



ESO, Karl-Schwarzschild-Str.2  
D-85748 Garching bei München,  
Germany  
Telephone: +49 (0)89 3200 6855  
Telefax: +49 (0)89 3200 6480  
hubble@eso.org

[www.spacetelescope.org](http://www.spacetelescope.org)

**Keywords: discoveries, exoplanet, dark matter, dark energy, exoplanet, Hubble constant, Deep Field, black hole**

| <b>Hubblecast Episode 98: Hubble's biggest discoveries - part I</b>   | <b>Visual notes</b>  |
|---|--|
| <p>00:00<br/>[Narrator]<br/>1. Since its launch in 1990, Hubble has revolutionised many areas of astronomy. From imaging the most stunning phenomena in the cosmos, to studying invisible parts of the Universe, to observing the most distant objects ever seen.</p> <p>This is the first part of an exploration of some of Hubble's most important discoveries in its almost 27-year history.</p> |  |

00:30

Intro



00:42

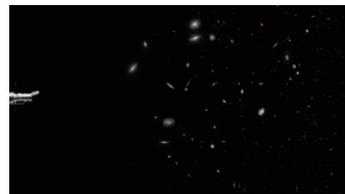
[Narrator]

2. Even before its launch, astronomers had already defined several important scientific goals for Hubble. Among them was the detailed study of the formation and evolution of galaxies.

In 1995, Hubble spent ten days observing a tiny patch of dark sky. However, when this image — the famous Hubble Deep Field — came back, it was not so dark after all.

In an area of sky with a width equal to just one twelfth that of the full Moon, Hubble had found almost 3 000 distant galaxies. Some of them existed only two billion years after the Big Bang. Their diminutive size and irregular structure strongly indicated that today's galaxies formed after smaller ones merged.

The survey was so successful that it was followed by the Hubble Ultra-Deep Field in 2004 and the eXtreme-Deep Field in 2012.



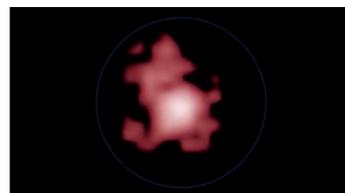
01:55

[Narrator]

However, the Deep Fields were far from being the only programmes to study the distant Universe. In recent years, the Frontier Fields have used clusters of galaxies as magnifying lenses to study objects that are otherwise too faint to be seen by Hubble.

In another survey, the most distant known object was discovered: this remote galaxy existed just 400 million years after the Big Bang.

In 2016, these deep images also helped to count the



total number of galaxies in the observable Universe:  
two trillion.

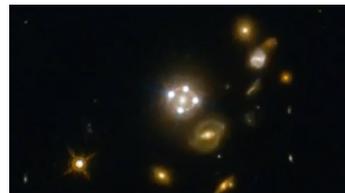
02:48

[Narrator]

3. Another scientific goal of Hubble was to determine the Hubble constant. This constant is a measurement of how fast the Universe is currently expanding — as discovered by the astronomer Edwin Hubble. As such, the Hubble constant is a key value needed to understand the cosmos.

Before Hubble's launch, estimates of the value of the constant differed by a factor of two. With the help of the telescope, astronomers were able to determine its value to a higher precision.

Even today, Hubble continues to measure this constant using different methods. However, the latest results indicate that the Hubble constant is different for the local and the primordial Universe. This hints at a problem at the very core of our understanding of the cosmos.



03:58

[Narrator]

4. With the precise measurements of the Hubble constant, the Hubble telescope was also able to determine the age of the Universe. Before its launch, estimates for the Universe's age ranged from 10 to 20 billion years. Now we are able to determine the age of the Universe to within a few million years.

Hubble observed stars with variable brightness — known as Cepheids — in distant galaxies. By doing so, astronomers were able to accurately determine the scale and age of the observable Universe.



04:40

[Narrator]

5. Hubble also played a critical role in one of the most groundbreaking discoveries of the 20th century: the accelerating expansion of the Universe.

It imaged distant supernova explosions, and by measuring how bright these explosions appeared to be, the distances to their host galaxies could be calculated.

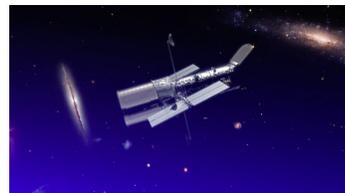
Hubble's accurate measurements, not possible from the ground, were crucial in showing that these supernovae were fainter than expected, and so the Universe's expansion must be speeding up. Astronomers now believe this expansion is driven by a mysterious dark energy.



05:28

With its sharp eye and precise measurements — made outside Earth's disruptive atmosphere — Hubble has revolutionised our knowledge of cosmology and the evolution of the Universe.

But these are far from the only important discoveries made by Hubble — more will be revealed in the second part of this double Hubblecast.



**End 06:47**