



## Laser Technology

### Contact-free measuring

The word "laser" is an acronym for "Light Amplification by Stimulated Emission of Radiation."

Laser light is located in the spectral range between infrared and ultraviolet radiation and can be generated to have extremely high intensity, very low beam divergence and a high degree of color purity.

Today lasers are used in many different fields, including medicine, materials processing and holography.

# Laser Technology



Fig. 1: Entrance to the DLR Institute of Atmospheric Physics

## Applications for Laser Technology

### LIDAR

Among other remote sensing approaches, scientists at the Institute of Atmospheric Physics use so-called LIDAR (Light Detection and Ranging) methodology, which is based on laser radiation.

The distance to some object is determined by how much time light requires to reach it and return, and how much light is reflected back from that object allows conclusions about its properties. This offers the possibility not only to determine the chemical composition of the atmosphere, but also the velocity of moving objects.

### Medicine

In recent years more and more applications have emerged in the medical area. This was made possible by technical advances which increased the precision and safety of working with lasers so that they could satisfy the strict safety criteria of the medical profession. Lasers are used especially often for eye operations, but also in operations performed by dermatologists and surgeons.

### Pollutant emissions

The DLR Institute of Combustion Technology is concerned with the problem of emissions. This topic is particularly timely because the limits established for the amount of particulate matter in the air have been repeatedly exceeded. Using a new high-pressure combustion chamber, modern laser measurement methods and computer simulations, scientists can now closely observe and optimize the process of fuel combustion. The ultimate goal is to achieve pollutant-free emission.

## DLR\_School\_Lab

The Laser Technology Experiment at the DLR\_School\_Lab conveys an idea of how this highly effective radiation can be used, and is primarily concerned with measuring distances and velocities using LIDAR. There is also an opportunity for the students to carry out their own measurements using modern measurement equipment.

### Generating laser light

In order to carry out such measurements in the first place, a basic understanding is needed of how a laser works. In the



Fig. 2: Laser technology is precision work

beginning of the 20th century Albert Einstein established the theoretical basis in his description of the phenomenon of “stimulated emission of radiation,” in which electrons are excited, collected, and then allowed to return to their previous state in a regulated way. The first true laser, a ruby laser, was, however, only developed in 1960 by Theodore Maiman. The students learn about the functioning and generation of laser light using such a helium-neon laser as a typical example.

Today, laser applications range from medical treatment to data transmission. But also in everyday life there are uses for lasers, for example in a laser printer, a CD burner or a laser pointer. Some of these application areas are explained and studied at DLR\_School\_Lab, including in particular the possibility to measure the distance to the moon.

#### How far is it to the moon?

Did the Americans really land on the moon? The rumor persists that the dramatic events which allegedly took place on the surface of the moon on July 20, 1969 actually happened in a Nevada desert. But using laser measurement technology it is possible to prove without a doubt that the lunar module



Fig. 3: The distance from the earth to the moon can be precisely determined with laser measurement technology

really landed on this earth satellite. And in the process one can also measure the distance to the moon.

How? You can find out at DLR\_School\_Lab!

## Glossary

### Holography

Holography is a process for recording image information about a photographed object and depicting it three-dimensionally. You need laser light to reproduce the interference pattern on photographic film.

### ADM

See the cover image, which is an artist's conception of the ADM (Atmospheric Dynamics Mission) Aeolus satellite, scheduled for launch into orbit in 2012. It carries an active Doppler wind LIDAR to provide three-dimensional representations of wind fields.

### Emission

In physics, emission refers to sending out visible light or other electromagnetic waves.

### LIDAR

This acronym stands for “Light Detection And Ranging” and describes a system that uses a laser beam instead of ordinary microwave radiation, such as in radar, to determine the location and velocity of an object.



Fig. 4: This experiment gives students an impression of laser technology

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ESA - European Space Agency

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Spiegel GmbH, 20444 Hamburg

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## DLR at a Glance

DLR is Germany's national aeronautics and space research center. Its extensive research and development activities in the fields of aeronautics, space, transportation and energy are integrated in national and international cooperative ventures. In addition to this research, as Germany's space agency the federal government has given DLR the responsibility to plan and implement the German space program and to represent German interests internationally. DLR is also the umbrella organization for Germany's largest project management agencies.

Approximately 6,500 people are employed at DLR's 13 locations, which include Köln (headquarters), Berlin, Bonn, Braunschweig, Bremen, Göttingen, Hamburg, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stuttgart, Trauen and Weilheim. DLR also operates offices in Brussels, Paris and Washington D.C.

## DLR Oberpfaffenhofen

Aerospace, environment and transportation are DLR's primary fields of interest in Oberpfaffenhofen. Some 1,500 people work there in nine different institutes and facilities, making DLR Oberpfaffenhofen the largest DLR location.



DLR

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