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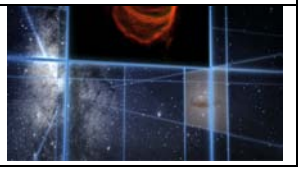
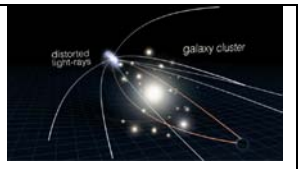
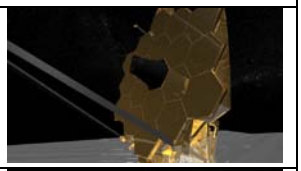
Hubblecast Episode 45: Building a treasure trove of observations		
00:00 [Narrator] After circling the Earth for over two decades, Hubble has been responsible for many fascinating scientific discoveries. After the visit by astronauts in 2009 to service the spacecraft and to install new instruments, the telescope is now at the height of its powers. As the observatory has matured, attention has turned to some ambitious projects on a scale that would not have even been considered a few years ago. Between them, these projects could help answer some of the biggest questions in astronomy today, and will contribute to science for many years to come.		
00:37		
01:05 [Dr J] Hello and welcome to the Hubblecast. Now, observing time on Hubble is a very precious commodity and it's hugely sought after. That means that when astronomers want to use Hubble, they have to apply for observing time. And in their application, they have to be very detailed about what it is exactly they want to study, and how they're going to do it. Now this process works just fine for the vast majority of projects which usually have very focused scientific goals. However, once in a while, Hubble gets used for something much bigger, with much broader scientific goals. And in these cases, the normal way of handing out time just isn't quite enough. Three such projects, called multicycle treasury programs, are underway right now, and they are the most ambitious projects ever to have been carried out with Hubble.		
01:54 [Narrator] The Hubble multicycle treasury programs are on a completely different scale from the telescope's usual work, featuring thousands of hours of observations split over several years.		

And rather of being tied to the research question of individual scientists, like Hubble observations usually are, the multicycle treasury programs are designed to create a treasure trove of data which can be used by as many people as possible in their work.		
02:22 [Dr J] For example, the Panchromatic Hubble Andromeda Treasury program is working on a detailed map of part of the nearby Andromeda Galaxy, going from its bright core to the wispy ends of its spiral arms. Andromeda is actually the closest spiral galaxy to the Milky Way and it gives us an unparalleled view of the structure of a galaxy somewhat similar to our own. It's actually quite big in the sky — several times the size of the full moon, but it's so faint that it's barely visible with the naked eye, even on a very dark night. For Hubble, though, it's ablaze with stars — and an estimated 100 million of them will have been mapped by the time the survey is complete.		
03:04 [Narrator] The survey won't just be plotting their position, but taking detailed colour information in visible, near infrared and ultraviolet light — something no other telescope can do. Accurately measuring the colours of stars is vital for studying many of their properties, for example their surface temperature. With this abundance of data, scientists will be making discoveries in the Andromeda Galaxy for a long time.		
03:33 [Dr J] Another of these Hubble treasury programs is looking far back into the evolution of our Universe. And that's the Cosmic Assembly Near-infrared Deep Extragalactic Legacy Survey… or CANDELS for short. By scanning large, dark areas of sky with very few foreground stars in them, this survey is is looking beyond the confines of our cosmic neighbourhood and into the farthest reaches of the Universe. They're observing galaxies that are so far away that their light has taken billions of years to reach us. This allows astronomers to study the distant past of the cosmos and how galaxies have evolved over time. Like the Andromeda Galaxy survey, CANDELS is using Hubble's ability to make detailed maps of the sky across the visible spectrum and into near-infrared and ultraviolet. From the early galaxies forming, to the emergence of galactic clusters to the age of quasars half way back through cosmic history, CANDELS is going to give a wealth of information to scientists studying some of the biggest questions in cosmology.		

04:39 [Narrator] The third of these multicycle treasury programs is the Cluster Lensing and Supernova survey with Hubble, or CLASH for short. CLASH is looking into huge clusters of elliptical galaxies. These have so much mass that their gravity noticeably bends the path of light, a bit like a huge magnifying glass. The lenses can actually help astronomers see distant galaxies that would otherwise be too faint by amplifying the light we receive from them. What's more, studying these clusters is key to explaining two of the big mysteries of modern astronomy, dark matter and dark energy.		
05:17 [Dr J] Studying normal matter in the Universe, like stars or gas clouds, is relatively easy because it emits or absorbs light. However, it turns out that most of the matter in the Universe is not in fact normal but rather so-called dark matter, which doesn't give off any radiation whatsoever. Now, astronomers don't really know what dark matter is . But by looking at how these clusters bend light from distant galaxies in the background allows us to reconstruct a map of how the dark matter is distributed inside these clusters. The CLASH survey is also going to study distant supernovae. This is going to probe the expansion rate of the Universe and help us understand the mystery of why this expansion is accelerating..		
06:02 [Narrator] In fact there are already discoveries being made with the first data released from this survey. In April of this year, a new study identified a faraway galaxy imaged by the gravitational lens in Abell 383 — the first of 25 to be mapped by this survey. Thanks to the cluster amplifying the light from this distant galaxy, astronomers were able to make much more detailed observations than would otherwise have been possible. And they discovered that the stars in this galaxy were surprisingly old: they must have been born just a few hundred million years after the Big Bang, much earlier than expected.		
06:42 [Dr J] So although Hubble is more than 20 years old, it's actually doing some of its most ambitious work right now, building a library of data which will serve astronomers far into the future. And this means that despite its age Hubble won't be eclipsed by the next big thing in space-based astronomy, the James Webb Space Telescope, or JWST.		
07:04 [Narrator] JWST, which launches later this decade, has been designed to answer some of the fascinating questions that Hubble asked: how do stars form? When did the first galaxies appear? What hides in huge dusty nebulae?		
07:21 [Dr J] To answer these profound questions, the JWST is designed to observe mainly in infrared light.		

That means that Hubble's ability to see across the spectrum from ultraviolet through the visible, all the way into the near infrared is a unique capability that no other telescope will have for decades to come. These multicycle treasury programs are taking full advantage of this, building up a legacy of data that will help scientists unravel the secrets of the cosmos for a long time to come.		
07:53 [Dr J] Thanks for watching the Hubblecast — once again nature has surprised us beyond our wildest imagination.		

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