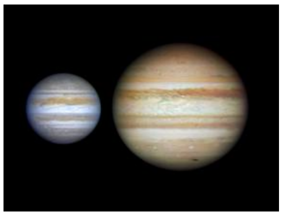
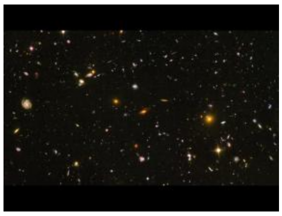
c/o ST-ECF
ESO, Karl-Schwarzschild-Str.2
D-85748 Garching bei München,
Germany
Telephone: +49 (0)89 3200 6306
Cellular: +49 (0)151 153 735 91
Telefax: +49 (0)89 3200 6480
hubble@eso.org

www.spacetelescope.org

Hubblecast Episode 40: Wide Field Camera 3 — Hubble's New Miracle Camera FOR IMMEDIATE RELEASE 29 October, 2010		
00:00 [Narrator] In early 2009, a team of astronauts visited Hubble to repair the wear and tear of twenty years of operating in a hostile environment — and to install two new instruments, the Cosmic Origins Spectrograph, and Wide Field Camera 3 — better known as WFC3. WFC3 is a combined ultraviolet, visible and infrared camera that dramatically extends Hubble's ability to image astronomical objects. With these new capabilities, Hubble is still pushing the boundaries of science after two decades in orbit.		
00:37 [Woman] This is the Hubblecast, news and images from the NASA/ESA Hubble Space Telescope. Travelling through time and space with our host Dr J, aka Dr Joe Liske.		Credits sequence
01:06 [Narrator] In episode 30 of the Hubblecast, we saw some of the very first pictures to come back from Wide Field Camera 3, Hubble's newest and most advanced instrument. Today we're going to look at some of the science behind these pictures. We'll find out how this remarkable new camera is helping Hubble to see the invisible, look far back in time and spot objects further away from us than ever before.		

1:32 [Dr J] WFC3 was installed on Hubble in place of WFPC2, the Wide Field and Planetary Camera 2, which for many years had been the main workhorse instrument on Hubble. Not only do the two instruments have very similar names, and look virtually identical, the capabilities of WFC3 are also in some respects just a tweaked version of those of its predecessor — although with sharper pictures and more sensitive light detectors. But on top of these incremental improvements, WFC3 also brings a whole battery of new functions to Hubble that are getting us astronomers really excited.		
2:08 [Narrator] WFC3 is actually two instruments in one: the ultraviolet and visible-light channel is WFPC2's replacement, cramming six times as many pixels into a similar field of view. As well as providing scientists with higher resolution observations than ever before, the pictures from this part of WFC3 are also Hubble's prettiest yet, revealing details never seen before through any telescope. But it is WFC3's infrared channel that is the real breakthrough.		
2:48 [Dr J] Infrared astronomy is getting a lot of attention right now. It's not just Hubble's new functions — ESA's Herschel Space Observatory, NASA's Spitzer Space Telescope and the forthcoming NASA/ESA/CSA James Webb Space Telescope were all designed to work in this part of the spectrum too. One of the reasons for this is that studying the sky in the infrared allows astronomers to look at relatively cool objects that emit little or no visible light. An example of these are so-called protoplanetary nebulae — a cool gas envelope that gets thrown off by a certain type of star as its nuclear fuel supply runs low.		
3:42 [Narrator] Looking at these nebulae through an optical telescope is hard, as they barely emit any visible light, forcing astronomers to rely instead on faint reflected starlight to see anything at all. But protoplanetary nebulae shine far more brightly in the infrared part of the spectrum.		
3:42 [Dr J] Infrared imaging is also extremely useful for peering through interstellar dust clouds, which are impenetrable to visible light. The reason for this is similar to why sunsets are red. Just as particles in the atmosphere scatter blue light more than red, interstellar dust clouds block visible light more than infrared.		

04:03 [Narrator] Hubble has become famous for its striking visible-light pictures of huge clouds of interstellar dust and gas. But sometimes scientists want to know what’s happening behind, or inside, the cloud of dust. Making infrared observations pulls away the veil and reveals the hidden stars.		
04:24 [Dr J] Until now, infrared imaging was challenging with Hubble. The Near Infrared Camera and Multi-object Spectrometer, or NICMOS, did allow astronomers to study objects in infrared light in ways not possible from the ground, but it forced them to make a difficult choice. Because its images were small — only about 65 000 pixels in total, similar to a mobile phone screen — NICMOS could produce the sharpest images only if it concentrated on a very narrow field of view. Taking in a wider view came at the cost of losing much of the detail.		
05:00 [Narrator] Along with a much wider field of view and better sensitivity, WFC3’s infrared channel has a million pixels, 15 times better than NICMOS, and similar to what you get on a computer screen. This means astronomers no longer have to compromise between how much of the sky they can observe, and how much detail they can study it in. These improvements mean Hubble is now far better at observing large areas of sky as well as very faint and very distant objects These are key for the science of cosmology, the study of the origins and development of the Universe.		
05:37 [Dr J] Because the Universe is expanding, light waves coming from distant objects are stretched as they travel through space, and the waves become longer. The further an object is away, the more its light is stretched on its journey to us, and the redder the light appears. Hence the effect is known as redshift. For really distant objects, the ultraviolet and visible light is redshifted so much it goes infrared — literally, “below red” — and that is the reason that infrared imaging is so important for spotting these very distant galaxies.		

06:13 [Narrator] This is the Hubble Ultra Deep Field, a visible light image taken in 2003 and 4 with Hubble's Advanced Camera for Surveys. The picture is of a little patch of sky almost a hundred times smaller than the area of the full moon. It contains no stars visible with the naked eye — but taking a million second exposure of this little black speck of space reveals these vanishingly faint faraway galaxies. Studying the same region with WFC3's infrared photography reveals galaxies more distant still: some of these are so far away that they have been redshifted out of the visible spectrum altogether. We see galaxies here as they were many billions of years ago. When the light from some of these galaxies started its long journey towards us, our Sun and Earth had not even begun to form.		
07:10 [Dr J] But what is really exciting cosmologists about WFC3's infrared imaging of the Hubble Ultra Deep Field is not just what's in the foreground so to speak, amazing as that is, but the scatter of tiny, faint specks just visible in the background, beyond these already faraway galaxies.		
7:28 [Narrator] Some of the flecks of light in this fuzzy image are just anomalies within the light detectors, but among them are faint impressions of early galaxies. In this photo we are looking at some of the most remote objects ever seen. They are so distant, and their light has travelled so far to reach us, that we see these galaxies as they were 13 billion years ago, when the Universe was only about 5% of its current age.		
7:58 [Dr J] Discovering and studying these galaxies can tell us a lot about the conditions that prevailed in the earliest years of the Universe, and confirm — or perhaps refute — our theories of early galaxy formation. Whatever the case may be, observations like these certainly take us a few steps closer to understanding the history of our Universe. This is Dr J signing off for the Hubblecast. Once again, nature has surprised us beyond our wildest imagination.		

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