MAST Users Group Meeting

Nov 18 2013

Hubble Legacy Archive & Hubble Source Catalog

Rick White & Brad Whitmore

November 18, 2013

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Hubble Legacy Archive (HLA)

http://hla.stsci.edu

- Goals:
  - Process HST data to produce higher-level, science-ready data products: combined images, mosaics, source catalogs
    - Based on software developed for data analysis (e.g., multidrizzle) and research projects (e.g., Anton's pipelines for GOODS, COSMOS, etc.)
  - Develop advanced web interfaces to the archive using next-generation browser technology
- Primary future focus is on data product generation as MAST portal becomes the user interface
  - HLA user interface concepts (and some technology) adopted by portal and used for many other MAST services already
- History: DR1 (2008 Feb 08) through DR7.2 (2013 Oct 23)

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HLA current staffing

- Staff ~ 4 FTEs
- Departures:
  - Stefano Casertano (on sabbatical)
  - Niall Gaffney (to U. Texas)
- Addition:
  - Lou Strolger

Lee Quick	Steve Lubow
Rachel Anderson	Brian McLean
Mark Kyprianou	Lou Strolger
Kevin Lindsay	Michael Wolfe
Rick White	

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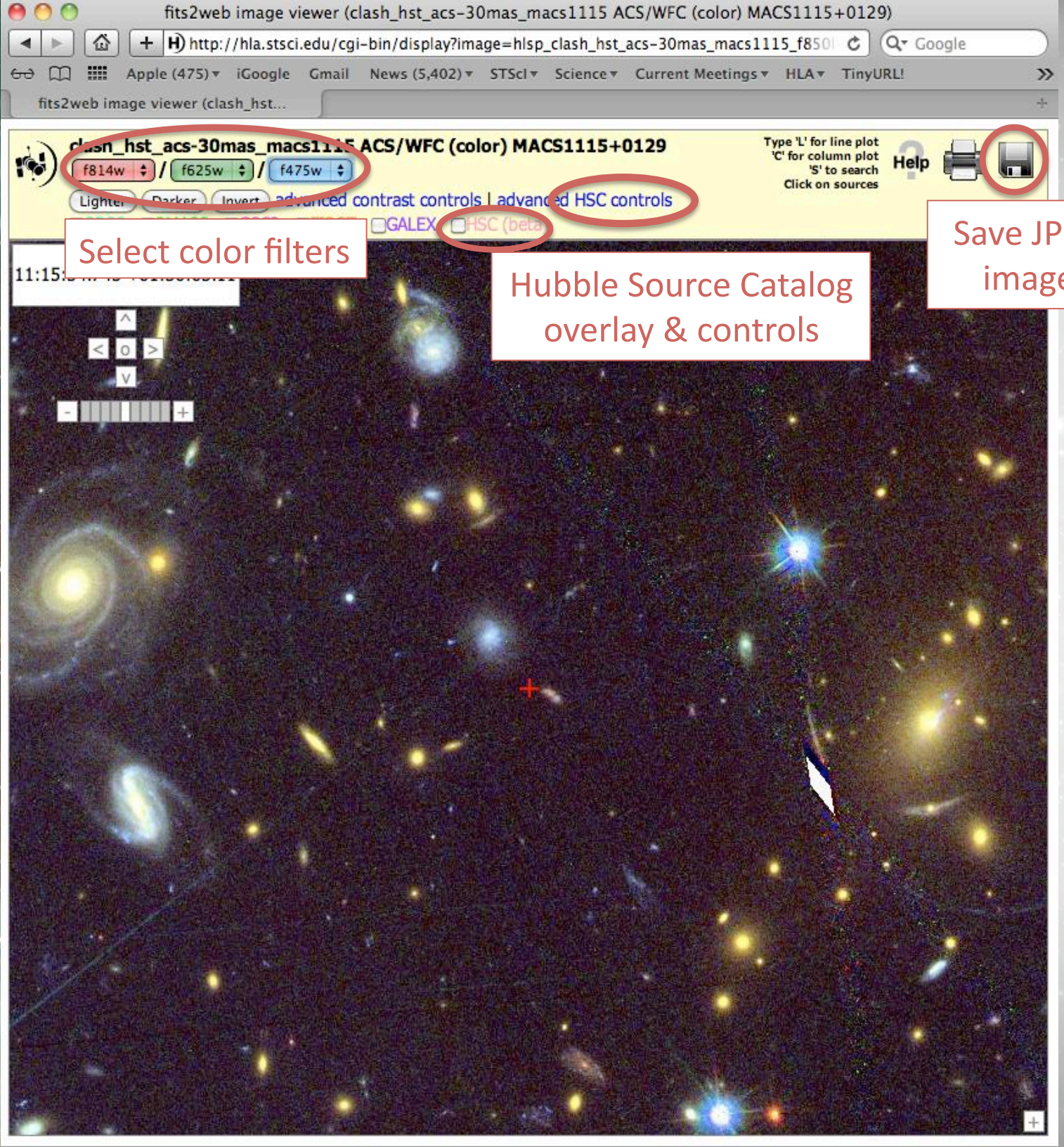
HLA Data Releases in Past Year

Release	Date	Data Products	User Interface
DR7	2012 Nov 02	HLSP spectra MCTs: CANDELS, CLASH, PHAT New HLSP: ORION, BORG, …	Scatter plot tool Spectrum plotter Fast catalog overlay
DR7.1	2013 May 08	Hubble Source Catalog (beta) HLSP: PHAT, CLASH, CANDELS, HUDF12, XDF	HSC options Color filter chooser
DR7.2	2013 Oct 23	Improved WFC3 source lists	

New Interface Capabilities



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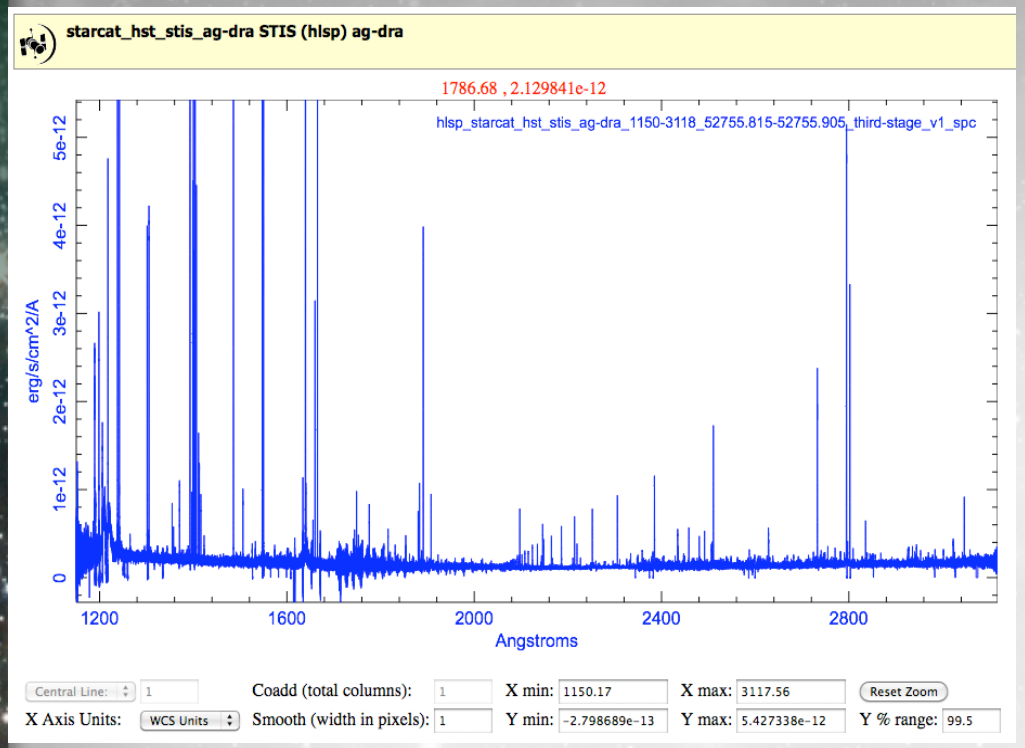
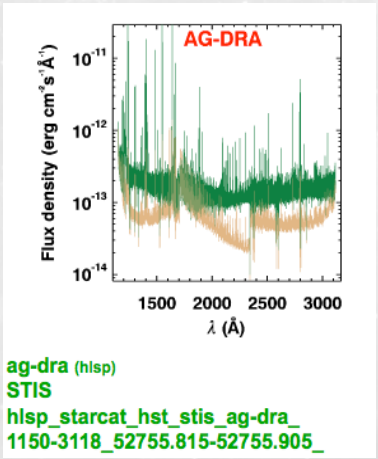
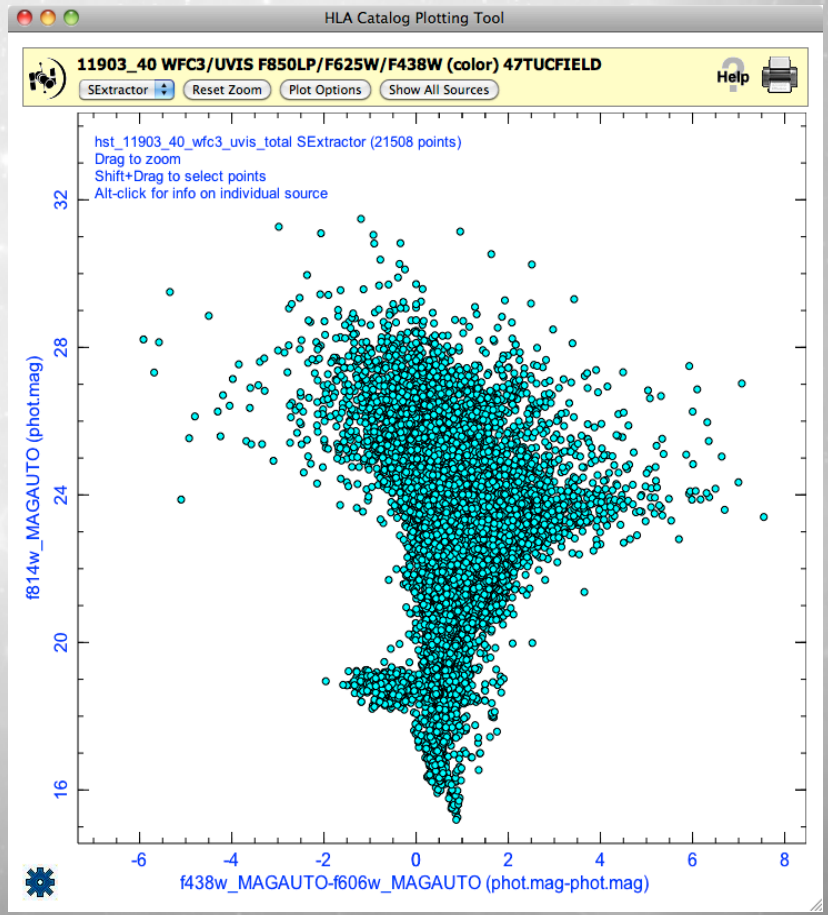
New Interface Capabilities



Spectrum plotting



Catalog plotting



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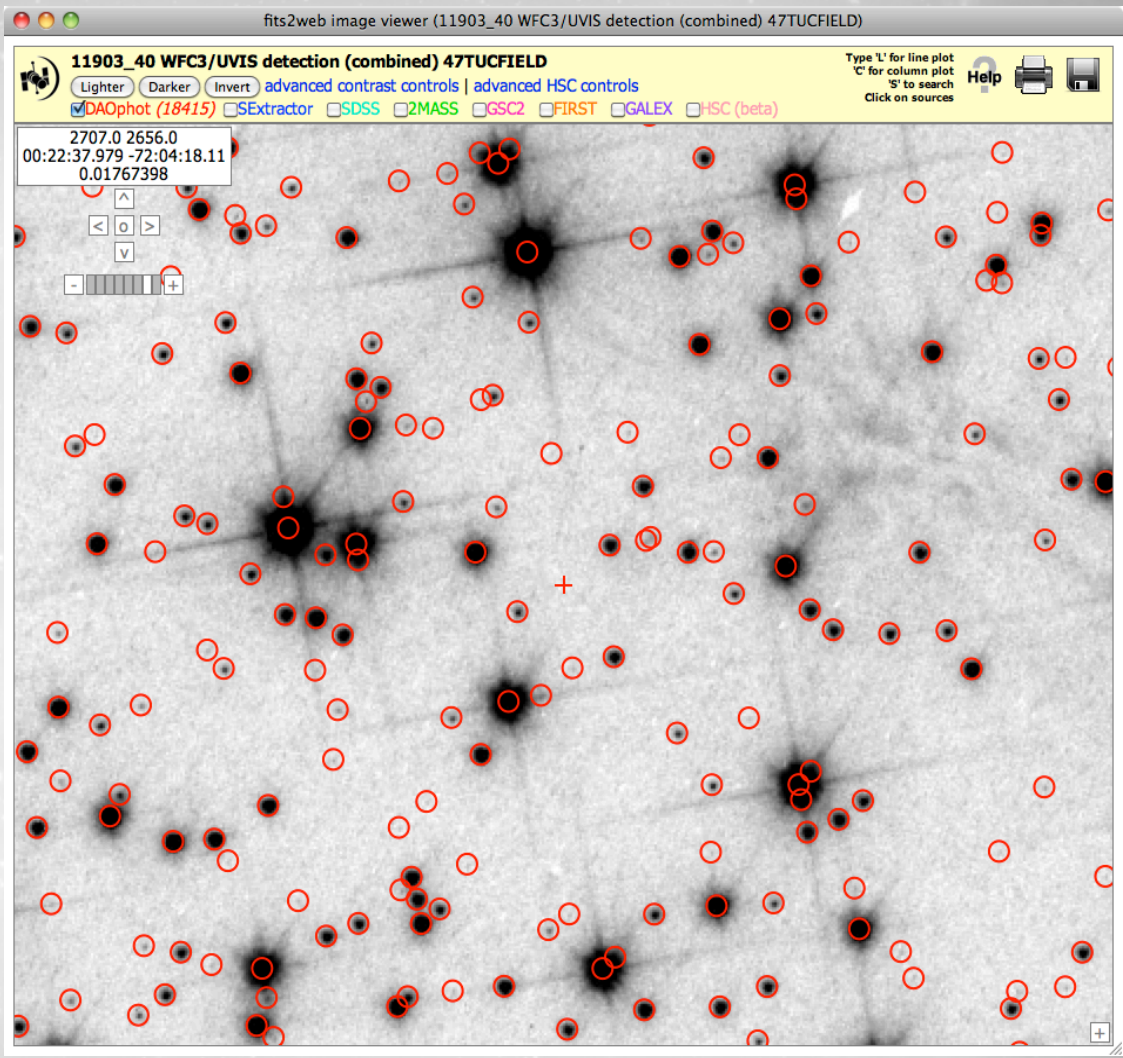
New Data Products

- WFC3 source lists
  - Improved flagging of spurious sources
  - 85% of HLA WFC3 images have at least one source list (DAOphot or SExtractor)
- New HLSP
  - Multi-cycle Treasury Programs: CANDELS, CLASH, PHAT
  - StarCAT (HST STIS Echelle Spectral Catalog of Stars), Orion, BoRG, GHOSTS, HUDF12, XDF



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Hubble Source Catalog (HSC)

http://archive.stsci.edu/hst/hsc

- Goal: Create master catalog of objects from HST images to enable database-driven research
- Challenges:
  - Highly inhomogeneous sky coverage, hundreds of filters
  - Unreliable astrometry makes cross-matching hard
- History:
  - Beta 0.1 (2012 June): ACS/WFPC2 HLA SExtractor source lists (Budavari & Lubow 2012 paper)
  - Beta 0.2 (2013 May): Improved source matching (using automated pre-offsets from 2MASS), improved tools (HLA source overlays, summary form, …)
  - HSC Working Group (including both internal and external members) formed after beta 0.2 release

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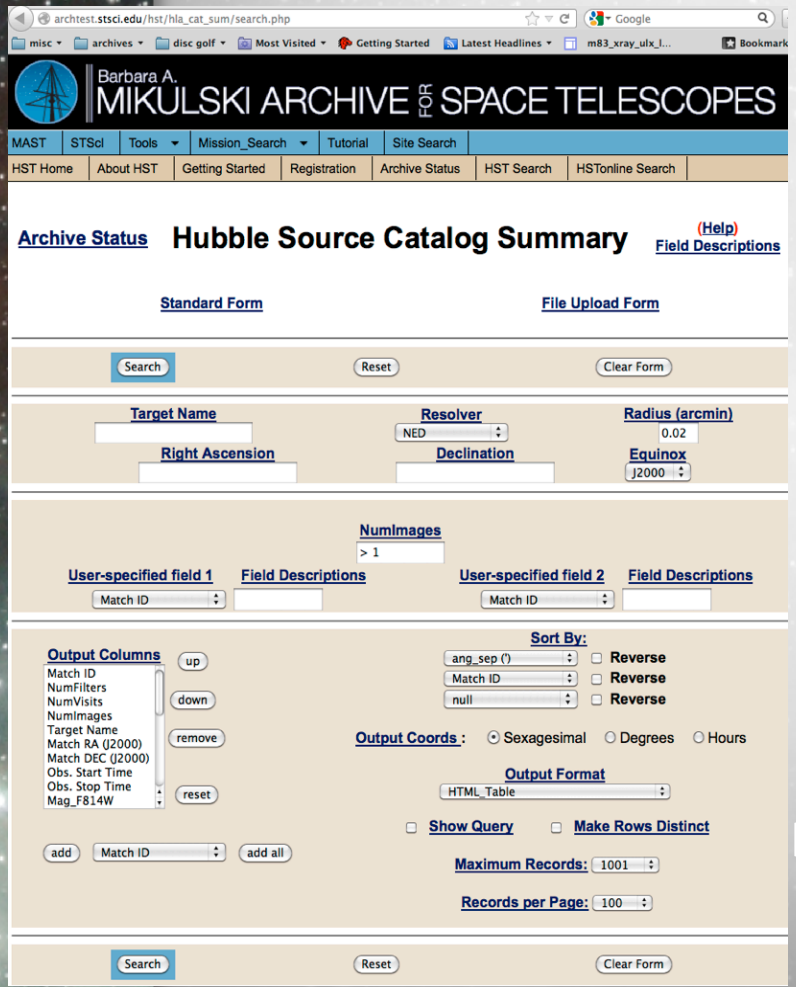
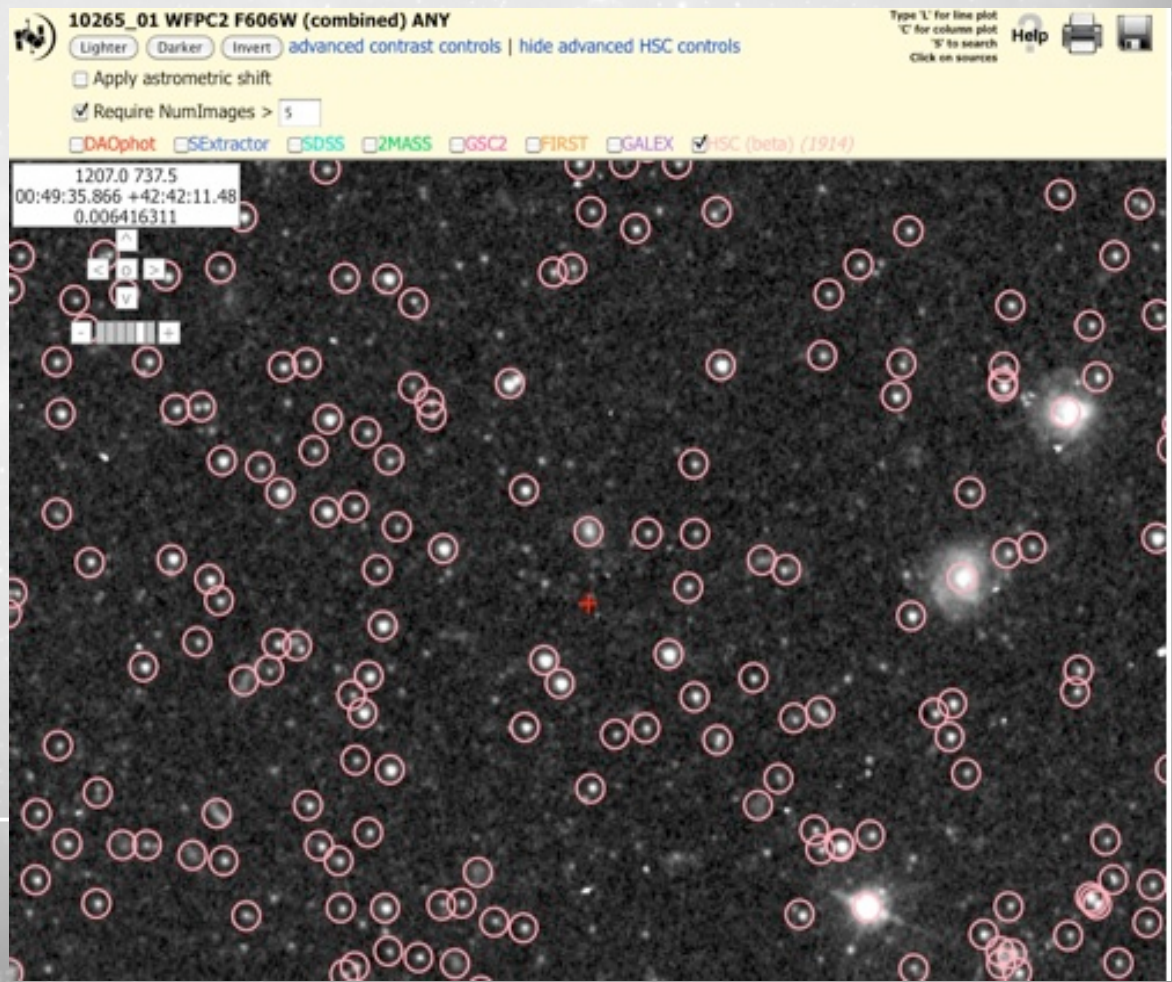
HSC Staff

- Core Group: Sahar Allam, Tamas Budavari, Stefano Casertano, Steve Lubow, Lee Quick, Lou Strolger, Rick White, Brad Whitmore





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Five reasons to build the Hubble Source Catalog

1. Time-variable phenomena – The HSC supports time-variable studies over >20 year baseline.

2. Mosaics – Accurate spatial offsets needed to build the HSC can be used to make mosaics for the ~ 90 % of the archives that are not treasury programs.

Related to MUG recommendation: Improving HST astrometry

3. Exorbitant datasets – To replicate what is available in the HSC in seconds would take most groups weeks, months, or years to produce.

4. Enable HST Database astronomy – Enable cross reference with existing (e.g., SDSS, Chandra, Spitzer, …) and future (e.g., panSTARRS, LSST, …) source lists.

5. Future usage – In a decade from now, most astronomers (e.g., JWST users) will not take time (or have the expertise) to re-reduce the HST data that overlaps their targets.

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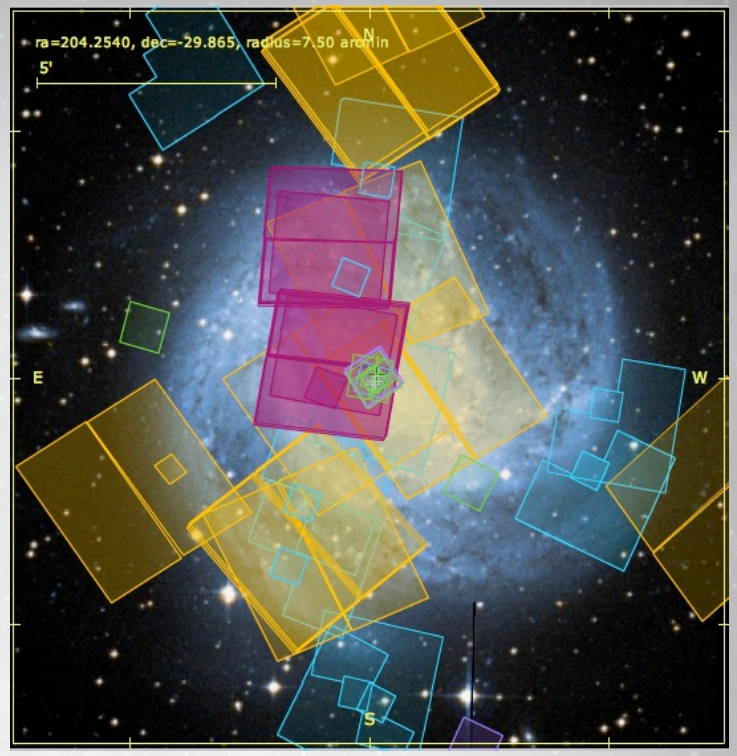
Examples of potential HSC Users:

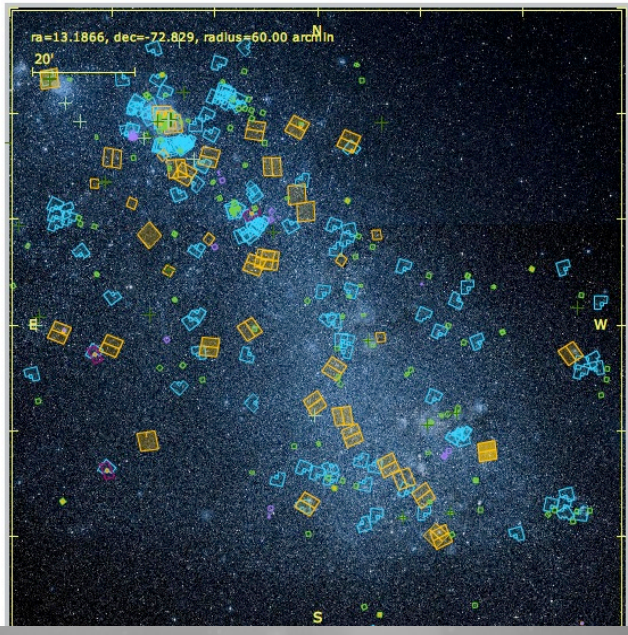
1. JWST observer cross matching with their new observations of M83 (would need to combine catalogs from 269 images – not an HST user so don't know differences between WFPC2/ACS/WFC3/NICMOS).

2. Someone making CMD of stars in the entire SMC (> 3000 observations)

3. Brad Whitmore – "A catalog of young star clusters in 500 galaxies" – 20 are done after 3 years (Problem: cross- matching WFPC2 and ACS difficult now but will be trivial after HSC)

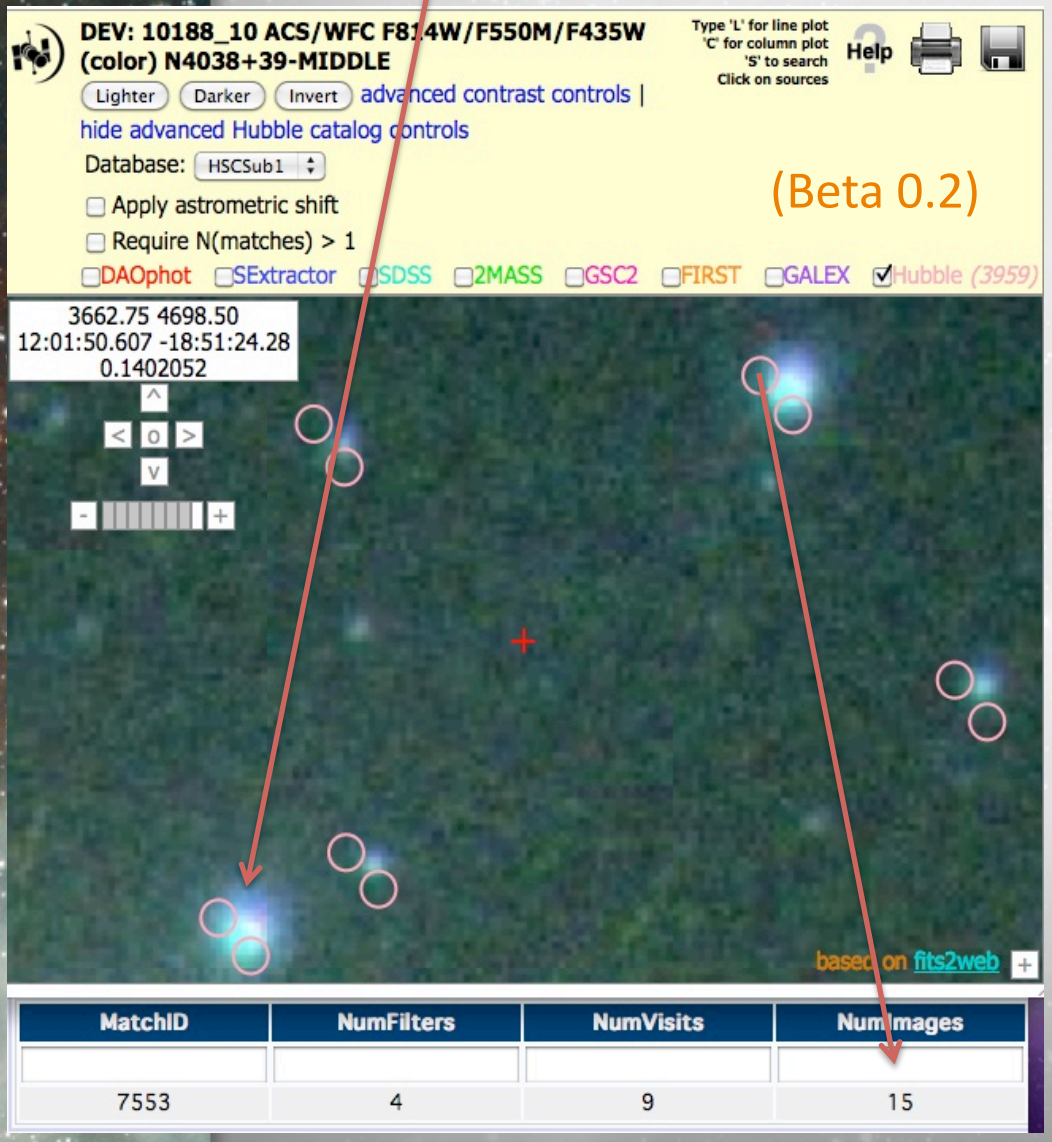


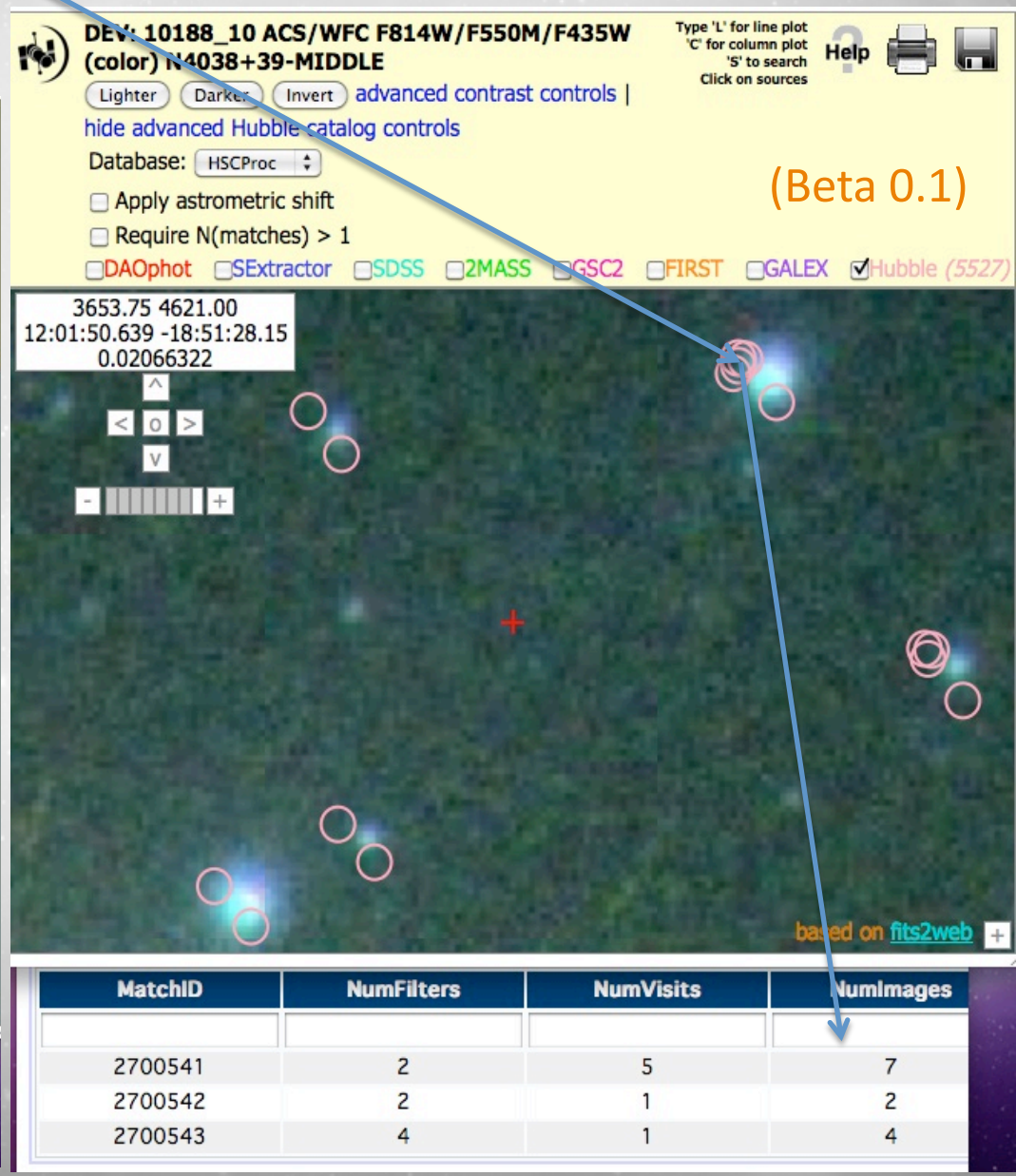
Instruments	#Footprints
ALL	3720
ACS	376
ACSGrism	0
WFPC2	916
WFPC2-PC	813
NICMOS	126
NICGrism	0
WFC3	6
COS	452
STIS	844
FOS	143
GHRS	44



Recent Technical Progress: Example of matching issues

- Multiple detections greatly improved for Beta 0.2
- "Double detections" have been removed for some but not all sources for Beta 0.2 (i.e., ~ 30 % of fields still have issues like this). Goal for Beta 0.3 is < 5%.





Recent Progress: Use Cases

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Note: See extra slides for more info on use cases in development

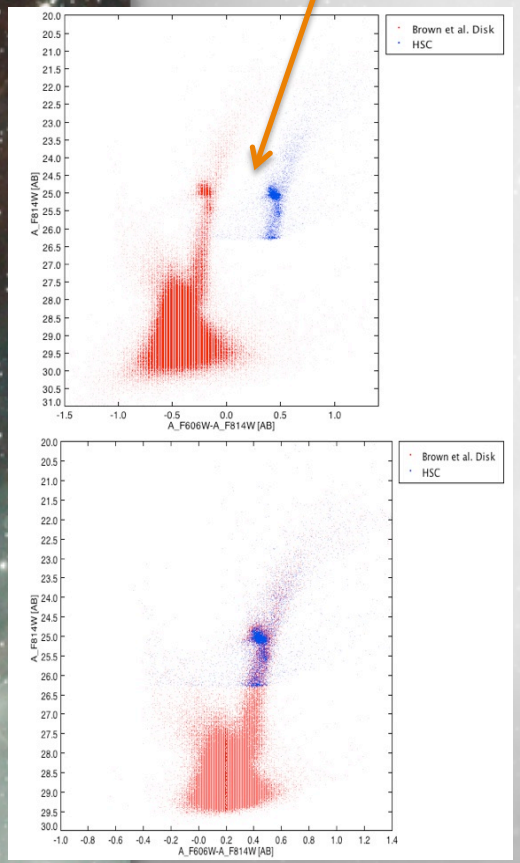
FAQ - Uses Cases

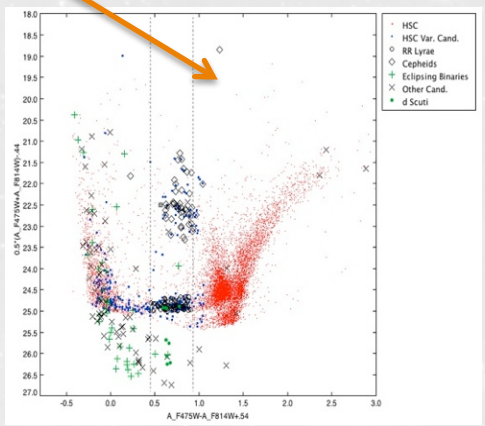
1. Are there any Use Cases available for the HSC?

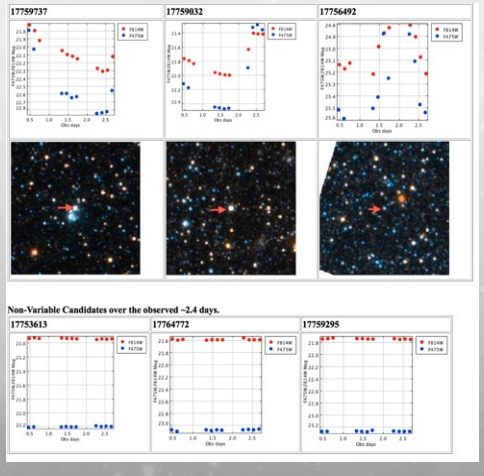
Yes there are. The HSC step-by-step Use Cases are designed to provide training material, demonstrate the level of quality you will find in the HSC and illustrate limitations that you should be aware of.

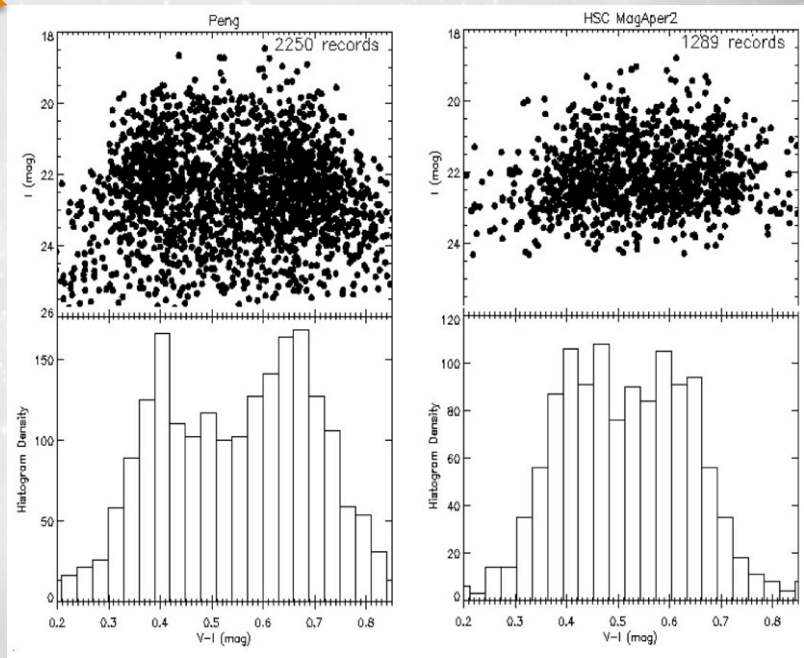
Here are the available Use cases:

- M31 - Point Source Photometry
- Galaxy IC 1613 - Time Variable Phenomena
- M87 - Photometry of Slightly Resolved Objects (video tutorial)









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HLA & HSC Plans

- HLA is mainly a data project in the future
  - Portal will replace HLA interface
- HLA & HSC schedules are integrated
  - HSC production relies on HLA products
  - HLA mosaics will use updated astrometry from HSC

HLA near-term highlights	HSC near-term highlights
• Complete WFC3 astrodrizzle pipeline • Port WFC3 pipeline to WFPC2 (CADC) and ACS • Generate new images & catalogs for WFC3, WFPC2, ACS • Mosaic pipeline development	• Improve astrometric pre-offsets using SDSS, Pan-STARRS (Beta 0.3) • Work on integration with portal • PASP paper • Better ACS, WFPC2 & WFC3 source lists plus portal integration (Version 1)

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Integrated HSC and HLA Timeline

Date	Hubble Source Catalog	Hubble Legacy Archive
Nov 2013	Improve astrometric pre-offsets.	WFC3 source lists available.
Dec	Construct new version of HSC using WFC3 source lists. Testing.	Complete new astrodrizzle-based WFC3 pipeline.
Jan 2014	**Beta 0.3 release** – WFC3 inclusion. Better matching.	**DR8 release** – Reprocessed WFC3 using astrodrizzle.
Feb		Port WFC3 pipeline to WFPC2 (CADC) and ACS.
Mar	Develop portal integration use cases and requirements.	
Apr		WFPC2 images available (generated by CADC).
May		
Jun	Draft PASP paper available for review.	
Jul	Testing of portal integration.	New ACS and WFPC2 source lists ready.
Aug	Generate new version of HSC. Testing.	**DR9 release** – Better ACS and WFPC images and source lists.
Sep	**Version 1 release** – Better ACS, WFPC2 source lists. Better tools. Portal integration.	Mosaic pipeline development (using HSC astrometry)
Oct 2014	PASP paper submitted.	

Extra slides

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HSC Use Cases – Details

Formation of HSC working group (19 external, 22 internal members)

Related to MUG recommendation: Science working group for HSC

- Meet (via webex) every two months

- Development of 2 walk-throughs and 3 use cases.
  - Tom Brown's M31 Dataset (Proposal ID = 10265) - Brad Whitmore
  - Searching for Variable Stars (V4334 Sgr) - Ron Downes
  - M31- Point Source Photometry – Sahar Allam
  - Galaxy IC 1613: Time Variable Phenomena – Sahar Alam
  - M87: Photometry of Slightly Resolved Objects – Rupe Dopkins (also video)

- Several additional use cases are currently under development
  - Variability in AGNs – Sahar Allam
  - Galaxy Number Counts in CL0024+16 - Sahar Allam
  - CASJOBS (walkthrough and use case) – Rupe Dopkins
  - LBV search in M83 – Brad Whitmore
  - Cross-matching using the Discovery Portal – Sahar Allam
  - Astrometric comparison between Spitzer and Hubble Source Lists in the Antennae – Harry Teplitz

HSC Timeline – Near Future

January 2013 – Beta 0.3 release

- Include ACS/WFC, WFPC2, WFC3 catalogs from DR7.2
- Improve matching (reduce problem cases from ~30 % to ~5 %)
- Improved tools/documentation (Use Cases, prototype version of CasJobs)

~ September 2014 – Version 1

- New ACS and WFPC2 catalogs (based on WFC3-type algorithms)
- CasJobs generally available
- PASP paper available

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HSC Timeline – Far Future

~Mar 2015 – Version 2

- Discovery Portal Integration Phase 2 (e.g., cross-matching of spectroscopic observations)
- Inclusion of NICMOS and automated ACS/WFC and WFC3 source lists (i.e., within 3 months of when the proprietary period is up)
- New source detection algorithms
- Extensive cross matching (PanSTARRS, SDSS, Spitzer, …)

~Oct 2015 – Version 3

- Discovery Portal Integration Phase 3 (e.g., inclusion of interactive display capabilities, inclusion of CASJOB capabilities)
- HLA mosaics and incorporation of mosaic-based source lists

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Future HLA Plans

- Current and future baseline product generation
  - Process all public WFC3 data
  - Extend new WFC3 pipeline and data formats to other imaging instruments (WFPC2, ACS, NICMOS)
  - Develop robust mosaic pipeline using HSC astrometry
  - Produce mosaics for more pointings, instruments
  - Incorporate source lists and produce uniform metadata for HLSP
  - Enhance presence of spectral data in HLA
    - Include more existing products
    - Encourage teams to provide HLSP whenever possible
    - Foster development of spectral pipeline
  - Consider feasibility of WFC3 grism analysis tools
  - Develop tools to combine moving-target images

Future HLA Plans cont.

- Other products and features
  - Develop tools to investigate time-domain data
  - Process solar system targets
  - Expand capabilities of image display
  - Continue educational and outreach endeavors
- Integrate HLA interface into MAST portal
  - Ultimately portal will incorporate all HLA interface capabilities
  - Common look-and-feel for seamless navigation
  - Identify HLA services and functions to incorporate

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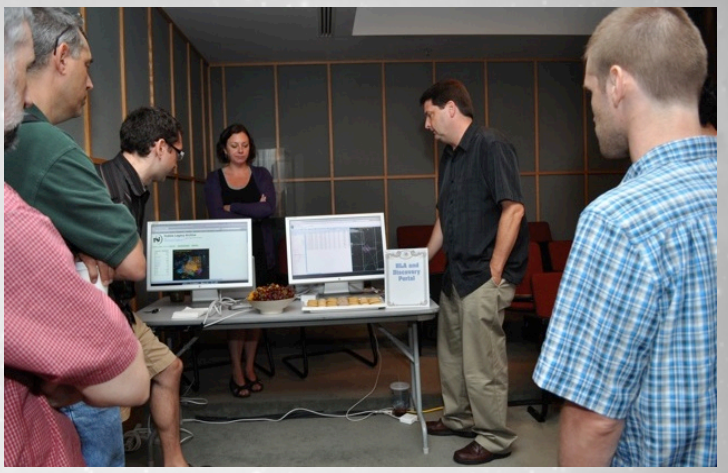
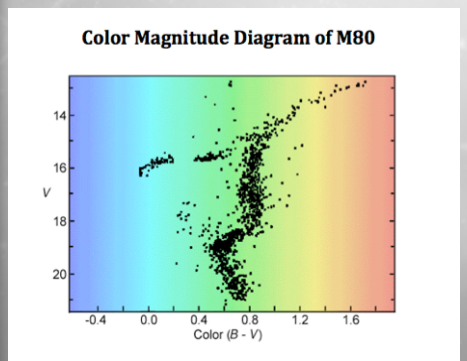
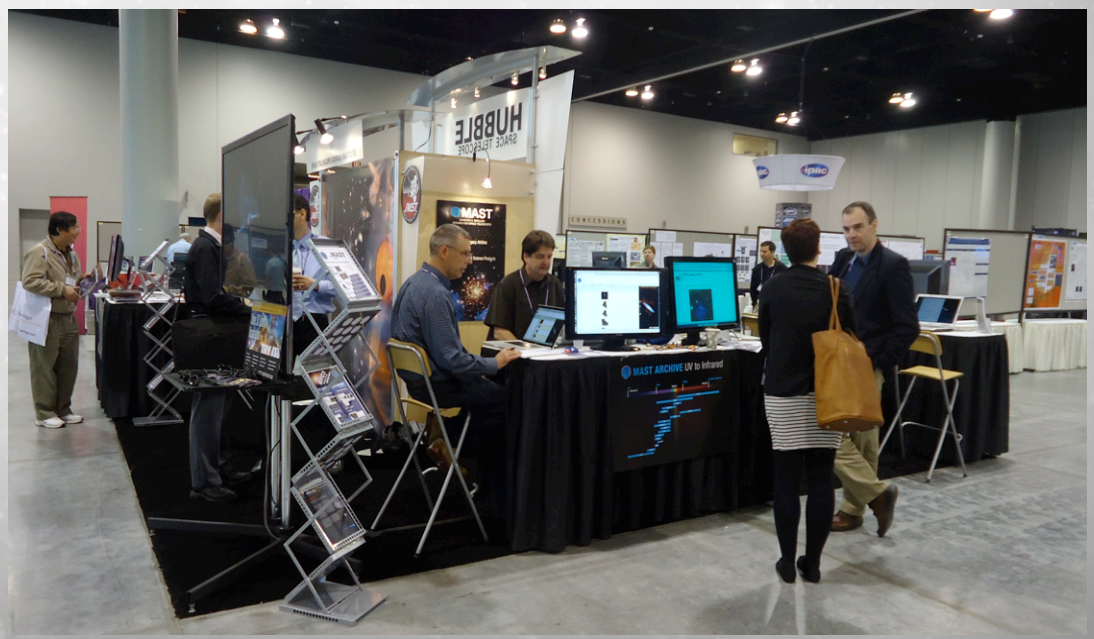
Outreach and Education

- AAS Winter/Summer Sessions
- ADASS – October 2013
- STScI Spectroscopy Workshop

- Educational materials now available