

HIDDEN UNIVERSE

A 3D Documentary Adventure for IMAX[®] Theatres and Giant-Screen Cinemas

An extraordinary journey into deep space, the documentary adventure *Hidden Universe* brings to life the farthest reaches of our universe with unprecedented clarity through real images captured by the world's most powerful telescopes—seen on-screen and in 3D for the first time.

Stunning, high-resolution 3D images of space allow moviegoers to peer deep inside the earliest galaxies and nebulae, watch stars being born in vivid clouds of gas and dust, tour the surface terrain of Mars, and witness images of distant celestial structures including awe-inspiring views of the Sun. Seen for the first time in IMAX 3D, these dramatic new images offer fresh insight into the origins and evolution of the universe.

Narrated by Golden Globe winner Miranda Richardson, *Hidden Universe* is a December Cinema Productions film produced in association with Film Victoria, Swinburne University of Technology, and the European Southern Observatory (ESO). Executive produced by Emmy[®]-award-winning producer Tony Wright. Produced in association with MacGillivray Freeman Films. Produced by Stephen Amezdroz and written and directed by Russell Scott. The film features a musical score by Dale Cornelius.

December Cinema Productions is a division of December Media, one of Australia's most experienced producers of award-winning live action and documentary television. With more than 20 years of experience, the company is known for its high-quality dramas, documentaries and series made for Australian and international markets. *Hidden Universe* is the company's first film for IMAX theatres and follows in its long tradition of making screen-based entertainment that excites and inspires.

www.hiddenuniversemovie.com

About the Production

Destination: The Farthest Reaches of Our Universe

Since the beginning of humanity, people have turned their eyes toward the sky with a series of profound questions: how did the universe come to exist? How does it change and evolve? What is the probability of other life out there?

Today's top astronomers are exploring the deepest reaches of the universe in search of answers—and they are using the world's newest, most powerful telescopes capable of seeing back in time to the formation of the earliest galaxies more than 13 billion light years away.

Now, their work is being brought to life on the giant screen in *Hidden Universe*, a new 3D documentary adventure for IMAX theatres and giant-screen cinemas produced by award-winning Australian filmmaker December Media in association with Film Victoria, Swinburne University of Technology, European Southern Observatory (ESO) and MacGillivray Freeman Films.

“We've made a film about what lies within the gaze of this new generation of telescopes—telescopes so powerful they can locate images in space equivalent to distinguishing the headlights of a car on the surface of the moon,” said producer Stephen Amezdroz, a longtime documentary filmmaker. “This new technology is allowing scientists to peer back even further into space, revealing secrets about the cosmos that until recently were completely hidden from view and inspiring new theories about how the universe was formed.”

More than two years in the making, *Hidden Universe* features spectacular space imagery captured by state-of-the-art telescopes such as the Very Large Telescope (VLT) and the ALMA telescope, which represent the very latest advances in astronomy, as well as other telescopes like the NASA/ESA Hubble Space Telescope. Viewers will peer deep into the earliest galaxies, watch stars being born inside vivid clouds of gas and dust, witness two galaxies colliding, tour the detailed surface of Mars, and see images of distant celestial structures including stunning new views of the sun—seen on-screen and in 3D for the first time.

Viewers will also meet two astronomers—Dr. Jonathan Whitmore and Dr. Gregory Poole—as they examine space images from these powerful telescopes, and work to further human knowledge of the universe.

But in order to bring these images to the giant screen, the filmmakers had to tackle a daunting challenge: how to turn the 2D images captured by the telescopes into IMAX-quality 3D images? The answer required the expertise and new technology from the scientists and engineers at Swinburne University of Technology's Centre for Astrophysics and Super-computing located in Melbourne. There, *Hidden Universe* writer and director Russell Scott, a master of capturing complex space phenomena in stunning 3D imagery, spent two years in R&D to create proprietary CGI techniques and software just for the film. Though this is the first giant-screen film Scott has helmed, he earned his chops at the bleeding edge of 3D CGI animation, directing and animating space films at Swinburne 3D Productions.

"We started with the highest resolution 2D images obtained from the telescopes, then used real scientific data provided by astronomers to re-master them as fantastic IMAX-resolution 3D images," explained Scott. "None of the simulations are make-believe. Every image is based on real data, be it Mars, a nebula, the sun, or a galaxy."

The result is an intergalactic journey through the farthest reaches of the universe, in spectacular IMAX 3D.

When asked about his favorite part of the film, Scott said, "I love the Mars scenes. We fly over landscapes of Mars mapped in 10-inch resolution – in such detail they almost look earthlike, with their towering mountains, deep canyons and valleys, and clear signs of ancient lakes and rivers. When you see what the scientists have captured, and what Mars really looks like, it's a pretty mind-blowing experience."

For the Mars sequences, photographs from the Mars Reconnaissance Orbiter's HiRISE space camera were used. The highest-resolution photos of any planetary exploration mission yet obtained, these photographs were mapped onto detailed height data of the actual Martian surface to create 3D visuals of the red planet.

"You're seeing a real image, on a real height map, based on the real contours of Mars," said Scott. "It's all real. This is not Hollywood dreaming."

Continues Scott, "One of the things you realize from the pictures is that it's a red planet, but it's not just mono-color. There are many types of materials and minerals there, much like on Earth, and there are different colors of rock on Mars. Much of the variation is from water flowing down the surface. We don't know, but that's one of the big mysteries with Mars: when was the last time water flowed properly on the surface?"

In making this film, the filmmakers became like scientists themselves, working hard to bring these great questions posed by astronomers to life with compelling imagery, and at the same time acting as a bridge of inspiration and entertainment between the scientific community and a broad audience of moviegoers.

“In making a film you are educating yourself, giving yourself new life experiences, as well as translating those to audiences,” said Amezdroz. “The things we choose are the ones we have an inherent fascination with, so we’re pretty much the audience ourselves when we go out there to make a film like this.”

Exploring Space—Adventures on Terra Firma

While the film is an exploration of the outer reaches of the universe, making the film was an adventure right here on terra firma. To bring *Hidden Universe*’s story of frontier science to life, the filmmakers traveled to remote parts of Chile, Australia, and astronomical laboratories on two continents to capture stunning depictions of deep space phenomena, and otherworldly landscapes here on Earth.

To get the best view of space, the telescopes featured in *Hidden Universe*—the VLT and ALMA telescopes—are positioned in an extreme environment, as high as 16,400 feet in Chile’s remote Atacama Desert. The austere, moon-like landscape provides ideal conditions to see deep into space because there is less atmosphere at altitude, the sky is almost always clear due to the extremely dry climate, and it is so remote there is no light pollution at all. Typically when shooting things barely visible to the human eye in the night sky, filmmakers would rely on a software app that tells them where the stars will be as they rise and set throughout the night. Not here.

“In Chile, the sky is so dark and so clear, you can actually see the shot you are going to take in the night sky. The stars are so bright, you can see your shadow cast by the Milky Way,” said director Russell Scott.

While this presents a unique set of observational advantages, astronomers working there face the challenges of high altitude, arctic cold, and isolation as they work. It’s a place where IMAX[®] cameras have never gone. Until now.

To capture a sense of the remote setting—and find the perfect place to film the Atacama’s austere, rocky, mountainous landscapes that are not unlike what you would find on the moon, Mars or other planets—Amezdroz first had to scout the location.

After following a vehicle to a spot in the desert known only by the locals, then striking off in his 4WD for another 30 miles with no roads at all, Amezdroz found himself truly alone. Without a satellite phone, at 16,000 feet, in an area that still had land mines from a 1970’s border dispute between Chile and Bolivia, he found the location for their shoot: a breathtaking landscape for time-lapse sequences of stars rising and setting behind other-worldly rock formations called the Cathedrals, silhouetted against the night sky.

As he looked around, he watched his step.

“We took a leaf out of Greg MacGillivray’s playbook in finding that location,” chuckles Amezdroz, referring to the two-time Oscar[®]-nominated, pioneering IMAX filmmaker from MacGillivray Freeman Films, who consulted on the film. “I suppose you’re really led by your own fear; you go as far as you think humanly possible, with the idea of bringing an audience to a location they would never otherwise experience. That’s the essence of IMAX, pushing out further than anyone would normally do.”

Adds Scott, “The Atacama is one of the most amazing places in the world. When the wind doesn’t blow it’s deathly silent; you can only hear yourself. It’s just empty. But when the wind blows it’s a howling gale that shapes the rock itself. I would guess maybe a hundred people have visited that place in the entire lifetime of humanity. It’s just so remote and so harsh.”

“There is no phone reception, nothing out there. If anything happens to you no one is going to find you,” said Amezdroz, who is certain these are the only IMAX images the public will ever see of this place.

Even the film stock in the cameras felt the sting of the desert. “The Atacama is the driest desert in the world,” recalls Amezdroz. “It was the second-to-last day in Chile and we had to get our shots. The film in the Solido 3D IMAX camera kept snapping every time we turned the camera on. We couldn’t figure out what was happening. Later at the hotel, one of the guys had a strip of film that had broken near his shower and he saw the whole thing rejuvenate, and go from brittle to supple. So the camera guys made this giant diaper for the film canisters, to keep them moist. It worked like a charm.”

An Eye For The Cosmic: Mind-Blowing Telescopes

At high altitude in Chile's Atacama Desert, the most powerful telescopes in the world provide the best view of space. These telescopes are capable of seeing objects 4 billion times more faint than the human eye can see. They collect and focus light so powerfully they can see things more than 13 billion light years away. This means they are seeing light emitted from objects 13 billion years ago, the youngest of galaxies, just coming into existence, not long after the beginning of the universe itself.

These tools are expanding human knowledge, fundamentally changing the way we see the universe – it's shape and size, the speed at which it is expanding, the speed of light itself, which new research suggests may not be the universal constant we thought it was.

“History has taught us that no matter how well we understand a system - be it a biological system like a person or a physical system like a galaxy - when we look at it in a new or more penetrating way, we see and learn new things,” said astronomer Greg Poole. “It's hard or impossible to say exactly what form these new insights will take - for that is the very nature of scientific discovery - it's impossible to predict.”

The Very Large Telescope (VLT)

Though its name is unimaginative, its observations are astounding: the Very Large Telescope – or VLT – provided the first images of an exoplanet, a planet outside our solar system, and has tracked individual stars orbiting the supermassive black hole at the center of our galaxy. The VLT is the most productive ground-based facility for astronomy, with only the Hubble Space Telescope generating more scientific papers. It is operated by the European Southern Observatory on Cerro Paranal, an 8,530 feet mountain in the Atacama Desert, and is used and maintained by scientists from all over the world, collaborating to further human knowledge.

The VLT actually consists of four Unit Telescopes, which are generally used separately but can be used together, acting as a single telescope 650 feet in diameter, to achieve astonishingly high resolution. The Unit Telescopes each have a light-gathering mirror 27 feet across, representing the upper limit of optical technology; they are so massive they would break under their own weight if they were any bigger.

In addition to optical light, the VLT sees in infrared, which enables astronomers to learn

much more about their subjects. *Hidden Universe* showcases the infrared imaging that exposed a super massive black hole at the center of the nearby galaxy Centaurus A, and through X-Ray imaging, audiences will see jets of plasma a million light years long, shooting out of the black hole at half the speed of light.

The VLT's infrared sensors, while providing valuable data to scientists, presented challenges to the filmmakers. They had to work quickly inside these massive telescopes, and only got one take for many of their shots because they are so sensitive that body heat can distort their readings.

The Earth's atmosphere also distorts signals coming in from space, especially weak light from extremely distant stars and galaxies. To counter this, the VLT shoots lasers 60 miles up into the sky, creating a fake star, a fixed point, by which to calibrate for the distortion of the atmosphere. In one amazing scene in *Hidden Universe* called the "Celestial Dance," lasers shoot from the top of the VLT at irregular intervals during a time-lapse sequence showing the VLT's four telescopes moving in concert as they track specific stars rotating through the night sky.

The ALMA Telescope

At an altitude almost twice as high as the VLT, at 16,400 feet on the Chajnantor Plateau, the Atacama Large Millimeter Array, or ALMA, is a collection of 66 radio telescopes, the largest astronomical project in existence.

ALMA does not detect optical light; the group of 66 giant, 39-foot to 23-foot diameter antennas looks for radio signals from outer space. Each weighs 100 tons – they are so massive they must be built at a lower altitude and transported to the Chanjantor Plateau on a huge, remote-controlled flatbed truck called Otto. The antennas operate together as one giant telescope, to provide images up to ten times sharper than the Hubble. To do so, the 66 antennas and peripheral electronics must be synchronized to within one millionth of a millionth of a second.

As seen in *Hidden Universe*, the signals ALMA detects come from vast clouds of gas and dust in interstellar space, at temperatures only a few degrees above absolute zero (-459 F) in some of the earliest and most distant galaxies in the Universe. The temperature and composition of these regions tells us if new stars are being born there. These clouds are often dark in visible light, but they shine brightly in the part of the spectrum ALMA sees, providing scientists with a new way of seeing the cosmos.

Celestial Matter: An Intergalactic Recipe for Life

When the Hubble Space Telescope trained its eye on what was thought to be an empty patch of sky and took a long exposure image, the results were astonishing. Astronomers discovered the Hubble Ultra Deep Field, which revealed that the empty patch actually held ten thousand galaxies – with billions of stars each. As a result, our understanding of how galaxies evolve was deepened. In *Hidden Universe*, viewers get a glimpse of the Hubble Ultra Deep Field in 3D, on the giant screen, giving a new perspective on the enormity of the universe.

The telescopes being used by today’s astronomers reveal not only how vast the universe actually is, but also that the basic elements of life on Earth are present in countless other places in the universe.

Infrared imaging featured in *Hidden Universe* has enabled astronomers to peer deep inside the interior of massive dust clouds in star-forming nebulae, where optical light doesn’t penetrate. These stars, often made of hydrogen and helium, constantly undergo nuclear fusion—they’re massive factories for the more complex elements needed for planets, and life.

“We’ve found the birthplace of stars, around which any planet with the possibility of hosting life, must revolve,” said Amezdroz. “Here we’ve found carbon, hydrogen, oxygen – the basic elements that are the building blocks of literally everything in the universe, including every cell in our bodies. And we’ve found that planets revolving around stars outside our solar system are far more numerous than previously known; the ingredients for life on Earth are present in countless locations throughout our universe.”

“All the forces out there are the same as here on Earth. Every element you find on Earth, you find in space. So when you think of the processes that formed life on Earth, they’re the same processes happening in billions and billions of galaxies in the universe,” said Scott.

“The real question is, what’s the possibility there is not life out there?” said Amezdroz. “With the space images seen in *Hidden Universe*, you’re not seeing something that is alien, you’re seeing something we are deeply connected to. In the film we aim to show that everything is interconnected. We come from space. Everything we are, every single piece of us, was made possible by the stars. There’s no boundary.”

A Score that Makes Space Feel Inviting

The score for *Hidden Universe* is awe-inspiring like the film's subject, and as human as its viewers. Composer Dale Cornelius, whose career of composing scores for film and TV spans 20 years, has been described as having an ability to evoke an immediate emotional connection with an audience through music. His aural accompaniment to the incredible views of deep space seen in *Hidden Universe* connotes nothing short of the heavenly.

"The film goes back in time to see some of the earliest galaxies that are twice the age of our own planet. It's quite awe-inspiring and I'd like that element to hit home with the audience, and to reinforce that with the music," said Cornelius.

Cornelius took cues from the film's portrayal of the elemental connection between space and life on Earth. Acoustic arrangements give a warm sense of our home planet while elements of electronica are a nod to the high-tech telescopes and computers used by astronomers to capture otherworldly phenomena seen on screen.

Cornelius also uses vocals as part of the textural elements in the music, "specifically because the human voice gets straight to the core of a lot of emotional things, especially when you're looking at the universe and how we relate to it as human beings."

"When we're in space, we want the audience to look at it not as something foreboding – which in a lot of sci-fi films it is – so we explore space as welcoming, we explore it from a human perspective," said Cornelius, whose scores have been called hauntingly beautiful and truly sublime.

He describes the film's time-lapse scene called the "Celestial Dance," in which the VLT's four telescopes turn in synchronized movement, tracking stars across the night sky. "It is almost like they are dancing with each other and spinning around. That's really cool, especially when the lasers go off. We tried to unleash some energy onto those scenes, rhythmically and otherwise," said Cornelius.

There are also instances where Cornelius' visceral yet meticulously crafted compositions take a backseat to what's happening on screen, but still get the audience's thoughts and emotions immersed in the scene. Cornelius said there may even be portions where there is no music at all, but the audience feels vibrations through the sub woofers.

When asked why he was interested in working on this film, Cornelius quipped, "IMAX!"

He explained: “It doesn’t get any cooler than that, especially for sound or music. After the visuals, they’re a hugely important part of the film. Just like the IMAX screen, the sound in an IMAX theatre is vastly different in its scale. The cinema is laid out like a massive lecture theater, with a big, curved back wall and surround speakers behind you. Because this film is about the universe, and space is such an expansive subject, I want viewers to be completely immersed in what’s happening on screen. We can really use those speakers behind the audience to give them a sense, almost like an underwater scene, of being submerged in the galaxies.”

The Astronomers

Dr. Gregory Poole, (astronomer), is a lecturer at the University of Melbourne, and a two-time recipient of a University of Victoria Fellowship, R.M. Petrie Memorial Fellowship, and the Governor General’s Gold Medal. As a cosmologist, he uses supercomputer simulations and modern statistical methods to understand the nature and evolution of the Universe's largest structures. He has extensive experience in classroom lecturing and public outreach, and has been invited to speak at numerous universities including Stanford and the University of Leiden. He is on the steering committee of the Australian National Institute for Theoretical Astrophysics, and is a member of the WiggleZ Dark Energy Survey of 200,000 galaxies. Poole earned his PhD in astronomy at the University of Victoria, Canada.

Dr. Jonathan Whitmore, (astrophysicist), earned his PhD in physics from University of California, San Diego and is now a Postdoctoral Research Associate in Extragalactic Fundamental Physics at Swinburne University’s Centre for Astrophysics and Supercomputing. He collaborates with astronomers from around the world and is a member of a European Southern Observatory Large Programme, researching whether universal constants, like the speed of light, are actually constant. Whitmore is an expert on spectroscopy, and has developed new algorithms and methods to analyze high precision astronomical data. He has observed at world-class facilities like the Subaru Telescope at the National Astronomical Observatory of Japan, the Keck Telescope at the W. M. Keck Observatory, and the Very Large Telescope at the European Southern Observatory. Whitmore has given numerous talks on astrophysics at conferences and universities including Caltech, UCSD, USC, and Swinburne University.

Narrator—Miranda Richardson

Miranda Richardson is one of the most respected international actresses working today, having won a Golden Globe Award for her performance in the art house hit *Enchanted April* as well as Academy Award and Golden Globe nominations for Best Supporting Actress for her performance in Louis Malle's *Damage* for which she won the BAFTA Award. She received another Academy Award nomination for her work in the biopic of T.S. Eliot, *Tom & Viv*, and two more Golden Globe Awards for her roles in HBO's original movie *Fatherland* and the NBC miniseries *Merlin*. Equally well-regarded in both Hollywood and the British stage, Richardson has delivered decades of stellar performances on both stage and screen. *Hidden Universe* is her first giant-screen documentary for IMAX theatres.

The Filmmakers

Tony Wright (Executive Producer) is an award winning and highly experienced producer in documentary, drama and children's television production. He has worked with the commercial networks, ABC and SBS in Australia, as well as the BBC and Nickelodeon in the UK and other European broadcasters. His credits include *The Doctor Blake Mysteries*, the acclaimed docudrama *Captain Cook: Obsession and Discovery*, the multi award-winning science documentary *Catching Cancer, Australia on Trial, Mrs. Biggs, Nature* and the family-friendly 13-part documentary series *Chris Humfrey's Wild Life*.

Stephen Amezdroz (Producer) has 35 years of experience in high-end documentary series and drama. With a career that started by working on such cult classics as *The Road Warrior* and *Mad Max Beyond Thunderdome*, Amezdroz's long experience and understanding of the international marketplace has enabled him to lead December Media's move into the financing and production of 3D giant-screen films. His credits include *Stories of the Stone Age, Australians at War, The Human Journey, Africa High and Wild, Captain Cook - Obsession & Discovery, The Extraordinary Tale of William Buckley*, and most recently, the television series, *Nature*.

Russell Scott (Writer, Director) earned his chops at the bleeding edge of 3D CGI animation, as lead animator on space films at Swinburne 3D Productions, a leader in high definition 3D animation and visual recreations associated with Swinburne University's Center for Astrophysics and Supercomputing. He later shifted gears to become director at Swinburne 3D Productions, and brings extensive filmmaking knowledge, and a rare combination of analytical and creative skills, to *Hidden Universe's* top tier 3D imagery of awe-inspiring deep space phenomena.

Malcom Ludgate, ACS (Director of Photography) is a world-class cinematographer specializing in underwater cinematography, extreme environments and the IMAX format. He has won more than 60 international cinematography awards and his career has taken him on filming assignments to over 65 countries. Having spent eight months in Antarctica shooting topside and undersea ice in IMAX, he won a Golden Eagle Cine Award for his camera work in *Antarctica*. Since 1985 he has specialized in shooting blue chip documentaries for global broadcasters such as National Geographic, the BBC, and Discovery, including over 25 films on great white sharks. He won the Grand Festival Award Best Documentary, New York Film Festival for *Cuttlefish* in 2008, and the United Nations Media Peace Prize for *Brazilian Rain Forest* in 1989.

Dale Cornelius, (Composer) is an AGSC multi-award nominee and recipient of the 2013 AACTA award for Best Music & Design in a Documentary. He has composed music for internationally acclaimed feature films and television series by BBC, Discovery and National Geographic. He has been described as highly inventive, a truly unique artist, and having an ability to evoke an immediate emotional connection with an audience through music. Cornelius' musical diversity and distinct scores have made him one of Australia's premiere film composers, and he has crafted an extraordinary soundtrack to *Hidden Universe* that reflects both the human aspects of life on earth and the incredible technology used to explore space.

December Media (formerly December Films) is one of Australia's most experienced producers of live action and documentary television. Based in Melbourne, December Media is known for its quality drama, documentaries and series made for Australian and international markets. With more than 20 years of experience in documentary, education, award-winning live action and animated children's television, December Media brings a wealth of development, financing, production and co-production experience as well as having extensive network, distribution and financing relationships across the globe.

Swinburne University of Technology's Center for Astrophysics and Supercomputing is dedicated to inspiring a fascination with the Universe through research and education. The Center's production division, Swinburne 3D Productions, is a leader in scientific film production and high-end space visualizations, combining scientific data with innovative, proprietary techniques in CGI animation and 3D imaging. Specializing in film, interactive content and educational packages, Swinburne has more than 10 years of experience producing stereo-3D films.

Film Victoria, a state agency and strategic partner to the film industry, funds and promotes great original films made in Victoria, Australia, committing over \$7.2 million to local film and television projects last year alone. The agency has secured international and out-of-state productions for Victoria, including *I Frankenstein*, the HBO mini-series *The Pacific*, *Don't Be Afraid of the Dark*, *Where the Wild Things Are*, *Ghost Rider* and *Knowing*.

ESO (European Southern Observatory) is the foremost intergovernmental astronomy organisation in Europe and the world's most productive ground-based astronomical observatory by far. It is supported by 15 countries: Austria, Belgium, Brazil, the Czech Republic, Denmark, France, Finland, Germany, Italy, the Netherlands, Portugal, Spain, Sweden, Switzerland and the United Kingdom. ESO carries out an ambitious program focused on the design, construction and operation of powerful ground-based observing facilities enabling astronomers to make important scientific discoveries. ESO also plays a leading role in promoting and organising cooperation in astronomical research. ESO operates three unique world-class observing sites in Chile: La Silla, Paranal and Chajnantor. At Paranal, ESO operates the Very Large Telescope, the world's most advanced visible-light astronomical observatory and two survey telescopes. VISTA works in the infrared and is the world's largest survey telescope and the VLT Survey Telescope is the largest telescope designed to exclusively survey the skies in visible light. ESO is the European partner of a revolutionary astronomical telescope ALMA, the largest astronomical project in existence. ESO is currently planning the 39-metre European Extremely Large optical/near-infrared Telescope, the E-ELT, which will become "the world's biggest eye on the sky".

MacGillivray Freeman Films is the world's foremost independent producer and distributor of giant-screen films for IMAX theatres, including the Oscar®-nominated films *Dolphins* and *The*

Living Sea, and *Everest*, the highest grossing giant-screen film of all time. For the past forty years, the company's films have been shown in leading institutions around the world, making the company the first documentary filmmaker to reach the \$1 billion box office benchmark. MacGillivray Freeman's films are known for their artistry and successful blend of education and entertainment, as well as their celebration of science and the natural world.