New projector systems in planetariums invite the audience to take part in virtual adventures in the dark depths of the cosmos.

Hurtling boulders of ice and stone compel the pilot of the spaceship to make evasive maneuvers, during which the passengers are jolted back and forth in their seats.

Riding the Comet

Deafening alarm sirens warn of impending collisions, and finally the nucleus of the comet fills the entire field of view of the panorama dome which arches over the viewers' heads. The engines roar for a last time, and billows of smoke blur visibility. This is followed by a truly icy silence. With 200 passengers on board, starship Walther Bauersfeld has landed on the icy nucleus of the Shoemaker Levy 9 comet.

Virtual Space Flights into the Depths of the Cos

During the next few minutes, the armchair space travelers will "age" by more than 50 years. In quick motion, they are propelled on the comet through the solar system until, when flying past the huge planet of Jupiter, they are catapulted onto a new orbit. After a few loops around Jupiter the flying iceberg is ultimately torn apart by the planet's tidal forces and, in the end, the debris plunges into the storm-lashed atmosphere of the huge celestial body. Literally in the last minute, the space travelers can save their skins and embark on a new space adventure ...

The future has already begun. With the exception of the billows of smoke and the jogging effects which can currently only be imitated by space simulators in leisure parks, such a show could already be presented in today's planetariums from Carl Zeiss. Originally, a planetarium was only intended as an instrument that could reproduce the celestial motions in the Earth's sky. At least this was what Oskar von Miller, the founder of the Deutsches Museum in Munich, "ordered" from Carl Zeiss. Professor Walther Bauersfeld, head engineer at Carl Zeiss at that time, surprised his client with the pioneering concept of a projection planetarium. With this ingenious idea, he banished earlier attempts to visualize the heavens and planetary motion into the museum for all time and simultaneously created a self-contained "star theater."

Since then, the opto-mechanical apparatus equipped with many lenses and gears has been enhanced into a complex, highly modern projection system that leaves (practically) nothing to be desired. This can be witnessed not only by visitors to the Olympics in Peking (where the new planetarium was opened on Xi Zhi Men Wai Street in 2004), but also by vacationers to the Austrian town of Judenburg. From 2008, the new technology from Carl Zeiss can also be experienced at various locations in the USA: Peoria in Illinois, Fort Worth in Texas and in Kingsport, Tennessee. In the Japanese city of Nagoya, the *UNIVERSARIUM* planetarium projector is being installed in the world's largest planetarium dome with a diameter of 35 meters as part of a new science center. The new building is due for completion in 2011.

Glass fiber stars – as radiant as the real sky. The glass fiber projection now used for all projector sizes guarantees a realistic star-lit sky, the like of which is difficult to find in today's light-polluted centers of civilization. Thanks to modern electronic control, the planet projectors are no longer brought into (approximately) the right position in a time-consuming procedure using slowly moving gear mechanisms, but are activated digi-

mos

Longing for a night sky: Planetariums are becoming increasingly popular.

tally by step motors. This allows any desired journeys through time and space within a single program – even a ride on the nucleus of a comet or a trip to one of the many moons in the solar system.

These new possibilities of sky and planet projection are supported either by the *powerdome®ADLIP HD* laser-supported, all-dome projection system (All Dome Laser Image Projection High Definition) or by the *powerdome®SPACEGATE* system also developed by Carl Zeiss. Their two or five digital projectors – needless to say, featuring high quality ZEISS *DIGIGON* lenses – illuminate the entire dome surface (360° x 180°) evenly and practically without any discernible transitions. Alternatively, two or four projectors containing SXRD technology (Silicon Xrystal Reflective Display) can be used. They combine SONY's wealth of experience in the field of digital movie projector technology with the ZEISS *DIGIGON* wide-angle lenses specially developed for dome projection.

Complex electronics allow simple operation. Powerful software is required for the precise simultaneous control of the planetarium projector and all-dome projection in pre-produced programs and for live shows in particular. Carl Zeiss offers the *powerdome®* system for this purpose. Behind this name is a comprehensive control platform that combines the opto-mechanical systems with the digital projectors and simultaneously manages all image and sound data. Powerdome® was developed in collaboration with the Fraunhof Institute for Computer Architecture and Software Technology in Berlin and permits intuitive operation, regardless of whether the traditional control panel or a keyboard and mouse are used. This allows practically limitless navigation in the universe, the seamless transition from a terrestrial view of the sky to virtual spaceflights into the depths of the cosmos.

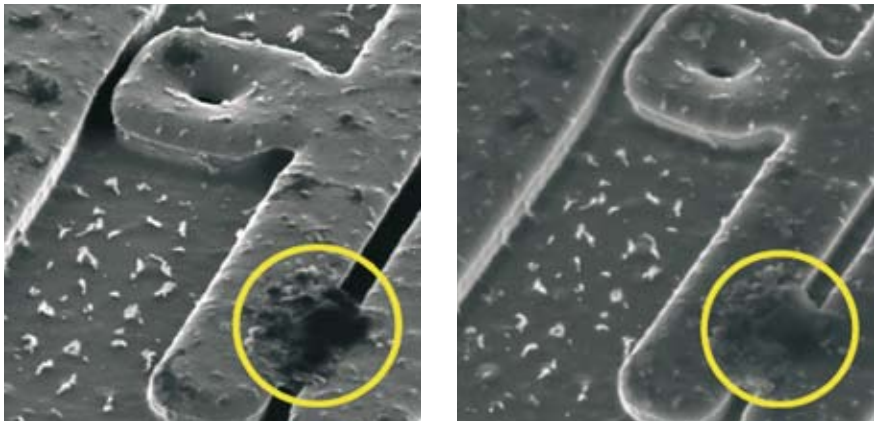
The development continues. The former planetarium originally developed for the newly founded Deutsches Museum in Munich has therefore become a "Universarium" in the true sense of the word. And Carl Zeiss is still constantly devising new ideas for improving and expanding its spectrum of applications. Wilfried Lang, Manager of the Planetariums business unit: "All-dome or full-dome projection is still in its infancy. Carl Zeiss concentrates on projection solutions which promise high image quality. The applications will continue to far exceed current planetarium presentations. These include, for example, possible uses in the entertainment and health fields."

Hermann-Michael Hahn

An Eagle Eye for the Nano World

The new helium-ion microscope generates particularly high-resolution images.

ORION™ had to pass its first test right when it was delivered. Because the doors in Building E at the Manfred von Ardenne Ring were not wide or high enough, it was forced to take the more tedious route through the window. Thanks to the active support of dedicated employees, a crane and many wooden pallets, it was possible to nonetheless complete this difficult procedure with the heavy instrument. This new type of microscope that goes by the brand name _ORION_ has resided in its rightful place at the Carl Zeiss Innovation Center in Dresden since the end of October.



Display of a defect on a semiconductor structure with helium-ion technology: the ORION™ helium-ion microscope (left) stands out, in particular, as a result of its brilliant contrast which scanning electron microscopes (right) cannot achieve with their very high resolution.

Behind the stellar name is a pioneering technology that generates helium-ion images from the nano world, in which the dimensions of a billionth of a meter are the measure of all things. The development of this new microscope can be traced to the patented work of ALIS in Peabody, Massachusetts, under the management of Bill Ward. This start-up company was acquired by Carl Zeiss SMT during the summer of 2006 and has now been fully integrated. "With *ORION*, we have launched a truly revolutionary product," says proud inventor Ward, Chief Technologist of Carl Zeiss SMT in the USA that is now also headquartered in Peabody to the north of Boston. The helium-ion microscope at the Technopark Nord in Saxony's capital is the only one of its kind in Europe. Together with a microscope based on cross beam technology (CrossBeam 1540 EsB) that uses electron and ion beams for imaging and material processing of the smallest particles and structures, it is the heart of the Innovation Center that will advance the development of future chip generations as part of the joint Nanoanalysis project. In addition to Carl Zeiss SMT, the project sponsored by the German Federal Ministry of Education and Research (BMBF) with a total of 12 million euros also includes semiconductor manufacturers AMD and Qimonda.

Increasingly complex structures in ever smaller dimensions. Imaging procedures have repeatedly provided the foundation for new insights into the natural sciences. Images, whose resolution and contrast set standards, can be generated with an intensive beam of single helium ions. The most important element for the microscope is a durable source for the helium ions in which a sharp tungsten needle is placed in a high vacuum at very low temperatures. The applied high voltage generates an extremely thick electrical field around the nee-

dle tip, whose strength is sufficient to ionize the helium atoms flying by. During this process, an electron is released via the tunnel effect on the tip so that positively charged helium ions are created which are accelerated away from the needle. The ion beam is then guided through a column with a series of focusing, adjusting and probing elements before it is bundled on an almost unimaginably small surface with a diameter of only 0.75 nanometers. Here, the beam scans the probe pixel by pixel, similar to a scanning electron microscope. "The gray scale value of each single image element is determined by the number of secondary electrons detected," explains Ward. The potential of the new method can be estimated based on the dispersion pattern created when the helium ions scatter while penetrating the specimen: its cross section is clearly smaller than with an electron beam and ensures the high resolution. In this regard, *ORION* is clearly superior to a scanning electron microscope.

"The size of the specimen is approximately one square centimeter where we can examine up to six of the objects at the same time. The largely automated change takes less than 10 minutes, the processes thus permits very good throughput," emphasizes Dr. Heiko Stegmann, head of the Carl Zeiss team at the Innovation Center in Dresden. Together with partners from the chip industry, the group of scientists is working on the 3D characterization of semiconductor structures and new materials for chip fabrication. "As a manufacturer of innovative microprocessors, we are faced with the challenge of producing increasingly more complex structures in ever smaller dimensions with maximum yield," says Dr. Udo Nothelfer, Vice President of AMD Fab 36, explaining the commitment of the three partners. "With the structural dimensions that we have now achieved, the current storage cells can only be seen under an electron microscope," confirms Frank Prein, President of Qimonda Dresden GmbH and Global Head of Technology at Qimonda AG.

Biological specimens and semiconductors. The new cutting-edge tool is not only available to the project partners but all interested companies and institutes in greater Dresden. All of the approximately 250 employees of the Silicon Saxony Network, which includes the technical university in Dresden and the Fraunhofer Center for Nanoelectronic Technologies (CNT), for example, can ask and receive answers to nanotechnology application questions. Furthermore, biological specimens from the natural science and medical institutes at the University of Tübingen (NMI) are currently being examined in Dresden.

Strategic Alliances. The use of the new precision instrument from Carl Zeiss is not limited to leading micro-electronic companies in Europe. There is also enormous interest from across the Atlantic. Systems have already been installed at key customers such as the National Institute for Standards and Technology in Gaithersburg, Maryland. Harvard University in Cambridge, Massachusetts, also relies on technology from Carl Zeiss for its Center for Nanoscale Systems (CNS). Harvard has ordered eight electron and ion microscopes from Carl Zeiss SMT, including an *ORION*. "This order, which also means a long-term strategic partnership for our company, is a great honor and accolade," says Dirk Stenkamp, Member of the Board at Carl Zeiss SMT. Hopefully the "scientific heavyweights" will also fit through the doors at the CNS.

Extremely heavy, leading-edge instrument: the ORION™ helium-ion microscope

Klaus Jopp