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Press Release

Light as a tool for space travel and Earth exploration

Photonics deepens understanding of the universe

- **Laser-based communication and measurement technology in space**
- **Photonics provides key technologies for Earth exploration**
- **Key players at Laser World of Photonics 2025**

Light is the key to understanding the universe. Photonic processes provide an insight into distant galaxies, the composition of the Earth's atmosphere, and the mechanisms of climate change. They enable broadband data transfers over many millions of kilometers as well as precise measurements and positioning of satellites. Laser World of Photonics will be the meeting place for key players from June 22 to 27, 2025.

The laser was less than ten years old when the Eagle made the first manned Moon landing on July 20, 1969. But the lunar module of the Apollo 11 mission already had a laser reflector on board, which Buzz Aldrin placed on the Moon for future Lunar Laser Range (LLR) measurements. To this day, this reflector made of special Heraeus quartz glass has defied the temperature fluctuations and intense radiation on the Moon. Its 100 triple prisms reflect laser beams sent from the Earth back to their starting point. The transit time of the light reveals the exact distance between the Earth and the Moon. Five of these reflectors are in use; the new generation is being installed in current missions. After all, long-term measurement series generate important data on the drifting apart of the Earth and the Moon, the rotation of the Earth's satellite, and the gravitational and tidal forces acting there.

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Today, laser processes deliver position data from satellites and space debris with millimeter precision or measure the topography of planets and moons. The data is collected in a growing network of ground stations and satellites with increasingly powerful lasers and more sensitive detectors.

Data traffic in satellites and over many millions of kilometers

Wireless data transmission is also an important field of application for the laser. LASER exhibitor optoSiC is providing Fast Steering Mirrors (FSM) for NASA's Psyche mission, which recently transmitted laser signals over a record distance of 460 million kilometers. Kilowatt lasers on Earth sent the signals to the Psyche space probe, which will explore an asteroid 3.5 billion kilometers away from Earth from 2029. Photonics provides the equipment for that: a multispectral camera, a magnetometer and a gamma neutron spectrometer. At the same time, the mission is testing Deep Space Optical Communication (DSOC). For video streams to Earth, the data rates reach several megabits per second despite the huge distance.

The European Space Agency (ESA) is also working on optical communication. The aim, among other things, is for communication satellites to supplement fiber optic networks on Earth and serve as a fallback level for damaged subsea cables. The Laser Zentrum Hannover (LZH) is providing a laser amplifier with 100 watts of optical output power for wavelength division multiplexing: It amplifies ten closely spaced wavelengths in one fiber for ten separate data channels, thus ensuring the highest transmission rates. Lasers and laser diodes for optical communication between and within satellites are supplied by TOPTICA Eagleyard, among others. Satellites constantly exchange information in the course of Earth observation, communication and navigation. At the same time, their respective subsystems are also networked. Due to the high data rates, low latency and low power requirements, laser-based data transmission is increasingly in demand.

LIDAR, spectroscopy, atomic clocks and frequency combs

LIDAR (Light Detection and Ranging) systems and spectrometers also have a

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photonic basis. Exhibitors such as the LZH or the Fraunhofer Institutes for Applied Optics and Precision Engineering IOF in Jena and for Laser Technology ILT in Aachen are constantly developing them further. ESA's "Copernicus Anthropogenic Carbon Dioxide Monitoring" mission, which will use two satellites to measure CO₂ and methane levels in the atmosphere from 2026, shows what is possible. The Fraunhofer IOF has developed an optical assembly for it, which comprises two prisms and a nanostructured grating that splits the light reflected from the Earth into its spectral colors. The CO₂ content can be read from these spectra with accuracies of less than one hundred CO₂ particles per one billion molecules. The satellites can thus determine exactly how much greenhouse gas is being emitted in which region and by which (human) sources. The Fraunhofer ILT is involved in another mission that aims to monitor methane using LIDAR. The small satellite MERLIN will send light pulses into the atmosphere and determine the concentration of greenhouse gases from the reflected light.

Numerous LASER exhibitors are regularly involved in space missions. Suppliers such as Excelitas, Ametek Zygo, OHARA, POG Präzisionsoptik Gera and LASEROPTIK provide robust optics designed for the harsh environmental conditions in space and in low Earth orbits. Others such as AEMtec, DIAMOND, Glenair or SEDI-ATI Fibres Optiques each provide space-certified micro (opto-)electronic and fiber optic solutions or connectors. Specialists such as Acktar are represented with deep black coatings for passive heat management and stray light suppression or, like CILAS, supply dichroic filters and mirrors that have made it to Mars in the high-tech photonic instruments of the Perseverance rover. The diversity of solutions and providers shows that space travel is teamwork and requires the entire range of photonic expertise, from the precise fiber optic positioning of MPS Micro Precision Systems to astro-frequency combs and high-end lasers for atomic clocks from Menlo Systems or TOPTICA Photonics.

LASER exhibitors supply key technologies for space travel

When looking at the Moon missions of 1969 to 1972, another exhibitor catches the eye: Northrop Grumman, the parent company of SYNOPTICS, was awarded the contract back then to build all the lunar modules for the Apollo program as

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the leading manufacturer of satellites. The company also played a prominent role in the development and construction of the James Webb Space Telescope, which reached its orbit 1.5 million kilometers from Earth in 2022. Since then, it has provided breathtaking insights into the origins of the universe from a distance of up to 13 billion light years. High-end mirrors focus a broad spectrum of infrared light wavelengths on high-end photonic detectors and thus provide fascinating images of distant galaxies, stars, exoplanets and black holes. It is also backed by the teamwork of almost 260 companies, universities and research institutes from 14 nations, including LASER exhibitors such as Coherent, Fraunhofer IOF, Physik Instrumente (PI) and Teledyne Technologies.

You can find this press release including images for download at the [LASER newsroom](#).

About the LASER World of PHOTONICS

The LASER World of PHOTONICS is the world's leading platform for the laser and photonics industry. Europe's largest World of Photonics Congress is part of the trade fair. The program comprises a number of scientific conferences held by globally leading organizations. In addition, Messe München offers practical presentations on photonics applications ("Application panels"). The LASER World of PHOTONICS has been held every two years since 1973; the next edition will be held from June 24 to 27, 2025, in Munich, the next World of Photonics Congress parallelly from June 22 to 27, 2025 at the ICM - Internationales Congress Center München. LASER World of PHOTONICS will also feature the third World of QUANTUM, the leading platform for the international quantum community.

world-of-photonics.com/en

About the global network of LASER World of PHOTONICS

The LASER World of PHOTONICS has established an international network. The LASER World of PHOTONICS CHINA and the LASER World of PHOTONICS INDIA are regional leading trade fairs for lasers and optical technologies, and are organized annually in China (Shanghai) and India (switching between Bengaluru, Mumbai and New Delhi) respectively. With the trade fairs in Munich, China and India, Messe München is the world's leading trade fair organizer for lasers and photonics.

About Messe München

As one of the world's leading trade fair organizers, Messe München presents the world of tomorrow at around 90 trade fairs worldwide. These include twelve of the world's leading trade fairs such as bauma, BAU, IFAT and electronica. Messe München's portfolio comprises trade fairs for capital and consumer goods, as well as for new technologies. Together with its 1,300 employees in the group and associated companies, it organizes trade fairs in China, India, Brazil, South Africa, Turkey, Singapore, Vietnam, Hong Kong, Thailand and the USA. With an international network of affiliated companies and foreign representatives, Messe München is active worldwide. Each year, more than 150 events attract around 50,000 exhibitors and around three million visitors in Germany and abroad. This makes Messe München an important economic engine that generates billions in purchasing power.