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## Hubble Space Telescope Turns 25, With Discoveries and Drama Galore

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To appreciate the full significance of the \$2 billion orbiting observatory's place in science and culture, you have to factor in the human drama behind Hubble's ups and downs, said Mario Livio, an astrophysicist at the Baltimore-based Space Telescope Science Institute.

"What has been very unique to Hubble is that it has really taken the excitement of discovery, which normally only the scientists involved enjoy, and has made the general public part of that," Livio told NBC News.

### **How the Hubble Telescope Has Changed the Way We See Space**

NBC News

The idea of sending a large, general-purpose telescope into orbit dates back to the 1940s, when namesake astronomer [Edwin Hubble](#) was still working out the implications of his discovery that the universe was expanding. Scientists and engineers built the instrument over the course of a decade — but Hubble's "birth" is marked on the calendar as April 24, 1990, when the 43.5-foot-long (13.2-meter-long) telescope was launched into space aboard the shuttle Discovery.

After Hubble was deployed, astronomers assumed the drama was over. But the first fuzzy pictures to come down revealed that [something had gone horribly wrong](#). Eventually, the Hubble team figured out that the curve of the telescope's main mirror was off by about a

millimeter — enough to ruin the focus.

"We went from being the heroes of the science world to just wanting to hide," said John Troeltzsch, a project manager at Ball Aerospace who was part of the Hubble crisis team and is now working on the [Sentinel space telescope](#).

## Recalling redemption

The story of how scientists, engineers and astronauts redeemed themselves and rescued the telescope — by installing corrective lenses during a series of five high-tension spacewalks in 1993 — is being recounted repeatedly this week for the 25th anniversary of Hubble's launch:

- PBS is presenting the premiere of a "NOVA" documentary titled ["Invisible Universe Revealed"](#) on Wednesday, with Livio and other luminaries putting Hubble's past, present and future in context.
- The National Geographic Channel is airing ["Hubble's Cosmic Journey,"](#) narrated by astrophysicist Neil deGrasse Tyson.
- Hubble images are being [flashed up on giant screens](#) several times an hour at New York's Times Square, and the movie ["Hubble 3D"](#) is being featured at selected IMAX theaters across America.
- NASA is set to unveil the official [Hubble 25th-anniversary image](#) at the Newseum in Washington on Thursday.

The drama has continued since the '90s for most of Hubble's life. Four more space shuttle missions were devoted to upgrading Hubble's instruments, including a [final overhaul](#) in 2009 that [almost didn't happen](#).

"The whole story of Hubble being renewed is really critical to its success," said Patrick McCarthy, who was part of the science team for the telescope's Wide Field Camera 3 and is now director of the [Giant Magellan Telescope Organization](#).

## [Audio: Spacewalker Story Musgrave on Hubble's Meaning](#)

## Quantity and quality

Hubble's orbital odometer has now passed the 3.4 billion-mile (5.5 billion-kilometer) mark, and from its 350-mile-high (560-kilometer-high) orbit, it has sent back more than a million observations that tally up to more than 100 trillion bytes of data.

The discoveries are notable for their quality as well as their quantity:

- The telescope's observations of a special kind of supernova were crucial to the discovery that the universe was dominated by a mysterious factor known as [dark energy](#), which appears to be behind the accelerating expansion of the universe. The discoverers won the [Nobel Prize for physics in 2011](#).
- Hubble set records for its [far-seeing views of the cosmos](#). Those views showed that galaxies started forming earlier in the universe's history than scientists expected, and that

they [look very different](#) from the galaxies that are closer to us in time and space.

- Studies of how the universe has changed over time, made possible by Hubble and other space observatories, helped physicists narrow down their estimates of the observable universe's age to [13.8 billion years](#).
- Hubble's detailed observations of gravitational interactions in distant galaxies led scientists to conclude that there are [supermassive black holes](#) at the centers of virtually all large galaxies — [including our own](#).
- Hubble provided amazing shots of [Mars](#), [Jupiter](#) and [Saturn](#), [charted new moons and rings around Uranus](#), and spotted [four previously unknown moons of Pluto](#). Its observations of [Comet Shoemaker-Levy 9's crash into Jupiter](#) was a wake-up call about cosmic impacts.
- The telescope and its team also helped get the ball rolling for [the study of planetary systems beyond our own](#). Last year, scientists used Hubble's observations to produce the [best weather map ever created for an extrasolar planet](#).

Exotic discoveries aren't the only reasons for Hubble's popularity. It was built to provide pictures across a wide range of wavelengths, from ultraviolet to near-infrared, but the sweet spot is in the visible part of the spectrum. "Hubble provides the images that match your eyeballs," said Mark LaPole, director of advanced imaging at Ball Aerospace.

The result? Looking at Hubble's pictures make you feel as if you're on the final frontier yourself — even though the colors on that frontier might sometimes be [artificially enhanced](#).

## [Gallery: Classic Hits From Hubble](#)

### **Mission accomplished?**

So what's next for Hubble? Six years ago, the final servicing mission left the space telescope in its best condition ever. "The telescope has been performing extremely well," said Ken Sembach, the head of the Hubble mission at the Space Telescope Science Institute. For now, the discoveries will continue.

The next big project on the horizon is the \$8.8 billion [James Webb Space Telescope](#), which is on track for launch in late 2018 after a series of cost overruns and schedule slips. JWST, which is named after [NASA's second administrator](#), is bigger and more powerful — with a foldable 21-foot (6.5-meter) mirror that dwarfs Hubble's 8-foot (2.4-meter) primary mirror.

But the Webb telescope is not designed to be serviced in space. Instead, it will be on its own, a million miles from Earth at a [vantage point known as Earth-Sun L2](#). It's also optimized to see infrared wavelengths rather than visible light.

NASA wants Hubble to last until at least 2020, so that there's some overlap with JWST's observations of far-off galaxies and exoplanets. A new generation of ground-based telescopes, including the Giant Magellan Telescope, also will complement those observations. There's talk about even farther-out space telescopes to come, including a [Wide-Field Infrared Survey Telescope](#), or WFIRST, and a [12-meter space telescope](#) capable of analyzing exoplanetary atmospheres.

"If we learned a lesson from Hubble, it's that we shouldn't be afraid to think big," Livio said.

During that last servicing mission, Hubble was outfitted with a docking adapter that would make it easier for a robotic tug to pull the telescope down to its destruction in a controlled atmospheric re-entry — perhaps sometime in the 2030s. But LaPole hopes that Hubble will last long enough to allow for yet another service call, perhaps by astronauts riding [new breeds](#) of [spaceships](#).

"All of us folks who work on it would love to see that happen," LaPole told NBC News. "It's our child, and we want to see it continue."

### [\*\*Flash Interactive: How Hubble Works\*\*](#)

*This report has been corrected to reflect the fact that the shuttle Atlantis, rather than Discovery, took on the final Hubble servicing mission.*