ESOcast Episode 43: Seeing Sharp **Special 50th anniversary episode #3**		
00:00 **[Visuals start]**		**Images:**
00:20 **[Dr J]** Hello and welcome to this special episode of the ESOcast. Leading up to ESO's 50th anniversary in October 2012 we will showcase eight special features portraying ESO's first 50 years of exploring the southern sky.		
00:46 **[Dr J]** 1. Bigger is better - at least when it comes to telescope mirrors. But larger mirrors have to be thick, so that they don't deform under their own weight. And really large mirrors deform anyway, no matter how thick and heavy they are.		Dr J outside NTT building
01:00 **[Dr J]** 2. The solution? Thin, lightweight mirrors - and a magic trick called active optics. ESO pioneered this technology in the late 1980s, with the New Technology Telescope.		Dr J walking into the enclosure of the NTT, followed by a close-up of the thin mirror
01:15 **[Dr J]** 3a. And this is the state of the art. The mirrors of the Very Large Telescope – the VLT – are 8.2 metres across... .		Dr J at catwalk in UT4, with full telescope visible
01:23 **[Dr J]**		Dr J close to UT4 mirror

3b. ...but only 20 centimetres thick. And here's the magic: a computer-controlled support system ensures that the mirror keeps its desired shape at all times to nanometre precision.		
01:53 **[Narrator]** 4. The VLT is ESO's flagship facility. Four identical telescopes, joining forces on top of Cerro Paranal, in the north of Chile. Built in the late 1990s, they provided astronomers with the best available technologies.		zoom-in sequence from space to Paranal
02:15 **[Narrator]** 5. In the middle of the Atacama Desert, ESO created an astronomer's paradise.		Footage of VLT, seen from platform Change into time-lapse movies of VLT UT's operating under a slowly rotating night sky
02:36 **[Narrator]** 6a. Scientists stay in La Residencia, a guest house partly buried under the dirt and rubble of one of the driest places on the planet. But inside are lush palm trees, a swimming pool, …		Pan from desert scape to exterior view of Residencia, followed by interior views (with astronomers swimming and eating)
02:48 **[Narrator]** 6b. … and delicious Chilean sweets.		
02:54 **[Narrator]** 7. Of course, the unique selling point of the Very Large Telescope is not its swimming pool, but its unequalled view of the Universe.		View of VLT silhouetted against darkening sky, as seen from basecamp; stars become more and more impressive
03:07 **[Dr J]** 8. Without thin mirrors and active optics, the VLT would not be possible. But there's more.		Close-up of Dr J (in VLT control room)
03:13 **[Dr J]**		Dr J in VLT control room, next to monitor showing blurry stars; animation showing blurring effect of

9. Stars appear blurry, even when observed with the best and largest telescopes. The reason? The Earth's atmosphere distorts the images.		atmosphere may also appear on monitor
03:27 **[Narrator]** 10. Enter the second magic trick: adaptive optics. On Paranal, laser beams shoot out into the night sky to create artificial stars. Sensors use these stars to measure the atmospheric distortions. And hundreds of times per second, the image is corrected by computer-controlled deformable mirrors.		Again, night views (both real time and time-lapse) of VLT, now with lasers. Insets (maybe slowly drifting from right to left) show elements of adaptive optics
03:52 **[Dr J]** 11. And the end effect? As if the turbulent atmosphere were completely removed. Just look at the difference!		Dr J at monitor again, showing blurry picture of astronomical object that cuts into AO-view of same object
04:06 **[Narrator]** 12. The Milky Way is a giant spiral galaxy. And at its core – 27 000 light-years away – lies a mystery that ESO's Very Large Telescope helped to unravel.		Animation of Milky Way galaxy
04:21 **[Narrator]** 13. Massive dust clouds block our view of the Milky Way's core. But sensitive infrared cameras can peer through the dust and uncover what lies behind.		Optical view of Milky Way centre, with dust clouds, crossfade into infrared view (dust clouds 'dissolve') Non-AO close-up infrared view of Milky Way centre, with blurry stars
04:38 **[Narrator]** 14. Assisted by adaptive optics they reveal dozens of red giant stars. And over the years, these stars are seen to move! They orbit an invisible object at the very centre of the Milky Way.		Crossfade into same view, but with AO. Movie of orbiting giant stars in Milky Way centre
04:54 **[Narrator]**		Animated sequence of IR images changes into 'scientific' diagram of stellar orbits

15. Judging from the stellar motions, the invisible object must be extremely massive. A monstrous black hole, weighing in at 4.3 million times the mass of our Sun. Astronomers have even observed energetic flares from gas clouds falling into the black hole. All exposed by the sheer power of adaptive optics.		Animation of supermassive black hole Flares from Milky Way black hole
05:20 **[Dr J]** 16. So thin mirrors and active optics make it possible to build giant telescopes. And the adaptive optics take care of the atmospheric turbulence, providing us with extremely sharp images. But we're not done yet with our magic tricks. There's a third one. And it's called interferometry.		Slow zoom-in on Dr J walking amidst the VLT enclosures; end with close-up or cut
05:41 **[Narrator]** 17. The VLT consists of four telescopes.		Zoom-out to overview of four UTs
05:44 **[Narrator]** 18. Together, they can act as a virtual telescope measuring 130 metres across.		Overlay the scene with image of hypothetical 130-metre telescope
05:52 **[Narrator]** 19. Light collected by the individual telescopes is channeled through evacuated tunnels and brought together in an underground laboratory. Here, the light waves are combined using laser metrology and intricate delay lines.		Views of interferometry tunnels, optical benches, delay lines, and laboratory
06:14 **[Narrator]** 20. The net result is the light-gathering power of four 8.2-metre mirrors, and the eagle-eyed vision of an imaginary telescope as large as fifty tennis courts.		Schematic top view of VLT. First: four circles marking the 4 UT mirrors. Then: giant circle to mark ‘virtual’ 130-m mirror.
06:28		Views of ATs, first in such a way that they appear

[Narrator] 21. Four auxiliary telescopes give the network more flexibility. They may appear tiny next to the four giants. Yet, they sport mirrors 1.8 metres across. That's bigger than the largest telescope in the world just a hundred years ago!		tiny as compared to the UT's; then more in close-up to reveal their true size Also a close-up of the telescopes inside
06:47 **[Dr J]** 22. Optical interferometry is something of a miracle. Starlight magic, wielded in the desert. And the results are impressive.		Dr J sitting on railing at VLT platform, close to stairway to control room. He then walks down metal staircase and enters door to control room
07:00 **[Narrator]** 24a. The Very Large Telescope Interferometer reveals fifty times more detail than the Hubble Telescope.		Dr J walks toward control room chair and sits down
07:09 **[Narrator]** 24b. For instance, it gave us a close-up of a vampire double star. One star is stealing material from its companion.		SS Lep video (full frame)
07:23 **[Narrator]** 25. Irregular puffs of stardust have been detected around Betelgeuse — a stellar giant about to go supernova.		Images related to VLTI results Betelguese (full frame)
07:34 **[Narrator]** 26a. And in dusty discs surrounding newborn stars, astronomers have found ...		Images related to VLTI results on protoplanetary disks (full frame)
07:41 **[Narrator]** 26b. ... the raw material of future Earth-like worlds.		View of Dr J looking at monitor (from back of monitor)
07:45 **[Narrator]** 27. The Very Large Telescope is mankind's sharpest eye on the sky.		Slow pan from desert to VLT overview

07:51 **[Narrator]** 28. But astronomers have other means to expand their horizons and broaden their views. At the European Southern Observatory, they have learned to see the Universe in a completely different kind of light.		Upward pan to night sky Crossfade to (false-) colourful view of nebulae seen by VISTA
08:10 **[Dr J]** This is Dr J, signing off from this special episode of the ESOcast. Join me again next time for another cosmic adventure.		
08:18		**[Outro]**

09:21
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