

40
YEARS

Planetarium
Stuttgart



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CULTURAL
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ASTRONOMY



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PLANETARIUMS



40
YEARS

IMPRINT

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Planetarium
Stuttgart



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THE PLANETARIUM

A spaceship? An UFO?
Definitely a loner in the
Mittlere Schlossgarten.





On 22 April 2017 the Carl Zeiss Planetarium Stuttgart will be celebrating its 40th birthday. In the midst of the Stuttgart-Ulm rail construction project, this eye-catching building currently cuts a somewhat lonely figure in the Mittlere Schlossgarten. Since 1977, this part of the city park has been

dominated by the unusual stepped pyramid designed by architect Wilfried Beck-Erlang. The Stuttgart Planetarium has not only made its mark on the city's landscape but also plays an important role in its cultural life. Every year, more than 130,000 visitors set out on a fascinating journey into the depths of the universe.

With the introduction of full-dome projection technology in 2016, the Planetarium is now rated as one of the world's top planetariums.

On the weekend of its 40th anniversary, residents of Stuttgart are warmly invited to come along and experience the Planetarium free of charge. I'm sure everyone, young and old, will enjoy the special programme of short talks and attractions that is on offer.

I hope all the visitors enjoy the birthday celebrations and will have many more star-

filled hours at the Planetarium. And as for the Planetarium's staff, here's hoping the cosmos continues to send them joy and inspiration in their work. Reach for the stars!

DR. FABIAN MAYER

Mayor of General Administrative, Legal and Cultural Affairs





**STARS – EVERY
STAR HAS A STORY**

Excerpt from the show





The Stuttgart Planetarium first opened its doors in April 1977. This proved to be a turbulent year of political and social change and major advances in science and technology. Just the year before, NASA had landed a spacecraft on Mars, and the alignment of the planets made it possible to send a probe to the outer solar system with relative speed. Two Voyager probes were readied for launch to Jupiter and Saturn in the summer of 1977.

Unfortunately the launch of Stuttgart's new planetarium was not without its problems. The planetariums that had sprung up in Germany before the war had proven to be disappointing in terms of comfort, and they were affected by the onset of the global economic crisis.

Many facilities were then destroyed during the war, people were plagued by day to day concerns and there was little interest in rebuilding these in post-war Germany.

Despite this, plenty of people were still interested in astronomy, and they wanted Stuttgart to be home to a planetarium once again.

The new planetarium was finally built thanks to generous donations and the tireless efforts of Stuttgart's Lord Mayor, Arnulf Klett.

Under its first director, Prof. Hans-Ulrich Keller, locals and tourists immediately began flocking to the unusual building with its spectacular projection technology.

The Planetarium's public performances became increasingly diverse. The weekend shows for children were an instant hit, and a special schools programme offered educational events with content that was in line with school curricula.

Despite all this, for many years the Planetarium was run using quite limited technology. The star projector was an electro mechanical marvel but it had its limitations. Images were projected onto the dome and film sequences could only be shown as small inserts within the larger picture. It was only with the introduction of the new

computer-driven Mark IX Universarium computer-controlled projector in 2001 and the powerdome video projection system in 2016 that Stuttgart Planetarium was in a position to offer a full range of scientific, artistic and cultural events.

After 40 years we are in the midst of a full-blown success story. Now we just have to make sure it continues.

DR. UWE LEMMER

Director of the Carl Zeiss Planetarium in Stuttgart





**DISTANT WORLDS –
ALIEN LIFE?**

Excerpt from the show



TELL ME ABOUT THE UNIVERSE!

Planetariums play a key role in bringing astronomy to a wider public. They are first and foremost astronomical institutes that provide information on the latest developments in astronomy. People have always been fascinated by the universe, and today is no exception. Planetariums clearly demonstrate the composition of the universe, how the cosmos was formed and the laws that govern it. Along with presenting the very latest research findings, planetariums also tackle age-old philosophical questions such as:

- How did the world begin?
- Do the physical laws that affect the Earth also apply in space?

- Is there life on other planets?
- Do the moon and planets influence what happens to us?
- Are black holes just science fiction or do they actually exist?

Planetariums also answer more down-to-earth questions, such as:

- Why do we need such big, expensive telescopes?
- Why do we spend billions on international space programmes?
- How does increasing our knowledge of planets, comets, stars and far-off galaxies contribute to society?
- Does the sky in Australia look like ours?

And we soon come to the big, emotive questions that encompass humanity and the whole of nature: Where do we come from – and where are we going?

The aim of planetariums is to transmit knowledge and popularise science. By presenting the latest research, they provide visitors with opportunities to expand their horizons, build their store of knowledge, and tackle the big philosophical questions that help them to make sense of the world.

EMBRACED BY THE UNIVERSE

The planetarium was invented in August 1923, and shortly after the first projector commenced tentative operation under the cupola of the Zeiss factory in Jena, it became clear that planetariums exert an extraordinary appeal that goes far beyond the simple transfer of knowledge.

For many people, when they set foot in the dome they feel they have entered a “temple of science”. Far from the hustle and bustle of daily life and media overload, in a planetarium it is possible to concentrate on oneself and on the upper 180 degrees of our natural environment – the sky. This





effect is perfectly accentuated by an outstanding simulation of the night sky. These days, light pollution makes it increasingly difficult for city dwellers to see the stars.



AN IMPORTANT ELEMENT OF CULTURAL LIFE

Many of the world's major cities view their planetariums as important elements of their cultural life, and their ability to attract tourists is in itself a good reason for providing them with financial assistance. A successful planetarium adds to the "soft factors" that attract tourists to a city. Large planetariums are also status symbols that make cities appear more forward-looking than their rivals. Up-and-coming cities are keen to build state-of-the-art planetariums with sophisticated architecture as a way of improving their image.

TERABYTES OF DATA FROM SPACE

For the first few decades of their history, planetariums used electro-mechanical projectors to produce the simulations. These allowed an accurate simulation of the night sky to be projected onto a dome in order to show the movements of the moon, sun and planets in time-lapse format. At that time it was not possible to produce more advanced effects, such as the feeling of travelling in space.

Discussions on the possibility of building a planetarium in Stuttgart began in the 1970s, a decade when astronomy was making great strides that provided the scientific foundation for our current simulations.

Today, our knowledge of the universe is exploding. Satellite observatories circle the Earth or head out beyond the moon to the sun, from where they send back a steady

"Stuttgart Planetarium has a serious job to do. The star shows in the dome are designed to help people understand their place in the universe and show them the inconceivable vastness of space. So many things that we think are important suddenly fade into insignificance when we see ourselves in relation to the cosmos."

Prof. Hans-Ulrich Keller,
Planetarium Director
1976-2008



stream of new images and data. Space probes are penetrating the furthest reaches of the solar system, landing on planets and collecting material samples from comets and asteroids. The huge memory banks of data centres are brimming with scientific data. The number of scientific publications is increasing every year.

Technology has also been progressing in leaps and bounds over recent decades. Since the mid-1990s, large-scale video projection systems mean that simulations of the universe can be projected onto the dome. The word "immersive" was born, meaning that viewers feel they are right in the middle of the cosmic events. Unlike the dry lectures of popular science, planetariums speak to the brain and emotions in equal measure, without the restriction and isolation of wearing virtual reality goggles.

Millions of people flock to planetariums in Germany every year, drawn by their desire to know more about the complexity of creation and their fascination with nature beyond the narrow confines of our globe.

Every year, 100 million people visit planetariums around the world. The technology of optical illusions is part of the lasting appeal of planetariums.

LIFELONG LEARNING

First encounters with the sun, moon and stars tend to happen before children reach school age, and they often involve attending a children's show at a planetarium. These early encounters can shape the rest of their lives. They can determine whether they take an interest in scientific and technical advances and whether they accept or reject them.



A UNIQUE STEPPED PYRAMID

The striking pyramid shape of the Stuttgart Planetarium was the brainchild of Erlangen-born architect Wilfried Max Beck-Erlang (1924 - 2004). The pyramid structure with external frame was a first in Europe when it was built in 1977, so it attracted a great deal of interest. In 1984 the city of Mannheim commissioned Beck-Erlang to build a similar planetarium. But the Mannheim building did without the steel web and instead was fitted with glass panels, so the Stuttgart stepped pyramid remained a unique design.



For many people, the moment they leave school marks the end of any systematic contact with science. Then they start to take a "fast-food" attitude to learning. Nowadays many adults only learn new things in bite-sized pieces. The widely respected idea of lifelong learning clashes with the harsh realities of our constantly changing multimedia age. Planetariums also have to face up to the challenges that this presents.

If the idea of lifelong learning is to be more than hollow words, a wide range of educational and informational programmes needs to be made available to the public in order to maintain their interest in the fast-changing state of knowledge about our world. Planetariums have a special role to play because they offer easy, low-threshold access to a scientific discipline that is in a state of constant advancement, without the need to join an association or register on a course. Of course not every young person who is interested in the stars will become an astronomer after a visit to a planetarium, but direct exposure to astronomical phenomena can lead them to study other scientific disciplines. Few areas of physics have the power

"The 40th anniversary of the Stuttgart Planetarium reminds me of my school days: the numerous visits with our school class, family and friends in the early 1980s certainly contributed to consolidating my motivation for studying aerospace technology. Nowadays the Planetarium is an important partner in the training of aerospace engineers as well as a great place for public outreach relating to the SOFIA project, an aircraft-based observatory for infrared astronomy. To this end, I would like to wish the planetarium many more successful years inspiring and motivating the young generation of natural scientists and engineers, spreading the fascination to the general public. May numerous big birthdays follow!"

Prof. Dr. Ing. Stefanos Fasoulas is the Director of the Institute for Space Systems, University of Stuttgart. And Decan of the Faculty of Aerospace

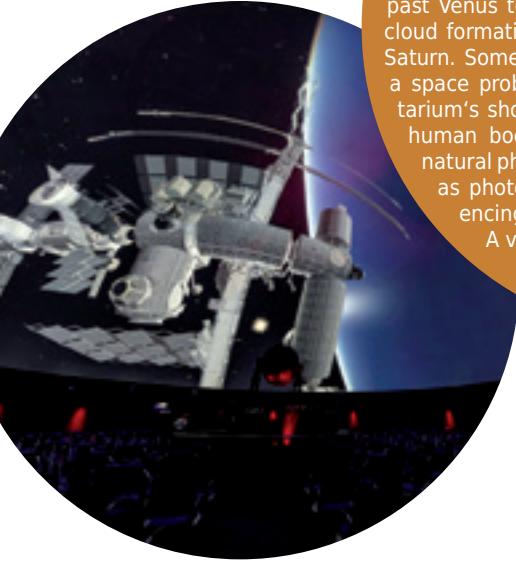




WEISST DU, WIEVIEL STERNLEIN STEHEN?

(Do you know how many stars there are?) was the name of the first, fairly simple, show for children in 1994. Twenty years later, children can experience a thrilling ride across the universe. Today they travel to the blistering heat of the surface of Mercury, past Venus to the canyons of Mars, on to the towering cloud formations of Jupiter, and fly through the rings of Saturn. Some special shows even allow them to control a space probe as it travels through space. The Planetarium's shows make it possible to travel through the human body and provide accurate simulations of natural phenomena. Even abstract processes such as photosynthesis can be grasped by experiencing them in a direct and tangible way.

A visit to the Planetarium becomes a multi-media experience.



to excite people like astronomy. It appeals to both genders, and is an effective way of interesting girls in science and technology.

A CINEMA, A THEATRE, A MUSEUM?

People are always trying to compare planetariums with other entertainment venues. Sometimes they are described as cinema domes. But they can't be compared to cinemas because they do not show films on the dome. Instead, a planetarium show is made

up of a number of projections using different systems, such as fibre-optic projection, video and lasers.

The role of cinemas is predominantly to provide entertainment, whereas planetariums fulfil a vital educational role that cannot be achieved by a commercial operation. The operator of a cinema buys or rents finished products that have cost millions of dollars to produce elsewhere. In contrast, most planetarium shows are self-produced and simply enhanced by purchasing other contributions. A cinema can be successful thanks to its infrastructure and selection of films, while a planetarium has to focus on providing real substance.

A planetarium is also not a museum, though it may be part of a museum. Its shows may explain historical developments in culture and science, but their focus is never solely on early technology. Planetariums are ver-

"Discover – Understand – Unify. Right from the start, it has been the mission of the Stuttgart Planetarium and its dedicated staff to communicate these goals to visitors young and old. It has always been a breeding ground for young science enthusiasts, and many have gone on to study aeronautics or other technical subjects. During the 40 years of its existence, Stuttgart Planetarium has become a highly respected educational establishment for astronomy and aeronautics. In this way, it has made a valuable contribution to Germany's long-term scientific, cultural, technological and economic growth."

Prof. Ernst Messerschmid was a physicist and astronaut at the Spacelab D1 Mission in 1985. He is now a Professor at the Institute of Space Systems at Stuttgart University.



satile audio-visual laboratories for describing the cosmos and its constituents.

In many respects a planetarium is like a theatre, because it has an equally complex infrastructure and similar processes in terms of research, script, props, stage equipment, rehearsals and performances. But everything is done in miniature and plays out in the digital hyperspace of a full-dome production. Theatre productions require a large team, including authors and dramatists, actors, make-up artists, lighting technicians, props managers, and scenery builders.

At planetariums these functions are looked after by a handful of people. The success

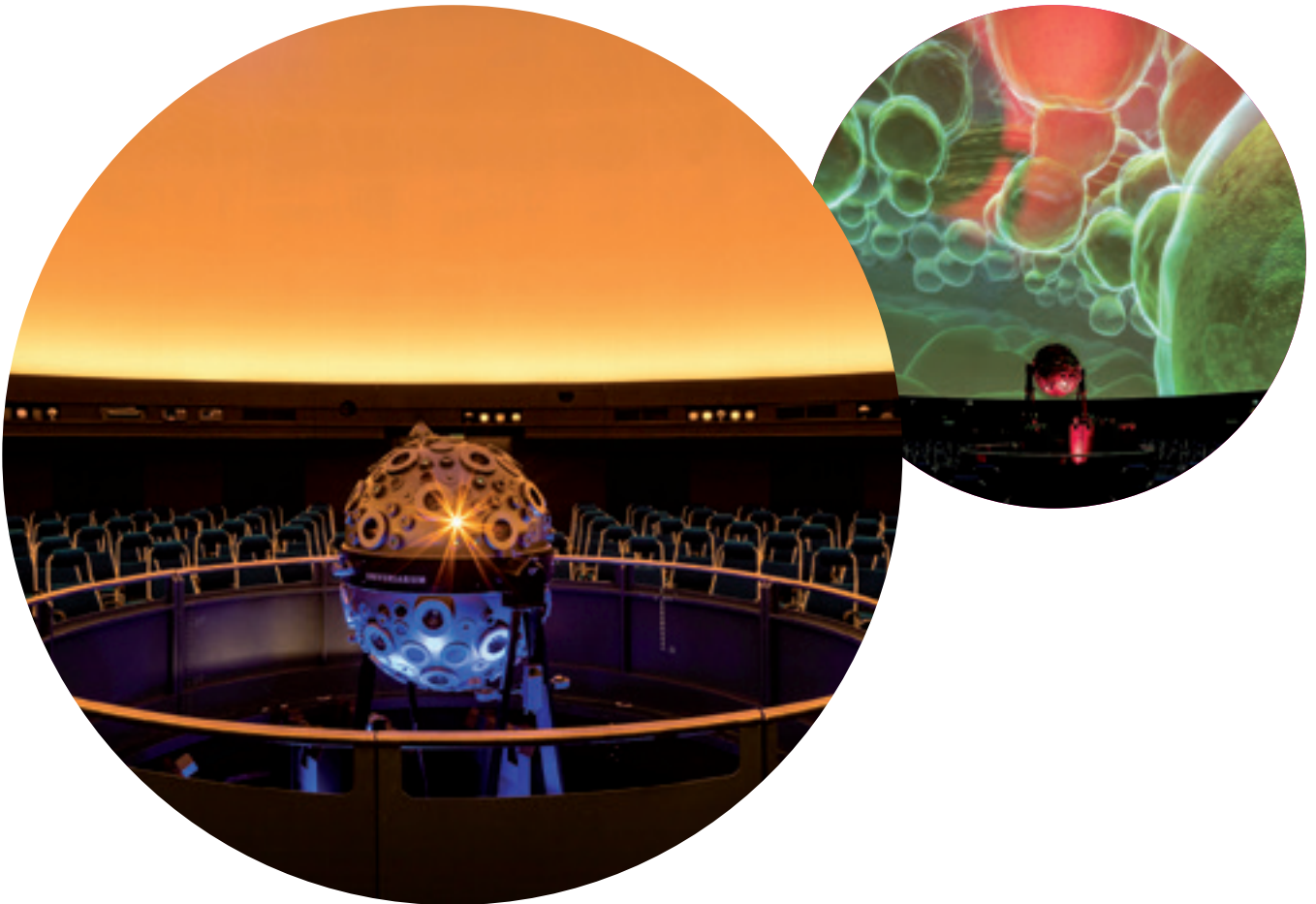
of the whole establishment depends on the commitment and hard work of a small team. The production of a gripping show and emotional experience also has similarities to staging a play. At a planetarium, the projection dome is the stage and the stars are the actors. Going beyond their purely informational function, the shows edify, entertain and invite reflection.

Modern planetariums are at the interface between theatre and multimedia. Their appeal and great strength lies in their fasci-

nating way of presenting the universe and the latest scientific results. Contemporary presentation styles that shift between educating and entertaining are needed to ensure that science and research are seen as exciting and worthwhile areas of human activity.

In the competition between media attention, esoteric smoke-screens and pseudo-scientific explanations of cosmic phenomena, planetariums have to act as credible providers of facts. To some extent, planetar-

iums are also required to deal with history, because we are telling the world's biggest and longest story – how our world has come to be.





STUTT GART PLANETARIUM – A WIDE RANGE OF PROGRAMMES

In Stuttgart we are following the trend of helping people to understand the universe by giving them an emotional experience. We speak to their eyes and ears. Conscious-

ly or unconsciously, viewers are aware of the visual and acoustic quality of our shows.

Since 1977, just about every night sky show has begun in the same way: a few introductory words are followed by the overture to Also sprach Zarathustra, then the Zeiss projector rises up out of the ground like an alien robot. It takes up its position in front of the viewers, who then turn their attention from the machine to the moon and stars as they appear on the dark dome above – at any time of day, and even if it's raining outside.

The visitors set off on a journey through time and space. On a quest to find the star of Bethlehem, they are shown the constellations that were present at the time of Christ's birth. They also discover the stars

of ancient Greece, navigate the islands of the South Seas, and learn about the work of Johannes Kepler. Of course a large part of the show revolves around modern space research, including space probes to Mars and Saturn, and the latest astrophysical discoveries about dark matter, black holes and the big bang theory.

The Planetarium is never short of subject matter. With its numerous research projects and space probe missions, modern astronomy offers a wealth of new discoveries. The challenge lies in deciding what to showcase from the deluge of published material.

But the Planetarium is more than just an educational establishment. For years it has also been an important cultural institution

LIKE A REAL-LIFE MOVIE SET

"My God! It's full of stars!" The words uttered by astronaut David Bowman in the classic movie 2001 – A Space Odyssey as he looked out at the cosmic monoliths also apply to the Planetarium. When darkness falls in the dome of the pyramid, thousands of stars twinkle realistically in the firmament above.

40 years ago, the architecture of the Stuttgart Planetarium unconsciously built another cinematic bridge. Inside, the 20-metre curve of the dome contrasts with the external, angular shape of the stepped pyramid. The building was not fully set on foundations because of the subsoil in this section of the Schlossgarten. Instead, it is supported by a six-part steel skeleton that gives the building its futuristic appearance.

Wilfried Beck-Erlang designed the glass cladding of the pyramid in such a way that it would absorb traffic noise. The glass was meant to reflect the surrounding trees and help the large structure to blend in with the rest of the park. This camouflage effect was rendered superfluous after the park was cleared in February 2012, and now the Planetarium can be seen from far and wide – indeed, it has never before been such a prominent part of the landscape. Now it reminds us of another science fiction movie: Roland Emmerich's Stargate.



in Stuttgart, hosting a number of special events and presentations. Concerts, readings and even plays are held under its artificial skies. A new event is Tunesday, where DJs play music under the dome while cosmic video clips are screened via the full-dome system.

"19:31:21 HH:MM:SS UTC. We lean back comfortably in our ergonomic seats and wait for it to start. We are gradually accelerating towards an amazing space station high above us, but this time our spaceship doesn't dock. Instead we fly past the station and head on into deepest space. An evening at the Planetarium fires up astronauts like me, and it always offers space experts and star-gazers something new, something that has never been seen before. Congratulations on your anniversary and I wish all our visitors a soft landing back in Stuttgart!"

Prof. Reinhold Ewald is a German physicist and astronaut who spent time aboard the Mir space station in 1992. Today he is Professor for Astronautics and Space Stations at the Institute of Space Systems at Stuttgart University.

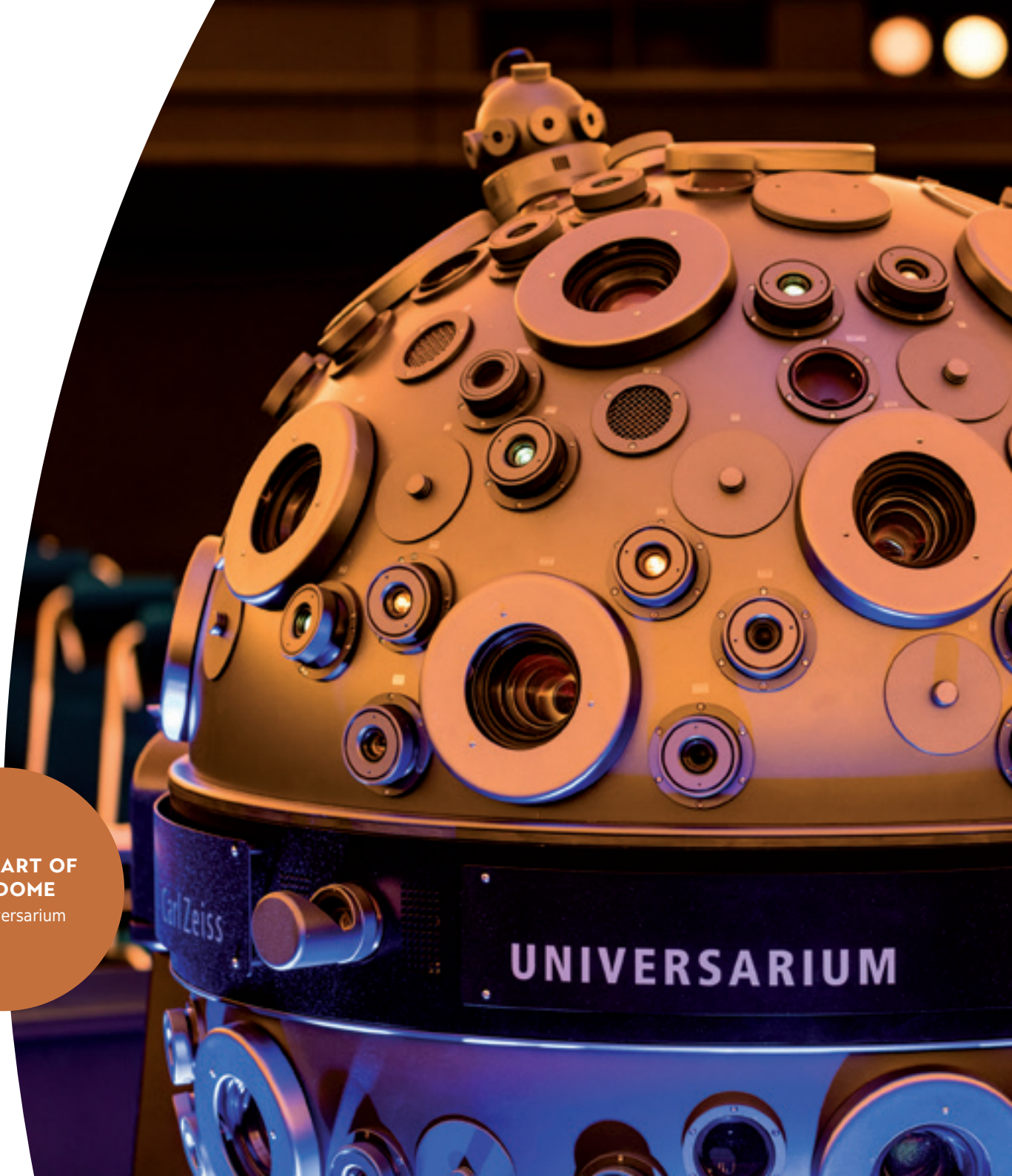


FUTURE LAB

In January 2018 the project "Future Lab" will be presented at the Carl-Zeiss Planetarium in Stuttgart, the State Capital of Baden-Wuerttemberg. During this congress Stuttgart's Office for Cultural Affairs will examine and appraise the future of individual cultural areas.

Save the date:
Music Innovation Congress
on 26 & 27 January
2018.





**THE HEART OF
THE DOME**
The Universarium

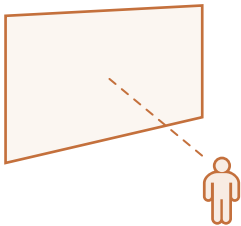
Carl Zeiss

UNIVERSARIUM

THE DOME ROOM – FULLDOME

Stuttgart Planetarium is one of the world's top planetariums. The city of Stuttgart invested 5.2 million euros in installing a new full-dome projection system and renovating the building.

The new digital full-dome projection system with nine high-contrast projectors makes it possible to present science in totally new ways. Massive databases and 360° full-dome video can be used to simulate flights into the depths of the universe. Planets, galaxies, space probes and other celestial bodies can be shown in precise detail. It is also possible to travel through the human body, and all kinds of natural phenomena can be presented in a realistic way.



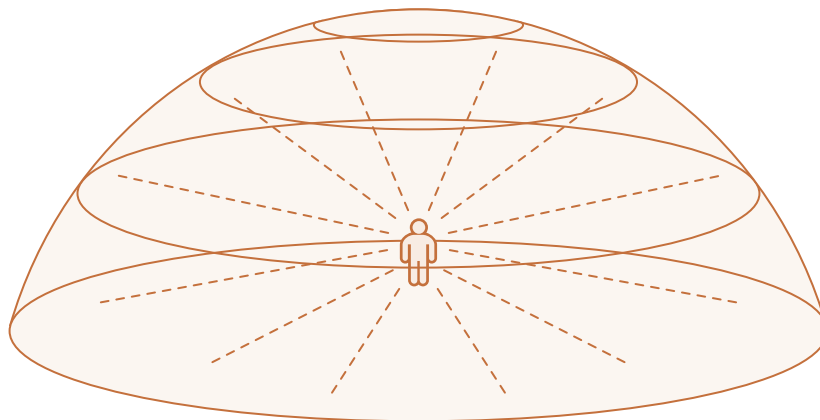
360° FULLDOME-VIDEO

All together, the nine individual pictures beamed by the projectors onto the dome create a full 360° x 180° image with a resolution of 6 K at 60 pictures per second. This means that the dome is filled with 6,144 x 6,144 pixels.

IMMERSIVE SHOWS

The viewer is totally immersed in the Planetarium show.

With flat, two-dimensional images, it is as if the viewer is standing in a house with one eye closed, looking out of the window at a forest. In immersive shows, the viewer is standing in the middle of the forest, looking around and listening to the birdsong on all sides.



The technology does not yet exist to create an immersive display that provides the same resolution as our eyes, but major advances are being made in planetariums and in virtual reality technology.

Even Leonardo da Vinci (1452 - 1519) tried to find ways of overcoming the restrictions of a two-dimensional image. He ascertained that such images always appear "artificial", so he went on to develop his own "natural perspective projection" in which he depicted the surroundings on a sphere from its centre.





In the early days, when slide projectors were still being used in planetariums, it was almost impossible to share content because the configuration of slide projectors and special projectors was different in every planetarium. Digital data is easy to copy and share on external hard drives or via the internet. It was very impractical to copy boxes of slides and then send them by post.

THE DOME MASTER FORMAT

Shows are projected onto the dome in what is called dome master format. This is a standard format in modern planetariums involving a sequence of circular images with separate soundtracks. It is like donning a supersize helmet: the lower part of the image is in front, the centre is directly above and the upper part of the image contains things that are behind the viewer. So everything in the upper quarter of the image in the dome master format is upside down, but as soon as the image is projected on the half dome in the planetarium it is the right way up.

The dome master format makes it possible for planetariums all over the world to share content and collaborate.

There are now more than 1,000 fulldome systems in operation around the world, many of them in planetariums and museums. Every year, another 60 systems join their ranks. This is a very respectable growth rate - the film industry needed 30 years to develop such a good network. As a result, international standards have been drawn up and the number of available productions is growing steadily.

The fulldome community now have their own festivals, such as the Domefest and ASTC Fulldome Showcase, and there is even an association of professional fulldome developers, IMERSA.

THE DOME

The projection room has a dome-shaped ceiling that is 12 metres high and 20 metres in diameter. The dome is made of perforated aluminium panels. The sections are curved to fit the half-dome, cover a surface area of 630 square metres and weigh 2.8 tonnes. The part that the audience can see is suspended on a load-bearing trellis. 5.8 million tiny holes with a diameter of 1 mm are evenly distributed across the projection area. They allow air to circulate and let the sound through. Behind the dome a 150,000-watt loudspeaker system with its 18 loudspeakers, 4 sub-woofers and 2 infrasound sub-woofers delivers an impressive sound experience.

THE LIGHTING IN THE DOME

The dome's lighting comes from 20,844 computer-controlled LEDs. They bathe the dome in beautiful light with 16.7 million colours. The lighting is totally integrated into Sky-Skan's media control system, which can be operated automatically or manually.



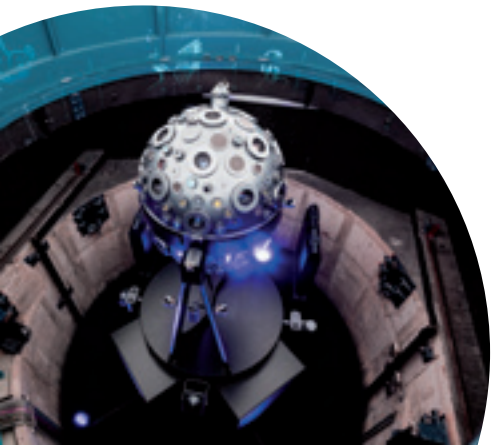


THE PROJECTION SYSTEM

A Full-dome-Show is created using a mixture of production techniques working hand-in-hand.

THE INSET PROJECTORS

Two inset, HD projectors allow information to be beamed onto the domed ceiling. The projectors are used before the shows begin



and for lectures and presentations. They are integrated into the media control system.

THE UNIVERSARIUM

In the Planetarium, the star projector is affectionately known as "The Egg", but in fact it is the Universarium Mark IX, which was installed by Zeiss in 2001. 9,100 stars shine out from 32 star fields in this miracle of optical technology. The "starball" measures one metre in diameter and is surrounded by projectors for the sun, moon and planets. A hydraulic system allows the star projector to sink below the floor, and it is covered with a cap. Two 400W lights provide the light that is needed to make the stars shine.

The Universarium is able to show the night sky at every time of year and every time of day from anywhere on Earth, across a time-span covering tens of thousands of years. It is on three adjustable axes, so it can simulate the Earth's rotation, latitude and arc of the horizon (azimuth).

THE LASER SYSTEM

The laser system turns the laser show into a pyrotechnic display that is set to music. A medium is required to scatter the light so that the laser beams can be seen in the room. Two powerful fog machines can fill the whole dome with thick fog in just a few seconds. The fog fluid is totally safe, and in high concentrations it can reduce visibility to less than 50 cm. However, it is normally diluted so that the projections on the dome are still visible.

The laser system is controlled by a Lacon 5 computer made by Lobo Electronic in Aalen. The light comes from 4 solid state lasers (OPSL technology on a Powerdeck 8 optical bench). These deliver red, green, cyan and blue light. The colours are mixed in the optical bench, and the beams travel through fibre-optic bundles to 6 fully digital AMP-6 laser projectors (also called scanners).

From here they fill the dome with laser beams. 48 effect mirrors on the dome horizon make it possible to channel and divide radiation at over 200,000 dots per second in order to create effects. Coherent light up to 15W is possible, but the actual intensity of the light is determined by a laser expert, who tests every new show to ensure safe levels of radiation.

HIGH-CONTRAST VIDEO PROJECTORS

The nine Velvets - projectors that have been specially developed for planetariums - can dim the images on the dome one pixel at a time. These special projectors developed by Zeiss achieve a native contrast ratio of 2,500,000 to 1 and are the first in the world to provide a totally black backdrop.



THE VIDEO WALL

Twelve 4K monitors make up the video wall in the dome's entrance lobby. The Planetarium's staff call it "Viewspace", after a NASA invention. It can be used as a single, 15-metre-wide monitor to show beautiful shots of the night sky from Welzheim Observatory, or screen information about galaxies, stars, planets and space probes. It also shows clips from current Planetarium shows and the latest news in space research.

It has a resolution of 2,160 x 49,152 pixels with more than 106 million image points shown at a rate of 30 images per second. This requires huge computing capacity.



AUDIO GUIDES AND AIDS FOR PEOPLE WITH HEARING DIFFICULTIES

The dome room has an induction loop system for people who wear hearing aids. Visitors can borrow a hearing loop system from the ticket desk, along with audio guides that provide English commentary for the shows. Viewers who would like to use their own phone with earphones need an app that links them to a special Wi-Fi system in the dome.





**LIFE –
A COSMIC STORY**

Excerpt from the show



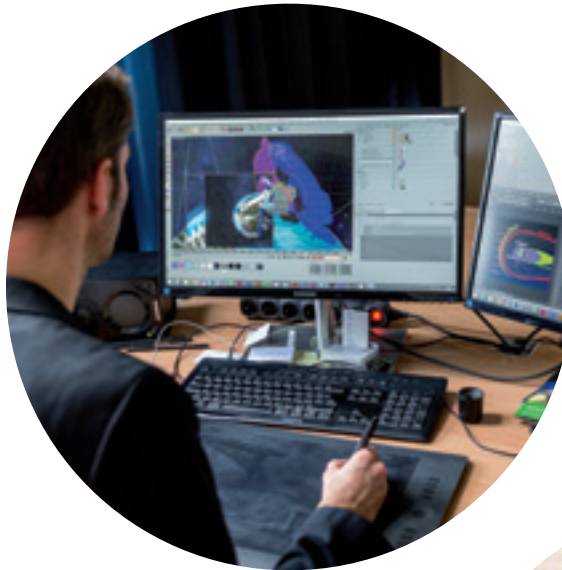
PRODUCTION TECHNOLOGY

PRODUCTION WORKSTATIONS

To create a show one needs visuals, audio and a couple of computer-clusters.

VIDEO AND EDITING WORKSTATIONS

There are four production workstations in the Planetarium for producing visual materials. These high-performance computers are specially designed to handle the requirements of 3D animation and video editing - with 64 GB RAM, 8 cores in the Intel Core i7-4770 processor, a clock speed of 3.4 GHz per core, and Nvidia Quadro K4200 graphics cards. The production workstation is linked via fibre-optic cabling to a fail-safe 50 TB NAS-RAID, where all data relevant to production is stored.



THE SOUND STUDIO

Alongside the projections, it is vital to have excellent sound in the dome. Sound and images have to be perfectly coordinated. The Planetarium not only creates its own visual content, but also often produces soundtracks in its in-house sound studio. This includes translations, the acoustic editing of external content, and in-house productions for the star shows. The sound studio is located in the basement, together with a workstation that is predominantly used for the Avid Protools audio production software, along with a soundproof recording cabin for two narrators.

SERVER ROOM WITH COMPUTER CLUSTERS

The images for a production have to be projected and distorted in a geometrically correct way, and the various projectors have to be precisely synchronised. Three racks in the server room accommodate the computer clusters. One is for sound, another for the live system, and one for rendering, the process of finishing pre-programmed raw data. The live system uses the Zeiss Powerdome software, which takes all these calculations and runs them in parallel on 10 computers. The computer hubs on the three racks have a number of functions.





LIGHTING AND SOUND CONTROL

The sound and lighting control rack holds a huge array of connectors for loudspeaker systems, the audio guide system and the two computers that control the multimedia system.

THE UNIVIEW DIGITAL UNIVERSE

The middle rack of the computer cluster holds everything that is needed for the Planetarium's live operations on visual playback systems. Each of the nine Velvet projectors has a single computer (its client), which delivers the video signal. In turn, all these computers are controlled by a master computer.

Uniview is a real-time universe simulation system made by Swedish firm SCISS. Unlike most other systems, it is based on open interfaces. For example, it supports Collada 3D objects, XML scripting and the KML Support Uniview makes it possible to fly through the universe in real time at any speed without hardware barriers.

Astronomical databases can also be integrated into the simulation system. When a

LASER COMPUTER

The laser computer controls the lasers and fog machines, and live laser control is possible via the VIPE control field and attachable MIDI keyboard.

UNIVERSARIUM COMPUTER

The Universarium is controlled via the two screens of the Universarium computer.

SOUND COMPUTER + MIXING DESK

The astrogators can access the sound system via the computer that controls the audio systems, and the digital mixing desk. The microphone level can be adjusted for live shows.

WORKPLACE COMPUTER

The astrogators can use e-mail and internet on the workstation computer and access relevant information for live shows.



new star, supernova, comet or whole galaxy cluster is discovered and entered into a public database, it instantly appears in the system.

Maps in Google Earth's high-quality resolution are also available. By using overlays, such as those containing demographic data, it is possible to give live representations of the Earth's surface with regard to CO2 emissions and similar. Of course Uniview also allows these functions to be used in the whole virtual universe, so it is pos-

sible to show the ISS, orbits, or the event horizons of black holes.

Uniview also facilitates audience interaction. Using a wireless X-Box controller, viewers can navigate a probe through space.

Uniview can also be used as a live moderation tool, to explore the cosmos, and as a render base for creating finished video sequences for dome projections.

THE RENDER FARM

The last rack holds the render farm. This comprises 16 Render Blade computers that have been specially optimised for high-speed graphics processing. The production department uses them for the sole purpose of creating content. Whenever "rendering" is referred to in the production process (such as Cinema4D, After Effects and Uniview), it is handled by these computers.

In the (3D) animation programme, objects such as spheres (planets) are described mathematically, for example as short formulae. These 16 computers have to convert this information into real pixels and image data so that it can be projected onto the dome. Every computer is equipped with 2 CPUs, each with 4 cores, 32 GB Ram, and CUDA graphics cards. A special render management software called Deadline controls all the computers so that this does not have to be done individually.

LIGHTING CONTROL

The lighting of the Digital-Sky / Spice system is controlled in SPICE and Tarragon EX. The lighting can also be controlled manually.

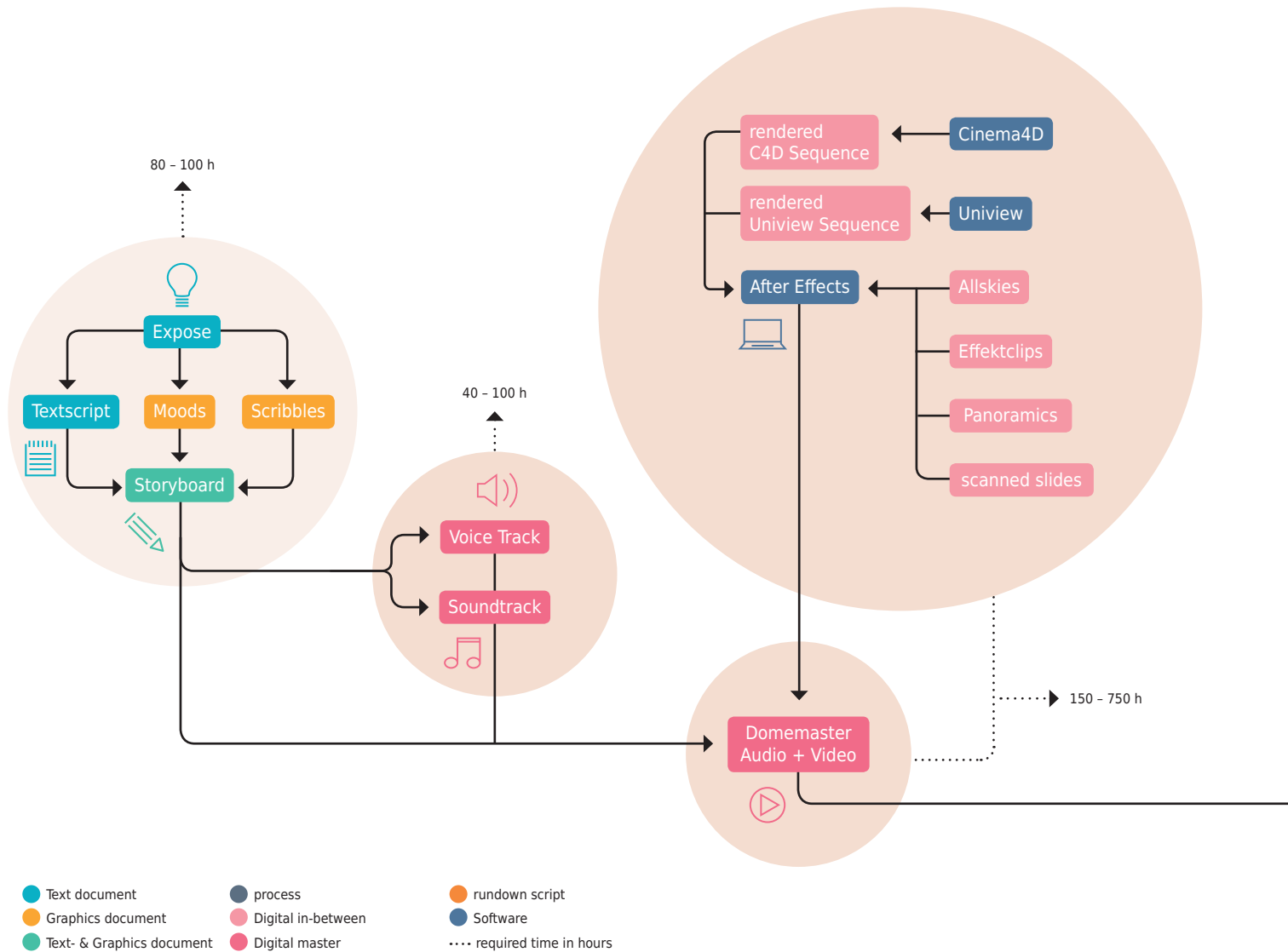
POWERDOME3

The Powerdome3 operating system controls the fulldome video and Uniview live software (with X-Box controller).



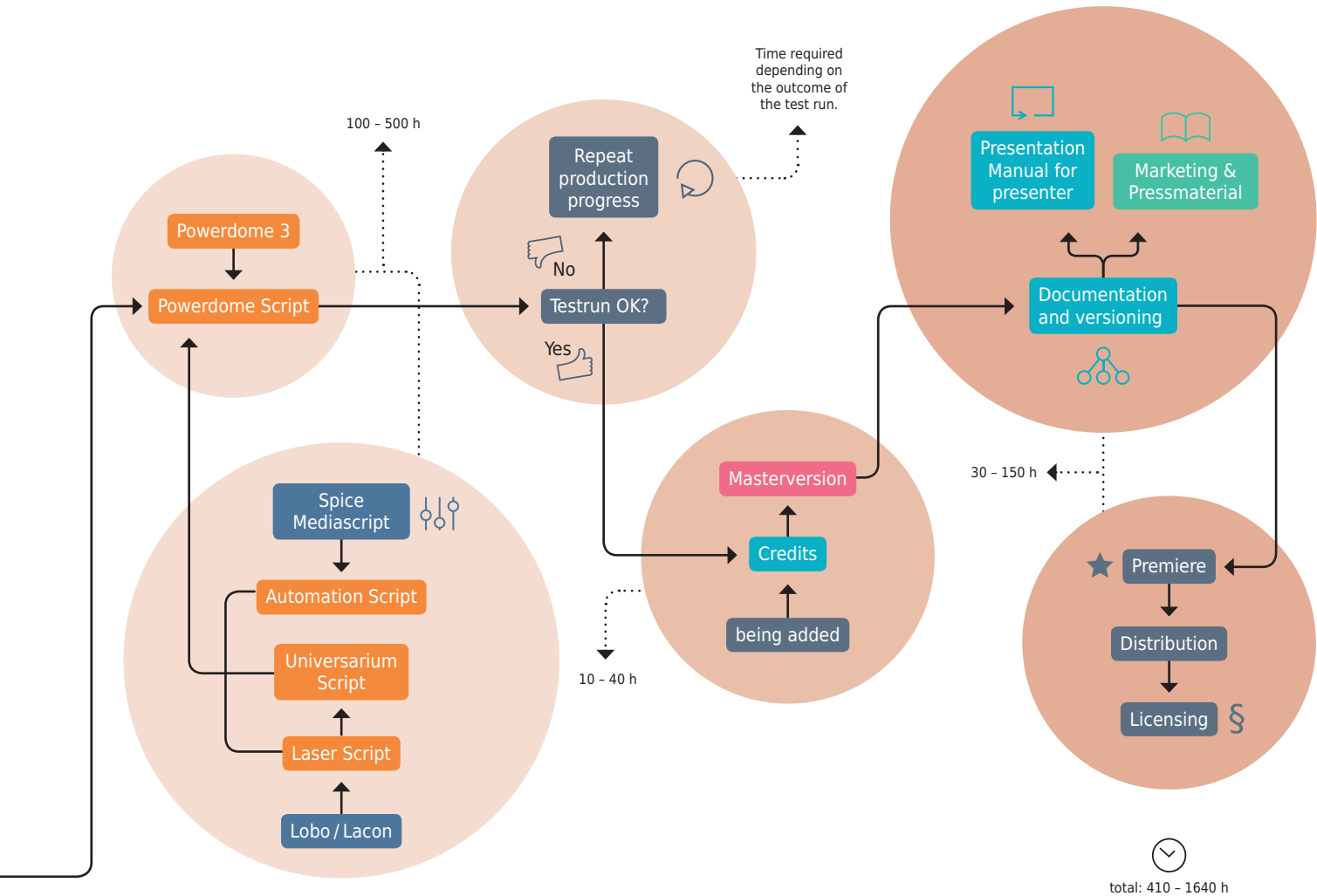


THE LONG JOURNEY FROM SKETCHES TO THE FINISHED PLANETARIUM SHOW



Concept Creation

Production



Revision

Mastering

Showphase





ALL HANDS FULL

Work never runs dry for our on-board engineers.

JOB DIVERSITY AT THE PLANETARIUM

TICKET OFFICE STAFF

On arrival please visit the box office in the welcome area. Tickets, vouchers and relevant information are all available here. International guests can borrow headsets with the English versions of the Planetarium's events. At the box office you will be greeted by members of our administration who can assist with scheduling.



ASTROGATORS

The show itself is run by the astrogators, who take visitors on a journey through the universe and are available during and after shows to answer their questions.

ON-BOARD ENGINEERS

A great deal of clever tinkering goes on in the Planetarium's workshop, and the technology it uses has to be regularly serviced. This work is done by the Planetarium's engineers, who also help out the astrogators when needed. We call them on-board engineers, in keeping with the Planetarium's spaceship feel.

PRODUCERS

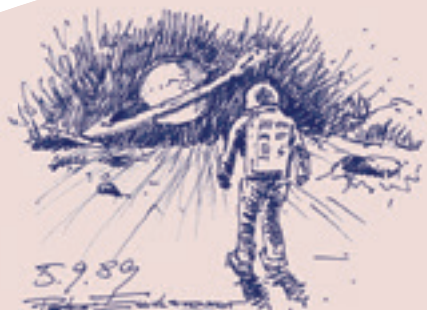
Much of the Planetarium's content is produced in-house, involving a number of specialists who design and create video projections, scenes of the universe, and laser effects with appropriate sound. They set the stars in motion, bring images to life, and often create whole planets in a virtual cosmos.



ASTROGATOR?!

The word comes from the German sci-fi TV series *Raumpatrouille Orion*, and describes what they do much better than "guide" or "operator". An astrogator is a combination of astronomer and navigator. From the dome's cockpit they expertly navigate the audience through space.





5.9.89

Reiner Beck
MPIPR Bonn

Mit herzlichem Danke für die
Möglichkeit meine "Erste" Ausstellung
zu veranstalten.
Ich kann dem Planetarium nur
viele Besucher wünschen

Peter Zwick

HIGHLIGHTS
FROM OUR
GUESTBOOK

gut, daß alle Völker wenigstens 110.000.000
die gleichen Sterne haben!

Selenite v. K. 1888.

Ursprung und Schicksal des Kosmos

Erweckt die Quantenfeld-Vakuum-Energie die Expansion des Weltalls
seit mehr als 10 Milliarden Jahren? Wird uns das HUBBLE
SPACE TELESCOPE das Problem lösen mit einer Messung
der Hubble-Konstante? Ist $H_0 < 70 \frac{\text{km}}{\text{s Mpc}}$ ($\approx 20 \frac{\text{km}}{\text{Tag}}$) oder ist $H_0 > 70 \frac{\text{km}}{\text{s Mpc}}$!!

17. Okt. 1985

Wolfgang Freiler



Professor Kellers
neuer Projektor !!!
(Zeiss Modell 382)

Oct. 11. 86

很高兴到斯图加特天文馆参观访问, 感谢
Dr. Leumer 的友好接待, 以及 Udo Gersmann 的讲解和
讲解, 很容易就认识了个别的恒星, 不过今天第一次
来德意志, 听说32位, 为5个节目, 5小时!

北京天文馆 邵俊

I'm glad to visit Stuttgart Planetarium.
thanks all of you!

Jin Guo
Beijing Planetarium
Oct. 11. 86



Richard Hardy
11-5-80

Rich. M. Hardy 12.3.80
Birmingham, England



viele Dank-
ganz wunderbar
Heinrich Stauffel
19.9.1981



DIRECTOR

The director is the mastermind behind the Planetarium. He is an expert in astrophysics, and it is he who sets the course in all kinds of ways. He decides what will be shown at the Planetarium, and when. He comes up with concepts, develops ideas for new shows and gives lectures. He is also involved in all the administrative processes and acts as the face of the Planetarium. He receives plenty of praise, but of course he also has to face his share of criticism. It's a typical management role - the buck stops with him.

CLEANING STAFF

2,200 square metres of space have had to be kept clean for the last 40 years. This is looked after by our housekeeper, who does her rounds every day to ensure that anything left behind by the hordes of visitors is cleared away in time for the next guests.



SECRETARIES' OFFICE

The Secretaries' office is the hub of the Planetarium. This is the nerve centre where everything comes together - something that is particularly important because the Planetarium operates a shift system. This office is generally the first point of contact for customers, either by telephone or in person.

ADMINISTRATION

The Planetarium is part of Stuttgart's department of culture, so it has to comply with its procedures. The Administration office looks after the finances and other administrative tasks. These include controlling, data protection, procurement, PR, contracts and crisis management - the staff are never short of work.





**LONG
QUEUES AT
THE TICKET
DESK**

A familiar image already in the year of opening

FROM START TILL NOW

1919 Prof. Walther Bauersfeld invents the first projection planetarium in Jena.

1923 16 August: The first public planetarium show is held under the cupola of the Zeiss factory in Jena.

1923 25 October: The Mark I projector is installed at the Deutsche Museum in Munich.

1924 22 December: Stuttgart City Council approves the construction of a planetarium in Stuttgart.

1928 16 May: Stuttgart's first planetarium opens in the former Hindenburgbau building at the main station. Its dome measures 25 metres in diameter and there is space for 450 visitors. The projection equipment (Zeiss Mark II) can show the night sky from everywhere on earth and is considered to be a wonder of optical and mechanical engineering. Over the next years, hundreds of thousands of visitors come to marvel at the night sky and discover the basic principles of astronomy.

The Planetarium welcomes Stuttgart's residents and school visits, and later on also serves to entertain soldiers and residents.

1935 In conjunction with the Württembergische Filmbühne, the Planetarium's programme includes arts films, which also feature a short star show.

1943 17 June: The City Council decides to close the Planetarium. The Zeiss Mark II projector is taken down and relocated.

1944 The Hindenburgbau is bombed in February and March 1944 and suffers fire damage.

1945 After 1945, Walther Bauersfeld, the inventor of planetarium projection, is the first to restore the projector, which is still in good condition. But in the destruction of

Showings of arts films in the 1940s were subject to entertainment tax. In 1943 the programme included films such as *Ich kenn Dich nicht und liebe dich*, *Oh diese Männer*, *Wetterleuchten mit Barbara*, *Fronttheater*, *Mutterliebe* and *Kameraden*.

(Source: City Archives)





post-war Stuttgart people have other concerns - and there is no suitable location for a planetarium.

In the late 1950s and early 1960s the dawn of the space age ignited a whole new interest in space. Astronomers, star-gazers, teachers, and the press all agreed that Stuttgart had to restore this attractive institution. But there was a lack of money and the question of location was a thorny one.



LORD MAYOR MANFRED ROMMEL IN HIS OPENING SPEECH ON 22 APRIL 1977:

"The city of Stuttgart is proud of its Planetarium (...) Let us hope that the Planetarium also makes many people aware that the secret of creation is not shrouded in mystery, despite all the scientific advances, but that every door that scientists open leads on to new rooms with new doors, and behind them lies the unknown."

1969 The Carl Zeiss Foundation has donated the world's most modern planetarium projector, the Mark VI A, to the City of Stuttgart.

1974 4 April: Stuttgart City Council approves the construction of a planetarium in the Mittlere Schlossgarten on Neckarstrasse (now Willy-Brandt-Strasse).

1975 The construction of the planetarium commences in the spring. It has been designed by Stuttgart architect Wilfried Beck-Erlang (1924-2002), who also designed the adjacent Staatsgalerie subway station.



1977 22 April: The new planetarium opens in a pyramid-shaped building to coincide with the German Horticultural Show in the Schlossgarten. Its architecture is copied by other planetariums, and in 1977 it is awarded the distinguished Bonatz Prize by the Association of German Architects. It also makes the shortlist for the Steel Construction Prize.

The projector (Zeiss Mark VI A) is one of the most modern in the world, involving an analogue magnetic tape system. For the first time in the history of Zeiss planetariums, the shows can be projected any number of times without loss of quality.

FOUNDING DIRECTOR PROF. HANS-ULRICH KELLER ON THE OPENING

On 21 April 1977, the day before the Planetarium's official opening, there was a power cut during a press conference. The Planetarium's architect, Wilfried Beck-Erlang, rushed out and returned in a panic. The whole city was in the midst of a ten-minute power cut, with trams coming to a halt and traffic lights going dark. Next day, the newspapers reported: "If the dress rehearsal is a disaster, the show will go without a hitch!" And this was what happened. On 22 April 1977 the golden key to the Planetarium floated down from the dome on a red parachute. It was handed over to Mayor Rommel, and from that moment the Planetarium was officially open.

1977 May: The Kommunale Kino moves into the Keplersaal at the Planetarium. This remains the cinema's main auditorium until its move to the Filmhaus in 1997. It shows a wide range of genres, including poetic realism, political, historical, feminist, and experimental films, and original language versions.

1981 4 September: The Planetarium welcomes its one millionth visitor.

1984 27 - 31 August: As part of the 8th International Planetarium Directors' Conference (IPDC), the heads of major planetariums from all over the world come together at Stuttgart Planetarium.

1986 8 September: The METEOSAT receiving station begins operations. A parabolic antenna is installed on top of the pyramid.

1987 22 April: Stuttgart Planetarium celebrates its 10th birthday with a lecture by Prof. Hans Elsässer, Director of the Max Planck Institute for Astronomy in Heidelberg, and a special exhibition that includes the world's first planetarium projector (Mark I), on loan from the Deutsche Museum in Munich.

**ZEISS
MARK VI A.
(1977 TO 2001)**

Weight of projector: 2,500 kg
Height above floor: 5 m
Number of objectives: 113
Number of fixed stars projected: 9,000
Storage medium: 1-inch magnetic tape
(14 analogue channels)
Performance: The most modern
electro-mechanical projector
of the 1970s.





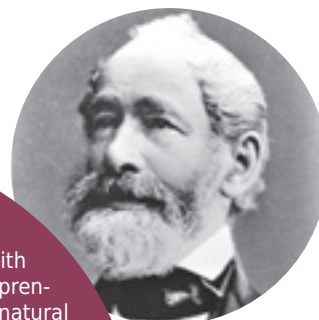
1992 6 September: Welzheim Observatory is opened by Welzheim's mayor Hermann Holzner and representatives of Baden-Württemberg's government and Stuttgart City Council.

1988 3 December: The City Council decides to rename Stuttgart Planetarium the Carl Zeiss Planetarium to honour the 100th anniversary of the death of the company's founder, Carl Zeiss (1816 – 1888).

1989 24 April: Celebrations to mark the 100th anniversary of the Carl Zeiss Foundation.

1990 1 March: The new Carl Zeiss Research Award is presented at the Planetarium.

1990 The construction of Welzheim Observatory is given the go-ahead. It will act as Stuttgart Planetarium's astronomical observation station.



Carl Zeiss (1816 – 1888), maker of optical instruments, spent his life trying to combine science with precision engineering. During his apprenticeship he attended lectures in the natural sciences. In 1845 he opened his own workshop in Jena and began making microscopes, which came to be recognised for their quality by experts in the field. In 1871 his mentor, Prof. Ernst Abbe, managed to precisely calculate the optical path of lenses. Now Zeiss was in a position to make customised lenses. For the first time it was possible to mass-produce powerful objectives while retaining consistent quality. In 1884 Zeiss helped to set up the Glastechnischen Laboratorium Schott und Genossen. This company enjoyed rapid success and earned international recognition – the combination of science and business proved to be a winner.



1994 20 July: On the occasion of the 25th anniversary of the moon landing, the Planetarium holds a press conference with NASA astronaut Charles Lacy Veach (1944 - 1995) and German astronaut Ernst Messerschmid (b. 1945). It also organises an exhibition under the banner From Apollo to the Space Shuttle.

1996 Start of building works to expand the Planetarium. 200 square metres of new space is created in the basement to house the library, archives and a new sound studio.

1999 11 August: The only total solar eclipse in the 20th century that can be seen from Germany. The totality zone covers Stuttgart and Welzheim. The second dome at Welzheim Observatory is put into operation, and the event is broadcast around the world by SWR with the help of the Observatory's sun telescope.

The central path of the solar eclipse of 11 August 1999 passed directly over Stuttgart. The media hype was huge, and demand for protective eclipse glasses outstripped supply. Thousands travelled to Stuttgart, which had dubbed itself sun city - but all they saw was a thick blanket of cloud. But it was still an impressive spectacle. In Welzheim the clouds parted just before totality and it was possible to take some amazing shots of the sun with its corona.

2000 As part of the plans for the new railway station complex, it was proposed that the Planetarium should move to Bad Cannstatt, where a new Science Centre was to be built.

2001 17 December: Stuttgart Planetarium takes delivery of a new projector from Jena (Zeiss Universarium Mark IX) with state-of-the-art computer controls and fibre optics for some 10,000 stars. Modern software and computer-controlled planet projectors make it possible to present the sky from every planet in the solar system.

ZEISS UNIVERSARIUM MARK IX (2001 TO DATE)

Weight of projector: 1,500 kg starball
and 830 kg for planets

Height above floor: 3.70 m

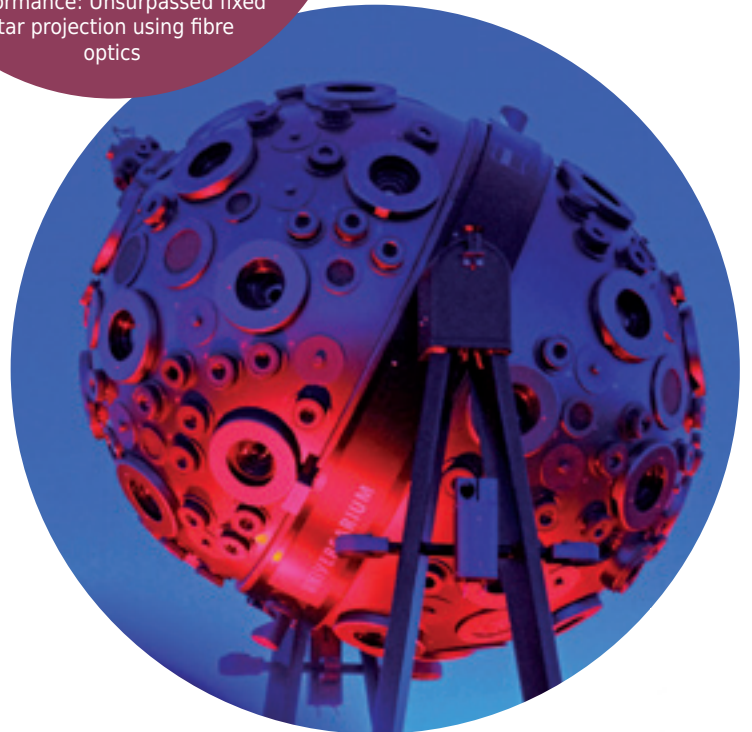
Number of objectives: 139

Projectors: 8, for sun, moon and planets
and other celestial objects

Number of fixed stars projected: 9,100

Storage medium: Hard disk

Performance: Unsurpassed fixed
star projection using fibre
optics





2004 8 June: Transit of Venus – our nearest neighbour passes across the face of the Sun

2005 16 January: The five millionth visitor is welcomed to a star show.

2006 6 March: The new 90-cm reflecting telescope is unveiled at a small ceremony at the Welzheim Observatory. It is the largest astronomical telescope in Baden-Württemberg.

2007 April: Stuttgart Planetarium celebrates its 30th anniversary with a special lecture and a performance of Gustav Holst's The Planets suite.

2008 1 September: Dr Uwe Lemmer is appointed as the new Director of Stuttgart Planetarium. His appointment coincides with plans to move the Planetarium to a new complex in the Neckarpark in Bad Cannstatt, due to open in 2011. It is planned that the former planetarium building in the Schlossgarten will have a new use as part of the Stuttgart 21 rail project.

2009 During this and the following years, a number of plans and models for the new Science Centre are drawn up and rejected.

2010 The first excavations begin in the Mittlere Schlossgarten in preparation for building the new underground railway station as part of the Stuttgart 21 project. For many years, the area around the Planetarium is the scene of demonstrations and occupations. The Planetarium is perceived as a neutral place by supporters and opponents of the project. It stands at the centre of events, but it is not the focus of the disputes.

2011 12 April: First Yuri's Night at the Planetarium to mark the 50th anniversary of Gagarin's first space flight. With the help of students at the Institute of Space Systems, Yuri's Night in Stuttgart is transformed from a party event to being an experience for all the family with lectures by astronauts, 3D films, docking simulations, displays of rockets and space probes, Star Wars fans in costume and a Space Bar.

20 July: The local music industry comes together in the dome room for the MARS Music Awards for the Stuttgart region, presented by Popbüro Stuttgart.

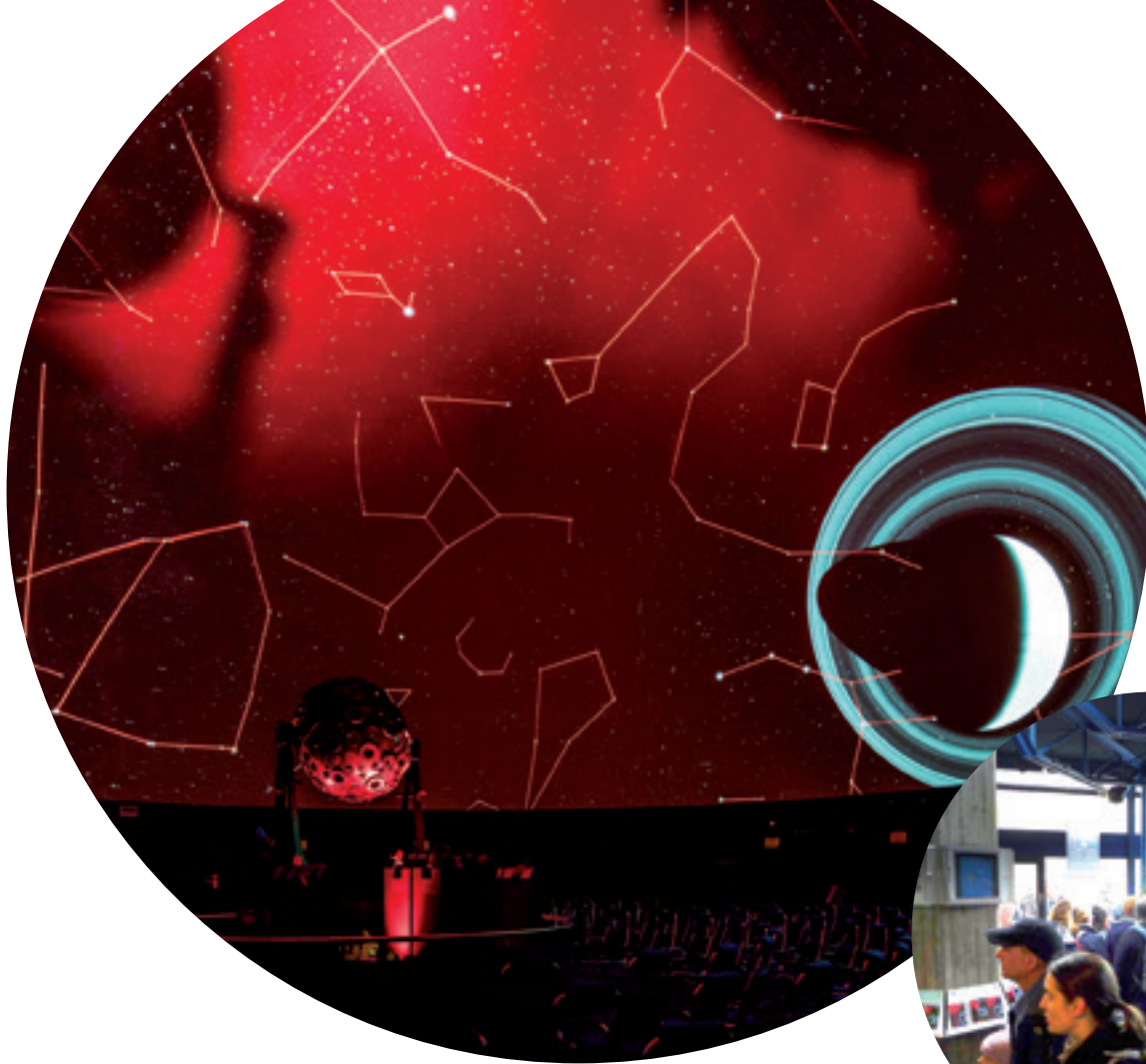
2012 18 April: The Planetarium welcomes its six millionth visitor.

2013 16 May: Plans for a Science Centre in Bad Cannstatt are shelved. Stuttgart City Council decides that the Planetarium should stay in its location in the Schlossgarten and be refurbished.

2015 30 March: The Planetarium is closed for a year for refurbishment and the installation of the very latest technology, including a full-dome projection system.

During these redevelopment works, the Planetarium team spend much of their time teaching the public about astronomy in schools and other institutions. They even take to the road in a rented mobile planetarium.





2016 22 April: After a year, the works are complete and Stuttgart Planetarium celebrates its official reopening. The planetarium projector is now joined by a modern digital dome projection system with high-contrast Zeiss projectors. A network of computers allow visitors to journey through time and space thanks to a huge astronomical database. 10,000 people flock to the Planetarium on the opening weekend. They love the new technology and new programmes such as Tuesdays.

2017 22/23 April: Stuttgart Planetarium celebrates its 40th birthday - with two open days, free entry and special anniversary events throughout the year.





**WELZHEIM
OBSERVATORY**

Observatory of the
Stuttgart Planetarium



WELZHEIM OBSERVATORY

Palls of dust and smog, light pollution from buildings and street lamps – these days it is almost impossible to make astronomical observations in our brightly lit towns and cities. For many years now, it has also been difficult to directly observe the stars in Stuttgart. This is why the founding director of Stuttgart Planetarium, Prof. Hans-Ulrich Keller, was keen to set up an external observatory right from the start.

With the help of Welzheim town council, a suitable location was found on Markung Langenberg. The climatic conditions in Welzheim forest are ideal for star-gazing, as there is very little pollution and the night sky is fairly dark.

In 1989 the decision was made to build Welzheim Observatory. With the support of the state of Baden-Württemberg, the Rems Murr regional council and a number of sponsors, Welzheim went ahead with the project to build the observatory and its domes. The City of Stuttgart contributed the telescope and other technical equipment.

The observatory was officially opened on 6 September 1992, and since then it has served as the observation station for Stuttgart Planetarium. Thousands of visitors have looked through the telescopes and marvelled at the wonders of the cosmos. It is run by volunteers and financed by donations and contributions from visitors and sponsors.

The Welzheim Observatory offers public observation sessions and also takes images of the sky, which are used for shows at the Planetarium.

Synoptic observations of the stars make it possible to check air and climate parameters in order to learn more about atmospheric conditions and potential changes.

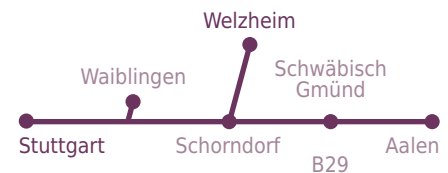
To mark the total solar eclipse of 11 August 1999, when Stuttgart and Welzheim were inside the totality zone, a second dome was built at Welzheim Observatory to house a special telescope for solar observation.

A third observatory dome with a base diameter of six metres was officially opened on 8 June 2004 to coincide with the transit of Venus, an extremely rare occurrence. It holds the Simon refractor and 90-cm reflecting telescope.

Since July 2010 Welzheim has also been home to a "planet trail" – a scale model of our solar system. It truly allows us to explore the dimensions of our cosmic home, the solar system.

The Welzheim Observatory is also celebrating a special occasion in September 2017 – its 25th birthday.

Welzheim
Observatory
Tel.: 07182 - 4284
(attended only
during observation
times).



The Observatory is reached via the Schorndorf to Welzheim road. From Welzheim take the Langenberg turning and follow the signs to the Observatory ("Sternwarte"). The car park is signed. From here a 430-metre path leads to the observatory; vehicles are not allowed.

