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<b>Hubblecast Episode 99: Hubble's biggest discoveries - part II</b>	<b>Visual notes</b>
<p>00:00</p> <p>1. To many, Hubble is best known for its stunning images of celestial objects. But among astronomers, it is admired for the valuable data it delivers, which have helped revolutionise many areas of astronomy over the past 27 years.</p> <p>This is the second part of an exploration of some of Hubble's most important discoveries throughout its history.</p>	

00:28

Intro



00:39

[Narrator]

In the first episode we saw how Hubble had explored the early Universe, calculated its age and helped in the search for the elusive dark energy.

Dark energy, however, was not the only invisible thing Hubble helped to reveal. The telescope carried out a survey to study a huge swathe of the night sky, searching for clues about the equally mysterious — but unrelated — dark matter.

Astronomers used Hubble to create a map of everyday, visible matter, from which they could trace the large-scale distribution of dark matter by studying how its gravitational presence distorted light in the images.

Maps like these are a key step in understanding this mysterious component of the Universe.



01:39

[Narrator]

7. While dark matter is still a mystery, Hubble lifted the veil surrounding the cosmic monsters that lurk at the centre of most galaxies: supermassive black holes.

Using its spectroscopic observing capabilities, Hubble peered into the galaxy cores and found that the stars there moved in tight orbits at enormous velocities. This strange behaviour indicated the presence of a truly colossal gravitational field — produced by a supermassive black hole. This was the first solid proof of their existence!

Today it is known that black holes are located in the centres of almost all galaxies. Some of them are very



active, consuming gas from their surroundings — and even whole stars!

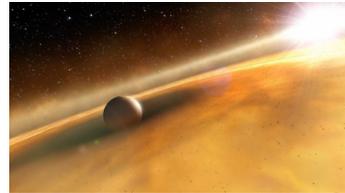
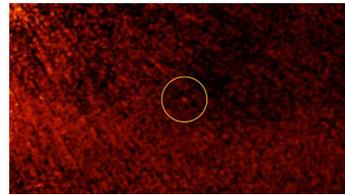
02:40

[Narrator]

8. In 2008, Hubble made something else visible for the first time. While studying the bright star Fomalhaut, the telescope discovered a tiny point of light in the extensive dusty ring surrounding it. Hubble turned its attention to planet hunting, taking the first direct visible-light image of a planet in another star system.

While not one of its original science goals, Hubble has since made a name for itself as an exoplanet explorer — in particular studying exoplanet atmospheres.

The chemical makeup of a planet's atmosphere leaves a unique fingerprint on the starlight that passes through it. In this way, Hubble analysed for the first time the atmosphere of a super-Earth, 40 light-years away. And in the future, Hubble could possibly find hints of life in one of these fingerprints.



03:50

[Narrator]

9. Beyond discovering and imaging exoplanets, Hubble has also revolutionised our overall understanding of planet formation.

Studying the Orion Nebula, Hubble made the stunning discovery that at least half of the stars in the region were surrounded by vast discs of rotating gas and dust — the raw materials necessary for the formation of planets.

Prior to Hubble's work, just one planetary system had ever been confirmed. Hubble's observations showed that planets are being formed around many more stars than previously thought, increasing the possibility that life could exist somewhere out there.



04:41

[Narrator]

Alongside planet formation, Hubble has always been interested in the birth, life and death of their parent stars.

Hubble's high resolving power has been crucial in the investigation of star formation regions, both in the Milky Way and in other galaxies; and its infrared capabilities have allowed it to peer through the thick clouds of dust and gas present in these regions.

The death of a star can be as beautiful and interesting as its birth. Hubble has observed both Sun-like stars as they come to the end of their lives in the form of planetary nebulae, and massive stars experiencing explosive deaths as supernovae.

By studying them at different times in their lives, Hubble has allowed us to paint a more complete picture of stars, the building blocks of galaxies.



05:57

[Narrator]

10. Throughout the last 27 years, Hubble — and nature itself — have continued to surprise us beyond our wildest imaginations. And there is no doubt that they will continue to do so in the future.



**Ends xx:xx**