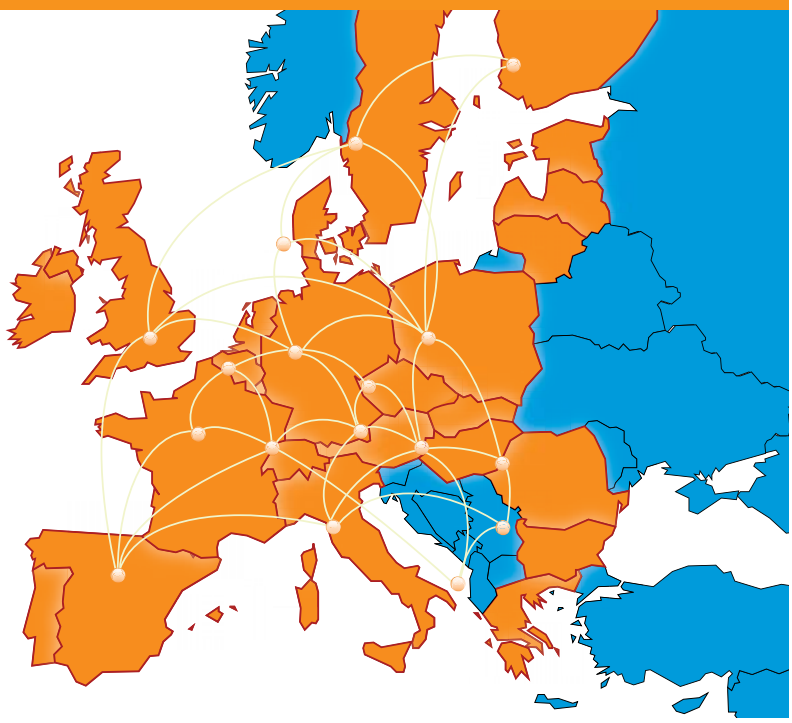
ENLIGHT

European Network for Light Ion Hadron Therapy

http://cern.ch/ENLIGHT



State-of-the-art techniques borrowed from particle accelerators and detectors are a key element in hadrontherapy and several European projects are actively fostering the collaboration amongst the various disciplines and countries.

ENLIGHT was established in 2002 to coordinate these European efforts in hadron therapy. The ENLIGHT network is formed by the European hadrontherapy Community, with more than 300 participants from twenty European countries. A major achievement of ENLIGHT has been the blending of traditionally separate communities so that clinicians, physicists, biologists and engineers with experience and interest in particle therapy are working together.

ENLIGHT demonstrates the advantages of regular and organised exchanges of data, information and best practices. It also determines strategies to be followed and actions to be implemented for future needs in research and technological development in the field. In 2006, the ENLIGHT community agreed that the goals of the collaboration could be best met by two complementary approaches: research in areas needed for highly effective hadrontherapy, and networking, to establish and implement common standards and protocols for treating patients. The primary mandate of ENLIGHT is therefore to develop strategies for securing the funding necessary to continue the initiative in these two fundamental aspects.

Specifically, in research these have been identified as important to:

- understand the biological mechanisms and the molecular players involved in the response of tumour tissues to hadrons
- enhance clinical research by increasing the first cohort of European patients treated with common protocols
- develop innovative techniques and tools to continuously improve the treatment and decrease the harm to healthy tissue and organs

and in networking:

- develop a European training platform for current and future professionals
- expand the awareness of hadrontherapy among the general public
- exchange knowledge and data across Europe

Under the umbrella of ENLIGHT, there are currently four EC funded projects; PARTNER, ULICE, ENVISION and ENTERVISION, with total funding of 24 million Euros. All these projects are directed towards the different aspects of developing, establishing and optimising hadrontherapy (further details are available on the ENLIGHT website http://cern.ch/ENLIGHT).

Hadrontherapy: history and current status

Radiation therapy is the medical use of ionizing radiation to treat cancer. In conventional radiation therapy, beams of X rays (high energy photons) are produced by accelerated electrons and then delivered to the patient to destroy tumour cells. Using crossing beams from many angles, radiation oncologists irradiate the tumour target while trying to spare the surrounding normal tissues. Inevitably some radiation dose is always deposited in the healthy tissues.

When the irradiating beams are made of charged particles (protons and other ions, such as carbon), radiation therapy is called hadrontherapy. The strength of hadrontherapy lies in the unique physical and radiobiological properties of these particles; they can penetrate the tissues with little diffusion and deposit the maximum energy just before stopping. This allows a precise definition of the specific region to be irradiated. The peaked shape of the hadron energy deposition is called Bragg peak and has become the symbol of hadrontherapy. With the use of hadrons the tumour can be irradiated while the damage to healthy tissues is less than with X-rays.

The idea of using protons for cancer treatment was first proposed in 1946 by the physicist Robert Wilson, who later became the founder and first director of the Fermi National Accelerator Laboratory (Fermilab) near Chicago. The first patients were treated in the 1950s in nuclear physics research facilities by means of non-dedicated accelerators. Initially, the clinical applications were limited to few parts of the body, as accelerators were not powerful enough to allow protons to penetrate deep in the tissues.

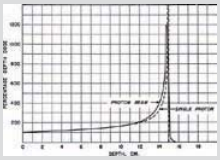
In the late 1970s improvements in accelerator technology, coupled with advances in medical imaging and computing, made proton therapy a viable option for routine medical applications. However, it has only been since the beginning of the 1990s that proton facilities have been established in clinical settings, the first one being in Loma Linda, USA. Currrently about thirty proton centres are either in operation or in construction worldwide.

Although protons are used in several hospitals, the next step in radiation therapy is the use of carbon ions. These have some clear advantages even over protons in providing both a local control of very aggressive tumours and a lower acute or late toxicity, thus enhancing the quality of life during and after cancer treatment. The modern version of carbon ion beam radiotherapy was developed between 1992 and 1997 at the GSI in Darmstadt. Between 1997 and 2008 more than 430 patients where treated with carbon ions at GSI. The GSI pilot project serves as the prototype for the commercial European ion beam radiotherapy centres. Since the birth of hadrontherapy, more than 60,000 patients have been treated globally with hadrons, including 5,500 with carbon ions.

In Europe, the interest in hadrontherapy has been growing rapidly and the first dual ion (carbon and protons) clinical facility in Heidelberg, Germany started treating patients at the end of 2009. Two more facilities, CNAO in Pavia and PTC in Marburg, will be treating patients soon and others, such as MedAustron in Wiener Neustadt, are in the construction phase.

1895 – discovery of X-rays by Wilhelm Roentgen

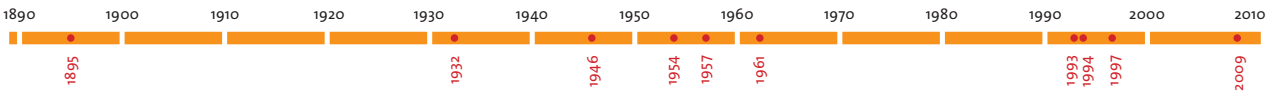
1932 – first cyclotron developed by Ernest Lawrence

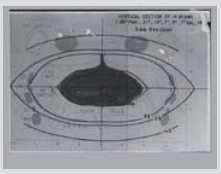


1946 – proton therapy proposed by Wilson, exploiting the properties of the Bragg peak

1954 – Berkeley treats the first patient and begins extensive studies with various ions

1957 – first patient treated with protons in Europe at Uppsala





1961 – collaboration between Harvard Cyclotron Laboratory and Massachusetts General Hospital

1993 – patients treated at the first hospital-based facility at Loma Linda

1994 – first facility dedicated to carbon ions operational at HIMAC, Japan

1997 – First patient treated with carbon ions at GSI

2009 – first European proton-carbon ion facility starts treatment in Heidelberg

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