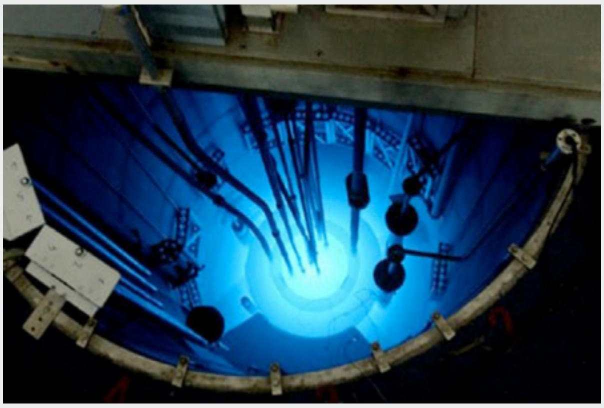
» FOCUS ON



BORON NEUTRON CAPTURE THERAPY (BNCT), AN EXPERIMENTAL SELECTIVE RADIOTHERAPY AGAINST CANCER CELLS

This is a particular form of cancer hadron therapy. An experimental radiotherapy based on neutron irradiation of tumours after treating patients with a drug containing boron ten (^{10}B): *Boron Neutron Capture Therapy* (BNCT). BNCT was discussed this month in Pavia during the eighth edition of the *Young Researchers BNCT meeting*. Organised by the INFN of Pavia - with the support and patronage of many institutional and private partners and with the participation of the *National Center of Oncological Hadrontherapy* (CNAO) - this is an international conference dedicated to young researchers, offering them the opportunity to discuss with leading BNCT experts on various aspects of basic research and clinical application of this technique. Moreover, a workshop was organised in Pavia, which was attended by clinicians applying BNCT worldwide and by CNAO radiotherapists, to discuss the common and complementary aspects of BNCT and proton and carbon ion therapy.

BNCT is an interdisciplinary methodology that requires the collaboration of physicists, clinicians, chemists and biologists. It uses thermalised neutrons, i.e. neutrons slowed down to very low energy levels, comparable to thermal energy. The method is based on the ability of ^{10}B to capture thermal neutrons with consequent emission of a nucleus of lithium and a nucleus of helium. In the medical application, ^{10}B is bound to special molecules which, administered to the patient, are absorbed by cancer cells to a larger extent than healthy cells. Neutron irradiation of the patient triggers the capture reaction on the ^{10}B. The energy released by these reactions, and transported by the lithium and helium nuclei, is absorbed locally within distances comparable to the average size of the cells. BNCT therefore selectively destroys the malignant cells, because the damage is confined to the cell containing the boron, preserving the functionality of the surrounding healthy tissue.

Until now, the neutron beams used to conduct BNCT clinical trials on patients suffering from various forms of cancer (glioblastoma multiforme of the brain, head and neck cancer, cutaneous melanomas) have been derived from suitably modified nuclear research reactors. Many patients have been treated

FOCUS ON

at these facilities located in Europe, Japan, USA, Argentina and Taiwan, and the clinical results have shown that BNCT is effective and safe, even against recurring and inoperable tumours. On the other hand, the specific design and safety requirements of a nuclear plant are too challenging to install reactors in the hospital environment. For this reason, since several years, basic BNCT research has been increasingly focusing on the development and construction of particle accelerators dedicated to the production of neutron beams sufficiently intense for BNCT. For example, this is happening at the INFN National Laboratories in Legnaro, which are developing an RFQ (*Radio Frequency Quadrupole*) proton accelerator; neutron fluxes adequate for BNCT are obtained from the collision of protons on a suitable target. In collaboration with the Pavia INFN Unit, a beam for clinical applications of BNCT is being designed as part of the MUNES (*Multidisciplinary Neutrons Source*) project. ■