

Program: Visualizing Hubble's Colorful Universe (via Zoom)

Speaker: Zolt Levay, Space Telescope Science Institute (retired)

Introduced by: Alan Schmidt

Attendance: 87 devices logged in (sometimes multiple people viewing a single device)

Scribe: Hank Wolfla

Editor: Carl Warner

The Zoom copy of today's presentation lives on the Sciencetech Club website and can be accessed by clicking on: <http://www.sciencetechclub.org/zoom/458.mp4>

Zolt started with a summary of his talk that included highlights of images, an overview of outreach imaging, and showed case studies from the Hubble Space Telescope (HST).

The images are real photographs of real places, and the HST is a powerful force in science and public imagination. Its power comes from its location in space. Hubble is about the size of a school bus. The design of the telescope was started in the 1970's but it did not reach space until the 1990's. Hubble has been in operation for over 30 years and has been serviced 5 times for repairs and upgrades. Hubble's operation is complicated by the fact that physical service went away with the space shuttle making its longevity even more amazing. The update to a new near infrared camera has allowed it to make many of its major advances in science. It uses a guidance system comprised of 3 gyros and precision sensors locking on stars that allow it to be held to 7/1000 of an arc second stability and then be moved by adjusting the speed of the gyros.

The data from the telescope's 94 inch primary mirror translates the invisible into the visible. It uses multiple scientific instruments that include UV, visible, near IR imaging as well as spectroscopy, astrometry, and photometry. This data is obtained by ACS (Advanced Camera for Surveys), COS (Cosmic Origins Spectrograph), FGS (Fine Guidance Sensors), NICMOS (Near Infrared Camera and Multi-object Spectrometer), STIS (Space Telescope Imaging Spectrograph) and WFC3 (Wide Field Camera 3) that provide the scientists with observational "gold". The data from these instruments maximize information content while permitting a balance of aesthetics and science. The motivation for this is not to make "pretty pictures", but to visualize the invisible data and engage the public; it satisfies part of the NASA/Congress mandate to publicize and explain results to the funding taxpayers and next generation of explorers. Astronomy images are closer to art photography, specifically outdoor nature photography.

Zolt then shared a number of images that he worked with so we could appreciate that the Hubble is a general purpose telescope able to provide us views of space from our nearby neighborhood, our solar system, to many wonders within our home Milky Way Galaxy, to distant galaxies and the far reaches of the universe. Hubble provides a stream of dramatic, colorful pictures of space landscapes that complement and illustrate the analytic scientific results and allows us to re-image the look of space. The images are a by-product of science, using the same exquisite data to visualize the targets of scientific inquiry, at once aesthetically abstract, but also entirely representational. Using filters whose colors match the dominant emission of the elements, like oxygen at 502 nm (nanometer) visible as cyan (blue-green) and hydrogen at 657 nm and sulfur at 673 nm in the reds, processing can dramatically improve images, such as with the pillars of creation, making it more attractive and informative. Zolt used many images to show how this done with the instruments and filters, and how computer processing can turn just a black and white photo from the Hubble into the wonderful pictures we have seen in so many journals over the years. Remember, the HST does not have a color camera.

In his pictures he showed what Einstein theorized many years ago, that light is affected by gravity. He also showed in his pictures that the universe is expanding. We think of expanding as in a specific direction, but our universe is expanding in all directions at once.

It is difficult to tell a story about the images from the HST without the images and the narration that Zolt provided. For that reason, please take some time to enjoy the outstanding presentation the club received today with the video link above. He recommended the Mikulsk Archive – Space Telescopes

publication (<https://www.stsci.edu/> and <http://archive.stsci.edu/>) as an excellent review of how infrared is used in the mosaic of the Horsehead Nebula. Also see <https://hubblesite.org/> and <https://hubblesite.org/hubble-30th-anniversary/images> for much more.



Zoltan Levay (from Hubblesite.org)