

ESO Ultra HD Expedition: New clarity for astronomy outreach

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Summary

In the spring of 2014 a team of ESO Photo Ambassadors embarked on a pioneering expedition to the European Southern Observatory's observing sites in Chile. Their mission was to capture time-lapses, stills, videos and panoramas in crisp Ultra High Definition from some of the darkest night skies on Earth.

Introduction

Ultra High Definition (Ultra HD), also known as 4K, has been hailed as the next revolution¹ for television after High Definition (HD) TV. With four times as many pixels as HD this crisp and clear format has recently risen to prominence and become the norm for many top-range TV displays.

Although the technology has flourished there is currently very little free, high-quality, Ultra HD content available.

The European Southern Observatory (ESO) set out to change this by delivering free Ultra HD for use by anyone from public consumer to broadcaster. ESO is perhaps the first scientific organisation to produce 4K content for free on a regular basis.

Why Ultra HD?

Astronomy is a very visual science and, with four times the resolution of HD, Ultra HD offers new clarity to our stunning footage of the cosmos.

The vision of the ESO Ultra HD Expedition^{2,3} was to deliver breathtaking Ultra HD footage that transcended astronomical, geographic and scientific frontiers and brought the Universe closer than ever before.

The expedition was originally conceived as one of the regular visits to the ESO sites where photos and video are taken to document changes and work at the sites. However, this time it was decided that the visit would go further and upgrade to the most current technologies in time-lapse imaging and high-resolution filming.

on the equipment cases. Protective cases, called Peli Cases, were offered to the team by Peli and filled to the brim at ESO's headquarters in Garching, Germany. The hard-back cases carried technology ranging from a Vixen Polaris Star Tracker — which allows photographers to capture the night sky whilst aligned to the planet's poles — to Angelbird's SSD2go PRO solid-state disks that store the Ultra HD content the team produced with the Canon cameras.

The team first flew from Europe to Chile's capital city, Santiago, home to the ESO Guesthouse. Getting through customs in Santiago with all the high-tech equipment was an interesting experience for the team, but fortunately the official letters and paperwork did the job.

The Guesthouse is a fabulous place to either recover from jetlag or from weeks of consecutive observing at the observatories, and a good stop before heading on to the next stage of the team's adventure — to capture the night sky in high resolution.

Embarking on an adventure

In late March 2014, after six months of planning, the team of four world-renowned astro-photographers including ESO's videographer Herbert Zodet, and the three ESO Photo Ambassadors Yuri Beletsky, Christoph Malin and Babak Tafreshi departed. They left equipped with the most powerful photographic and video-graphy tools from the world's top technology names⁴.

The logistical challenges of transport to Chile combined with the barren environment in the Atacama Desert put high demands

Paranal — Jewel on the Mountaintop

The ESO Ultra HD Expedition team first travelled to Paranal Observatory⁵, home to the Very Large Telescope (VLT) — ESO's flagship facility for European ground-based astronomy.

Following a short flight from Santiago to Antofagasta, the team picked up their two



Figure 1. The ESO Ultra HD Logo. Credit: ESO.



Figure 2. A look back to the team's time at Paranal. Credit: ESO/B. Tafreshi

four-wheel drives and began the journey to Paranal. The drive through the dusty mining capital Antofagasta presents a great contrast to the hustle and bustle of the modern Chilean capital, as does the drive through the arid desert beyond the city

limits. The need for the four-wheel drives became quickly apparent.

The first signs of approaching Paranal are the four Unit Telescopes of the VLT. The telescopes, named Antu, Kueyen, Melipal and Yepun, guided the team to their first

destination — a technological oasis 2635 metres above sea level. The views from the mountain peak are breathtaking and the team took advantage of them, taking some sunset shots at this beautiful location.

Atacama Large Millimeter/submillimeter Array

Having spent some time at Paranal the team set off to their next location, the Atacama Large Millimeter/submillimeter Array (ALMA)⁶.

ALMA is a large interferometer composed of 66 high-precision antennas. Located on the Chajnantor Plateau, 5000 metres above sea level in northern Chile, the individual antennas can be combined and act together as a giant single telescope.

Having arrived at the basecamp of the ALMA Observatory the team went through



Figure 3. This Ultra HD photograph shows almost the full VLT platform with the red shades of airglow visible overhead. Credit: ESO/Y. Beletsky (LCO)



Figure 4. Night view of one of the ALMA transporters, Otto, at the ALMA high site on the Chajnantor Plateau. Credit: ESO/Y. Beletsky (LCO)



Figure 5. UHD image taken with a long exposure to show the movement of the ALMA antennas. Credit: ESO/Y. Beletsky (LCO)

the mandatory medical exam to check that their bodies could cope with the high altitude conditions and fortunately all of them passed the test. However, human operations at the Array Operations Site (AOS), 5000 metres above sea level, are limited to

an absolute minimum due to the extremely high altitude, so they could not linger too long. But they worked hard to deliver as many stunning shots as they could in the limited time available.



Figure 6. A curtain of stars surrounds the 3.58-metre New Technology Telescope in this Ultra High Definition photograph from the ESO Ultra HD Expedition. Credit: ESO/B. Tafreshi

Yuri caught a rare night view of one of the ALMA antenna transporters, Otto, at the high site.

Otto is one of the two transporters that are used to reposition the antennas. The twin vehicles are 20 metres long, 10 metres wide and 6 metres high, and each has 28 tyres. The ability to relocate the antennas and change focus is an integral part of what makes ALMA such a powerful telescope.

La Silla — ESO's first observatory

To end the trip the ESO Ultra HD Expedition headed to where it all began — La Silla, ESO's first observatory⁷. Located on the edge of the Atacama Desert, La Silla is 600 kilometres north of Santiago, and 2400 metres above sea level. It is home to the ESO 3.6-metre telescope and the 3.58-metre New Technology Telescope (NTT). Many of the ESO Member States use the site for targeted national projects such as the Swiss 1.2-metre Leonhard Euler Telescope.

Inaugurated in 1969, the facilities at La Silla led Europe to the frontline of astronomical research and, with more than 300 clear nights per year, it provides the perfect backdrop for the 4K shots.

Herbert was able to obtain some Ultra HD footage of the ESO 3.6-metre telescope and the NTT during the opening of their respective enclosures at sunset. The rest of the team took a range of further time-lapse shots at sunset, during the night and at sunrise — both indoors and outdoors.

In particular, the team were keen to take some more transition shots like the fish-eye view, in stunning Ultra HD, 4K format. It is here at La Silla that the team took their last shots of the Ultra HD Universe, at least for now.

Follow-up

Following the expedition, there was a lot for the team to do in terms of processing, colour-correcting and combining all the many SSD disks full of material taken at each of the ESO sites.

The graphics team at ESO Headquarters scrutinised every detail of the IMAX-size



Figure 7. The sun sets at La Silla Observatory in this stunning Ultra HD panorama. In the centre, the ESO 3.58-metre New Technology Telescope and to the right, the ESO 3.6-metre telescope with ESO's videographer Herbert Zodet at work. Credit: ESO/B. Tafreshi

4K images and videos using a professional Sharp Ultra HD display which offers extraordinarily high resolution. In order to work seamlessly on the large 4K video files two special Magic Multimedia PC workstations were built and optimised for multi-layer 4K video editing, each with 48 cores and 128 GB of RAM.

The results are now available for free under Creative Commons with more than 200 spectacular photos from the expedition having been published⁸. Several are still in the pipeline as ESO Pictures of the Week and will be released over the coming months. Almost 100 Ultra HD videos are also available, with a few more still being polished, which will then become available over the next months⁹.

A behind-the-scenes view of the expedition was released as an ESOcast¹⁰. It follows the story of the team's journey across the arid Atacama Desert, and includes some of the many wonderful time-lapses, stills and panoramas. As part of the campaign, the team also shared their thoughts on the ESO Ultra HD blog¹¹, explaining some of the background of the work. A variety of other outputs from ESO also track the exhibition¹².

Spurred by the success of the expedition ESO has continued to produce 4K videos about other topics, and there are now more than 200 free Ultra HD clips published in ESO's video archive¹³.

But there's more! ESO's education and Public Outreach Department has now eyed an even larger prey: 4K planetarium shows with frames that are almost twice as big as Ultra HD. With the upcoming ESO Supernova Planetarium and Visitor Centre¹⁴ in mind high-quality material — ultra high-resolution stills and 4K full-dome frames for use in planetarium shows — are now pouring online¹⁵.

Acknowledgements

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References

Madsen, C. 2012, *Jewel on the Mountaintop — The European Southern Observatory through Fifty Years* (Wiley), Hardcover (free E-book available at http://www.eso.org/public/products/books/book_0050/)



Figure 8. This Ultra HD photograph taken during the ESO Ultra HD Expedition captures ESO's Paranal Observatory in a 360-degree fish-eye view that can be used for full-dome projection in planetariums. The swirling Milky Way can be seen at its centre. Credit: ESO/Y.Beletsky

Notes

- 1 The 4K Ultra HD Revolution <http://www.youtube.com/watch?v=miKmxszDg6Q>
- 2 ESO Ultra HD website <http://www.eso.org/public/outreach/ultra-high-definition/>
- 3 ESO Ultra HD Expedition brochure http://www.eso.org/public/archives/epublications/pdf/epub_0001.pdf
- 4 The expedition's equipment included: Vixen Optics Polaris Star Tracker, Canon® EOS-1D C camera, Stage One Dolly and eMotimo TB3 3-axis motion control camera robot, Angelbird SSD2go, LRTImelapse software, Peli™ Cases, 4K PC workstations from Magic Multimedia, Novoflex QuadroPod system, Intecro batteries and Granite Bay Software.
- 5 More information on Paranal Observatory: http://en.wikipedia.org/wiki/Paranal_Observatory
- 6 More information on ALMA: <http://www.eso.org/sci/facilities/alma.html>
- 7 More information on La Silla: http://en.wikipedia.org/wiki/La_Silla_Observatory
- 8 Images from the exhibition: <http://www.eso.org/public/images/?search=%2B%22uhd%22>
- 9 Videos from the exhibition: <http://www.eso.org/public/videos/?search=%2B+%22uhd%22>
- 10 ESOcast 65: The Chilean Sky in Ultra High Definition <http://www.eso.org/public/videos/esocast65a/>
- 11 ESO Ultra HD Blog <http://www.eso.org/public/outreach/ultra-high-definition/blog/>
- 12 Announcements about the exhibition: The results from the exhibition: <http://www.eso.org/public/announcements/ann14035/> ESO Ultra HD Expedition Begins, <http://www.eso.org/public/announcements/ann14023/>
- 13 All 4K material available on the ESO website can be found here: <http://goo.gl/5J84Rm>
- 14 Find out more about the Supernova Planetarium and Visitor Centre Donated to ESO: <http://www.eso.org/public/news/eso1349/>
- 15 Free Fulldome Material for Planetariums is available here: <http://www.eso.org/public/announcements/ann14051/>

Biographies

Ryan Laird is a science communicator from the UK with a great passion for astronomy and all things space. He obtained a degree in Physics with Astrophysics MPhys (Hons) from the University of Leicester and is an alumnus of the International Space University (ISU) Space Studies Program (SSP). He worked as an intern at Universe Awareness (UNAW; Space Scoop) and at the European Southern Observatory (ESO) in the education and Public Outreach Department (ePOD). In 2009, he was also the UK Student Representative for the Opening Ceremony of the International Year of Astronomy 2009 (IYA2009).

Lars Lindberg Christensen is a science communication specialist, who is Head of the ESO education and Public Outreach Department (ePOD) in Munich, Germany. He leads public outreach and education for the La Silla-Paranal Observatory, for ESO's part of ALMA and APEX, for the European Extremely Large Telescope, for ESA's part of the Hubble Space Telescope and for the IAU Press Office.

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More details on the website:
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