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BOOK OF ABSTRACT

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#P132 - Investigation of applicability of alanine pellets and films for dosimetry of proton clinical beams

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Laser-driven proton has recently gained a great interest as an alternative to conventional and more expensive acceleration techniques. These ion beams have desirable qualities such as small source size, high luminosity and small emittance to be used in different physics fields. This is very promising specially for the future perspective of a new concept of hadrontherapy based on laser-based devices could be developed, replacing traditional accelerating machines.
ELIMED (Medical Applications at Extreme Light Infrastructure) is a task-force originally born by an idea of ELI-Beams (Prague) and INFN-LNS (Italian Institute for Nuclear Physics of Catania) researchers.
ELIMED main goal is to perform proof-of-principle experiments aimed to demonstrate that laser-accelerated high-energy proton beams (up to 70 MeV in the first phase) can be potentially used for the specific case of ocular proton therapy.
In this work we report the investigation of the dosimetric features of alanine pellets exposed to protons produced by means of the CATANA (Centro di AdroTerapia e Applicazioni Nucleari Avanzate) proton therapy facility. This analysis is preliminary for the application of the alanine dosimeters in laser-driven proton beams.
ESR spectrometry with alanine is now widely recognized as the most accurate method of transfer dosimetry in the industrial (kGy) dose range. It is well established for calibrating industrial radiation sources against national standards (NIST, IAEA, NPL) and for comparisons between national laboratories. The accuracy of the method is generally very high, largely due to the low sensitivity of the alanine response to irradiation variables (energy, dose rate, temperature, etc.), and the ability of ESR spectrometers to measure dosimeter signals very precisely. As a matter of fact, the main requirements for a suitable system such as: linear response to dose, sensitivity, tissue equivalence, absence of energy dependence, absence of fading, small dimensions, ruggedness, and non-destructive readout, to a large extent are met by the alanine/ESR dosimetry.
Here we analyzed the performances of two different alanine/ESR systems (3 mm pellets and 0.1 mm films) irradiated with therapy proton beams (62 MeV). The LET dependence of the response was obtained from the analysis of pellet irradiated with a modulated beam. The energy dependence of the response was derived from the analysis of film stacks irradiated with pristine beams. Use of thin films allowed for a high resolution sampling of the proton slowing down mechanisms. Alanine measurements are compared with Markus parallel plate ionization chamber and are aided by Monte Carlo calculations for medical physics using GEANT4 code.

#P133 - Comparison of EPR response of pure alanine and alanine with gadolinium dosimeters exposed to TRIGA Mainz reactor

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The development of Neutron Capture Therapy (NCT) for cancer treatments has stimulated the research for beam characterization in order to optimize the therapy procedures. The NCT has found to be promising for treatments of tumours which hardly can be treated with other techniques, such as gliomas. Alongside with the improvements of this technique, the development of procedures for the beam characterization arouses great interest in order to optimize the therapy protocol by reliably determining the various (neutronic and photonic) components of the mixed beam usually employed for therapy.
Electron Paramagnetic Resonance (EPR) dosimetry for electron and photon beams with alanine has attracted the attention of many research groups for dosimetric purposes. Furthermore, the applications of EPR dosimetry for high LET radiation beams, such as carbon ions and neutrons, are continuously increasing. This is because of the very good dosimetric features of alanine EPR detectors such as: tissue equivalence for photon beams, linearity of its dose-response over a wide range, high stability of radiation induced free radicals, no destructive read-out procedure, no need of sample treatment before EPR signal measurement and low cost of the dosimeters. Moreover, in order to improve the sensitivity to thermal neutrons of alanine dosimeters the addition of nuclei such as gadolinium oxidewas previously studied.
The choice of Gd as additive nucleus is due to its very high capture cross section to thermal neutrons and to the possibility for secondary particles produced after interaction with thermal neutrons of releasing their energy in the neighbourhood of the reaction site. In particular, it was found that low concentration (i.e. 5% by weight) of gadolinium oxide brings about an neutron sensitivity enhancement of more than 10 times without heavily reducing tissue equivalence.
We have studied the response of alanine pellets with and without gadolinium exposed to the thermal column of the TRIGA Mark II research reactor at the University of Mainz.