The Hubble Legacy Archive - Project Update

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STUC Meeting, April 12, 2007

OUTLINE

- Potential for Enhanced Science
- Update on Progress and Near-Term Plans
- Brief Demo

Potential for Enhanced Science

Our main goal is to optimize the science return from the Hubble Space Telescope.

In the 1990's, the HST archives and pipeline revolutionized the way astronomers worked, and provided an order of magnitude improvement in the ability to use observations for science.

The Hubble Legacy Archive (and NVO) has the potential to lead to a second archival revolution.

What has Changed ?

HST archive has grown

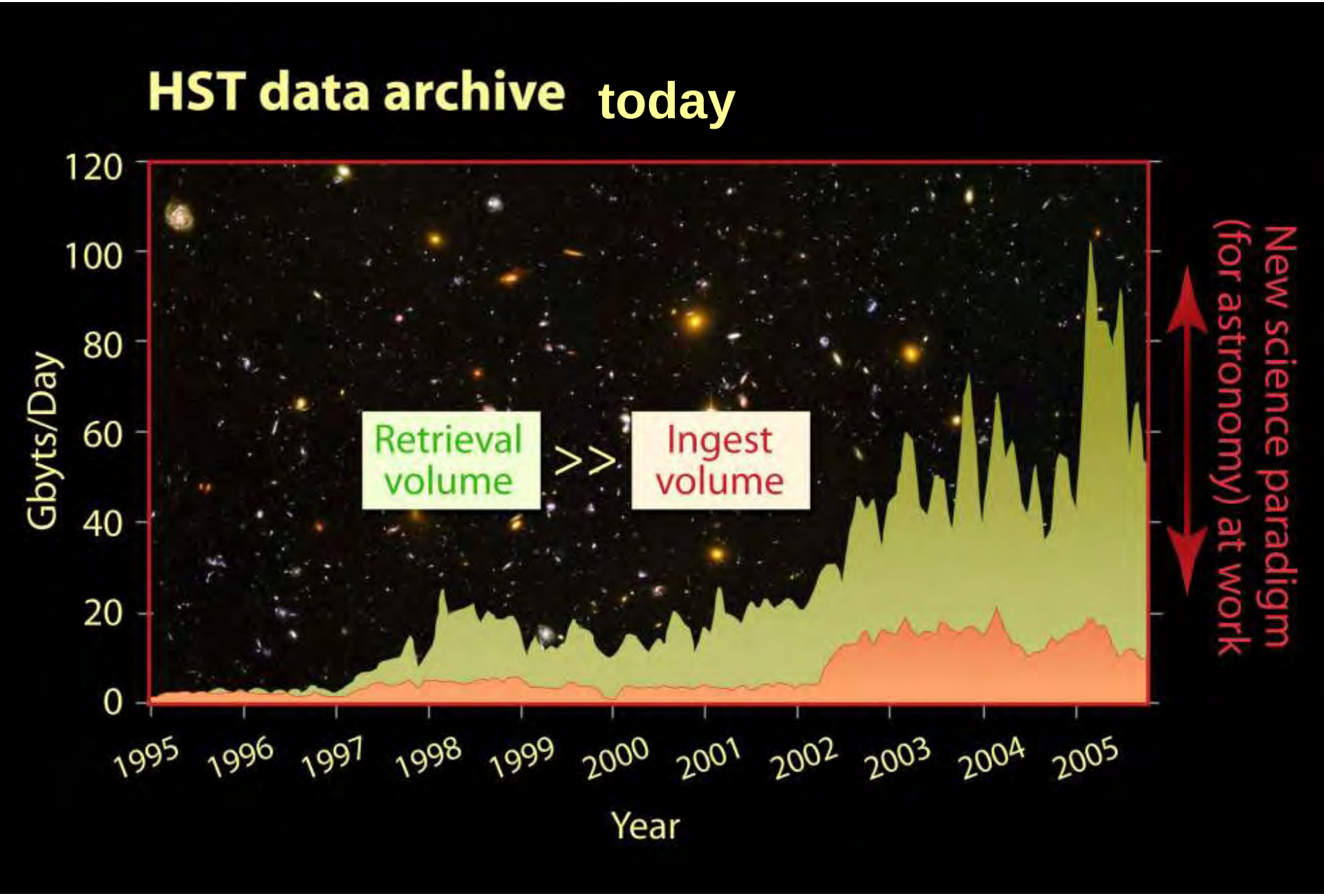
- Observers are likely to find what they need in the archives rather than having to propose themselves.

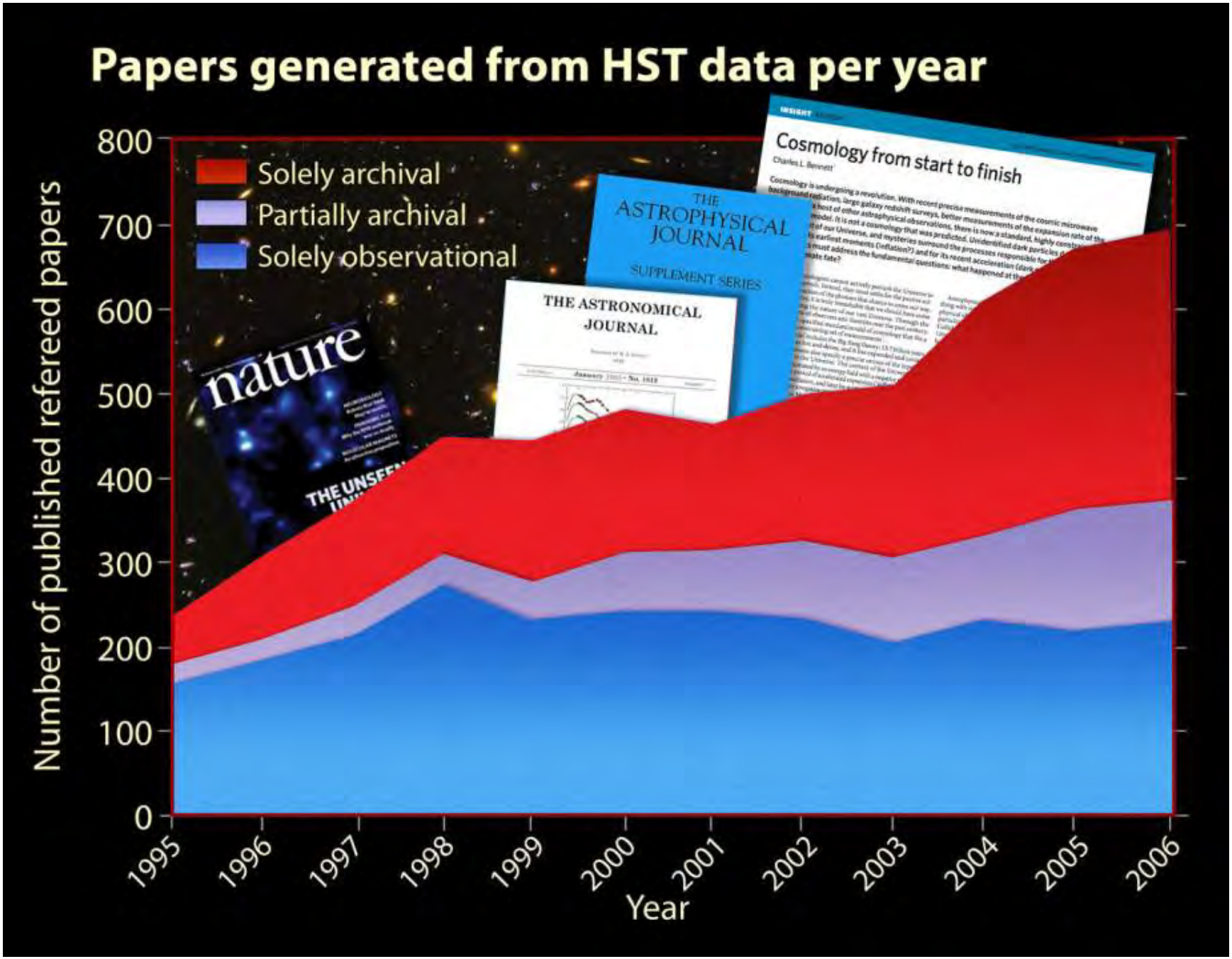
Existence of the internet; cheap disk space

- Hubble data can be made more accessible, both now and for future generations (e.g., via the National Virtual Observatory).

Products and services have been “upgraded”

- Improved science products for legacy instruments (e.g., “ACS-like” products for WFPC2).
- New science capabilities possible.


HST data archive today
120
100
80
60
40
20
0
Gbyts/Day
Retrieval volume
>>
Ingest volume
New science paradigm (for astronomy) at work
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year


Papers generated from HST data per year
Solely archival
Partially archival
Solely observational
Number of published refereed papers
800
700
600
500
400
300
200
100
0
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Year
nature
THE ASTROPHYSICAL JOURNAL
SUPPLEMENT SERIES
THE ASTRONOMICAL JOURNAL
Cosmology from start to finish

Initial HLA Image Products

• Enhanced Image Products (combined calibrated drizzled images, mosaics, “ACS-like” products for WFPC2, color images, …)

• Online access (“seconds not hours or days”; an analog - difference between the library and ADS)

• Improved Astrometry (better cross-matching, smaller error boxes)

• Footprints (graphical way to browse and identify datasets)

• Cutouts (fast access; enable real-time services to be developed)

• Source Lists (quick look facility; allow many users to skip the “analysis” step and go straight to the “interpretation” step; eventually make an all-HST-sky source list)

Current plans for Hierarchy of HLA Image Products
(similar logic will be used in future for spectroscopy)

Level # 3 – Mosaic (i.e., widest field-of-view)

- Combine all overlapping images from all visits, astrometrically corrected

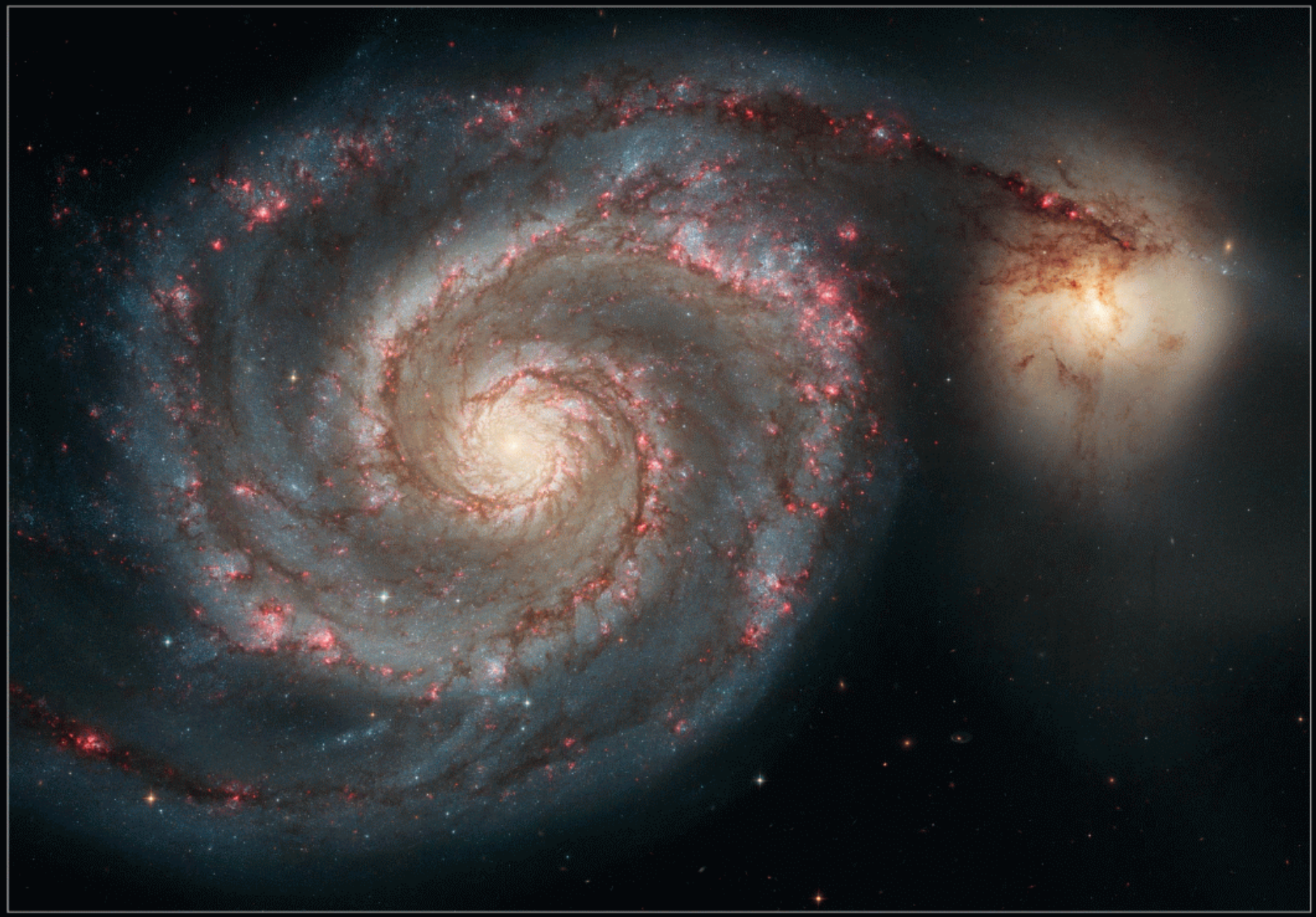
Level # 2 – Combined (i.e., deeper images)

- Combined images from a single visit, astrometrically corrected

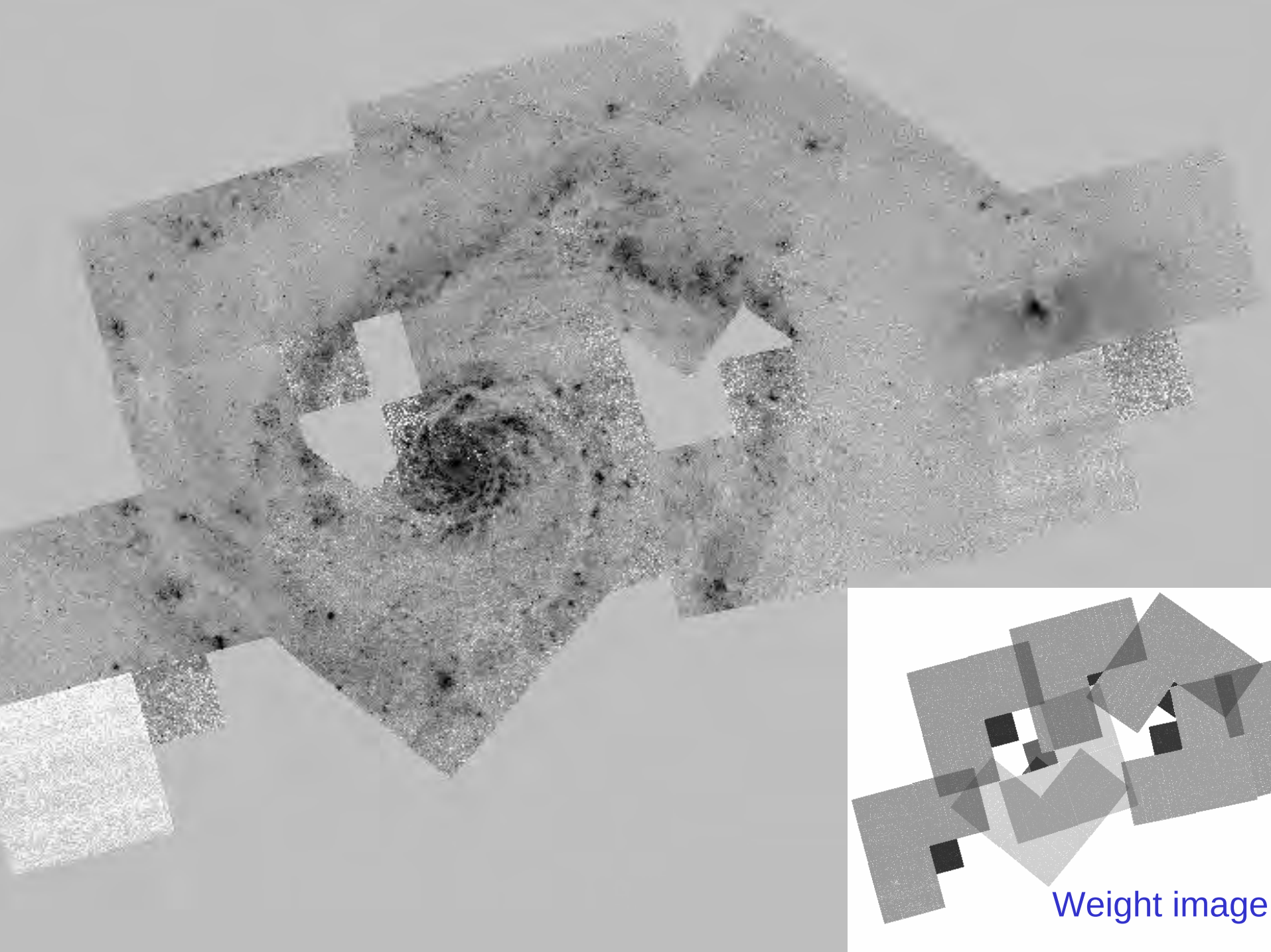
Level # 1 – Individual Exposures (i.e., basic atom)

- Astrometrically corrected (still contains cosmic rays)

Whirlpool Galaxy ▪ M51



Hubble Heritage


Weight image

Hubble Legacy Archive

SPACE TELESCOPE European Coordinating Facility

HLA Slitless Spectroscopy

prepared by Wolfram Freudling

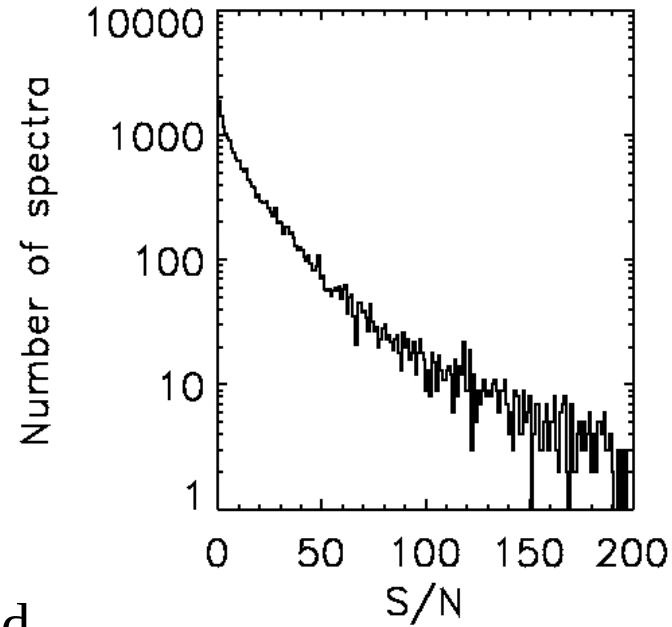
- goal: extract science-ready spectra from slitless spectrographs (STIS, NICMOS, ACS, WFC3)
- motivation:
  - data from slitless spectrographs cannot be judged from simple preview of images
  - extracting spectra requires substantial expertise
  - spectra in archive underused
  - ST-ECF has unique experience with slitless spectroscopy

Hubble Legacy Archive

SPACE TELESCOPE European Coordinating Facility

NICMOS Pilot Project

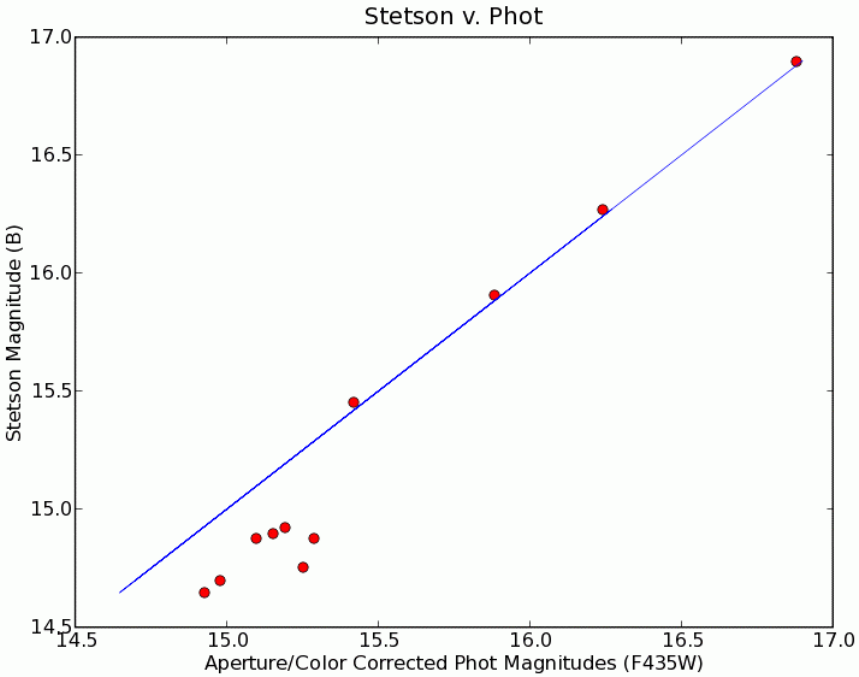
- goal: domonstrate pipeline and user interace to deliver high-quality extracted spectra
- NICMOS G141 is limited but interesting dataset:
  - about 11,000 associations
  - about 28,000 spectra, 8,000 with s/n > 20
- Status:
  - Pipeline for HLA Grism data (PHLAG) automatically extracts spectra
  - Internal release of prototype user interface
  - new calibration data in progress
  - first run on all available G141 data completed

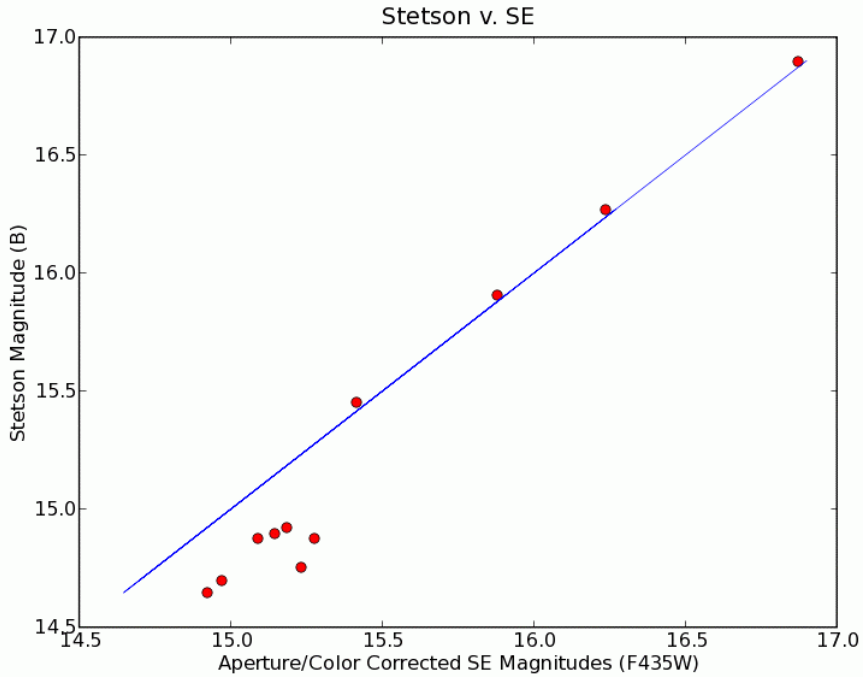


Keys to Success

1. Provide products/services users really want.
   - Consultants group: Durand (CADC), Freudling (ECF), Heckman (JHU), Donahue (MSU), Ferguson, Brown, Casertano (STScI)
   - Consult with STUC (and have STUC member on "HLA Board")
   - Detailed user testing starting this Spring

2. Earn trust via validation, quality control, and publication
   - Comparison of HLA source lists with published lists
   - Automatic monitoring of quality (e.g., astrometry)
   - Publication (e.g., in PASP)

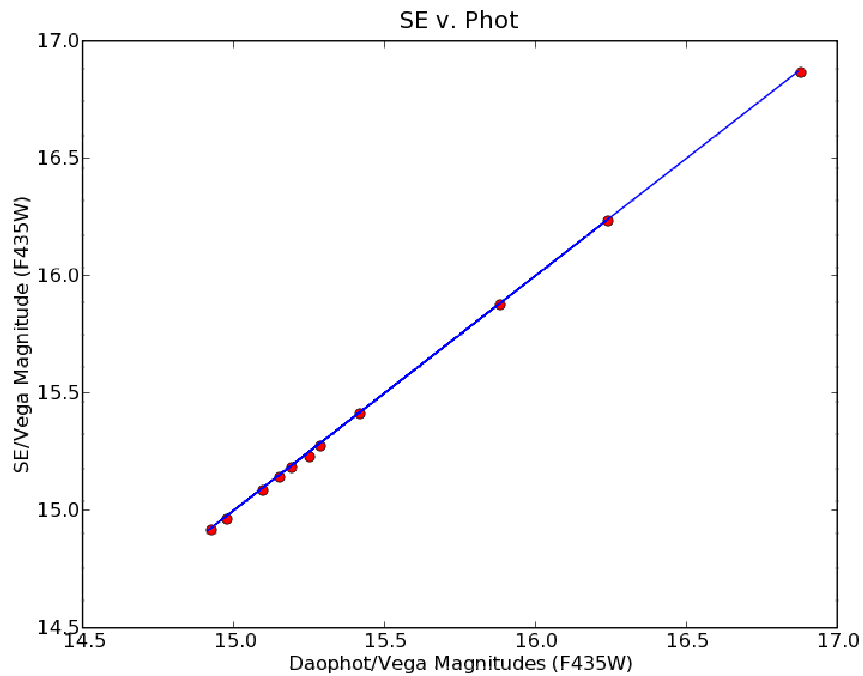




Comparison of HLA source lists with Stetson ground-based photometry of 47 TUC.

- offset = 0.02 mag (N=4)
- RMS scatter = 0.007 mag (N=4)

(objects in bottom left are saturated stars)



The HLA "Board"

Charter (as defined in a Tripartite Agreement between CADC, ECF, and STScI)

"The board will be charged with being the guardian of the "HLA brand". It will meet when products and services are ready for release and coordinate an assessment procedure to determine whether an adequate standard is reached. The board will have no direct control over activities at the three sites. "

Membership

- Ken Carpenter (GSFC)
- Richard Hook (ECF)
- Warren Miller (STScI)
- David Schade (CADC)
- Brad Whitmore (STScI)
- STUC member (not a member of CADC, ECF, STScI)

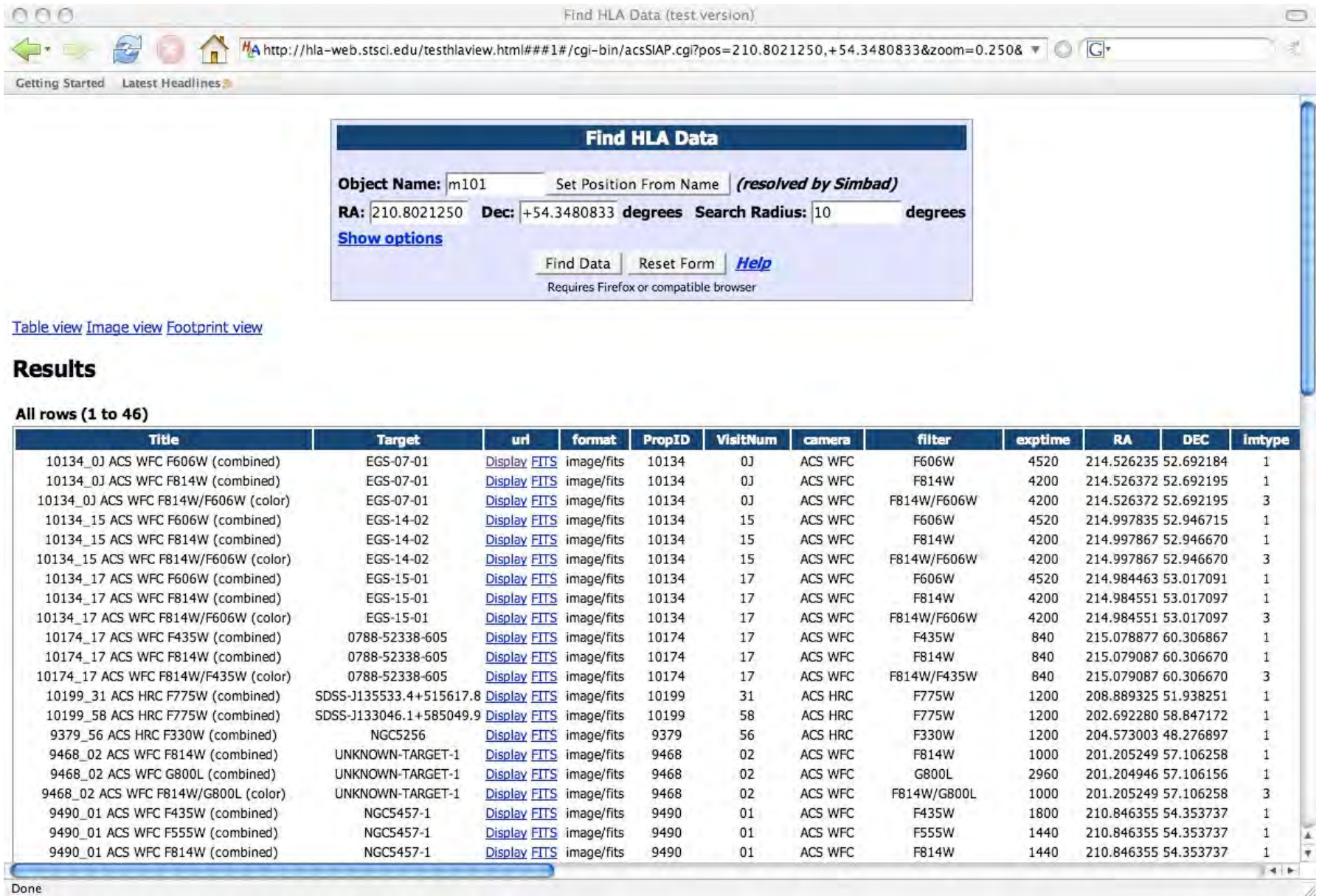
Release Goal 1: Summer 2007

- Products
  - ACS Level 1 (exposure) images
  - ACS Level 2 (combined) images
  - Point-source & extended-source, multi-wavelength source lists
  - Improved astrometry
- Services
  - Basic footprints, cutouts, data download capabilities
  - Simple web-based user interface demonstrator
  - Simple VO access to data
- Key Dates
  - Process all products by May 2007
  - Pre-release testing May through June 2007
  - Collect initial user input July - September 2007

Release Goal 2: Winter 2008

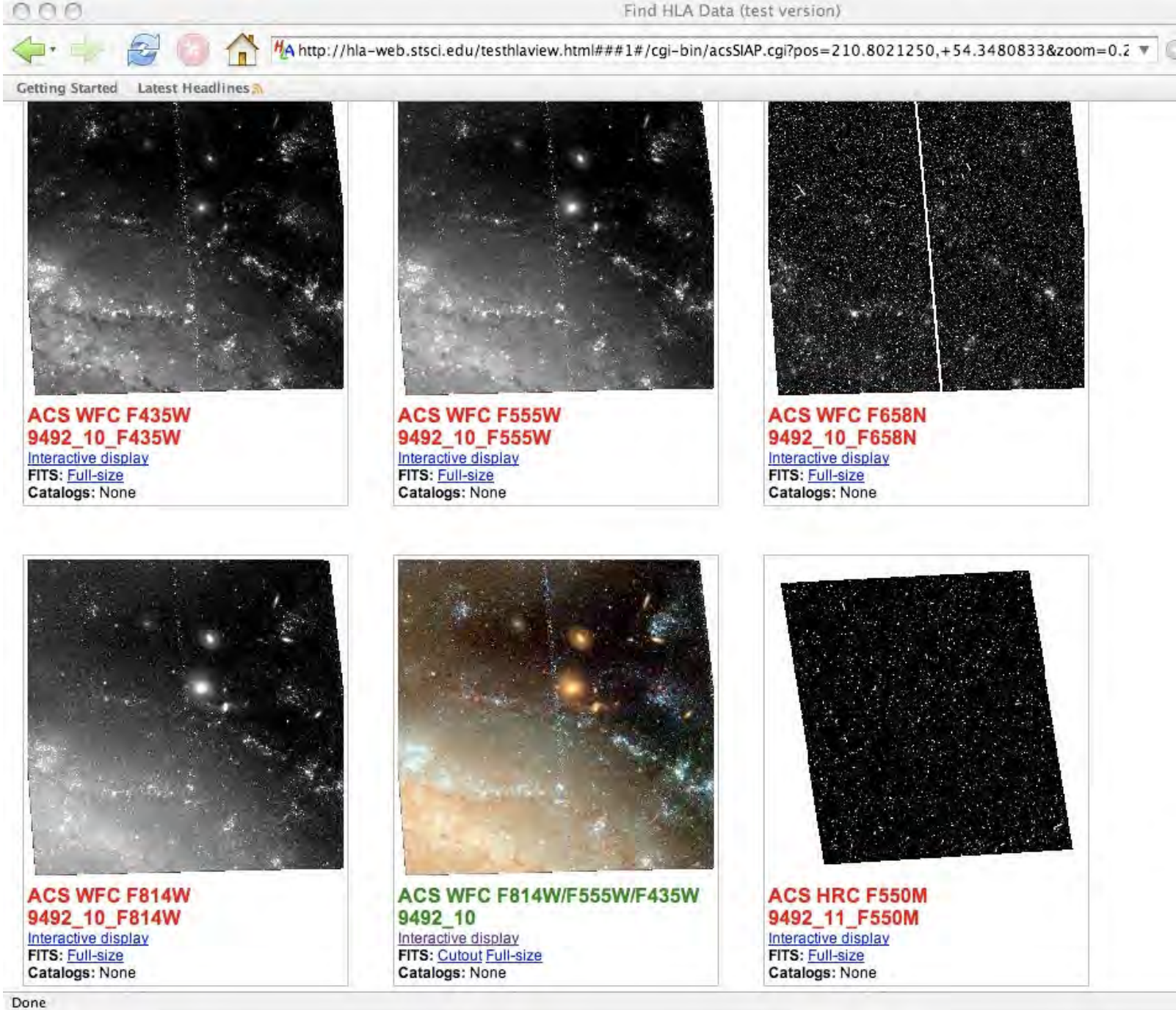
- Products
  - ACS Level 3 (mosaic) images
  - NICMOS Grism extractions (ST-ECF)
  - ACS-like WFPC2 Level 1 (exposure), Level 2 (combined) and Level 3 (mosaic) images
- Services
  - Improved basic services from Release 1
  - Advanced search capability
- Key Dates
  - Process all products by November 2007
  - Conduct trials and demonstrations during November and December 2007 (ADASS, AAS, …)

Example HLA webpage: One box and “Table View” for M101 images.

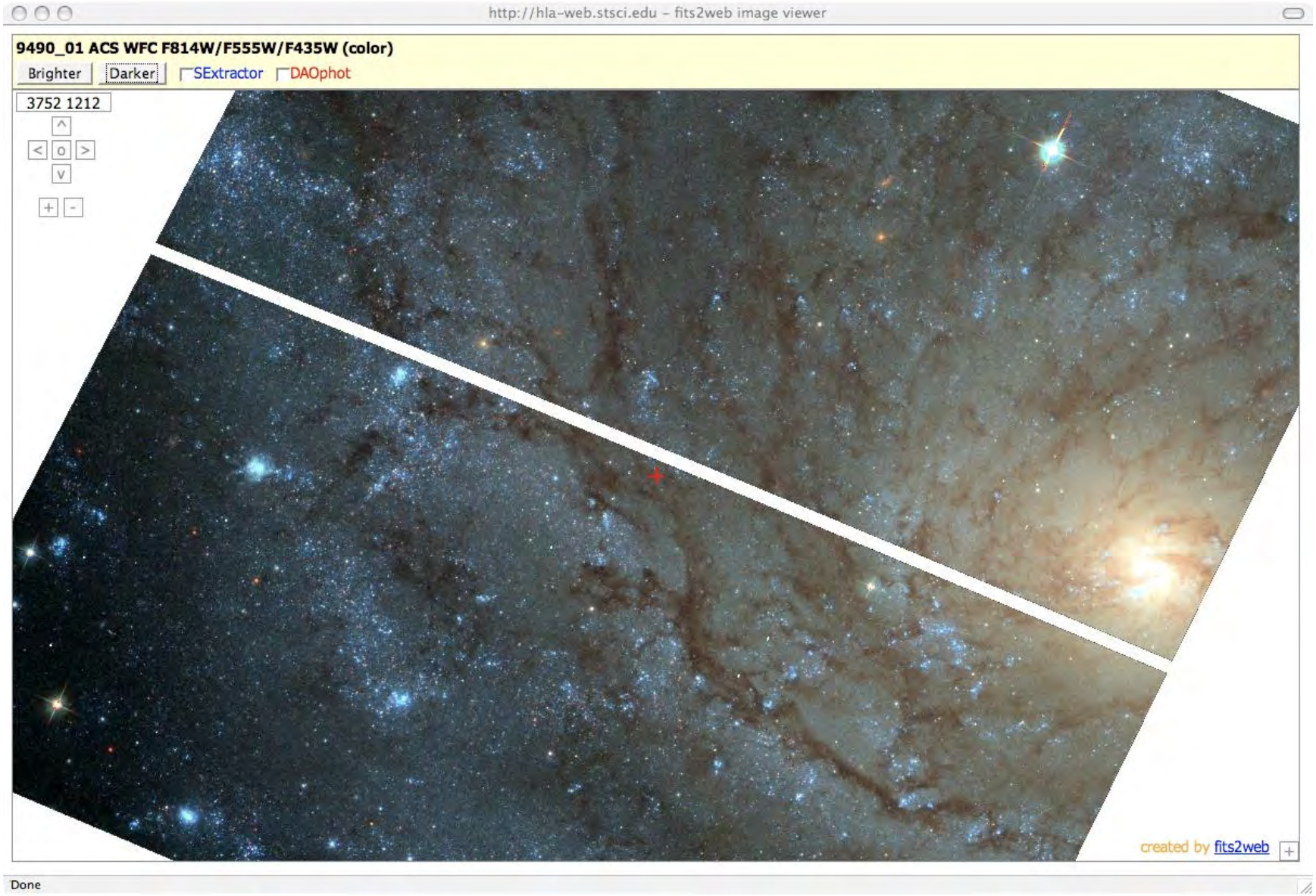


Title	Target	url	format	PropID	VisitNum	camera	filter	exptime	RA	DEC	imtype
10134_0J ACS WFC F606W (combined)	EGS-07-01	Display FITS	image/fits	10134	0J	ACS WFC	F606W	4520	214.526235	52.692184	1
10134_0J ACS WFC F814W (combined)	EGS-07-01	Display FITS	image/fits	10134	0J	ACS WFC	F814W	4200	214.526372	52.692195	1
10134_0J ACS WFC F814W/F606W (color)	EGS-07-01	Display FITS	image/fits	10134	0J	ACS WFC	F814W/F606W	4200	214.526372	52.692195	3
10134_15 ACS WFC F606W (combined)	EGS-14-02	Display FITS	image/fits	10134	15	ACS WFC	F606W	4520	214.997835	52.946715	1
10134_15 ACS WFC F814W (combined)	EGS-14-02	Display FITS	image/fits	10134	15	ACS WFC	F814W	4200	214.997867	52.946670	1
10134_15 ACS WFC F814W/F606W (color)	EGS-14-02	Display FITS	image/fits	10134	15	ACS WFC	F814W/F606W	4200	214.997867	52.946670	3
10134_17 ACS WFC F606W (combined)	EGS-15-01	Display FITS	image/fits	10134	17	ACS WFC	F606W	4520	214.984463	53.017091	1
10134_17 ACS WFC F814W (combined)	EGS-15-01	Display FITS	image/fits	10134	17	ACS WFC	F814W	4200	214.984551	53.017097	1
10134_17 ACS WFC F814W/F606W (color)	EGS-15-01	Display FITS	image/fits	10134	17	ACS WFC	F814W/F606W	4200	214.984551	53.017097	3
10174_17 ACS WFC F435W (combined)	0788-52338-605	Display FITS	image/fits	10174	17	ACS WFC	F435W	840	215.078877	60.306867	1
10174_17 ACS WFC F814W (combined)	0788-52338-605	Display FITS	image/fits	10174	17	ACS WFC	F814W	840	215.079087	60.306670	1
10174_17 ACS WFC F814W/F435W (color)	0788-52338-605	Display FITS	image/fits	10174	17	ACS WFC	F814W/F435W	840	215.079087	60.306670	3
10199_31 ACS HRC F775W (combined)	SDSS-J135533.4+515617.8	Display FITS	image/fits	10199	31	ACS HRC	F775W	1200	208.889325	51.938251	1
10199_58 ACS HRC F775W (combined)	SDSS-J133046.1+585049.9	Display FITS	image/fits	10199	58	ACS HRC	F775W	1200	202.692280	58.847172	1
9379_56 ACS HRC F330W (combined)	NGC5256	Display FITS	image/fits	9379	56	ACS HRC	F330W	1200	204.573003	48.276897	1
9468_02 ACS WFC F814W (combined)	UNKNOWN-TARGET-1	Display FITS	image/fits	9468	02	ACS WFC	F814W	1000	201.205249	57.106258	1
9468_02 ACS WFC G800L (combined)	UNKNOWN-TARGET-1	Display FITS	image/fits	9468	02	ACS WFC	G800L	2960	201.204946	57.106156	1
9468_02 ACS WFC F814W/G800L (color)	UNKNOWN-TARGET-1	Display FITS	image/fits	9468	02	ACS WFC	F814W/G800L	1000	201.205249	57.106258	3
9490_01 ACS WFC F435W (combined)	NGC5457-1	Display FITS	image/fits	9490	01	ACS WFC	F435W	1800	210.846355	54.353737	1
9490_01 ACS WFC F555W (combined)	NGC5457-1	Display FITS	image/fits	9490	01	ACS WFC	F555W	1440	210.846355	54.353737	1
9490_01 ACS WFC F814W (combined)	NGC5457-1	Display FITS	image/fits	9490	01	ACS WFC	F814W	1440	210.846355	54.353737	1

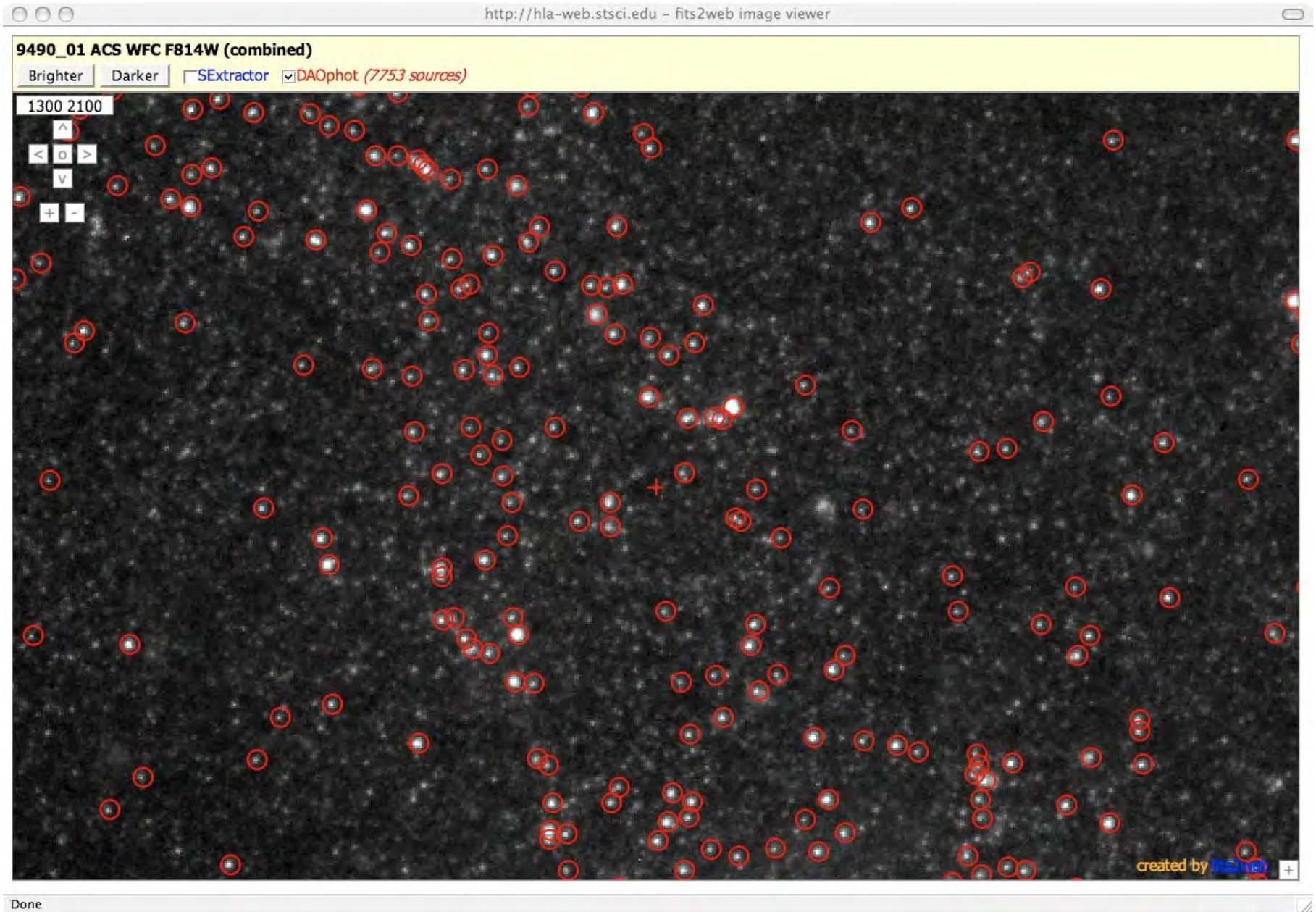
Example HLA webpage: "Image View" for subset of M101 images.



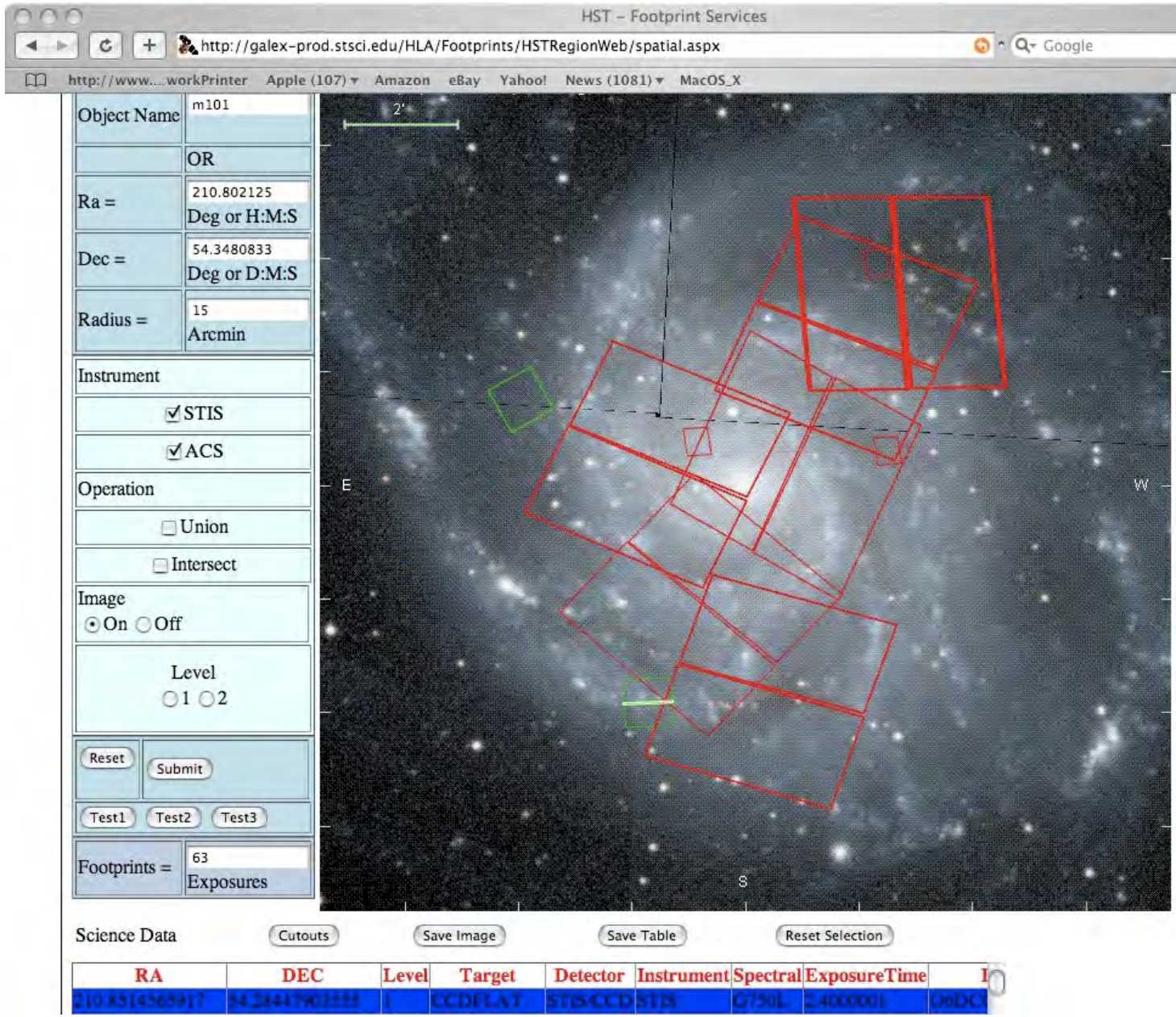
Example HLA webpage: “Interactive Display” of M101 image



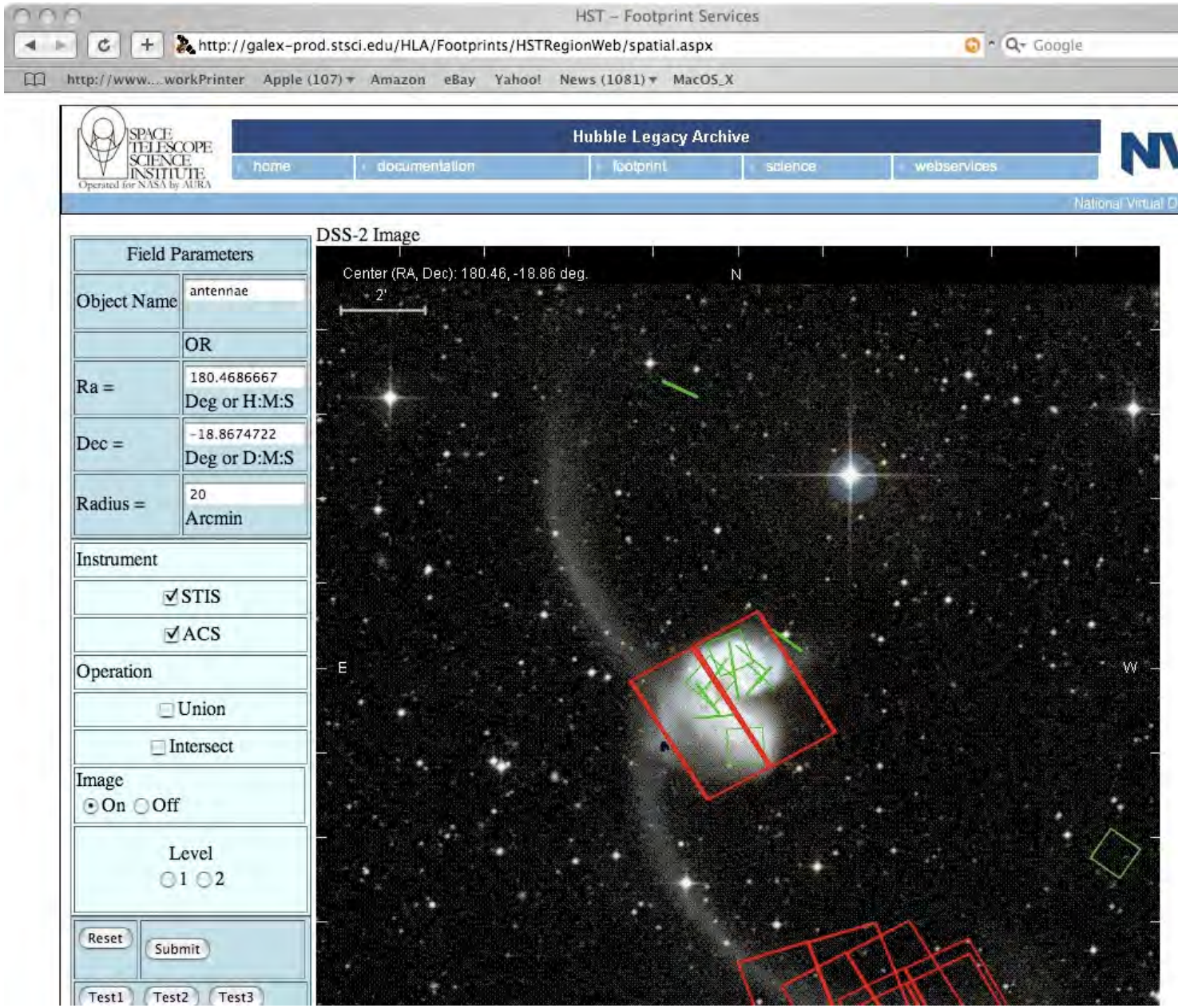
Example HLA webpage: Source list overlay for blowup of M101 image.



Example HLA webpage:
ACS and STIS footprints for M101.

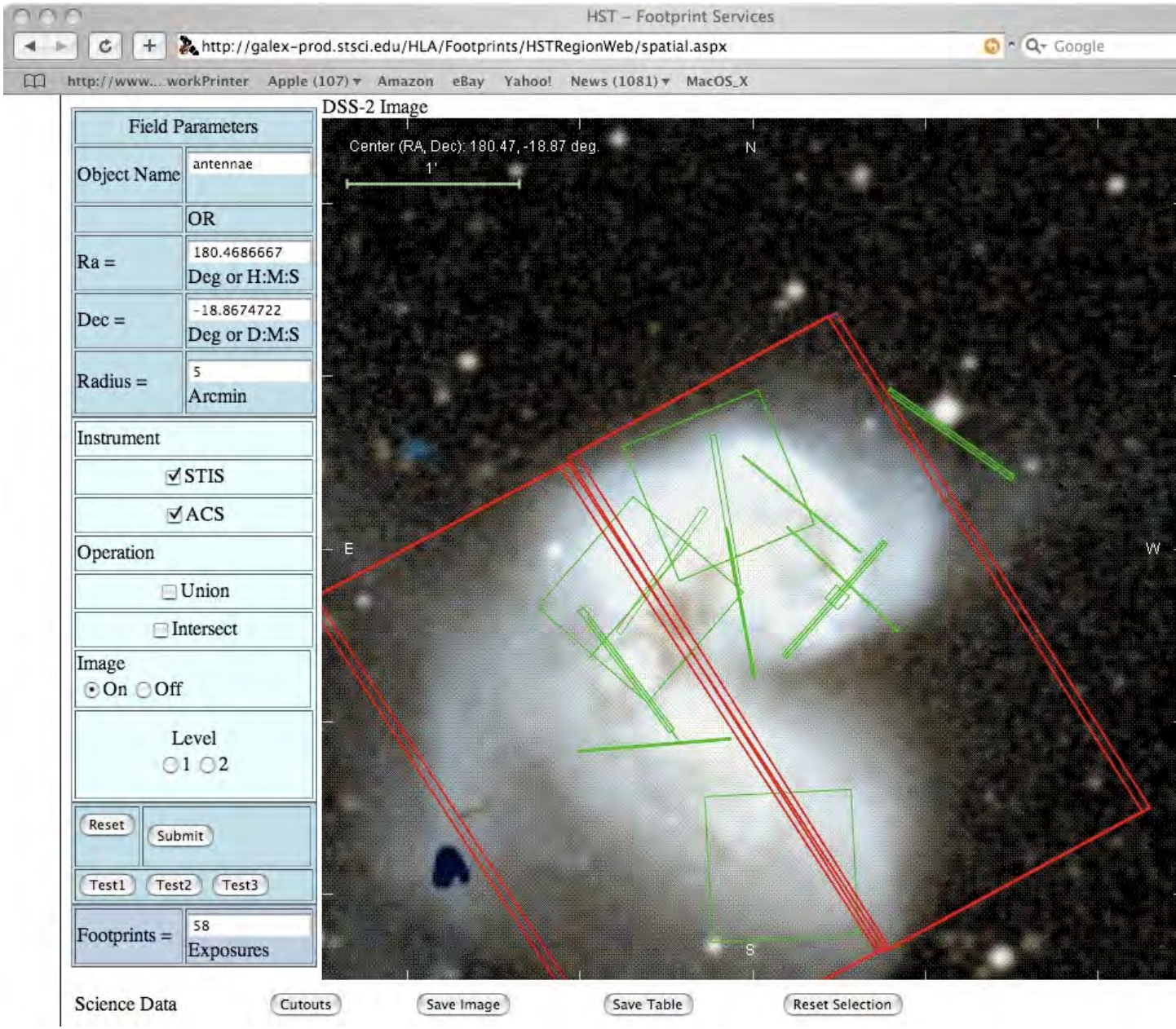


Example HLA webpage:
ACS and STIS footprints for Antennae galaxy.



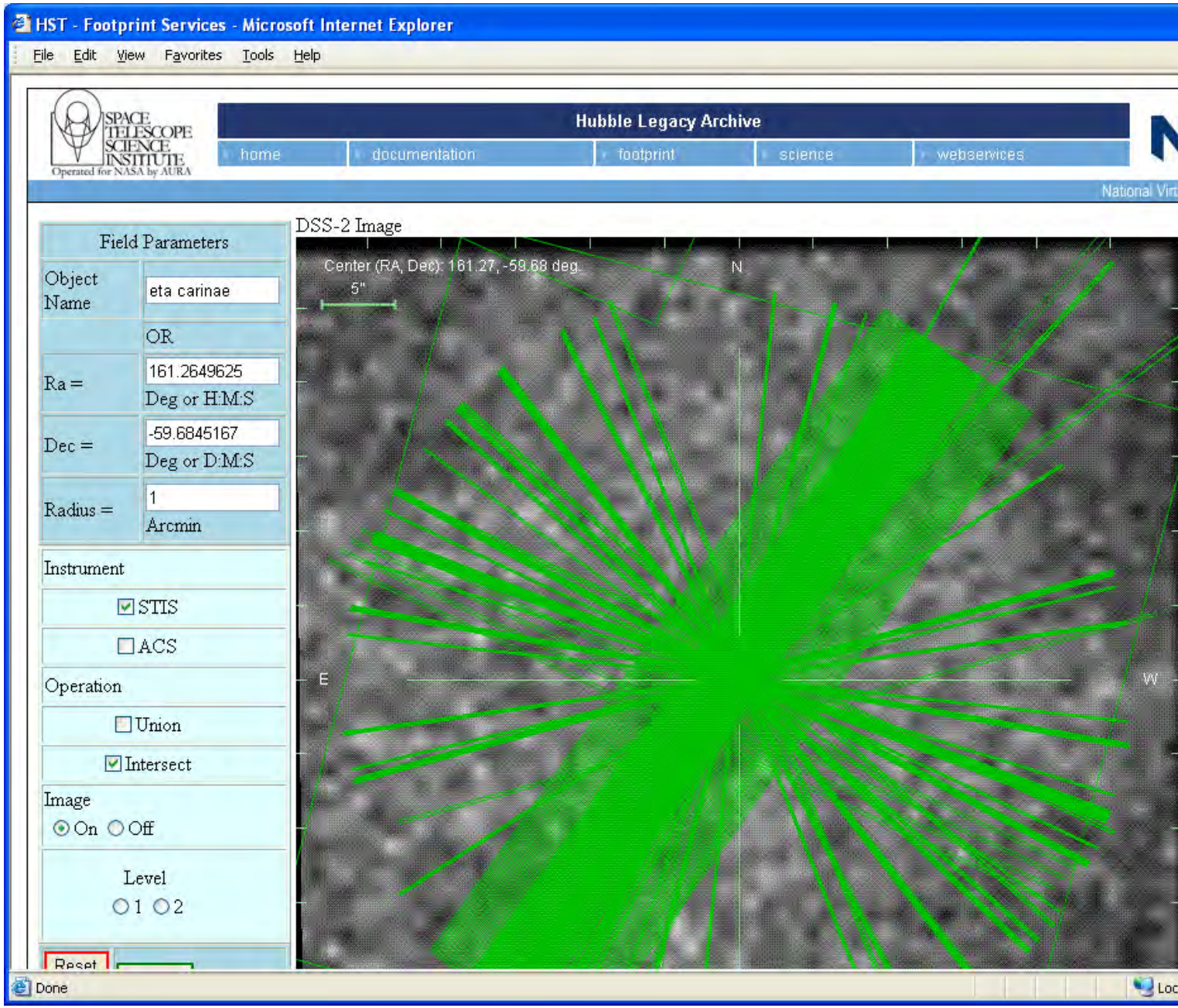
Example HLA webpage:

ACS and STIS footprints for inner part of Antennae galaxy.



Example HLA webpage:

STIS footprints for Eta Carinae.



Conclusions

- The new HLA science products have the potential to dramatically increase the total science output from HST, both now and for future generations.

- Development of the Hubble Legacy Archive will allow us to provide full compatibility with Virtual Observatory standards.

- We are planning an initial release (primarily featuring ACS images) this summer.

- We are looking for your input and endorsement.

The Team (small fractions for most)

STScI (integration, cutouts, footprints, associations, source lists, interfaces, …)

- Warren Miller (Acting Project Manager, Lead Engineer)
- Brad Whitmore (Project Scientist, source lists)
- Anton Koekemoer (Integration Scientist, astrometry)
- Niall Gaffney (Software Engineer)
- Rick White (cutouts)
- Steve Lubow, Gretchen Greene (footprints)
- Brian McLean (astrometry)
- Bob Hanisch (interfaces)
- Helmut Jenkner (consultant)

ECF (spectra, e.g., NICMOS grism extractions)

- Richard Hook (ECF Proj. Man.)
- Wolfram Freudling (NICMOS pilot lead)
- Alberto Micol (pipeline meta data)
- Martin Kuemmel (grism extraction)
- Harald Kuntschner (science validation)

CADC (associations, source lists, …)

- David Schade (CADC Proj. Man.)
- Daniel Durand (assoc., source lists)