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THE SURVEY OF HUBBLE TELESCOPE

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Abstract: **NASA's Hubble telescope will revolutionize our understanding of the galaxy. The concept of a large telescope in space is as old as the space program itself. In a classified study in 1946, Lyman Spitzer first articulated the scientific and technical rationale for space astronomy. He continued to be the champion of the dream of a large telescope in space until it was realized. Supported by colleagues John Bahcall, George Field, and others, Spitzer was a tireless advocate within the astronomical community, to the public, and to the Federal Government. The outcome was a "new start" for the mission, authorized by Congress in 1977.**

In this paper we summarize the development of Hubble telescope including working, assembly, inspection and maintenance.

Keywords: **Hubble telescope, galaxy, spitzer telescope, reflector.**

OBJECTIVES

- To understand the concept of Hubble telescope
- To familiarize with parts of the Hubble telescope
- To know the working of the Hubble telescope

1. INTRODUCTION

The **Hubble Space Telescope** (abbreviated **HST** or **Hubble**) is a space telescope that was launched into low Earth orbit in 1990 and remains in operation. It was not the first space telescope, but it is one of the largest and most versatile and is well known as both a vital research tool and a public relations boon for astronomy. The Hubble telescope is named after astronomer Edwin Hubble and is one of NASA's Great Observatories, along with the Compton Gamma Ray Observatory, the Chandra X-ray Observatory, and the Spitzer Space Telescope.

One of the great pioneers of modern astronomy, the American astronomer Edwin Powell Hubble (1889–1953) started out by getting a law degree and serving in World War I. However, after practicing law for one year, he decided to "chuck law for astronomy and I knew that, even if I were second rate or third rate, it was astronomy that mattered."

Using the largest telescope of its day, a 2.5-meter reflector, he studied Andromeda and a number of other nebulae and proved that they were other star systems (galaxies) similar to our own Milky Way.

He devised the classification scheme for galaxies that is still in use today, and obtained extensive evidence that the laws of physics outside the galaxy are the same as on Earth—in his own words: "verifying the principle of the uniformity of nature."

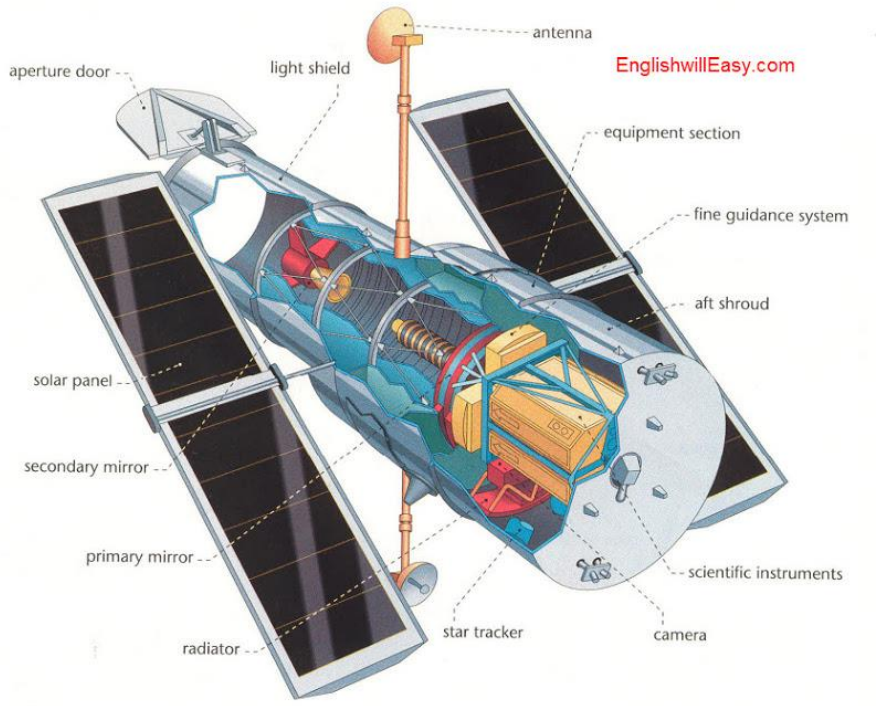

Fig.1. The Hubble Telescope

1.1 History

The Hubble telescope was built by the United States space agency NASA with contributions from the European Space Agency. The Space Telescope Science Institute (STScI) selects Hubble's targets and processes the resulting data, while the Goddard Space Flight Center controls the spacecraft.

Space telescopes were proposed as early as 1923. Hubble was funded in the 1970s, with a proposed launch in 1983, but the project was beset by technical delays, budget problems, and the Challenger disaster (1986). It was finally launched by Space Shuttle Discovery in 1990, but its main mirror had been ground incorrectly and created a spherical aberration, compromising the telescope's capabilities. The optics were corrected to their intended quality by a servicing mission in 1993.

2. PARTS OF HUBBLE TELESCOPE

2.1. Hubble mirror

The heart of the HST is its 94-inch-diameter Cassegrain mirror with a 24-inch center hole. Construction and assembly of the space mirror was a painstaking process spanning almost a decade. Corning Glass Works fabricated the 13-inch-thick blank mirror made of ultra-low expansion glass. To accommodate changing temperatures, they designed it in the form of a sandwich that had a honeycomb core (alternating hexagonal sections of glass and hollow voids) 10 inches thick fused between 1.5-inch-thick solid glass front and back plates. In addition to allowing the glass to expand and contract without cracking, this design reduced the weight. A solid core mirror blank of the same size would weigh 12,000 pounds; Hubble's weighed only 2,400 pounds. The cooling processes took three months to drop from the 2,156 degrees Fahrenheit liquid mass down to room temperature.

Fig.2.1. Hubble Mirror

2.2. Blurred vision

When the HST was launched, an optimistic NASA spokesperson called the telescope a new window on the universe. Entering orbit, all systems functioned properly when astronomers sent the remote signal to open the door that covered the telescope optics to take the first picture. The so-called first light occurred on May 20, 1990.

2.3. Hubble contact lens

As an alternative astronaut to make the repairs during a spacewalk. Optical engineers fabricated the Corrective Optics Space Telescope Axial Replacement (COSTAR) to correct the defective mirror. COASTER was essentially a contact lens for Hubble's huge eye.

2.4. Hubble camera

HST carries an array of four different types of cameras, all of which are mounted on an apparatus capable of positioning them, one at a time, at the end of the mirror to produce photographs. Three are responsible for capturing visible light and one for infrared, the slightly longer wavelength just beyond visible light. Each of the four cameras has a different function.

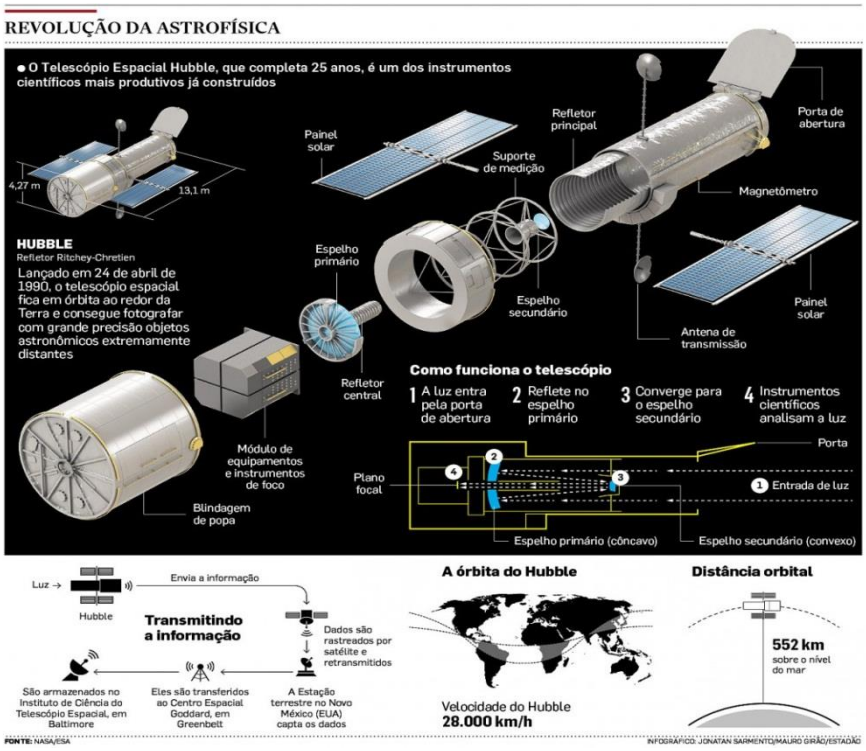

Fig.2.Parts of Hubble telescope

3. THE TWO TELESCOPES

3.1. Chandra x-ray observatory

The **Chandra X-ray Observatory** (**CXO**), previously known as the **Advanced X-ray Astrophysics Facility** (**AXAF**), is a Flagship-class space telescope launched on STS-93 by NASA on July 23, 1999. Chandra is sensitive to X-ray sources 100 times fainter than any previous X-ray telescope, enabled by the high angular resolution of its mirrors. Since the Earth's atmosphere absorbs the vast majority of X-rays, they are not detectable from Earth-based telescopes; therefore space-based telescopes are required to make these observations. Chandra is an Earth satellite in a 64-hour orbit, and its mission is ongoing as of 2019.

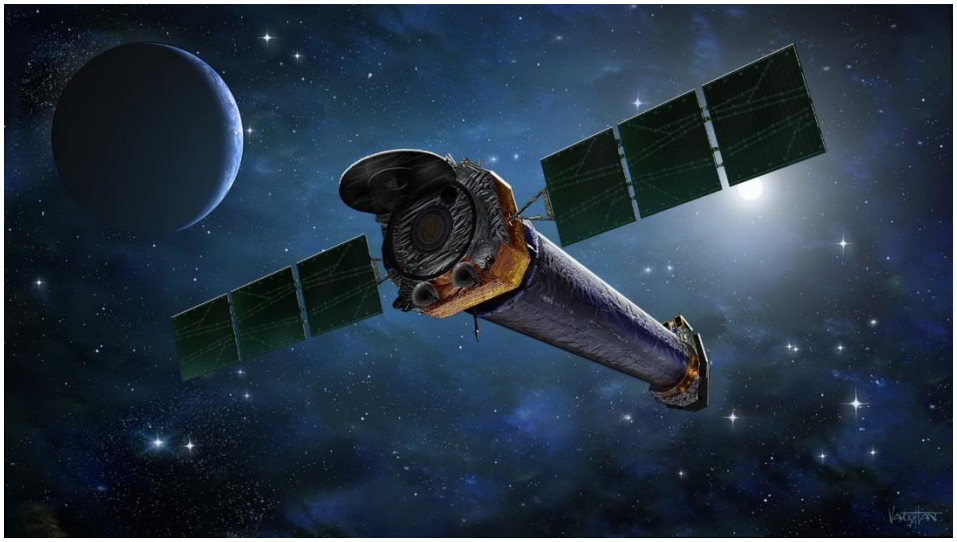

Fig.3.1. Chandra x-ray observatory

3.2. Spitzer space telescope

The **Spitzer Space Telescope** (**SST**), formerly the **Space Infrared Telescope Facility** (**SIRTF**), is an infrared space telescope launched in 2003 and still operating as of 2019.

The planned mission period was to be 2.5 years with a pre-launch expectation that the mission could extend to five or slightly more years until the onboard liquid helium supply was exhausted. This occurred on 15 May 2009. Without liquid helium to cool the telescope to the very low temperatures needed to operate, most of the instruments are no longer usable. However, the two shortest-wavelength modules of the IRAC camera are still operable with the same sensitivity as before the cryogen was exhausted, and have continued to be used to the present in the **Spitzer Warm Mission**. All Spitzer data, from both the primary and warm phases, are archived at the Infrared Science Archive (IRSA).

Fig.3.2. Spitzer space telescope

4. FEATURES

Table 4: Hubble telescope features

Mission duration	Elapsed: 29 years, 1 month, 10 days
Manufacturer	Lockheed (spacecraft) Perkin-Elmer (optics)
Launch mass	11,110 kg (24,490 lb)
Dimensions	13.2 m × 4.2 m (43.3 ft × 13.8 ft)
Power	2,800 watts
Launch date	April 24, 1990, 12:33:51 UTC
Rocket	Space Shuttle Discovery (STS-31)
Launch site	Kennedy LC-39B
Deployment date	April 25, 1990
Entered service	May 20, 1990
Regime	Low Earth
Eccentricity	0.000283
Inclination	28.47 °
Period	95.42 minutes
Velocity	7.59 km/s (4.72 mi/s)
Epoch	August 15, 2018, 21:40:27 UTC
Revolution no.	35,441

5. CONCLUSION

In this paper we define the development of Hubble Telescope, its various parts, their function. The Hubble telescope Program's storied history is vast and well documented. Understanding the design and operations of this unique and complex object is not confined to the study of one program, but of many. It touches on only a handful of the lessons that were learned through the various supersonic and hypersonic research programs that laid the foundation for Hubble telescope.

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