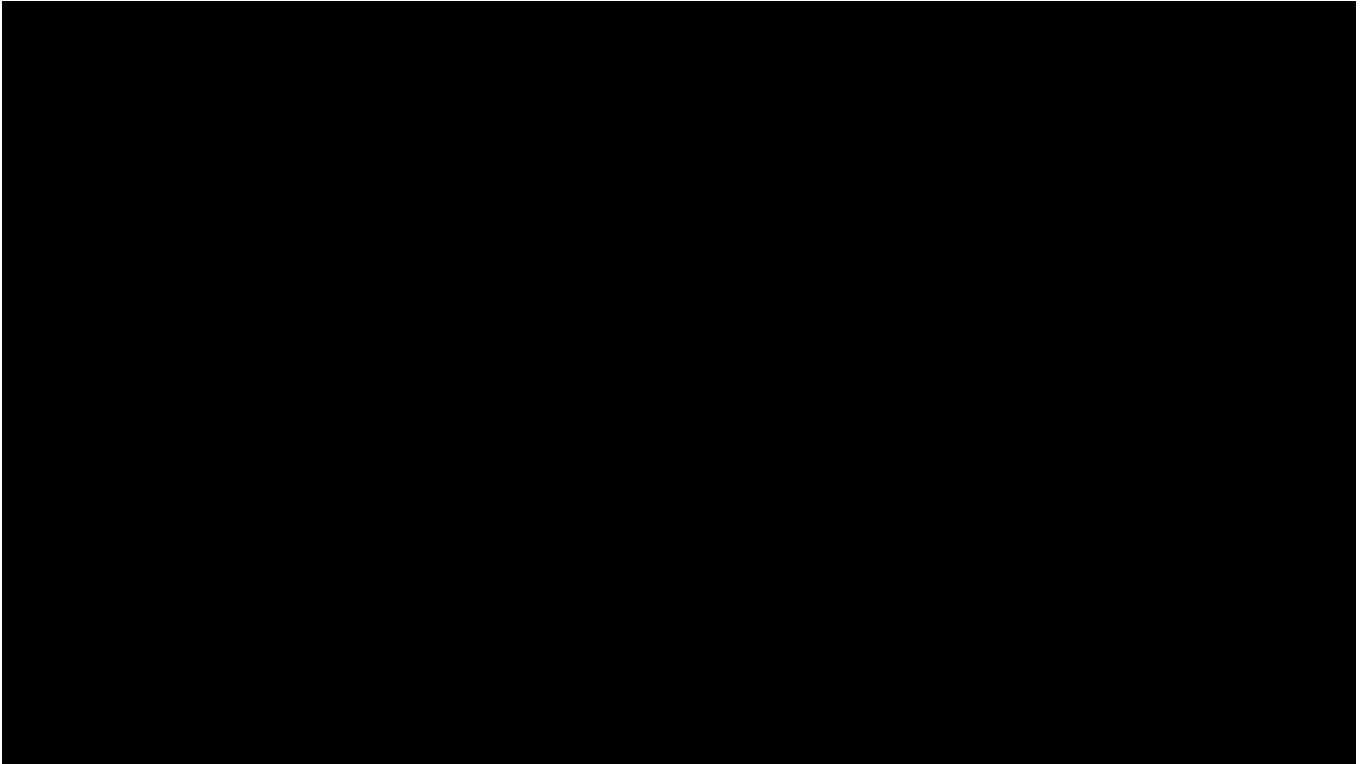


How Big is The Universe?

FrameNotes generated this readable video note. Each fragment includes a time range, key image, and matched transcript.

Fragment 1

Time range: 00:00 - 00:06



Matched transcript

No. No, the rest would have got to be Mr. Bright, but he is certainly Mr. Seuss. The blue chase will meet with that star Jim Clancy for a couple of weeks.

Fragment 2

Time range: 00:06 - 00:12



Matched transcript

The blue chase will meet with that star Jim Clancy for a couple of weeks. Earth. Our home planet.

Fragment 3

Time range: 00:12 - 00:18



Matched transcript

A tiny blue dot floating in the immense cosmic ocean. Here resides everyone you ever knew.

Fragment 4

Time range: 00:18 - 00:21



Matched transcript

Here resides everyone you ever knew. Every human who ever lived. Every story that was ever told.

Fragment 5

Time range: 00:21 - 00:27

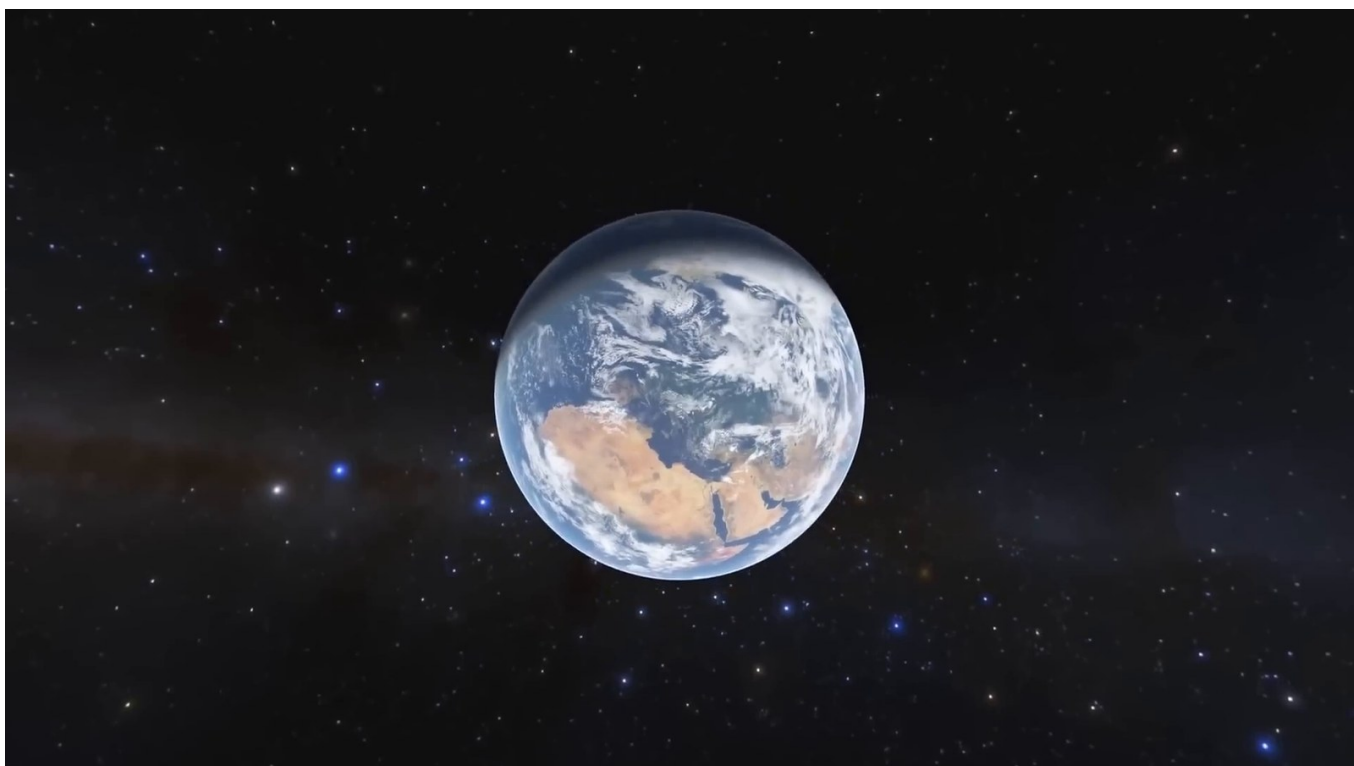


Matched transcript

Every story that was ever told. It's where our journey begins. But as we zoom out, beyond our atmosphere,

Fragment 6

Time range: 00:27 - 00:33



Matched transcript

But as we zoom out, beyond our atmosphere, past the moon, beyond the familiar planets and the sun, we embark on an epic quest, a

Fragment 7

Time range: 00:33 - 00:39



Matched transcript

past the moon, beyond the familiar planets and the sun, we embark on an epic quest, a quest to grasp the true scale of our universe. As we leave Earth's embrace, the first marker

Fragment 8

Time range: 00:39 - 00:45



Matched transcript

quest to grasp the true scale of our universe. As we leave Earth's embrace, the first marker on our cosmic journey is the moon, about 384,400 kilometers away, a distance so vast that if

Fragment 9

Time range: 00:45 - 00:51

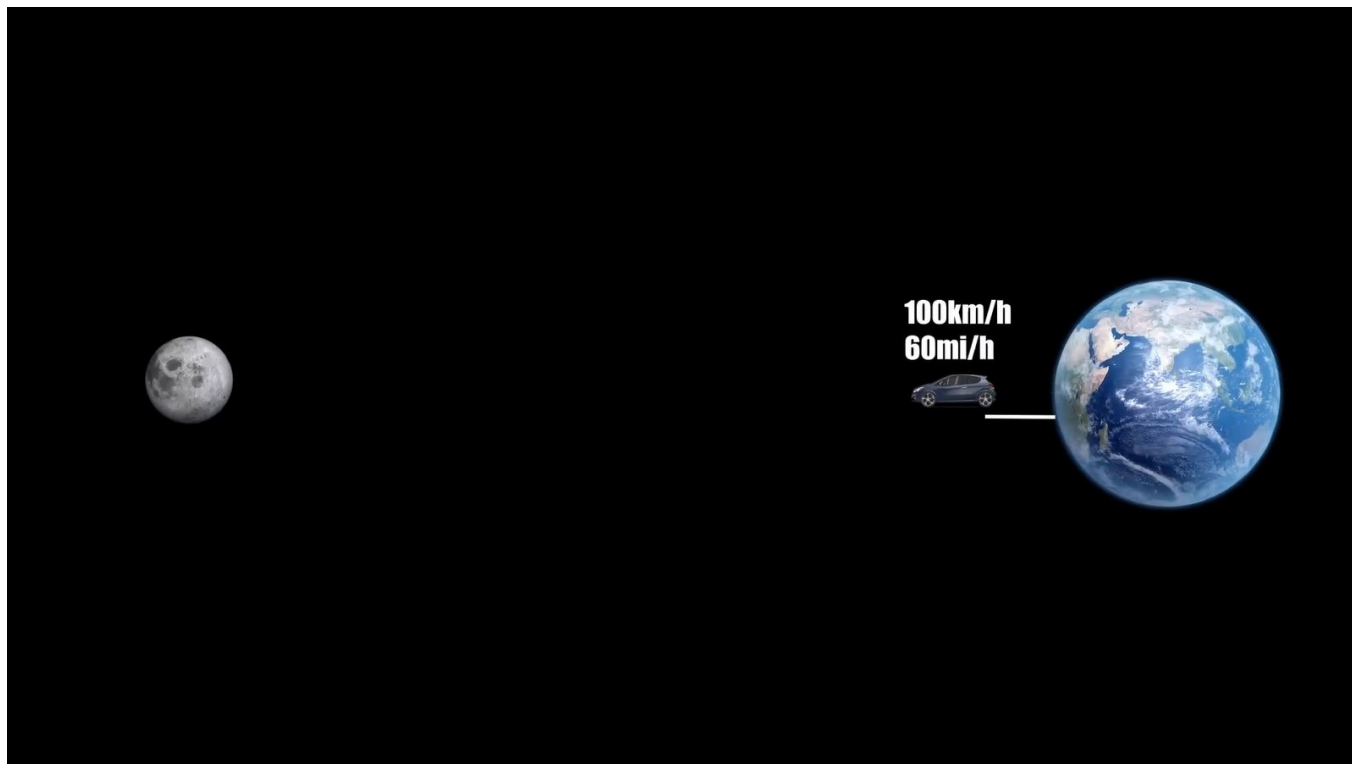


Matched transcript

on our cosmic journey is the moon, about 384,400 kilometers away, a distance so vast that if you were to drive a car at a constant speed of 100 kilometers per hour, it would take

Fragment 10

Time range: 00:51 - 00:56

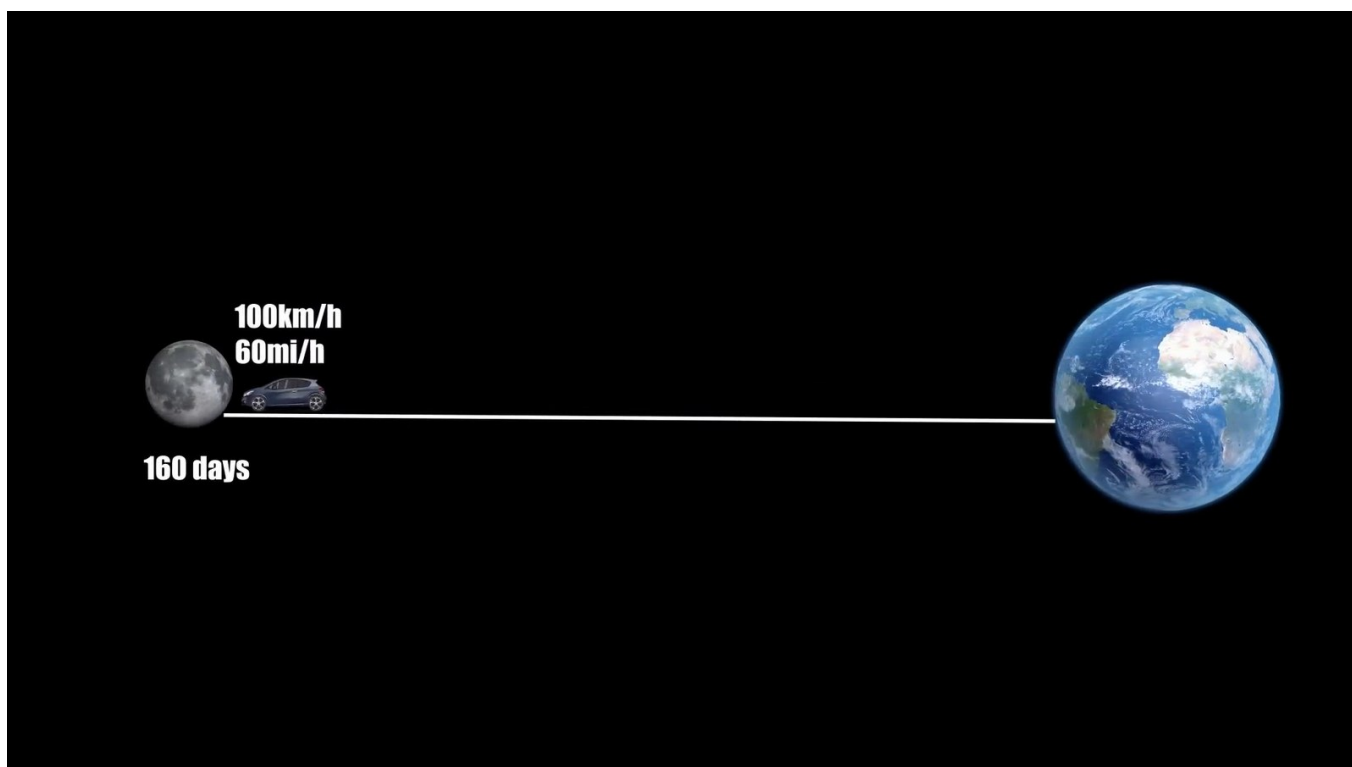


Matched transcript

you were to drive a car at a constant speed of 100 kilometers per hour, it would take you over 160 days to reach it. And from this lunar vantage point, Earth appears as a fragile

Fragment 11

Time range: 00:56 - 01:02



Matched transcript

you over 160 days to reach it. And from this lunar vantage point, Earth appears as a fragile sphere of blues and greens, cradled in the black void of space, a sight that puts our existence

Fragment 12

Time range: 01:02 - 01:08



Matched transcript

sphere of blues and greens, cradled in the black void of space, a sight that puts our existence into a humbling perspective. This is Earth as seen from the moon.

Fragment 13

Time range: 01:08 - 01:14

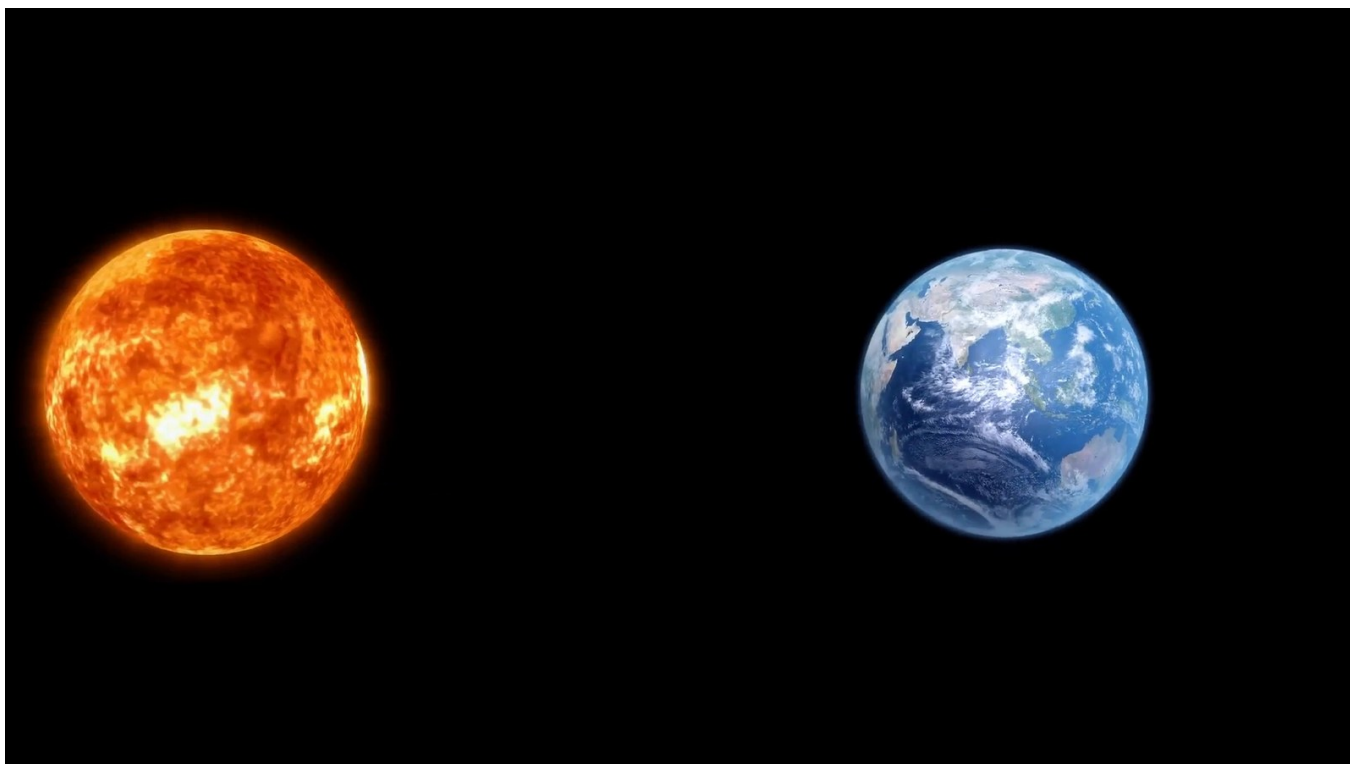


Matched transcript

into a humbling perspective. This is Earth as seen from the moon. As we continue our outward journey, the next milestone is the sun, lying approximately one

Fragment 14

Time range: 01:14 - 01:20

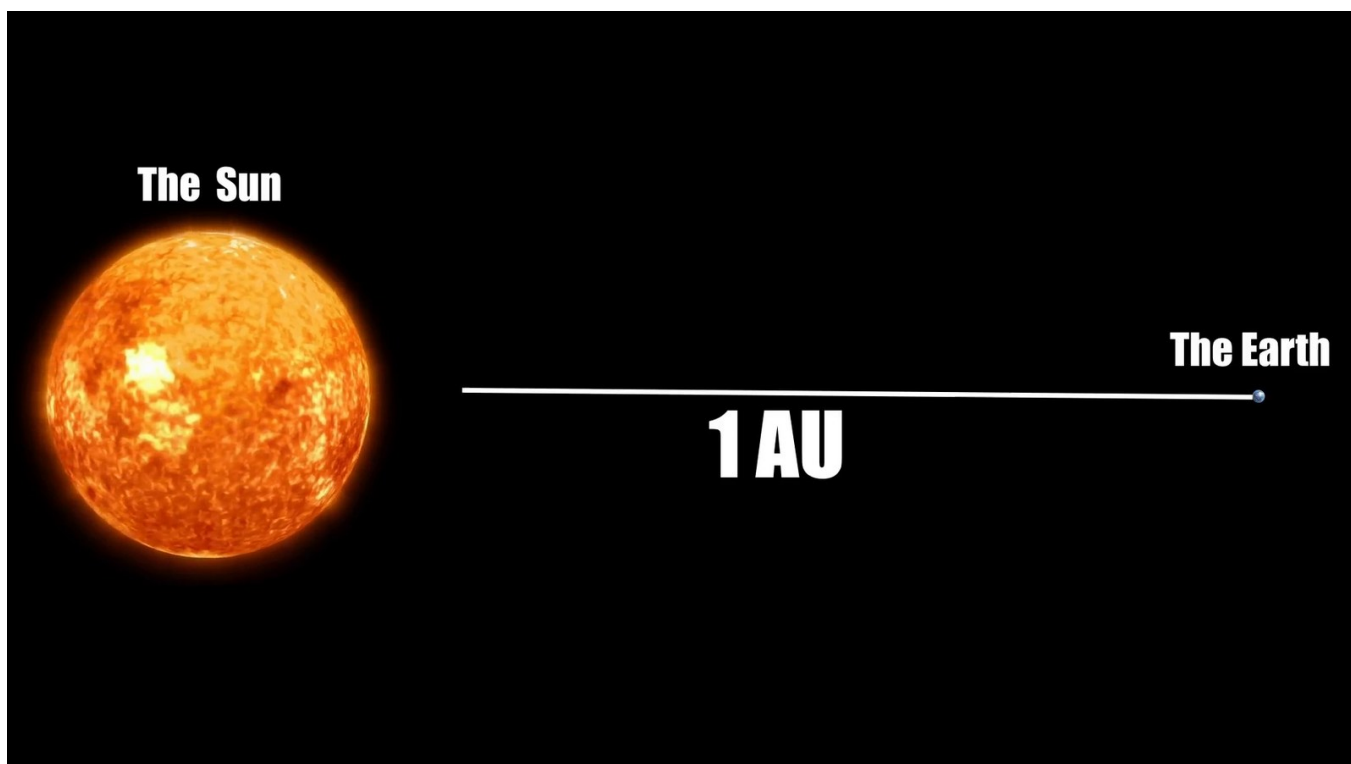


Matched transcript

As we continue our outward journey, the next milestone is the sun, lying approximately one astronomical unit away from Earth. This unit, equivalent to about 150 million kilometers,

Fragment 15

Time range: 01:20 - 01:24

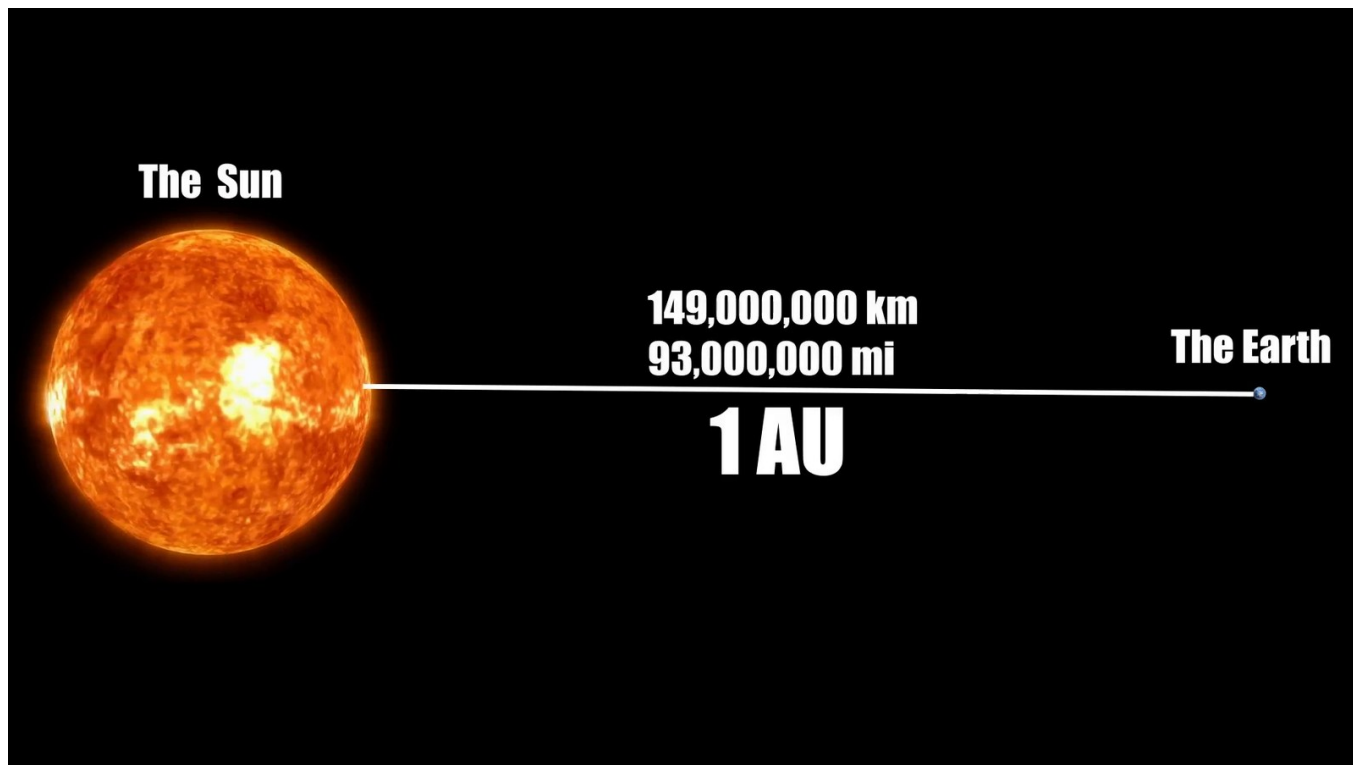


Matched transcript

astronomical unit away from Earth. This unit, equivalent to about 150 million kilometers,

Fragment 16

Time range: 01:24 - 01:29

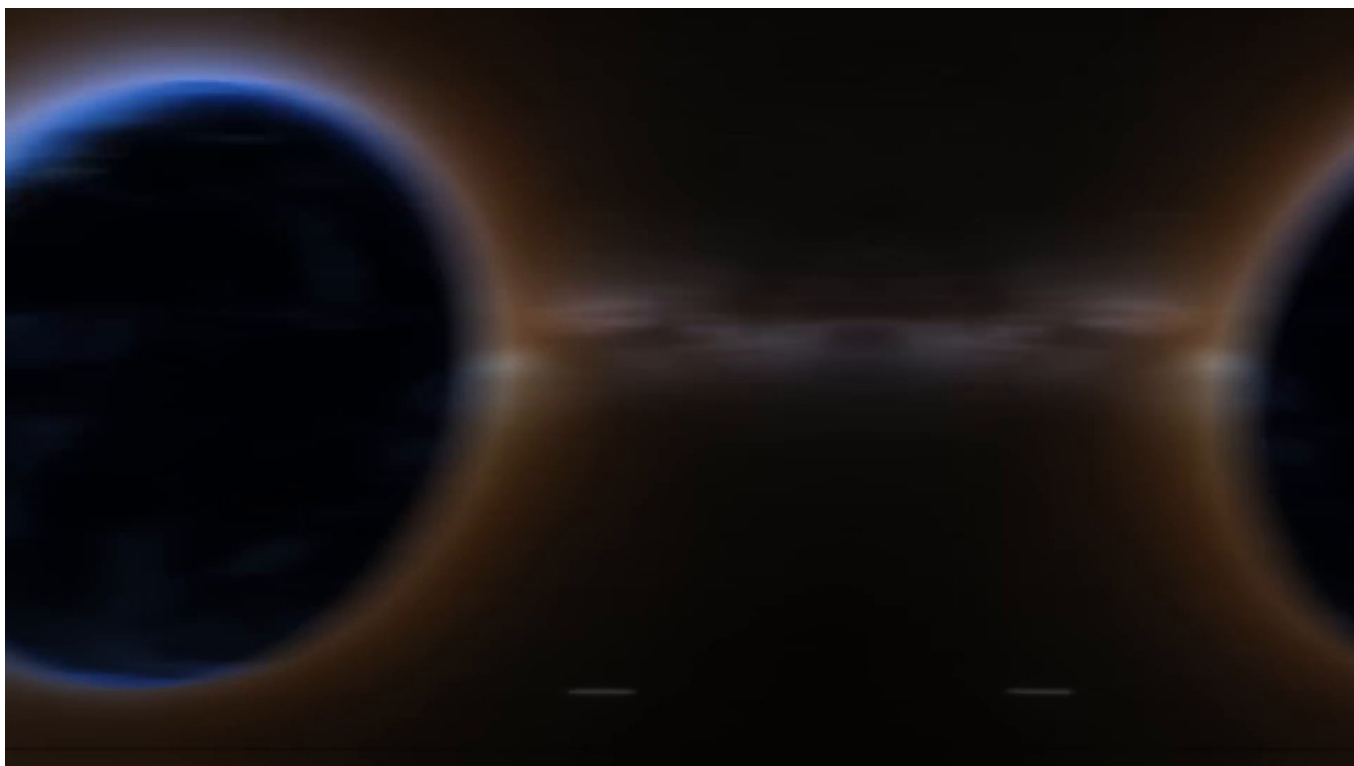


Matched transcript

astronomical unit away from Earth. This unit, equivalent to about 150 million kilometers, is the standard measuring stick for distances in our solar system. Imagine this. Light,

Fragment 17

Time range: 01:29 - 01:35



Matched transcript

is the standard measuring stick for distances in our solar system. Imagine this. Light, traveling at an astounding speed of 300,000 kilometers per second,

Fragment 18

Time range: 01:35 - 01:41



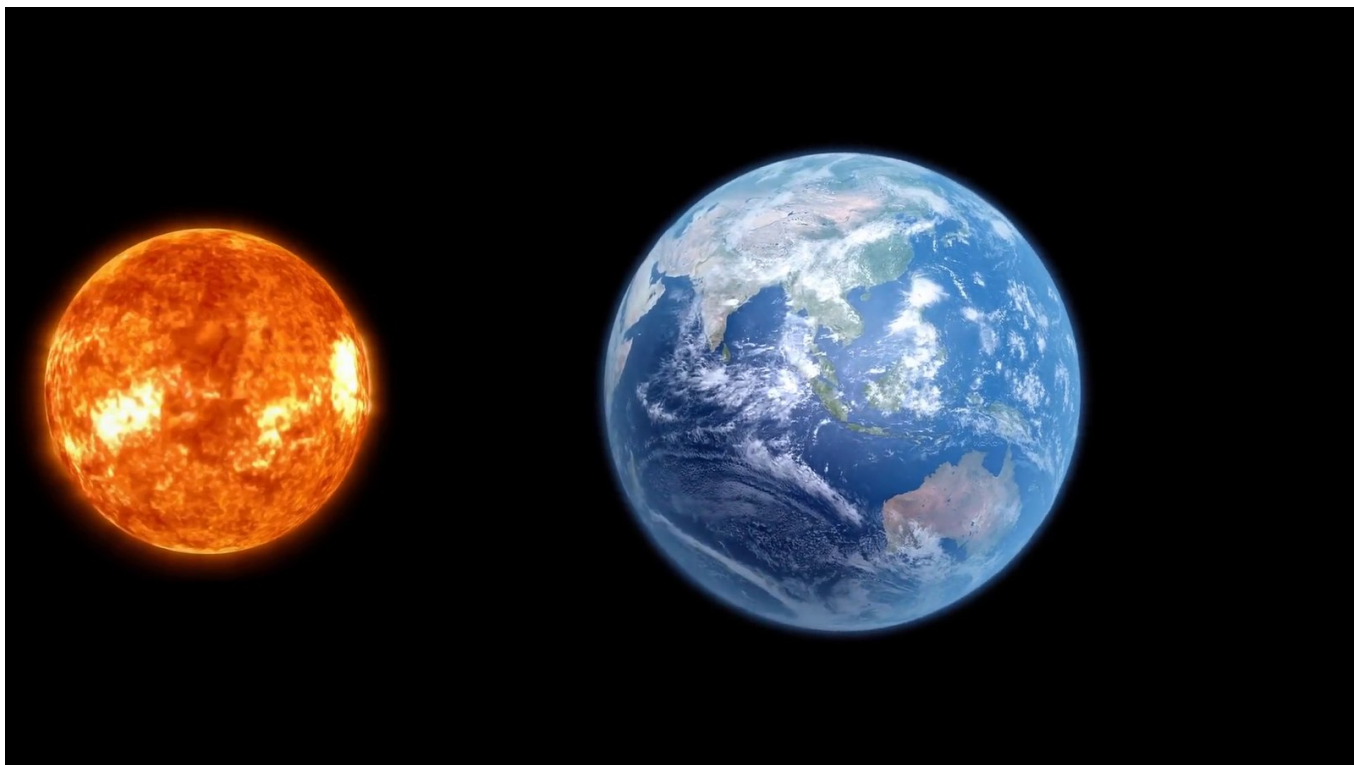
300,000 km/sec
186,000 miles/sec

Matched transcript

traveling at an astounding speed of 300,000 kilometers per second, takes about 8 minutes and 20 seconds to journey from the sun to Earth. If you were to travel this distance in a commercial jet, flying at 900 kilometers per hour,

Fragment 19

Time range: 01:41 - 01:49

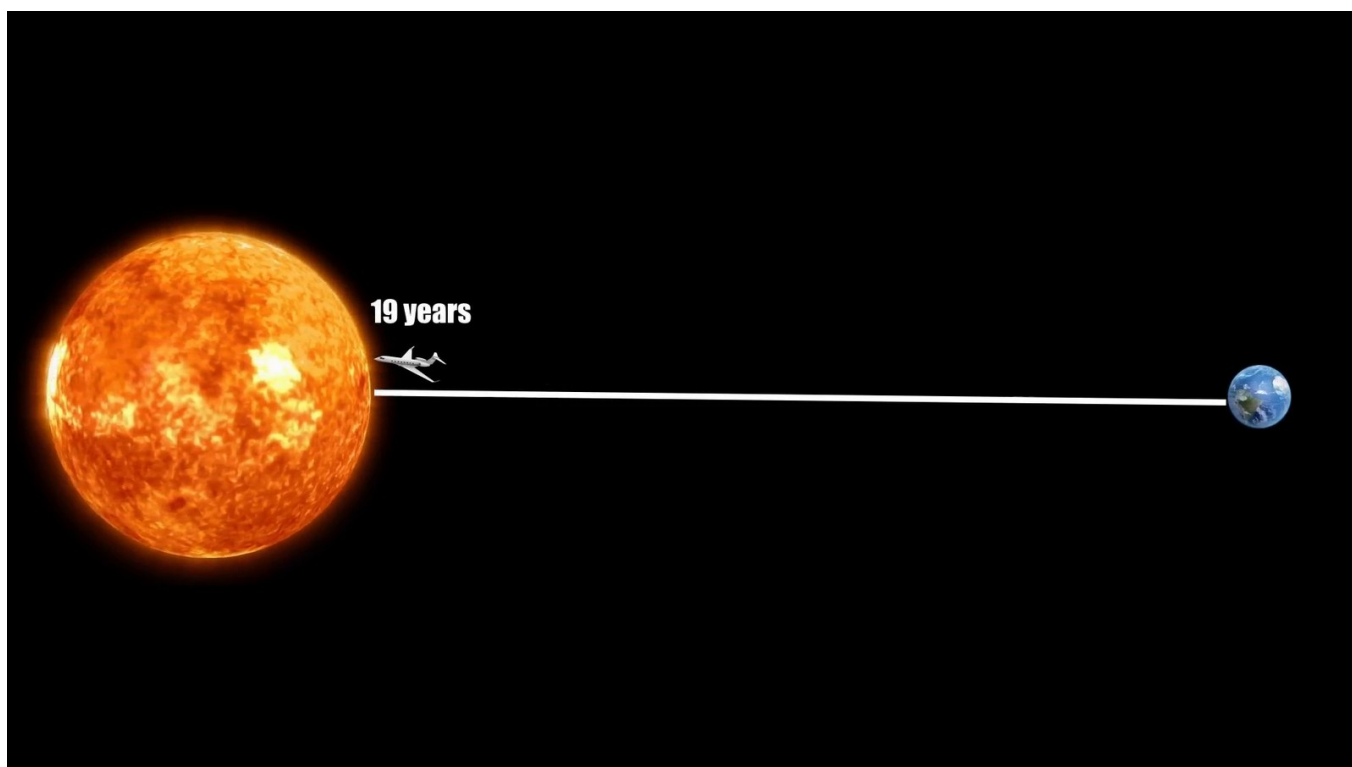


Matched transcript

If you were to travel this distance in a commercial jet, flying at 900 kilometers per hour, it would take you about 19 years. This immense distance is a stark reminder of the vastness of

Fragment 20

Time range: 01:49 - 01:52

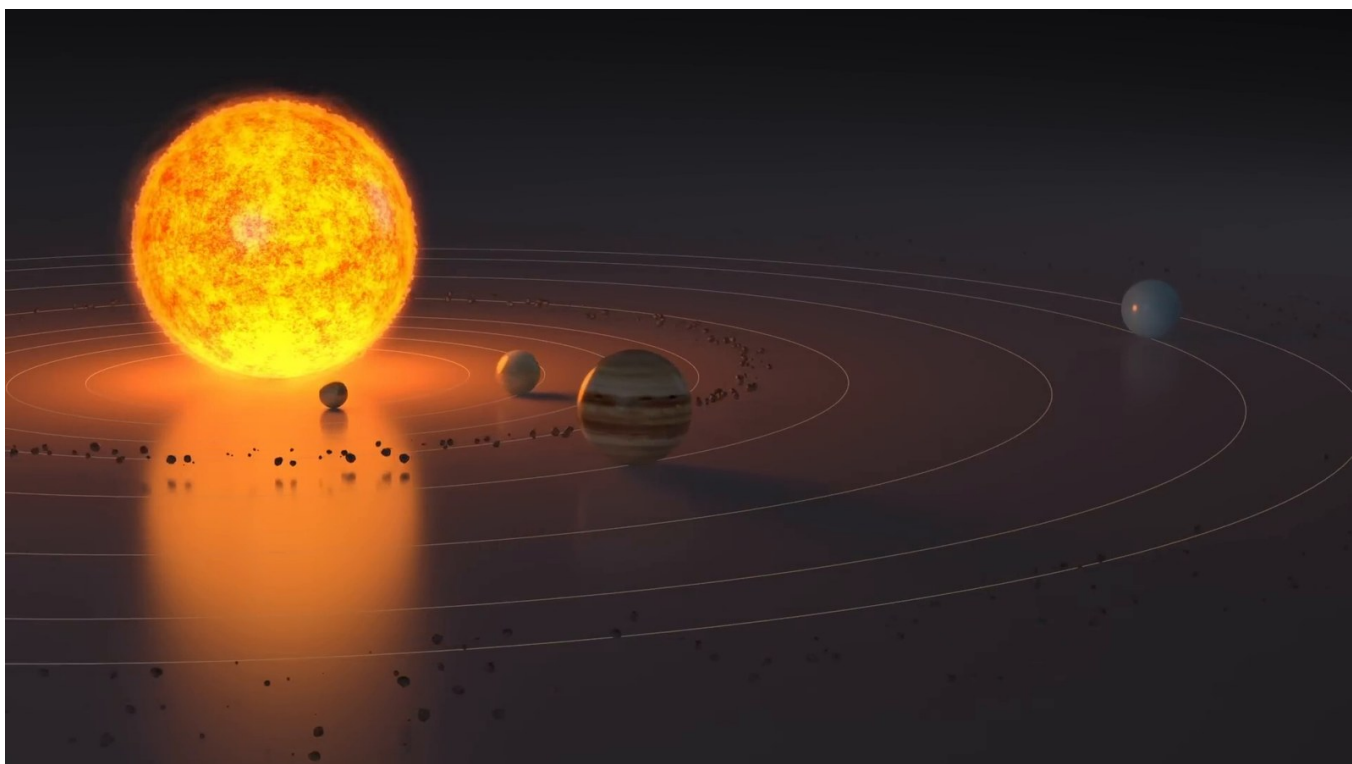


Matched transcript

it would take you about 19 years. This immense distance is a stark reminder of the vastness of

Fragment 21

Time range: 01:52 - 01:56



Matched transcript

it would take you about 19 years. This immense distance is a stark reminder of the vastness of space, even within our own solar system. The Sun, a fiery behemoth, provides life-sustaining energy

Fragment 22

Time range: 01:56 - 02:03

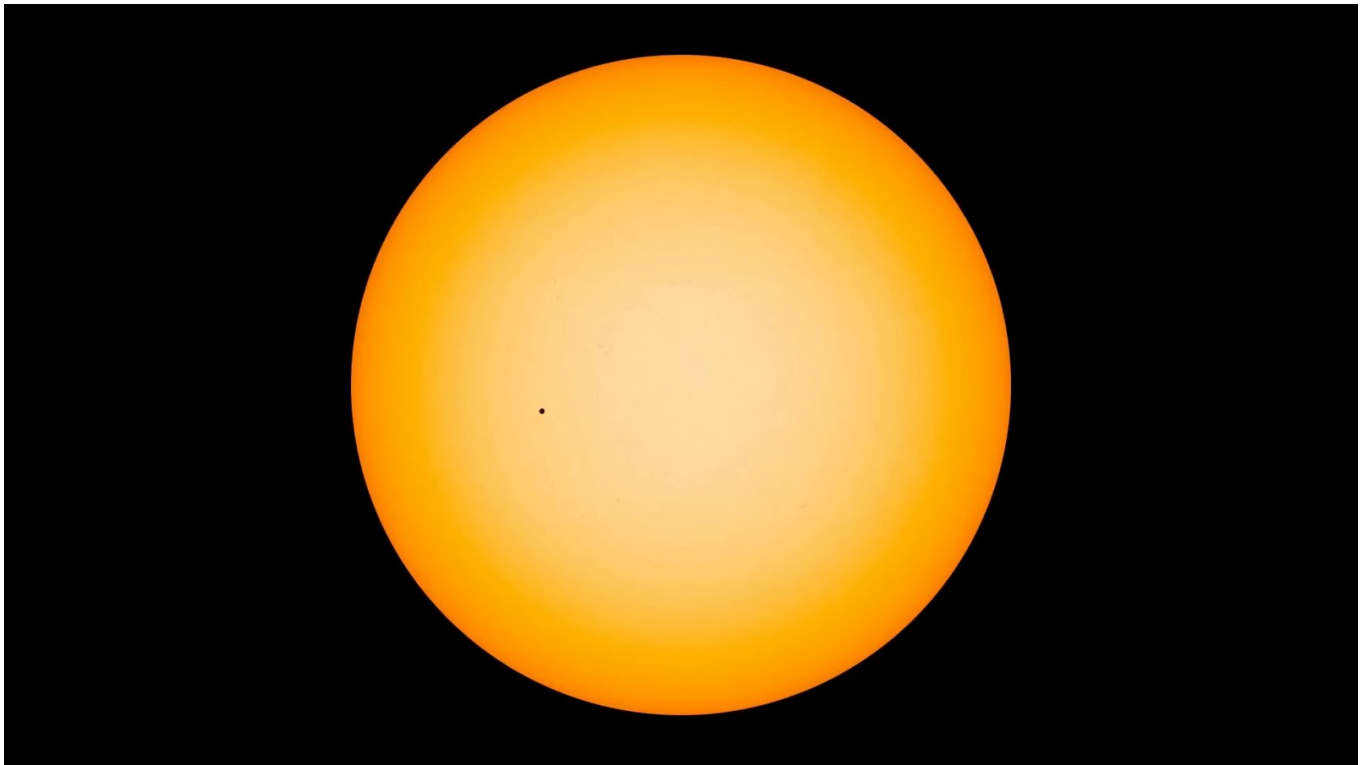


Matched transcript

space, even within our own solar system. The Sun, a fiery behemoth, provides life-sustaining energy to our planet from this incredible distance. Venturing beyond our home planet and its solar

Fragment 23

Time range: 02:03 - 02:09



Matched transcript

to our planet from this incredible distance. Venturing beyond our home planet and its solar companion, the Sun, we set our sights on Mars, our enigmatic red neighbor. Mars, at its closest

Fragment 24

Time range: 02:09 - 02:17

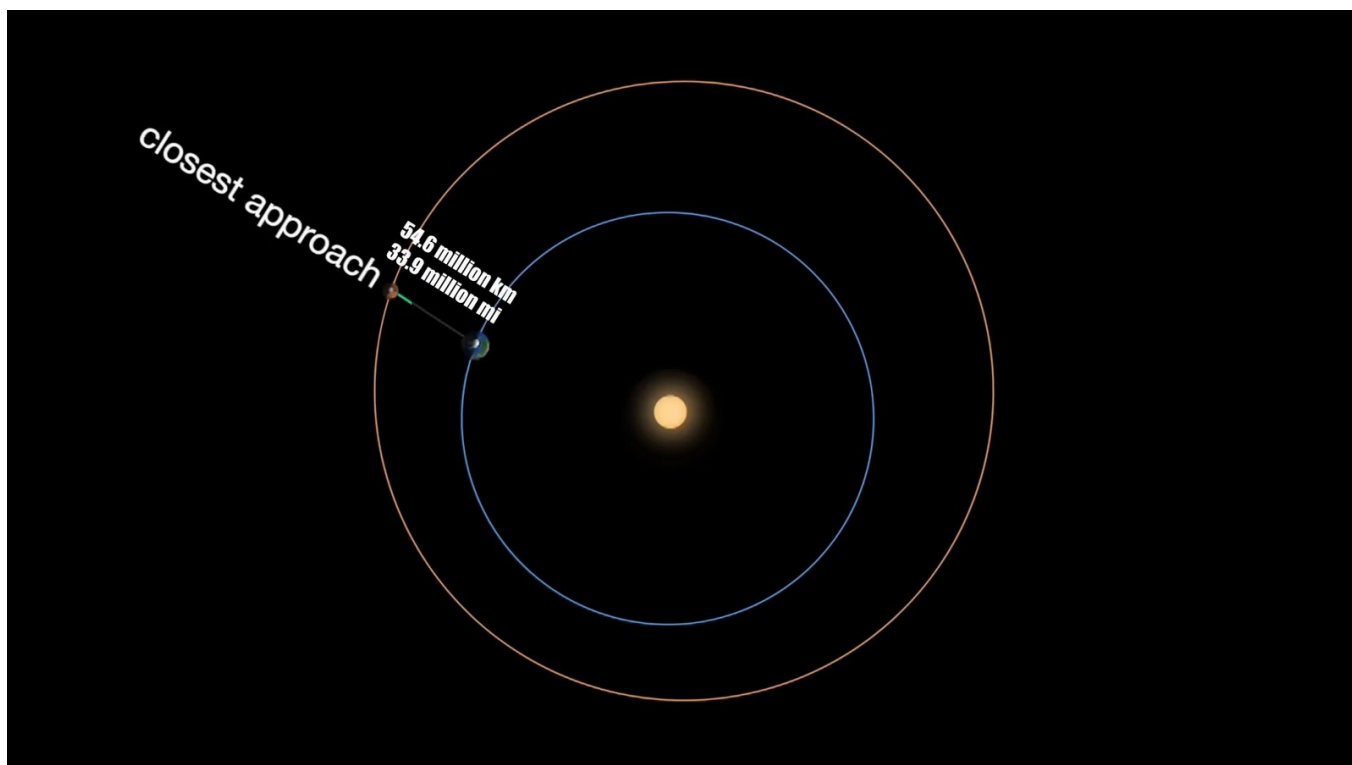


Matched transcript

companion, the Sun, we set our sights on Mars, our enigmatic red neighbor. Mars, at its closest approached to Earth is about 54.6 million kilometers away. However, this distance can

Fragment 25

Time range: 02:17 - 02:21

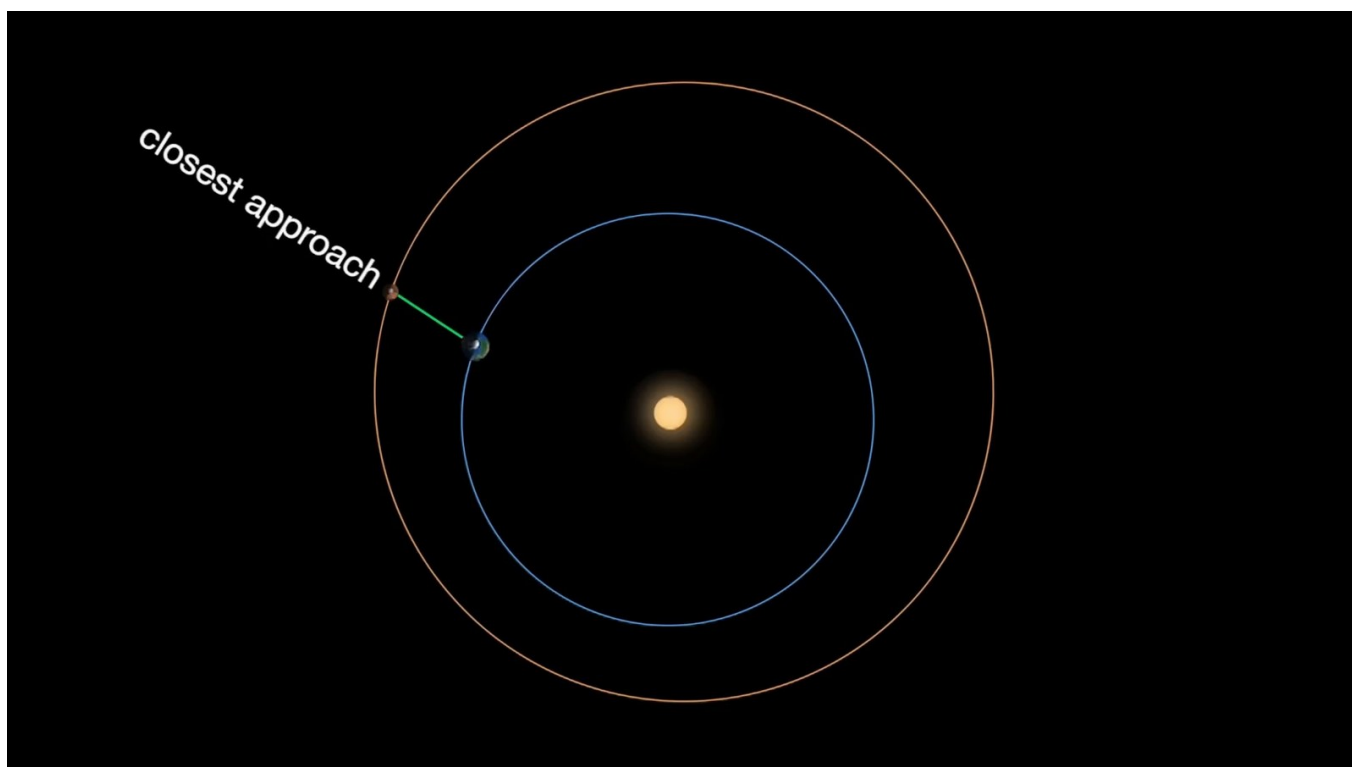


Matched transcript

approached to Earth is about 54.6 million kilometers away. However, this distance can stretch up to 401 million kilometers when the two planets are on opposite sides of the

Fragment 26

Time range: 02:21 - 02:27



Matched transcript

stretch up to 401 million kilometers when the two planets are on opposite sides of the Sun. To put that in perspective, traveling to Mars at the speed of a commercial jet would

Fragment 27

Time range: 02:27 - 02:33

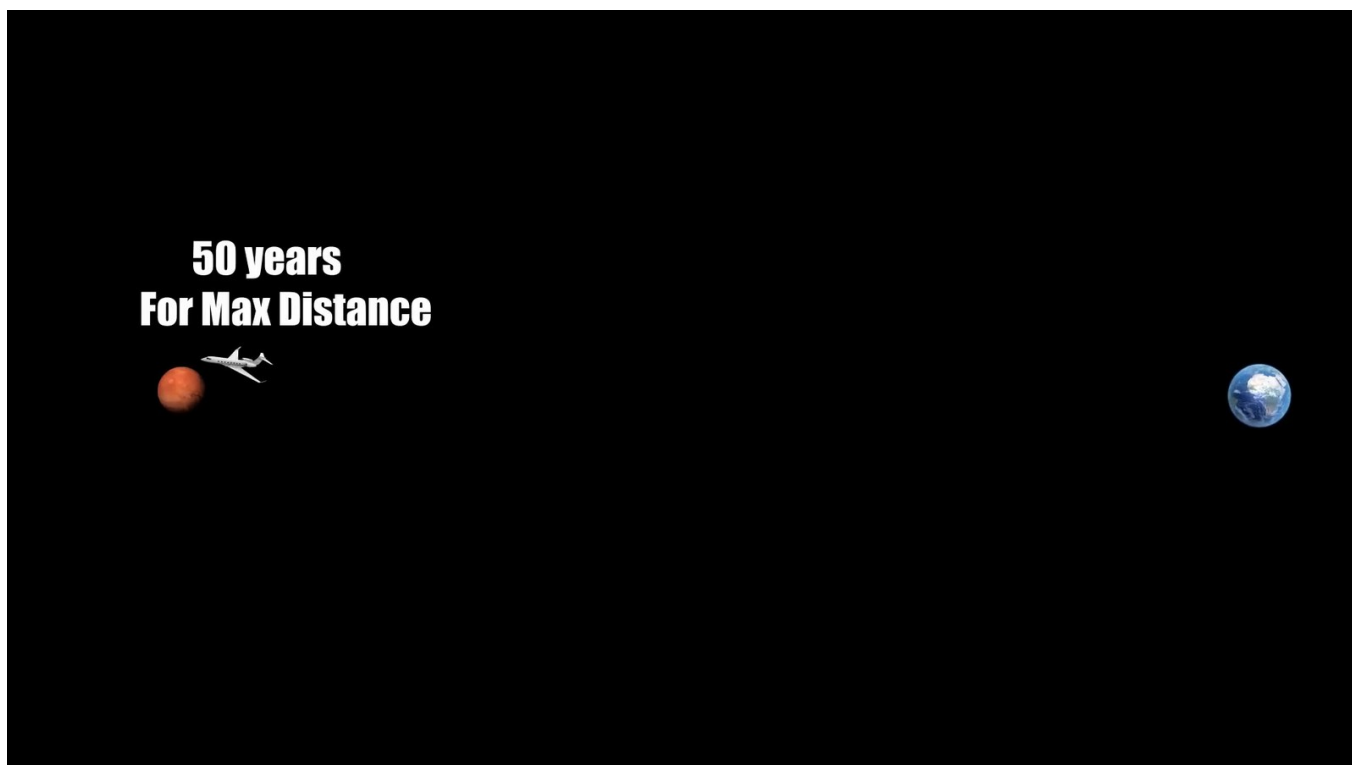


Matched transcript

Sun. To put that in perspective, traveling to Mars at the speed of a commercial jet would take upwards of 50 years. This vast expanse of space between Earth and Mars has been a

Fragment 28

Time range: 02:33 - 02:36



Matched transcript

take upwards of 50 years. This vast expanse of space between Earth and Mars has been a

Fragment 29

Time range: 02:36 - 02:42

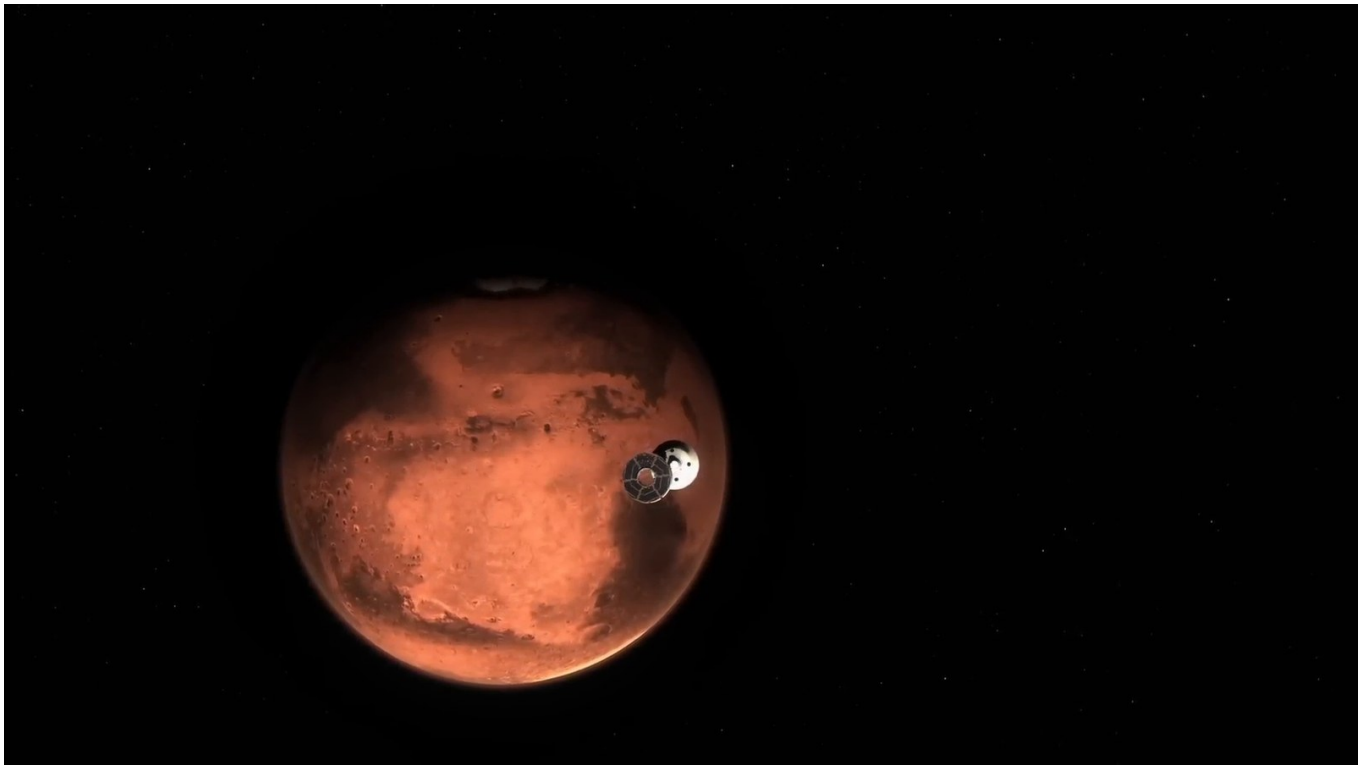


Matched transcript

take upwards of 50 years. This vast expanse of space between Earth and Mars has been a significant challenge for space exploration. The rovers and probes we have sent to the red planet embark on a journey that is not just far but fraught with complexities due to the constantly changing distances and orbital dynamics As we journey to the outermost reaches of our solar

Fragment 30

Time range: 02:42 - 02:49



Matched transcript

red planet embark on a journey that is not just far but fraught with complexities due to the constantly changing distances and orbital dynamics As we journey to the outermost reaches of our solar

Fragment 31

Time range: 02:49 - 02:55

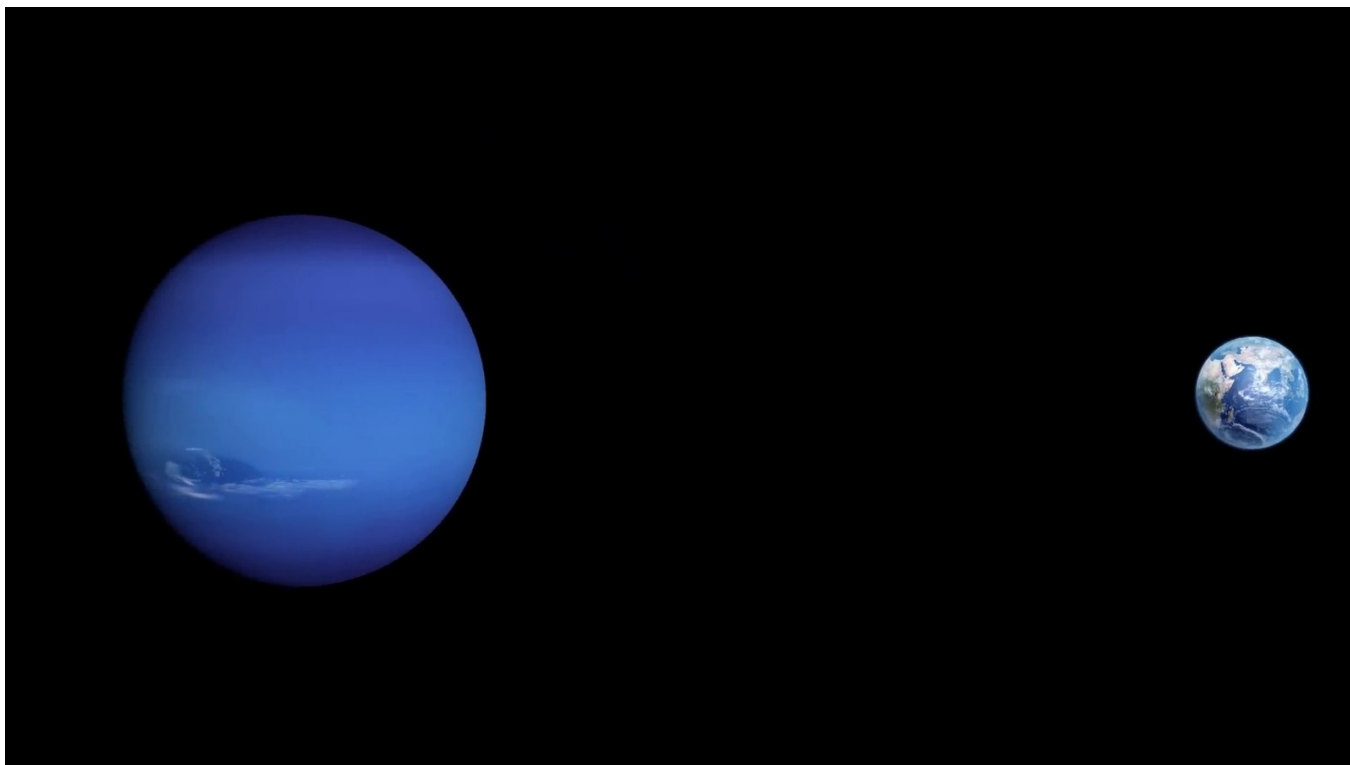


Matched transcript

red planet embark on a journey that is not just far but fraught with complexities due to the constantly changing distances and orbital dynamics As we journey to the outermost reaches of our solar system, we encounter Neptune, the distant ice giant. Lying roughly 4.5 billion kilometers from

Fragment 32

Time range: 02:55 - 03:01

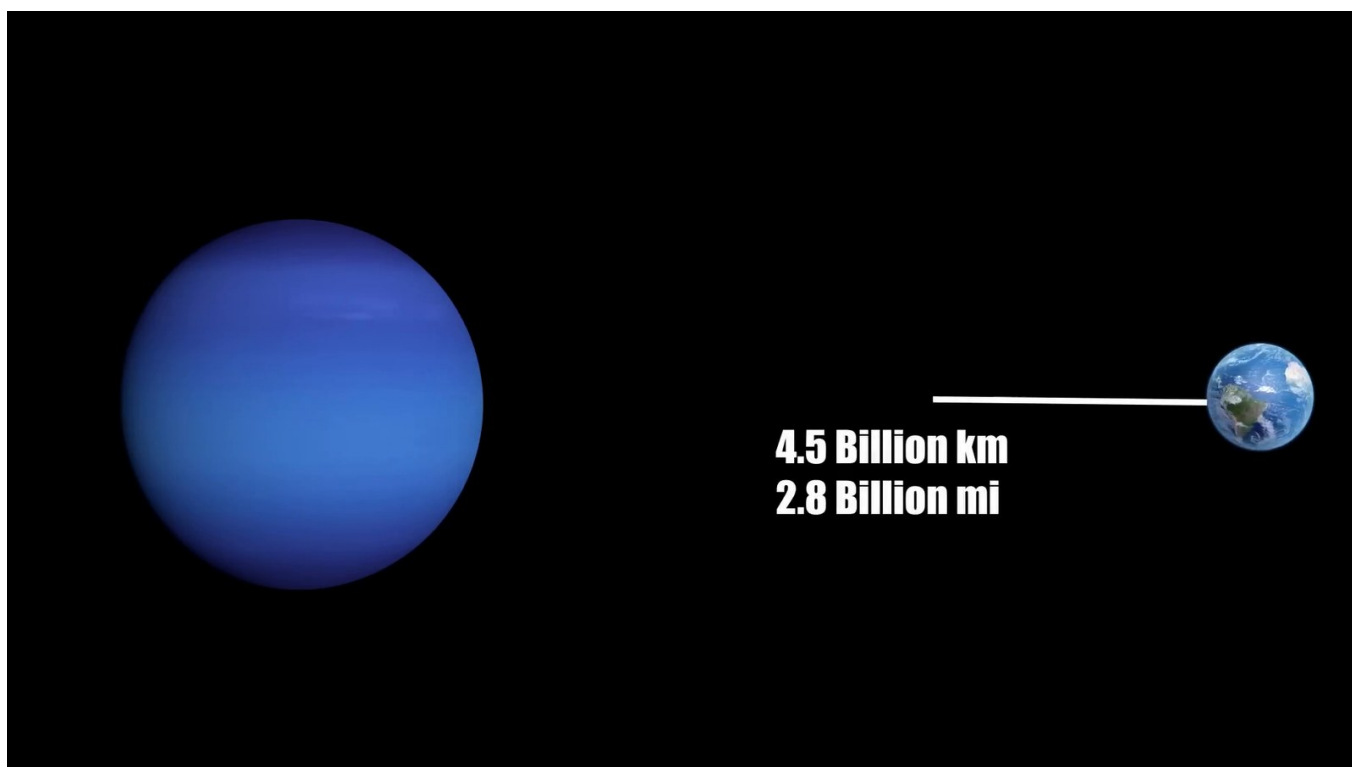


Matched transcript

system, we encounter Neptune, the distant ice giant. Lying roughly 4.5 billion kilometers from

Fragment 33

Time range: 03:01 - 03:07

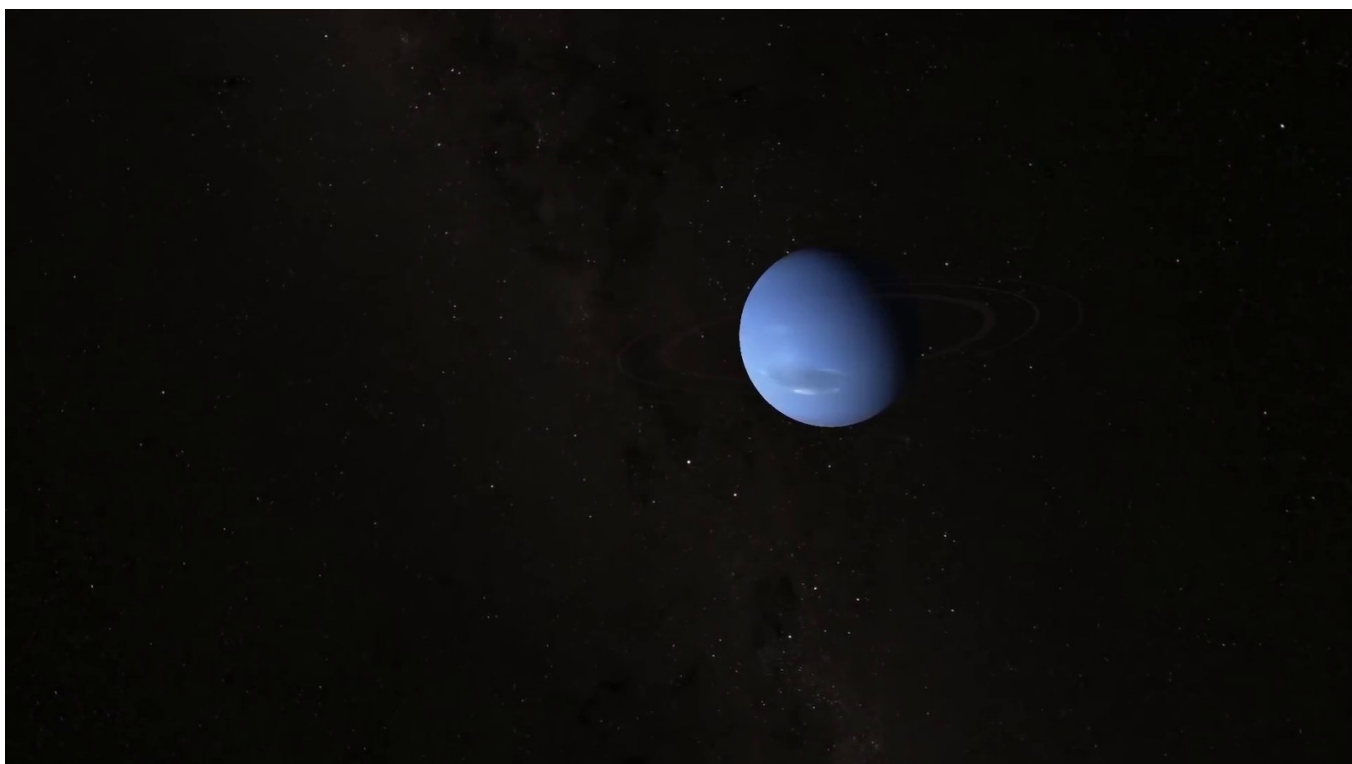


Matched transcript

system, we encounter Neptune, the distant ice giant. Lying roughly 4.5 billion kilometers from Earth, Neptune marks the edge of our solar neighborhood. Sunlight, racing across the vacuum

Fragment 34

Time range: 03:07 - 03:10

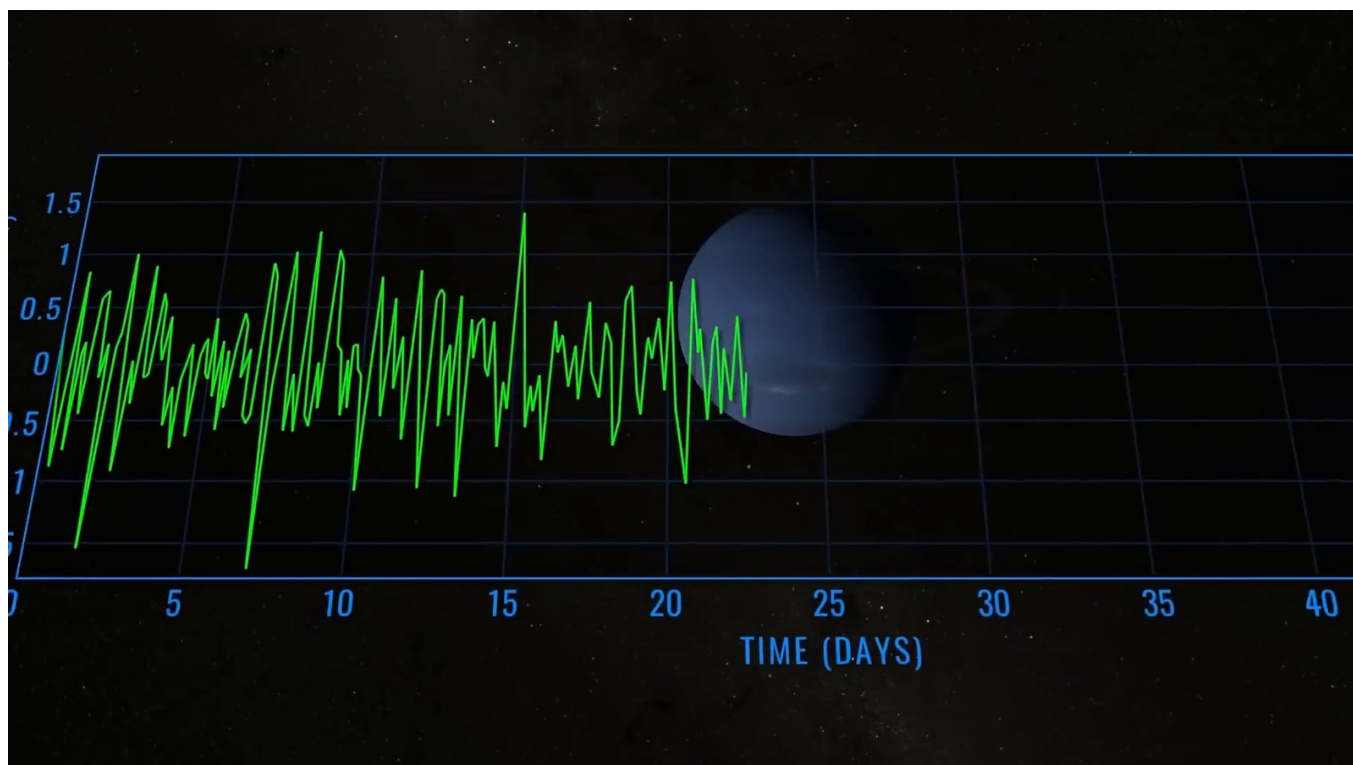


Matched transcript

Earth, Neptune marks the edge of our solar neighborhood. Sunlight, racing across the vacuum of space takes about 4 hours and 15 minutes to reach Neptune from the Sun. This staggering

Fragment 35

Time range: 03:10 - 03:16

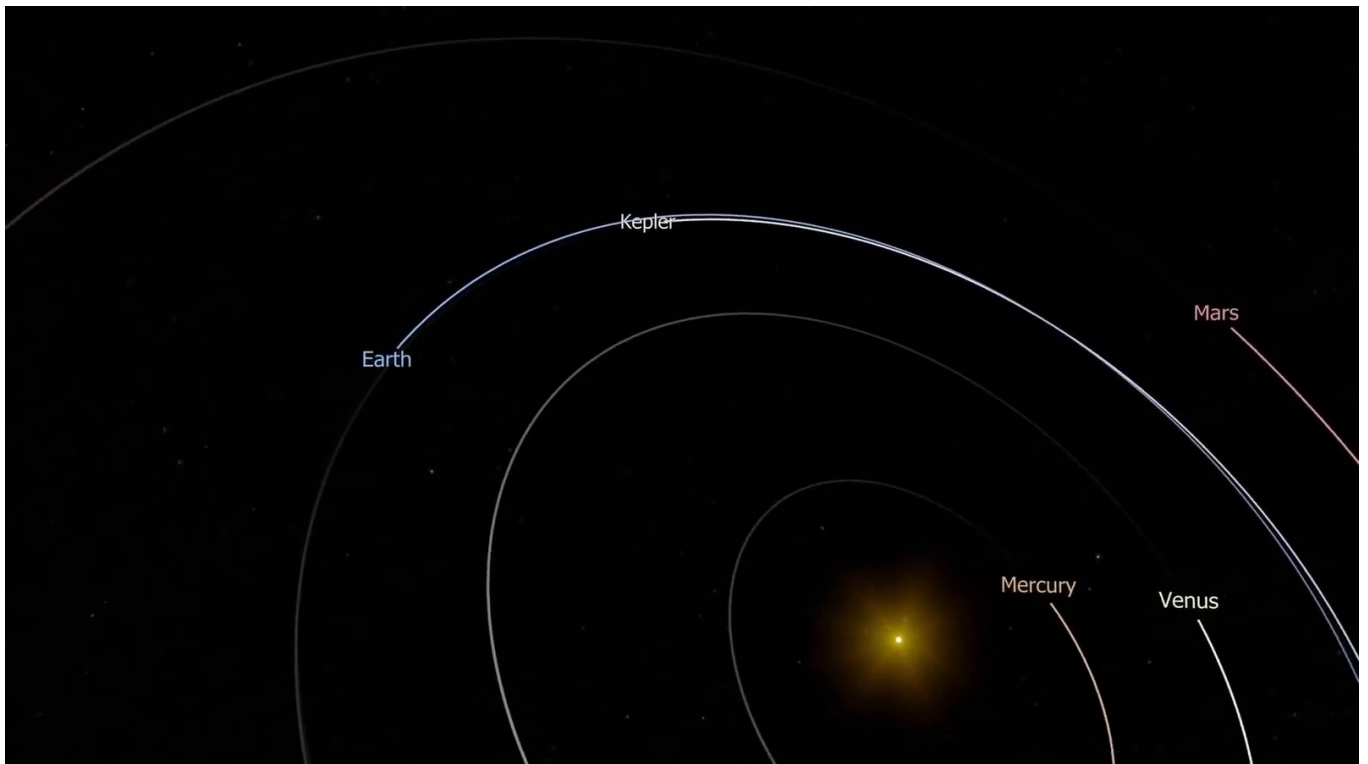


Matched transcript

of space takes about 4 hours and 15 minutes to reach Neptune from the Sun. This staggering distance showcases the enormity of our solar system.

Fragment 36

Time range: 03:16 - 03:22

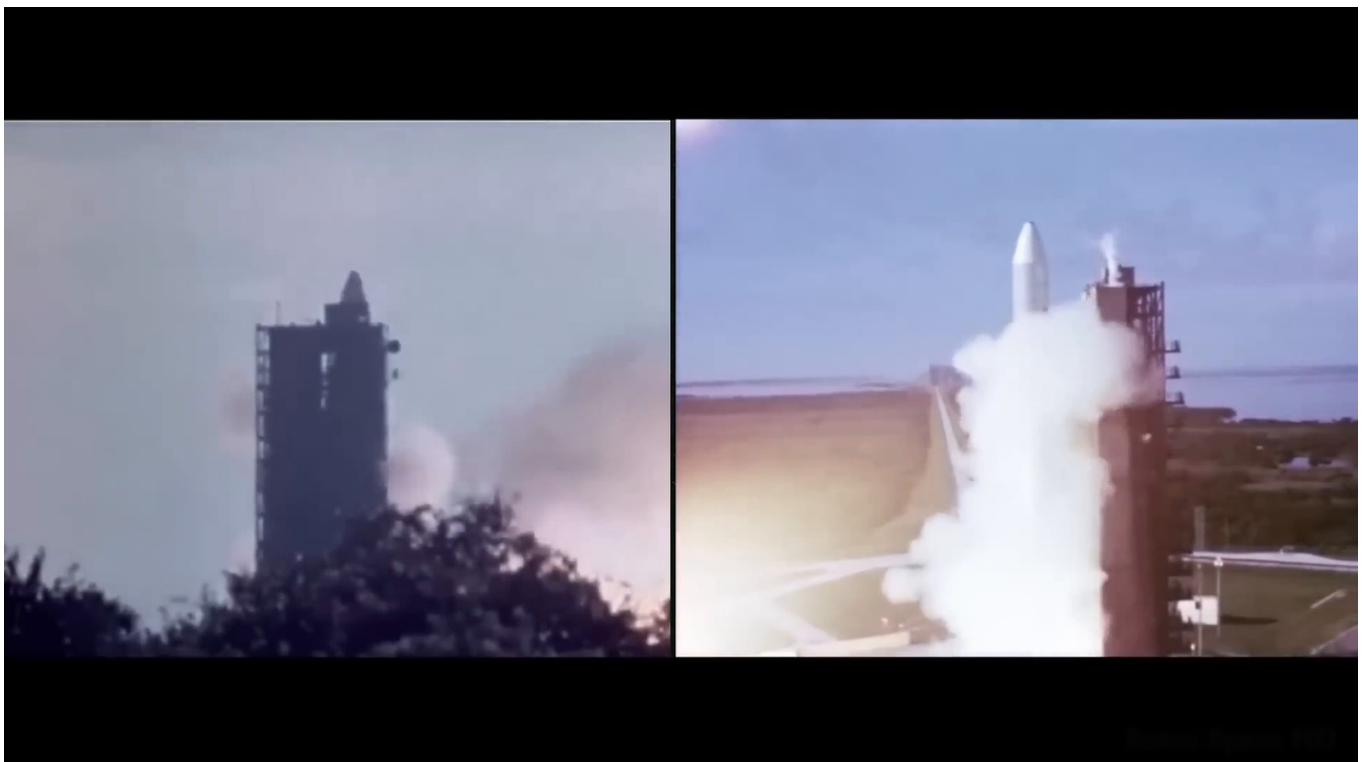


Matched transcript

distance showcases the enormity of our solar system. Launched in 1977, the Voyager 1 space probe represents humanity's insatiable curiosity

Fragment 37

Time range: 03:22 - 03:28



Matched transcript

Launched in 1977, the Voyager 1 space probe represents humanity's insatiable curiosity and our desire to explore beyond known boundaries. As of now, Voyager 1 has traveled for over

Fragment 38

Time range: 03:28 - 03:34

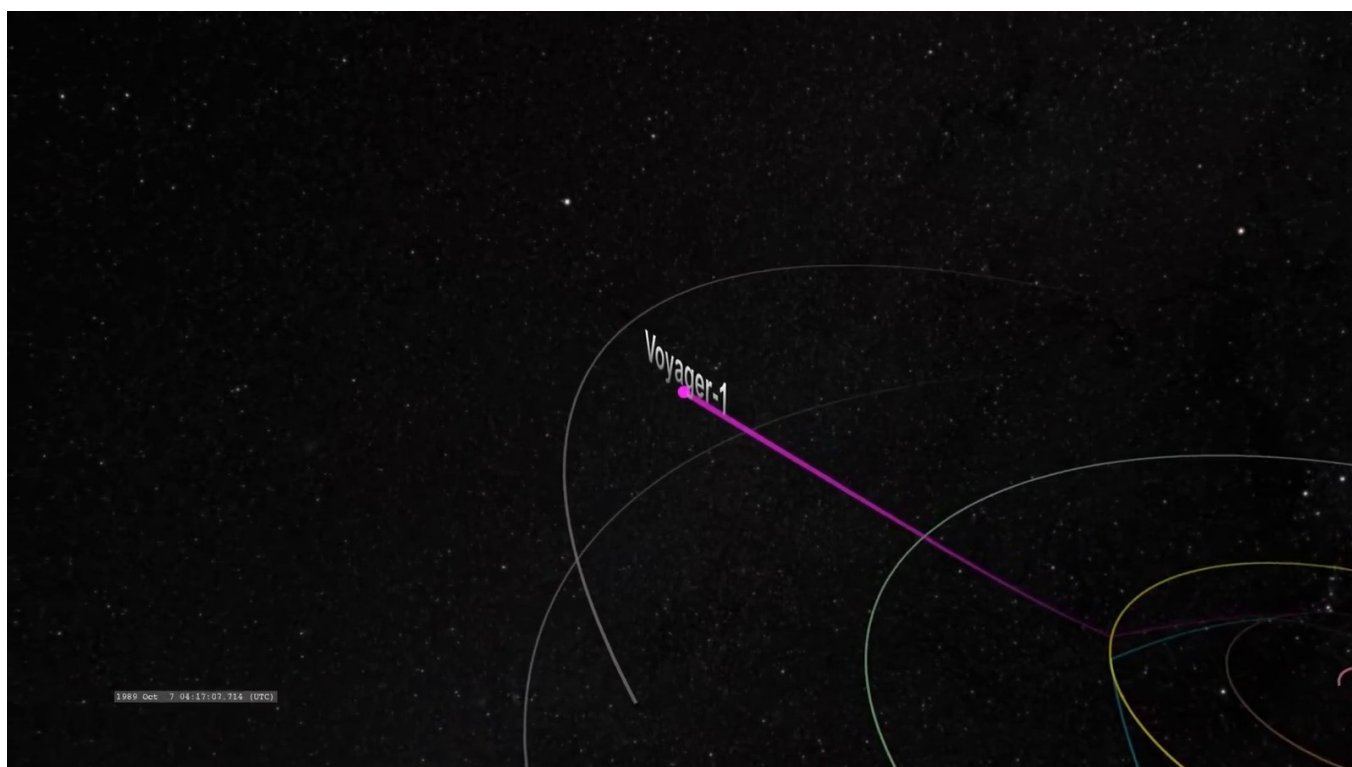


Matched transcript

and our desire to explore beyond known boundaries. As of now, Voyager 1 has traveled for over four decades, covering a staggering distance of more than 22 billion kilometers from Earth.

Fragment 39

Time range: 03:34 - 03:40



Matched transcript

four decades, covering a staggering distance of more than 22 billion kilometers from Earth. It's the farthest human-made object from our planet, a silent wanderer in the cosmic sea.

Fragment 40

Time range: 03:40 - 03:46



Matched transcript

It's the farthest human-made object from our planet, a silent wanderer in the cosmic sea. In 1990, at the suggestion of the renowned astronomer Carl Sagan, Voyager 1 turned its

Fragment 41

Time range: 03:46 - 03:49



Matched transcript

In 1990, at the suggestion of the renowned astronomer Carl Sagan, Voyager 1 turned its

Fragment 42

Time range: 03:49 - 03:55

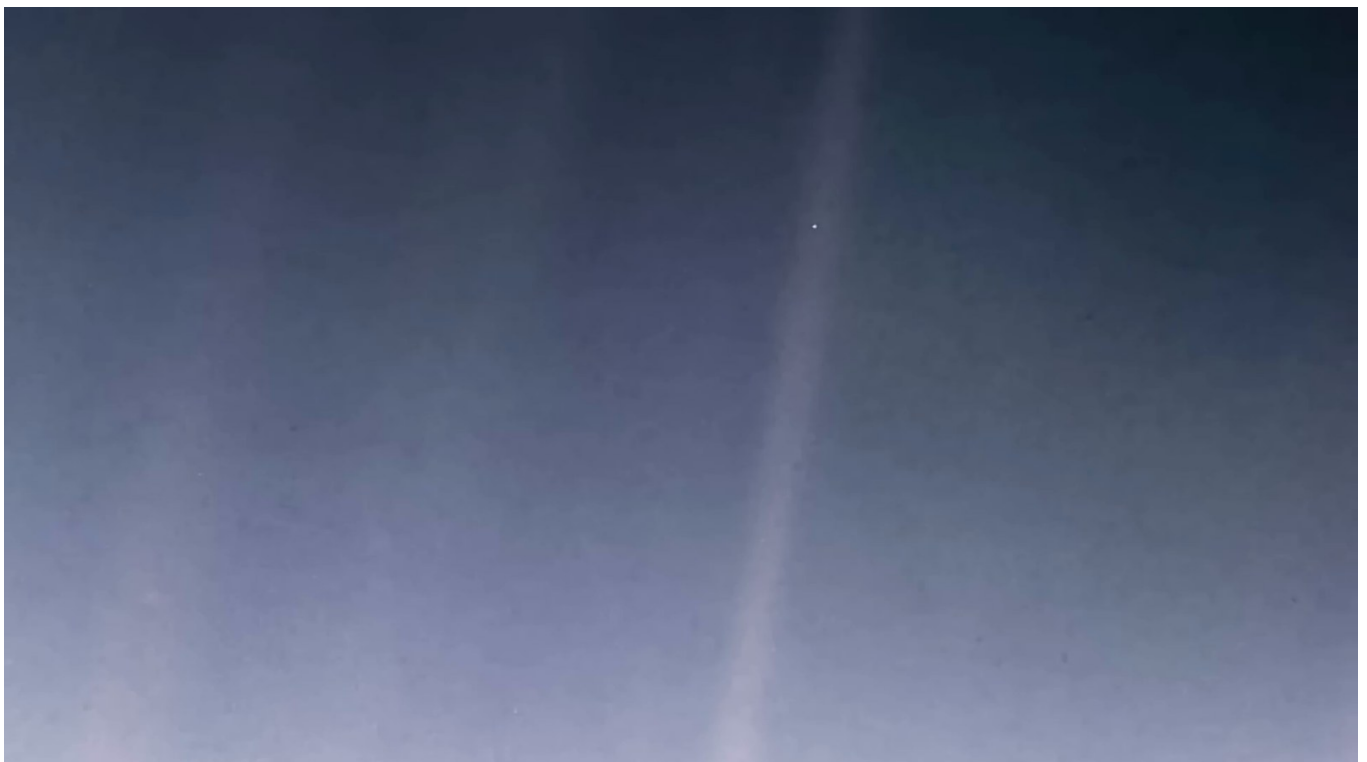


Matched transcript

In 1990, at the suggestion of the renowned astronomer Carl Sagan, Voyager 1 turned its camera back towards Earth for one final photograph. This resulted in the iconic pale blue dot

Fragment 43

Time range: 03:55 - 04:02



Matched transcript

camera back towards Earth for one final photograph. This resulted in the iconic pale blue dot image. At a distance of about 6 billion kilometers from Earth, our planet appeared as a tiny,

Fragment 44

Time range: 04:02 - 04:08



Matched transcript

image. At a distance of about 6 billion kilometers from Earth, our planet appeared as a tiny, faint dot in the vastness of space. Sagan poetically reflected on this image, emphasizing

Fragment 45

Time range: 04:08 - 04:12

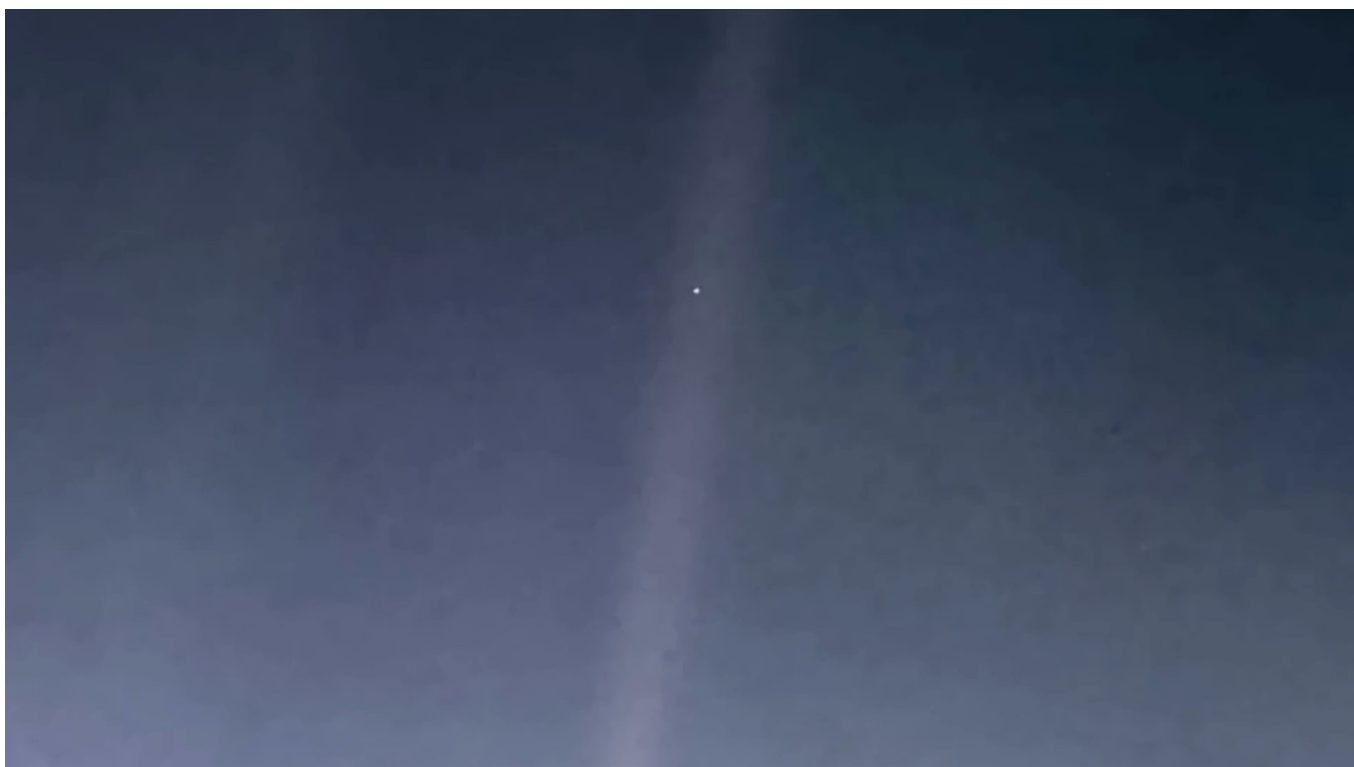


Matched transcript

faint dot in the vastness of space. Sagan poetically reflected on this image, emphasizing our responsibility to cherish and preserve our only home, a small speck in the immense universe.

Fragment 46

Time range: 04:12 - 04:17



Matched transcript

our responsibility to cherish and preserve our only home, a small speck in the immense universe.

Fragment 47

Time range: 04:17 - 04:23

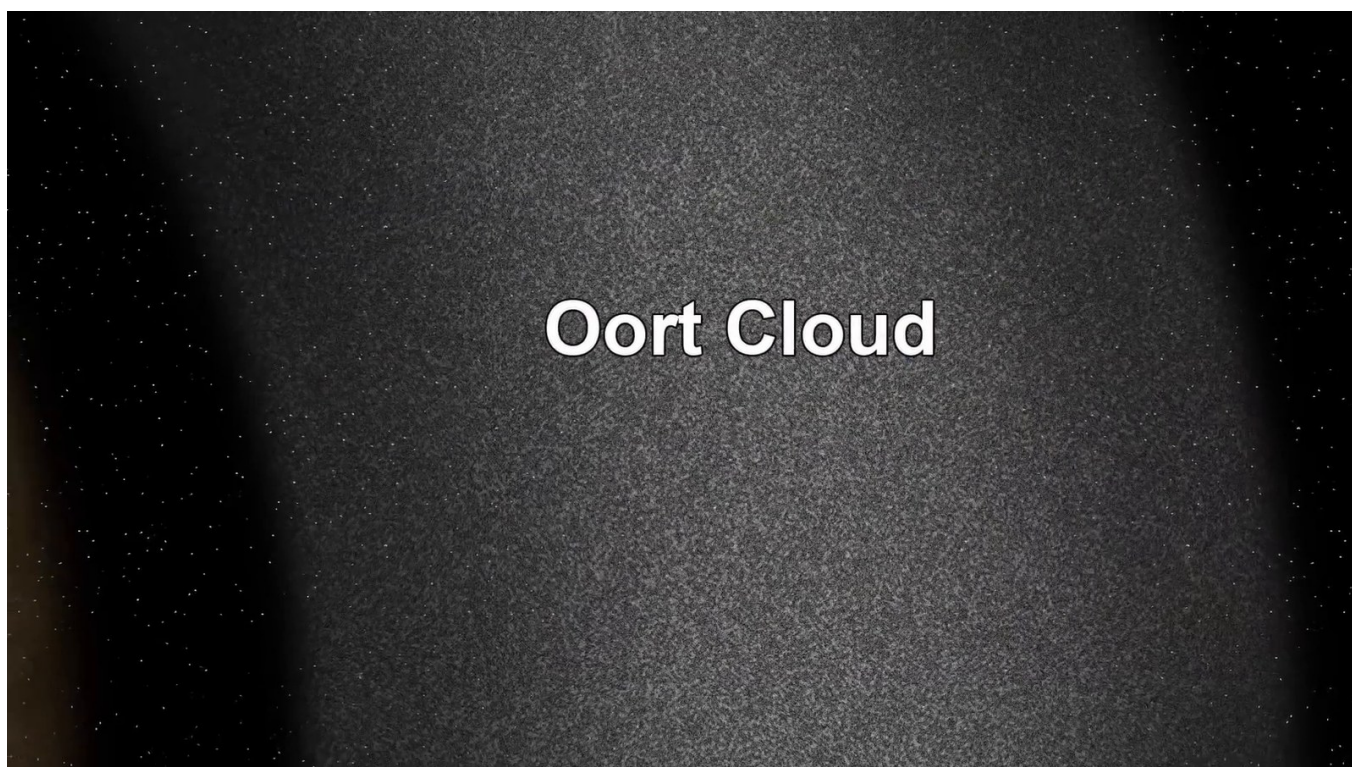


Matched transcript

At the very fringes of our solar system lies the Oort cloud, a vast theoretical sphere of icy

Fragment 48

Time range: 04:23 - 04:29

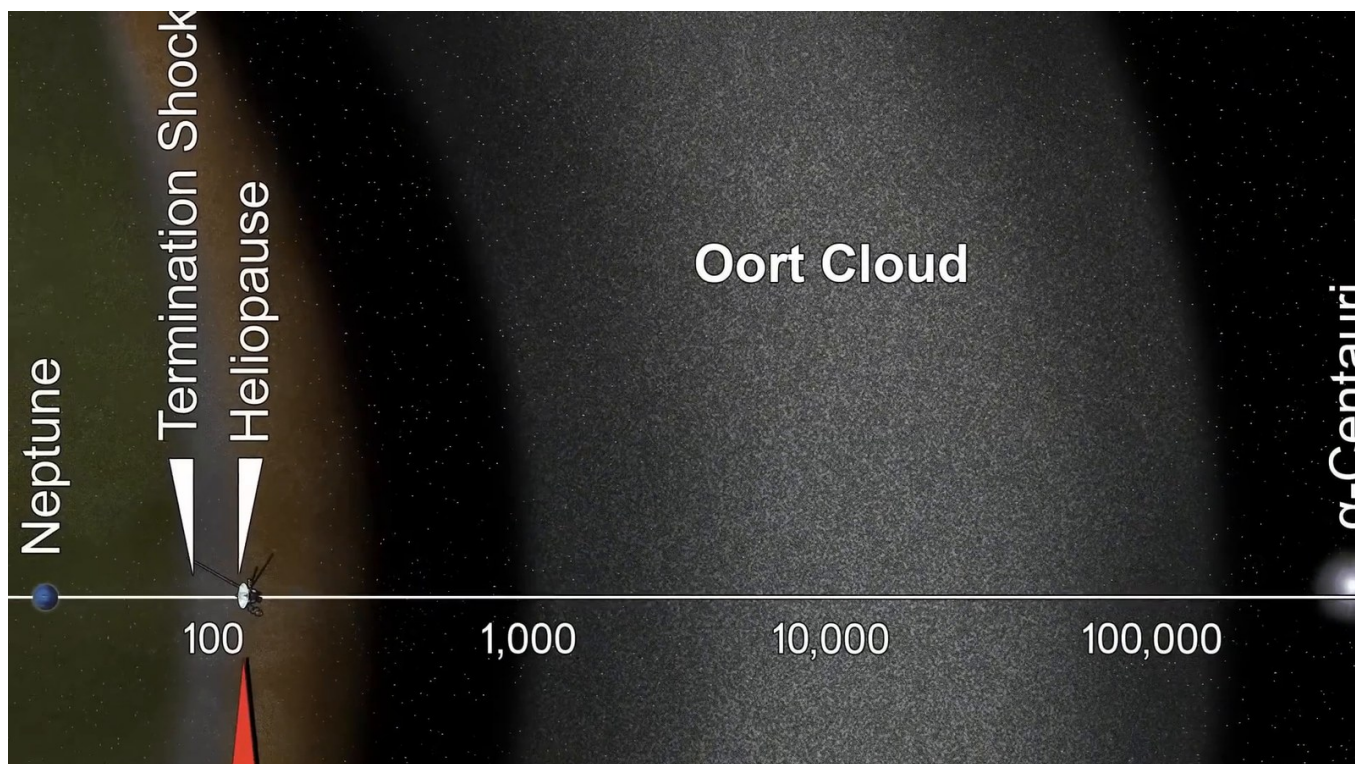


Matched transcript

At the very fringes of our solar system lies the Oort cloud, a vast theoretical sphere of icy objects. This distant cloud is thought to extend up to a staggering 100,000 astronomical

Fragment 49

Time range: 04:29 - 04:35

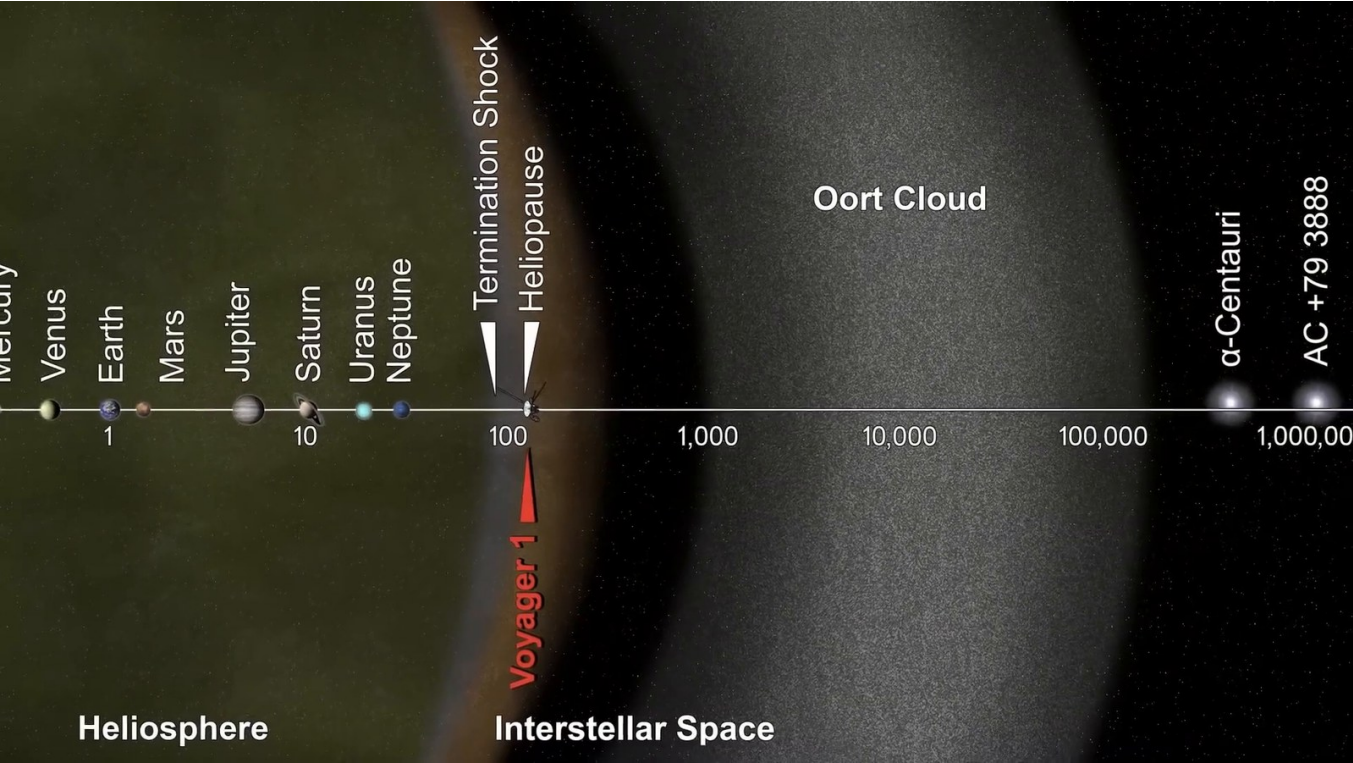


Matched transcript

objects. This distant cloud is thought to extend up to a staggering 100,000 astronomical units from the Sun. That's about 1.9 light-years, a distance so immense that it's on the cusp

Fragment 50

Time range: 04:35 - 04:41



Matched transcript

units from the Sun. That's about 1.9 light-years, a distance so immense that it's on the cusp of interstellar space. Scientists determine the boundary of interstellar space, known

Fragment 51

Time range: 04:41 - 04:47

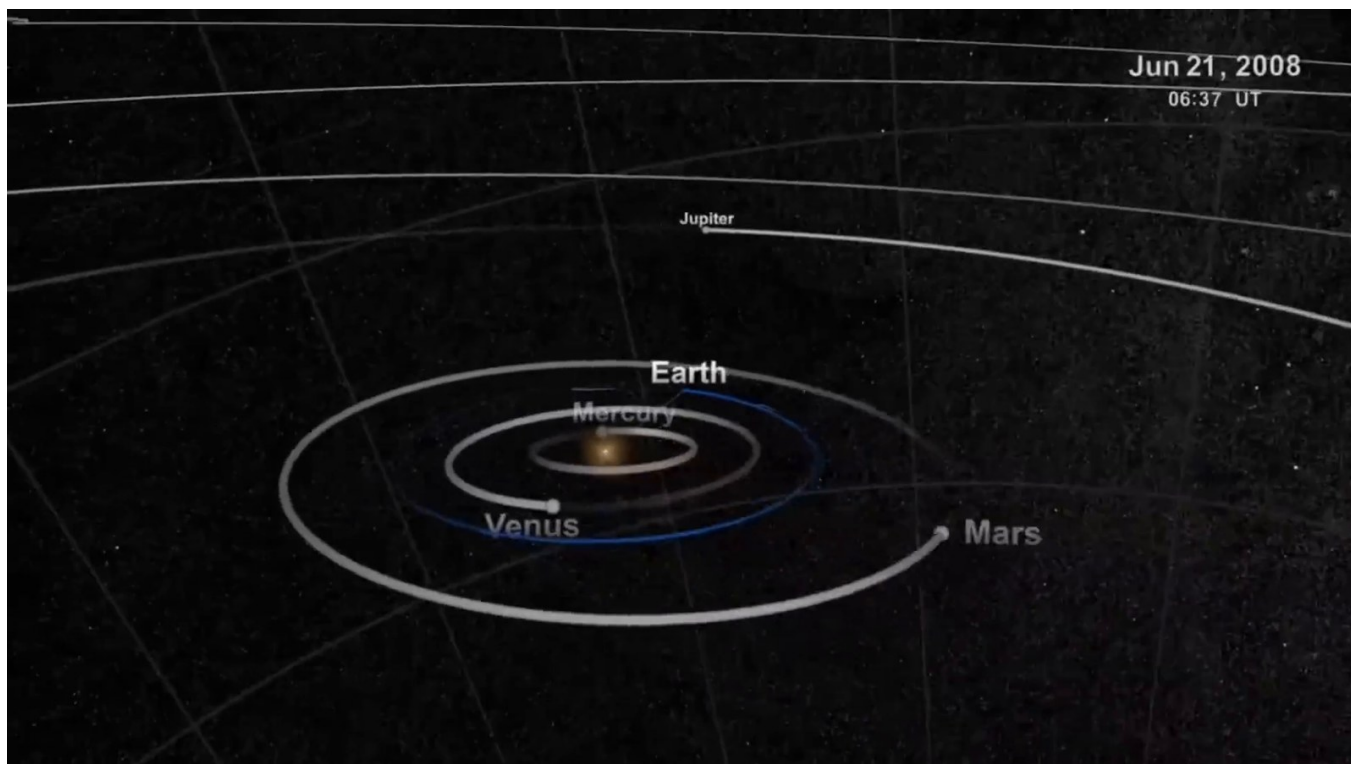


Matched transcript

of interstellar space. Scientists determine the boundary of interstellar space, known as the heliopause, where the Sun's solar wind is stopped by the interstellar medium.

Fragment 52

Time range: 04:47 - 04:53

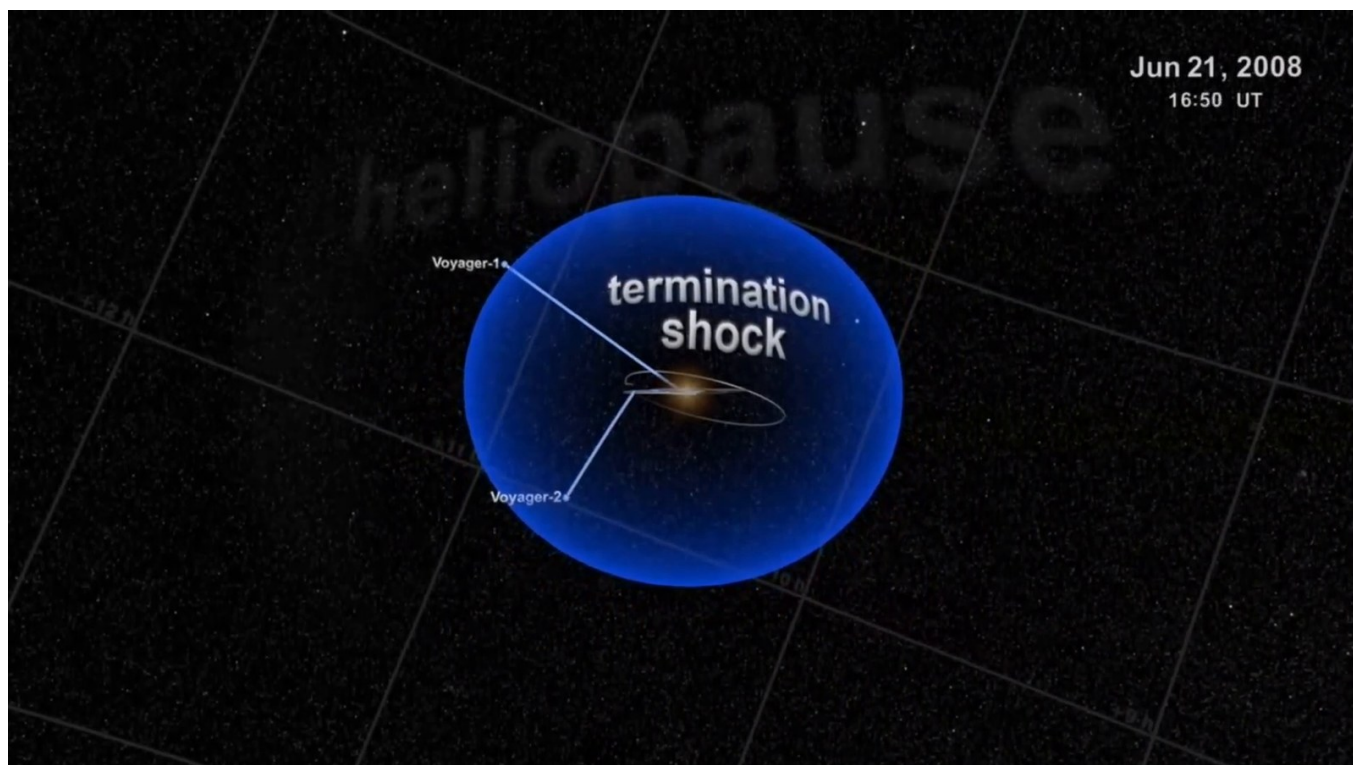


Matched transcript

as the heliopause, where the Sun's solar wind is stopped by the interstellar medium. This is where the influence of our sun ceases and the vast realm of interstellar space begins.

Fragment 53

Time range: 04:53 - 04:56

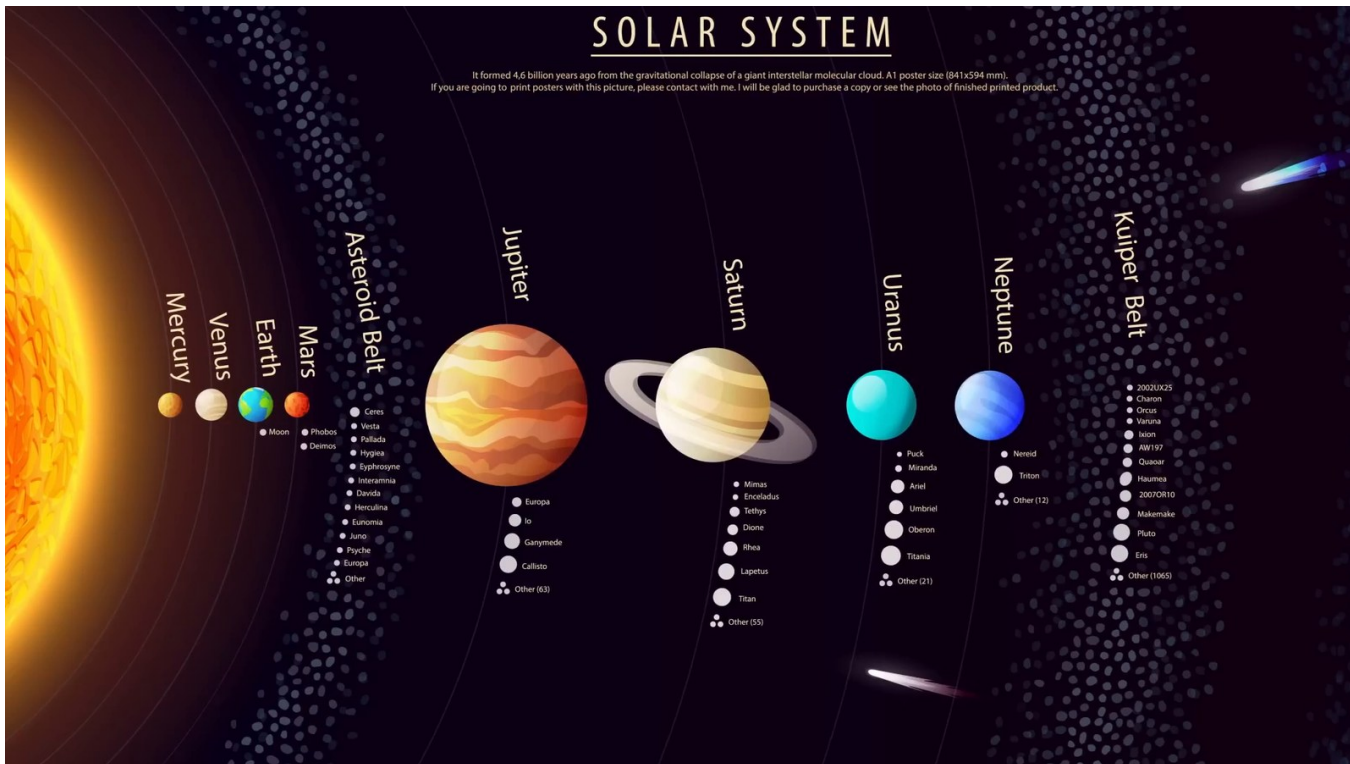


Matched transcript

This is where the influence of our sun ceases and the vast realm of interstellar space begins.

Fragment 54

Time range: 04:56 - 05:03

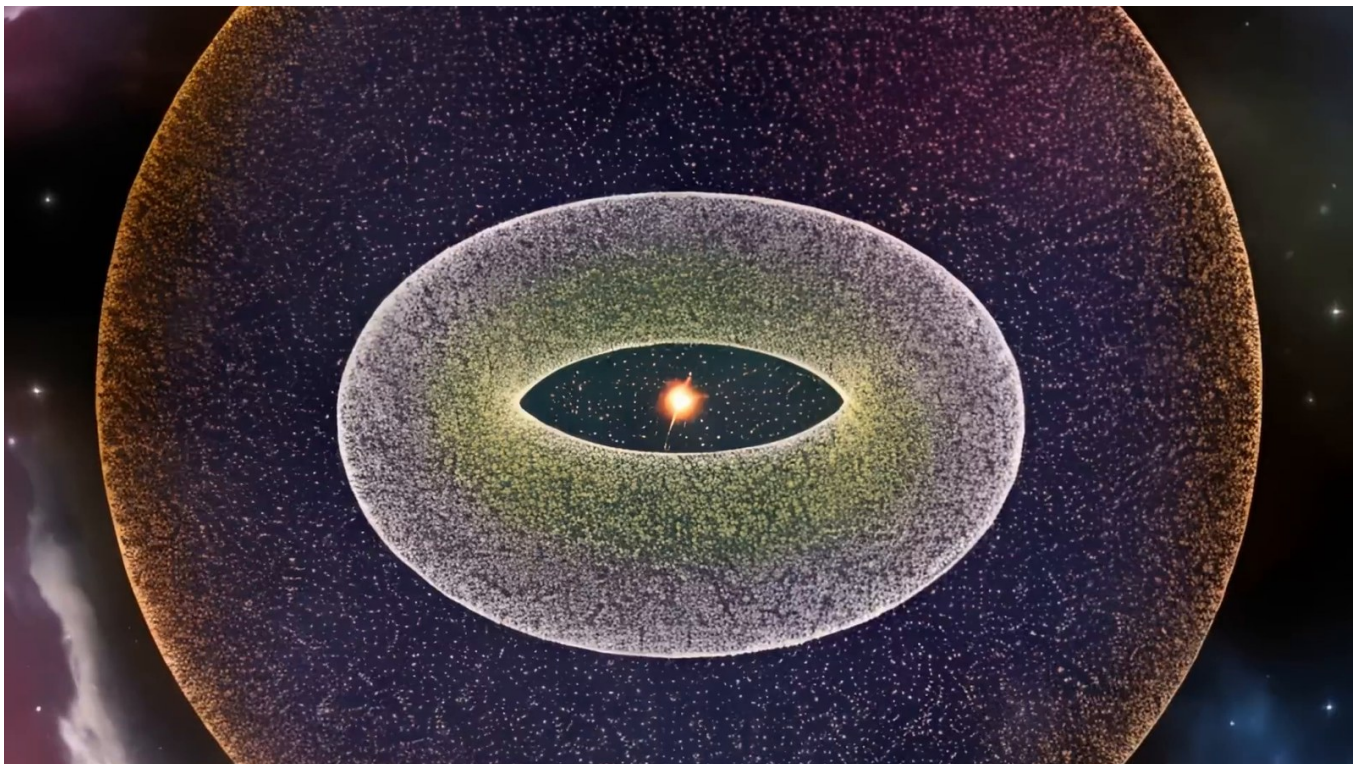


Matched transcript

This is where the influence of our sun ceases and the vast realm of interstellar space begins. The Oort cloud represents the final frontier of our solar system, a boundary zone where the sun's influence wanes and the cosmic journey into the galaxy truly begins.

Fragment 55

Time range: 05:03 - 05:09



Matched transcript

the sun's influence wanes and the cosmic journey into the galaxy truly begins. As we venture beyond the confines of our solar system, our next point of interest is Alpha

Fragment 56

Time range: 05:09 - 05:15

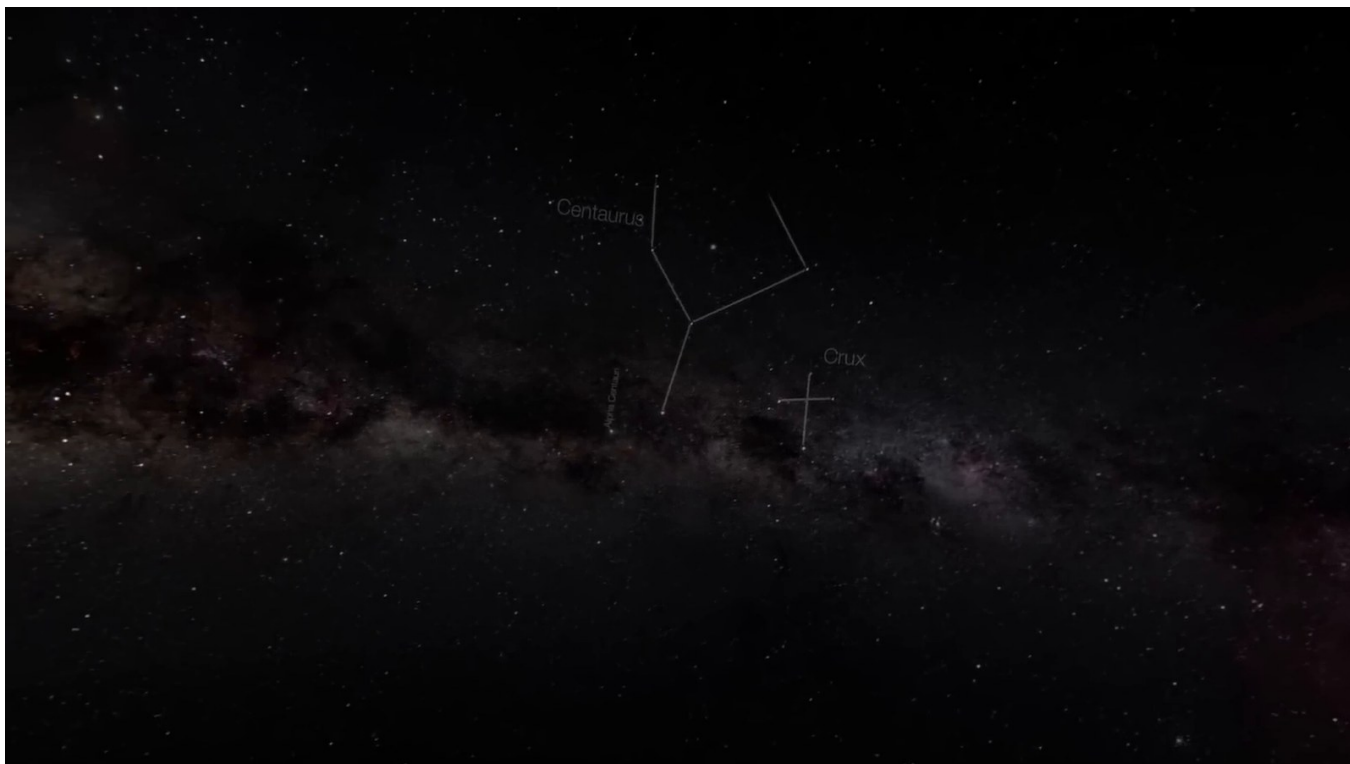


Matched transcript

As we venture beyond the confines of our solar system, our next point of interest is Alpha Centauri, the closest star system to our Sun. Located about 41.3 trillion kilometers away,

Fragment 57

Time range: 05:15 - 05:21



Matched transcript

Centauri, the closest star system to our Sun. Located about 41.3 trillion kilometers away, this distance is equivalent to over 276,000 astronomical units. At such colossal distances,

Fragment 58

Time range: 05:21 - 05:27



Matched transcript

this distance is equivalent to over 276,000 astronomical units. At such colossal distances,

Fragment 59

Time range: 05:27 - 05:31

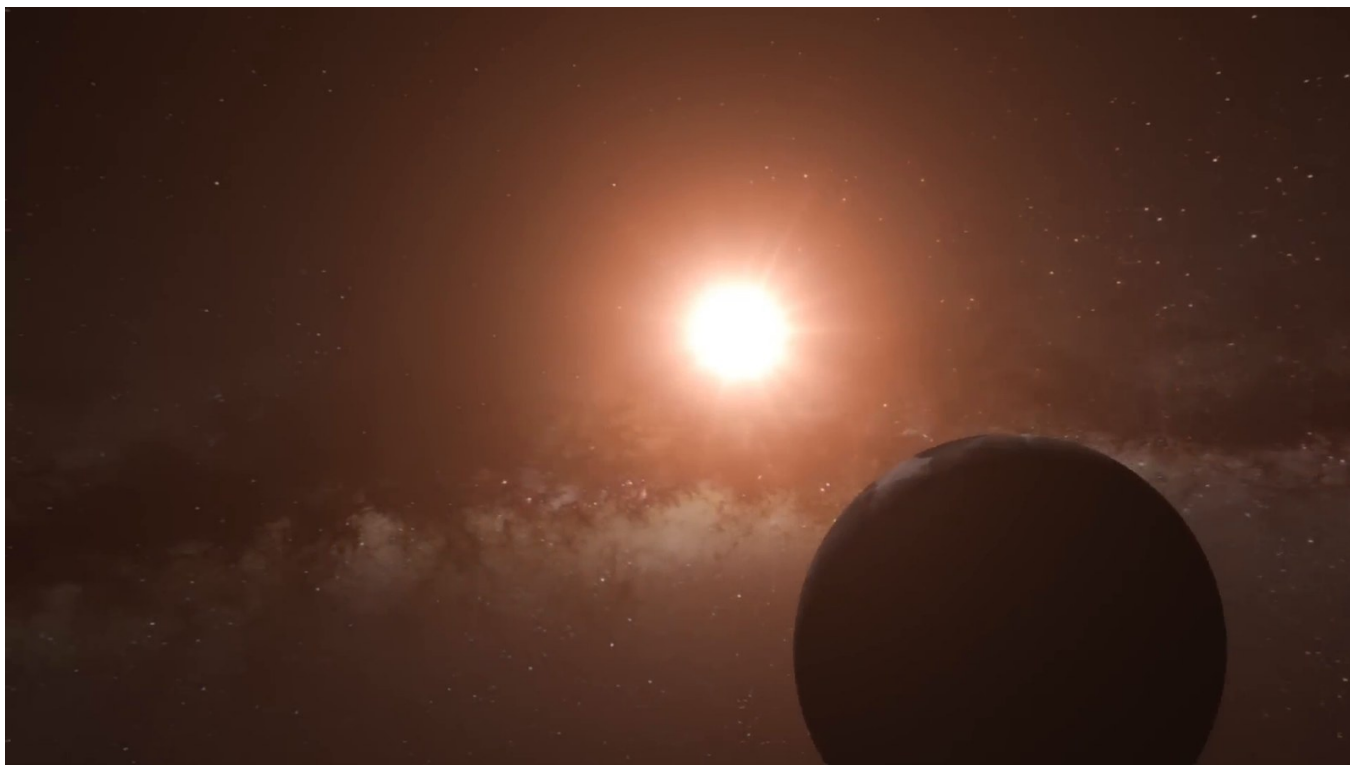


Matched transcript

this distance is equivalent to over 276,000 astronomical units. At such colossal distances, the AU a measure so convenient within our solar system begins to lose its practicality Hence astronomers use the light year the distance light travels in one year for interstellar measurements

Fragment 60

Time range: 05:31 - 05:37



Matched transcript

the AU a measure so convenient within our solar system begins to lose its practicality Hence astronomers use the light year the distance light travels in one year for interstellar measurements

Fragment 61

Time range: 05:37 - 05:43

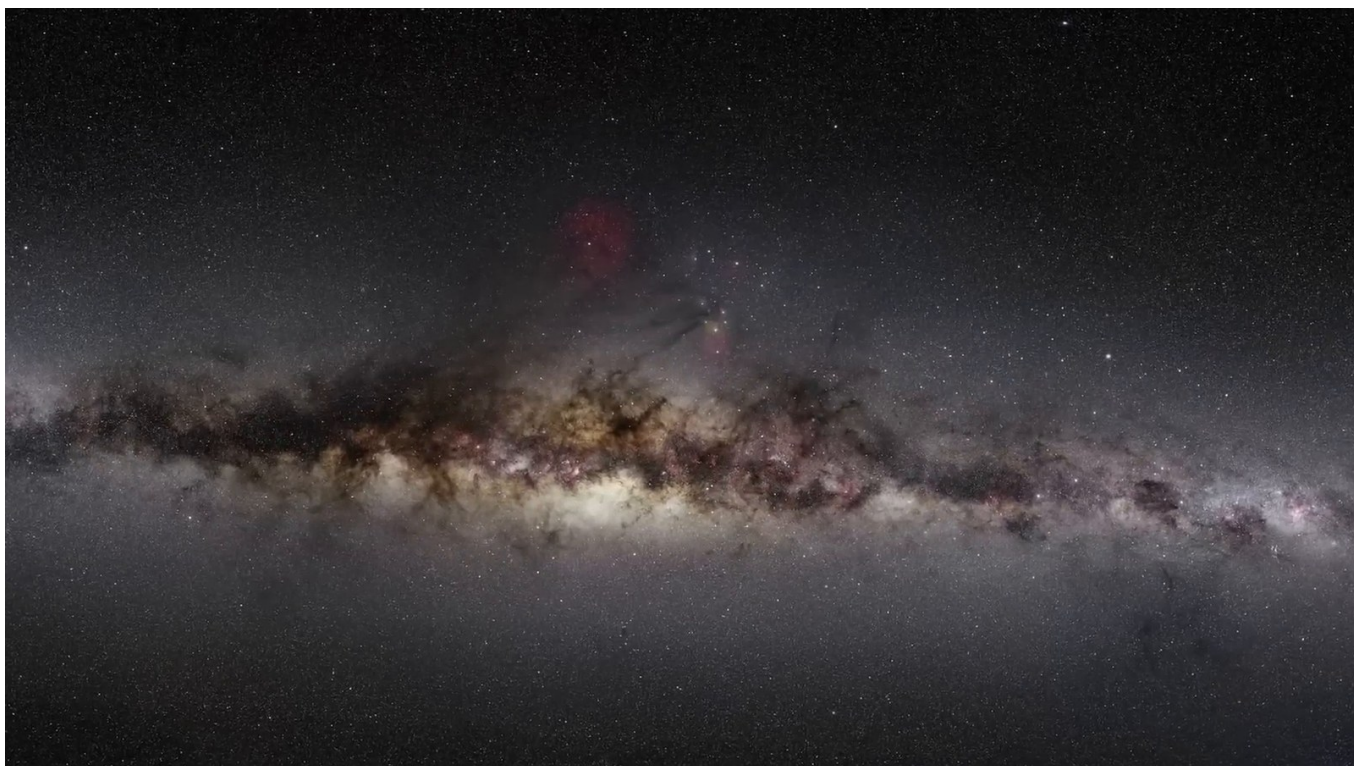


Matched transcript

the AU a measure so convenient within our solar system begins to lose its practicality Hence astronomers use the light year the distance light travels in one year for interstellar measurements Alpha Centauri is about 4.4 light years away from us.

Fragment 62

Time range: 05:43 - 05:49

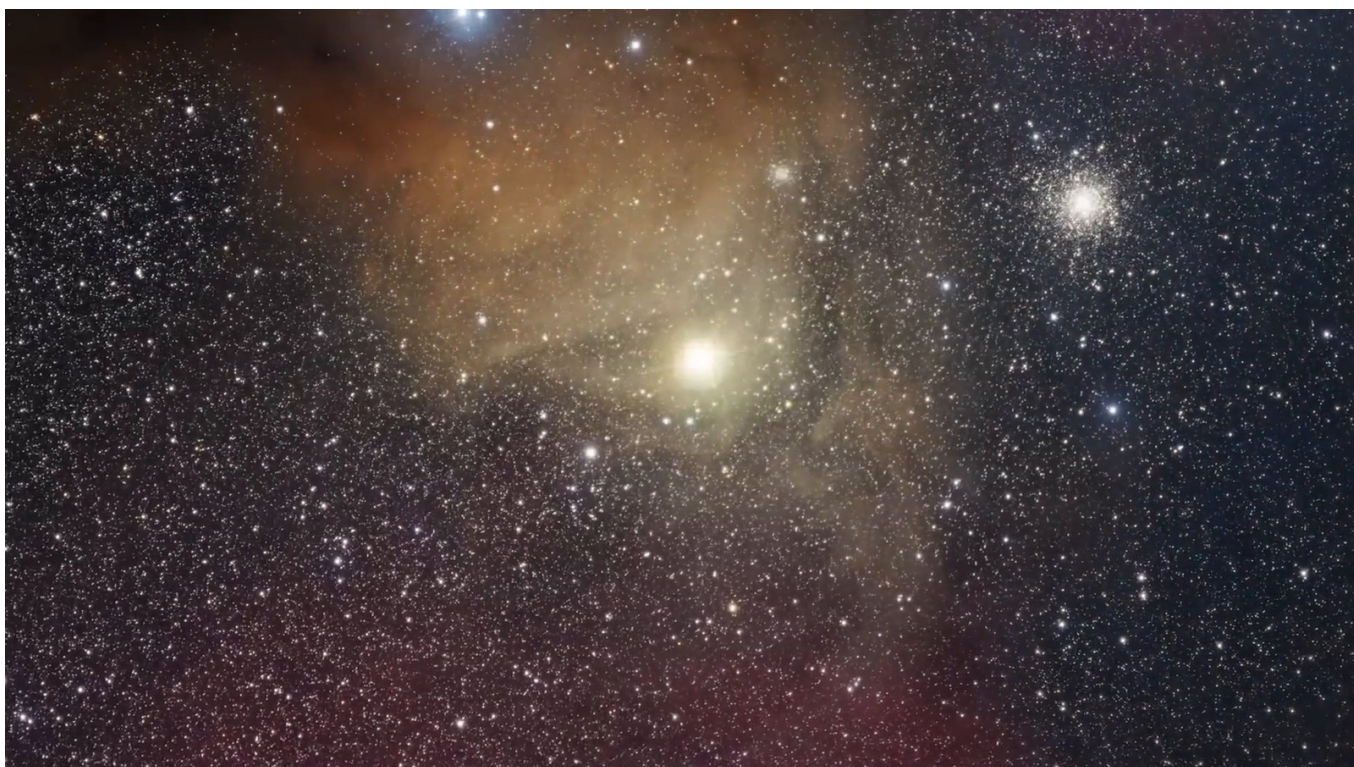


Matched transcript

Alpha Centauri is about 4.4 light years away from us. Considering our current space travel technology, a journey to Alpha Centauri is almost unfathomable.

Fragment 63

Time range: 05:49 - 05:55

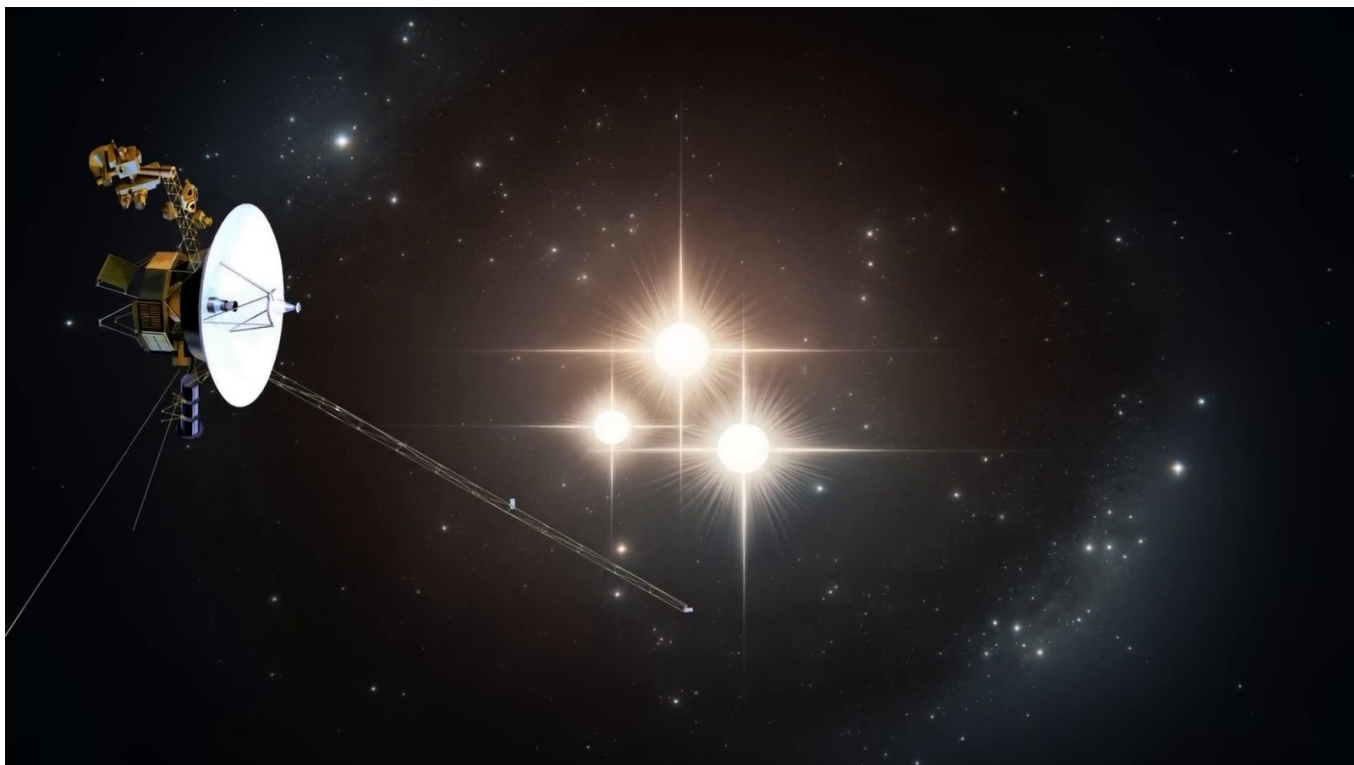


Matched transcript

Considering our current space travel technology, a journey to Alpha Centauri is almost unfathomable. For instance, the Voyager spacecraft, traveling at about 17 kilometers per second, would take over 70,000 years to reach this neighboring star system.

Fragment 64

Time range: 05:55 - 06:01

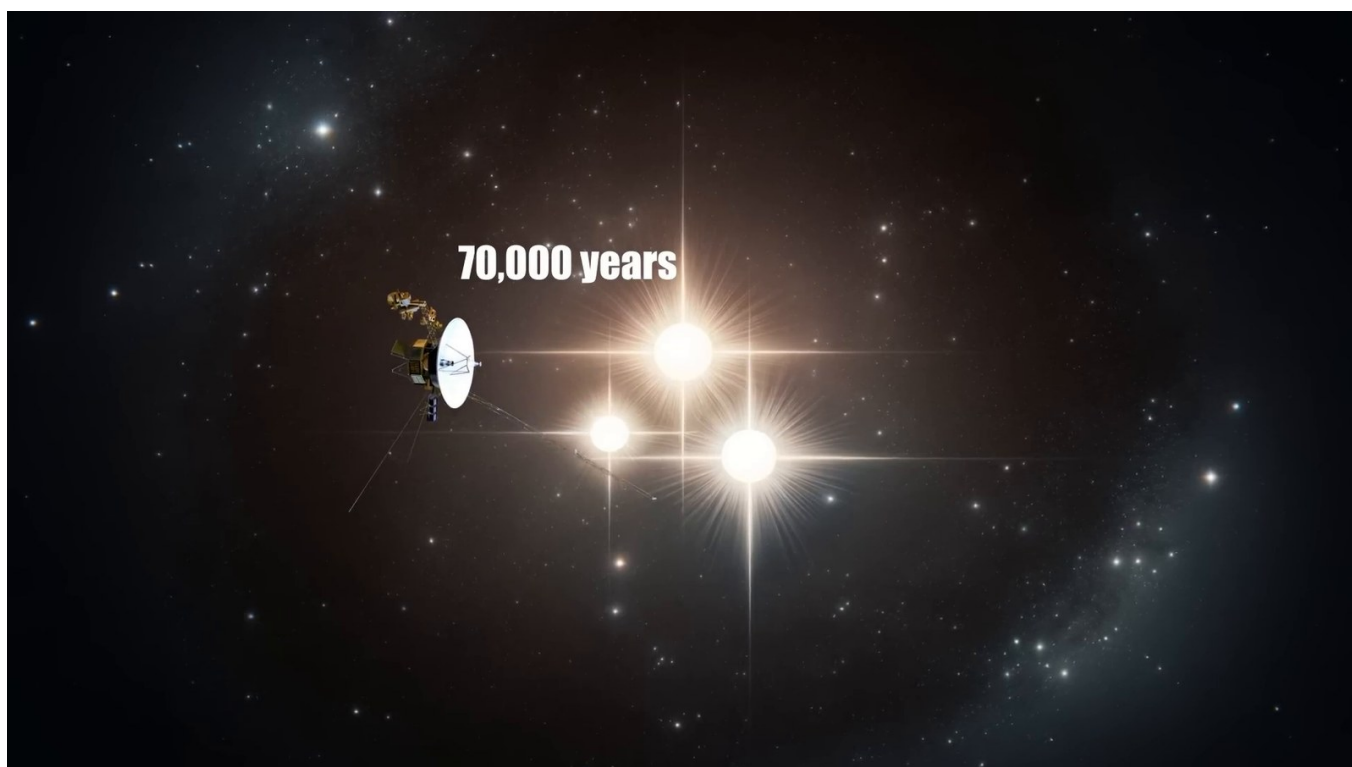


Matched transcript

For instance, the Voyager spacecraft, traveling at about 17 kilometers per second, would take over 70,000 years to reach this neighboring star system.

Fragment 65

Time range: 06:01 - 06:04



Matched transcript

For instance, the Voyager spacecraft, traveling at about 17 kilometers per second, would take over 70,000 years to reach this neighboring star system. This immense distance underscores the vastness of space that separates the stars and highlights the challenges of interstellar travel.

Fragment 66

Time range: 06:04 - 06:10



Matched transcript

This immense distance underscores the vastness of space that separates the stars and highlights the challenges of interstellar travel.

Fragment 67

Time range: 06:10 - 06:16

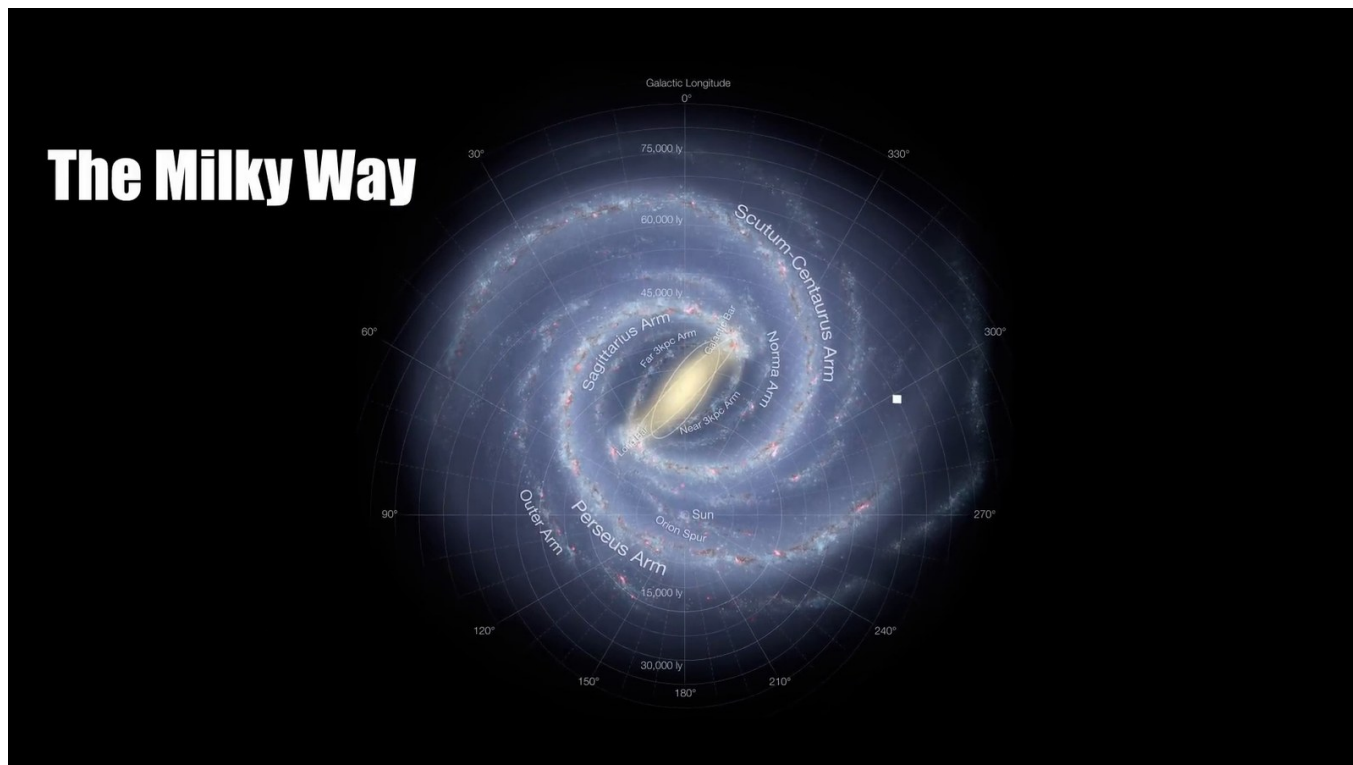


Matched transcript

Our journey now takes us to the grand scale of our home galaxy, the Milky Way.

Fragment 68

Time range: 06:16 - 06:22

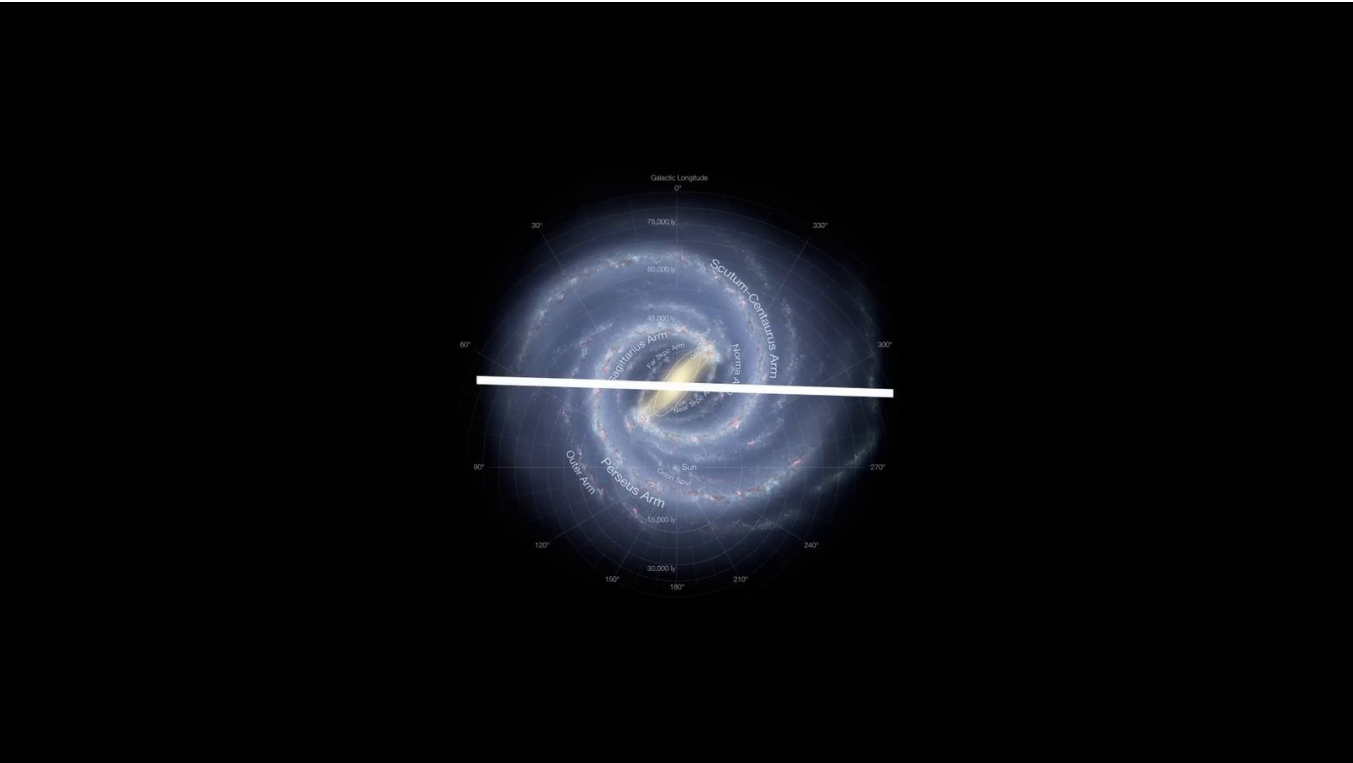


Matched transcript

Spanning about 100,000 light-years in diameter, this vast spiral galaxy is home to hundreds of billions of stars,

Fragment 69

Time range: 06:22 - 06:28



Matched transcript

this vast spiral galaxy is home to hundreds of billions of stars, each potentially hosting their own planetary systems. Within this immense structure, there's a tiny sphere known as the human radio bubble,

Fragment 70

Time range: 06:28 - 06:34



Matched transcript

Within this immense structure, there's a tiny sphere known as the human radio bubble, extending about 100 light-years from Earth.

Fragment 71

Time range: 06:34 - 06:40



Matched transcript

extending about 100 light-years from Earth. This bubble represents the farthest extent of human influence in the cosmos, the reach of our radio and television broadcasts into space.

Fragment 72

Time range: 06:40 - 06:46



Matched transcript

the reach of our radio and television broadcasts into space. Beyond this bubble, it's as if humanity never existed.

Fragment 73

Time range: 06:46 - 06:49

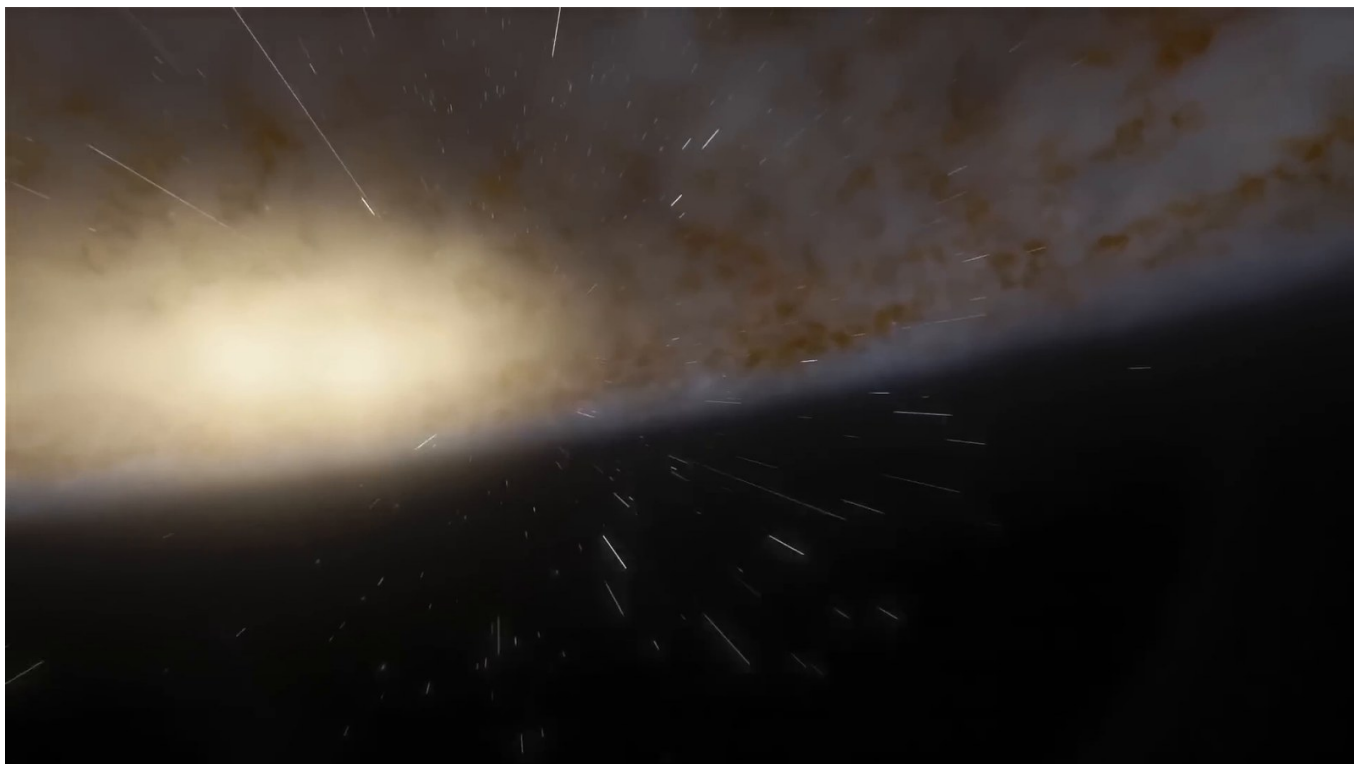


Matched transcript

Beyond this bubble, it's as if humanity never existed. Any civilizations residing in the vast majority of our galaxy would be oblivious to our presence,

Fragment 74

Time range: 06:49 - 06:55

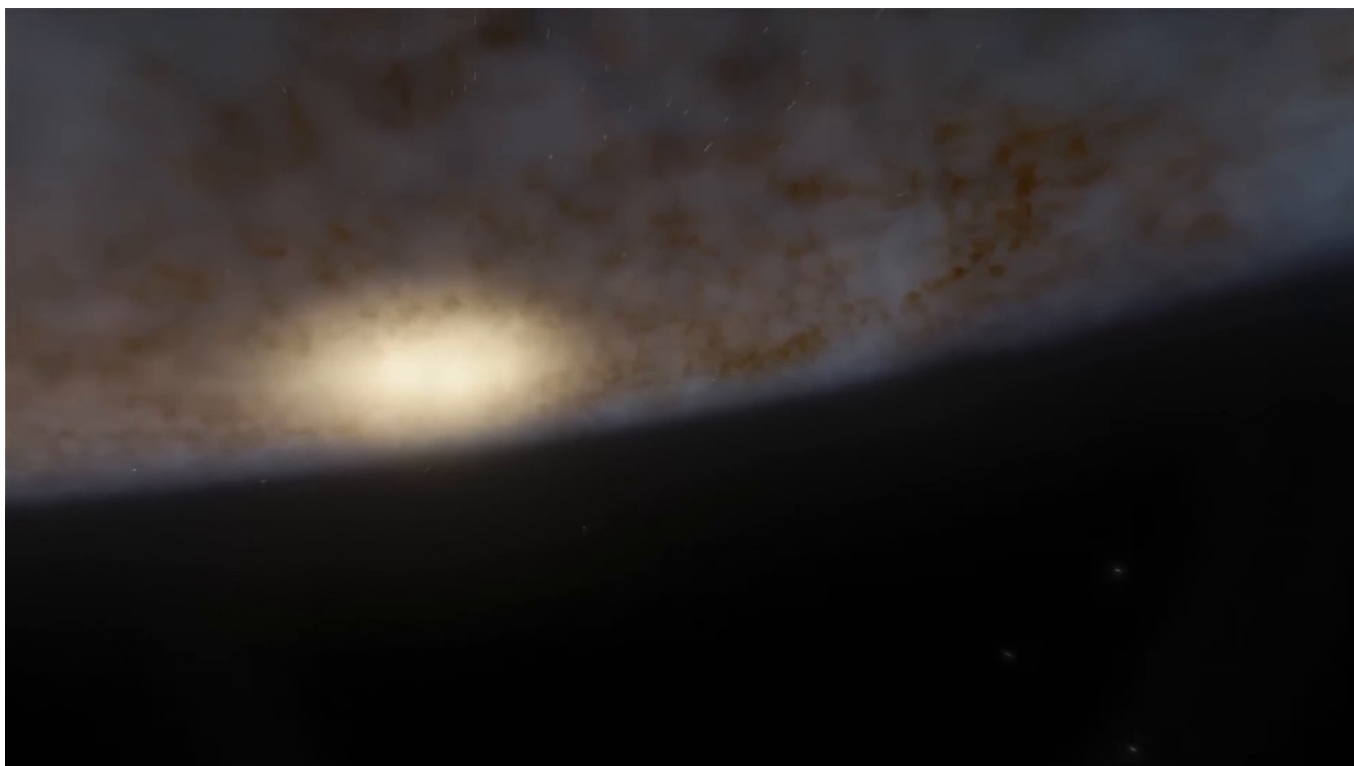


Matched transcript

Any civilizations residing in the vast majority of our galaxy would be oblivious to our presence, given that our signals haven't reached them yet.

Fragment 75

Time range: 06:55 - 07:00

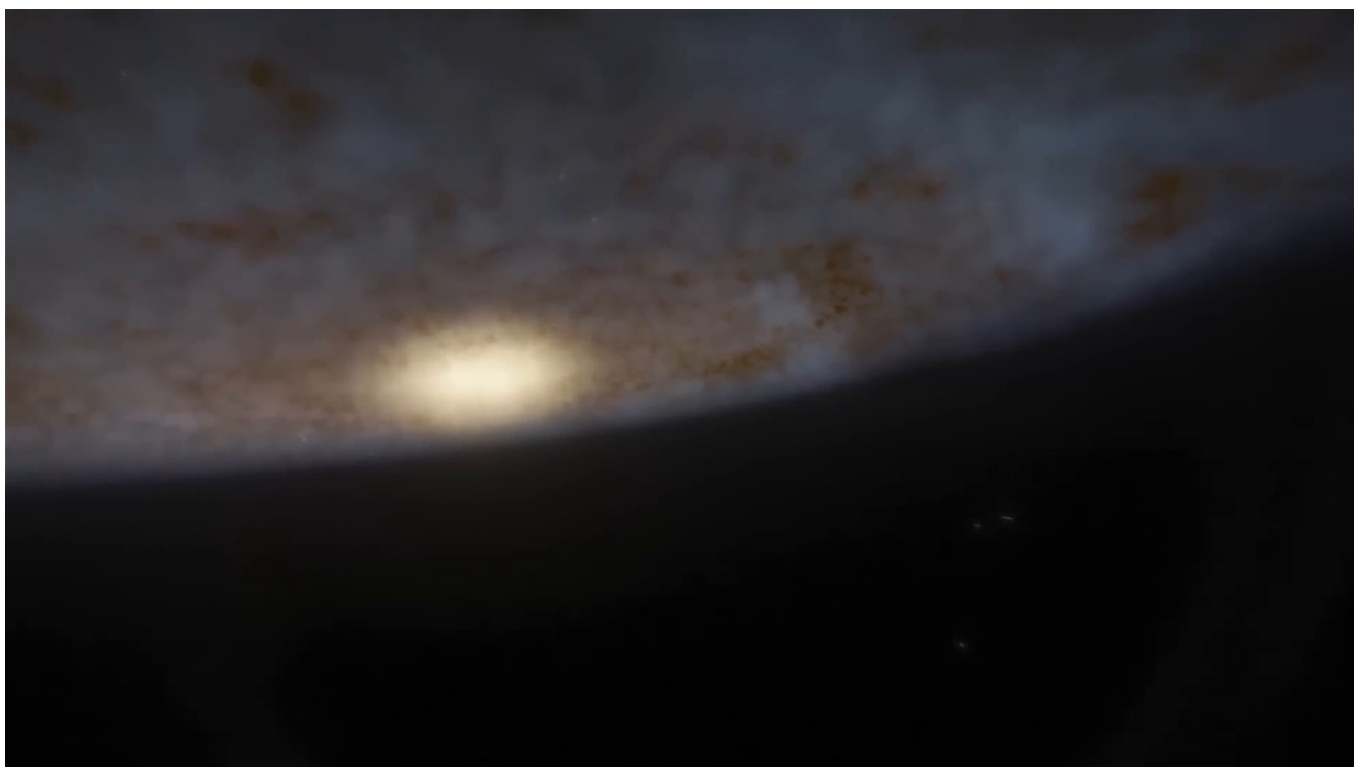


Matched transcript

given that our signals haven't reached them yet. The scale of the Milky Way is so vast that our entire recorded history is but a whisper in the cosmic wind,

Fragment 76

Time range: 07:00 - 07:08



Matched transcript

The scale of the Milky Way is so vast that our entire recorded history is but a whisper in the cosmic wind, undetectable beyond this small bubble. As we leave the Milky Way, we enter the vast, almost incomprehensible realm of intergalactic space.

Fragment 77

Time range: 07:08 - 07:14



Matched transcript

As we leave the Milky Way, we enter the vast, almost incomprehensible realm of intergalactic space. Here, galaxies float in the cosmic ocean, separated by mind-boggling distances.

Fragment 78

Time range: 07:14 - 07:20



Matched transcript

Here, galaxies float in the cosmic ocean, separated by mind-boggling distances. Our galaxy is part of a small cosmic neighborhood known as the Local Group, a cluster of more

Fragment 79

Time range: 07:20 - 07:23

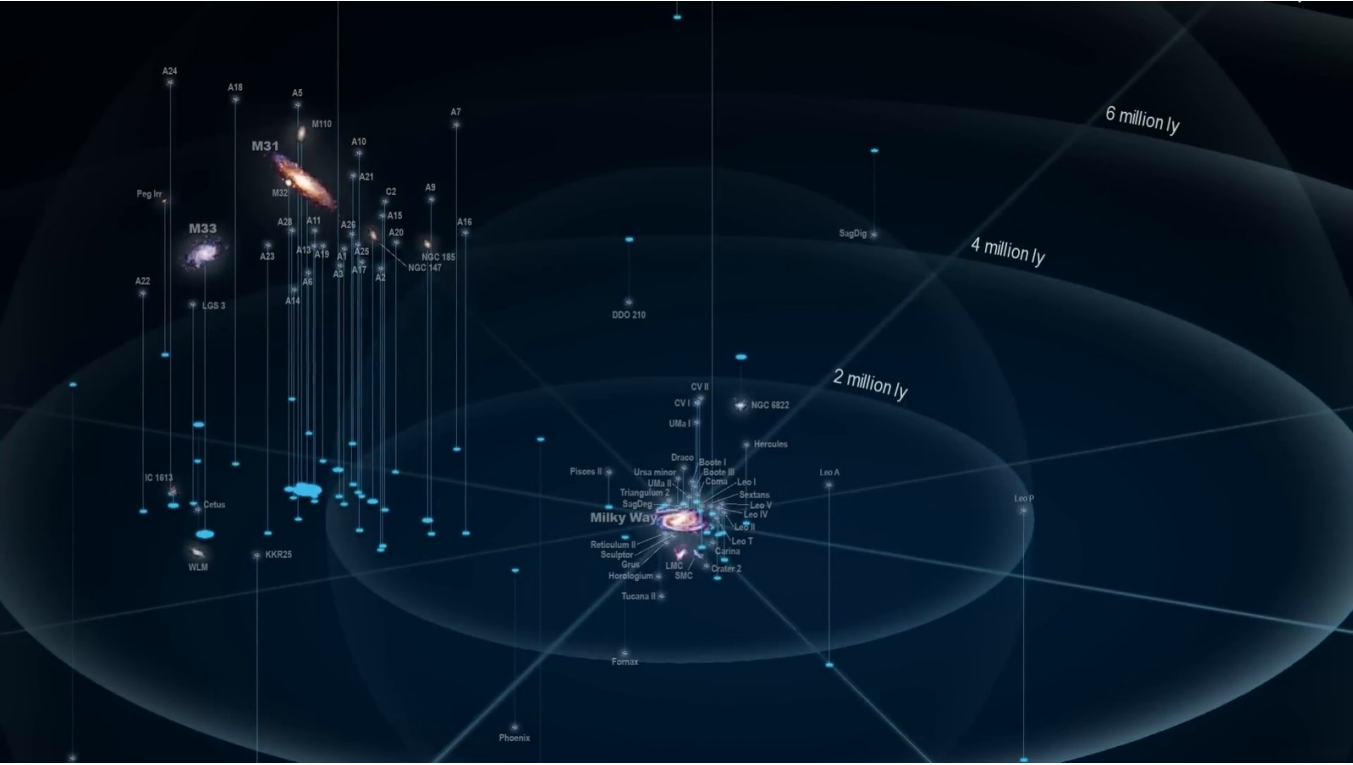


Matched transcript

Our galaxy is part of a small cosmic neighborhood known as the Local Group, a cluster of more

Fragment 80

Time range: 07:23 - 07:29

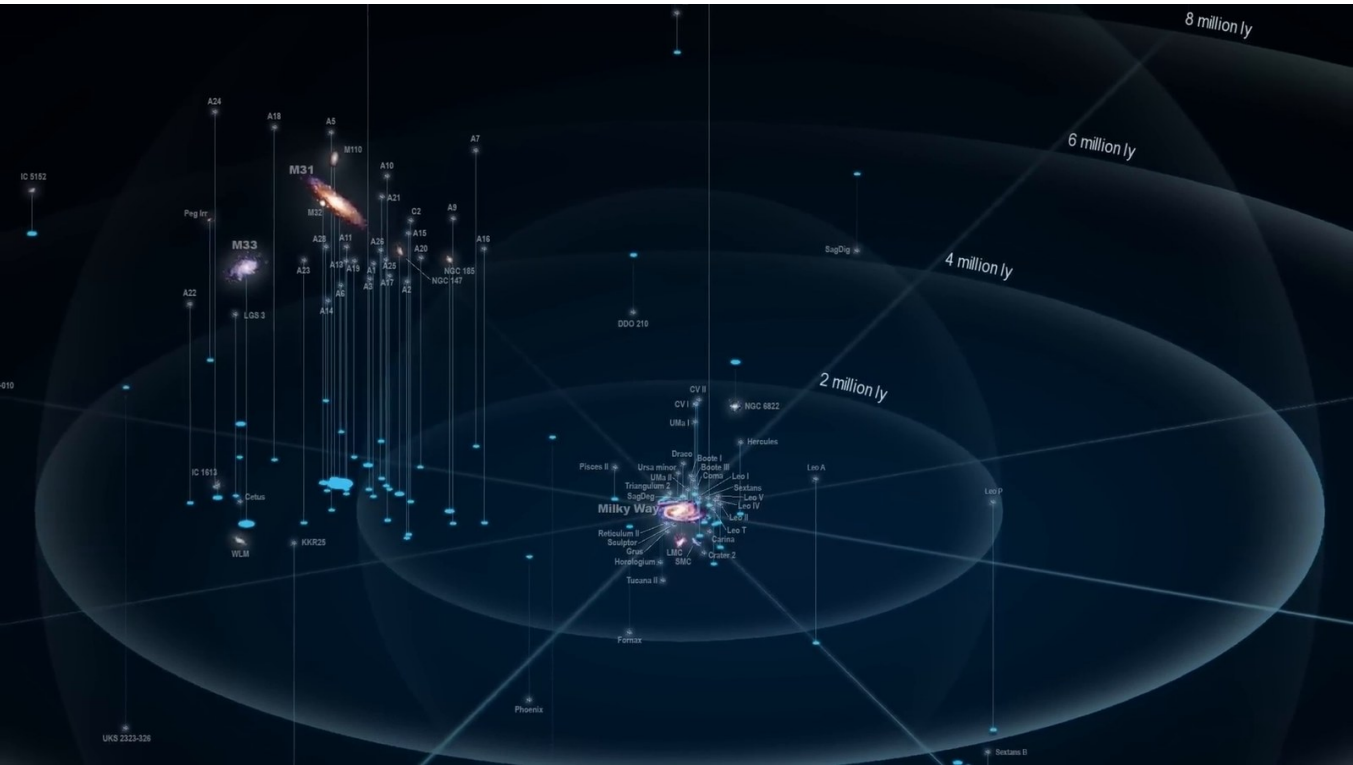


Matched transcript

Our galaxy is part of a small cosmic neighborhood known as the Local Group, a cluster of more than 50 galaxies spread across approximately 10 million light-years.

Fragment 81

Time range: 07:29 - 07:36

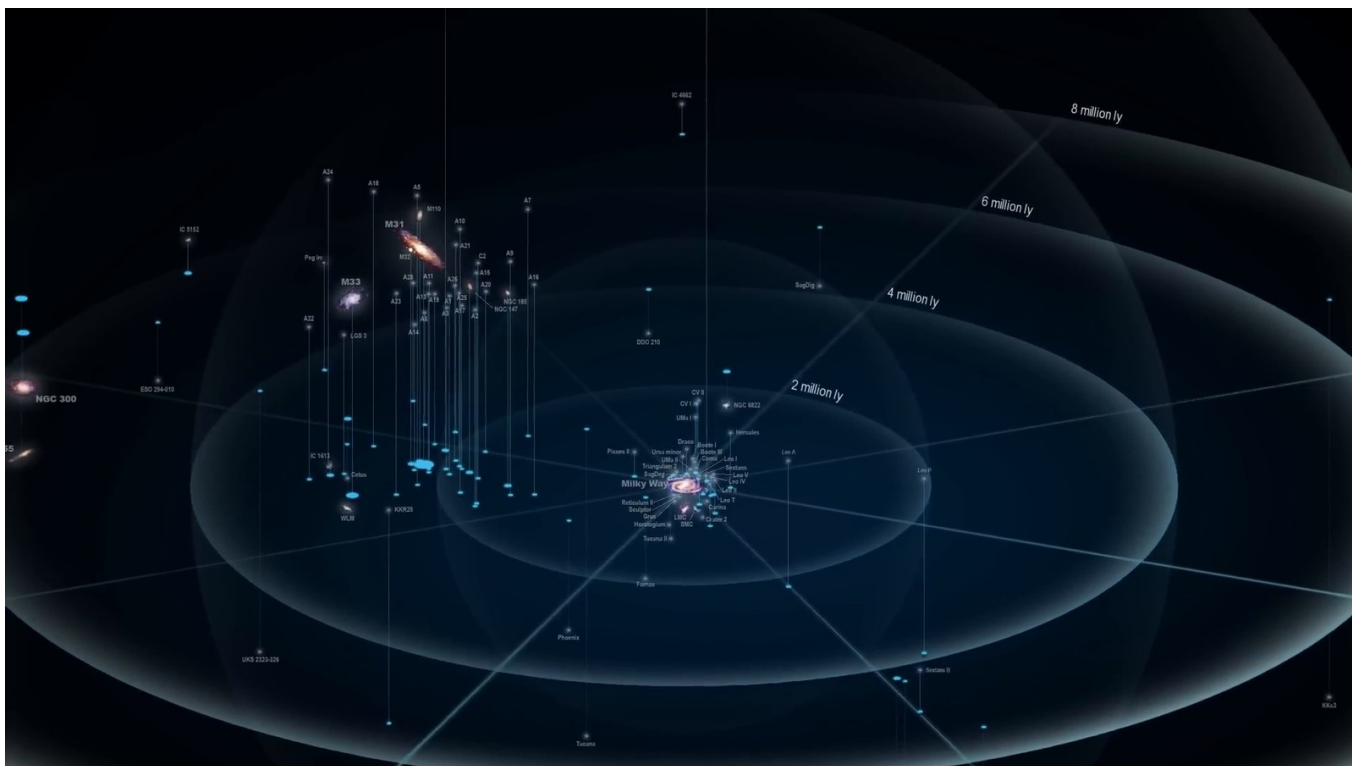


Matched transcript

than 50 galaxies spread across approximately 10 million light-years. The Local Group is a diverse assembly, including not just spiral galaxies like the Milky Way and Andromeda, but also a multitude of smaller dwarf galaxies.

Fragment 82

Time range: 07:36 - 07:42

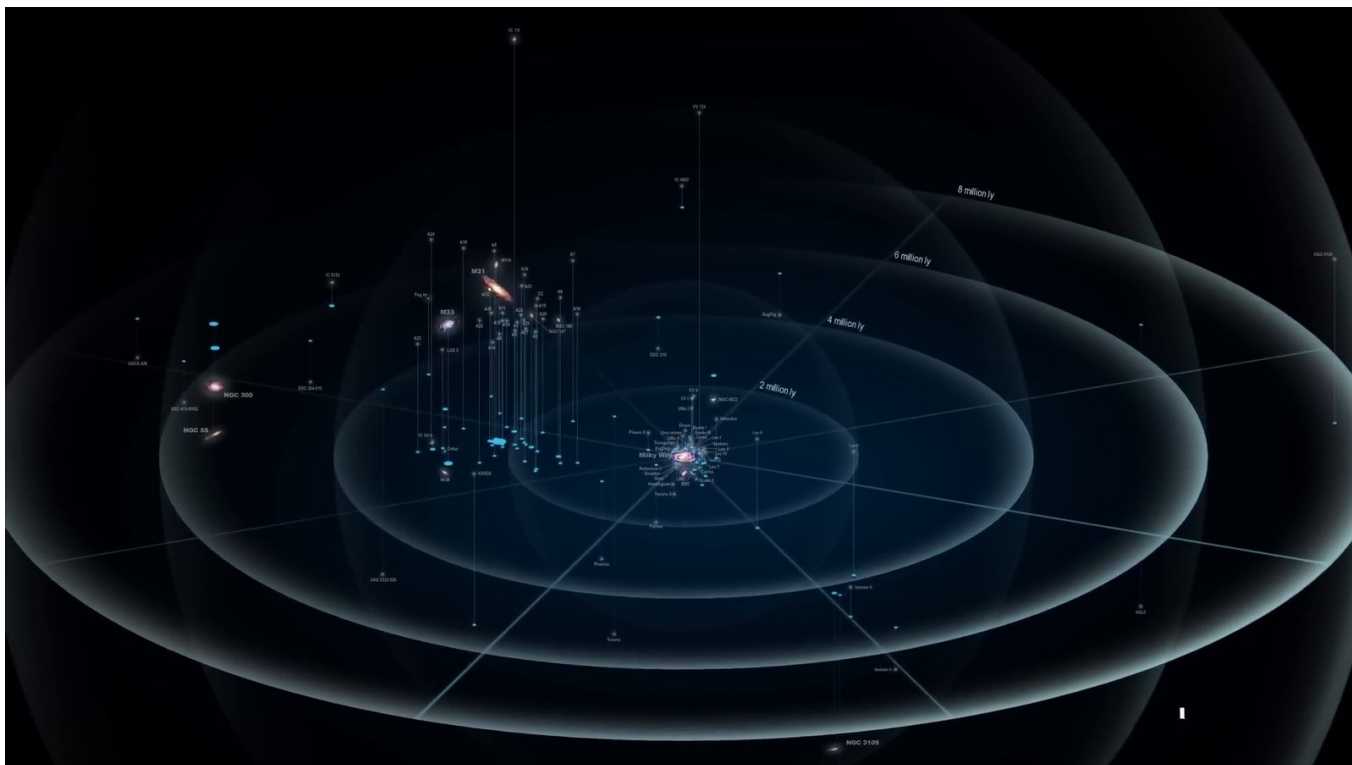


Matched transcript

and Andromeda, but also a multitude of smaller dwarf galaxies. The distances here are so vast that light from one end of the local group to the other

Fragment 83

Time range: 07:42 - 07:48

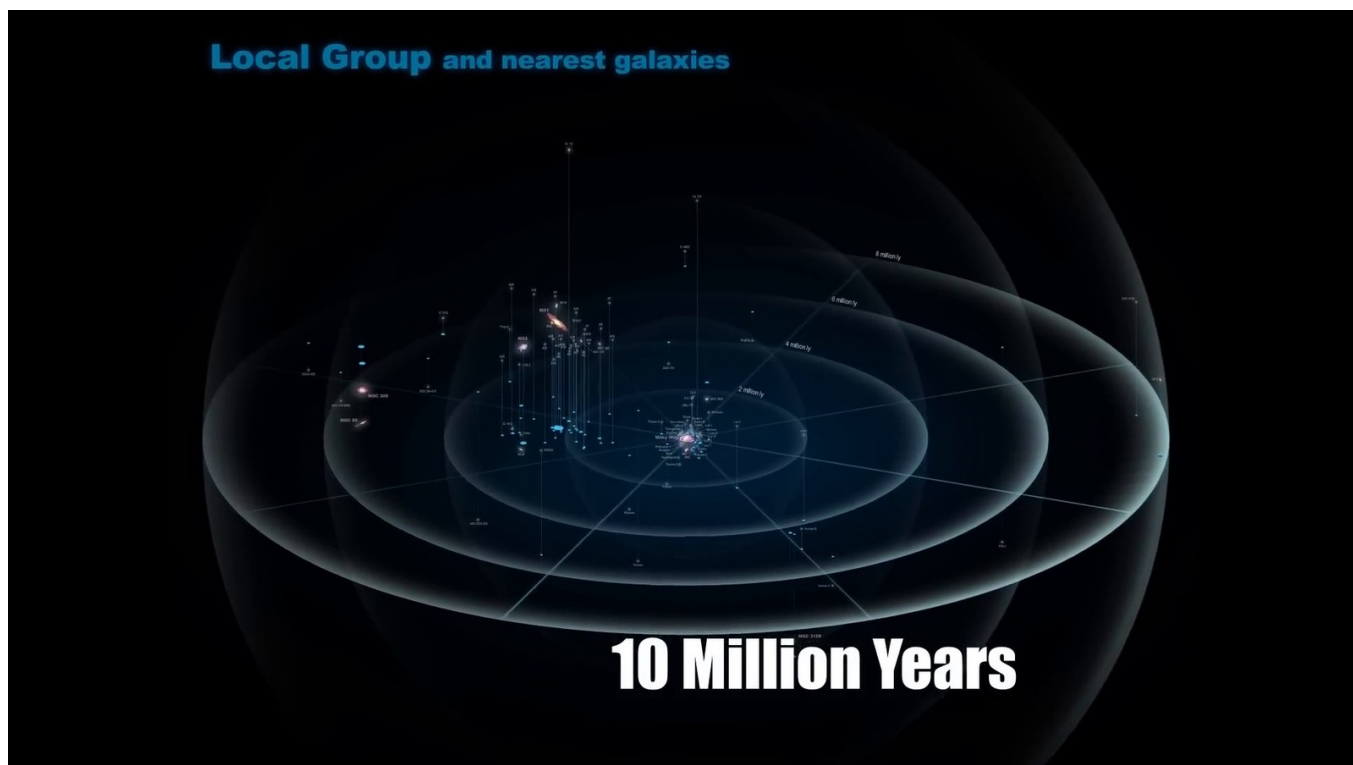


Matched transcript

The distances here are so vast that light from one end of the local group to the other would take 10 million years to traverse. This scale dwarfs anything within our own galaxy, underscoring the enormity of the universe.

Fragment 84

Time range: 07:48 - 07:51

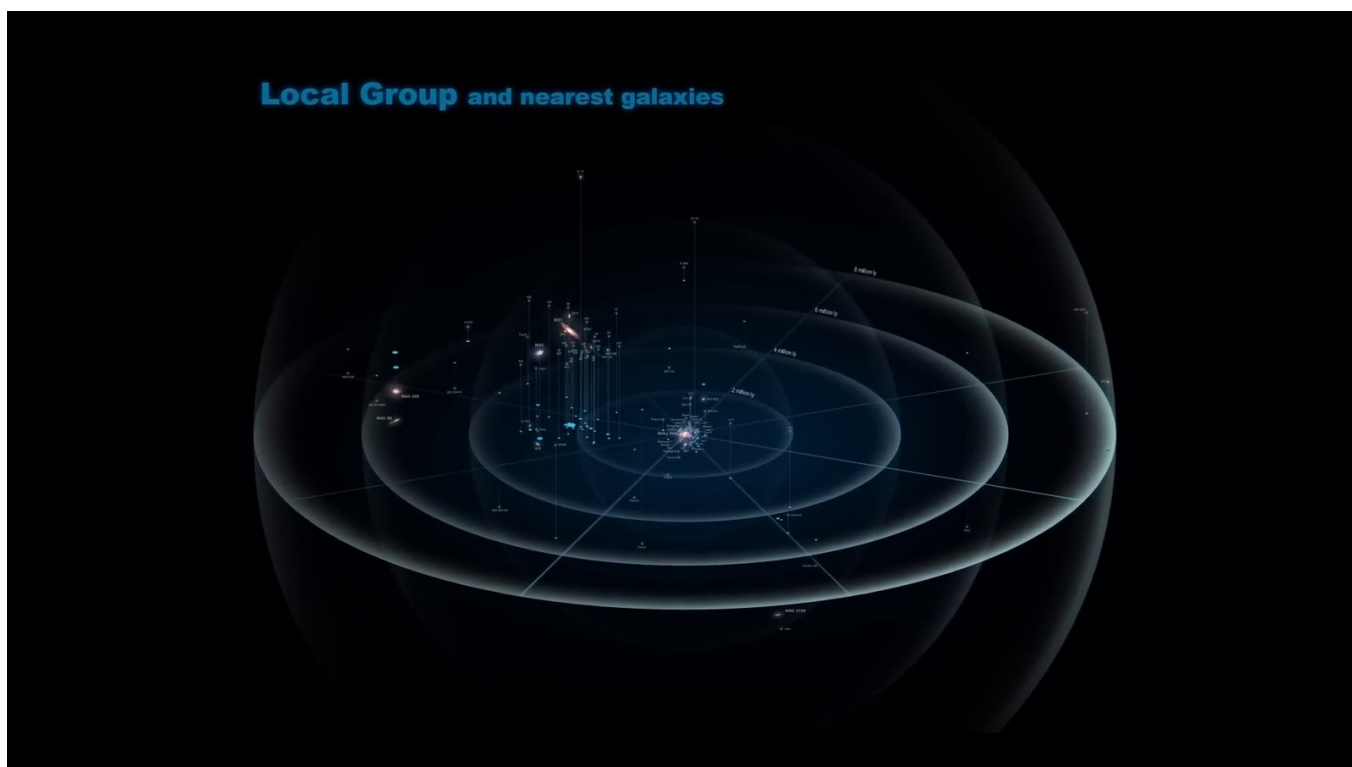


Matched transcript

This scale dwarfs anything within our own galaxy, underscoring the enormity of the universe.

Fragment 85

Time range: 07:51 - 07:57

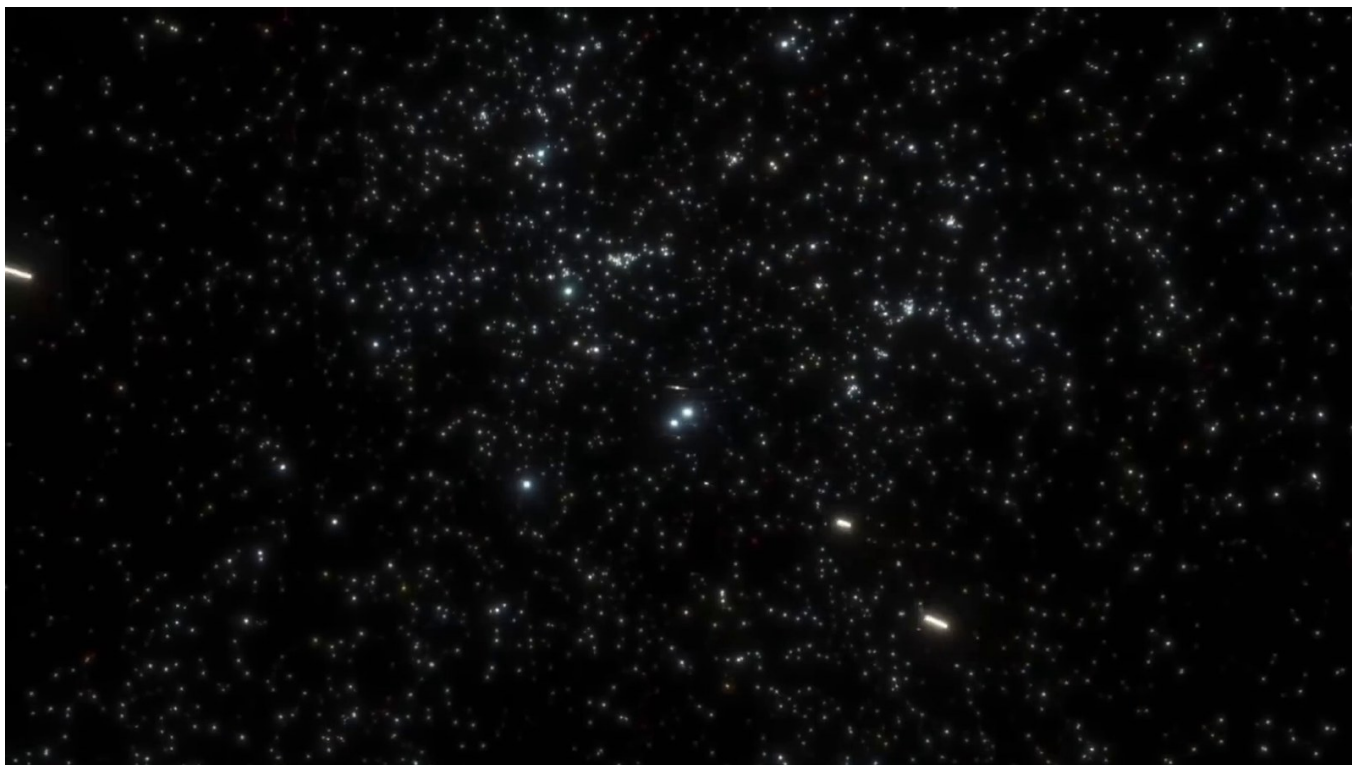


Matched transcript

This scale dwarfs anything within our own galaxy, underscoring the enormity of the universe. Intergalactic space is a silent expanse, a vast wilderness between the islands of galactic

Fragment 86

Time range: 07:57 - 08:03

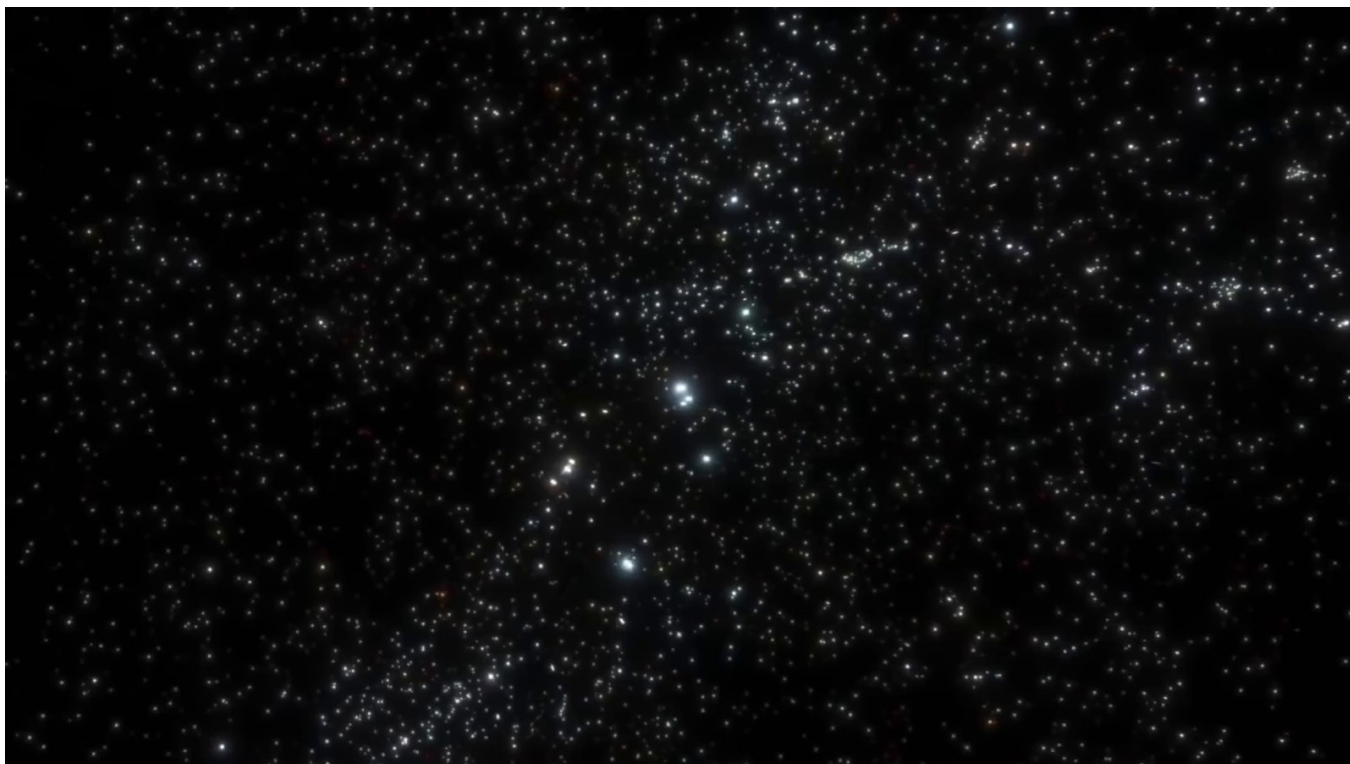


Matched transcript

Intergalactic space is a silent expanse, a vast wilderness between the islands of galactic light. In this immense void, our galaxy, home to our entire history, is just a tiny speck among

Fragment 87

Time range: 08:03 - 08:09



Matched transcript

In this immense void, our galaxy, home to our entire history, is just a tiny speck among a single story in the grand cosmic library. As we extend our cosmic gaze beyond the local

Fragment 88

Time range: 08:09 - 08:15



Matched transcript

a single story in the grand cosmic library. As we extend our cosmic gaze beyond the local group we encounter the colossal Virgo supercluster an immense collection of galaxy groups and clusters including our own local group Encompassing a region of space about 110 million light in diameter or 33 megaparsecs

Fragment 89

Time range: 08:15 - 08:21

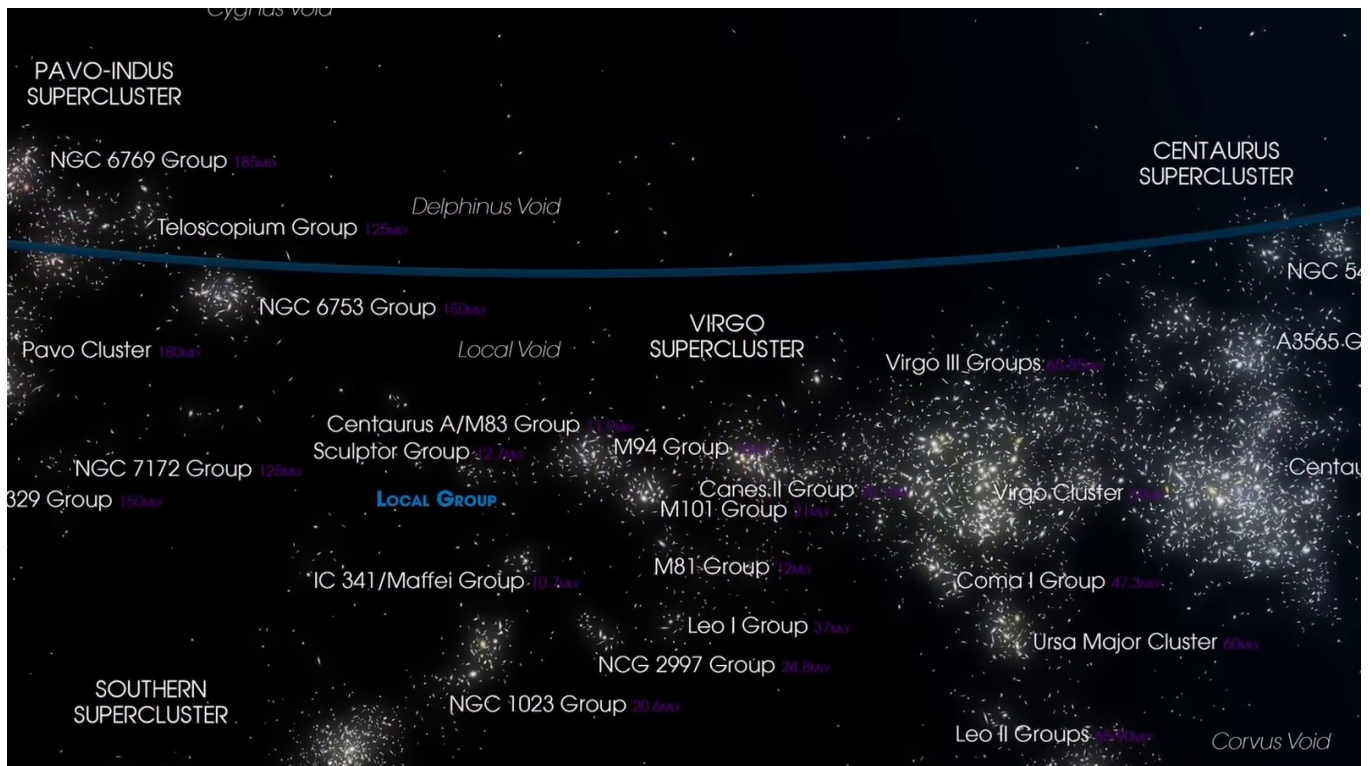


Matched transcript

group we encounter the colossal Virgo supercluster an immense collection of galaxy groups and clusters including our own local group Encompassing a region of space about 110 million light in diameter or 33 megaparsecs

Fragment 90

Time range: 08:21 - 08:24

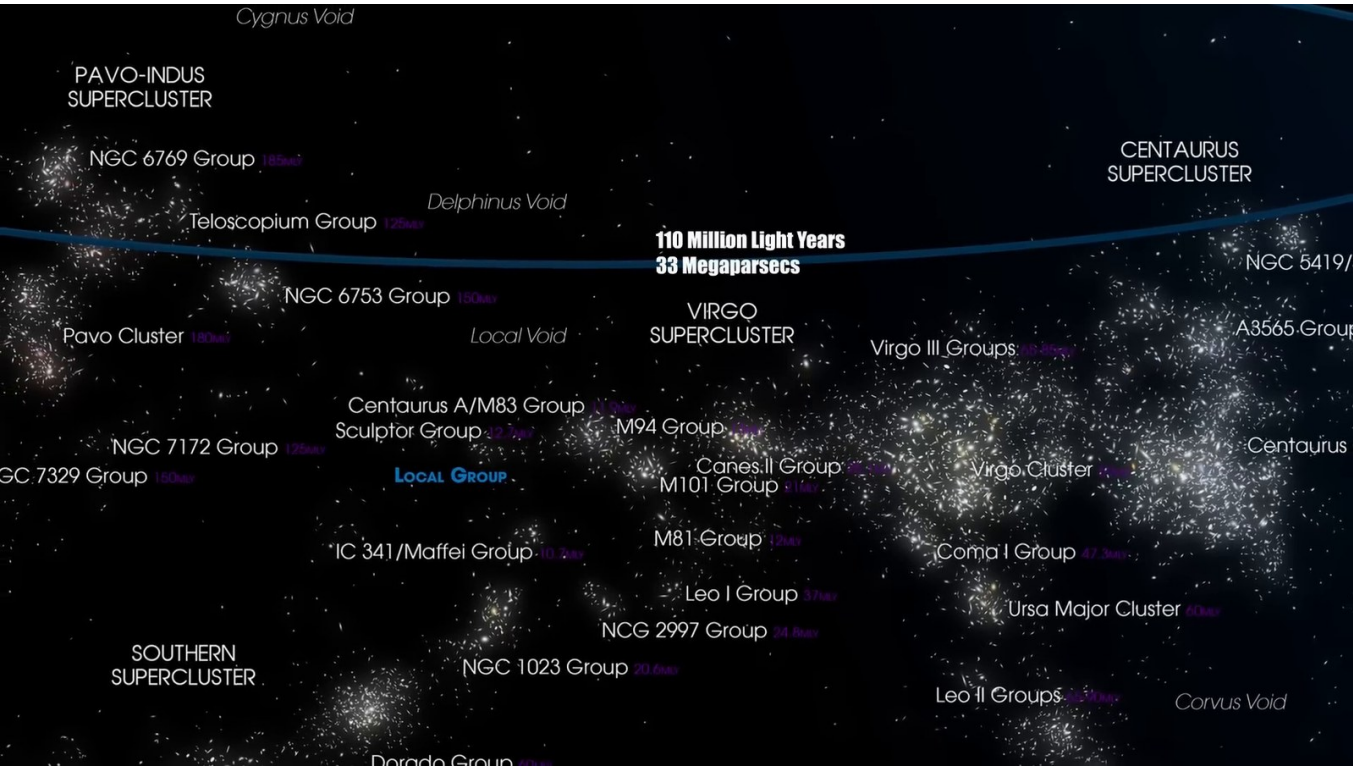


Matched transcript

group we encounter the colossal Virgo supercluster an immense collection of galaxy groups and clusters including our own local group Encompassing a region of space about 110 million light in diameter or 33 megaparsecs

Fragment 91

Time range: 08:24 - 08:33

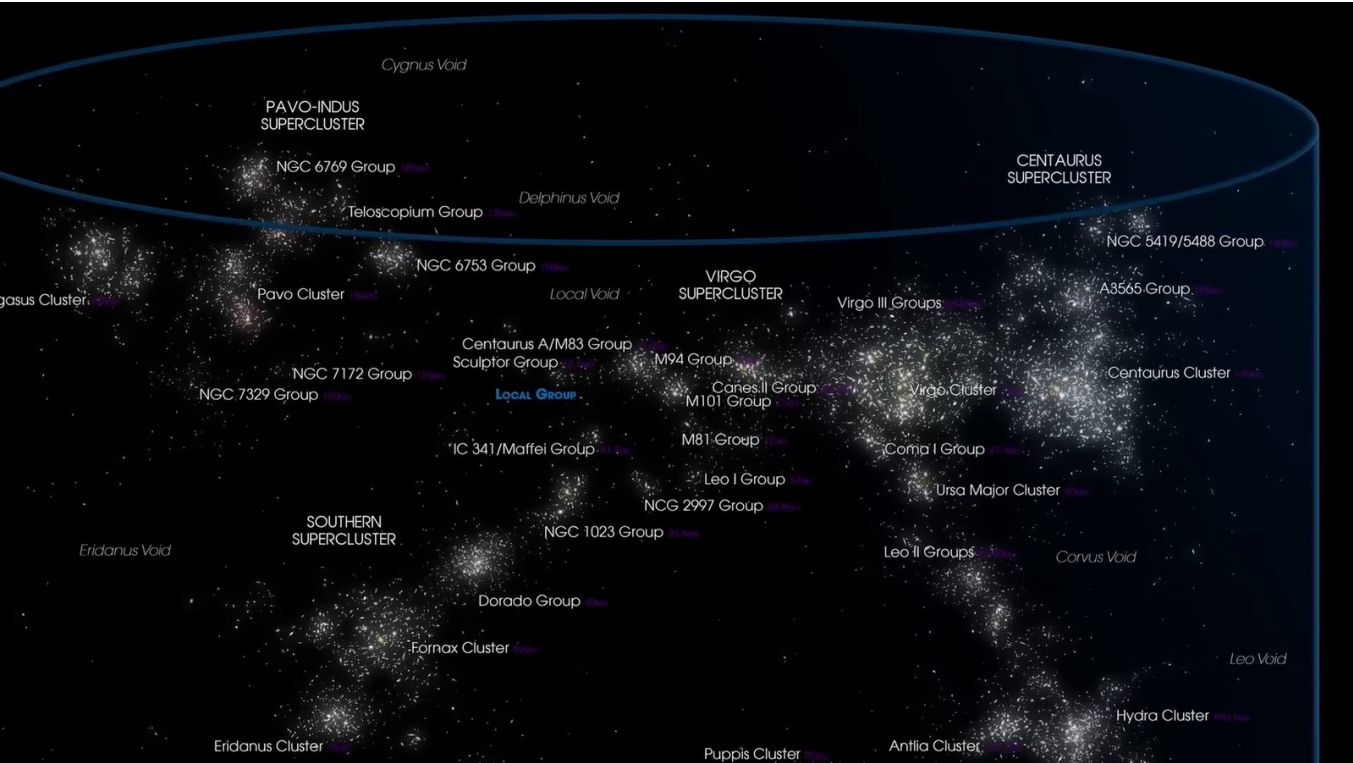


Matched transcript

group we encounter the colossal Virgo supercluster an immense collection of galaxy groups and clusters including our own local group Encompassing a region of space about 110 million light in diameter or 33 megaparsecs the Virgo supercluster is a titanic structure in the universe, containing thousands of galaxies from at least 100 galaxy groups and clusters,

Fragment 92

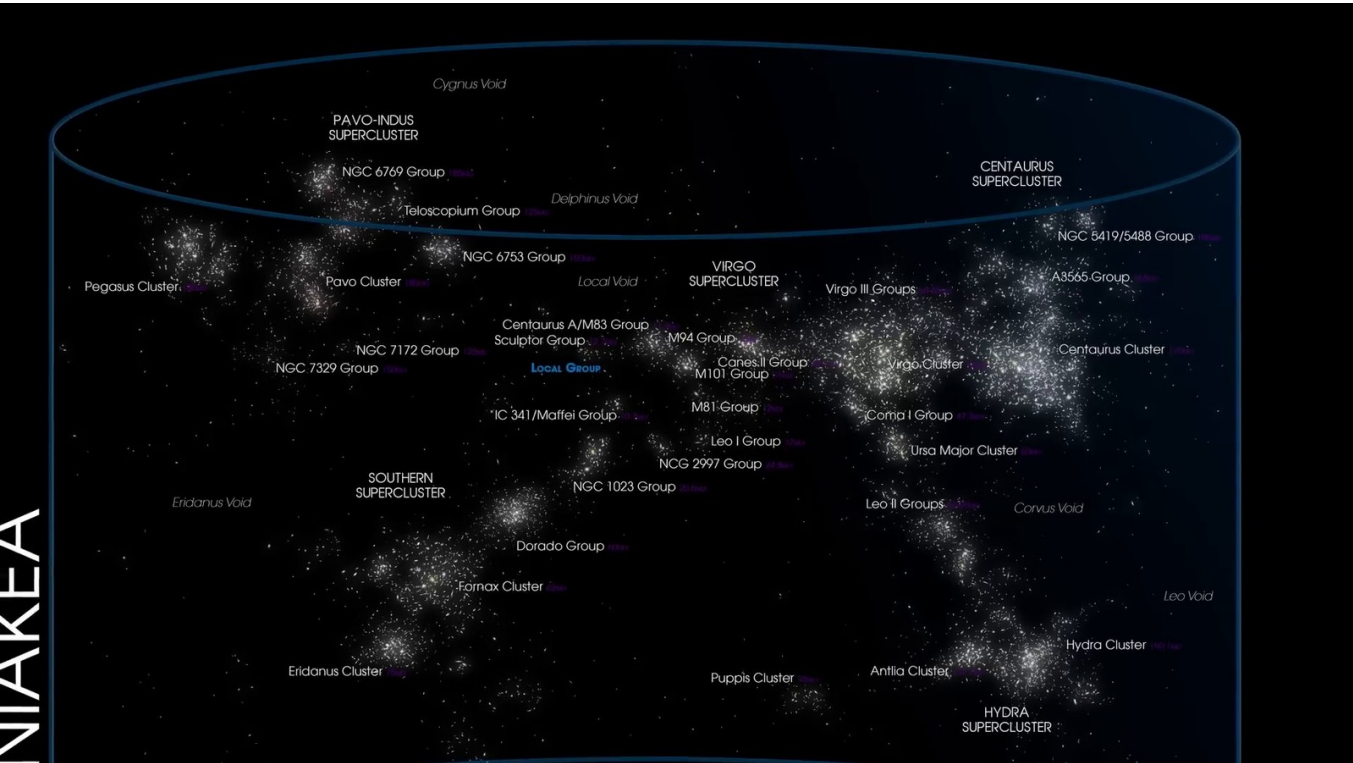
Time range: 08:33 - 08:36



Matched transcript
containing thousands of galaxies from at least 100 galaxy groups and clusters,

Fragment 93

Time range: 08:36 - 08:42

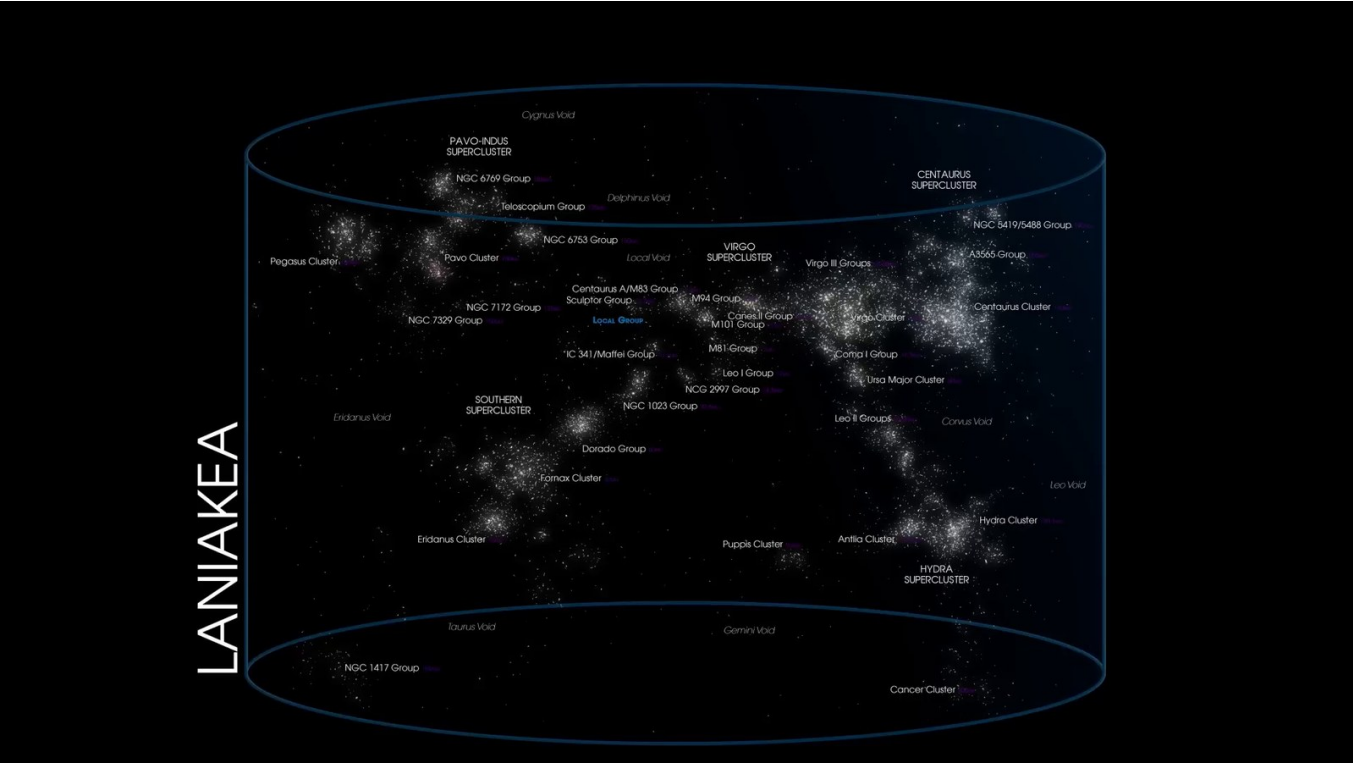


Matched transcript

containing thousands of galaxies from at least 100 galaxy groups and clusters, each with their own myriad stars and planets. As we journey outward from the Virgo supercluster,

Fragment 94

Time range: 08:42 - 08:47

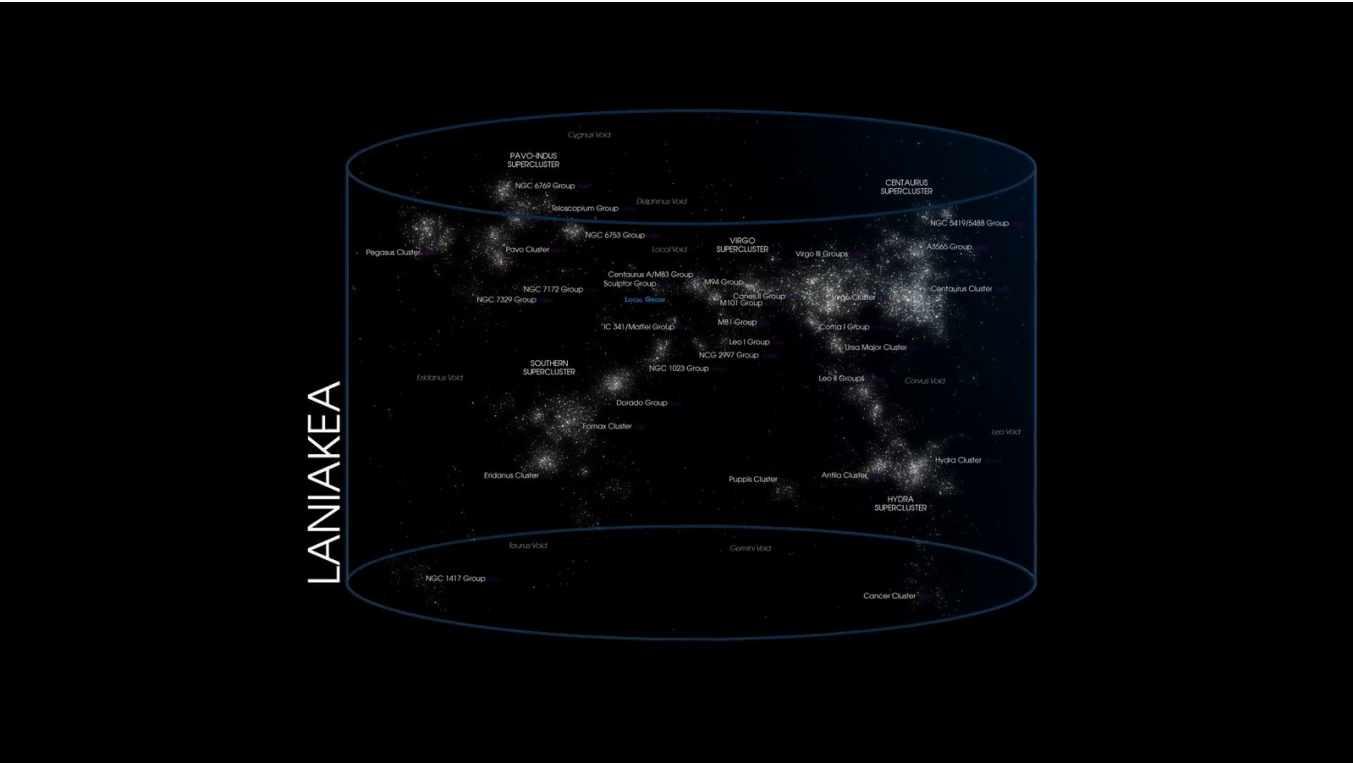


Matched transcript

As we journey outward from the Virgo supercluster, we arrive at an even more staggering cosmic structure, the Laniakia supercluster. This

Fragment 95

Time range: 08:47 - 08:56

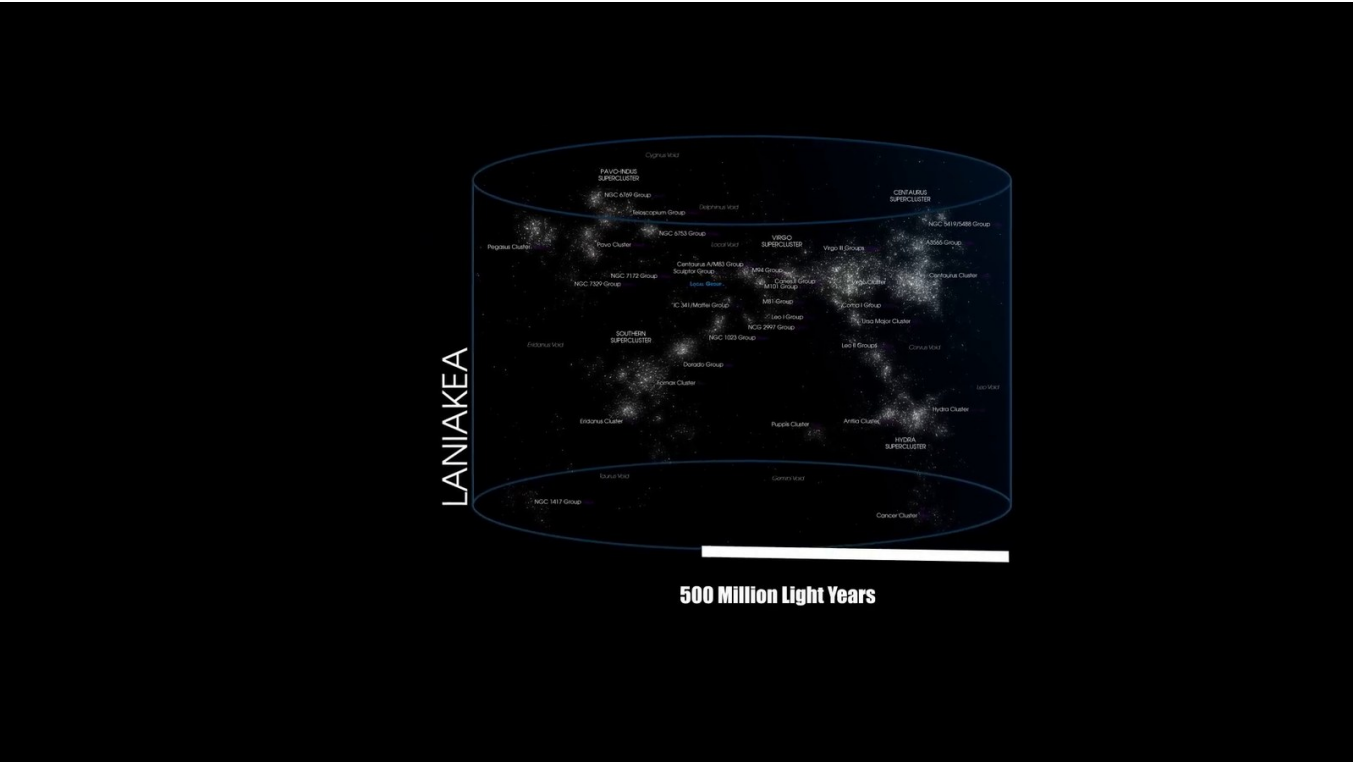


Matched transcript

we arrive at an even more staggering cosmic structure, the Laniakia supercluster. This immense congregation of galaxies, which includes the Virgo supercluster and extends over 500 million

Fragment 96

Time range: 08:56 - 08:59

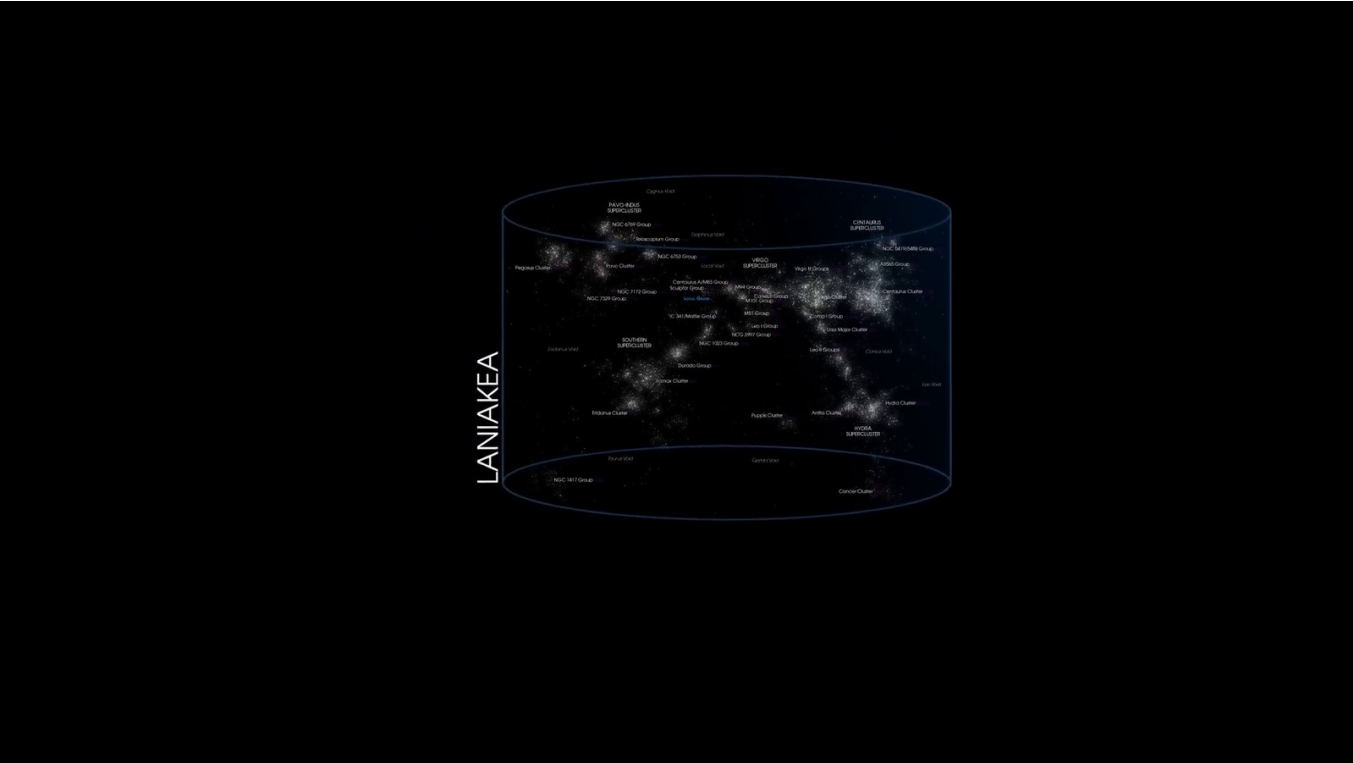


Matched transcript

immense congregation of galaxies, which includes the Virgo supercluster and extends over 500 million light-years, is our galactic home on a grand scale. Laniakia, meaning immense heaven in Hawaiian,

Fragment 97

Time range: 08:59 - 09:05



Matched transcript

light-years, is our galactic home on a grand scale. Laniakia, meaning immense heaven in Hawaiian, truly lives up to its name. Containing the mass of 100 million billion suns, Laniakia is a

Fragment 98

Time range: 09:05 - 09:11



Matched transcript

truly lives up to its name. Containing the mass of 100 million billion suns, Laniakea is a gravitational masterpiece with galaxy clusters, superclusters, and countless celestial bodies

Fragment 99

Time range: 09:11 - 09:17



Matched transcript

gravitational masterpiece with galaxy clusters, superclusters, and countless celestial bodies bound in a cosmic web of attraction and motion. At the heart of Laniachia lies the Great Attractor,

Fragment 100

Time range: 09:17 - 09:23



Matched transcript

bound in a cosmic web of attraction and motion. At the heart of Laniachia lies the Great Attractor,

Fragment 101

Time range: 09:23 - 09:26

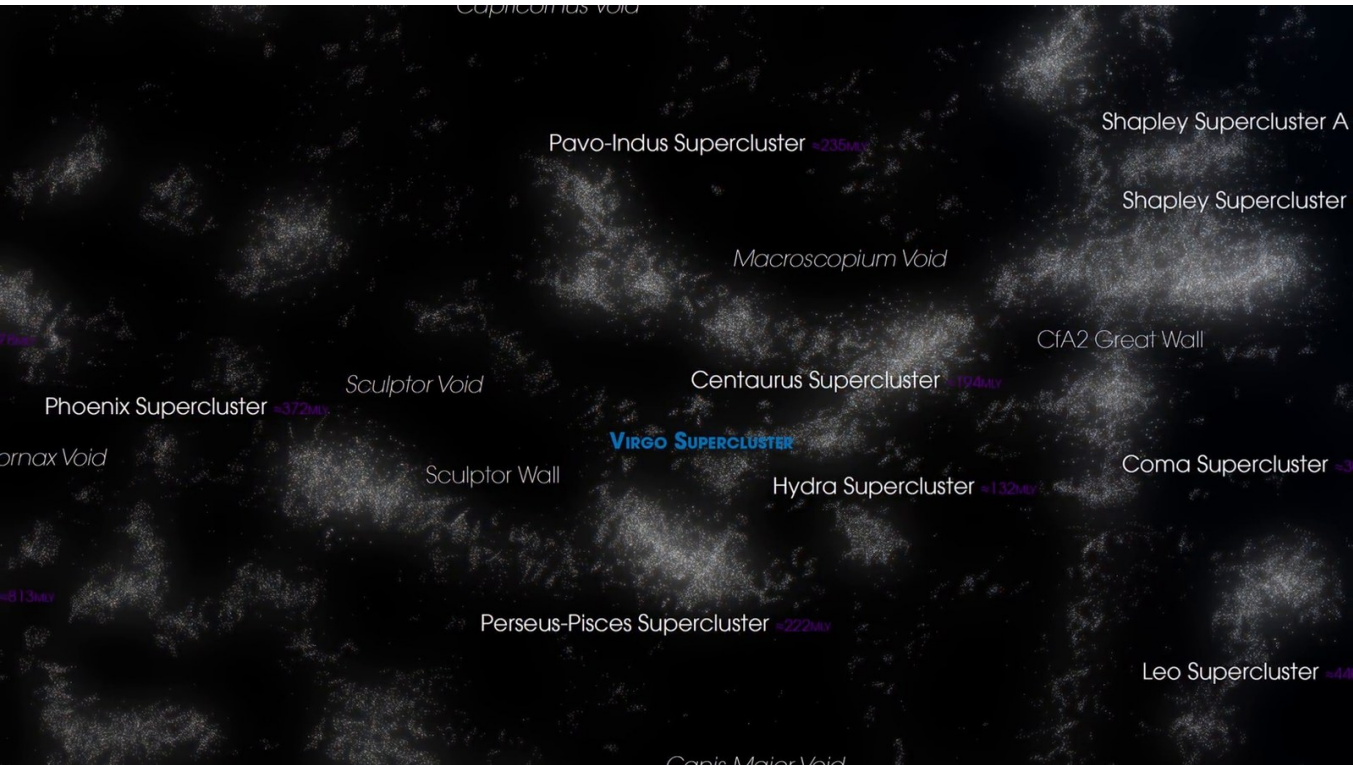


Matched transcript

bound in a cosmic web of attraction and motion. At the heart of Laniachia lies the Great Attractor, a mysterious region of space that exerts a massive gravitational pull on the galaxies

Fragment 102

Time range: 09:26 - 09:32

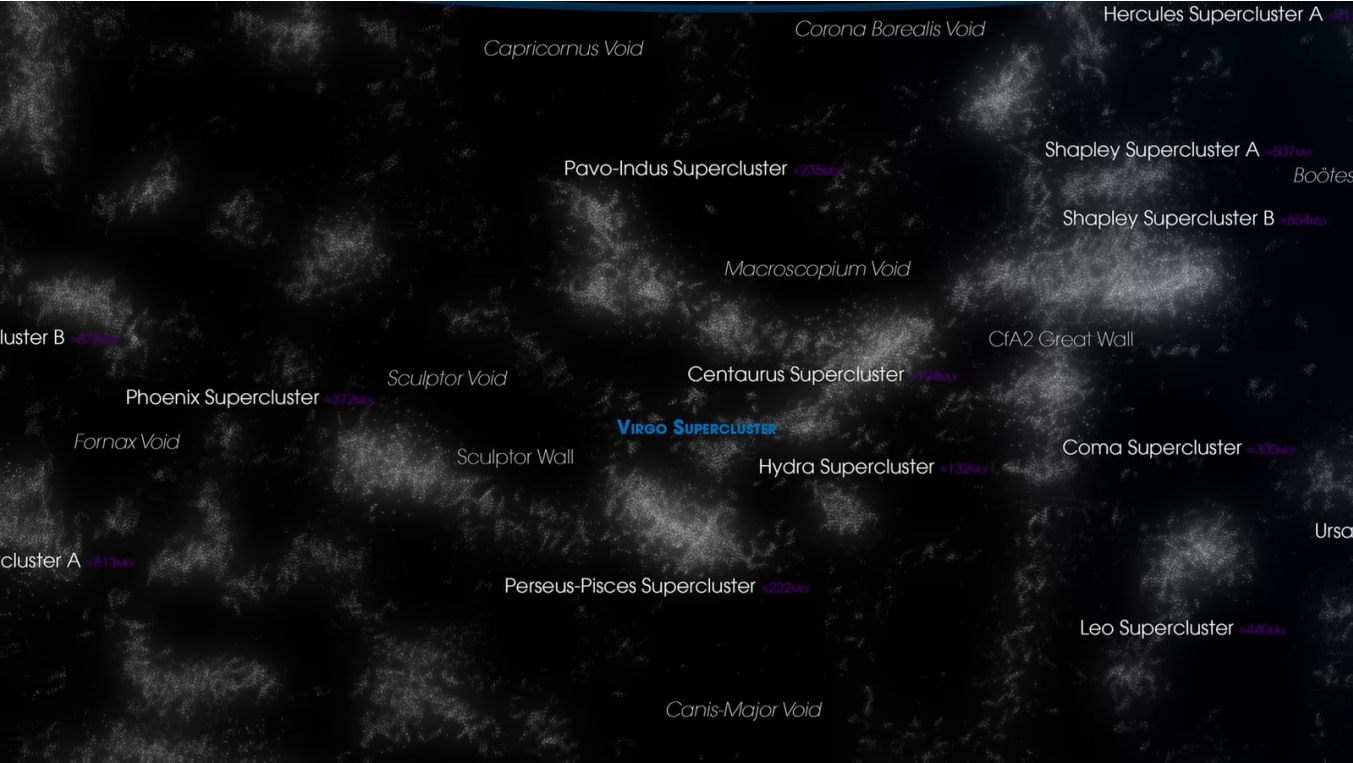


Matched transcript

a mysterious region of space that exerts a massive gravitational pull on the galaxies within this supercluster. In this vast expanse, our Milky Way, the entire local group, and even

Fragment 103

Time range: 09:32 - 09:38

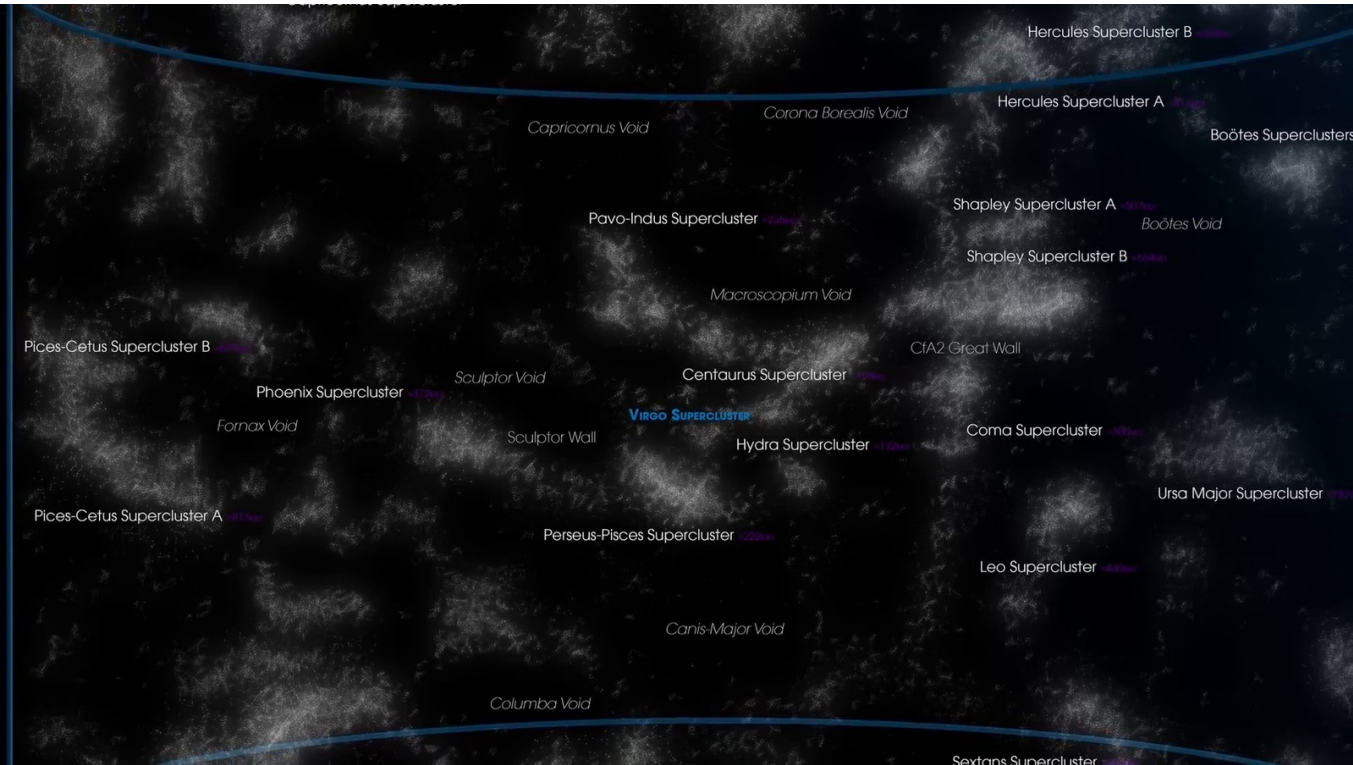


Matched transcript

within this supercluster. In this vast expanse, our Milky Way, the entire local group, and even the Virgo supercluster are just tiny components of this gigantic structure. Laniakia provides

Fragment 104

Time range: 09:38 - 09:44

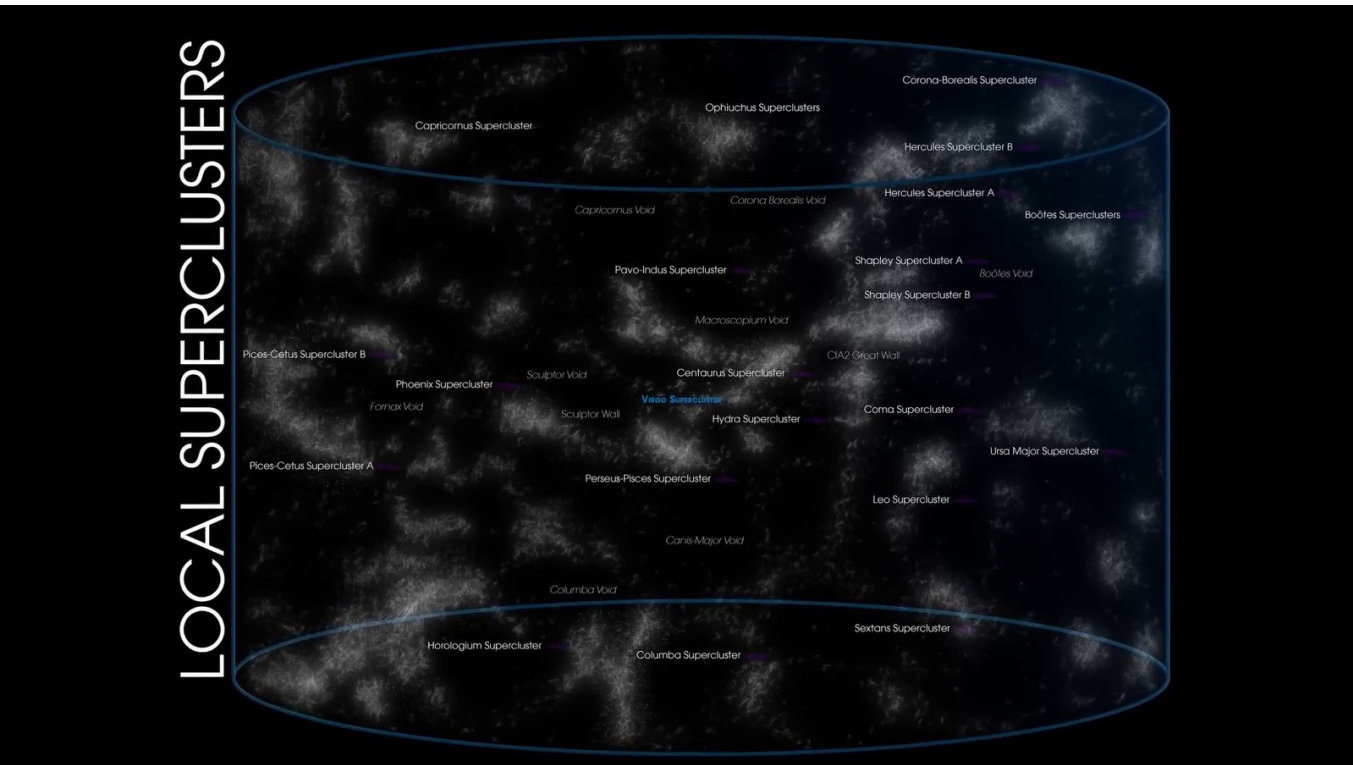


Matched transcript

the Virgo supercluster are just tiny components of this gigantic structure. Laniakia provides a profound context for our existence. In this immense supercluster, we are part of something

Fragment 105

Time range: 09:44 - 09:50

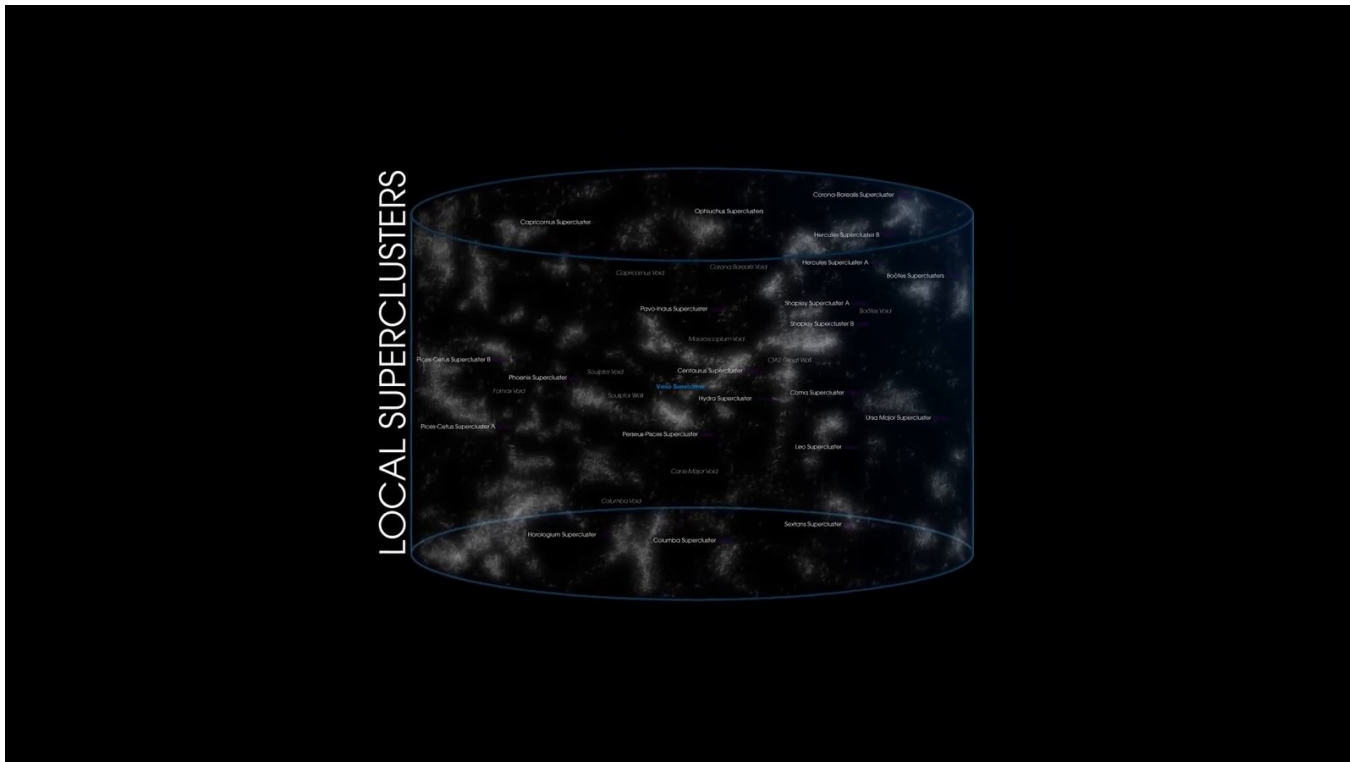


Matched transcript

a profound context for our existence. In this immense supercluster, we are part of something far greater and more majestic than we can fully comprehend.

Fragment 106

Time range: 09:50 - 09:56

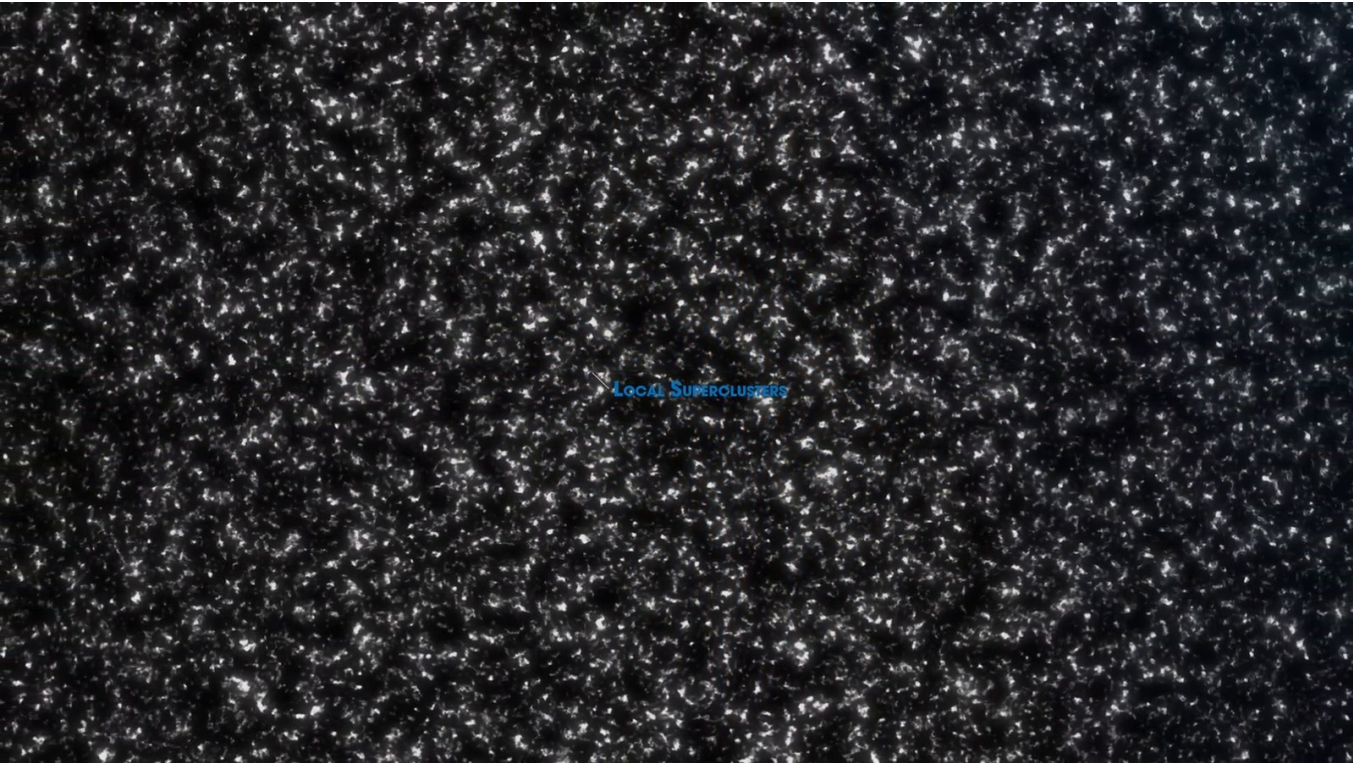


Matched transcript

far greater and more majestic than we can fully comprehend. As we reach the boundaries of our cosmic exploration, we encounter the limits of the observable

Fragment 107

Time range: 09:56 - 10:02

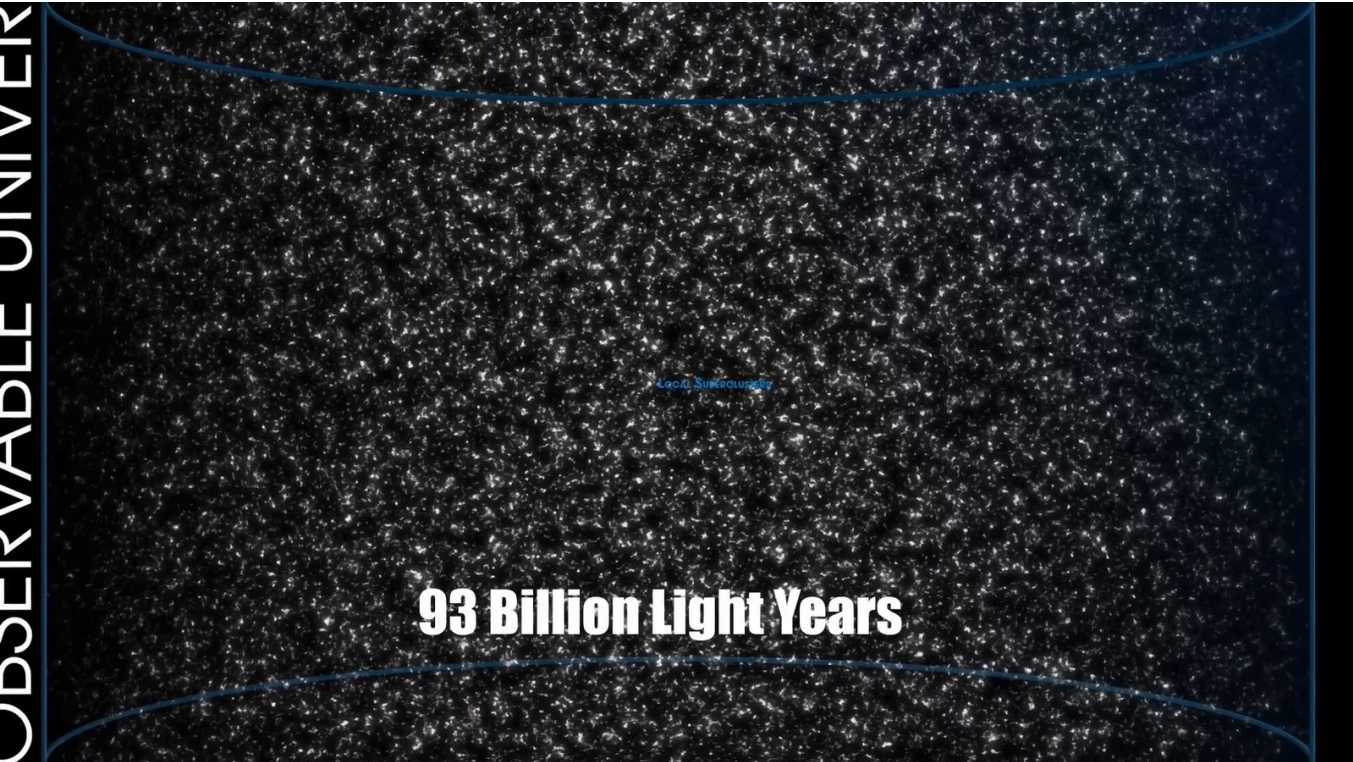


Matched transcript

As we reach the boundaries of our cosmic exploration, we encounter the limits of the observable universe, an astronomical marvel stretching about 93 billion light-years in diameter.

Fragment 108

Time range: 10:02 - 10:08

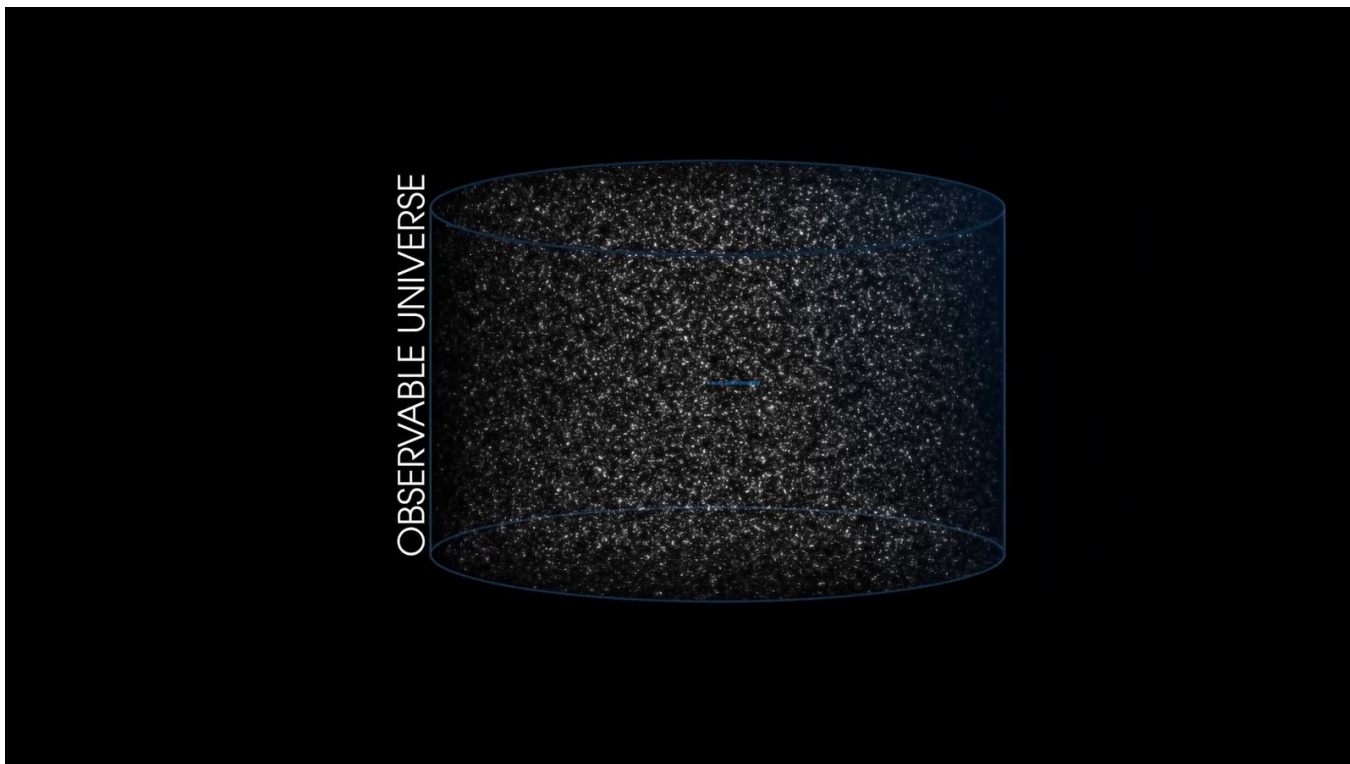


Matched transcript

universe, an astronomical marvel stretching about 93 billion light-years in diameter. This begs a fascinating question. If the universe is only 13.8 billion years old, how can it be so vast?

Fragment 109

Time range: 10:08 - 10:14



Matched transcript

If the universe is only 13.8 billion years old, how can it be so vast? The answer lies in the nature of cosmic expansion.

Fragment 110

Time range: 10:14 - 10:17



Matched transcript

The answer lies in the nature of cosmic expansion. The universe has been expanding since the Big Bang, stretching space and increasing distances

Fragment 111

Time range: 10:17 - 10:23



Matched transcript

The universe has been expanding since the Big Bang, stretching space and increasing distances between celestial bodies.

Fragment 112

Time range: 10:23 - 10:29



Matched transcript

between celestial bodies. But what lies beyond the observable universe? This remains one of the greatest mysteries of cosmology.

Fragment 113

Time range: 10:29 - 10:35



Matched transcript

This remains one of the greatest mysteries of cosmology. Some regions of space are expanding away from us faster than the speed of light, placing

Fragment 114

Time range: 10:35 - 10:41



Matched transcript

Some regions of space are expanding away from us faster than the speed of light, placing them forever out of our view. Consequently, the true size of the entire universe remains unknown and potentially infinite.

Fragment 115

Time range: 10:41 - 10:51



Matched transcript

Consequently, the true size of the entire universe remains unknown and potentially infinite. The observable universe, vast as it is, might just be a tiny fragment of the entire cosmic expanse.

Fragment 116

Time range: 10:51 - 10:54



Observable Universe $\neq$ Entire Universe

Matched transcript

expanse. We are left with the humbling realization that there might always be regions of space, entire

Fragment 117

Time range: 10:54 - 10:57



Matched transcript

We are left with the humbling realization that there might always be regions of space, entire

Fragment 118

Time range: 10:57 - 11:03



Matched transcript

We are left with the humbling realization that there might always be regions of space, entire galaxies and wonders that we will never witness as they retreat endlessly into the depths

Fragment 119

Time range: 11:03 - 11:09



Matched transcript

galaxies and wonders that we will never witness as they retreat endlessly into the depths of the ever-expanding universe.

Fragment 120

Time range: 11:09 - 11:09



Matched transcript

No transcript was available for this time range.

Full Transcript

Language: English

Duration: 11 min 9 sec

Transcript quality: timestamped

The transcript includes timestamps and has been matched under the corresponding image by time range.

00:00 - 00:40

No. No, the rest would have got to be Mr. Bright, but he is certainly Mr. Seuss. The blue chase will meet with that star Jim Clancy for a couple of weeks. Earth. Our home planet. A tiny blue dot floating in the immense cosmic ocean. Here resides everyone you ever knew. Every human who ever lived. Every story that was ever told. It's where our journey begins. But as we zoom out, beyond our atmosphere, past the moon, beyond the familiar planets and the sun, we embark on an epic quest, a quest to grasp the true scale of our universe. As we leave Earth's embrace, the first marker

00:40 - 01:25

on our cosmic journey is the moon, about 384,400 kilometers away, a distance so vast that if you were to drive a car at a constant speed of 100 kilometers per hour, it would take you over 160 days to reach it. And from this lunar vantage point, Earth appears as a fragile sphere of blues and greens, cradled in the black void of space, a sight that puts our existence into a humbling perspective. This is Earth as seen from the moon. As we continue our outward journey, the next milestone is the sun, lying approximately one astronomical unit away from Earth. This unit, equivalent to about 150 million kilometers,

01:25 - 02:05

is the standard measuring stick for distances in our solar system. Imagine this. Light, traveling at an astounding speed of 300,000 kilometers per second, takes about 8 minutes and 20 seconds to journey from the sun to Earth. If you were to travel this distance in a commercial jet, flying at 900 kilometers per hour, it would take you about 19 years. This immense distance is a stark reminder of the vastness of space, even within our own solar system. The Sun, a fiery behemoth, provides life-sustaining energy to our planet from this incredible distance. Venturing beyond our home planet and its solar

02:05 - 02:41

companion, the Sun, we set our sights on Mars, our enigmatic red neighbor. Mars, at its closest approached to Earth is about 54.6 million kilometers away. However, this distance can stretch up to 401 million kilometers when the two planets are on opposite sides of the Sun. To put that in perspective, traveling to Mars at the speed of a commercial jet would take upwards of 50 years. This vast expanse of space between Earth and Mars has been a significant challenge for space exploration. The rovers and probes we have sent to the

02:41 - 03:20

red planet embark on a journey that is not just far but fraught with complexities due to the constantly changing distances and orbital dynamics. As we journey to the outermost reaches of our solar system, we encounter Neptune, the distant ice giant. Lying roughly 4.5 billion kilometers from Earth, Neptune marks the edge of our solar neighborhood. Sunlight, racing across the vacuum of space takes about 4 hours and 15 minutes to reach Neptune from the Sun. This staggering distance showcases the enormity of our solar system.

03:20 - 04:04

Launched in 1977, the Voyager 1 space probe represents humanity's insatiable curiosity and our desire to explore beyond known boundaries. As of now, Voyager 1 has traveled for over four decades, covering a staggering distance of more than 22 billion kilometers from Earth. It's the farthest human-made object from our planet, a silent wanderer in the cosmic sea. In 1990, at the suggestion of the renowned astronomer Carl Sagan, Voyager 1 turned its camera back towards Earth for one final photograph. This resulted in the iconic pale blue dot image. At a distance of about 6 billion kilometers from Earth, our planet appeared as a tiny,

04:04 - 04:48

faint dot in the vastness of space. Sagan poetically reflected on this image, emphasizing our responsibility to cherish and preserve our only home, a small speck in the immense universe. At the very fringes of our solar system lies the Oort cloud, a vast theoretical sphere of icy objects. This distant cloud is thought to extend up to a staggering 100,000 astronomical units from the Sun. That's about 1.9 light-years, a distance so immense that it's on the cusp of interstellar space. Scientists determine the boundary of interstellar space, known as the heliopause, where the Sun's solar wind is stopped by the interstellar medium.

04:48 - 05:28

This is where the influence of our sun ceases and the vast realm of interstellar space begins. The Oort cloud represents the final frontier of our solar system, a boundary zone where the sun's influence wanes and the cosmic journey into the galaxy truly begins. As we venture beyond the confines of our solar system, our next point of interest is Alpha Centauri, the closest star system to our Sun. Located about 41.3 trillion kilometers away, this distance is equivalent to over 276,000 astronomical units. At such colossal distances,

05:28 - 06:09

the AU a measure so convenient within our solar system begins to lose its practicality. Hence astronomers use the light year the distance light travels in one year for interstellar measurements. Alpha Centauri is about 4.4 light years away from us. Considering our current space travel technology, a journey to Alpha Centauri is almost unfathomable. For instance, the Voyager spacecraft, traveling at about 17 kilometers per second, would take over 70,000 years to reach this neighboring star system. This immense distance underscores the vastness of space that separates the stars and highlights the challenges of interstellar travel.

06:10 - 06:52

Our journey now takes us to the grand scale of our home galaxy, the Milky Way. Spanning about 100,000 light-years in diameter, this vast spiral galaxy is home to hundreds of billions of stars, each potentially hosting their own planetary systems. Within this immense structure, there's a tiny sphere known as the human radio bubble, extending about 100 light-years from Earth. This bubble represents the farthest extent of human influence in the cosmos, the reach of our radio and television broadcasts into space. Beyond this bubble, it's as if humanity never existed. Any civilizations residing in the vast majority of our galaxy would be oblivious to our presence,

06:53 - 07:34

given that our signals haven't reached them yet. The scale of the Milky Way is so vast that our entire recorded history is but a whisper in the cosmic wind, undetectable beyond this small bubble. As we leave the Milky Way, we enter the vast, almost incomprehensible realm of intergalactic space. Here, galaxies float in the cosmic ocean, separated by mind-boggling distances. Our galaxy is part of a small cosmic neighborhood known as the Local Group, a cluster of more than 50 galaxies spread across approximately 10 million light-years. The Local Group is a diverse assembly, including not just spiral galaxies like the Milky Way

07:34 - 08:12

and Andromeda, but also a multitude of smaller dwarf galaxies. The distances here are so vast that light from one end of the local group to the other would take 10 million years to traverse. This scale dwarfs anything within our own galaxy, underscoring the enormity of the universe. Intergalactic space is a silent expanse, a vast wilderness between the islands of galactic light. In this immense void, our galaxy, home to our entire history, is just a tiny speck among a single story in the grand cosmic library. As we extend our cosmic gaze beyond the local

08:12 - 08:56

group we encounter the colossal Virgo supercluster an immense collection of galaxy groups and clusters including our own local group Encompassing a region of space about 110 million light in diameter or 33 megaparsecs the Virgo supercluster is a titanic structure in the universe, containing thousands of galaxies from at least 100 galaxy groups and clusters, each with their own myriad stars and planets. As we journey outward from the Virgo supercluster, we arrive at an even more staggering cosmic structure, the Laniakia supercluster. This immense congregation of galaxies, which includes the Virgo supercluster and extends over 500 million

08:56 - 09:35

light-years, is our galactic home on a grand scale. Laniakia, meaning immense heaven in Hawaiian, truly lives up to its name. Containing the mass of 100 million billion suns, Laniakia is a gravitational masterpiece with galaxy clusters, superclusters, and countless celestial bodies bound in a cosmic web of attraction and motion. At the heart of Laniachia lies the Great Attractor, a mysterious region of space that exerts a massive gravitational pull on the galaxies within this supercluster. In this vast expanse, our Milky Way, the entire local group, and even

09:35 - 10:16

the Virgo supercluster are just tiny components of this gigantic structure. Laniakia provides a profound context for our existence. In this immense supercluster, we are part of something far greater and more majestic than we can fully comprehend. As we reach the boundaries of our cosmic exploration, we encounter the limits of the observable universe, an astronomical marvel stretching about 93 billion light-years in diameter. This begs a fascinating question. If the universe is only 13.8 billion years old, how can it be so vast? The answer lies in the nature of cosmic expansion.

10:16 - 10:57

The universe has been expanding since the Big Bang, stretching space and increasing distances between celestial bodies. But what lies beyond the observable universe? This remains one of the greatest mysteries of cosmology. Some regions of space are expanding away from us faster than the speed of light, placing them forever out of our view. Consequently, the true size of the entire universe remains unknown and potentially infinite. The observable universe, vast as it is, might just be a tiny fragment of the entire cosmic expanse. We are left with the humbling realization that there might always be regions of space, entire

10:57 - 11:04

galaxies and wonders that we will never witness as they retreat endlessly into the depths of the ever-expanding universe.