

1  
00:00:08,960 --> 00:00:13,380  
HUBBLE... THE TELESCOPE THAT WAS SUPPOSED  
TO UNLOCK SOME OF THE BIGGEST MYSTERIES OF

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00:00:13,380 --> 00:00:17,890  
THE UNIVERSE ... WELL, IT DID ALL THAT, AND  
THEN SOME.

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00:00:17,890 --> 00:00:23,929  
Grunsfeld: Hubble, more than any of the others,  
had so much capability in its basic design

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00:00:23,929 --> 00:00:29,719  
that it allowed scientists to answer those  
questions, but in the process, many more questions

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00:00:29,719 --> 00:00:30,660  
popped up.

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00:00:30,660 --> 00:00:37,659  
Livio: Hubble's greatness was not so much perhaps  
in discovering entirely new things but in

7  
00:00:39,729 --> 00:00:46,729  
taking all kinds of hints and suggestions  
that we've had before on a variety of phenomena

8  
00:00:48,469 --> 00:00:53,230  
and turning those into actual facts.

9  
00:00:53,229 --> 00:00:59,038  
FOR EXAMPLE... WE'VE  
KNOWN FOR A LONG TIME THE UNIVERSE IS EXPANDING IN ALL

10  
00:00:59,039 --> 00:00:59,960  
DIRECTIONS

11  
00:00:59,960 --> 00:01:04,430  
Saul: The big question at the time was "how  
much was the universe slowing down" and

12  
00:01:04,430 --> 00:01:09,010  
the reason that this was such an exciting  
question was because that would tell you how

13  
00:01:09,010 --> 00:01:13,079  
much stuff there was in the universe that  
would gravitationally attract and slow the

14  
00:01:13,078 --> 00:01:13,688  
expansion.

15  
00:01:13,688 --> 00:01:18,408  
BUT ASKING THAT QUESTION LED TO ONE OF THE  
BIGGEST SURPRISES OF THE 20TH CENTURY... OUR

16  
00:01:18,409 --> 00:01:24,630  
UNIVERSE IS EXPANDING AT AN EVER FASTER RATE...  
UNDER THE PUSH OF WHAT'S BEEN CALLED "DARK

17  
00:01:24,629 --> 00:01:25,218  
ENERGY."

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00:01:25,218 --> 00:01:32,218  
Adam: Dark energy is this pretty mysterious  
component of the universe. It makes up about

19  
00:01:32,259 --> 00:01:37,420  
70% of the mass energy budget of the universe  
and its strange aspect is it appears

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00:01:37,420 --> 00:01:42,469  
to have kind of a repulsive gravity which  
is causing the universe to expand faster and faster.

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00:01:42,899 --> 00:01:47,549  
Saul: It's actually speeding up and that's  
bizarre... that's nothing that we expected

22  
00:01:47,549 --> 00:01:51,840  
and apparently, there's a new entity in  
the story that we had not taken into account.

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00:01:51,840 --> 00:01:57,200  
Adam: It's not often you discover most of  
the universe. That can only happen once.

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00:01:57,200 --> 00:02:04,200  
AND THAT DISCOVERY LED TO WORLD WIDE ACCLAIM

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00:02:12,120 --> 00:02:14,090

IN 2011. Professor Saul Perlmutter, Professor Brian Schmidt, Professor Adam Riess, you have been awarded the Nobel Prize in Physics for the discovery of the accelerating expansion of the universe.

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00:02:14,090 --> 00:02:21,090

Saul: I couldn't imagine a more fun scientific measurement to make than something that would

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00:02:23,219 --> 00:02:27,719

tell you if the universe was infinite and tell you if there was an end to the universe.

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00:02:27,719 --> 00:02:32,469

It turned out though that the answer was even more fun than that.

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00:02:32,469 --> 00:02:36,939

BUT DARK ENERGY ISN'T THE ONLY ELUSIVE MYSTERY OF THE UNIVERSE HUBBLE HAS TACKLED.

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00:02:36,939 --> 00:02:42,079

Ford: A supermassive black hole is... where the equivalent of several hundred thousand

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00:02:42,080 --> 00:02:49,080

stars... or a million, or 10 million stars like the Sun... have been crammed into a region space smaller than a pencil point.

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00:02:52,250 --> 00:02:54,099

smaller than a pencil point.

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00:02:54,099 --> 00:03:00,289

Jennifer Wiseman: What Hubble did is to confirm, that in fact, there really are these supermassive

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00:03:00,289 --> 00:03:07,289

entities, black holes, in the centers of galaxies... and it seems like that the mass of these interior black

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00:03:08,229 --> 00:03:15,229

holes is related to the amount of star mass in that global central region of these galaxies.

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00:03:16,430 --> 00:03:21,319

Ford: It tells us a lot about how galaxies

form and ... how they grow

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00:03:21,319 --> 00:03:28,319

and what it was that led to the production of life on this tiny planet in this vast cosmos.

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00:03:31,009 --> 00:03:36,039

A COSMOS FILLED WITH POTENTIALLY COUNTLESS PLANETS LIKE OUR EARTH... BUT TOO FAR AWAY

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00:03:36,039 --> 00:03:41,949

TO EVER VISIT. HUBBLE HAS BEEN TAKING US TO THEM... IN A WAY WE NEVER DREAMED WE COULD.

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00:03:41,949 --> 00:03:46,539

Sing: Hubble has really given us our first look at what a planet's atmosphere looks

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00:03:46,539 --> 00:03:53,539

like outside of our own solar system... what's the composition for instance, what's in the planet, what is it made out of... So it's really opened

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00:03:54,729 --> 00:03:57,389

the window to that whole universe out there.

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00:03:57,389 --> 00:04:01,919

Deming: The first detection of the atmosphere of an extrasolar planet was made with Hubble

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00:04:01,919 --> 00:04:05,789

by looking at the transmission of light through the atmosphere and detecting sodium

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00:04:05,789 --> 00:04:10,000

absorption... if you can detect the absorbing of sodium, you can conceivably detect

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00:04:10,000 --> 00:04:15,080

molecules that were essential to life or indicative of life in the atmosphere of small planets.

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00:04:15,080 --> 00:04:21,069

Livio: It's not that we will actually look through our telescopes and see a crocodile

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00:04:21,069 --> 00:04:28,069  
walking there. So when we say, that we will detect  
life, what we mean by that is that the life

49  
00:04:28,769 --> 00:04:35,680  
forms on that particular extrasolar planet  
have done enough to modify the atmosphere

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00:04:35,680 --> 00:04:42,300  
of that planet... so that we can detect those biosignatures, signatures that can

51  
00:04:42,300 --> 00:04:46,400  
only be formed by life, then we  
will start to be convinced that...we're

52  
00:04:46,399 --> 00:04:49,769  
seeing the existence of life.

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00:04:49,769 --> 00:04:54,740  
AND WHAT ELSE WE'RE SEEING IS A UNIVERSE  
FAR DIFFERENT THAN THE ONE WE IMAGINED

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00:04:54,740 --> 00:04:55,418  
BEFORE HUBBLE.

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00:04:55,418 --> 00:04:59,990  
FROM THE SPACE TELESCOPE SCIENCE INSTITUTE,  
I'M MARY ESTACION.