Europe to the Stars [2024]

English script – Time-stamped

TIME	Voice	ENGLISH
00:00:09,533 --> 00:00:13,343	Main narrator	This is the story of an epic adventure.
00:00:13,571 --> 00:00:19,746	Main narrator	A story of cosmic curiosity, courage and perseverance...
00:00:20,000 --> 00:00:25,388	Main narrator	The story of Europe’s quest to explore the Universe.
00:00:53,651 --> 00:01:00,568	Main narrator	Welcome to ESO, the European Southern Observatory… Europe’s portal to the stars.
00:01:07,520 --> 00:01:17,001	Main narrator	At ESO, astronomers and engineers from around the world join forces to unravel the secrets of the Universe.
00:01:17,657 --> 00:01:18,550	Main narrator	How?
00:01:18,931 --> 00:01:27,975	Main narrator	By building the largest telescopes on Earth. Designing sensitive cameras and instruments. Scrutinising the heavens.
00:01:31,720 --> 00:01:34,623	Main narrator	Seeing comets traversing the Solar System

00:01:35,004 --> 00:01:36,665	Main narrator	stellar nurseries ...
00:01:37,160 --> 00:01:40,520	Main narrator	distant galaxies at the edge of space and time ...
00:01:41,129 --> 00:01:46,634	Main narrator	Giving us fresh insights and an unprecedented view of the Universe.
00:01:51,092 --> 00:01:56,454	Main narrator	The idea for a joint European observatory came in 1953.
00:01:57,331 --> 00:02:02,668	Main narrator	Twelve astronomers from six countries gathered in the Netherlands to formulate a plan.
00:02:03,545 --> 00:02:11,316	Main narrator	Individually, no one European country could compete with the United States. But together, they might.
00:02:15,049 --> 00:02:21,810	Main narrator	Nine years later, the European Southern Observatory started out with five founding member states.
00:02:22,920 --> 00:02:26,906	Main narrator	They began to search for the perfect location for their observatory.
00:02:31,048 --> 00:02:49,771	Main narrator	Despite its beauty, Europe is not a prime location for astronomy. European astronomers were hindered by light pollution and poor weather. And from Europe, only part of the sky can be seen. To fill in the gaps, you have to travel south.
00:02:51,320 --> 00:03:04,907	Main narrator	From here, the centre of the Milky Way, our home galaxy, passes high overhead, and also the Magellanic Clouds – two small companion galaxies to the Milky Way.
00:03:05,811 --> 00:03:11,495	Main narrator	Invisible from the North, but very conspicuous if you’re south of the equator.

00:03:12,409 --> 00:03:18,069	Main narrator	In 1960, the astronomers turned their attention to South America...
00:03:19,440 --> 00:03:24,439	Main narrator	In 1963, the die was cast: Chile it would be!
00:03:25,430 --> 00:03:35,888	Main narrator	Six months later, Cerro La Silla, a mountain in the arid Atacama Desert, was picked as the future site of the European Southern Observatory.
00:03:37,040 --> 00:03:39,798	Main narrator	ESO was no longer a distant dream.
00:03:40,560 --> 00:03:44,748	Main narrator	Europe had embarked on a grand voyage of cosmic discovery.
00:03:46,120 --> 00:03:56,718	Main narrator	Soon, other European countries followed and joined ESO. Today, ESO is supported by 16 members states and two partner countries.
00:04:05,964 --> 00:04:14,850	Main narrator	167,000 years ago, a star exploded in a small galaxy orbiting the Milky Way.
00:04:25,480 --> 00:04:31,055	Main narrator	At the time of the distant explosion, Homo sapiens started to roam the African savannah.
00:04:32,046 --> 00:04:40,779	Main narrator	But no one could have noticed the cosmic fireworks, as the blast of light had only just embarked on its long journey towards Earth.
00:04:43,448 --> 00:04:53,838	Main narrator	By the time light from the supernova had completed 98 percent of its journey, Greek philosophers had just started to think about the nature of the cosmos.
00:04:56,215 --> 00:05:03,787	Main narrator	Just before the light reached Earth, Galileo Galilei trained his first primitive telescopes on the heavens.

00:05:12,689 --> 00:05:26,323	Main narrator	And on 24 February 1987, when photons from the explosion finally rained down on our planet, astronomers at La Silla were ready to observe the supernova in great detail.
00:05:43,648 --> 00:05:50,729	Scientist 1	Supernova 1987A flared up in the southern sky – unobservable from Europe or the United States.
00:05:51,720 --> 00:05:59,675	Scientist 1	But by this time, ESO had already built its first big telescopes at La Silla. A front-row seat to a cosmic spectacle!
00:06:02,000 --> 00:06:07,819	Main narrator	The telescope is the central tool that allows us to unravel the secrets of the Universe.
00:06:09,800 --> 00:06:21,240	Main narrator	Using lenses or mirrors, telescopes collect far more light than the unaided human eye, so they reveal fainter stars and let us peer deeper into space.
00:06:24,533 --> 00:06:28,836	Main narrator	Like magnifying glasses, they also show finer detail.
00:06:34,809 --> 00:06:43,974	Main narrator	And, when equipped with sensitive cameras and spectrographs, they provide us with a wealth of information about planets, stars and galaxies.
00:06:48,410 --> 00:06:52,502	Main narrator	ESO’s first telescopes at La Silla were a mixed bunch.
00:06:57,683 --> 00:07:04,011	Main narrator	They ranged from small national telescopes to large astrographs and wide-field cameras.
00:07:08,849 --> 00:07:16,760	Main narrator	The 3.6-metre telescope, sitting atop Cerro La Silla, was the biggest achievement of ESO’s early years.
00:07:17,680 --> 00:07:23,661	Main narrator	Although built in 1976, it now leads a second life as a planet hunter.

00:07:25,680 --> 00:07:33,722	Scientist 1	Since the discovery of the first alien world orbiting another star, planet hunters have found thousands of such exoplanets.
00:07:34,760 --> 00:07:41,532	Scientist 1	And these exoplanets vary in size, mass, temperature, and they have a variety of orbits.
00:07:49,230 --> 00:08:01,160	Main narrator	The 3.6-metre telescope hosts HARPS, one of the most efficient planet-hunting instruments. So far, it has discovered hundreds of exoplanets.
00:08:03,680 --> 00:08:11,454	Main narrator	Its biggest discovery to date: finding a planet in the habitable zone around the nearest star to the Sun.
00:08:23,040 --> 00:08:31,430	Scientist 1	Finding planets around other stars is a new frontier in astronomy. Imagine if we could find a planet similar to our Earth?
00:08:34,773 --> 00:08:46,137	Main narrator	Another key player was the 2.2-metre telescope – built in 1983, it has produced some of ESO's most iconic views of the cosmos.
00:09:17,040 --> 00:09:26,488	Main narrator	Swedish astronomers built a shiny dish fifteen metres across to study invisible microwaves from cool cosmic clouds.
00:09:27,255 --> 00:09:32,945	Main narrator	Together, these telescopes have helped to unveil the Universe in which we live.
00:09:38,089 --> 00:09:48,593	Main narrator	Modern telescopes use large mirrors to collect the faint light of distant objects. Bigger is better – at least when it comes to telescope mirrors.
00:09:49,920 --> 00:09:55,055	Main narrator	But larger mirrors have to be thick, so that they don't deform under their own weight.
00:09:56,160 --> 00:10:01,207	Main narrator	And really large mirrors deform anyway, no matter how thick and heavy they are.

00:10:02,253 --> 00:10:09,807	Main narrator	The solution? Thin, lightweight mirrors – and a magic trick called active optics.
00:10:11,408 --> 00:10:23,180	Main narrator	ESO pioneered this technology in the late 1980s, with the New Technology Telescope, the NTT — a ground-breaking feat of engineering and design.
00:10:28,651 --> 00:10:34,287	Main narrator	NTT was the frontrunner for the Very Large Telescope, or VLT.
00:10:42,211 --> 00:10:48,681	Main narrator	Built in the 1990s, the VLT is ESO's flagship visible-light facility.
00:10:54,168 --> 00:11:07,300	Main narrator	Four identical 8.2-metre telescopes, perched high on Cerro Paranal in northern Chile. In the middle of the Atacama Desert, ESO created an astronomer's paradise.
00:11:09,773 --> 00:11:19,404	Main narrator	Scientists stay in La Residencia, a guest house partly buried under the dirt and rubble of one of the driest places on the planet.
00:11:23,009 --> 00:11:27,550	Main narrator	But inside the environment is made hospitable for people…
00:11:27,969 --> 00:11:37,404	Main narrator	Of course, the unique selling point of the Very Large Telescope is not its Residencia, but its unequalled view of the Universe.
00:11:44,289 --> 00:11:48,479	Main narrator	And this is the state of the art for mirror technology.
00:11:49,089 --> 00:11:57,838	Main narrator	The mirrors of the Very Large Telescope – the VLT – are 8.2 metres across, but only 17 centimetres thick.
00:11:59,209 --> 00:12:10,000	Main narrator	And here's the magic: a computer-controlled support system ensures that the mirror keeps its desired shape at all times to nanometre precision.

00:12:12,211 --> 00:12:17,426	Main narrator	Without thin mirrors and active optics, the VLT would not be possible.
00:12:18,493 --> 00:12:19,803	Main narrator	But there's more.
00:12:23,880 --> 00:12:34,494	Main narrator	Stars appear blurry, even when observed with the best and largest telescopes. The reason? The Earth's atmosphere distorts the images.
00:12:36,089 --> 00:12:40,670	Main narrator	Enter the second magic trick: adaptive optics.
00:12:41,280 --> 00:12:50,743	Main narrator	On Paranal, laser beams shoot out into the night sky to create light patterns in the upper atmosphere which look similar to stars.
00:12:53,432 --> 00:13:06,012	Main narrator	Sensors use these artificial stars to measure atmospheric distortions. And hundreds of times per second, the image is corrected by computer-controlled deformable mirrors.
00:13:06,528 --> 00:13:14,528	Main narrator	And the end effect? As if the turbulent atmosphere was completely removed. Just look at the difference!
00:13:16,480 --> 00:13:25,789	Main narrator	Adaptive optics allows us to peer deeper into space, chasing after answers to some of the most fundamental questions of science.
00:13:29,680 --> 00:13:38,321	Main narrator	At the core of the Milky Way – our home galaxy – lies a mystery that ESO's Very Large Telescope helped to unravel.
00:13:42,253 --> 00:13:48,773	Main narrator	Massive dust clouds block our view of the Milky Way's core, 27 000 light years away.
00:13:50,526 --> 00:13:57,173	Main narrator	But sensitive infrared cameras can peer through the dust and uncover what lies behind.

00:14:21,480 --> 00:14:27,312	Main narrator	Assisted by adaptive optics, they reveal dozens of red giant stars.
00:14:27,960 --> 00:14:32,021	Main narrator	And over the years, these stars are seen to move!
00:14:32,440 --> 00:14:36,997	Main narrator	They orbit an invisible object at the very centre of the Milky Way.
00:14:40,160 --> 00:14:47,006	Main narrator	Judging from the stellar motions, the invisible object must be extremely massive and compact.
00:14:47,692 --> 00:14:54,251	Main narrator	A monstrous black hole, weighing in at 4.3 million times the mass of our Sun.
00:14:55,051 --> 00:15:04,450	Main narrator	This discovery, based on nearly 30 years of observations, was awarded a Nobel Prize in Physics in 2020.
00:15:05,240 --> 00:15:10,847	Main narrator	It was made possible in part thanks to the power of adaptive optics.
00:15:15,800 --> 00:15:29,407	Main narrator	Adaptive optics also allows for sharp views of exoplanets — planets outside our own Solar System. In 2004, the VLT took the first image ever of an exoplanet.
00:15:30,360 --> 00:15:35,681	Main narrator	The red dot in this image is a giant planet orbiting a brown dwarf star.
00:15:40,367 --> 00:15:48,739	Main narrator	A few years later, the atmosphere around another exoplanet was analysed for the first time using the VLT.
00:15:49,083 --> 00:15:58,431	Main narrator	As the planet transits in front of its parent star, starlight passes through the planet’s atmosphere and its chemical composition is revealed.

00:15:59,680 --> 00:16:05,486	Main narrator	The findings suggest that the atmosphere might consist of water in the form of steam.
00:16:06,134 --> 00:16:10,000	Main narrator	Is there water, the foundation of life, on a distant world?
00:16:13,871 --> 00:16:18,943	Scientist 2	In 2011, two independent research teams were awarded with the Nobel Prize in Physics.
00:16:19,667 --> 00:16:23,166	Scientist 2	Their work has been based on observations with ESO telescopes.
00:16:23,851 --> 00:16:32,783	Scientist 2	They showed that the expansion of the Universe is accelerating due to huge amounts of dark energy. But we still have no clue what this might be...
00:16:37,240 --> 00:16:42,708	Main narrator	So thin mirrors and active optics make it possible to build giant telescopes.
00:16:43,280 --> 00:16:50,618	Main narrator	And the adaptive optics take care of the atmospheric turbulence, providing us with extremely sharp images.
00:16:51,120 --> 00:16:58,642	Main narrator	But we're not done yet with our magic tricks. There's a third one. And it's called interferometry.
00:17:00,720 --> 00:17:10,000	Main narrator	By combining the light the VLT telescopes each collect, they can act as a virtual telescope measuring 130 metres across!
00:17:12,280 --> 00:17:21,988	Main narrator	This technique, known as interferometry, gives us the eagle-eyed vision of an imaginary telescope as large as fifty tennis courts.
00:17:23,120 --> 00:17:26,375	Main narrator	Optical interferometry is something of a miracle.

00:17:27,289 --> 00:17:33,239	Main narrator	Starlight magic, wielded in the desert! And the results are exciting.
00:17:36,320 --> 00:17:49,709	Main narrator	The Very Large Telescope Interferometer reveals fifty times more detail than the Earth-orbiting Hubble Space Telescope, and it has shown us some incredible things in the Universe around us...
00:17:52,049 --> 00:17:59,307	Main narrator	For instance, it gave us close-ups of vampire double stars — stars stealing material from each other.
00:18:12,600 --> 00:18:20,355	Main narrator	Irregular puffs of stardust have been detected around Betelgeuse — a stellar giant about to go supernova.
00:18:42,960 --> 00:18:52,778	Main narrator	And in dusty discs surrounding newborn stars, astronomers have found... the raw material of future Earth-like worlds.
00:19:07,169 --> 00:19:13,206	Main narrator	The Very Large Telescope is one of humankind’s sharpest eyes on the sky.
00:19:19,760 --> 00:19:28,517	Main narrator	The VLT has dramatically changed our view on the world we live in -- and posed millions of new questions left to be answered.
00:19:44,200 --> 00:19:47,356	Scientist 1	Many of us enjoy listening to music in our daily lives.
00:19:47,889 --> 00:19:54,138	Scientist 1	But suppose you had a hearing impairment. What if you couldn’t hear the low frequencies?
00:19:55,842 --> 00:19:57,505	Scientist 1	Or the high frequencies?
00:19:58,800 --> 00:20:01,364	Scientist 1	Astronomers used to be in a similar situation.

00:20:02,240 --> 00:20:08,303	Scientist 1	The human eye is only sensitive to a very small fraction of all the radiation in the Universe.
00:20:08,760 --> 00:20:11,254	Scientist 1	We just don’t perceive the whole cosmic symphony.
00:20:19,369 --> 00:20:26,773	Main narrator	In a dark room, you can’t see anything. But put on infrared goggles, and you can “see” body heat.
00:20:33,011 --> 00:20:45,132	Main narrator	Likewise, infrared telescopes reveal cosmic objects too cool to give off visible light, like dark clouds of gas and dust where stars and planets are born.
00:20:55,360 --> 00:21:01,746	Main narrator	For decades, ESO astronomers were keen to explore the Universe at infrared wavelengths.
00:21:03,880 --> 00:21:11,513	Main narrator	But today, telescopes like the VLT can reveal more of the Universe than we can see with our eyes.
00:21:12,465 --> 00:21:18,497	Main narrator	It can see the sky using infrared light — like seeing body heat in a dark room.
00:21:21,240 --> 00:21:27,415	Main narrator	This dark blob is a cloud of cosmic dust. It blots out the stars in the background.
00:21:30,080 --> 00:21:33,933	Main narrator	But in the infrared, we can look straight through the dust.
00:21:37,400 --> 00:21:40,643	Main narrator	And here’s the Orion Nebula, a stellar nursery.
00:21:43,158 --> 00:21:52,784	Main narrator	Most of the newborn baby stars are hidden by dust clouds. Again, infrared comes to the rescue, revealing stars in the making!

00:21:55,720 --> 00:22:02,924	Main narrator	Don’t forget the stars and gas clouds captured by the monstrous black hole in the core of our Milky Way galaxy.
00:22:04,080 --> 00:22:07,159	Main narrator	Without infrared cameras we would never see them.
00:22:17,560 --> 00:22:23,144	Main narrator	Close to Paranal is a small mountain peak with an isolated building on top.
00:22:26,459 --> 00:22:31,524	Main narrator	Inside this building is the 4.1- metre VISTA telescope.
00:22:32,400 --> 00:22:42,094	Main narrator	Unlike the VLT, VISTA only observes infrared and it has given us incredible vistas of the infrared cosmos.
00:22:44,691 --> 00:22:50,000	Main narrator	ESO has been doing optical astronomy since its birth over fifty years ago.
00:22:50,680 --> 00:22:53,944	Main narrator	And infrared astronomy for over thirty years.
00:23:24,609 --> 00:23:28,440	Main narrator	But there are more registers to the cosmic symphony.
00:23:31,769 --> 00:23:38,624	Main narrator	Five thousand metres above sea level, high in the Chilean Andes, is the Chajnantor plateau.
00:23:42,929 --> 00:23:45,337	Main narrator	Astronomy doesn’t go higher than this.
00:23:48,804 --> 00:23:53,825	Main narrator	This site is so inhospitable, it’s even hard to breathe!

00:23:56,720 --> 00:24:10,000	Main narrator	ALMA is one of the world's largest astronomical projects and could only come to fruition in a global partnership between ESO, North America, and East Asia, in cooperation with Chile.
00:24:11,200 --> 00:24:17,716	Main narrator	But it is not a conventional telescope. It is an array of 66 state-of-the-art-antennas.
00:24:21,449 --> 00:24:29,779	Main narrator	Instead of collecting and analysing visible light, it looks at a different and largely unmapped part of the spectrum.
00:24:30,800 --> 00:24:34,464	Main narrator	Millimetre and submillimetre waves from space.
00:24:36,979 --> 00:24:42,653	Main narrator	Light reaching us from some of the coldest and most distant objects in the Universe.
00:24:44,520 --> 00:24:50,000	Main narrator	ALMA is in search of answers to some of the deepest questions about our cosmic origins.
00:24:52,360 --> 00:24:54,236	Main narrator	How do stars and planets form?
00:24:59,514 --> 00:25:01,744	Main narrator	How did the first galaxies form?
00:25:08,048 --> 00:25:14,000	Scientist 1	ALMA is producing amazing results. It can show us how planetary systems form and evolve.
00:25:15,051 --> 00:25:22,039	Scientist 1	Take this view of the Antennae Galaxies, a pair of colliding galaxies with extremely distorted shapes.
00:25:22,920 --> 00:25:32,980	Scientist 1	The visible light shows us where the stars are, but ALMA now reveals the clouds of cold, dense gas out of which new stars are born in dramatic galactic mergers.

00:25:36,480 --> 00:25:42,962	Main narrator	And, combined with other telescopes around the world, it can even reveal what some black holes look like.
00:25:46,331 --> 00:26:01,066	Main narrator	By changing the way we look, we're closing in on the origins of planets, stars and galaxies. On the secrets of some of the Universe's most mysterious objects. On the symphony of the cosmos!
00:26:04,320 --> 00:26:10,181	Main narrator	The Universe is full of deep mysteries, hidden secrets, and staggering beauty.
00:26:49,360 --> 00:26:54,732	Main narrator	Astronomy is big science. And it's a science of big mysteries.
00:26:56,920 --> 00:26:58,240	Main narrator	Is there life beyond Earth?
00:26:59,440 --> 00:27:01,877	Main narrator	What is the origin of the Universe?
00:27:10,640 --> 00:27:15,964	Main narrator	ESO's new monster telescope will help in our quest to understand.
00:27:20,040 --> 00:27:23,740	Main narrator	That mountain down there is Cerro Armazones.
00:27:28,880 --> 00:27:41,530	Main narrator	Not far from Paranal, it will be home to the largest telescope in the history of humankind. ESO's Extremely Large Telescope, or ELT.
00:27:51,320 --> 00:27:59,677	Main narrator	Sporting a mirror almost forty metres across, the ELT simply dwarfs every telescope that preceded it.
00:28:05,040 --> 00:28:11,587	Main narrator	Almost eight hundred computer-controlled mirror segments. The world's biggest eye on the sky.

00:28:13,213 --> 00:28:31,302	Main narrator	Designing and building it has been pushing the boundaries of technology and innovation. Every system, from the mirror to the instruments, to the dome that encases it all is a challenge being addressed with the help of European engineers in academia and industry.
00:28:32,200 --> 00:28:44,675	Main narrator	When it first blinks up at the sky in the late 2020s, the ELT will tackle some of the biggest scientific challenges of our time and make yet unimaginable discoveries.
00:28:46,240 --> 00:28:51,952	Main narrator	It will track down Earth-like planets around other stars, perhaps finding life.
00:28:57,400 --> 00:29:01,363	Main narrator	It will explore individual stars in nearby galaxies.
00:29:04,411 --> 00:29:13,804	Main narrator	It will probe the 95% of the Universe that we currently can’t see — a mysterious, invisible substance called dark matter.
00:29:15,976 --> 00:29:20,154	Main narrator	And the elusive dark energy that repels gravity.
00:29:20,840 --> 00:29:30,000	Main narrator	Working as a cosmic time machine, the giant telescope will let us look back billions of years, to learn how everything began.
00:29:31,200 --> 00:29:37,161	Main narrator	To break the frontiers of astrophysics to venture into the unknown!