Barbara A. Mikulski Archive for Space Telescopes

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The Barbara A. Mikulski Archive for Space Telescopes (MAST) is one of NASA’s premier astronomy data centers, along with the High Energy Astrophysics Science Archive Research Center (HEASARC) and the NASA/IPAC Infrared Science Archive (IRSA). MAST is the primary archive repository for data from several large, active space missions (Hubble, Kepler, XMM-OM and Swift-UVOT), legacy data from past missions (GALEX, FUSE, IUE, EUVE, and others), planned data from future missions, such as James Webb Space Telescope, and all-sky surveys such as VLA-FIRST, GSC and DSS.

MAST supports the scientific research carried out by the astronomical community by facilitating access to its collections, offering expert user support and software for calibration and analysis, and providing value-added scientific data products. These include high-level science products (HLSPs) such as mosaics, catalogs, and spectra delivered to MAST by science teams, as well as enhanced products accessible via the Hubble Legacy Archive (HLA). As of March 2014, the total volume of MAST’s data holdings was approximately 296 terabytes (TB), with an average of 18 TB of data downloaded per month. Current MAST news and updates are continuously posted on our main archive site (http://archive.stsci.edu) and on social media, including Facebook (https://www.facebook.com/MASTArchive) and Twitter (https://twitter.com/MAST_News).

**Hubble Frontier Fields high-level science products available in MAST**

The Hubble Frontier Fields Team has completed observations and delivery of HLSPs for the first epoch of each of the first two clusters, Abell 2744 and MACS J0416.1-2403. For Abell 2744, five weekly releases of v0.5 mosaics were delivered to the community during October–November 2013, followed by the full-depth v1.0 release on December 17, 2013. Subsequently, for MACS J0416.1-2403, four weekly releases of v0.5 mosaics were delivered to the community during January 2014, followed by the v1.0 release on February 28, 2014. For each cluster, the v1.0 release consists of full-depth combined mosaics in all the Frontier Fields program filters for ACS (F435W, F606W, F814W) and WFC3/IR (F105W, F125W, F140W, F160W), also including all archival data, to produce the deepest possible images of these fields. These full-depth mosaics have been produced by the Frontier Fields Implementation Team at the Institute, who have carried out extensive scientific value-added processing beyond standard calibration, to address instrumental effects such as bias de-striping, time-variable sky background, persistence, flat-fielding, and a variety of other calibration effects, all of which are described in more detail in the documentation that is released together with the mosaics.

Initial science results related to data from the Frontier Fields program are already being published by several different teams in the community on a variety of topics, including newly discovered high-redshift galaxy candidates (e.g., Atek et al. 2014; Laporte et al. 2014; Schmidt et al. 2014; Vanzella et al. 2014; Zheng et al. 2014), high-redshift supernovae (Rodney et al. 2013; Brammer et al. 2014), spectroscopic catalogs (Ebeling et al. 2014), dark matter and lensing (e.g., Bayliss et al. 2014; Schultz et al. 2014), and Spitzer observations (Bradač et al. 2014). In addition, for each of the six Frontier Fields clusters, MAST has publicly released gravitational lensing models that had been constructed and delivered by several independent teams in the community (led by M. Bradač, J.-P. Kneib, P. Natarajan, J. Merten, A. Zitrin, K. Sharon, and L. Williams). These models have been made available through a web-based interface at MAST, enabling their direct use by the community to estimate magnification parameters at any location on the cluster fields. All these products may be accessed directly from the MAST Frontier Fields website: http://archive.stsci.edu/prepds/frontier/.
**Hubble Legacy Archive Star Clusters Project**

The **Hubble Legacy Archive Star Clusters Project** (Whitmore et al. 2014) presents compact star cluster catalogs for 20 nearby, star-forming galaxies using observations from the Advanced Camera for Surveys (ACS) and source lists generated by the HLA. A typical cluster luminosity function can be approximated by a power-law, with an average value for the index of \(-2.37\) and r.m.s. scatter = 0.18. The uniform database provided by these HLA catalogs results in a small scatter (0.5 magnitude) in the correlation between the magnitude of the brightest cluster (\(M_{\text{brightest}}\)) and log of the number of clusters brighter than \(M = -9\) (log N). The images and catalogs are all available for download from the HLA Star Cluster project website: [http://archive.stsci.edu/prepds/hlastarclusters/](http://archive.stsci.edu/prepds/hlastarclusters/).

**Multi-Cycle Treasury programs complete**

All observations are now complete for the three Multi-Cycle Treasury (MCT) programs, namely CANDELS (P.I.: S. Faber and H. Ferguson; see Grogin et al. 2011, Koekemoer et al. 2011), CLASH (P.I.: M. Postman; see Postman et al. 2012), and PHAT (P.I.: J. Dalcanton; see Dalcanton et al. 2012), and the teams have delivered all the associated products to the archive. As of March 2014, more than 59 TB of mosaics and HLSPs created by these teams have been downloaded by the community, to over 3500 unique IP addresses. A total of 166 science papers have been published to date using data from these programs, covering topics from high-redshift supernovae, galactic evolution in the early universe, black holes, lensed high-redshift galaxies, physical properties of clusters, the dynamics and structure of M31, and the properties of its stellar populations. More details about these programs, as well as all the data, are available at: [http://archive.stsci.edu/prepds/candels/](http://archive.stsci.edu/prepds/candels/), [http://archive.stsci.edu/prepds/clash/](http://archive.stsci.edu/prepds/clash/), and [http://archive.stsci.edu/prepds/phat/](http://archive.stsci.edu/prepds/phat/).

**Hubble Space Telescope 24th anniversary image and associated products**

To commemorate the 24th anniversary of the launch of *Hubble*, the *Hubble* Heritage Team has carried out observations of a dramatic dust pillar in NGC 2174, using the WFC3 infrared camera. This new view is strikingly different than previous *Hubble* images obtained in visible light with the Wide Field Planetary Camera 2 (Proposal 9091, PI: Hester). The new WFC3 observations were obtained in February 2014, and include four tiles in a 2 x 2 mosaic pattern, where a small shift between tiles allows for the removal of detector artifacts (see proposal 13623, PI: Z. Levay, for details). The broad-band F105W, F125W, and F160W filters highlight unique physical processes occurring in and around the nebula, and they combine to produce a dramatic new color image. Parallel observations with the ACS Wide Field Channel were also obtained to create an H-alpha mosaic of the “horizon” feature just north of the target. The two sets of observations (ACS/WFC and WFC3/IR) showcase the ongoing multi-wavelength capabilities of the observatory and provide a preview of the capabilities of the *James Webb Space Telescope*. All the reduced mosaics are available at: [http://archive.stsci.edu/prepds/heritage/](http://archive.stsci.edu/prepds/heritage/).

**Survey of the Low-Redshift Intergalactic Medium with Hubble/COS**

A survey of the low-redshift intergalactic medium (IGM) has been performed by Danforth et al. (2014). Using *Hubble/COS* spectra of 75 UV-bright active galactic nuclei, several thousand absorption lines were identified from 2,518 distinct redshift systems at \(z < 0.723\). The spectral features were selected and measured using a semi-automated analysis to minimize bias in line identification. For each of the 75 sightlines, a co-added, continuum-fitted spectrum is provided in FITS format. Two catalogs for each sightline are presented: one catalog lists the identified spectral features sorted by wavelength, while another lists the absorption features associated with IGM systems sorted by redshift. Finally, preview plots of each sightline’s spectrum are provided, complete with line identifications. For convenience, we also provide machine-readable versions of tables from Danforth et al. (2014). All the data are available at: [http://archive.stsci.edu/prepds/igm/](http://archive.stsci.edu/prepds/igm/).

**Catalogs of unique GALEX sources from Bianchi, Conti & Shiao (2014)**

The *GALEX* spacecraft operated for over 10 years and surveyed nearly the entire sky during its lifetime. The telescope observed in both the far ultraviolet (FUV: 1344–1786 Å) and near ultraviolet (NUV: 1771–2831 Å) simultaneously until May 2009, when the FUV detector failed. The NUV detector
continued to operate until June 2013, when GALEX was retired and the mission ended. The standard GALEX data products at MAST include visit and coadd image files, as well as a source catalog produced by the GALEX reduction pipeline called the “MCAT.” The MCAT consists of over 200 million source measurements, but since it was run on each tile, there are multiple measurements of the same source due to tile overlaps and different surveys (AIS, MIS, DIS, Guest Investigator, etc.) To rectify the situation, Bianchi et al. (2014) have constructed catalogs of unique sources: one based on All-Sky Imaging Survey (AIS) tiles, and another based on Medium-Sky Imaging Survey (MIS) tiles. These catalogs (BCS AIS and BCS MIS, respectively) are homogeneous in depth and quality, and are optimal for cross-matching GALEX UV fluxes with data in other bands (e.g., for source selection combining optical or IR data), or for Galactic and extragalactic population studies. All the catalogs, together with interactive interfaces to query them, are available here: http://archive.stsci.edu/prepds/bcscat/.

Hubble Legacy Archive (HLA)

The HLA has made available Data Release 7.2, which includes improved source lists for WFC3, totaling 85% completion of approved source lists for all image products. We are also pleased to announce the Beta 0.3 release of the Hubble Source Catalog (HSC—http://archive.stsci.edu/hst/hsc/). The goal of the HSC is to combine the tens of thousands of visit-based Hubble Legacy Archive source lists into a single master catalog. The primary improvements in Beta 0.3 are the inclusion of WFC3 source lists from the HLA, and improvements to the matching algorithms that result in an increase of “good” catalog regions from about 70% in Beta 0.2 to about 95% in Beta 0.3.

For further details, please see the HLA page (http://hla.stsci.edu/) where updates continue to be posted as they become available.

Kepler updates

All Q17 data are now available as batch downloads through the search interface, online for both light curves and target pixel files, and as tar files (for light curves only). See the webpage (http://archive.stsci.edu/kepler/) that explains ways to retrieve data other than via batch requests. In addition, the tar files containing light curves for targets labeled Kepler Objects of Interest (KOI) have been recreated to reflect the newly updated list. Finally, the Ecliptic Plane Input Catalog (EPIC) for the proposed K2 mission has also been made available; please see the K2 webpage at MAST for further details (http://archive.stsci.edu/k2/).

As always, please feel free to contact the MAST help desk (archive@stsci.edu) with questions, or contact us through Facebook (MASTArchive) or Twitter (@MAST_News) to provide suggestions on how we can improve our sites and services.

References

Brammer, G. et al. 2014, ATel 5728
Rodney, S. et al. 2013, ATel 5496

Figure 5: Coverage map of the BCS catalog in Galactic coordinates. Blue are AIS tiles, green MIS tiles, and black are from other surveys (DIS, GII, etc., but are not included in the BCS catalog). For further details, see Bianchi, Conti & Shiao (2014).