS, HLSA, ...)



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HLA/HSC future plans

- NICMOS and STIS astrodrizzled images with source lists
- Incorporate HLA pipeline products into standard HST data processing
- NICMOS and STIS imaging source lists included
- Mosaic image source lists included
- Hubble Catalog of Variables data products and algorithmic improvements (e.g., improved photometry)
- Forced photometry and photometry-on-demand
- Photometric redshifts, SEDs, and other higher-level products



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Future of the HLA interface

- HLA user interface concepts (and some technology) have been adopted by portal and used for many other MAST services
- Current plan is to retire the HLA interface in late spring/early summer 2017
 - Aging HLA hardware and software would require additional support to continue operating
 - Transition plan assures that HLA functionality is present in the portal
- Recent MAST survey asked for input on this subject
 - Some users definitely feel strongly about HLA
- We are exploring the option of investing additional effort to make the HLA interface supportable for a longer period and to allow a “softer” transition to the portal for users
 - We ask the MUG for input on this topic