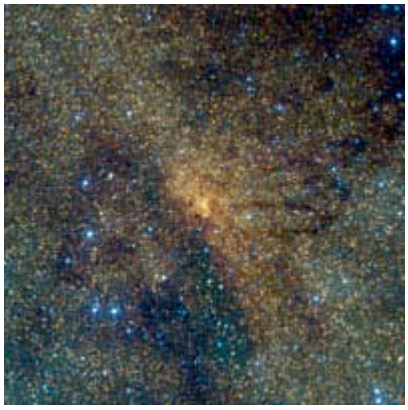
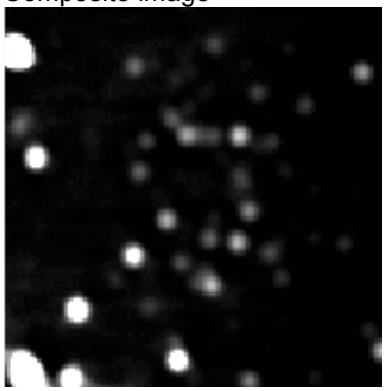
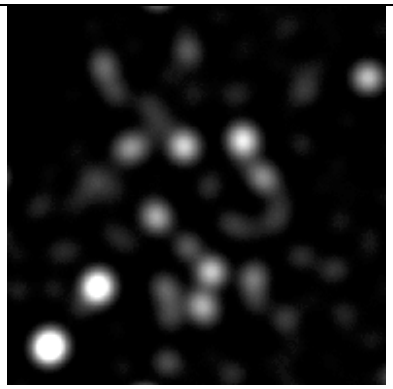
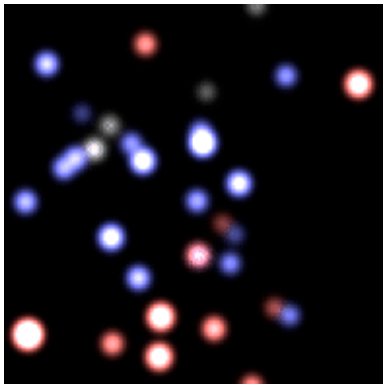
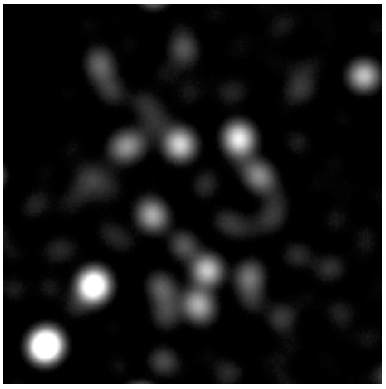
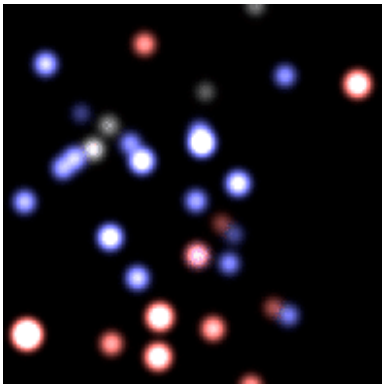
ESOcast Episode 2: **Unprecedented 16-year long study tracks stars orbiting Milky Way black hole** **EMBARGOED UNTIL 10 December 2008, 10:00 CET**		
00:00 **[Visual starts]** **[Narrator]** 1. In an unprecedented 16-year-long study, using several of ESO's flagship telescopes, astronomers have produced the most detailed view ever of the surroundings of the monster lurking at our Galaxy's heart — a supermassive black hole. The research has unravelled the hidden secrets of this tumultuous region by mapping the orbits of almost 30 stars.		 
00:28 **ESOcast intro** This is the ESOcast! Cutting-edge science and life behind the scenes of ESO, the European Southern Observatory. Exploring the Universe's ultimate frontier with our host Dr. J, a.k.a. Dr. Joe Liske.		ESOcast intro
00:45 **[Dr. J]** 2. Hello and welcome to the second episode of the ESOcast. Today, we have a very cool piece of science for you. A team of German astronomers, with characteristic precision and patience, has spent 16 years mapping out the motions of 28 stars orbiting the very centre of our Milky Way galaxy. Now, astronomers have believed for quite a while that the centre of our galaxy is the site of a supermassive black hole. Black holes are a consequence of General Relativity. They are		Dr. J in virtual studio. Slate: HOST: Dr. J EPISODE 2:

objects that are so dense and whose gravity is so strong, that not even light can escape them. These observations that we are going to show you today are the best evidence yet that black holes are not just theoretical constructs, but actually do exist in reality. This is truly a milestone result.		
01:31 **[Narrator]** 3. Observers under dark skies, far from the bright city lights, can marvel at the splendour of the Milky Way, arching in an imposing band across the sky. Zooming in towards the centre of our galaxy, about 25000 light years away, you can see that it is composed of myriads of stars. This is a pretty impressive sight, but much is hidden from view by interstellar dust, and astronomers need to look using a different wavelength, the infrared that can penetrate the dust clouds. With large telescopes, astronomers can then see in detail the swarm of stars circling the supermassive black hole, in the same way that the Earth orbits the Sun.		   Composite image  Real NACO data timelapse

The Galactic Centre harbours the closest supermassive black hole known, and the one that is also the largest in terms of its angular diameter on the sky, making it the best choice for a detailed study of black holes.		 Clean upinterpolated NACO timelapse 
02:27 **[Dr J]** 4. So what this team did was that, at various points over the past 16 years, they kept taking images of the very central region of the Milky Way. Now, from these images, they were able to map out the motions of a total of 28 stars. Now, what these motions showed was that these stars aren't just moving about randomly, but that they are clearly orbiting a very massive, central object. And the point is that this central object is completely unseen. Now, from the motions it's also possible to deduce the mass of the central object. It came out to be a little over four million times the mass of the Sun. Now, what's more, that enormous mass has to fit into a tiny little volume, and so one cannot escape the conclusion that the central object really is a black hole.		
03:12 **[Narrator]** 5. The observing campaign started with observations made in 1992 with the SHARP camera attached to ESO's 3.5-metre New Technology Telescope (NTT), housed at the La Silla observatory in Chile.		

More observations have subsequently been made in the last few years using two instruments mounted on ESO's 8.2 m Very Large Telescope (VLT). Over the 16 years of this study, ESO's telescopes have stared at this one region for 50 full nights.		 
03:46 **[Dr J.]** 6. This new research marks the first time that so many of these central stars have had their orbits determined so precisely. The data also reveal a lot about the characteristics of these stars and how they must have formed. For one of the stars, the astronomers were even able to follow it for a complete orbit! The star approached the central black hole to within just one light-day — that's just five times the distance between Neptune and the Sun. Professor Reinhard Genzel, from the Max Planck Institute for Extraterrestrial Physics in Germany, is the leader of the team that made the discovery. Reinhard, why is it so important to study the centre of the Milky Way?		Dr. J in virtual studio   Right screen: Reinhard Genzel

04:22 **[Genzel]** 7. “Well, you see, the Milky Way centre is one of the most important laboratories we have to study in very great detail what’s happening in the centres of galaxies — in much more detail than we can ever hope to do in all other galaxies. Yet, here we are, we can study whether there is a central black hole, what happens around it and so forth, all very general issues which we would like to explore and which you cannot really study that much in detail in other galactic nuclei.”		Reinhard Genzel, leader of team from the Max-Planck-Institute for Extraterrestrial Physics.
04:49 **[Dr J]** 8. Dr. Stefan Gillessen is the first author of the paper reporting this study. So Stefan, tell us, what’s the most important result you obtained?		Left screen: the lead author, Stefan Gillessen.
04:57 **[Gillessen]** 9. “The most important result of our research really is that we have now empirical evidence for the existence of a massive black hole in the centre of our Milky Way. The mass of this black hole is around four million solar masses and we know the mass at the percent level.”		Stefan Gillessen.
05:13 **[Dr J.]** 10. This is of course an amazing result, but the team doesn’t plan to stop here. Now, in the past they’ve used the novel technique of adaptive optics to remove the blurring effects of the atmosphere. In the future, they plan to do even better, and to get even higher resolution images by using another new technique called interferometry. This is where you combine the light from two or more of the VLT’s Unit Telescopes together. So Reinhard, what’s the next step?		VLT timelapse with laser guide star
05:39 **[Genzel]** 7. “Well you see at this point, we really are fairly sure that there is a massive black hole at the centre of our Milky Way. The next thing, we want to actually play with it! Play with it in the sense that we want to use it as a tool to test whether General Relativity, the theory of Einstein is actually wrong or right.”		Reinhard Genzel

05:57 **[Dr J.]** Wow! Playing with a black hole to test relativity... That's pretty cool stuff! I'm Dr. J signing off for the ESOcast. Join me again next time for another cosmic adventure.		Dr. J in virtual studio
06:11 **[Outro]**		ESOcast is produced by ESO, the European Southern Observatory. *ESO, the European Southern Observatory, is the pre-eminent intergovernmental science and technology organisation in astronomy designing, constructing and operating the world's most advanced ground-based telescopes.*
06:23 **END**		