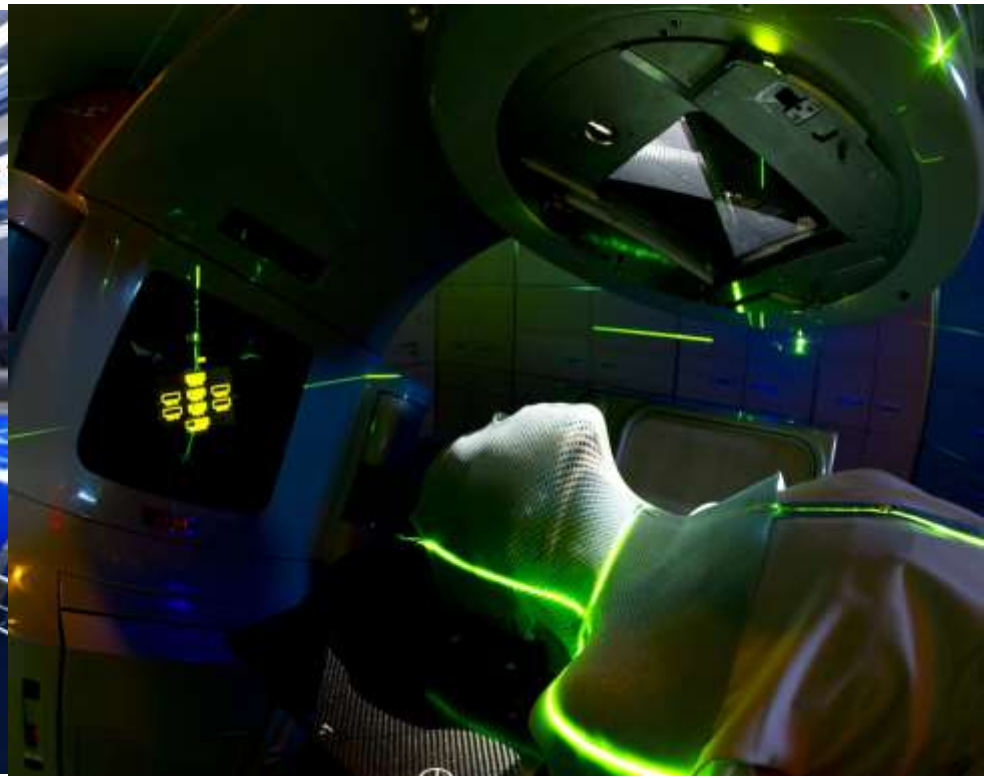
From Physics to Health applications: challenges and benefits

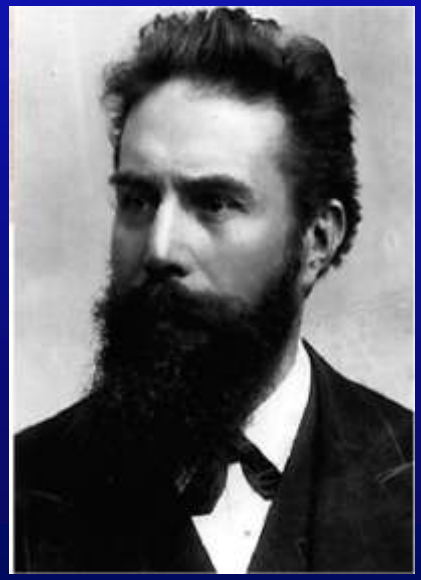


Manjit Dosanjh, CERN

Serbia Detector School , 13 September 2014

X-Rays, the fastest technology transfer example

- On November 8, 1895 Röntgen discovered X-Rays
- On November 22, 1895 he takes the first image of his wife's hand

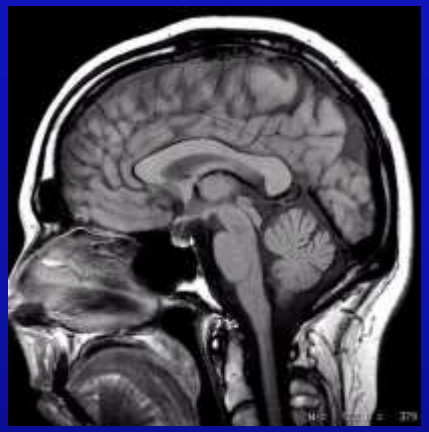


Röntgen received the first Nobel prize in physics in 1901

MRI, Magnetic Resonance Imaging

The Nobel Prize in Physics 1952

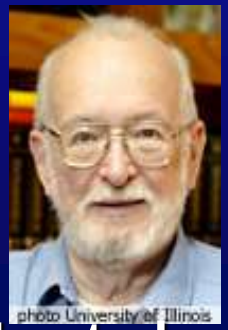
Felix Bloch
Physicist Stanford



Edward M. Purcell
Physicist Harvard

The Nobel Prize in Physiology or Medicine 2003

Sir Peter **Mansfield**
Physicist Nottingham



Paul C. **Lauterbur**
Chemist Uni. Illinois

Doctors

Patients/health

Cure

Conservative

Time (shorter)

Treatment costs (money)

Priority?

Physicists

Research

Cutting edge

Funding (money)

Time (longer term)

Benefit to society/Health

Priority?

Biomedical and Physics Needs

HEP

Highest possible performance

Lab environment/physicist operated

Complex maintenance

Complex operation

Single unit production

Non commercial

Industry as a manufacturer

Biomedical

Robustness

Non-specialist operate

Minimal maintenance

Simple to operate

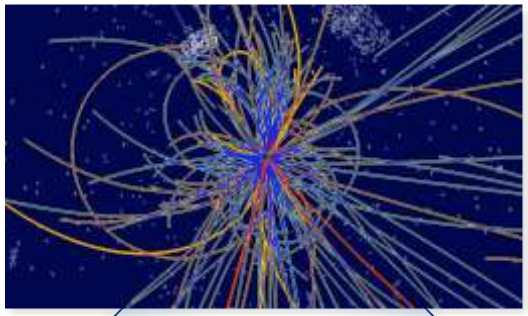
Small series production

Commercial distribution

Industry as a major partner

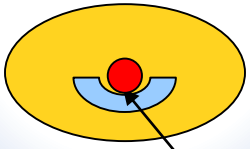
Physics technologies and innovation

accelerators, detectors and IT to fight cancer



Detecting particles

Accelerating particle beams



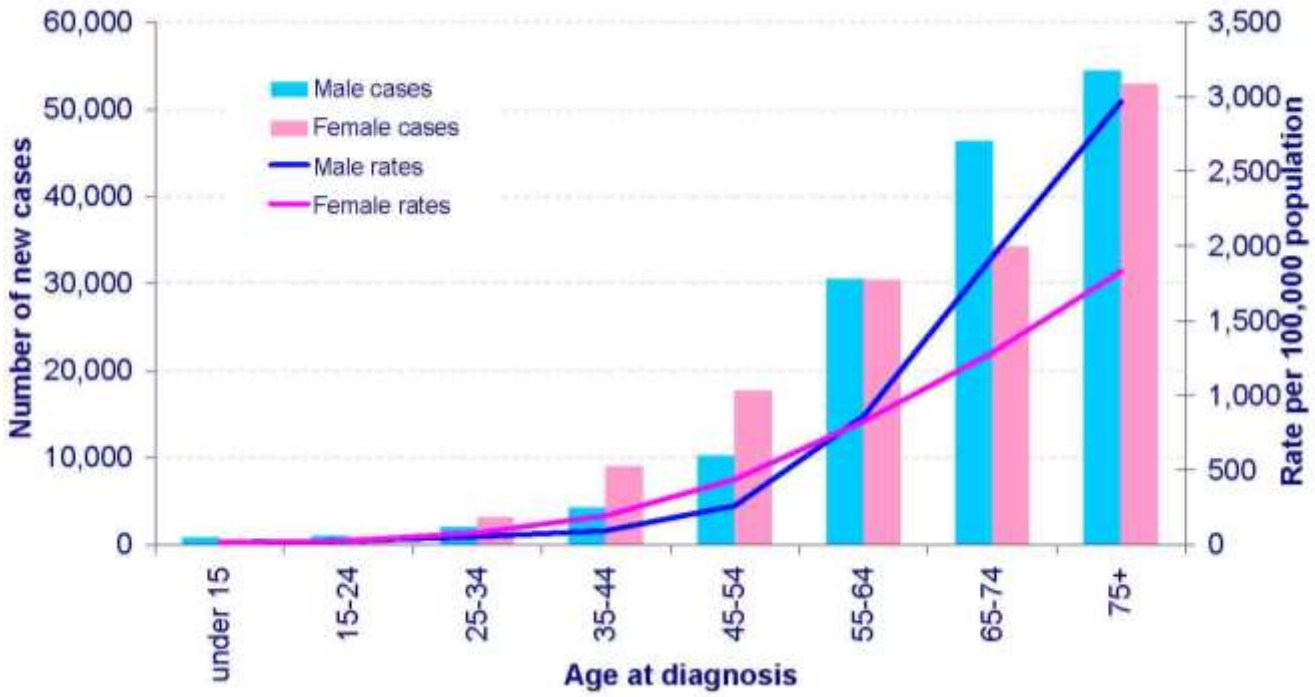
CANCER

Large-scale computing (Grid)

Cancer – a growing challenge

More than 3 million new cancer cases in Europe each year and 1.75 million associated deaths

Increase by 2030: 75% in developed countries and 90% in developing countries



Cancer is a large and growing challenge

Need: Earlier diagnosis, better control, fewer side-effects

How?

- new technologies
  - Imaging, dosimetry, accelerator & detector technology
  - Better understanding – genetics, radiobiology…
  - Advanced healthcare informatics …
- international collaboration
  - If progress is to be maintained

Although cancer is a common condition, each tumour is individual

→ personalised approach

→ Large patients data to understand the key drivers of the disease

Contribution from CERN & physics is considered timely

Catalysing collaboration in health field

Challenges:

- Bring together physicists, biologists, medical physicists, doctors
- Cross-cultural at European and global level

Why is CERN well placed to do this?

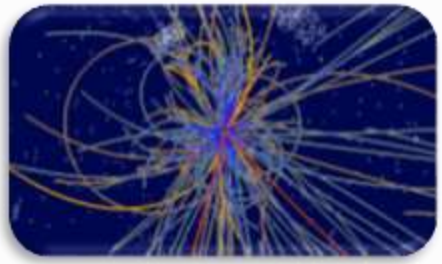
- It is widely acknowledged as a ***provider of technologies*** and as a ***catalyst*** for collaboration.
- It is international, non-commercial, not a health facility.

catalysing & facilitating collaboration

Accelerating particle beams

Particle Therapy

Detecting particles



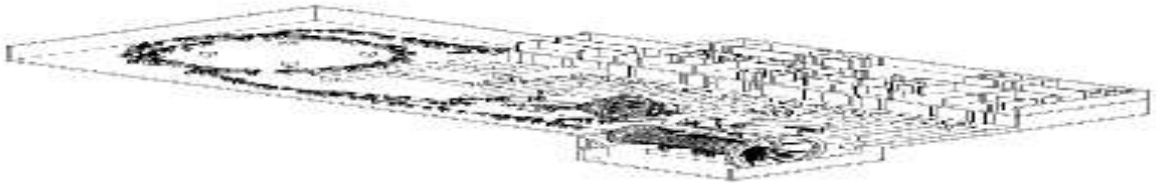
Medical imaging

Large scale **computing** (Grid)

Grid computing for medical data management and analysis

Accelerator Technologies

PIMMS 2000 (coordinated by CERN) has led to:



TERA Fondazione per Adroterapia Oncologica → fondazione CNAO

Treatment centre in Pavia, Italy.

First patient treated with in 2011

ebg MedAustron

Treatment centre in Wiener Neustadt, Austria, foundation stone in 2011, installation moved to MedAustron at beginning of 2012, first patient in 2015

ENLIGHT

Established in 2002 to coordinate European research in hadron therapy;

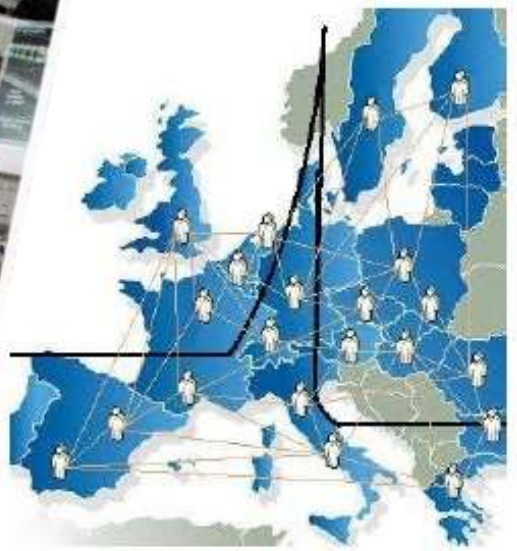
- Common multidisciplinary platform
- Identify challenges
- Share knowledge
- Share best practices
- Harmonise data
- Provide training, education
- Innovate to improve
- Lobbying for funding

CERN collaboration philosophy into health field

10 years of ENLIGHT collaboration

- Common m
- Identify cha
- Share kno
- Share bes
- Harmonis
- Provide t
- Innovate
- Lobbyin

Coordina



> 150 institutes

> 400 people

> 25 countries

(with >80% of MS involved)

EU funded projects

- Wide range of hadron therapy projects: training, R&D, infrastructures
- A total funding of **~24 M Euros**
- All coordinated by CERN,(except ULICE coordinated by CNAO
- Under the umbrella of ENLIGHT

PARTNER

- Marie Curie ITN
- 12 institutions

ULICE

- Infrastructures for hadron therapy
- 20 institutions

ENVISION

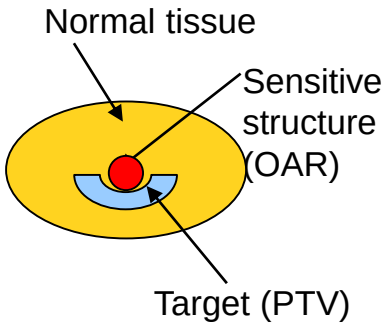
- R&D on medical imaging for hadron therapy
- 16 institutions

ENTERVISION

- Marie Curie ITN
- 12 institutions

Strategy for using Physics for Health

- review the progress in the domain of physics applications for health **together**
- identify the most **promising/necessary** areas for further developments
- explore **synergies** between physics and physics technology, health
- **catalyse dialogue** between doctors, physicists, medical physicists……
- Concrete common action plan



ICTR-PHE 2012

Uniting physics, biology and medicine for better healthcare

International Conference on Translational Research in Radio-Oncology

&

Physics for Health in Europe

February 27 – March 2, 2012 at CICG, Geneva

2 days devoted to physics, 2 days to medicine, 1 day of

Over 700 people registered, nearly 400 Abstracts

Chairs: Jacques Bernier (Genolier) and Manjit

Four physics subjects :

- Radiobiology in therapy
- Detectors and m
- Radioisotc and therapy
- Novel technolo es

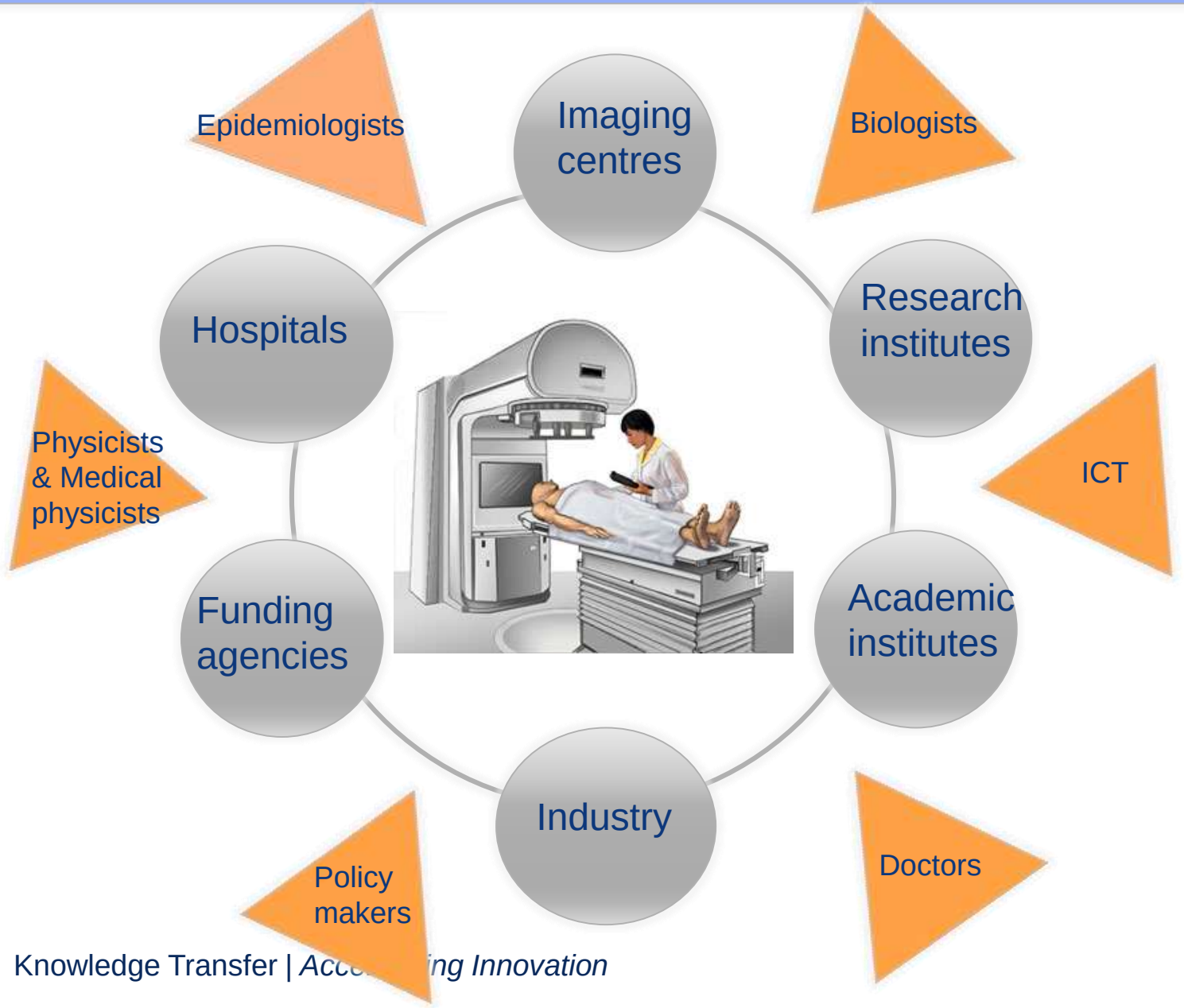
Last ICTR-PHE Conference 10-14 February 2014

We need to understand

This is not a patient!

Mazal, ICTR 2012

We need to collaboration



CERN contribution

- Provider of Know-how and Technologies
  - Design studies for Hadron Therapy facilities
  - Scintillating crystals for PET scanners
  - Fast detector readout electronics for counting mode CT
  - Grid middleware for Mammogrid, Health-e-Child

- Driving force for collaboration
  - Coordinator of the European Network for Light Ion Hadron Therapy (ENLIGHT) Platform

- Training centre
  - Coordinator of large EC-ITN funded programs, e.g. Particle Training Network for European Radiotherapy (PARTNER), ENTERVISION.PicoSec, Ardent..

The New (2013) CERN Medical Initiatives

1. Medical Accelerator Design
   - coordinate an international collaboration to design a compact, cost-effective accelerator facility, using the most advanced technologies
2. Biomedical Facility
   - creation of a facility at CERN that provides particle beams of different types and energies to external users for radiobiology and detector development
   - Iterative experimental verification of simulation results
3. Detectors for beam control and medical imaging
4. Diagnostics and dosimetry for control of radiation
5. Radio-Isotopes (imaging and treatment)
6. Large Scale Computing (large data transfers and analysis, treatment planning and simulations)
7. Applications other than cancer therapy

Will be carried out in a global collaboration


ENVISION
European NoVel Imaging Systems
for ION therapy

Thank you