

Munich-Centre for Advanced Photonics (MAP)

The next generation of laser technology

Photonics promises to be one of the fastest growing key technologies of the 21st century. What electrons did in the 20th century will be done by photons from lasers (in close cooperation with electrons) in the 21st. Lasers are considered to be universal tools in many areas of industrial manufacturing, medicine and everyday life. The 'Munich-Centre for Advanced Photonics' (MAP) is developing next-generation laser technologies with much higher photon energies and intensities, with better frequency accuracy and attosecond control of the light fields and with access to even more areas of the electromagnetic spectrum. These novel lasers open up a wealth of new applications in medicine, physics, chemistry and biology, ranging from real-time observation and steering of chemical reactions and electron motion, including the use of quantum phenomena for more powerful computers, to the determination of the atomic structure of biomolecules and medical diagnostics and therapy, for example of tumors. The interdisciplinary cooperation and a concentration of expertise in these fields at MAP is underpinning Munich's growing reputation as a world-leading location for optical technologies of the future.

Research areas

A Photon and Particle Beams

- A.1 Next-generation light sources
- A.2 Brilliant particle and photon sources

B Fundamental Interactions and Quantum Engineering

- B.1 Fundamental physics and nuclear transitions
- B.2 Optical transitions and quantum engineering

C Structure and Dynamics of Matter

- C.1 Electron dynamics in atoms, molecules, solids and plasmas
- C.2 Molecular dynamics and elementary chemical reactions
- C.3 Biomolecules and nano-assemblies

D Advanced Photonics for Medicine

- D.1 Laser-based photon and particle beams for medicine



The MAP Service Centre

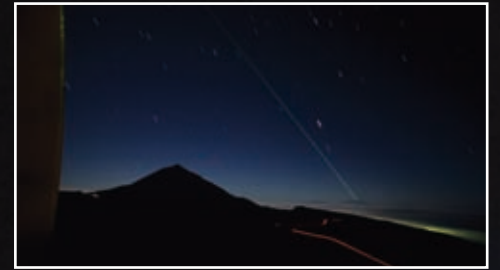
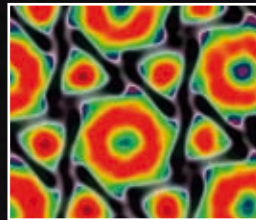
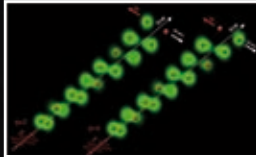
develops, constructs, and produces highly-developed components and devices for the research areas:

- Engineering Office and Workshops: components for all applications
- Multilayer Coating Laboratories: optical devices for lasers
- Target laboratory: diamond-like carbon foils for laser-driven acceleration experiments

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PHYSICAL CHEMISTRY

Motions of single atoms and electrons are not only shown but also controlled by attosecond laser pulses.

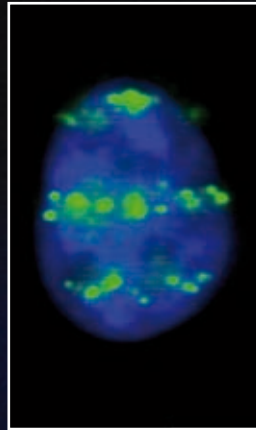
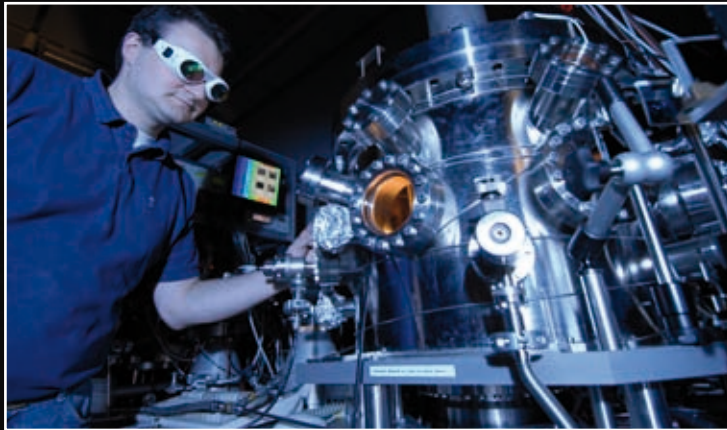


MATERIAL SCIENCE

Material states and characteristics (ferromagnetism, superconducting nature, and data-storage materials) can be investigated much more thoroughly using brilliant x-ray beams. Shown here is a self-assembled Kagomé lattice of silver ions.

BIOLOGY

Attosecond control of electron motion with light opens the way to influencing the structure and functionality of biological systems on a molecular level. Brilliant x-ray sources allow the structure of isolated biosystems to be determined.



ATTOSECOND AND HIGH-FIELD PHYSICS

More powerful electronic devices require smaller and faster circuits. An effective control of light fields is the basis for developing electronic devices to the ultimate frontiers.

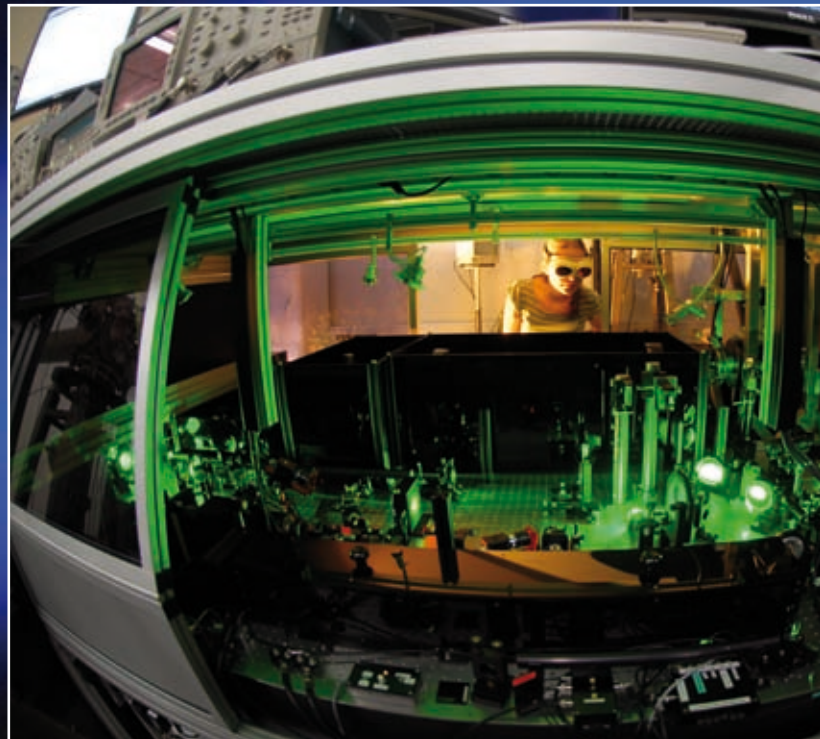


FUNDAMENTAL RESEARCH

Often leads to discoveries of entirely new materials and technologies.

PHYSICS

Compact particle accelerators deliver previously unachieved particle and photon pulses which will give new impulses to the investigation of atoms, molecules and solids.



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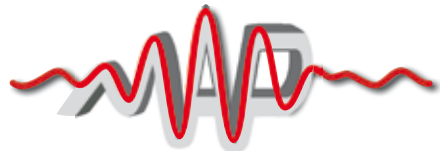


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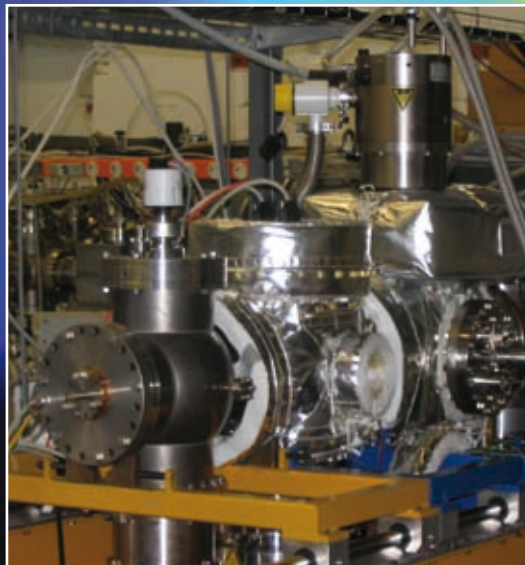


INFORMATION AND COMMUNICATIONS TECHNOLOGY

Atoms, molecules and photons are able to carry quantum information thus allowing new perspectives in computer science and communication technology.

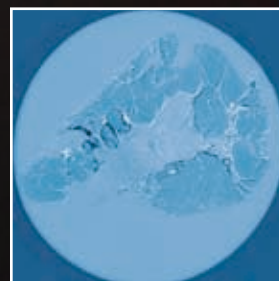
Lasers as a universal tool

The next generation



FUNDAMENTAL CONSTANTS OF NATURE

Ultramodern lasers combined with nuclear physics research will make it possible to analyze the time-variants of nature's fundamental constants. This would have long-range consequences for fundamental physical theories.

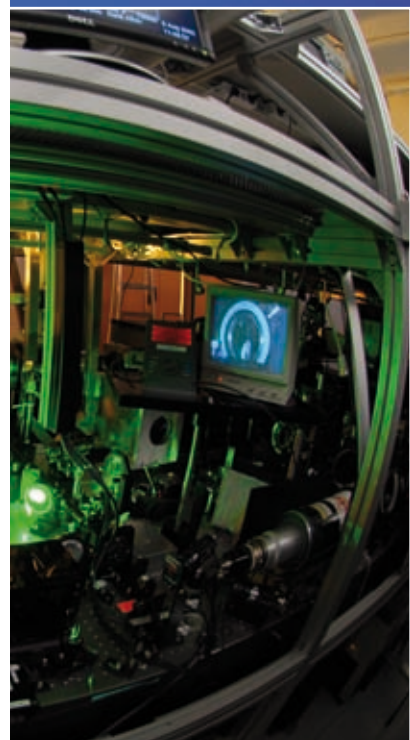


RADIOLOGICAL IMAGING

Brilliant x-ray radiation reveals the very finest tissue structures, thus facilitating a revolution in the early diagnosis of tumors and other tissue abnormalities.

RADIATION THERAPY

Through the development of more compact, cheaper machines based on laser-driven proton and ion acceleration, much more cancer patients will be able to gain access to one of the most efficient and promising methods of cancer therapy with particle beams than today.



MAP's special programs

... for young researchers

MAP provides excellent career opportunities for young scientists. There are many junior research groups and new W2- and W3-professorships are being established. All research projects offer diploma and doctoral theses on exciting, future-oriented themes.

... for family and career

MAP especially supports female scientists at all career levels through targeted offers and an active network. Young mothers and fathers are given additional support. The Dual Career Service provides the opportunity for professors' spouses to find an appropriate vacancy in the university or the research area.

... for teachers and students

MAP offers an extensive program closely oriented to the curriculum for advanced education in German schools. Each topic contains a theoretical introduction as well as a hands-on experiment or a lab tour.

The support provided for cutting-edge research in universities within the framework of the Excellence Initiative is aimed at promoting scientific collaborations in Germany of top international standing. The Munich-Centre for Advanced Photonics (MAP) was selected in a nationwide contest. It is now receiving funding from the German Research Foundation (Deutsche Forschungsgemeinschaft - DFG) to establish itself as a world-leading research and educational centre in photonics and laser science. The cooperation partners are a strategic alliance of the universities in Munich, several Max Planck Institutes and the industrial partner, Siemens AG Healthcare Sector.

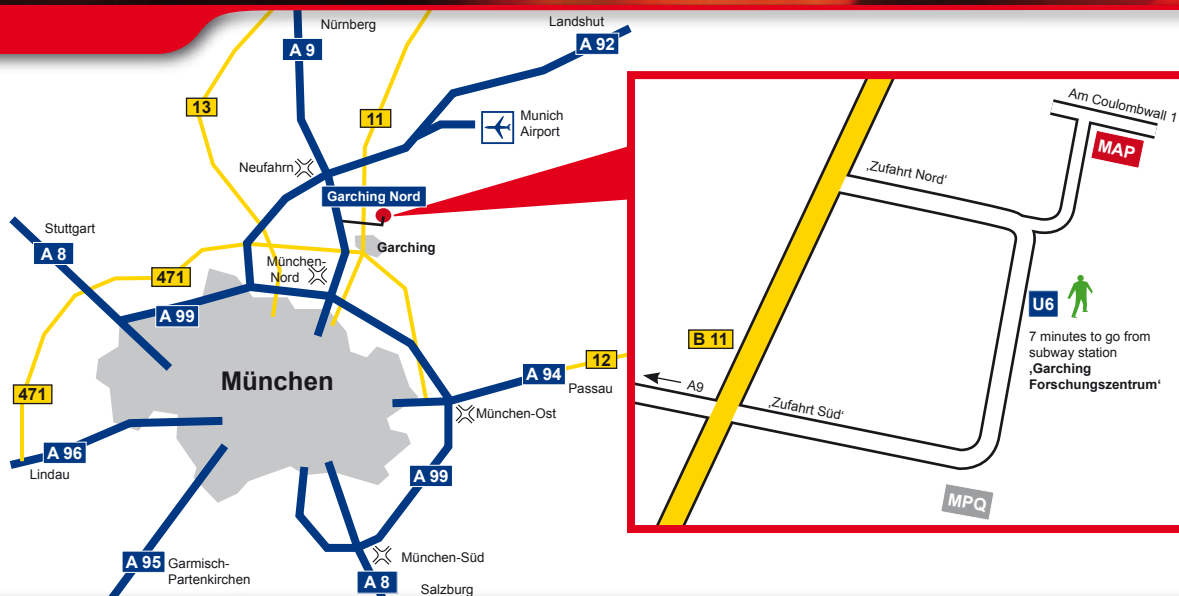
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