PHOTONICS 21

e-Health and Aging

The European Technology Platform

Photonics 21

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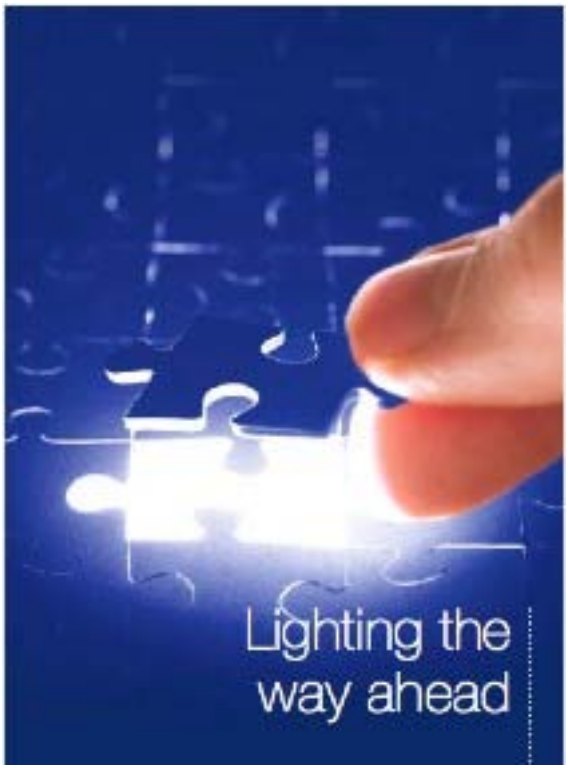
Photonics is a Key Technology based on Multidisciplinarity

- *"Photonics is the science and technology of harnessing light.*
- *Photonics encompasses the generation, detection and management of light through guidance, manipulation, and amplification,*
- *and most importantly, its utilisation for the benefit of mankind."*

1960: invention of the laser and introduction of laser diode (Maiman: Light Amplification by Stimulated Emission of Radiation).

1970s deployment of optical fibres as a medium for transmitting information using light beams led - the infrastructure of the internet

2010: The 50th anniversary of laser introduction - enormous development of photonic technologies - huge impact in medicine, lighting, information and communication as well as manufacturing.



The term photonics was coined by the French scientist Pierre Aigrain in 1967

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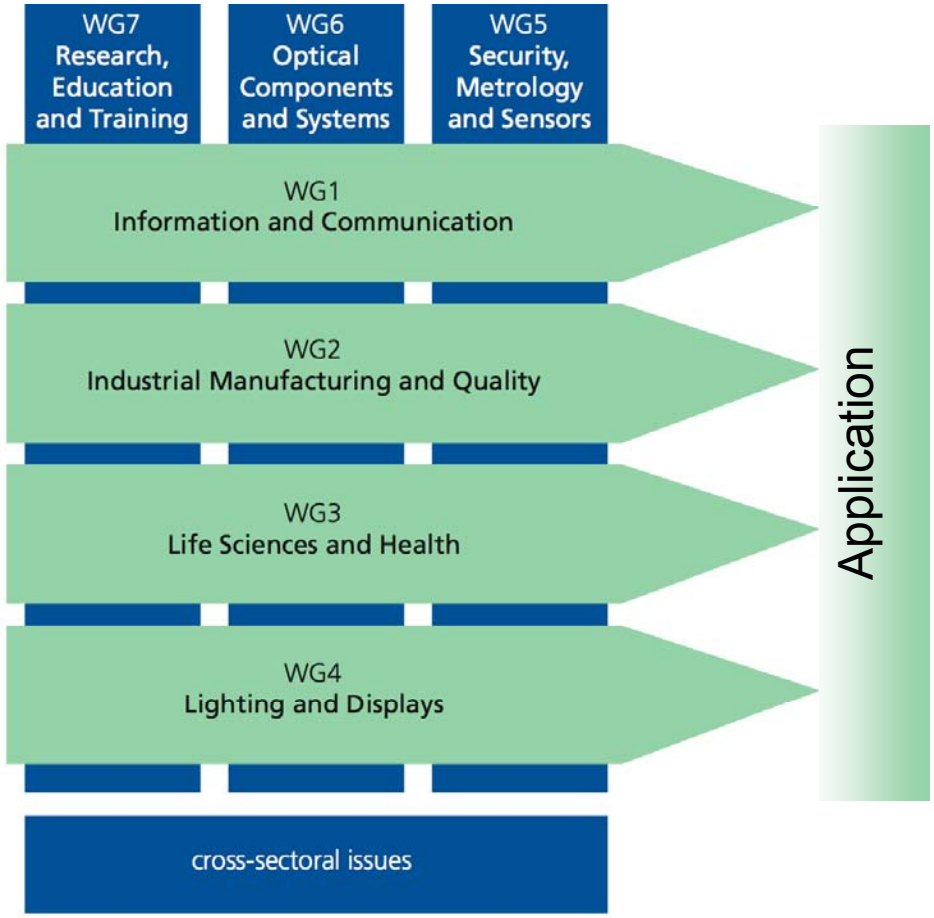
Photonics - a Key Technology for e-Health

WG1: Information and Communication

Information and communication play a vital role in every society.
The route to the information and knowledge society is through broadband internet connection, which affects health, employment, and education. Unlimited access to the internet is the most important driver of productivity and competitiveness.

WG3: Life Sciences and Health

Photonics has demonstrated a long tradition in the fields of life science and health care.
Today, it represents an indispensable tool and will play a major role in reducing costs and at the same time improving the quality of health care as well as the quality of life.



Membership: 1500 in 49 countries, including all 27 member states of the EU
Organization: 7 Working groups - Board of stakeholders - Executive Board

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Information and Communication as Basics for e-Health

The major highways of communication and information flows are optical.

The data rates of the internet are scaling with advances in lasers, optical fibres and optical coding technologies.

The mobile phone technology has progressed through text messages, personal web space on to social networking sites.

Many ‘connected’ people will have access to many gigabytes of online storage, carry a feature phone with computer-like processing power and have gigabytes of storage on their person in the form of USB memory devices and phone memory.

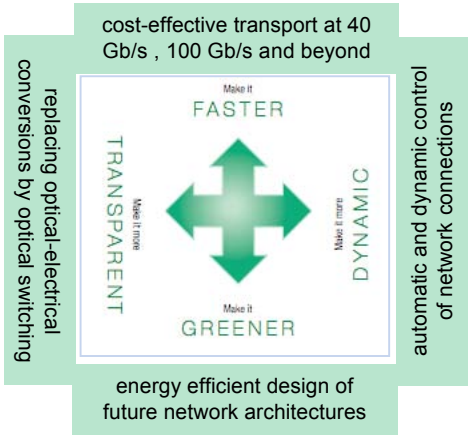
Increased web access yields:

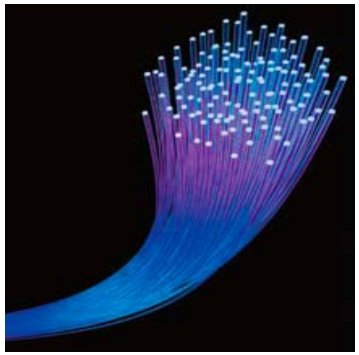
➔ huge benefits to social lives

➔ great improvements in healthcare

➔ strong advances in government and education

Fibres are the basis of optical networks and will be a key technology for Next Generation Broadband Deployment





Technology trends in photonics communications: Scaling the network in capacity and driving down the cost per managed bit

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Photonics in Life Sciences -> Biophotonics

- Biophotonics is a multidisciplinary research area that utilizes light-based technologies in medicine and life sciences.

- The vision behind biophotonics is
  - to gain a full understanding of the origins and molecular mechanisms of diseases - leading to a paradigm shift
  - prevention of disease - or at least,
  - precise and early diagnosis, followed by a patient specific individual treatment

- Human health is strongly influenced by external parameters such as food, water and air, thus, monitoring and controlling their purity are also included in biophotonics research.

Biophotonics - understand and create life processes

Photons have the potential to enter and traverse living cells. Cellular processes can be observed and monitored without interfering with their molecular functions and cell viability.

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Photonics and Aging

The main driver for the growing role of photonics in health-care and life science is one of the major social trends:

- ❏ demographic change leading to an aging society
- ❏ drastic increases in healthcare costs
- ❏ reduced quality of life

Thus, there is a strong and urgent need for an effective and affordable health care, aiming at:

- ❏ Prevention and early diagnosis of diseases
- ❏ individually tailored check-ups and personalized therapies.

Facts:

In 80% of diseases origins are still unknown - thus, only symptoms are treated.

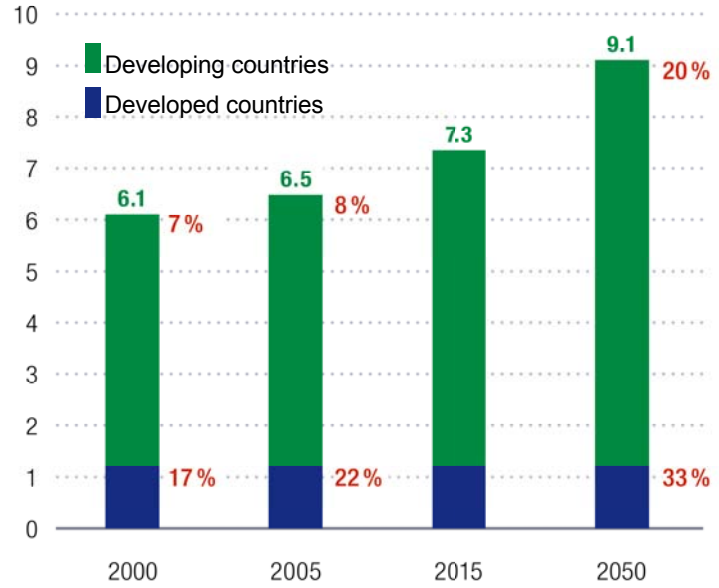
Cancer is a strongly age-related disease and still one of the fastest-growing threats to people's health.

Retinopathy or geriatric macular degeneration are age-related visual impairments, that often lead to blindness.

Symptoms of age-related diseases such as cardio-vascular and neurodegenerative diseases can early be detected in the eye.

Accelerated aging of the population

United nations world population forecasts in billions



Elderly dependency ratio

(ratio of population 65 or older to people of working age, 15 to 64)

	Developed countries		Developing countries	
From 100	older	younger	older	younger
2005	18	82	7	93
2050	25	75	17	83

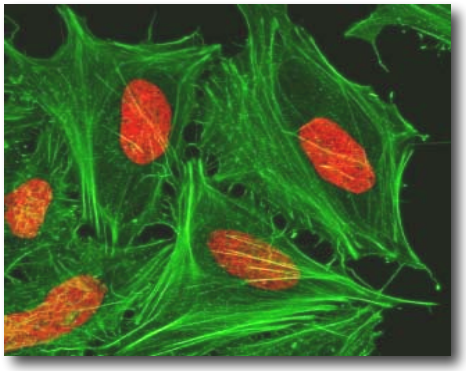
U.S. Government Accountability Office (GAO), 2006 Revision

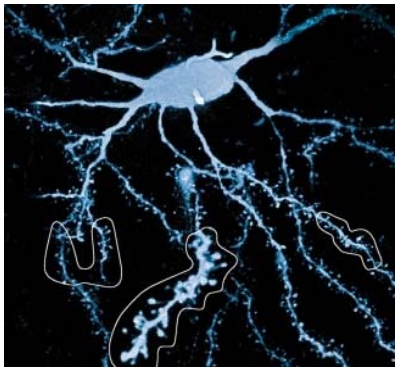
Early detection of disease

- **Modern microscopy** opened a window into the world of cells and bacteria and enable imaging cells in living organisms
- **Photonics** and **spectroscopy** become valuable tools for in-vitro studies of protein aggregation
- **Ultra-high-resolution** systems visualize cell structures smaller than 20 nanometres across

- Optical **coherence tomography** detects morphological changes in the eye and is standard in retinal and glaucoma diagnosis
- **Biochips** and optical methods for gene sequencing enable better diagnosis, opening ways for optimized cancer treatment. **Fluorescence methods** replace radiology in screening processes during drug development and are used for in-vivo cancer diagnosis.
- **Fluorescence in vivo imaging** of migration of immune cells in live mice - is a promising future human applications in stem cell therapy and regenerative medicine.
- Improved **flow cytometry** and microfluidic devices based on the varieties of Raman spectroscopy could allow spectroscopic examination of single cells

A surgical microscope being used for optimal vision in neurosurgery © Carl Zeiss





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Data acquisition and Handling

Combined optical technologies for **visualization** - including various fluorescence and spectroscopy methods - and optical **micromanipulation** are needed to detect cancer and diseases already at the cellular level. This will improve the specificity and selectivity of diagnostics and clearly advance patient specific cure.

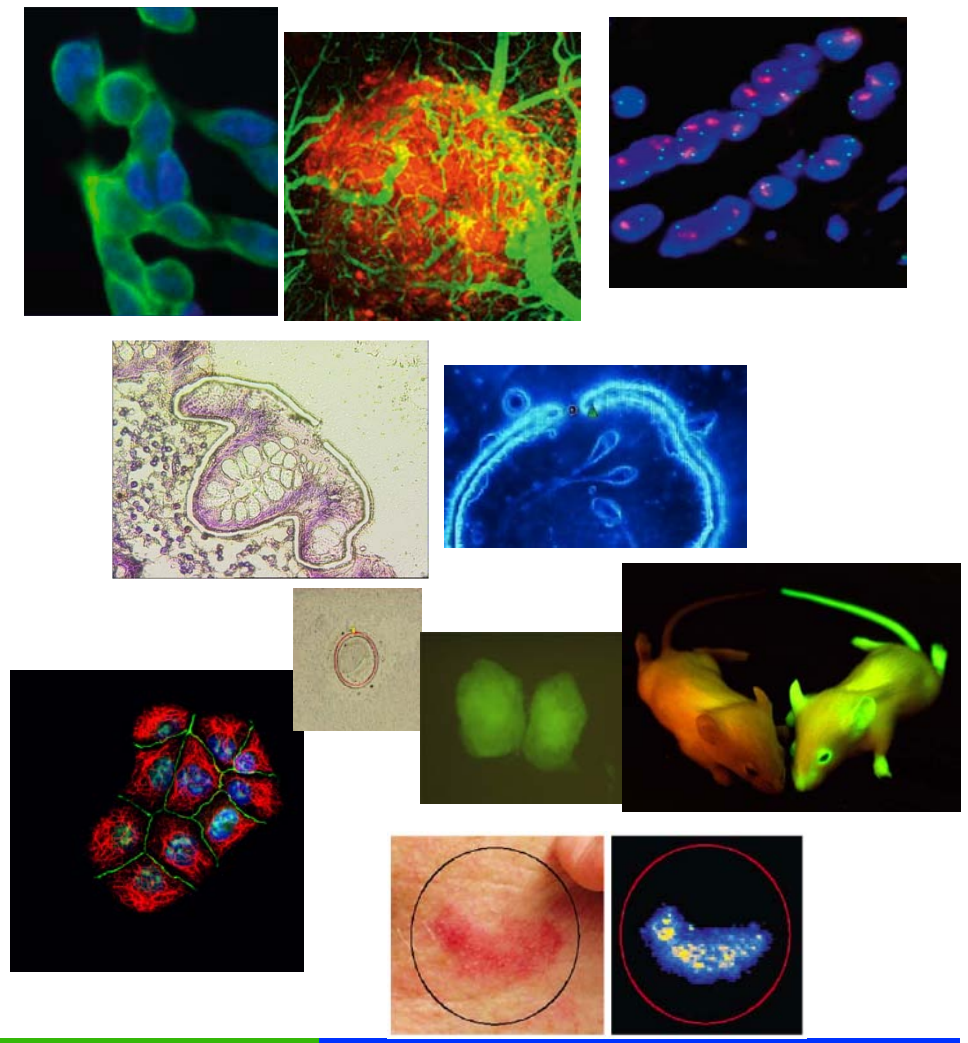
Goals:

Advanced optical methods will image

- three dimensional
- with high penetration depths
- increased sensitivity and specificity
- in real time (30 frames/s) and
- with high throughput and high content

Multimodal imaging generate complex data that must be analyzed and correlated with the development of the disease and ultimately transformed into clinically useful information which requires:

- fast data acquisition
- handling of large amounts of data
- huge storage capabilities
- extended software development



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Photonics and e-Health

eHealth
Better Healthcare for Europe

e-Health means Information and Communication Technologies tools and services for health.

Photonics *Life Sciences and Health* employs and further develops optical technologies and methods that produce a huge amount of digital information.
e-Health standards require to transfer them into useful medical information and enable data transmission with high speed, high quality and extreme safety to warrant optimal diagnosis and treatment as well as patient dignity.

Data have to be filed in secure storages.

Photonics *Information and Communication* provides the basics for fast data handling and data storage. Internet and data transfer modalities should be attuned to “e-health” standards and requirements.

e-Health covers the interaction between patients and health-service providers, institution-to-institution transmission of data, or peer-to-peer communication between patients and/or health professionals.

Health Websites: More and more people are searching the web for information on health matters, but which sites can be trusted?

Personal GPS-System - safety for dement people providing maximum freedom and movability

martin electronic systems

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Thank you for your attention!

You can find further information on the Photonics21 website:
www.photonics21.org

For any further information please contact:
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