

Awesome Universe
Exhibition Catalogue

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Preface

The signing of the ESO Convention in 1962 and the creation of ESO was the culmination of the dream of leading astronomers from five European countries, Belgium, France, Germany, the Netherlands and Sweden: a joint European observatory to be built in the southern hemisphere to give astronomers from Europe access to the magnificent and rich southern sky by means of a large telescope. The dream resulted in the creation of the La Silla Observatory near La Serena in Chile and eventually led to the construction and operation of a fleet of telescopes, with the 3.6-metre telescope as flagship. As Italy and Switzerland joined ESO in 1982 the construction of the New Technology Telescope, with pioneering advances in active optics, became possible, preparing the way for the next step: the construction of the Very Large Telescope. The VLT made adaptive optics and interferometry available to a wide community.

The decision to build a fully integrated VLT system, consisting of four 8.2-metre telescopes and providing a dozen foci for a carefully thought-out complement of instruments opened a new era in ESO's history, and has created the most advanced ground-based optical observatory in the world.

Today, in 2012, the original hopes of the five founding members have not only become reality but ESO has fully taken up the challenge of its mission to design, build and operate the most powerful ground-based observing facilities on the planet. On the Chajnantor Plateau in Northern Chile, together with North American

and East Asian partners, ESO is developing the biggest ground-based astronomical project in existence, the Atacama Large Millimeter/submillimeter Array (ALMA). And ESO is starting to build the world's biggest eye on the sky, the European Extremely Large Telescope.

In 2012, our 50th anniversary year, we are ready to enter a new era, one that not even the initial bold dreams of ESO's founding members could have anticipated. It is undoubtedly a most exciting time that we live in. It is a pleasure to thank everyone involved in making the ESO dream come true: to the ESO staff for their professionalism, ingenuity and passion, to Council and Committee members and the former Directors General for leading the observatory to new heights in astronomy. And to the public, educators and media who on a daily basis take part in ESO's discoveries.

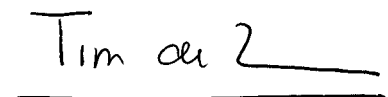
The year 2012 is also a time to congratulate all our Member States. The five founding members have been joined by Denmark (1967), Switzerland (1982), Italy (1982), Portugal (2001), the United Kingdom (2002), Finland (2004), Spain (2007), the Czech Republic (2007), Austria (2009), and Brazil, who will become the 15th, as well as the first non-European, Member State after parliamentary ratification of the Accession Agreement signed in December 2010. The Member States have adhered to ESO's courageous plans to lead ground-based astronomy, and offer us constant support and top-level people. Together these 15 countries contain approximately 30% of the world's astronomers,

and by now ESO is the most productive ground-based observatory in the world supplying data for more than 750 scientific papers per year.

The scientific community is to be congratulated for keeping astronomy at the forefront of scientific research, as well as our supporters and international partners for believing in our ambitious projects. ESO owes its success in a large part to these collaborations!

I now invite you to experience *Awesome Universe — the Cosmos through the eyes of the European Southern Observatory* — a series of public exhibitions celebrating 50 years of Europe's quest to explore the southern sky. It is presented internationally, in cooperation with ESO's partners in Europe and around the world. Visitors will discover these visually stunning images, showcasing celestial objects such as galaxies, nebulae, and star clusters as seen by ESO's observatories, as well as beautiful images of the observatories themselves, which are located in some of the most unusual places on Earth.

Welcome to the world of ESO!



Tim de Zeeuw
ESO Director General
Garching, June 2012



The E-ELT

Artist's impression of the European Extremely Large Telescope (E-ELT). The E-ELT will be the largest optical/infrared telescope in the world — the world's biggest eye on the sky.





Panoramic View of the Carina Nebula



A spectacular image from ESO's Wide Field Imager instrument on the MPG/ESO 2.2-metre telescope at the La Silla Observatory shows a part of the Carina Nebula. The image reveals exquisite details in the stars and dust of the region. Several

well known astronomical objects can be seen in this wide field image: to the bottom left of the image is one of the most impressive binary stars in the Milky Way, Eta Carinae, with the famous Keyhole Nebula just adjacent to the star.



The Helix Nebula

A colour-composite image of the Helix Nebula created from images obtained by the Wide Field Imager, an astronomical camera attached to the MPG/ESO 2.2-metre telescope at the La Silla Observatory in Chile. The blue-green glow in the centre of the Helix comes from oxygen atoms shining due to the intense ultraviolet radiation from the 120 000 degree Celsius central star. Further out from the star and beyond the ring of knots, the red colour from hydrogen and nitrogen is more prominent.

Paranal Observatory and the Volcano Lullaillo

A marvellous day to take aerial photographs. The Paranal Observatory lies only 12 kilometres away from the Pacific coast at an altitude of 2600 metres, whereas the snow-capped volcano Lullaillo, at an altitude of 6720 metres, rises some 190 kilometres further east on the Argentine border.







The Omega Nebula and its Hot Young Stars

ESO's 3.58-metre New Technology Telescope at the La Silla Observatory in Chile took the data for this composite image of the Omega Nebula (Messier 17, or NGC 6618). Located about 5500 light-years from Earth and extending over 15 light-years, the Omega Nebula is in the constellation of Sagittarius. The gas and dust of the nebula are lit from within by young, hot stars embedded in the cloud.

ESO's VLT Reveals the Carina Nebula's Hidden Secrets

This broad panorama of the Carina Nebula, a region of massive star formation in the southern skies, was taken in infrared light using the HAWK-I camera on ESO's Very Large Telescope. Many previously hidden features, scattered across a spectacular celestial landscape of gas, dust and young stars, have emerged.







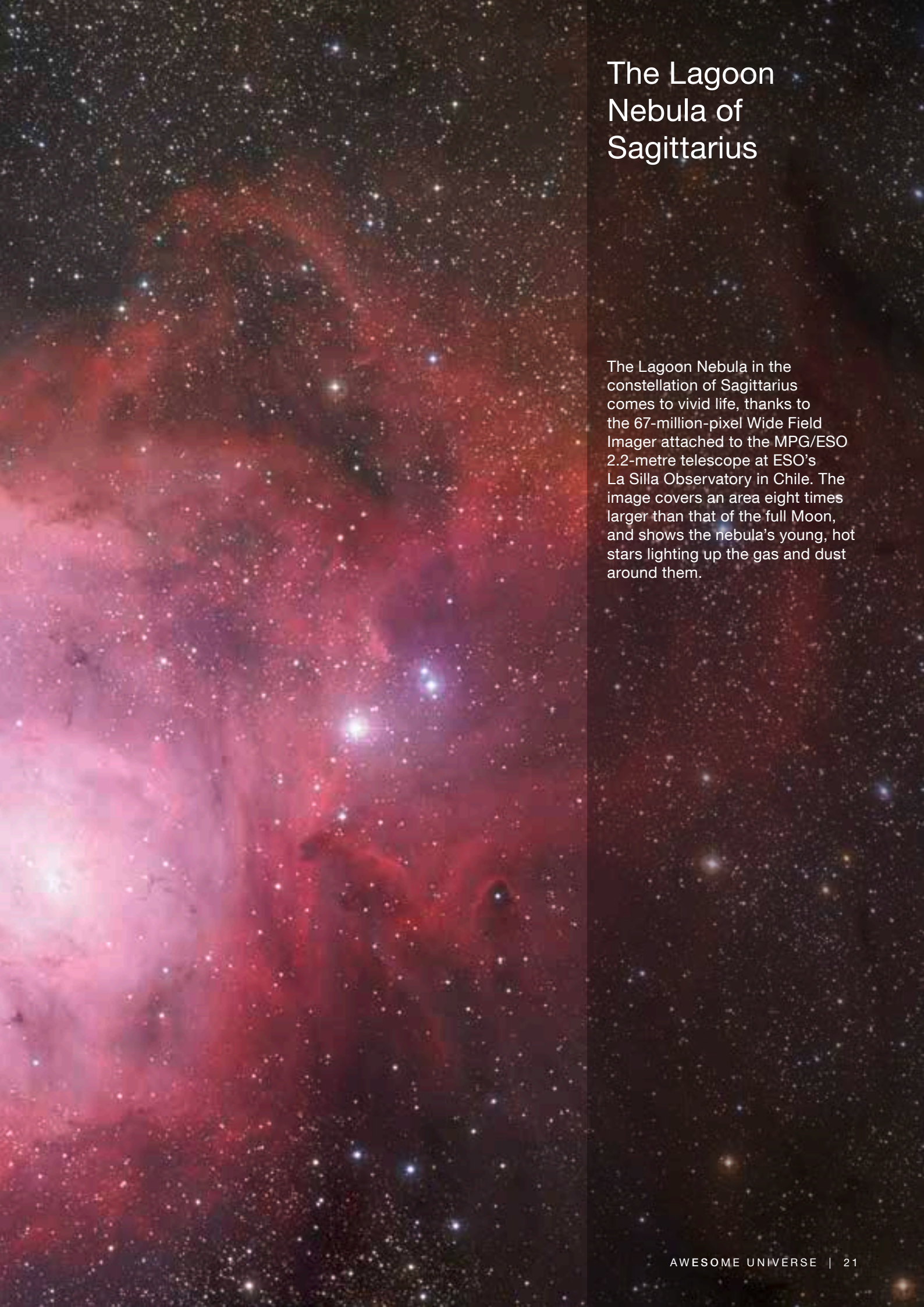
APEX Stands Sentry on Chajnantor



The Atacama Pathfinder Experiment (APEX) telescope looks skyward during a bright, moonlit night on , one of the highest and driest observatory sites in the world. The beautiful sky is a testament to the excellent conditions offered

by this site, which is also home to the ALMA observatory. On the left shine the stars in the tail of the constellation Scorpius (The Scorpion). In the centre, Sagittarius (The Archer) looms over APEX's dish.





The Lagoon Nebula of Sagittarius

The Lagoon Nebula in the constellation of Sagittarius comes to vivid life, thanks to the 67-million-pixel Wide Field Imager attached to the MPG/ESO 2.2-metre telescope at ESO's La Silla Observatory in Chile. The image covers an area eight times larger than that of the full Moon, and shows the nebula's young, hot stars lighting up the gas and dust around them.

The VLT in Action

The ESO Very Large Telescope during observations. In this picture, taken at twilight, the four giant 8.2-metre Unit Telescopes (UTs) are visible. From left to right, their names in the Mapuche language are Antu, Kueyen, Melipal and Yepun. A laser beam launched from UT4 (Yepun) creates an artificial guide star in the Earth's atmosphere, which allows astronomers to remove the effects of atmospheric turbulence, producing images almost as sharp as if the telescope were in space.







ESO Headquarters at Sunset



This panoramic photograph shows the European Southern Observatory's Headquarters in Garching, near Munich, Germany. The image shows the view from the roof of the main building just after sunset. This is the scientific, technical and administrative centre for ESO's

operations, and the base from which many astronomers conduct their research. The scientists, technicians and administrators who work here come from many different backgrounds, but all have one thing in common: a passion for astronomy.

VISTA's Infrared View of the Cat's Paw Nebula

This infrared image from the VISTA survey telescope depicts the vast star formation region of the Cat's Paw Nebula, 50 light-years across. It is one of the most active nurseries of young, massive stars in our galaxy, some nearly ten times the mass of the Sun and most born in the last few million years.







La Silla Soon after Sunset

The splendours of the southern sky can truly be appreciated from La Silla, ESO's first observatory site. The band of the Milky Way, including the central region of our galaxy, stretches across the sky with a myriad of stars crossed by dark lanes of dust. The MPG/ESO 2.2-metre telescope is seen in the foreground.

Fine Shades of a Sombrero

The famous early-type spiral galaxy Messier 104, which is widely known as the Sombrero (the Mexican hat) because of its particular shape. The Sombrero is located in the constellation of Virgo, the Virgin, at a distance of about 50 million light-years.



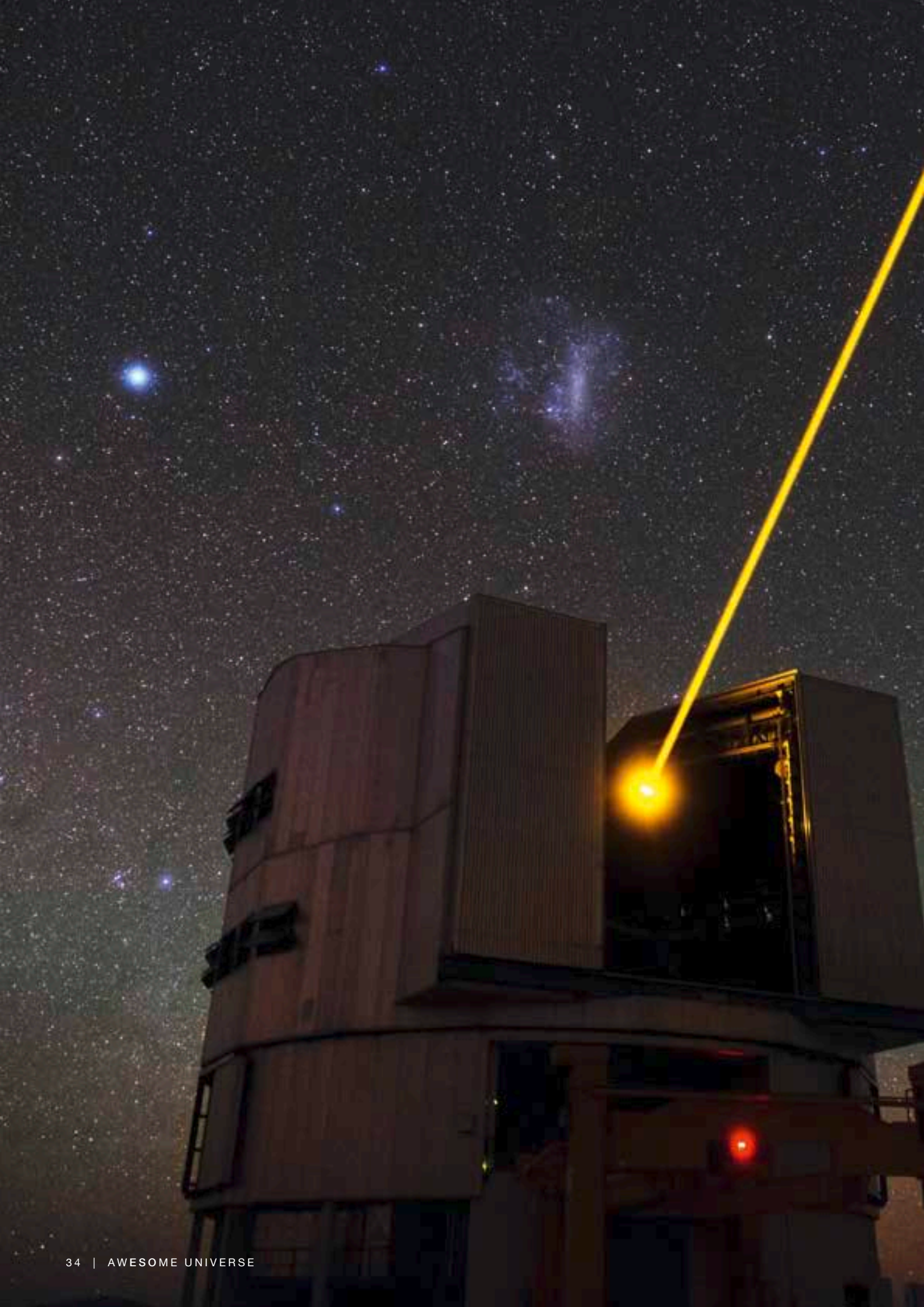


Starry La Silla



The stars rotate around the southern celestial pole during a night at ESO's La Silla Observatory in northern Chile. The dome in the foreground of the image hosts ESO's 3.6-metre telescope, home to HARPS, the world's foremost exoplanet hunter. The rectangular building seen in the lower right contains the 0.25-metre TAROT telescope, designed to react very quickly when a gamma-ray burst is detected.







Yepun's Laser and the Magellanic Clouds

A yellow laser beam is launched from Yepun, one of the four 8.2-metre Unit Telescopes (UTs) of the ESO Very Large Telescope (VLT) located in ESO's Cerro Paranal Observatory, Chile. The laser is aimed to create an artificial star at an altitude of 90 kilometres in the Earth's mesosphere. This Laser Guide Star (LGS) is part of the VLT's Adaptive Optics system, which allows astronomers to correct the blurry effects produced by the atmospheric turbulence, producing images almost as sharp as if the telescope were in space. Glowing brightly in the sky, the Large and Small Magellanic Clouds can be seen. These nearby irregular dwarf galaxies are conspicuous objects in the southern hemisphere. They are truly a joy to behold, even with the naked eye.

Spiral Galaxy NGC 1232

This image of the large spiral galaxy NGC 1232 combines three exposures in ultraviolet, blue and red light at ESO's Very Large Telescope in Chile. The central part of the image shows older, reddish stars, while the spiral arms have more young blue stars. A small companion galaxy is visible on the left. NGC 1232 is located around 70 million light-years from Earth in the constellation of Eridanus (The River).





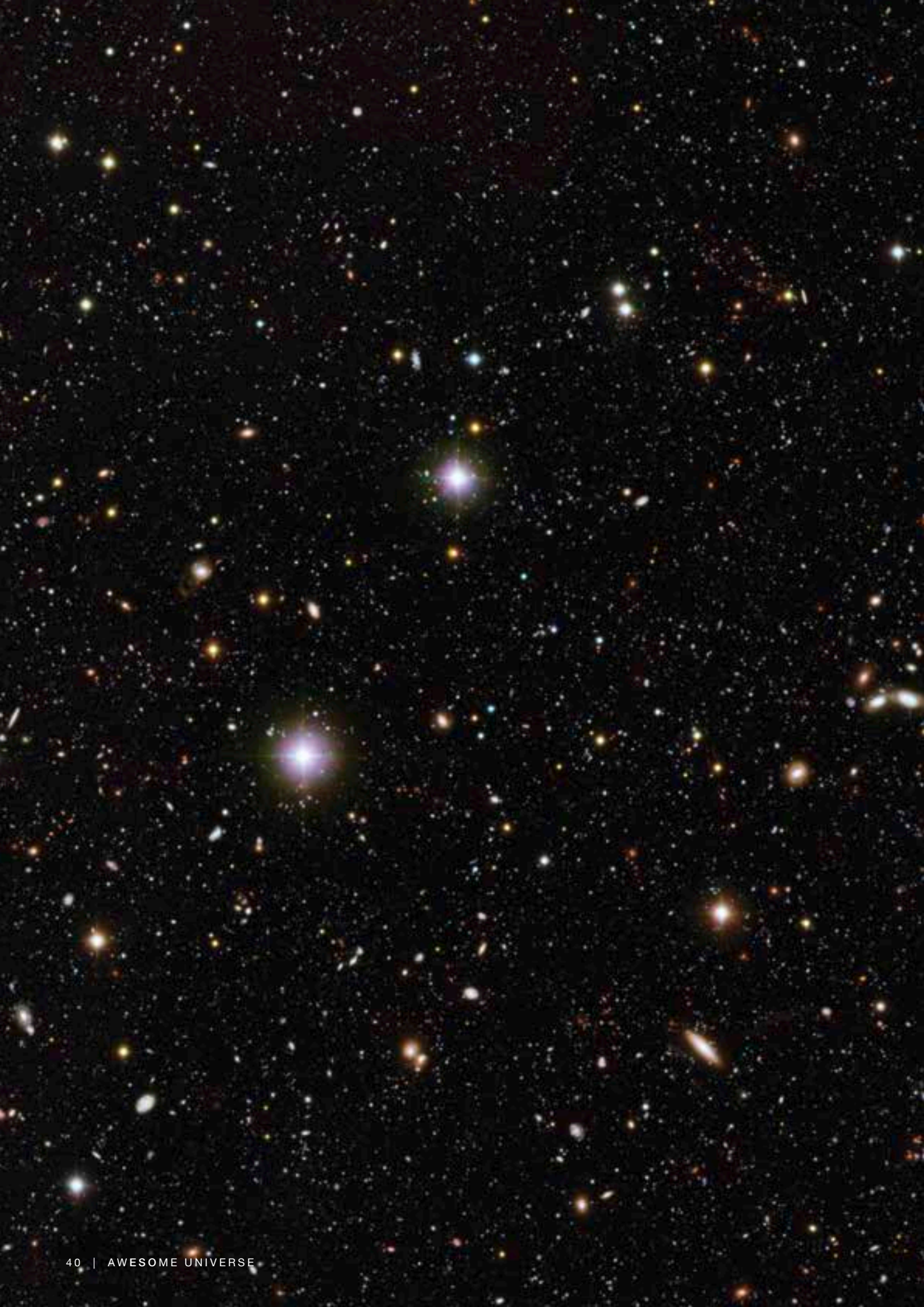


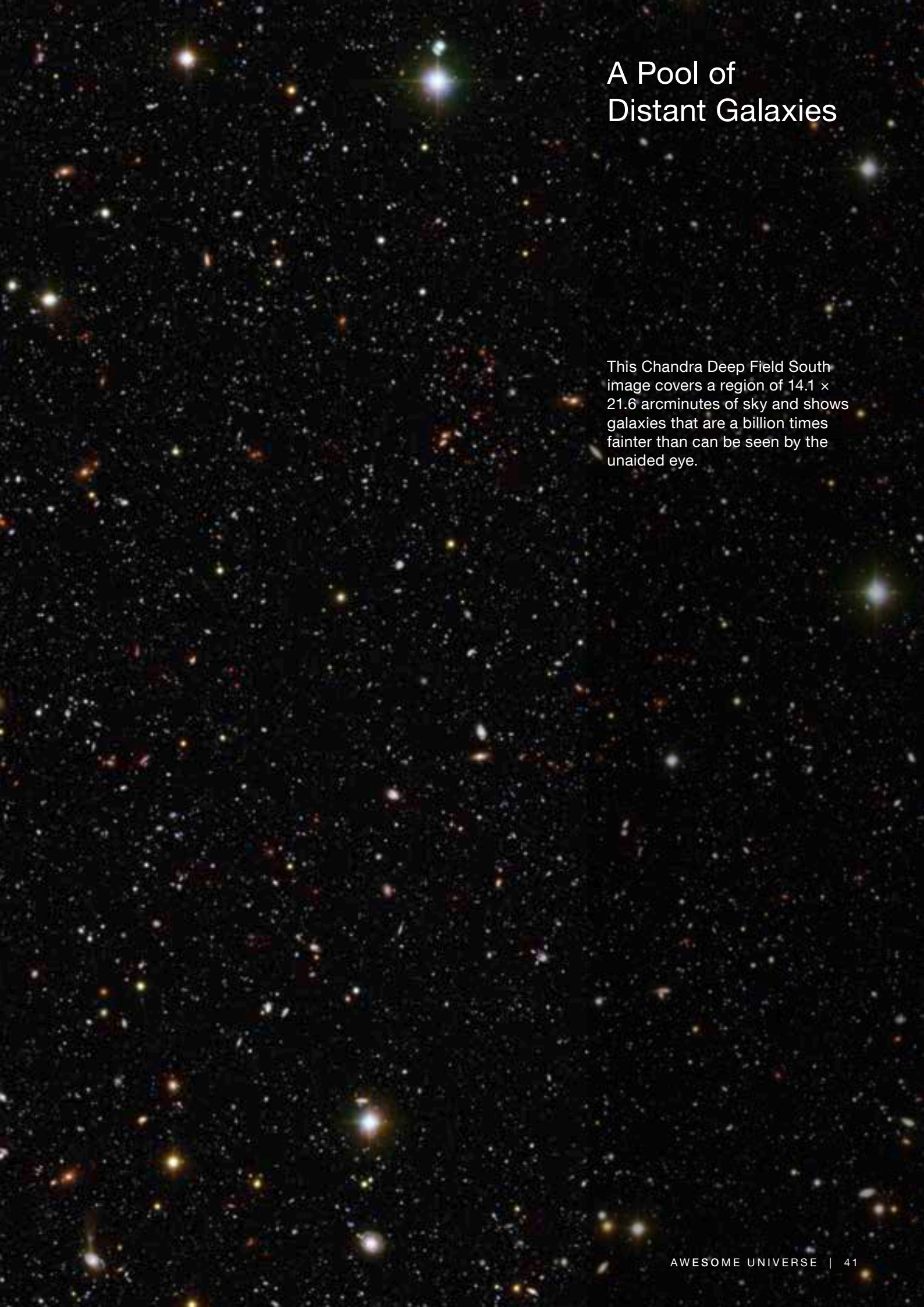
ALMA at Night



This panoramic view of the Chajnantor Plateau shows the antennas of the Atacama Large Millimeter/submillimeter Array (ALMA) ranged across the unearthly landscape, working as one giant

telescope. In the sky above the antennas the planet Jupiter shines brightly on the left, while our neighbouring galaxies the Large and Small Magellanic Clouds appear as smudges of light on the right.





A Pool of Distant Galaxies

This Chandra Deep Field South image covers a region of 14.1×21.6 arcminutes of sky and shows galaxies that are a billion times fainter than can be seen by the unaided eye.






VST Image of the Star-forming Region Messier 17

The spectacular star-forming region Messier 17, also known as the Omega Nebula or the Swan Nebula, as seen by the VLT Survey Telescope (VST). This vast region of gas, dust and hot young stars lies in the heart of the Milky Way in the constellation of Sagittarius (The Archer). The VST field of view is so large that the entire nebula, including its fainter outer parts, is captured — and retains its superb sharpness across the entire image.





NGC 2264 and the Christmas Tree Cluster

This colour image of the region known as NGC 2264 — an area of sky that includes the sparkling blue baubles of the Christmas Tree star cluster — was created from data obtained by the Wide Field Imager at ESO's La Silla Observatory. The image shows a region of space about 30 light-years across.



Another Perfect
Day at Paranal



Rolling red hills stretch out below the exceptionally clear blue sky that is typical of ESO's Paranal Observatory. The flattened mountaintop of Cerro Paranal is home to the ESO Very Large Telescope, the world's most

advanced ground-based optical and near infrared astronomical facility. To the right, the sea of clouds that typically covers the coast of the Pacific Ocean — only 12 kilometres away — is visible in the background.

The Eagle Nebula and the Pillars of Creation

A mosaic image of the Eagle Nebula (Messier 16, or NGC 6611), based on images from the Wide Field Imager camera on the MPG/ESO 2.2-metre telescope at ESO's La Silla Observatory in Chile. At the centre, the star-forming region known as the Pillars of Creation is visible. The Spire, another large pillar of gas and dust, is in the middle left of the image.









Stars are Born in the Dust-banded Trifid Nebula

The Trifid Nebula, a large star-forming region in Sagittarius, is so named for the dark dust bands that trisect its glowing heart. The Trifid Nebula is a rare combination of three nebula types that reveal both newly formed stars and hint at future star birth. This image was captured with the Wide Field Imager camera attached to the MPG/ESO 2.2-metre telescope at ESO's La Silla Observatory in northern Chile.

Icy Penitents by Moonlight

These striking ice and snow formations are known as *penitentes* (Spanish for penitents). Although they look like bizarre sculptures, they are natural marvels created by specific physical conditions in high altitude regions, such as here on the 5000-metre Chajnantor Plateau, the site of the Atacama Large Millimeter/submillimeter Array (ALMA).



The Crab Nebula in Taurus

This image shows the Crab Nebula (also known as Messier 1), as observed with the ESO Very Large Telescope in visible light. The Crab Nebula is the remnant of a supernova explosion at a distance of about 6000 light-years, which was first observed almost 1000 years ago, in the year 1054. It contains a neutron star near its centre, which spins 30 times per second around its axis.







A Lunar Eclipse from Paranal



This panorama shows Cerro Paranal in the Chilean Atacama Desert, home of ESO's Very Large Telescope, during the total lunar eclipse of 21 December 2010. The reddish disc of the Moon is seen on the right, while the Milky Way arches across the heavens.

The glow surrounding the brilliant planet Venus in the bottom left is zodiacal light, produced by sunlight reflecting off dust in the plane of the Solar System. It is so faint that it is normally obscured by moonlight or light pollution.





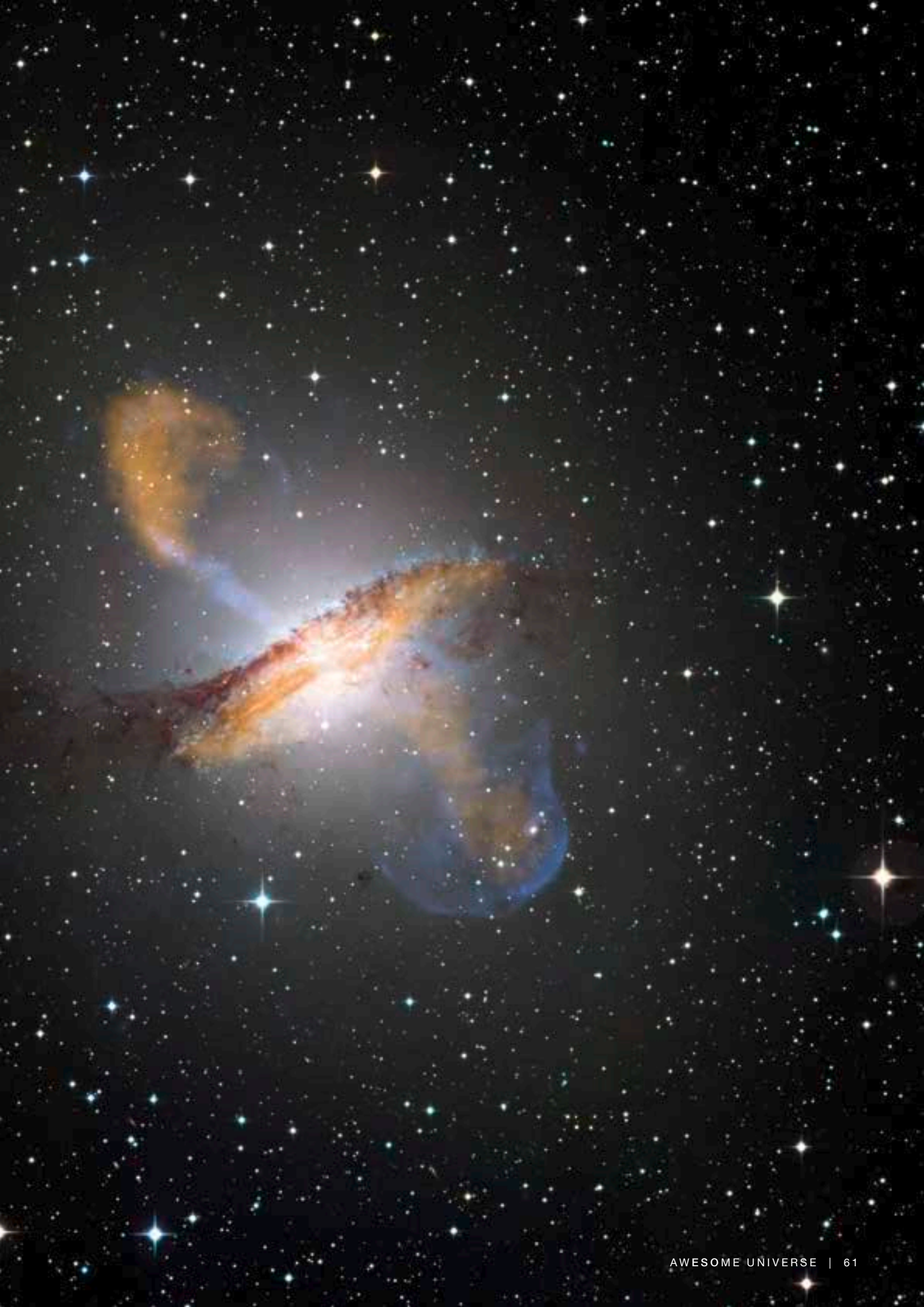
The Horsehead Nebula

This image of the famous Horsehead Nebula in the constellation of Orion, The Hunter, is based on three exposures in the visual part of the spectrum with the FORS2 multimode instrument at the VLT's 8.2-metre Unit Telescope, Kueyen, at Paranal.

Centaurus A

Colour-composite image of Centaurus A, revealing the lobes and jets emanating from the active galaxy's central black hole.







Messier 78: A Reflection Nebula in Orion

This image of the reflection nebula Messier 78 was captured using the Wide Field Imager camera on the MPG/ESO 2.2-metre telescope at the La Silla Observatory, Chile. This colour picture was created from many monochrome exposures taken through blue, yellow/green and red filters, supplemented by exposures through a filter that isolates light from glowing hydrogen gas.



Dark Sky and White Desert

The night sky above Cerro Paranal, the home of ESO's Very Large Telescope, is dark and dotted with the bright stars of the Milky Way, and more distant galaxies. On the ground, a rare layer of white snow is dotted with darker spots of the desert terrain beneath. Cerro Paranal is in the Chilean Atacama Desert, one of the driest places on Earth. Snow, however, does occasionally fall here, providing fleeting but magnificent views such as this one.






Paranal Panorama at Twilight



ESO's Very Large Telescope at the Paranal Observatory in Chile being prepared for a night of observations. The four 8.2-metre Unit Telescopes appear at the centre and right and the four smaller 1.8-metre

Auxiliary Telescopes on the left. The telescope domes are open to allow the air to circulate and help minimise turbulence. Behind the telescope enclosures the final colours of the sunset can be seen in the west.





Dust and Stars Towards the Heart of the Milky Way

A mosaic of images from the VISTA survey telescope looking towards the centre of the Milky Way in the constellation of Sagittarius (The Archer) reveals around one million stars, most of them not seen in visible light pictures. As well as absorbing light, interstellar dust scatters blue light from the more distant stars, which is why the centre of the image looks red.

The Pencil Nebula

This strange and beautiful structure is the Pencil Nebula, NGC 2736, a supernova remnant in the constellation of Vela (The Sails). The glowing filaments were created from material ejected in a supernova explosion that took place about 11 000 years ago. The brightest part resembles a pencil, hence the name, and the whole structure looks a little like a traditional witch's broom. This picture was captured by the Wide Field Imager on the MPG/ESO 2.2-metre telescope at ESO's La Silla Observatory in Chile.









Towards the Milky Way's Centre

A powerful laser beam, part of the laser guide star system, is launched from the VLT's 8.2-metre diameter Yepun telescope. It excites sodium atoms high in the Earth's mesosphere, creating an artificial star at an altitude of 90 kilometres. Seen arching across the starry sky is the Milky Way, our own galaxy, with the yellow bulge of the galactic nucleus crossed by prominent dark lanes of opaque intergalactic dust.

The Globular Cluster Omega Centauri

Omega Centauri, in the constellation of Centaurus (The Centaur), is the largest globular cluster in the sky, but the very wide field of view of the VLT Survey Telescope and its powerful camera OmegaCAM can encompass even the faint outer regions of this spectacular object. This view includes about 300 000 stars, and may be the best portrait of the cluster ever made.







ALMA and the Southern Milky Way

The antennas of the Atacama Large Millimeter/submillimeter Array (ALMA), set against the splendour of the Milky Way. The richness of the sky in this picture attests to the unsurpassed conditions for astronomy on the 5000-metre-high Chajnantor Plateau, in Chile's Atacama region.

N44 in the Large Magellanic Cloud

Southern part of the spectacular N44 region in the Large Magellanic Cloud, one of the Milky Way's nearest galactic neighbours. The green colour indicates the hottest areas. The field measures 27.5×26.5 arcminutes.









Portrait of a Dramatic Stellar Nursery

The Tarantula Nebula glows in the upper centre of the image. Slightly to the lower right, a web of filaments harbours the famous supernova SN 1987A. Many other reddish nebulae are visible in the image, as well as a cluster of young stars on the left, known as NGC 2100.

The Eagle Nebula in Infrared Light

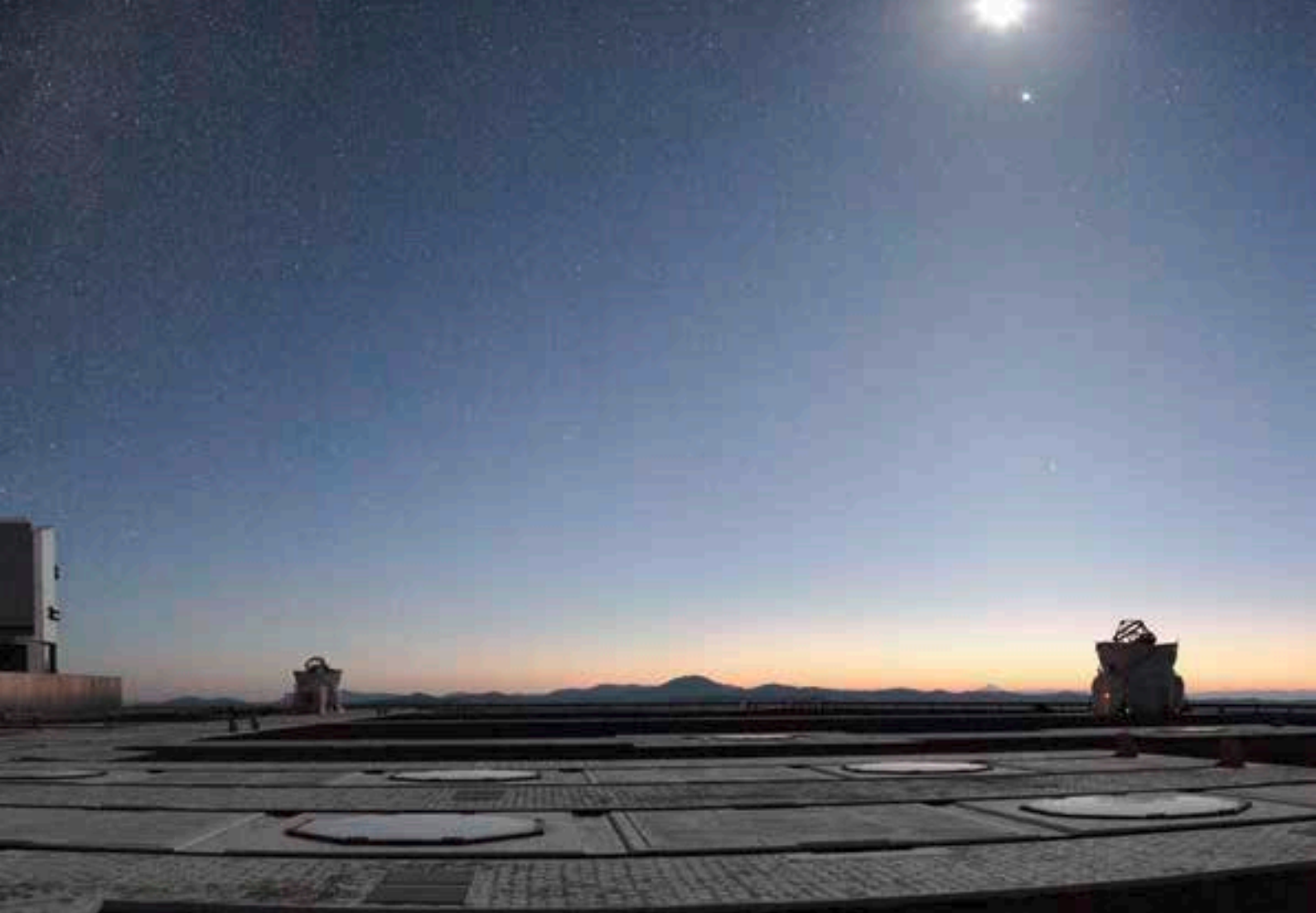
Messier 16 (M16), also known as The Eagle Nebula, imaged by the ESO Very Large Telescope (VLT) in infrared light. The star-forming region known as the Pillars of Creation can be seen in the centre. The vast pillars of cosmic dust and gas are mostly opaque in visible light, but the VLT's infrared observations allow us to peer deeper inside at the newly born stars within.







Early Morning on Paranal



This panorama was taken in the early morning with the Moon still high in the sky, and shows the observing platform of ESO's Very Large Telescope (VLT) on Cerro Paranal in Chile. The VLT's four giant 8.2-metre Unit Telescopes

are all targeting different celestial objects. A laser is fired from Unit Telescope 4, Yepun, creating an artificial guide star to help the adaptive optics system capture very sharp images.

ALMA Observations of the Antennae Galaxies

The Antennae Galaxies are a pair of distorted colliding spiral galaxies about 70 million light-years away. This image combines Atacama Large Millimeter/submillimeter Array (ALMA) observations, made during the observatory's early testing phase, with visible-light observations. While visible light — shown here mainly in blue — picks out the stars in the galaxies, ALMA's observations — shown here in red, pink and yellow — reveal the clouds of dense cold gas from which new stars form.







The Cool Clouds of Carina

Observations made at submillimetre wavelengths with the APEX telescope — shown here in orange tones, combined with a visible-light image — reveal the cold dusty clouds from which stars form in the Carina Nebula. This site of violent star formation, which plays host to some of the highest-mass stars in our galaxy, is an ideal arena in which to study the interactions between these young stars and their parent clouds.





VISTA at Sunset

This spectacular view of the VISTA telescope was taken from the roof of the building during the opening of the enclosure at sunset. The VLT is visible on the neighbouring mountain. VISTA is the largest survey telescope in the world and it is dedicated to mapping the sky at near-infrared wavelengths. Its primary mirror is 4.1 metres in diameter and is the most highly curved of its size. VISTA can map large areas of the sky quickly and deeply.

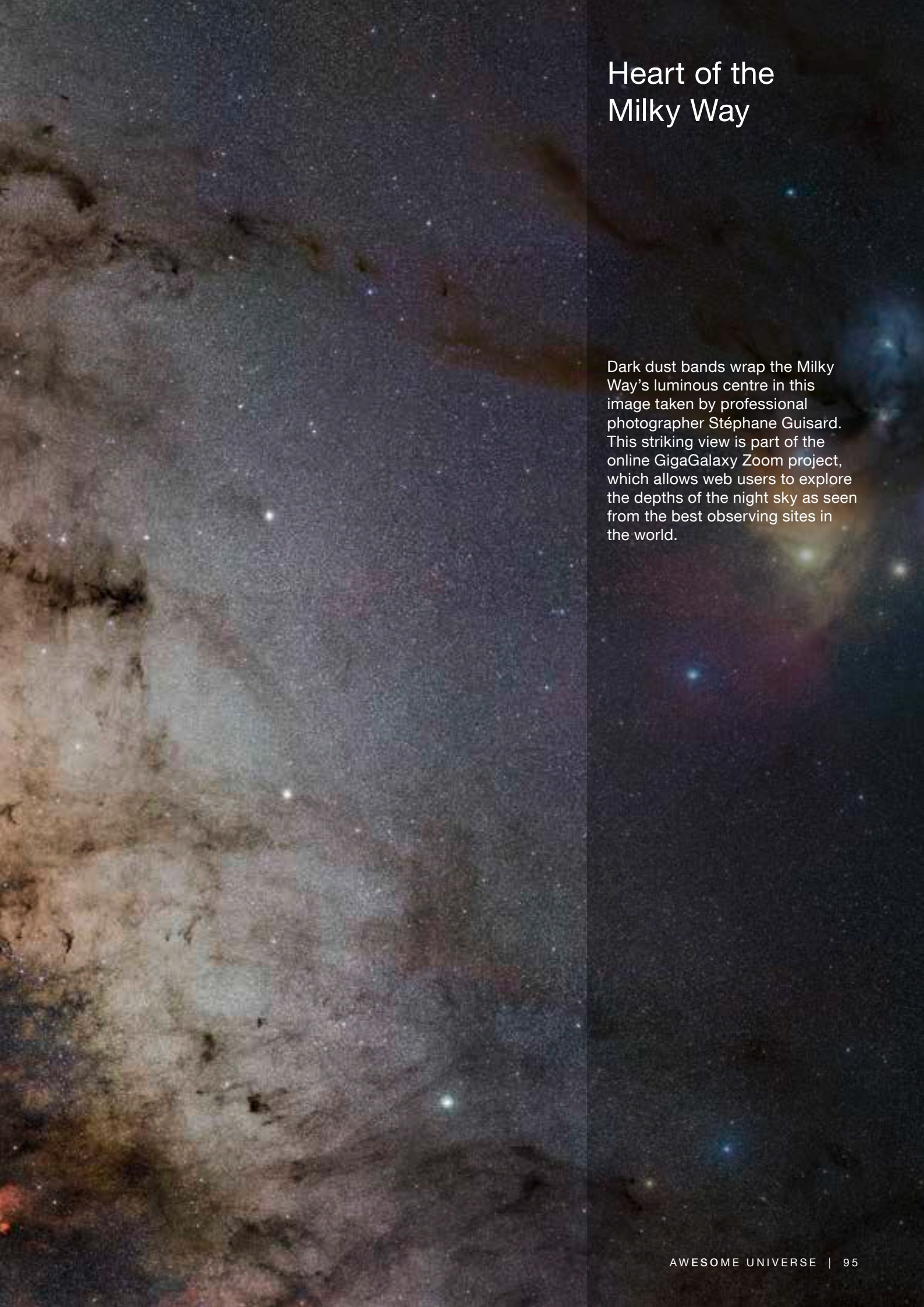
NGC 2467 and Surroundings

Area surrounding the stellar cluster NGC 2467, located in the southern constellation of Puppis, The Stern. With an age of a few million years at most, it is a very active stellar nursery, where new stars are born continuously from large clouds of dust and gas. The bright star at the centre of the largest pink region on the bottom of the image is HD 64315, a massive young star that is helping to shape the structure of the whole region of the nebula.









Heart of the Milky Way

Dark dust bands wrap the Milky Way's luminous centre in this image taken by professional photographer Stéphane Guisard. This striking view is part of the online GigaGalaxy Zoom project, which allows web users to explore the depths of the night sky as seen from the best observing sites in the world.





The R Coronae Australis Region

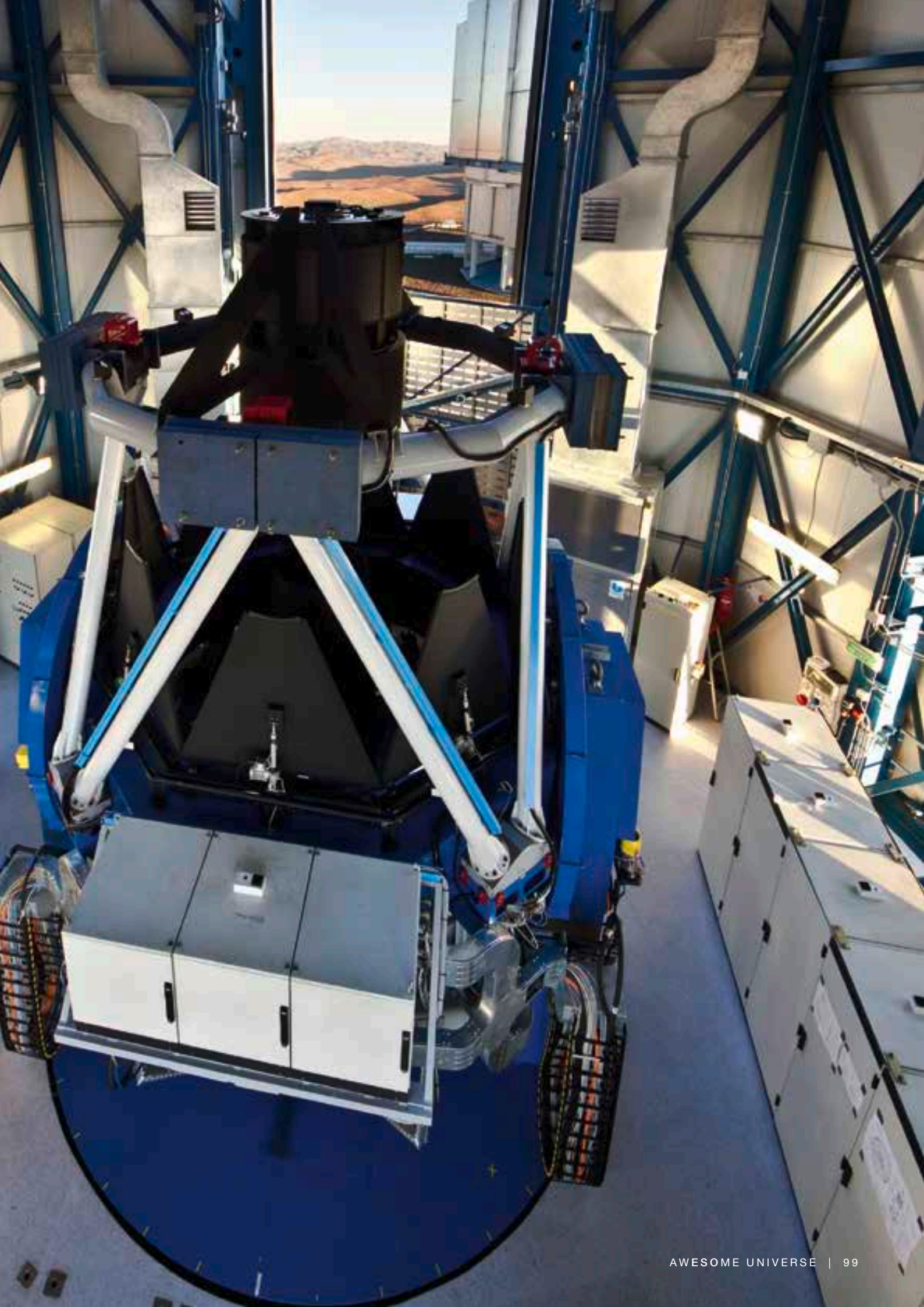
This magnificent view of the region around the star R Coronae Australis was created from images taken with the Wide Field Imager at ESO's

La Silla Observatory in Chile. R Coronae Australis lies in one of the nearest and most spectacular star-forming regions, surrounded by a delicate bluish reflection nebula.

The VLT Survey Telescope

The VLT Survey Telescope (VST) is housed in an enclosure immediately adjacent to the four VLT Unit Telescopes on the summit of Cerro Paranal. The VST is a 2.6-metre wide-field survey telescope with a field of view twice as broad as the full Moon. It is the largest telescope in the world dedicated to sky surveys in visible light.







The Hidden Fires of the Flame Nebula

The first publicly released image from VISTA, the world's largest survey telescope, reveals the Flame Nebula, or NGC 2024, in the constellation of Orion. An area of intense star formation, the core of the nebula is hidden behind obscuring dust, but with VISTA's infrared view, the cluster of young stars at the object's heart is revealed. Also visible are the glow of the reflection nebula NGC 2023, just below centre, and the ghostly outline of the Horsehead Nebula to the lower right.

La Silla from Base to Summit

A view of the La Silla mountain from base to summit. La Silla Observatory, ESO's first observatory site, can be seen on the summit. At the foot of La Silla is Camp Pelicano, in the narrow valley Quebrada Pelicano. The small oasis seen here provides the observatory's water. ESO installed its original base camp in Pelicano in the mid-1960s.







VISTA's Infrared View of the Orion Nebula

A wide-field view of the star-forming region in the Orion Nebula, lying about 1400 light-years from Earth, taken with the VISTA infrared survey telescope at ESO's Paranal Observatory in Chile. The telescope's huge field of view allows the whole nebula and its surroundings to be imaged in a single picture. VISTA's infrared vision means that it can peer deep into the normally hidden dusty regions and reveal the young stars buried there.

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