National Aeronautics and Space Administration

THE STAR WITNESS

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Special Feature

Hubble's Picture Book of the Universe

By NASA's Amazing Space reporters
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IN 1990, GEORGE BUSH SR. was the U.S. president, the Nintendo video game system, Game Boy, was not on the U.S. market, the World Wide Web did not exist for people to "surf" for information, and NASA's Hubble Space Telescope was launched into Earth orbit.

Astronomers had dreamed since the 1940s about launching a visible-light telescope into space. Ground-based telescopes are hampered by our Earth's atmosphere, which blurs the light from stars and makes them appear to twinkle.

That dream came true on April 24, 1990, when NASA launched Hubble aboard the space shuttle Discovery. The observatory is the first space-based visible-light telescope, orbiting about 380 miles (611 kilometers) from Earth. Hubble also sees in ultraviolet and near-infrared

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IMAGE: NASA, ESA, and STScI

"Eye" on the universe: The Hubble Space Telescope sports its new solar panels, installed in 2002. The telescope orbits 380 miles above Earth. NASA launched the bus-sized telescope aboard the space shuttle Discovery on April 24, 1990.

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light. The telescope is named after U.S. astronomer Edwin P. Hubble who, early last century, discovered galaxies beyond our Milky Way and determined that space is expanding.

The telescope is a behemoth: the size of a school bus (43.5 feet or 13.3 meters long) and weighing more than 12 tons (11,000 kilograms). Its primary mirror is 94.5 inches wide (2.4 meters). The tubular-shaped spacecraft looks like it has wings. These wings, however, are not used to fly. They are made up of solar panels, which collect light from the Sun to help power the spacecraft's instruments.

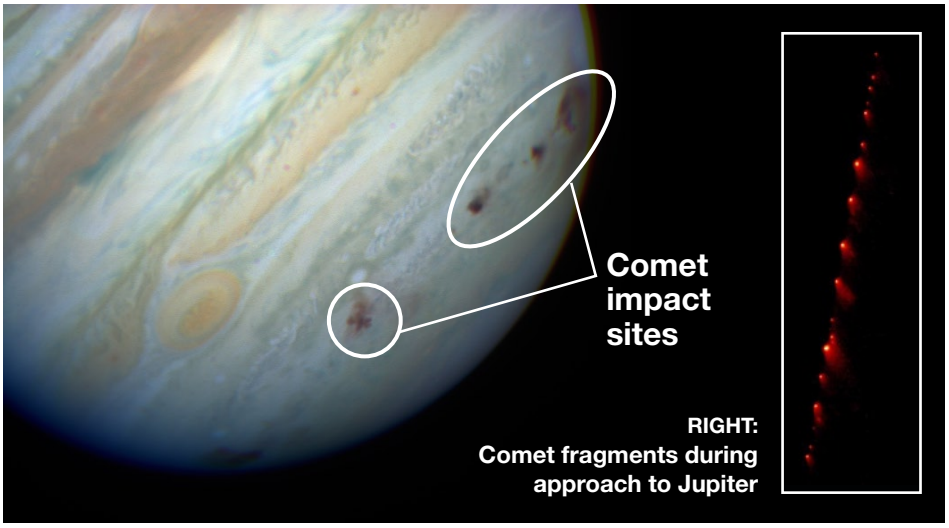
Hubble is the first of NASA's four Great Observatories, a series of space-borne telescopes designed to view the sky over many different wavelengths (visible, gamma rays, X-rays, and infrared). The second was the Compton Gamma Ray Observatory, in operation from April 1991 to June 2000. The other two Great Observatories are the Chandra X-ray Observatory, launched in July 1999, and the Spitzer Space Telescope, which sees in infrared light and was sent into space in August 2003.

The Hubble telescope is helping astronomers answer many important questions about the universe and is bringing pictures of many celestial objects into sharper view.

A sampler of "Greatest Hits"

Some of Hubble's biggest contributions to astronomy include witnessing a shattered comet plunge into Jupiter's atmosphere, studying planets outside our solar system, and providing the deepest views of the universe in ultraviolet, visible, and near-infrared light.

Jupiter's battle scars



ABOVE: Hubble Space Telescope Comet Team and NASA; INSET, right: STScI and NASA

Astronomers witnessed a rare event in 1994 when they watched the shattered comet Shoemaker-Levy 9 smash into Jupiter piece by piece. (Inset, above right, shows the comet fragments as they approached the planet.) This was the first time that scientists knew in advance where to view the collision of two bodies in space. The comet pieces left a line of dark smudges (circled on photo) after hitting Jupiter's upper atmosphere.

Caught in the act: A comet slams into Jupiter

Imagine setting off every atomic bomb on Earth all at once. Now imagine repeating such a titanic explosion two dozen times in a week! Unleashing such energy would destroy Earth's surface, but the giant planet Jupiter hardly flinched when it underwent such a catastrophe in 1994. Hubble provided a ringside seat to a once-in-a-millennium event when nearly two-dozen chunks of a comet smashed into Jupiter. Hubble provided dramatic images of massive explosions that sent towering mushroom-shaped fireballs of hot gas into Jupiter's sky. The doomed comet, called Shoemaker-Levy 9, had been pulled apart two years earlier by Jupiter's gravity. Each impact left temporary black marks in Jupiter's atmosphere.

Spying planets orbiting other stars

Hubble's sharp "eye" also contributed to a greater understanding of planets outside our solar system, called extrasolar planets. Astronomers using ground-based telescopes to hunt for extrasolar planets have discovered more than 100. They needed Hubble, however, to make the first direct measurement of the chemical makeup of the atmosphere of an extrasolar planet. The telescope detected the elements sodium, hydrogen, carbon, and oxygen in the planet's atmosphere. The unique observation demonstrates that Hubble and other telescopes can sample the chemical makeup of the atmospheres of distant planets. Astronomers could use the same technique someday to determine whether life exists on extrasolar planets.

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Glimpsing the early universe

Looking much farther away, Hubble provided astronomers with a "scrapbook" full of snapshots of the early universe. The scrapbook photographs revealed young galaxies that existed billions of years ago, long before the Earth and Sun were born. The telescope snapped the pictures of the "deep" universe in a series of unique observations, called the Hubble Deep Fields, the Great Observatories Origins Deep Survey, and the Hubble Ultra Deep Field. The observations provided the deepest views of the cosmos in visible, ultraviolet, and near-infrared light. Through these observations, astronomers can witness how galaxies form. By studying galaxies at different eras, astronomers can see how galaxies change over time.

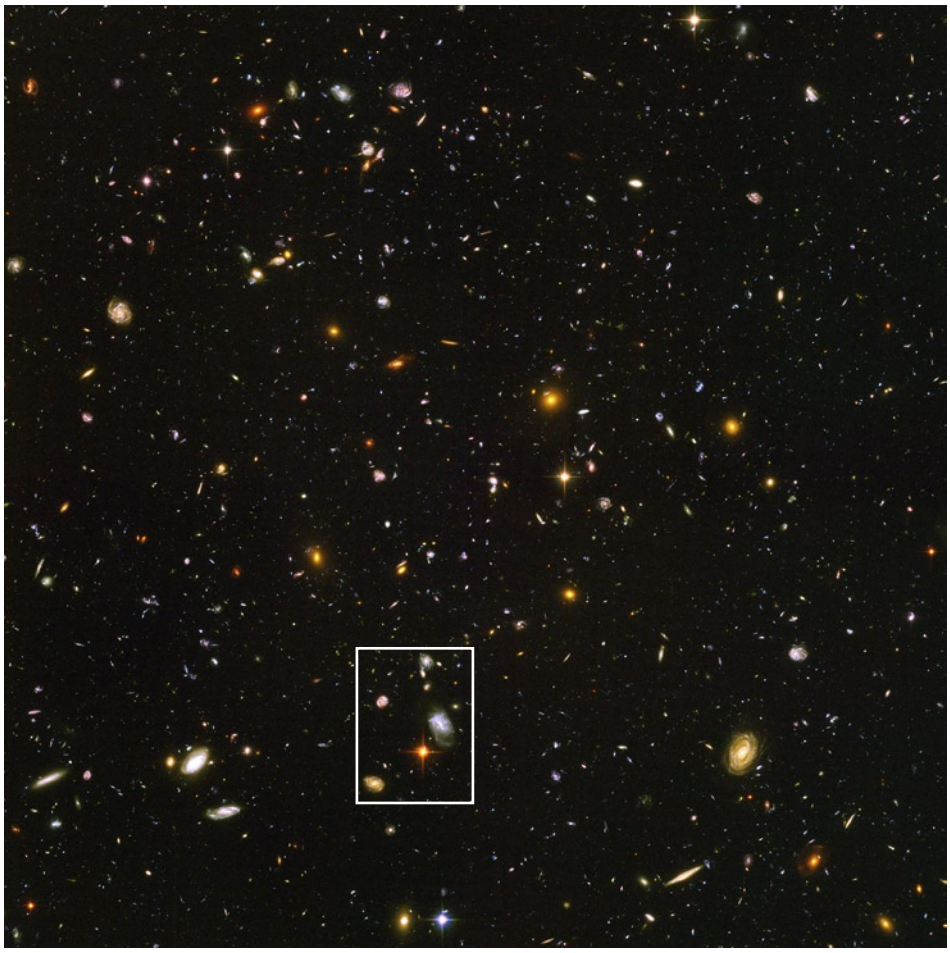
Telescope teamwork

Although Hubble has taken many jaw-dropping photographs of celestial objects, it does not always work alone. Sometimes astronomers must look at an object through the eyes of several telescopes that see different wavelengths of light. Hubble sees in ultraviolet, visible, and near-infrared light. Other telescopes — both ground- and space-based — see in wavelengths such as X-rays, gamma rays, and infrared light. By combining Hubble with those telescopes, astronomers get a more complete view of an object.

Looking to the future

Astronomers will continue to use Hubble and other telescopes to study the universe. Like detectives searching for clues to a crime, astronomers are hunting for evidence to solve many questions about our universe. Are there other worlds in space where life exists? Where did we come from?

The Hubble Ultra Deep Field



In the full Hubble Ultra Deep Field (at left, with detail enlargement below, right), Hubble uncovered 10,000 galaxies, most of which existed before Earth was born. Since the light from these distant galaxies must travel for billions of years before arriving at Earth, we are seeing the galaxies as they appeared when the light left them, billions of years ago. (NOTE: The bright orange object with a distinctive cross shape is a star, not a galaxy. A cross shape is created when a star's very bright light travels through the telescope.)

IMAGES: NASA, ESA, S. Beckwith (STScI), and the HUDF Team

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