Leading the world in improving uncertainty of dose to cancer patients receiving proton radiotherapy

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Proton radiotherapy

Proton radiotherapy is an advanced radiotherapy technique which enables optimal conformation of radiation dose delivered to the tumour. This is particularly beneficial in some patients significantly reducing unwanted radiation dose to the surrounding healthy tissues in comparison with conventional radiotherapy which uses high-energy x-rays beams.

World’s 1st primary-standard for proton radiotherapy

The radiation dose delivered to patients is traceable to primary standards to ensure accuracy and global consistency of radiotherapy. The National Physical Laboratory, the UK’s National Measurement Institute and Primary Standards Laboratory has built a portable primary-standard calorimeter to measure the radiation dose delivered by proton radiotherapy machines.

The calorimeter was tested at two NHS radiotherapy centres at the Clatterbridge Cancer Centre [2] and at The Christie, UK; and in three private radiotherapy centres at the Rutherford Cancer Centres in South Wales and the North East, UK, and at the Centro de Protonterapia Quirónsalud, Spain.

The calorimeter measures the temperature rise in the medium as a result of absorbed radiation.

It has a nested construction of graphite components, separated by vacuum, to minimise heat exchange with the environment.

The radiation energy, $E_{\text{rad}}$ is obtained from the measured temperature rise, the average specific heat capacity and mass of the core

$$E_{\text{rad}} = \frac{\text{mass}}{\text{specific heat capacity}} \times \Delta T$$

The new procedure based on the NPL calorimeter reduces the uncertainty on the radiation dose received by cancer patients undergoing proton radiotherapy by a factor of two, ensuring optimal tumour control and improved accuracy in proton radiotherapy treatments, both within and between treatment facilities, and establishes consistent standards that underpin the development of clinical trials. The direct use of a primary-standard in a proton beam is world leading and essential in helping to implement the safe and optimal outcome of cancer treatments using proton beam radiotherapy both for the individual patient and the patient population as a whole.


Conclusions