**LISA PATHFINDER - THE END AND A NEW BEGINNING**

**SUGGESTED WEBCOPY:**

The LISA Pathfinder mission finally shuts down on 18 July 2017 after a successful demonstration of the technology needed to detect gravitational waves in space. These vibrations in spacetime, first predicted by Einstein over a hundred years ago, are produced by huge astronomical events - such as two black holes colliding - and will allow scientists to open new windows into our universe.

The success of the LISA Pathfinder mission has paved the way for the newly selected LISA mission which, when built and launched, will detect gravitational waves from objects up to a million times larger than our Sun.

The film features interview soundbites from Dr Paul McNamara, LISA Pathfinder Project Scientist, at the European Space Agency’s European Technology and Science facility (ESTEC) in The Netherlands.

**AROLL**

TAPE STARTS: 10:00:00

VT STARTS: 10:00:10

10:00:10

[ANIMATION LISA PATHFINDER MISSION]

From the first day its equipment was switched on in 2016, the LISA Pathfinder mission exceeded all expectations.

10:00:20

[INSET CLIP: Dr Paul McNAMARA

LISA Pathfinder Project Scientist, ESA]

*“This mission is outstanding. Every aspect of it, from the operations, from the hardware to the development. It’s just been a wonderful mission.”*

10:00:27

[ANIMATIONS LISA PATHFINDER MISSION, LISA MISSION, GRAVITATIONAL WAVES AND EXPLODING STAR]

LISA Pathfinder was built to test the technology on board the future LISA mission that will detect gravitational waves from space. These ripples in spacetime, first predicted by Einstein over a century ago and about the millionth of a size of an atom, are produced by violent cosmic events - such as exploding stars.

10:00:57

[LISA PATHFINDER LAUNCH GVS. Caption: 3 Dec 2015]

The mission was launched in December 2015 - the same year that a ground based detector, LIGO,

10:01:06

[LIGO SIGNAL STILL; ANIMATION OF GRAVITATIONAL WAVES; UNIVERSE STILLS]

… confirmed the existence of gravitational waves for the first time, from the merger of two black holes. It was a huge achievement. And the new LISA mission will be able to expand upon it - detecting gravitational waves from galactic size events

10:01:24

[INSET CLIP: Paul McNamara]

*“When galaxies merge together eventually these black holes collide and when that happens it rips the universe apart and we’re looking for that Universe vibrating from the merger of these big, big events - something you can never ever do that on the ground. So LIGO will never be able to see the events that we see at LISA. But LISA Pathfinder is a demonstration mission. So it wasn’t actually detecting grave waves, it’s proven that we know how to do it. We can go to space, we can build LISA and we can then do this whole new science.”*

10:01:50

[ANIMATION LISA PATHFINDER MISSION AND TECHNOLOGY]

LISA Pathfinder did something extraordinary. It placed two metal cubes in free fall, shielded from all forces apart from gravity with unprecedented precision.

10:02:04

[ANIMATION LISA SPACECRAFT]

LISA will build on this achievement but will consist of not one but three spacecraft.

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[INSET CLIP: Dr Paul McNamara]

*“The big difference between LISA and LISA Pathfinder is the length of the arm. In LISA Pathfinder we had two gold platinum cubes in a spacecraft and they were separated by about 40 cms. Whereas in LISA the little cubes are separated by two and a half million kms. To put that into perspective, that’s about six times the distance to the Moon. So it’s a long long way.”*

10:02:29

[LISA PATHFINDER AND LISA MISSION ANIMATION]

In the final weeks of its lifetime, scientists continued to analyse LISA Pathfinder data to help with the design of the new LISA mission. When complete, it will look at a new part of the spectrum of gravitational waves, opening up the Universe to a new science.

10:02:50

[INSET CLIP: Dr Paul McNamara]

*“Gravitational waves allow us to see the dark side of the Universe. The things which are not shiny light, for example black holes. So now we can actually work there and really observe these things which we have no other way to see. And also gravitational waves were predicted by Einstein and this was one of the main pillars of general relativity and with LIGO, and even better with LISA, we can really start to probe general relativity and see if that is the theory that governs the gravity of the universe.”*

10:03:15

[ANIMATION SOLAR SYSTEM AND GALAXY STILLS]

When LISA launches in 2034 it will be able to detect gravitational waves from objects up to one hundred times the mass of our Sun. But none of that would have been possible without LISA Pathfinder. As its success has paved the way for a whole new window into the mysteries of our Universe.

10:03:42 end of a-roll

**BROLL**

10:03:42

[TITLE: Dr Paul McNamara

LISA Pathfinder Project Scientist, ESA]

*“To me the highlight of LISA Pathfinder is the very first day we turned it on because we didn’t expect the performance to be as good. We thought it would be close to what we had to do and then we would improve it. We would think about what we had to do, we’d fix things and it would get better. On day number one it met requirements and what showed us is that this is a very complex type of instrument but it’s doable. Industry now have the experience to make a mission like LISA and LISA Pathfinder.”*

*“The challenges of a mission like LISA and LISA Pathfinder is the fact that it’s built with, I think we had forty different companies from forty different countries building aspects and unlike some of the planetary missions and some of the astronomy missions where you have a camera and a telescope, our whole satellite is one instrument and if we go to LISA all three satellites from one instrument. So everything has to come together, it has to work and that’s what happened. We have a very great collaboration within Europe and when it all came together it worked as an instrument on day one.”*

*“We need Lisa because it’s looking at a whole new part of the spectrum of gravitational waves. There’s a whole new type of science we’re doing. With the LIGO detections they’re looking at objects at roughly the size of the sun, anywhere from one to one hundred times the mass of the Sun. In their case it was thirty solar mass black holes which were orbiting each other. Whereas with LISA we’re looking at galaxies merging. It’s no longer stellar like objects it’s now galactic objects. So things which are maybe a million times the mass of the Sun. The big black holes at the centres of the galaxies, when galaxies merge together eventually these big black holes collide and when that happens it rips the Universe apart and we’re looking for that Universe vibrating from the merger of these big big events - something you can never ever do that on the ground. So LIGO will never be able to see the events that we see at LISA. But LISA Pathfinder is a demonstration mission. So it wasn’t actually detecting grave waves, it’s proven that we know how to do it. We can go to space, we can build LISA and do this whole new science.”*

10:05:46

[TITLE: ANIMATION

LISA Pathfinder]

Animations showing the position of LISA Pathfinder and the two gold platinum cubes inside the spacecraft that were held in free fall.

10:07:16

[TITLE: ANIMATION

LISA]

Animation of the future LISA mission to detect gravitational waves from space.

10:08:27

[TITLE: ANIMATION

Gravitational waves]

10:09:48

[TITLE: ANIMATION

Exploding star]

10:10:06

[TITLE: ANIMATIONS

Galaxies and dust cloud fly-throughs]

10:10:48 :ends