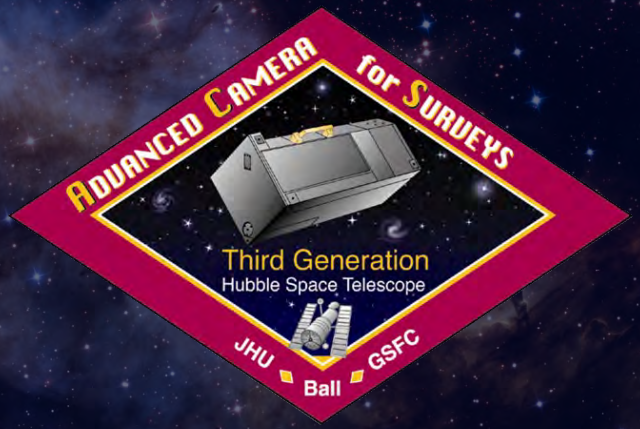

STScI | SPACE TELESCOPE SCIENCE INSTITUTE
EXPANDING THE FRONTIERS OF SPACE ASTRONOMY
Hubble Space Telescope
Celebrating 34 Years of Discovery

Hubble Documentation and Help Desk

HST User Documentation website (HDox) including Call for Proposals, Phase 2 Proposal Instructions, and instrument Handbooks
hst-docs.stsci.edu

HST Help Desk web portal: hsthelp.stsci.edu

Advanced Camera for Surveys (ACS)



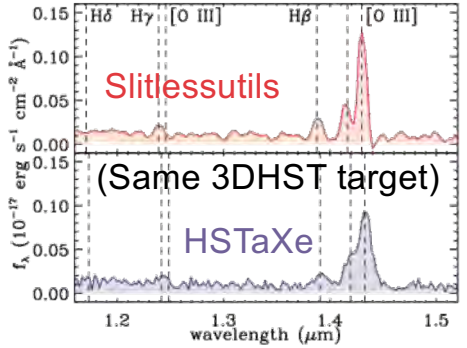
http://www.stsci.edu/hst/acs

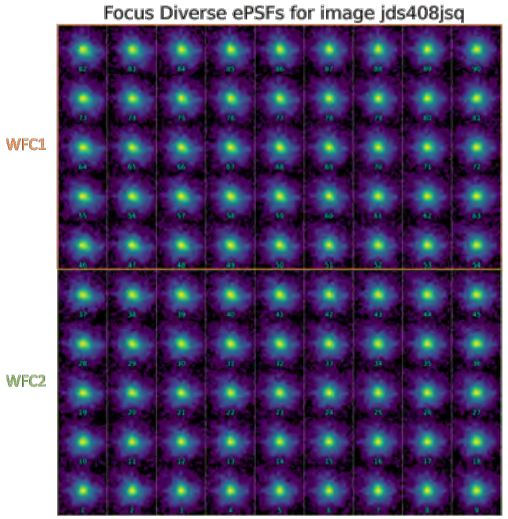

Orion Nebula

ACS News and Announcements

New grism/prism software, *slitlessutils*, publicly released

- Python-based code to perform reduction and spectral extractions of ACS/WFC and WF3/IR imaging slitless spectroscopy
- Incorporates the LINEAR algorithm for superior spectral extraction when provided with multiple position-angle observations to mitigate crowding contamination and extended-source smearing (*top figure*)
- 1st public release in Nov'23 supports both ACS and WFC3/IR grisms
- Mid'24 update will support ACS/SBC prisms and WFC3/UVIS grism
- Intented to fully supplant prior *HSTaXe* code, next year (2025)
- Code available on GitHub/PyPI with documentation at ReadTheDocs





New (as of Nov'23) ACS Focus-Diverse ePSF Webtool

- Input: Either single or tabulated (batch-mode) ACS image ID
- Output: multi-extension FITS file containing a grid of spatially

ACS News and Announcements

ACS Jupyter notebook tutorials are available at:

- https://github.com/spacetelescope/acs-notebook

Calibrate Raw Files

Now that we have the `*_raw.fits` files, we can process them with the ACS calibration pipeline `calacs`.

Updating Headers for CRDS

By default, the association file will trigger the creation of a drizzled product. In order to avoid this, we will filter the association file to only include table entries with `MEMTYPE` equal to 'EXP-DTH'. This will remove the 'PROD-DTH' entry that prompts AstroDrizzle.

In [ ]:
```
with fits.open(asn_file, mode='update') as asn_hdu:
    asn_tab = asn_hdu[1].data
    asn_tab = asn_tab[asn_tab['MEMTYPE'] == 'EXP-DTH']
```

Due to the computationally intense processing required to CTE correct full-frame ACS/WFC images, we have disabled the CTE correction here by default, however it can be turned on by changing the following variable to True:

In [ ]:
```
cte_correct = False
```

Calibration steps can be enabled or disabled by setting the switch keywords in the primary header to 'PERFORM' or 'OMIT', respectively. Switch keywords all end with the string `CORR` (e.g., `BLEVCORR` and `DARKCORR`). In this case, we want to update `PCTECORR`.

In [ ]:
```
for file in raw_files:

    if cte_correct:
        value = 'PERFORM'
    else:
        value = 'OMIT'

    fits.setval(file, 'PCTECORR', value=value)
```

ACS News and Announcements

DrizzlePac Jupyter notebook tutorials are available at:

- https://github.com/spacetelescope/notebooks

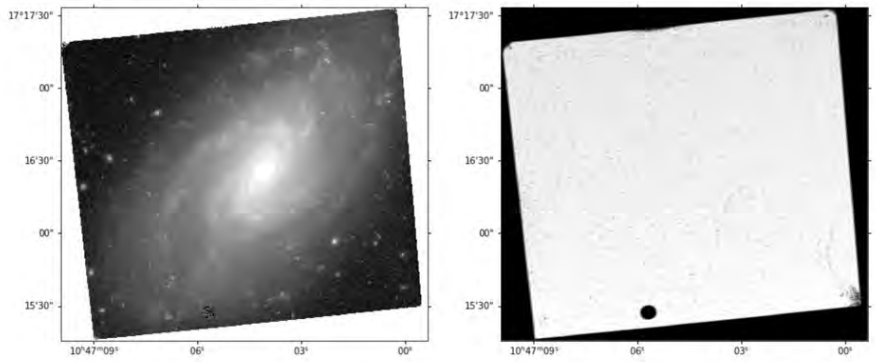
4. Results

The drizzled science and weight images produced from the first call to AstroDrizzle with no optimization of the plate scale and pixfrac are plotted below.

```
In [6]: with fits.open('f160w_noopt_drz.fits') as hdu:
            imlwcs = wcs.WCS(hdu[1].header)
            scil = hdu[1].data
            wht1 = hdu[2].data

        norml = ImageNormalize(scil, vmin=-0.2, vmax=25, stretch=LogStretch())
        fig, ax = plt.subplots(1, 2, figsize=(16, 8), subplot_kw={'projection':imlwcs})
        ax[0].imshow(scil, norm=norml, cmap='gray', origin='lower')
        ax[1].imshow(wht1, cmap='gray', origin='lower')

Out[6]: <matplotlib.image.AxesImage at 0x7f94a88e7e90>
```



The drizzled science image is on the left and the associated weight image is on the right, both without optimization of the plate scale and pixfrac.

To compare, the figure plotted below shows close ups of the same part of the sky from the two drizzled products.

New ACS Instrument Science Reports in the last year:

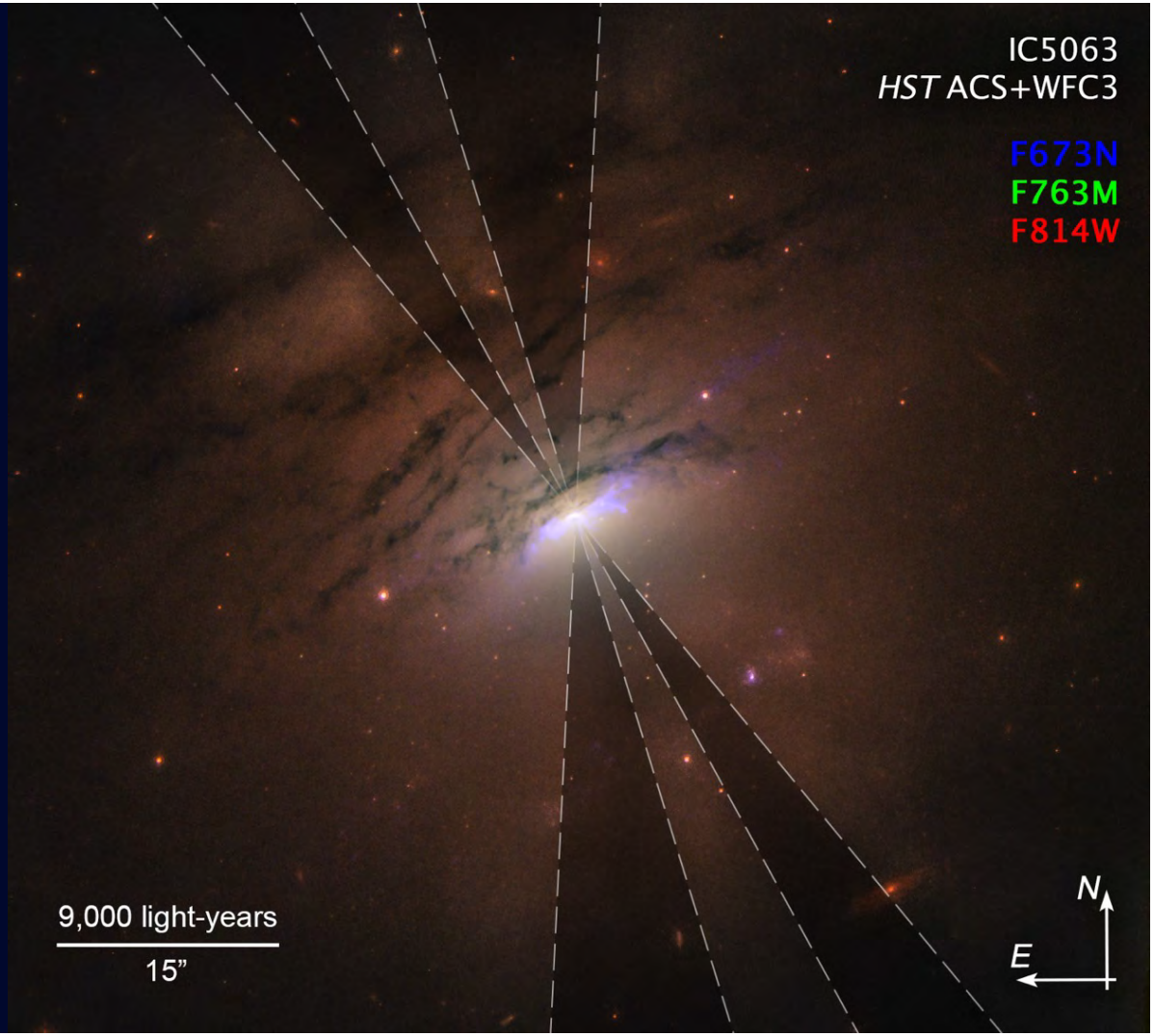
- ISR 2024-02: “The Impact of Charge Transfer Efficiency on Point Source Detection in Simulated ACS/WFC Imaging Data” (Stark et al.)
- ISR 2024-01: “Evolution of Sink Pixels in ACS/WFC and Connection to Charge Transfer Efficiency” (Guzman et al.)
- ISR 2023-06: “The ACS/WFC Focus-Diverse ePSF Webtool” (Anand et al.)
- ISR 2023-05: “HSTaXe - ACS & WFC3 Cookbook Tutorials” (Kuhn et al.)
- ISR 2023-04: “Dithering for ACS and WFC3 Primes and Parallels” (Anderson & Grogin)
- ISR 2023-03: “Measuring the Column Dependence of Read Noise in ACS/WFC Bias Frames” (Guzman & McDonald)

Dark Rays in IC 5063

19 November 2020

Nearly 156 million light-years away, IC 5063 is a galaxy with an active galactic nucleus, which is a supermassive black hole feeding on matter in the center of the galaxy. Using data from both the Advanced Camera for Surveys and the Wide Field Camera 3, astronomers think that the dark lanes (shown with dashed lines in the image to the right) are shadows cast by obscuring dusty material close to the black hole. The shadows that are cast by this material are at least 3,600 light-years long.

Image credit: NASA, ESA, STScI, and W. P. Maksym



Coma Cluster

29 November 2018

An Advanced Camera for Surveys mosaic of the Coma Cluster of galaxies. The full resolution 475 megapixel image of this mosaic is available at hubblesite.org.

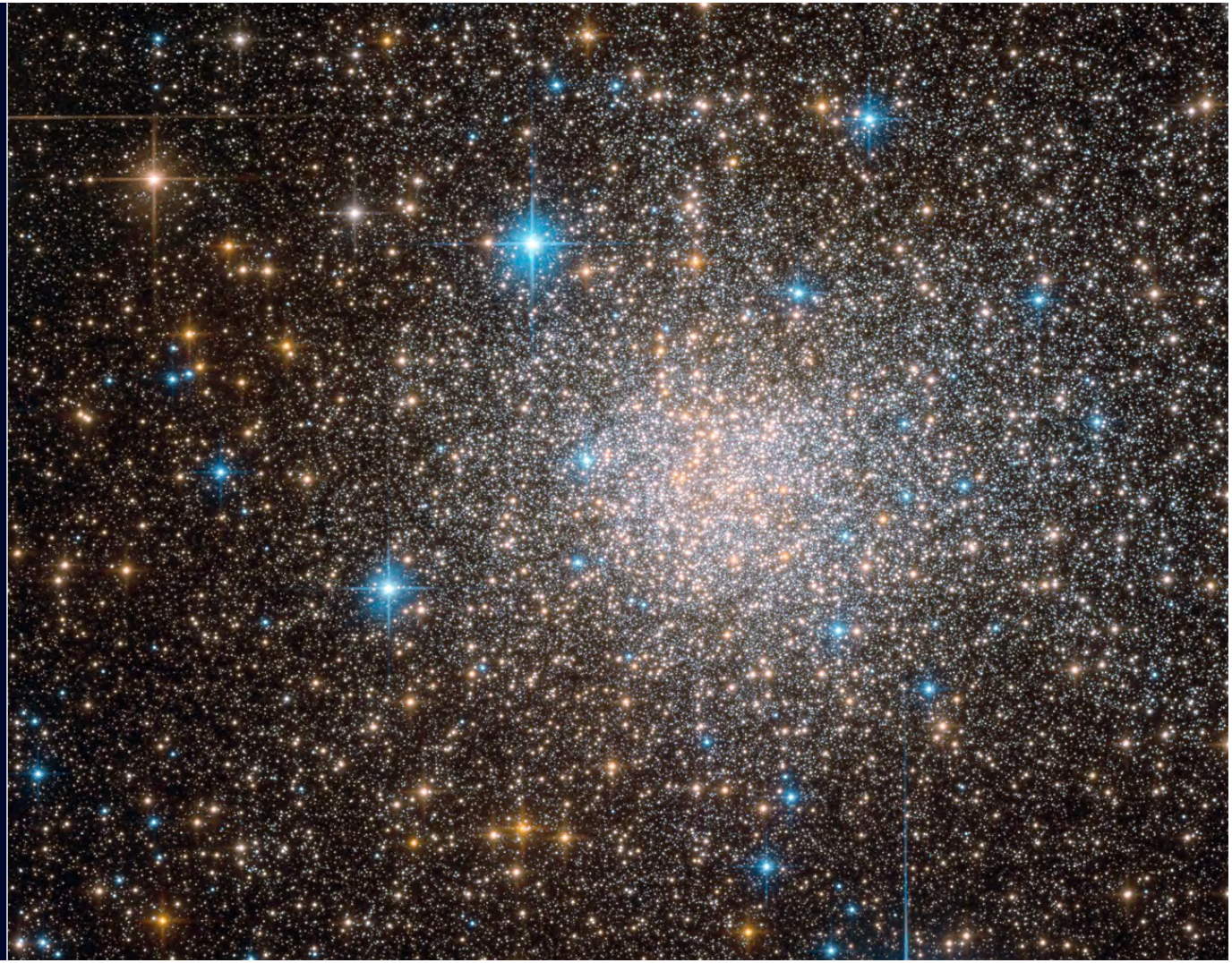
Image credit: NASA, ESA, J. Mack (STScI), and J. Madrid (ANTF).

Cluster Terzan 5

7 September 2016

Results from the Advanced Camera for Surveys, with additional Wide Field Camera 3 infrared data, indicate that the Milky Way globular star cluster Terzan 5 contains two distinct generations of stars separated by roughly 7 billion years. The properties of the stars are unusual for a star cluster, but are similar to the Galactic bulge perhaps indicating that Terzan 5 is a fossil relic of galaxy formation.

Image credit: NASA, ESA, F. Ferraro



Cluster Weslerlund 2

23 April 2015

This optical image mosaic taken with the Advanced Camera for Surveys (with additional IR imaging of the star cluster with the Wide Field Camera 3) was taken as part of the celebration of Hubble's 25th anniversary in 2015.

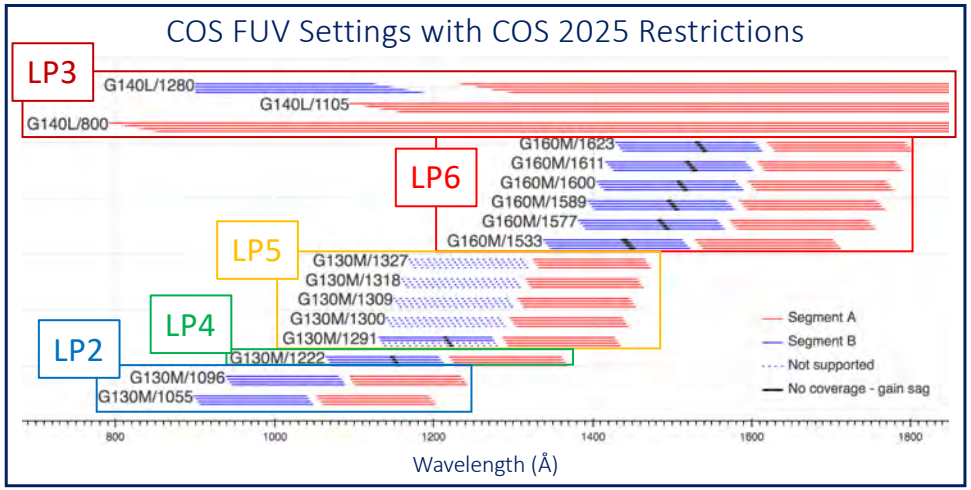
Image credit: NASA, ESA, the Hubble Heritage Team (STScI/AURA), A. Nota (ESA/STScI), and the Westerlund 2 Science Team

Cosmic Origins Spectrograph (COS)

http://www.stsci.edu/hst/cos

COS News and Announcements

- Multiple Lifetime Positions extend the life of COS:
  - All G140L cenwaves at LP3
  - All G160M cenwaves at LP6 for exposures > 0.5 orbits (otherwise at LP4)
  - G130M cenwaves 1291 – 1327 at LP5
  - G130M/1222 at LP4
  - Blue modes (G130M cenwaves 1055 and 1096) at LP2

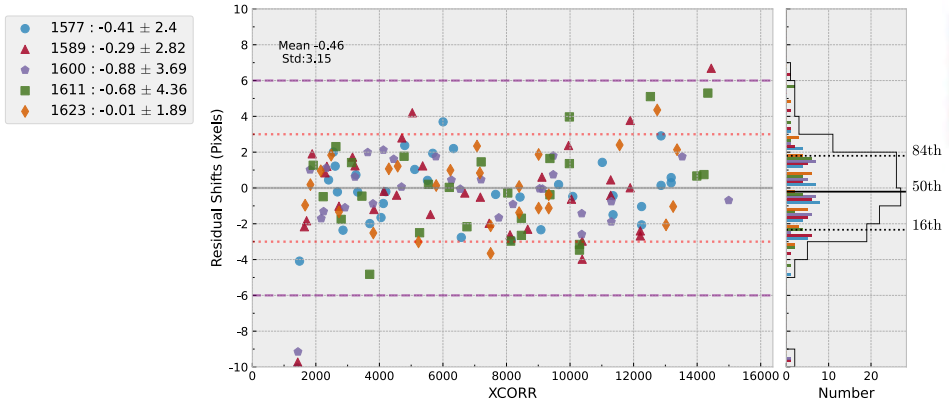


- LP6 G160M observations experience increased overheads and a slight reduction in resolution compared to LP4. Users who require the use of LP4 due to overheads must request to do so during the Phase I process. See the COS Instrument Handbook for more details.
- The COS 2025 policy remains in effect. It reduces the number of settings that place Ly α on the FUV detector, increasing its lifetime (COS ISR 2018-16).

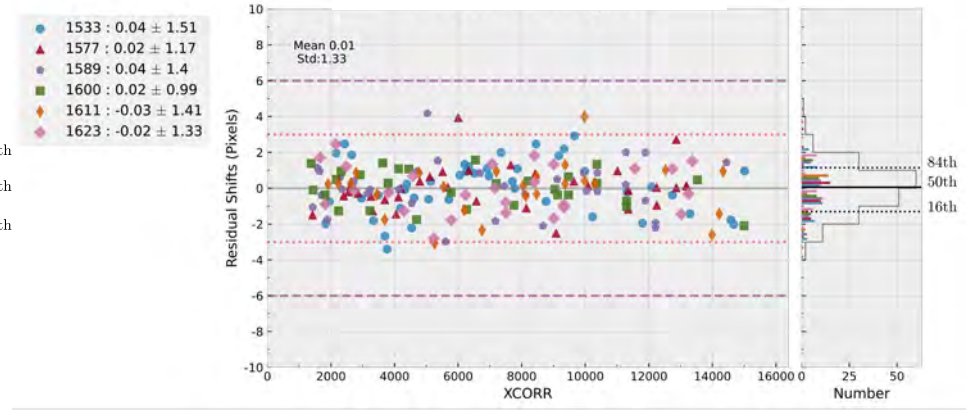
COS News and Announcements

- COS Geocorr and Walkcorr files will be updated (Fall 2024)
- Updated time dependent sensitivity reference files on March 20, 2024
- New high voltage sensitivity dependence corrections (early Fall 2024)

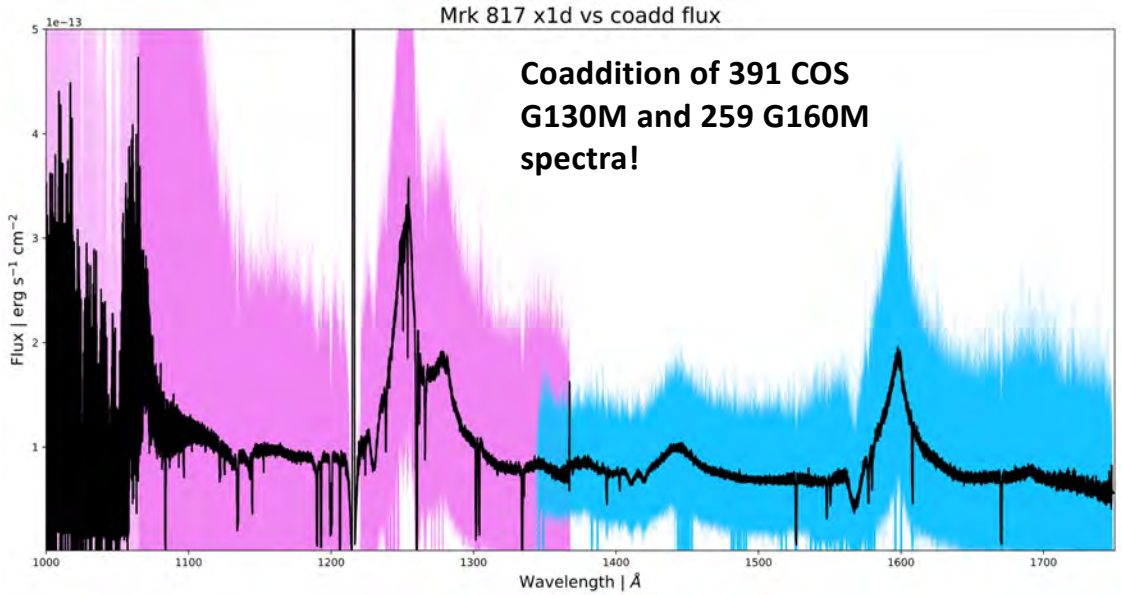
Current Walk/Geo: FUVA, LP4



New Walk/Geo: FUVA, LP4



Hubble Advanced Spectral Products



HASP Website

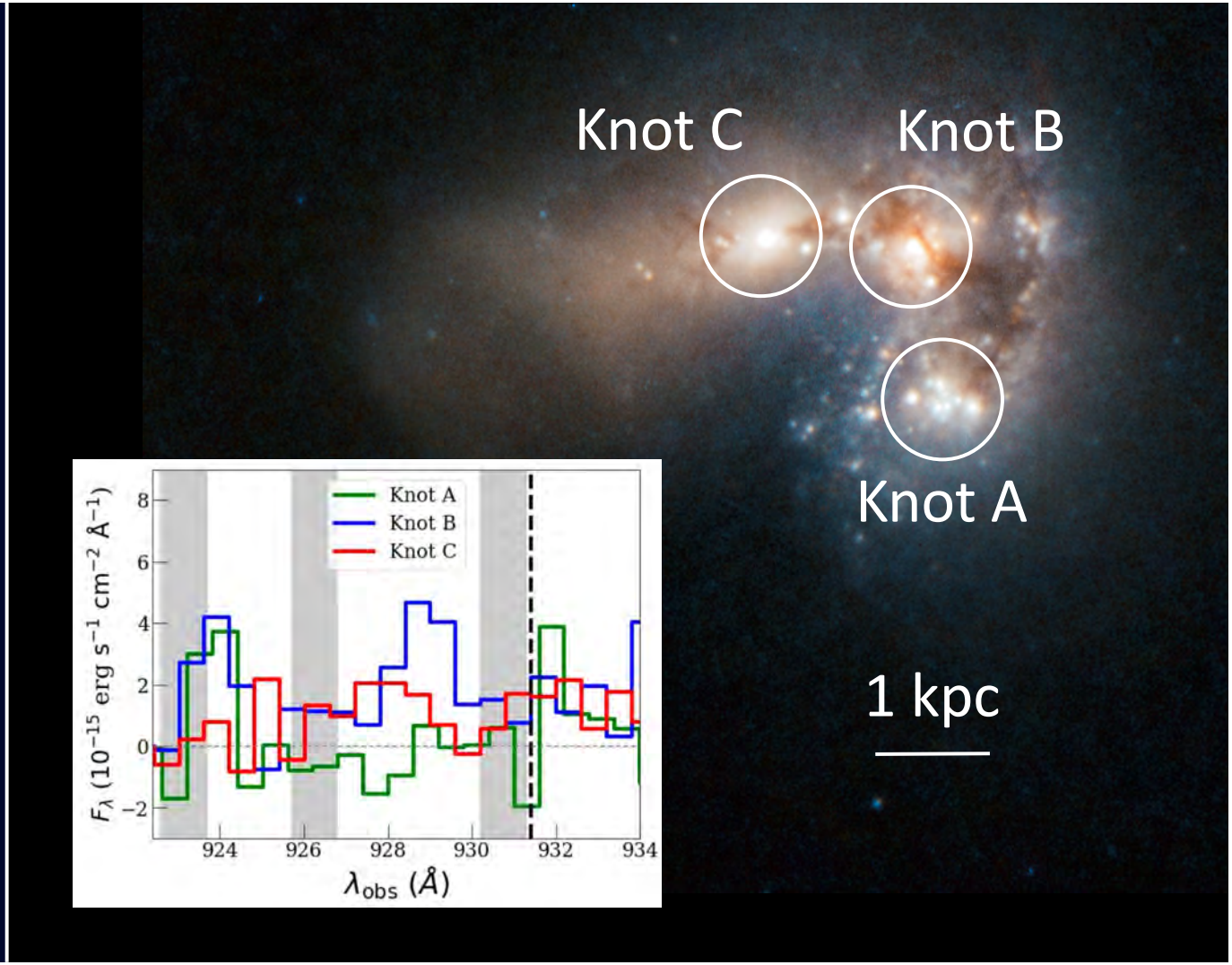
- Automated spectral coadds of COS and STIS observations at program and visit level
- Delivered via MAST in Winter 2024
- Custom coadditions also possible through scripts and example notebooks

Haro 11: The Spatially Resolved Lyman Continuum Sources

New HST/COS observations reveal spatially distinct Lyman Continuum emissions in Haro 11, identifying Knots B and C as primary sources, thereby providing crucial insights into the mechanisms of LyC escape and their implications for cosmic reionization.

Science Credit: NASA, ESA, and L. Komorova (Michigan)

Image Credit: HST/VLT

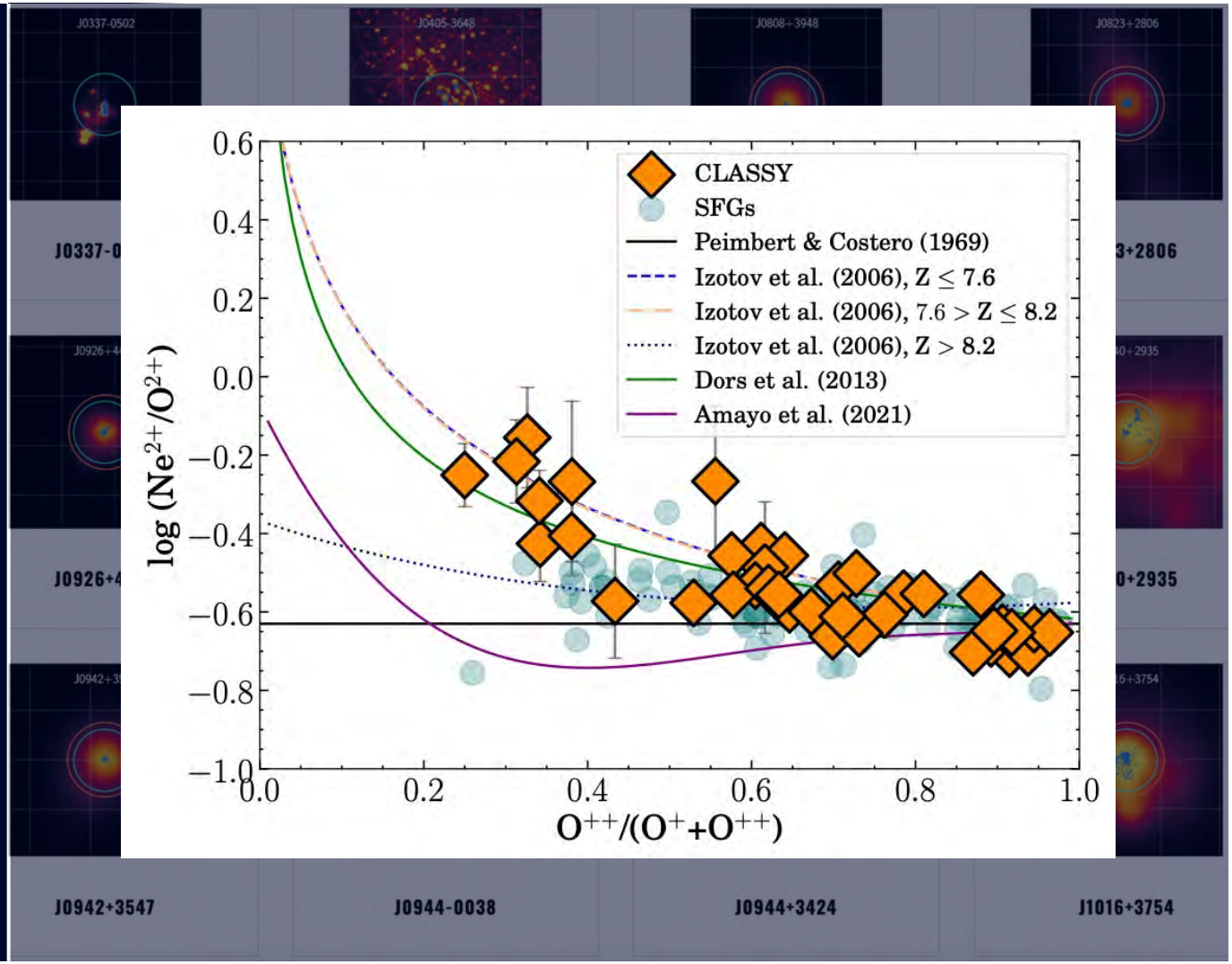


CLASSY IX: The Chemical Evolution of the Ne, S, Cl, and Ar Elements

Analyzing the COS Legacy Archive Spectroscopic Survey (CLASSY) data, the study provides detailed insights into the chemical evolution of neon, sulfur, chlorine, and argon across cosmic epochs, revealing consistent abundance patterns with metallicity and highlighting the challenges in applying ionization correction factors (ICFs) to integrated spectra.

Science Credit: NASA, ESA, and
K. Z. Arellano-Córdova (University of Edinburgh, UT-Austin)

Image Credit: STScI

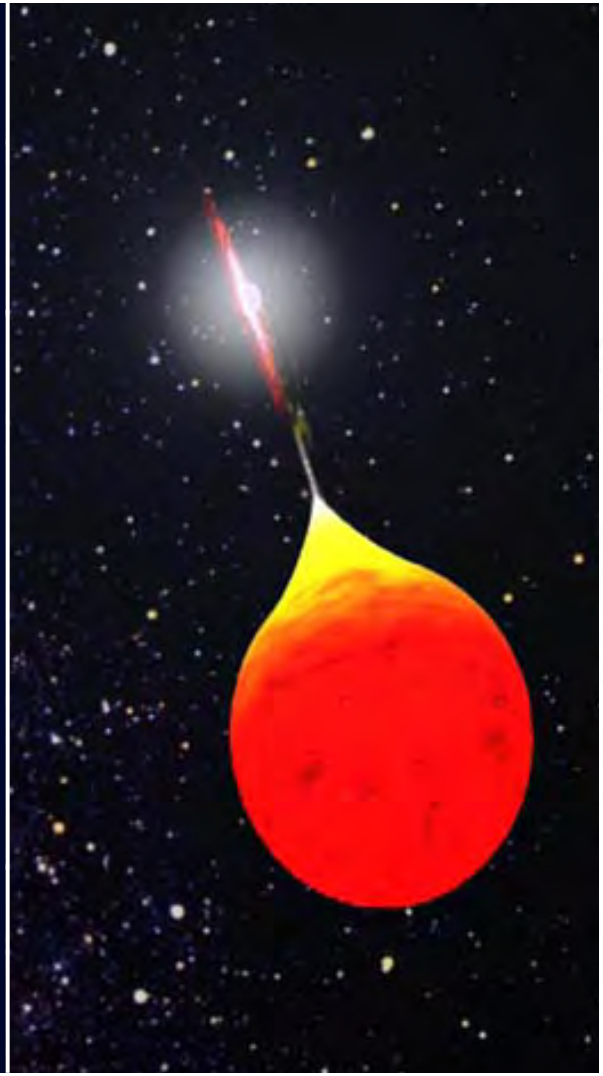


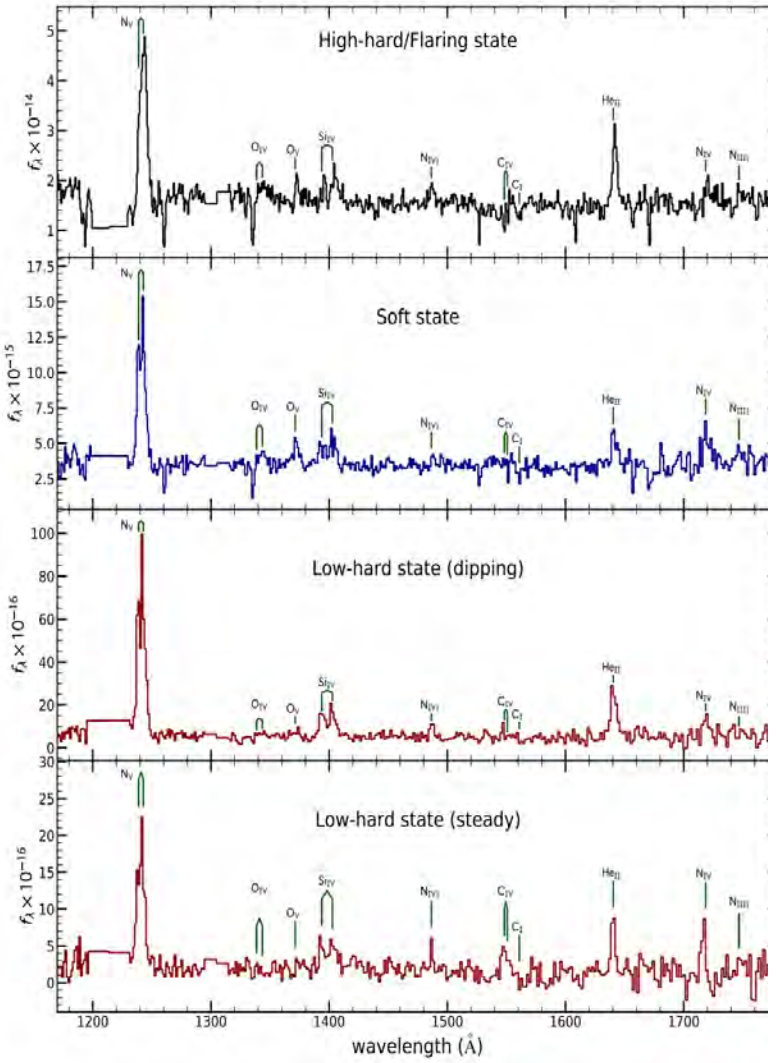
Shedding far-ultraviolet light on the donor star and evolutionary state of a neutron-star

Utilizing far-UV COS spectroscopy, this study characterizes the donor star in the neutron-star low-mass X-ray binary Swift J1858.6–0814, revealing its CNO processing history and properties like effective temperature and radius through detailed spectral analysis in various accretion states.

Science Credit: NASA, ESA, N. Castro Segura (University of Southampton)

Image Credit: NASA





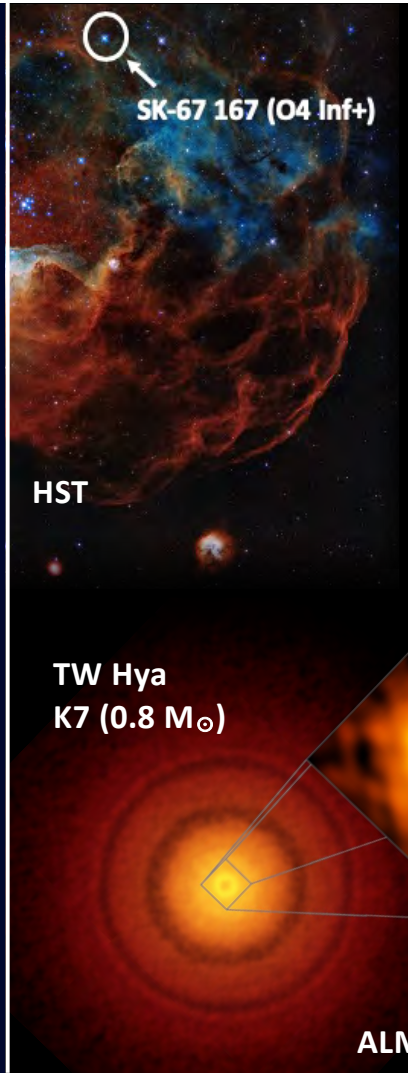
UV Spectral Atlases of Young High- and Low-mass Stars

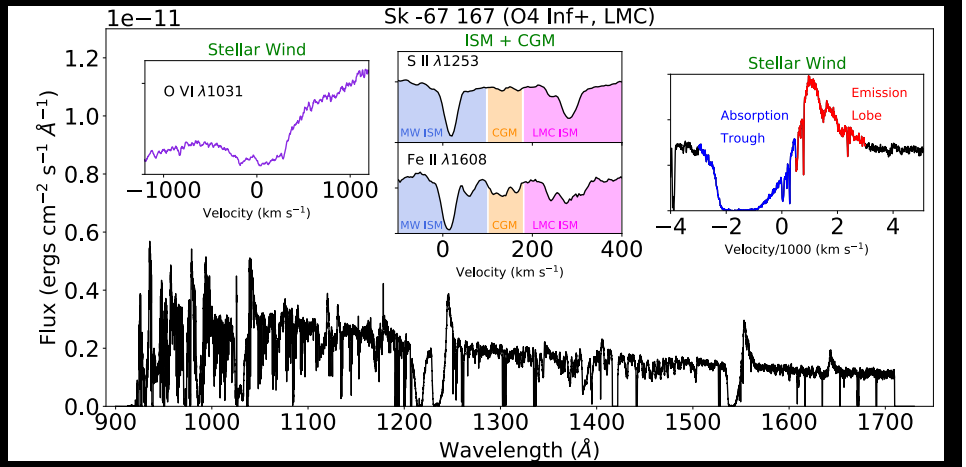
The UV Legacy Library of Young Stars as Essential Standards (ULLYSES) has completed. A 1000 orbit Director's Discretionary program with Hubble (the largest ever executed), ULLYSES uses the COS and STIS spectrographs to obtain a spectroscopic library of young stars, low and high mass, in the nearby universe.

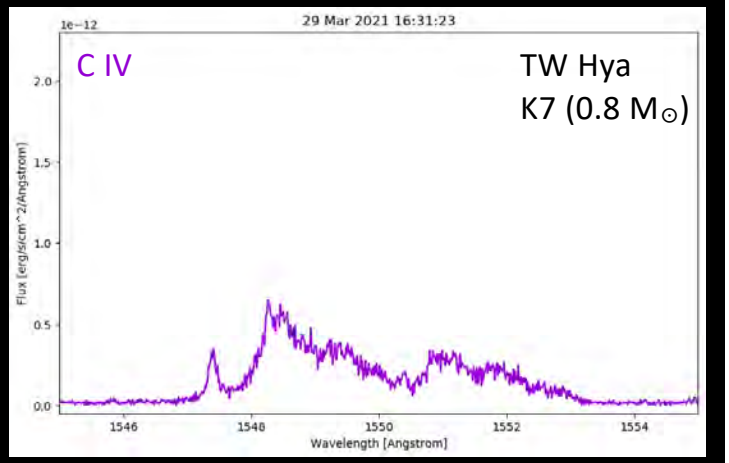
Science Credit: NASA, ESA, and J. Roman-Duval (STScI)

Image credits: NASA, ESA, ALMA

Movie credit: The ULLYSES Team





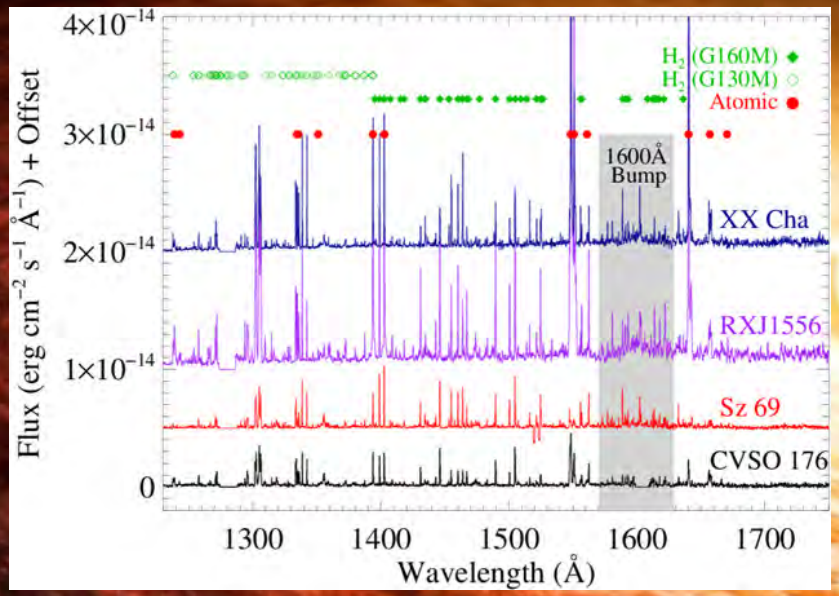


ULLYSES traces the distribution of H_2 in young stars

An analysis of 71 ULLYSES DR5 FUV spectra of young, accreting stars with protoplanetary disks shows that most of the H_2 emission in the UV comes from within ~1 au. The authors interpret these results as evidence for water molecules being dissociated by UV accretion emission as the inner disk becomes less opaque with the evolution of the protoplanetary disk.

Science Credit: NASA, ESA, K. France(LASP; U. of Colorado)

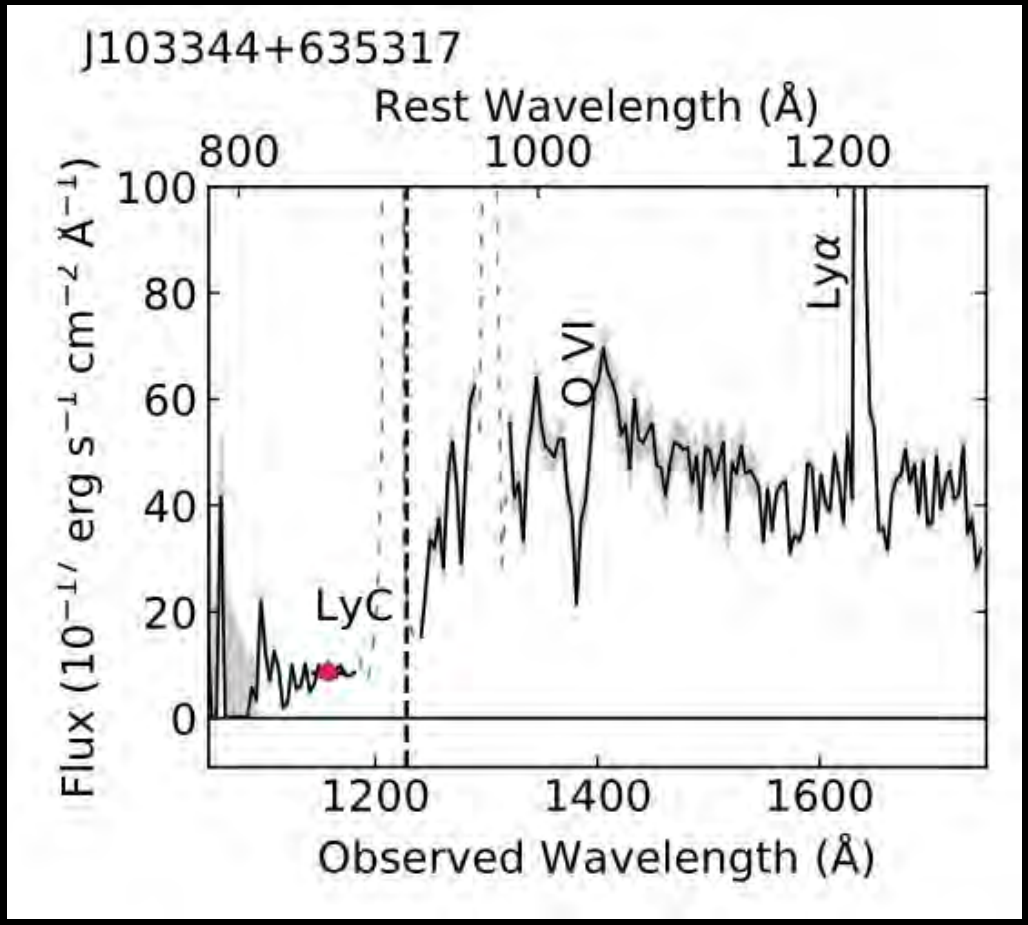
Image credit: NASA-JPL/Caltech



The Low-Z Lyman Continuum Survey (LzLCS)

An analysis of 66 COS FUV spectra of galaxies at low redshift discovered 35 new Lyman continuum emitters, nearly tripling the number of such objects. These galaxies are critical for understanding which types of galaxies were also present during the Epoch of Reionization.

Science and Image Credit: NASA, ESA, S. Flury (U. of Mass.)



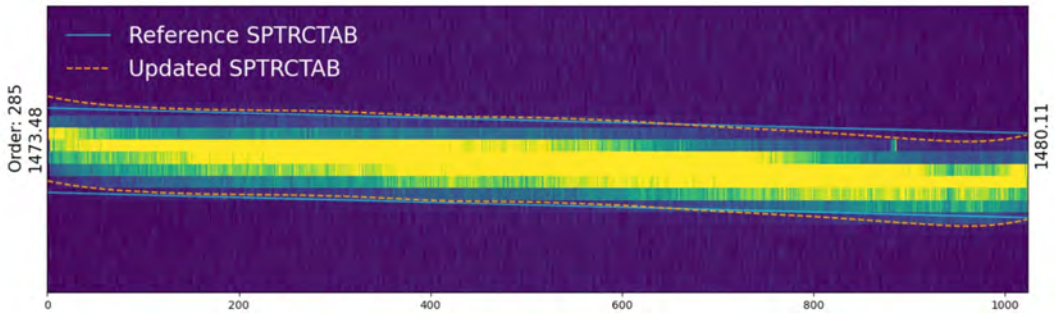
Space Telescope Imaging Spectrograph (STIS)

http://www.stsci.edu/hst/stis

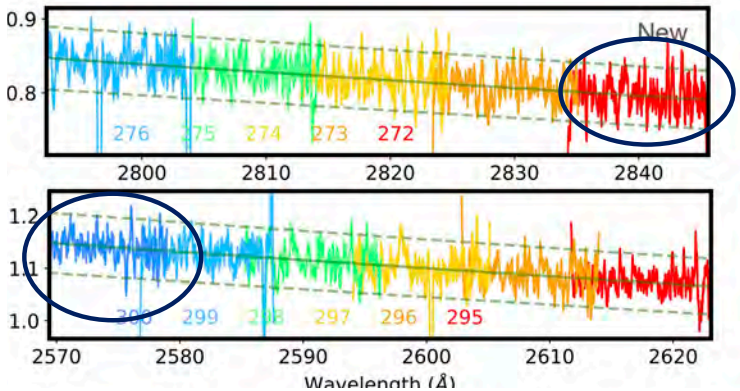
STIS News and Announcements

- STIS is updating the flux calibration of its major imaging/spectroscopic modes, following updates to the CALSPEC standard star models (Bohlin et. al 2020)
  - https://www.stsci.edu/hst/instrumentation/stis/flux-recalibration

- As part of the recalibration effort, some ***echelle modes*** have updated spectral trace tables (SPTRCTAB), improved blaze shift coefficients, and/or newly flux calibrated "edge" orders.



E214H/1562: new trace for spectral order 285



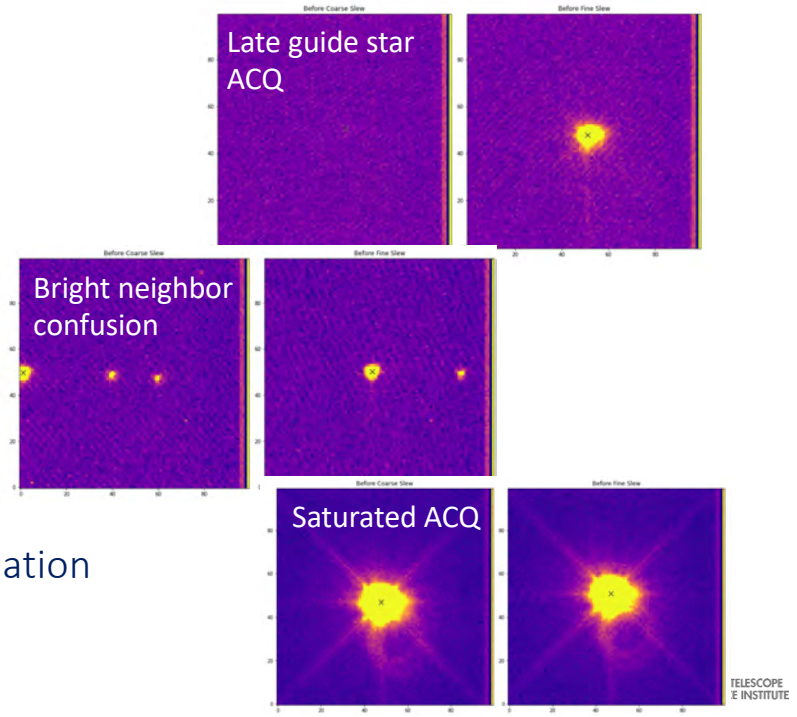
E230H/2713: orders 272 & 300 now flux calibrated

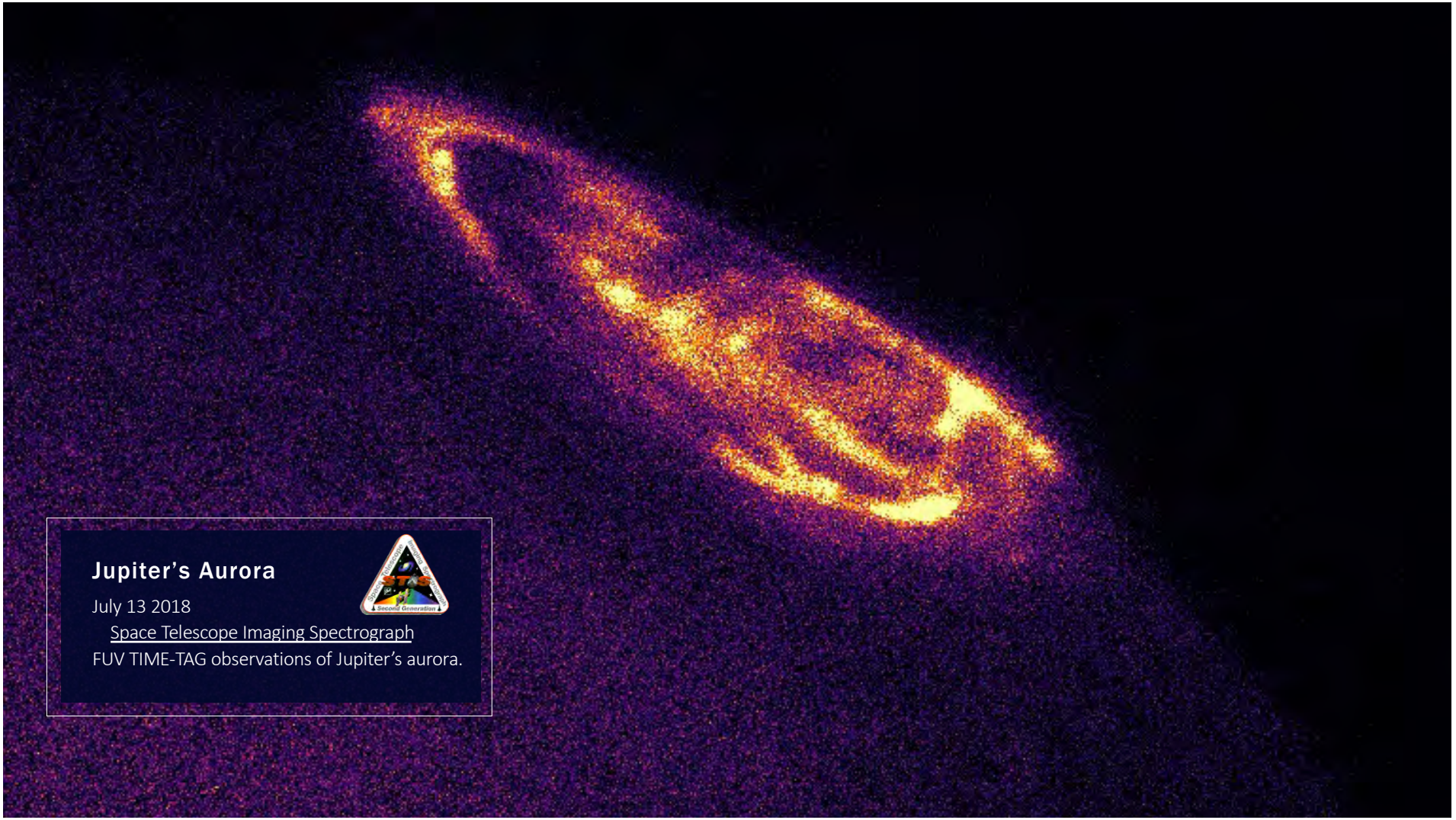
STIS Jupyter Notebook Repository

STIS Jupyter Notebooks have moved to their new home
https://spacetelescope.github.io/hst_notebooks/notebooks/STIS/README.html

Available Notebooks:

- STIS Coronagraphic Visualization Tool
- STIS DrizzlePac Tutorial
- Viewing STIS Data
- 1D Spectra Extraction
- CalSTIS 2D CCD Calibration Steps
- Custom CCD Darks
- **Evaluating STIS Target Acquisitions**
- Correcting for Missing Wavecals with Cross-Correlation





Jupiter's Aurora

July 13 2018

Space Telescope Imaging Spectrograph

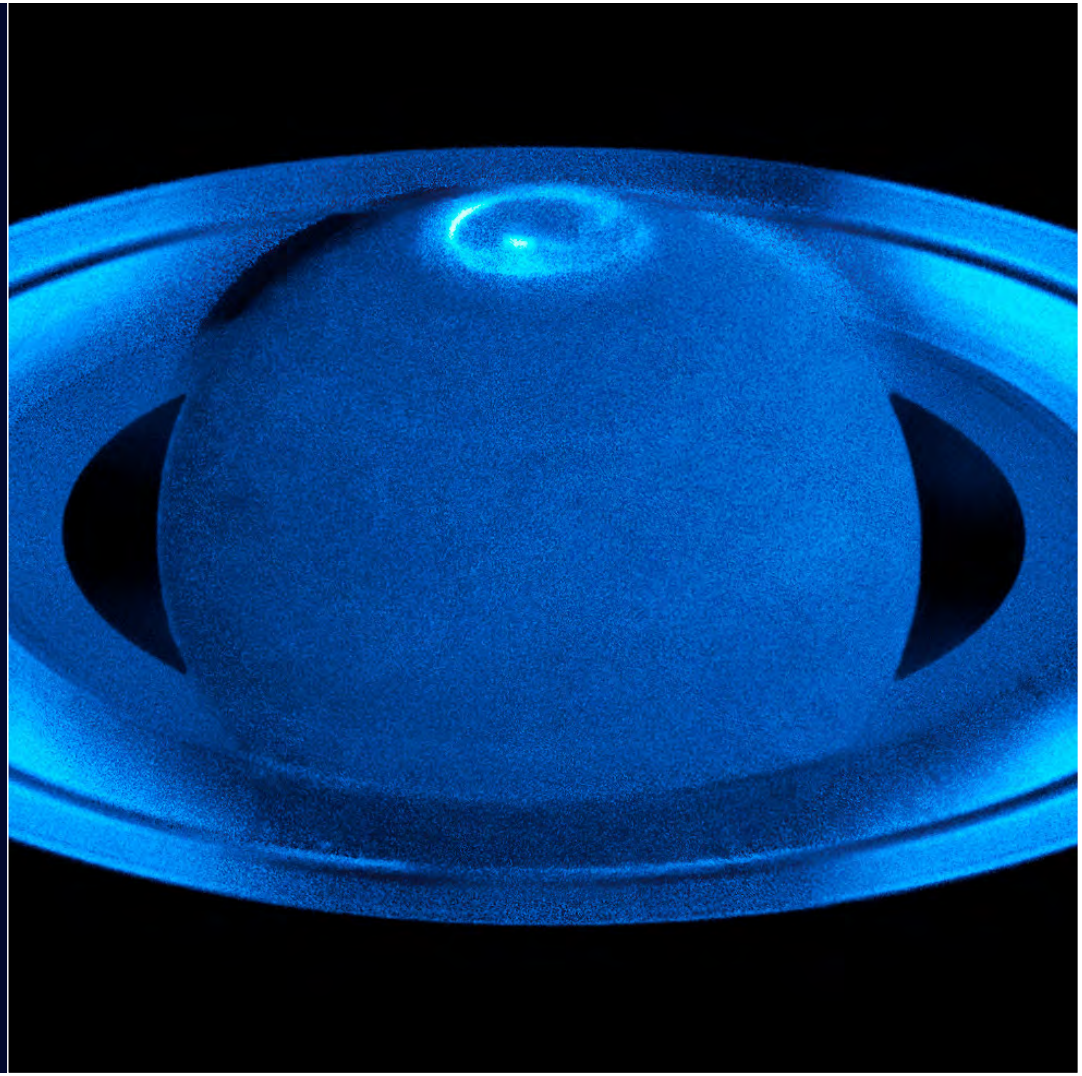
FUV TIME-TAG observations of Jupiter's aurora.

Aurorae on Saturn

30 August 2018

Captured with the Space Telescope Imaging Spectrograph, this image shows the ultraviolet aurora at Saturn's northern pole. The aurora is highly variable due to the interaction of Saturn's magnetosphere and the solar wind, but additional peaks in brightness at dawn and just before midnight have been observed. The previously unobserved midnight peak appears to be related to the interaction of the solar wind and magnetosphere during Saturn's solstice.

Image credit: NASA, ESA, and L. Lamy (Observatoire de Paris)

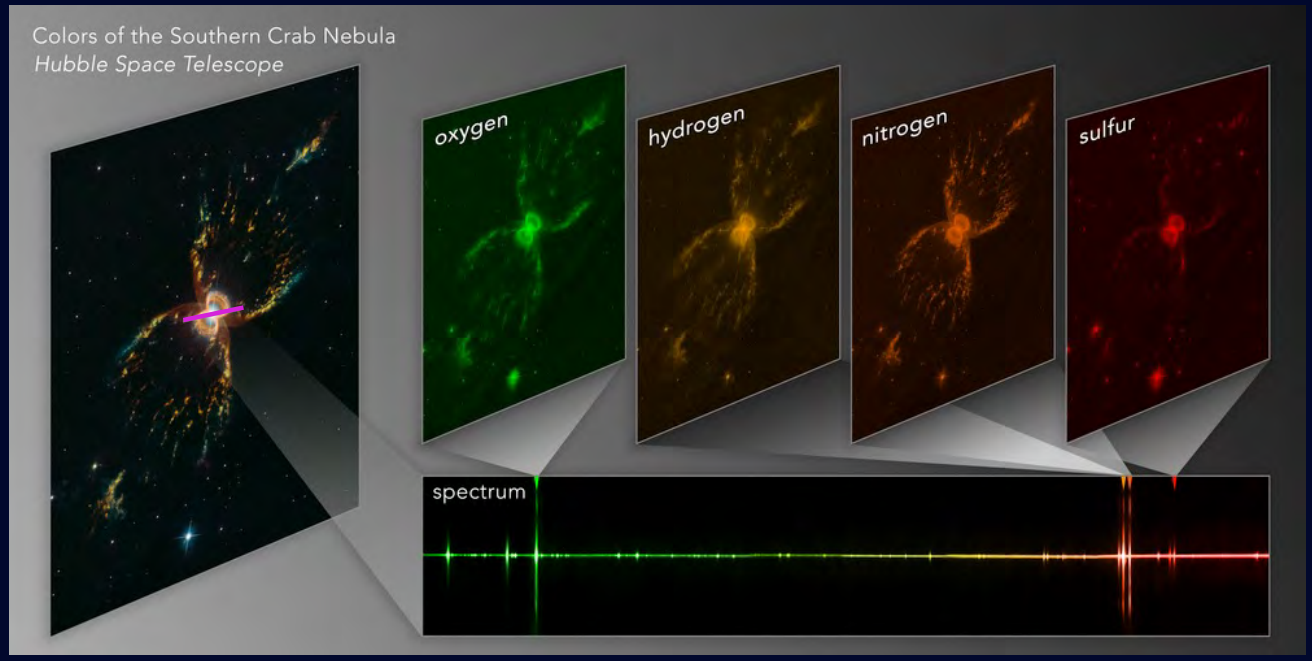


Southern Crab: Resolved Spectra

18 April 2019

The Southern Crab Nebula is an hourglass shaped nebula, formed by outflow from a red giant-white dwarf binary system at the center. The image is composed of WFC3 observations, while the Space Telescope Imaging Spectrograph spectrum was obtained by placing a slit (represented by the magenta line on the image) on the central binary pair at an angle to the hourglass shape. The spatially-resolved spectrum allows astronomers to trace both the location of relative speed of glowing elements, such as oxygen, hydrogen, nitrogen, and sulfur.

Image credits: NASA, ESA, J. DePasquale *(STScI)*

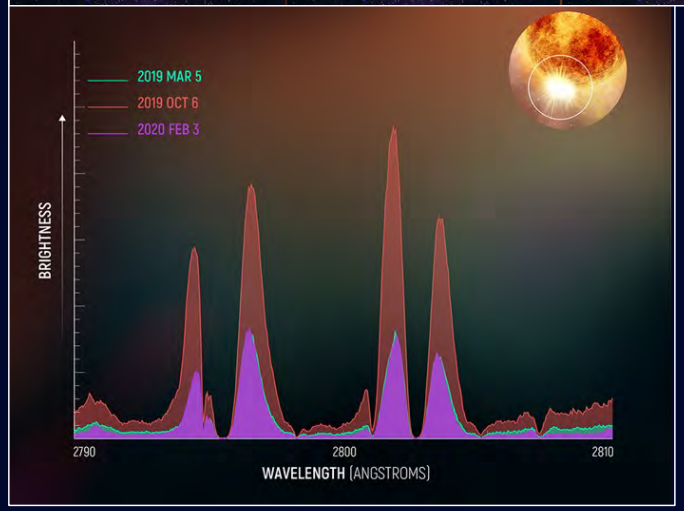


Betelgeuse's Outburst

13 August 2020

The red super-giant Betelgeuse underwent an historic dimming event that began in October 2020. Pre-dimming ultra-violet spectra obtained with the Space Telescope Imaging Spectrograph caught signs of an enormous outburst in the star's southeastern region, traced by emission of ionized magnesium. It is thought that the material from this outburst later cooled into dust, blocking our view of a portion of the star.

Image credits:
***Top**: NASA, ESA, E. Wheatley (STScI)*
***Bottom**: NASA, ESA, A. Dupree (CfA), E. Wheatley (STScI)*

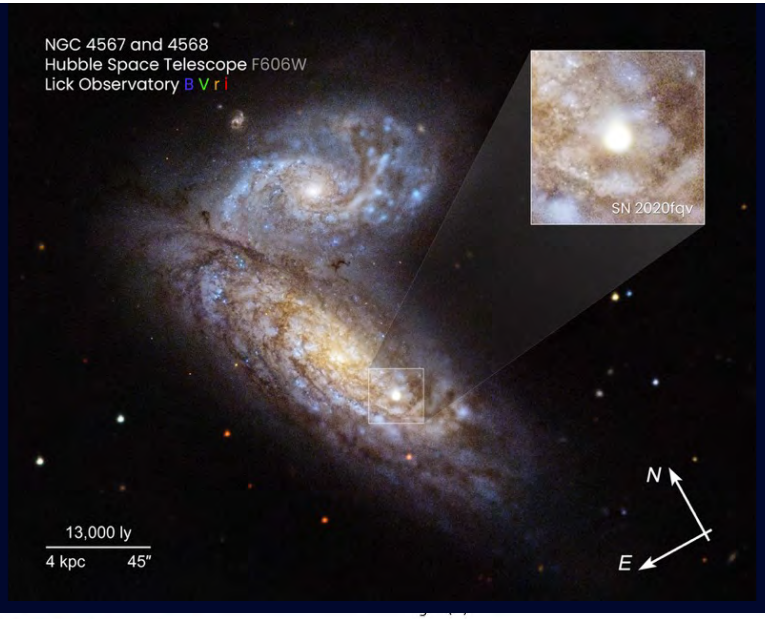


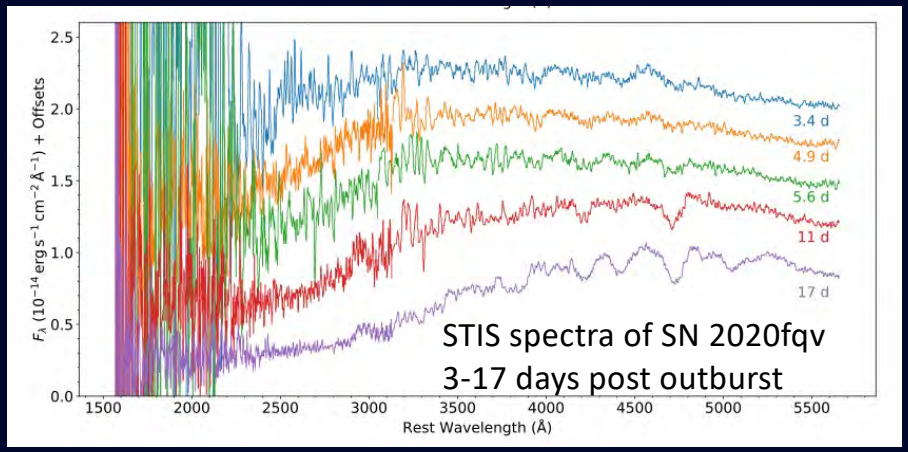
Watching a Star's Destruction

21 October 2021

Researchers obtained ultra-rapid follow-up spectra from the Space Telescope Imaging Spectrograph of Supernova SN 2020fqv, allowing them to track changes in the days following the explosion. Combining these data with other ground and space based monitoring pre- and post-outburst provides a holistic view of the progenitor star and the circumstellar environs soon after the star's demise.

Image credits:
Top: AUTHOR: Ryan Foley (UC Santa Cruz)
Bottom: *S. Tinyanont et al., 2021, MNRAS, 512, 2777, https://doi.org/10.1093/mnras/stab2887*



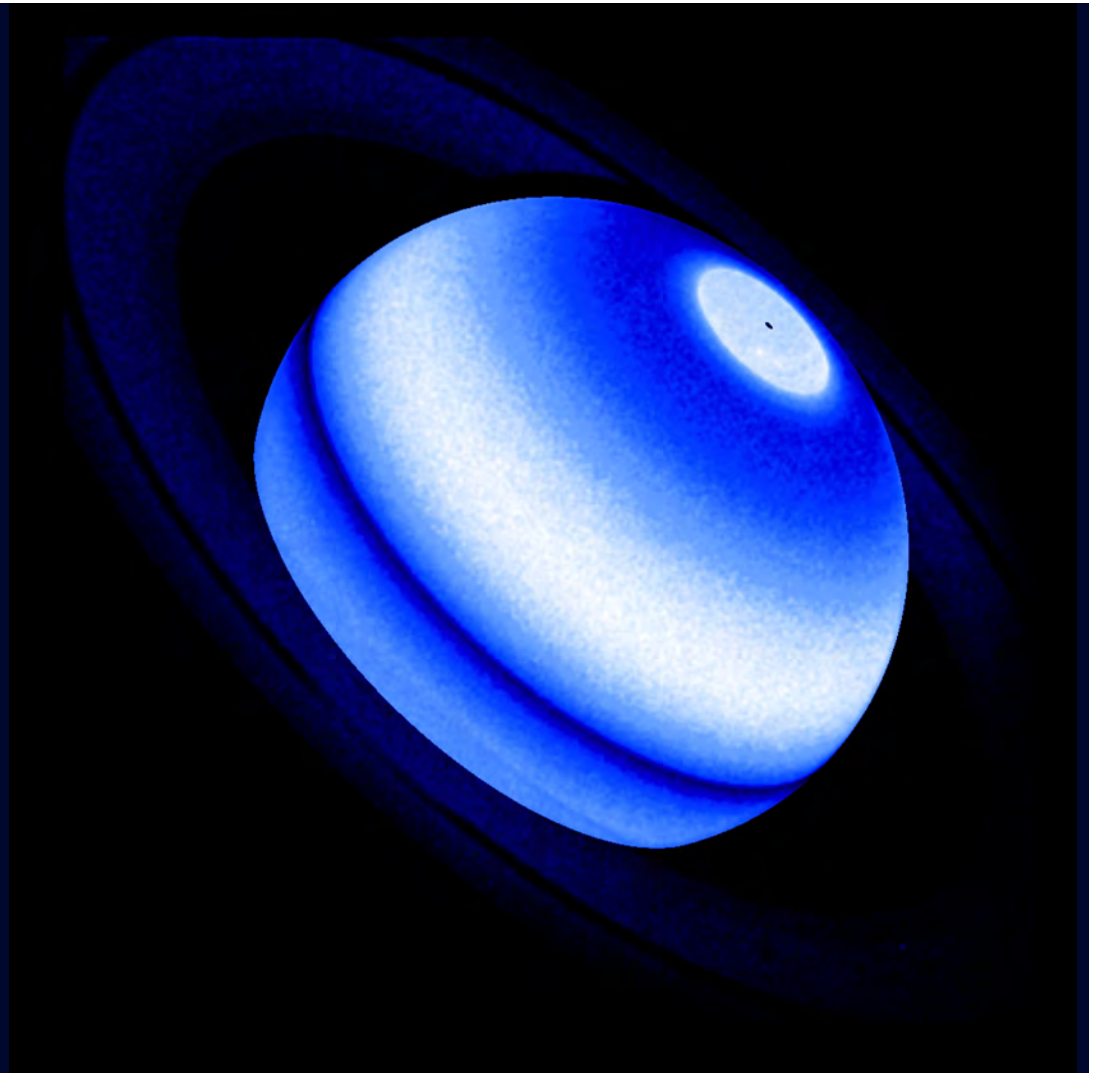


Saturn's Rings are Heating its Atmosphere

30 March 2023

The image composite to the right, using data from the the Space Telescope Imaging Spectrograph , shows the detection of the Lyman alpha emission from the Hydrogen atom in Saturn's atmosphere. While the emission at the poles is due to aurora, the bright bulge of emission at mid-latitudes is thought to be due hot hydrogen atoms. Researchers cross-calibrated four decades of ultraviolet (UV) data from the two Voyager Spacecraft, Cassini, the International Ultraviolet Explorer and Hubble to confirm the persistent excess UV emission. The suspected heating source is infalling ring particles, raining down on the upper atmosphere.

Image credits: NASA, ESA, Lotfi Ben-Jaffel (IAP & LPL)



Shadows in TW Hydrae's disk

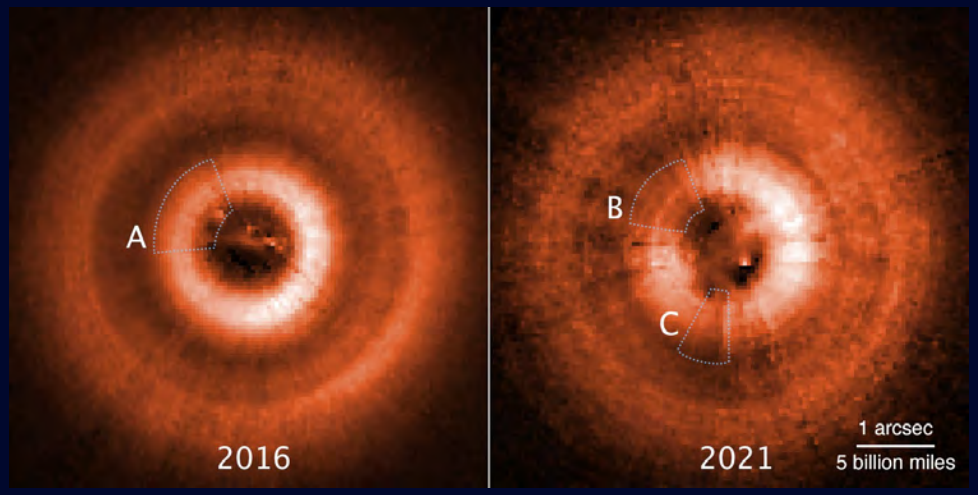
04 May 2023

TW Hydrae is surrounded by a planet forming disk, oriented face-on to our perspective on Earth. Data taken with the Space Telescope Imaging Spectrograph, separated by four years led to the discovery of first one and then a second shadow in the system. These shadows are due to slight inclinations of two inner disks in the system, tilted at different angles, which cast shadows on the much larger outer disk.

Top image: STIS discovery data. The first shadow is labeled "A" and "B", while the newest shadow is labeled "C"

Bottom image: An artist's concept of the tilted disk system.

Image credits:
***Top**:* NASA, ESA, STScI, John Debes (AURA/STScI for ESA)
***Bottom**:* NASA, AURA/STScI for ESA, Leah Hustak (STScI)

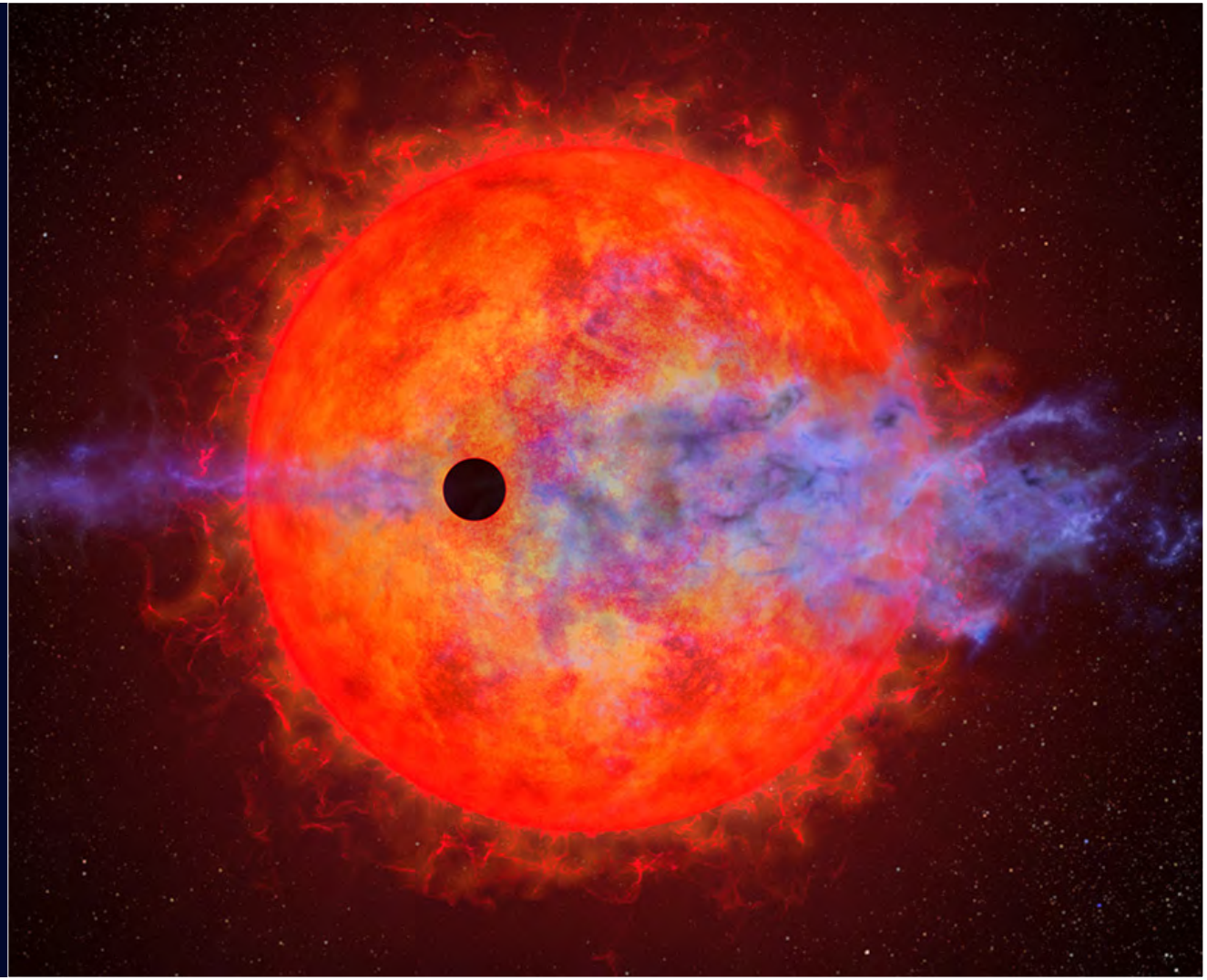


Hubble Sees Evaporating Planet Getting the Hiccups

July 27 2023

This artist's illustration shows a planet (dark silhouette) passing in front of the red dwarf star AU Microscopii. The planet is so close to the eruptive star a ferocious blast of stellar wind and blistering ultraviolet radiation is heating the planet's hydrogen atmosphere, causing it to escape into space. Four times Earth's diameter, the planet is slowly evaporating its atmosphere, which stretches out linearly along its orbital path. This process may eventually leave behind a rocky core. The illustration is based on measurements made by the Hubble Space Telescope with the Space Telescope Imaging Spectrograph.

Image credits: NASA, ESA, Joseph Olmsted (STScI)



Hubble Space Telescope
Wide Field Camera 3 (WFC3)
AAS 244 June 2024

http://www.stsci.edu/hst/wfc3

WFC3 Highlights

- More than 352,000 WFC3 images in archive - mast.stsci.edu/search/hst
- WFC3 software on HST Notebook Repository – spacetelescope.github.io/hst_notebooks/
  New notebook: performing PSF subtractions using ePSFs or PSF Image Library
- WFC3 Instrument Handbook - hst-docs.stsci.edu/wfc3ihb
- WFC3 Data Handbook – hst-docs.stsci.edu/wfc3dhb
- CTE losses – mitigation (ISR 2021-09); table-based corrections (ISR 2021-13), *hst1pass* software (ISR 2022-05)
- Hubble Advanced Products – single visit mosaics, multi-visit mosaics (ISR 2021-06)
- Observers: Mitigate UVIS CTE losses by ensuring ~20 e-/pix total background (ISR 2020-08)
  Improve IR repeatability by using >9 pix dithers (ISR 2019-07)
  For >4 dither points, use custom patterns (ISRs 2020-07, 2016-14)
- WFC3 STAN newsletter – Last one: Mar 2024 (on WWW site); next one: June 2024
  stsci.edu/hst/instrumentation/wfc3/documentation/stsci-analysis-newsletter-stan

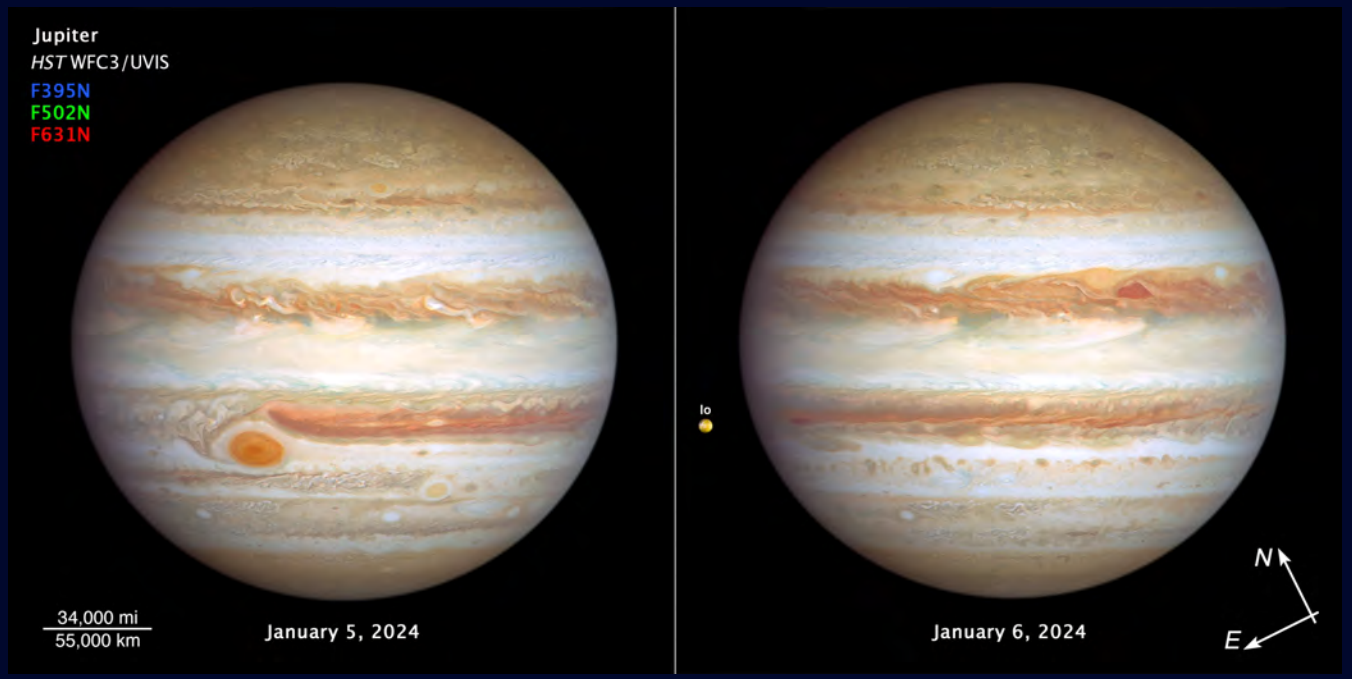
Jupiter's Stormy Weather

14 Mar 2024

The giant planet Jupiter, in all its banded glory, is revisited by NASA's Hubble Space Telescope in these latest images, taken on January 5-6, 2024, capturing both sides of the planet. Hubble monitors Jupiter and the other outer solar system planets every year under the Outer Planet Atmospheres Legacy program (OPAL)

Left: the classic Great Red Spot stands out prominently in Jupiter's atmosphere. To its lower right, at a more southerly latitude, is a feature sometimes dubbed Red Spot Jr.

Right: Storm activity also appears in the opposite hemisphere. A pair of storms, a deep red cyclone and a reddish anticyclone, appear next to each other at right of center.



Science: NASA, ESA, STScI, A. Simon (NASA-GSFC)

Hubble watches ‘Spoke Season’ on Saturn

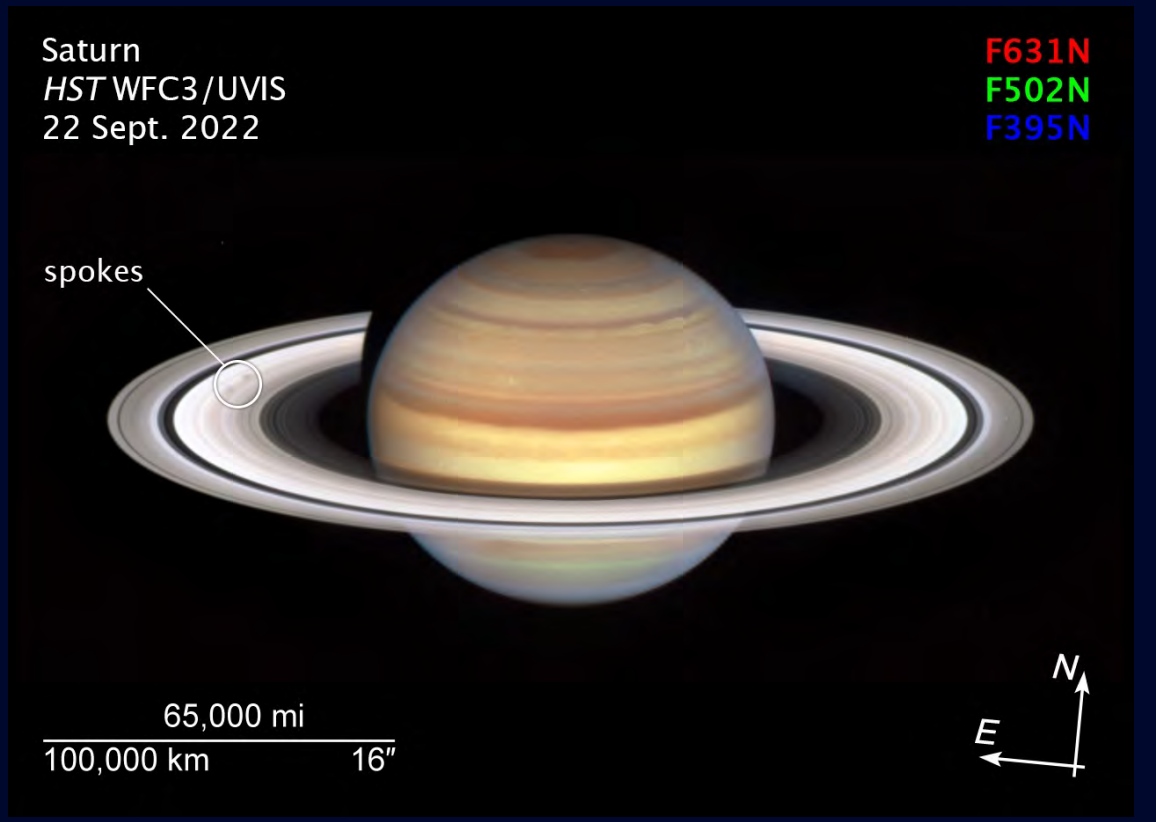
21 Dec 2023

This photo of Saturn was taken by NASA's Hubble Space Telescope on October 22, 2023, when the ringed planet was approximately 850 million miles from Earth. Hubble's ultra-sharp vision reveals a phenomenon called ring spokes.

Saturn's spokes are transient features that rotate along with the rings. Their ghostly appearance only persists for two or three rotations around Saturn. During active periods, freshly-formed spokes continuously add to the pattern.

Hubble's crisp images show that the frequency of spoke apparitions is seasonally driven, first appearing in OPAL data in 2021 but only on the morning (left) side of the rings. Long-term monitoring show that both the number and contrast of the spokes vary with Saturn's seasons. Saturn is tilted on its axis like Earth and has seasons lasting approximately seven years.

Science Credit:
NASA, ESA, A. Simon (NASA-GSFC)



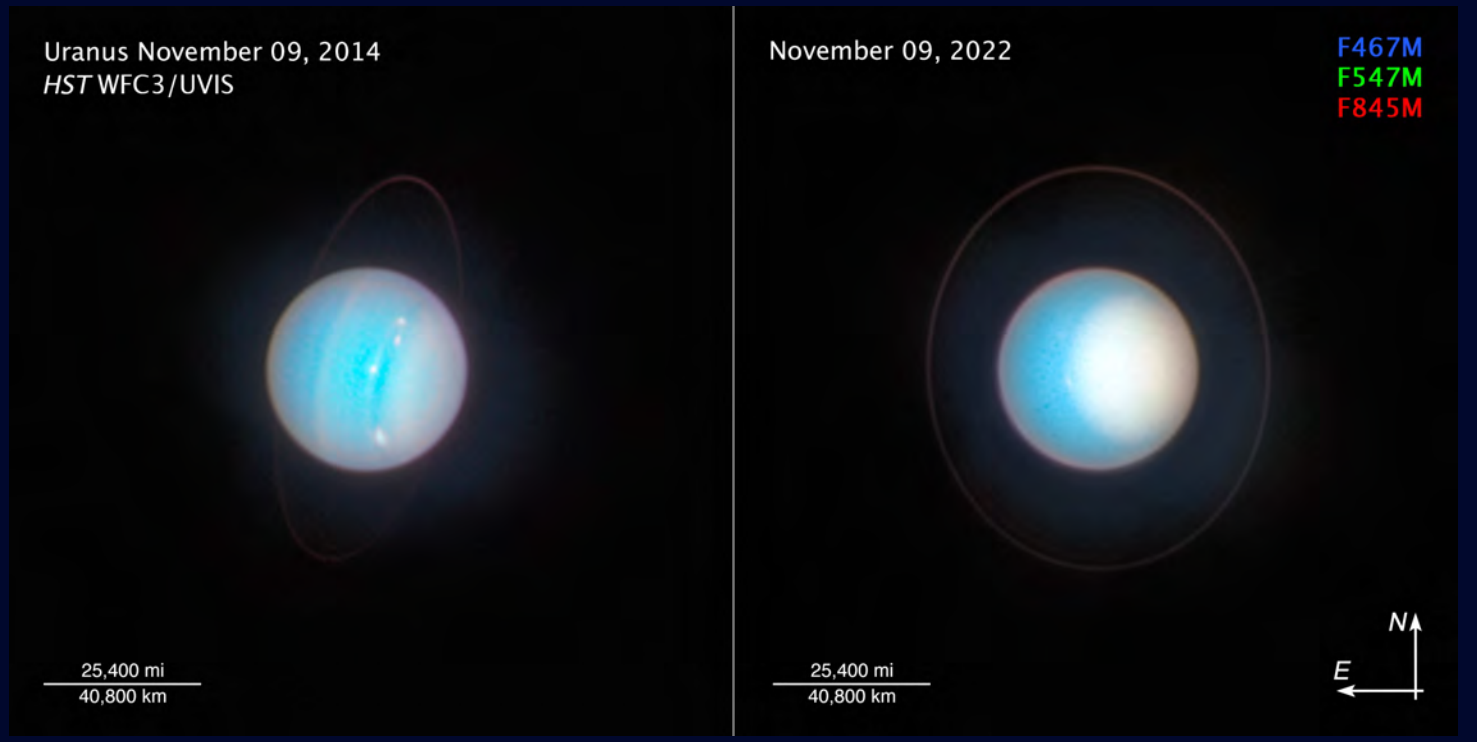
Uranus

23 Mar 2023

Left: Uranus in 2014, seven years after northern spring equinox when the Sun was shining directly over the planet's equator. Multiple storms with methane ice-crystal clouds appear at mid-northern latitudes above the planet's cyan-tinted lower atmosphere.

Right: Uranus' north pole shows a thickened photochemical haze that looks similar to the smog over cities. Several little storms can be seen near the edge of the polar haze boundary. At the Uranian equinox in 2007, neither pole was particularly bright. As northern summer solstice approaches in 2028 the cap may grow brighter still, and will be aimed directly toward Earth, allowing good views of the rings and north pole; the ring system will then appear face-on.

Science: NASA, ESA, STScI, A. Simon (NASA-GSFC), M. H. Wong (UC Berkeley)



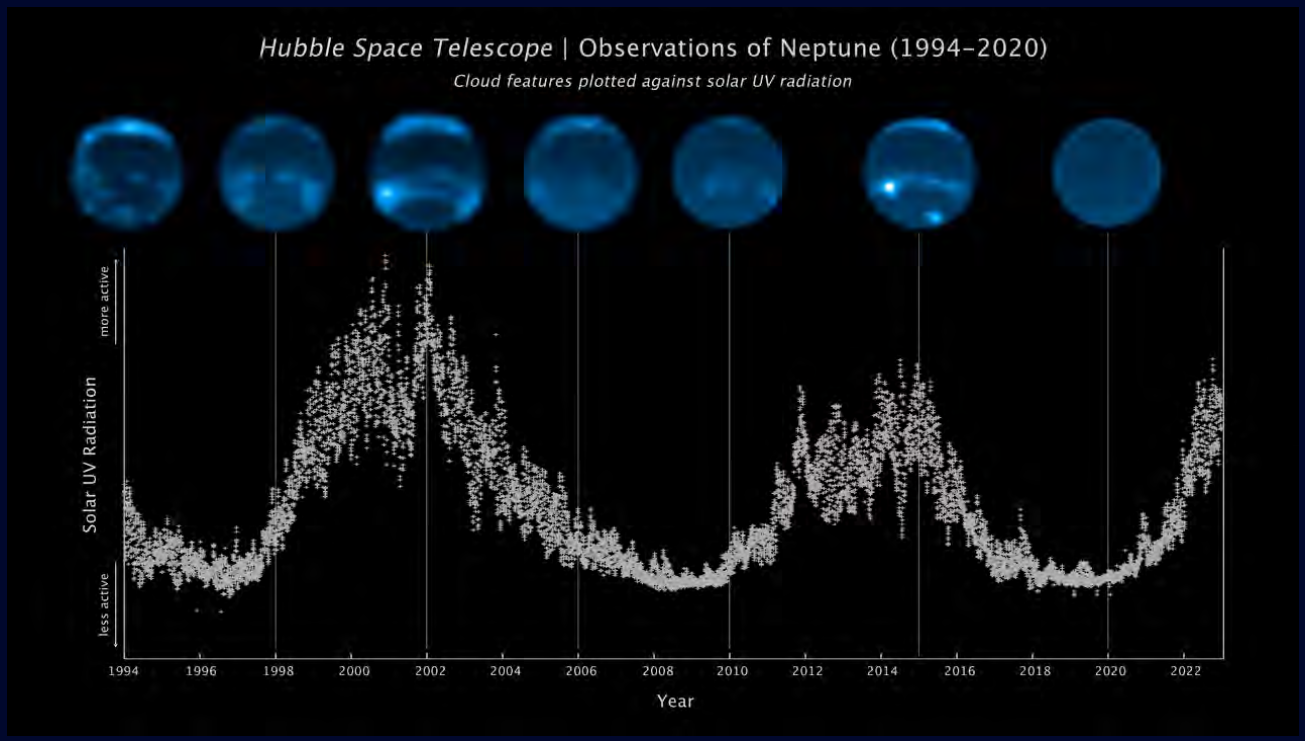
Neptune's Disappearing Clouds Linked to the Solar Cycle

Aug 2023

Astronomers have uncovered a link between Neptune's shifting cloud abundance and the 11-year solar cycle, in which the waxing and waning of the Sun's entangled magnetic fields drives solar activity.

This discovery is based on three decades of Neptune observations captured by NASA's Hubble Space Telescope and the W. M. Keck Observatory in Hawaii, as well as data from the Lick Observatory in California.

The link between Neptune and solar activity is surprising to planetary scientists because Neptune is our solar system's farthest major planet and receives sunlight with about 0.1% of the intensity Earth receives. Yet Neptune's global cloudy weather seems to be driven by solar activity, and not the planet's four seasons, which each last ~40 years.



Credits
Science: NASA, ESA, LASP,
Erandi Chavez (UC Berkeley),
Imke de Pater (UC Berkeley)

DART Asteroid Impact Debris

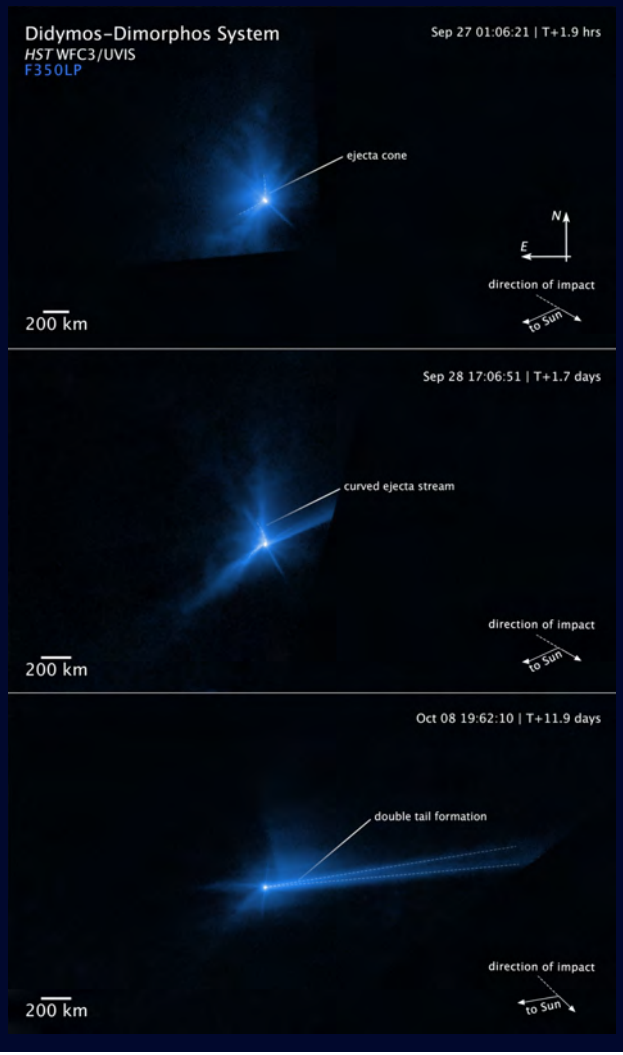
1 Mar 2023

Like a sports photographer at an auto-racing event, NASA's Hubble Space Telescope captured a series of photos of asteroid Dimorphos when it was deliberately hit by a 1,200-pound NASA spacecraft called DART on September 26, 2022.

The primary objective of DART, which stands for Double Asteroid Redirection Test, was to test our ability to alter the asteroid's trajectory as it orbits its larger companion asteroid, Didymos. Though neither Didymos nor Dimorphos poses any threat to Earth, data from the mission will help inform researchers how to potentially divert an asteroid's path away from Earth, if ever necessary. The DART experiment also provided fresh insights into planetary collisions that may have been common in the early solar system.

Hubble's time-lapse movie of the aftermath of DART's collision reveals surprising and remarkable, hour-by-hour changes as dust and chunks of debris were flung into space. Smashing head on into the asteroid at 13,000 miles per hour, the DART impactor blasted over 1,000 tons of dust and rock off of the asteroid.

Science Credit: NASA, ESA, STScI, Jian-Yang Li (PSI)



Hubble Sees Boulders Escaping from Asteroid Dimorphos

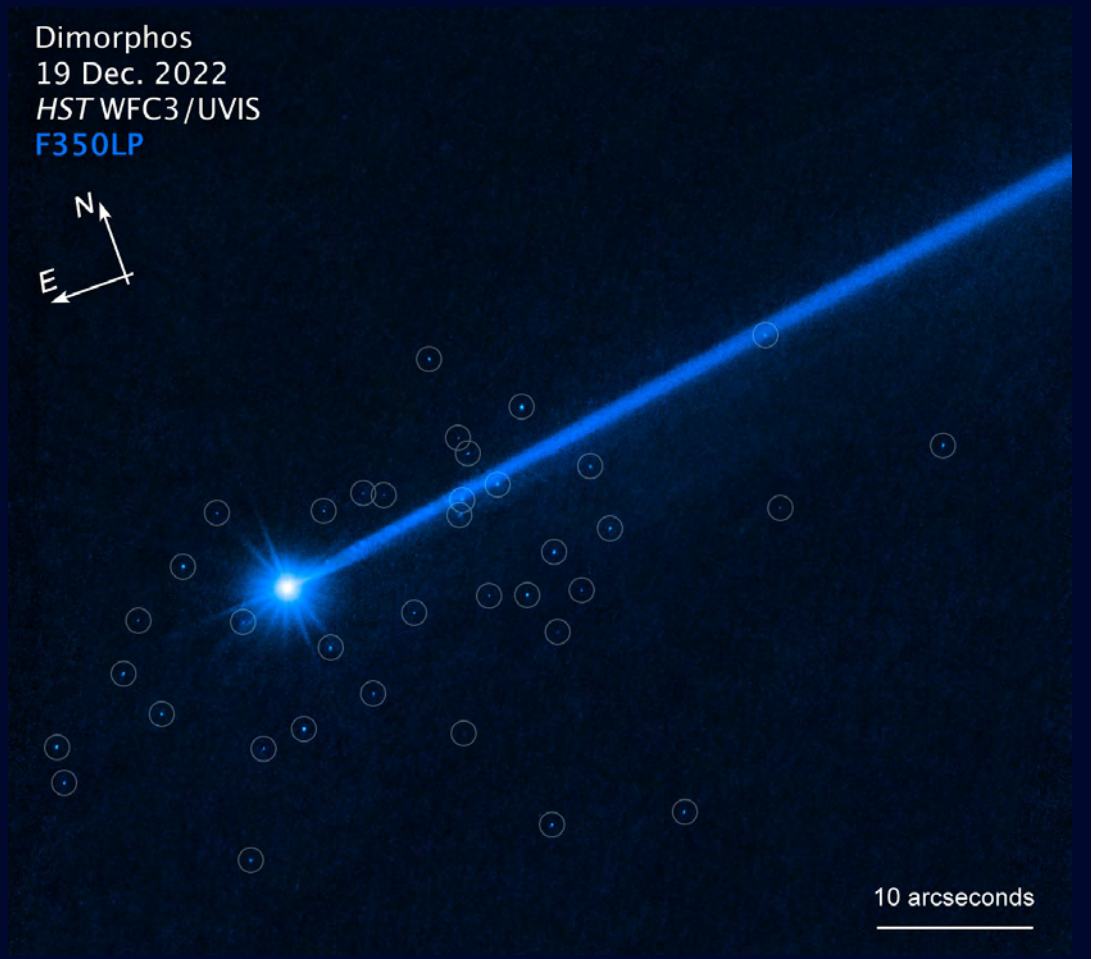
July 2023

Astronomers using HST have discovered a swarm of boulders that were possibly shaken off the asteroid when NASA deliberately slammed the half-ton DART impactor spacecraft into Dimorphos at approximately 14,000 miles per hour.

The 37 free-flung boulders range in size from three feet to 22 feet across, based on HST photometry. They are drifting away from the asteroid at little more than a half-mile per hour – roughly the walking speed of a giant tortoise. The total mass in these detected boulders is about 0.1% the mass of Dimorphos.

"This is a spectacular observation – much better than I expected. We see a cloud of boulders carrying mass and energy away from the impact target. The numbers, sizes, and shapes of the boulders are consistent with them having been knocked off the surface of Dimorphos by the impact," said David Jewitt of the University of California at Los Angeles.

Science Credit: NASA, ESA, David Jewitt (UCLA)
Image processing: Alyssa Pagan (STScI)



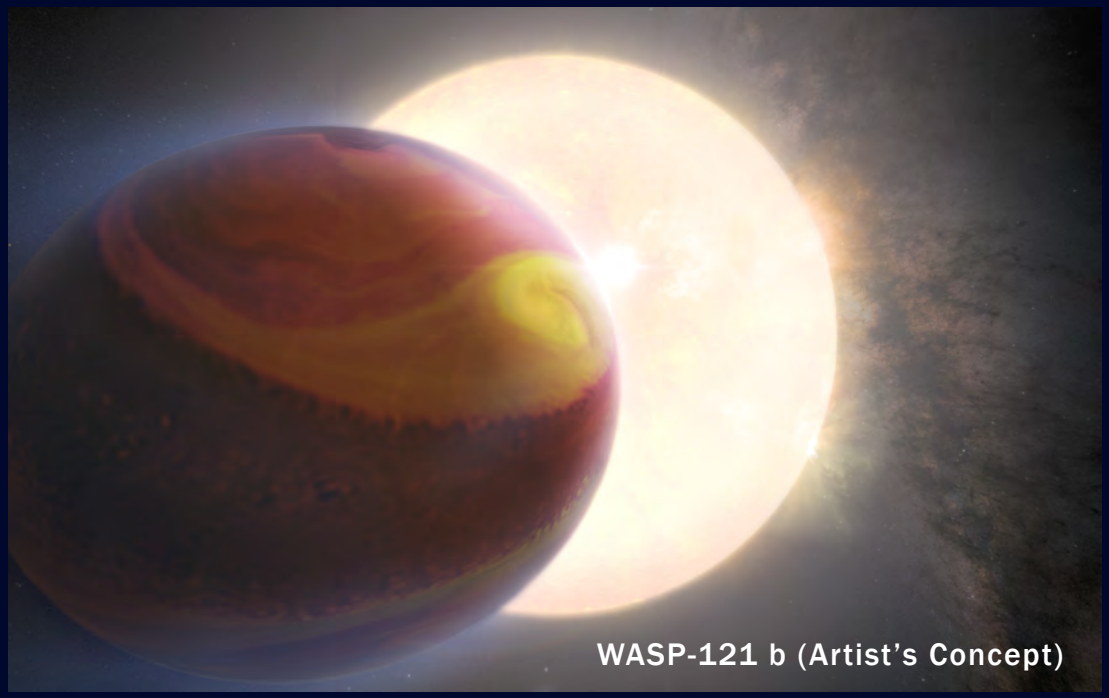
NASA's Hubble Observes Exoplanet Atmosphere Changing Over 3 Years

4 Jan 2024

By combining several years of observations from NASA's Hubble Space Telescope WFC3 instrument along with conducting computer modelling, astronomers have found evidence for massive cyclones and other dynamic weather activity swirling on a hot, Jupiter-sized planet 880 light-years away. They also detected an apparent offset between the exoplanet's hottest region and the point on the planet closest to the star, as well as variability in the chemical composition of the exoplanet's atmosphere (as measured via spectroscopy).

WASP-121 b is so close to its parent star that the orbital period is only 1.27 days. This close proximity means that the planet is tidally locked so that the same hemisphere always faces the star. Daytime temperatures approach 3,450 degrees Fahrenheit (2,150 degrees Kelvin) on the star-facing side of the planet.

Science Credit:
NASA, ESA, Quentin Changeat (ESA/STScI)



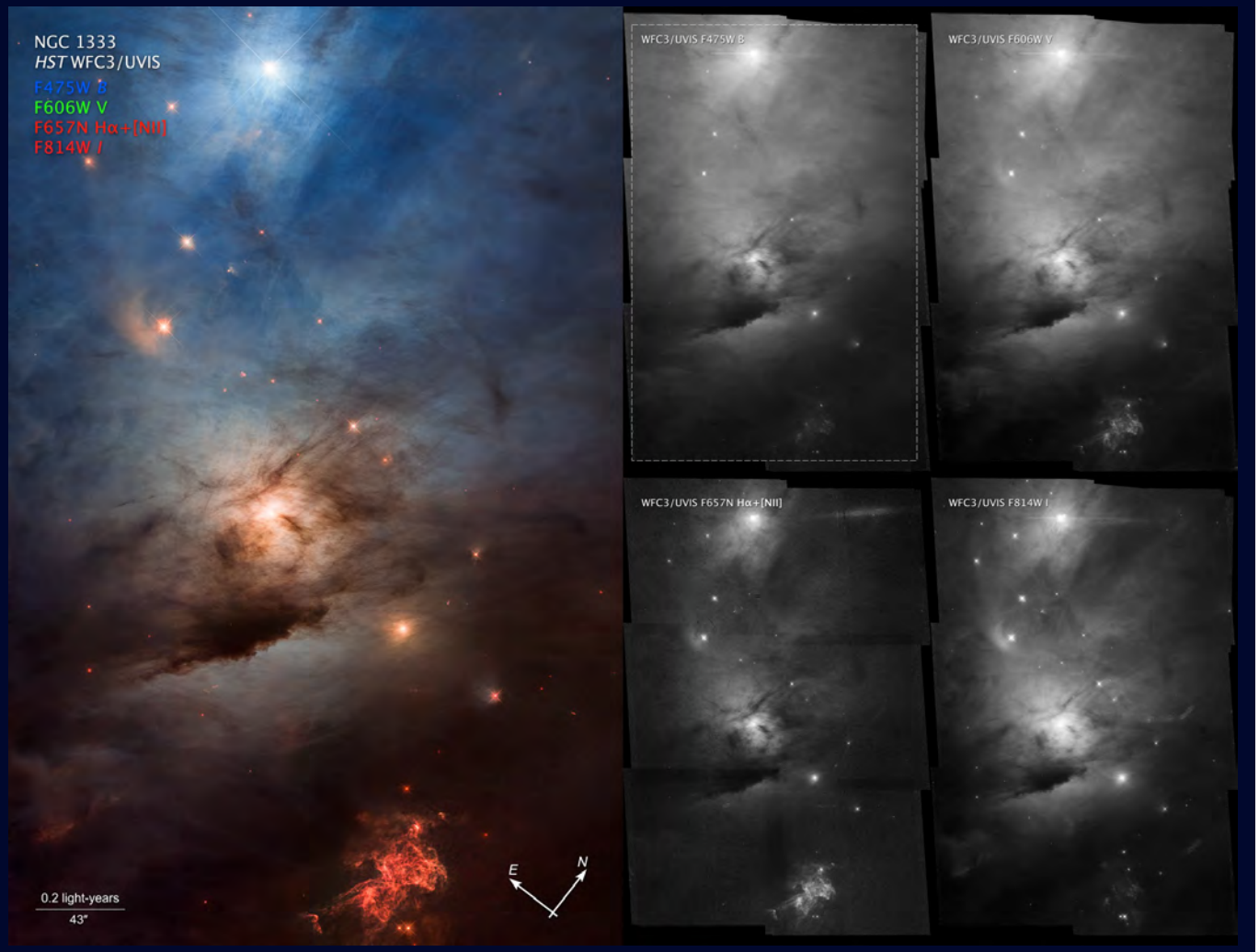
HST 33rd Anniversary Image

20 Apr 2023

Astronomers are celebrating NASA's Hubble Space Telescope's 33rd launch anniversary with an ethereal photo of a nearby star-forming region, NGC 1333. The nebula is in the Perseus molecular cloud, and located approximately 960 light-years away.

Hubble's colorful view, showcased through its unique capability to obtain images from ultraviolet to near-infrared light, unveils an effervescent cauldron of glowing gasses and pitch-black dust stirred up and blown around by several hundred newly forming stars embedded within the dark cloud.

Science: NASA, ESA, STScI
Image processing: V. Bajaj, J. DePasquale, and J. Mack (STScI)



Supernova Bubble Expands in New Hubble Time-Lapse Movie

Sep 2023

Astronomers used HST to observe very small slice of the leading edge of the Cygnus Loop, an expanding supernova bubble, where the supernova blast wave plows into surrounding material in space. HST images taken from 2001 to 2020 clearly demonstrate how the remnant's shock front has expanded over time, and they used the crisp images to clock its speed.

By analyzing the shock's location, astronomers found that the shock hasn't slowed down at all in the last 20 years, and is speeding into interstellar space at over half a million miles per hour – fast enough to travel from Earth to the Moon in less than half an hour. While this seems incredibly fast, it's actually on the slow end for the speed of a supernova shock wave. Researchers were able to assemble a "movie" from Hubble images (see online press release) for a close-up look at how the tattered star is slamming into interstellar space.

Image credits
NASA, ESA, STScI, and R. Sankrit

Hubble Sees a Glittering Globular Cluster Embedded Inside Our Milky Way

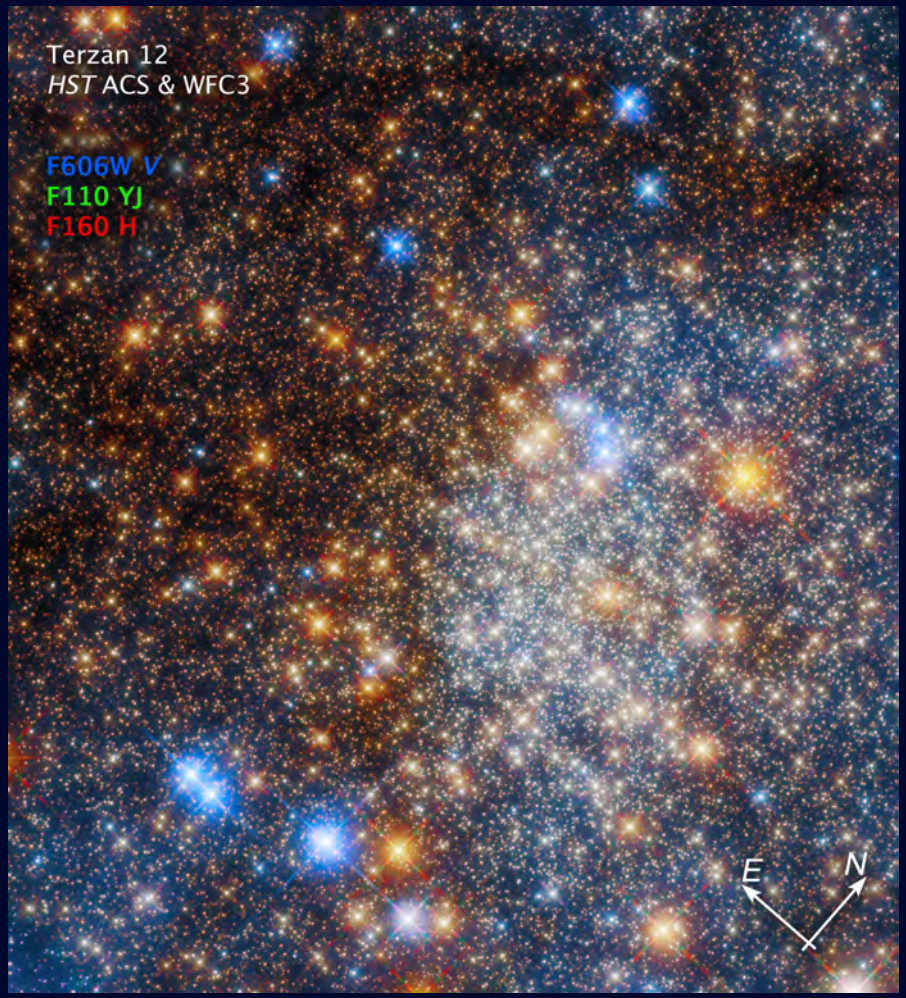
Sep 2023

This image of the globular star cluster Terzan 12 is a spectacular example of how dust in space affects starlight coming from background objects.

The location of this globular cluster, deep in the Milky Way in the constellation Sagittarius, means that it is shrouded in gas and dust which absorb and alter the starlight emanating from Terzan 12. The cluster is ~15,000 light-years from Earth. This location leaves a lot of room for intervening interstellar dust particles between us and the cluster to scatter blue light, causing only the redder wavelengths to come through to Earth. The interstellar dust clouds are mottled so that different parts of the cluster look redder than other parts along our line of sight.

The brightest red stars in the photo are bloated, aging giants, many times larger than our Sun. They lie between Earth and the cluster. Only a few may actually be members of the cluster. The very brightest hot, blue stars are also along the line of sight and not inside the cluster, which only contains aging stars.

Credit: NASA, ESA, ESA/Hubble, Roger Cohen (RU)



HST Traces ‘String of Pearls’ Star Clusters in Galaxy Collisions

Feb 2024

Long Trail of Clumpy Stars Follows Galaxy Interactions

When galaxies go bump in the night, they cook up new generations of stars that might otherwise have never been born. These close encounters between galaxies cause a gravitational tug-of-war, and gas and dust are drawn out into large streamers. The Hubble Space Telescope's vision is so sharp that it can see clusters of newborn stars strung along these tidal tails. They form when knots of gas gravitationally collapse to create about 1 million newborn stars per cluster. These "string of pearls" features are probably more common in the early universe when galaxies collided more frequently.

The image at right was created with Hubble data (WFPC2 and WFC3) from proposals: 11134 (K. Knierman) and 14937 (M. Rodruck).

Science credit: Michael Rodruck (Randolph-Macon College, Ashland, Virginia)

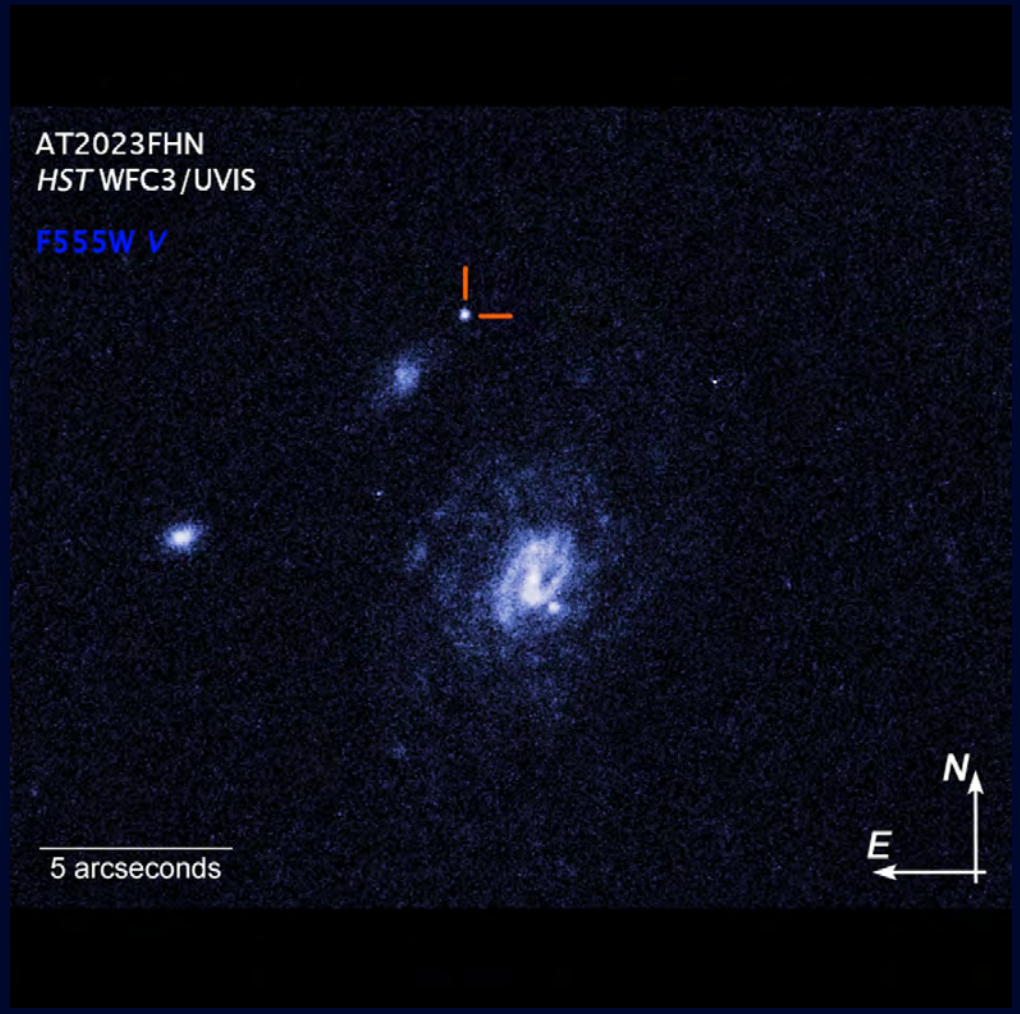
Hubble Finds Bizarre Explosion in Unexpected Place

Oct 2023

A very rare, strange burst of extraordinarily bright light in the universe just got even stranger thanks to HST. The phenomenon, called a Luminous Fast Blue Optical Transient (LFBOT), flashed onto the scene where it wasn't expected to be found, far away from any host galaxy. LFBOTs are among the brightest known visible-light events in the universe, going off unexpectedly like camera flashbulbs. Only a handful have been found since the first discovery in 2018 .

The latest LFBOT was observed by multiple telescopes across the electromagnetic spectrum, from X-rays to radio waves. Designated AT2023fhn and nicknamed "the Finch," the event showed all the tell-tale characteristics of an LFBOT. It shone intensely in blue light and evolved rapidly, reaching peak brightness and fading in a matter of days, unlike supernovae, which take weeks or months to dim. But, unlike any other LFBOT seen before, Hubble found that the Finch is located between two neighboring galaxies – about 50,000 light-years from a nearby spiral galaxy and about 15,000 light-years from a smaller galaxy.

Image credits
NASA, ESA, STScI,
Ashley Chrimes (ESA-ESTEC/Radboud University)



Dwarf Irregular Galaxy UGC 8091

20 Dec 2023

The dwarf galaxy is approximately 7 million light-years from Earth in the constellation Virgo. It is considered an "irregular galaxy" because it does not have an orderly spiral or elliptical appearance. Instead, the stars that make up this celestial gathering look more like a brightly shining tangle of string lights than a galaxy.

The data used in this image were taken by Hubble's Wide Field Camera 3 and the Advanced Camera for Surveys from 2006 to 2021. Twelve camera filters were combined to produce this image, with light from the mid-ultraviolet through to the red end of the visible spectrum. The red patches are likely interstellar hydrogen molecules that are glowing because they have been excited by the light from hot, energetic stars. The other sparkles on show in this image are a mix of older stars. An array of distant, diverse galaxies appear in the background, captured by Hubble's sharp view.

Media Contacts: Ray Villard (STScI)
Bethany Downer (ESA/Hubble)

FRB 20220610A

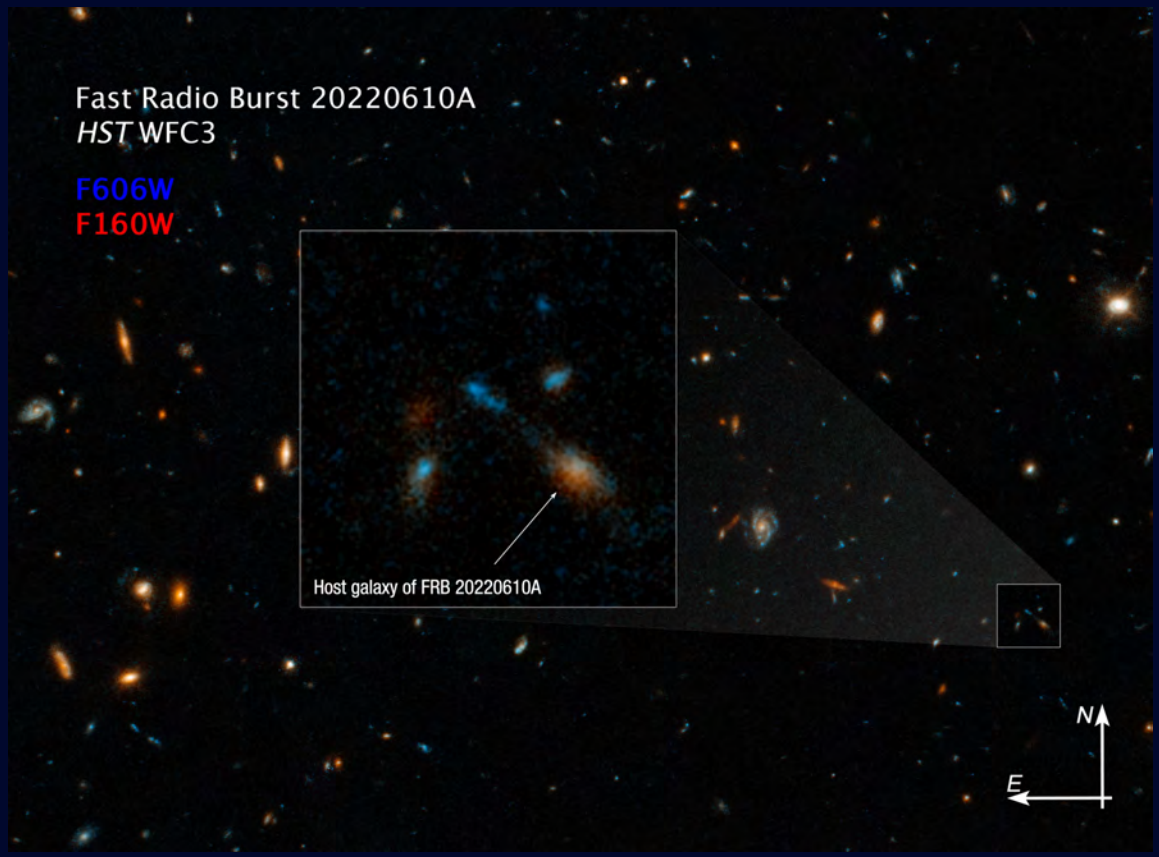
09 Jan 2024

Enigmatic Flash of Energy Comes from Merging Galaxies
Astronomers using NASA's Hubble Space Telescope have found a rare event in an oddball place.

It's called a fast radio burst (FRB), a fleeting blast of energy that can – for a few milliseconds – outshine an entire galaxy. Hundreds of FRBs have been detected over the past few years. They pop off all over the sky like camera flashes at a stadium event, but the sources behind these intense bursts of radiation remain uncertain.

This new FRB is particularly weird because it erupted halfway across the universe, making it the farthest and most powerful example detected to date. And if that's not strange enough, it just got weirder based on the follow-up Hubble observations made after its discovery. The FRB flashed in what seems like an unlikely place: a collection of galaxies that existed when the universe was only 5 billion years old. The large majority of previous FRBs have been found in isolated galaxies.

Science: NASA, ESA. Alexa Gordon (Northwestern University, Evanston, Illinois)



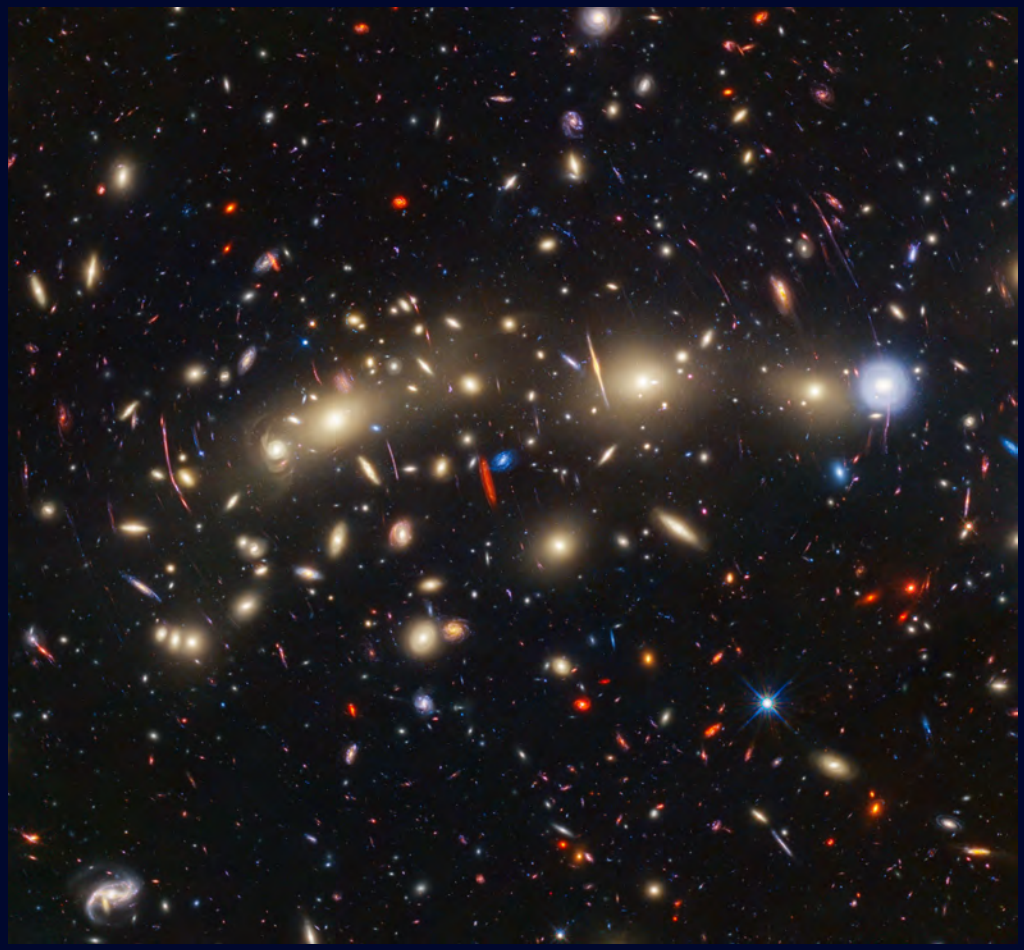
NASA's Webb, Hubble Combine to Create Most Colorful View of Universe

09 Nov 2023

This panchromatic view of galaxy cluster MACS0416 is a composite of separate exposures acquired by the Hubble and Webb Space Telescopes using the ACS, WFC3, and NIRCam instruments. To make the image, in general the shortest wavelengths of light were color-coded blue, the longest wavelengths red, and intermediate wavelengths green. The resulting wavelength coverage, from 0.4 to 5 microns, reveals a vivid landscape of galaxies that could be described as one of the most colorful views of the universe ever created.

The image reveals a wealth of details that are only possible by combining the power of both space telescopes. It includes a bounty of galaxies outside the cluster and a sprinkling of sources that vary over time, likely due to gravitational lensing – the distortion and amplification of light from distant background sources.

Media Contact: Christine Pulliam (STScI)



Dual Quasars

05 Apr 2023

The early universe was a rambunctious place where galaxies often bumped into each other and even merged together. Using NASA's Hubble Space Telescope and other space and ground-based observatories, astronomers investigating these developments have made an unexpected and rare discovery: a pair of gravitationally bound quasars, both blazing away inside two merging galaxies. They existed when the universe was just 3 billion years old.

Quasars are bright objects powered by voracious, supermassive black holes blasting out ferocious fountains of energy as they engorge themselves on gas, dust, and anything else within their gravitational grasp.

"We don't see a lot of double quasars at this early time in the universe. And that's why this discovery is so exciting," said graduate student Yu-Ching Chen of the University of Illinois at Urbana-Champaign, lead author of this study.

Science: NASA, ESA. Yu-Ching Chen (UIUC), Hsiang-Chih Hwang (IAS), Nadia Zakamska (JHU), Yue Shen (UIUC)