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BOOK OF ABSTRACT

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When also radiobiological data are plotted as a function of the mean ionization-cluster size M_1, the result is a clear relation between radiobiological cross sections and some of the cumulative distributions F_k. The correspondence between radiobiological cross sections and experimental nanodosimetric data for protons and carbon ions will be presented.

#510 - The impact of self-oxidation on the dosimetric performance of ferrous-sulfate/xylenol-orange gels

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Since their introduction in the 1980's, most of the research on ferrous-sulfate gel dosimeters has aimed at minimizing the ferric ion diffusion phenomena that blur the 3D distribution of the signal. However, equally important are the spontaneous oxidation effects, which alter the sensitivity of the gels over time. In some gels, this effect is very pronounced and must be accounted for even when production, calibration and use of the gels are separated by just a few days. In other cases, the effect is much milder, but should still be properly accounted for when gels are used over a long period a time, such as in the proposed monitoring of adaptive radiotherapy treatments. Our work examined and modeled the spontaneous oxidation processes occurring in ferrous-sulfate/xylenol-orange gels for 3D dosimetry. The model accounts for the time interval between production of the gels and their use, as well as for the fractionation schemes adopted for the irradiations. Based on a single kinetic constant and on the initial amounts of Fe2+ and Fe3+, our model predicts as a function of time the amount of Fe3+ present in the gels and coordinated with xylenol-orange.

#511 - Use of alanine EPR dosimeters for discriminating neutron and photon components in the thermal column of Pavia Triga reactor

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The optimization of the procedures of Neutron Capture Therapy (NCT) for cancer treatments involves research for beam characterization. One major issue for this therapy is the reliable dosimetric determination of the various (neutronic and photonic) components of the employed beam. In particular, the precise and accurate measurements of the gamma photon component is fundamental for evaluating the risks to healthy tissues hit by the mixed field.
Among solid state dosimeters the alanine detectors read by Electron Paramagnetic Resonance (EPR) technique present several advantages such as: tissue equivalence for photon and electron beams, linearity of its dose-response over a wide range, high stability of radiation induced free radicals, no destructive read-out procedure, no sample treatment before EPR signal measurement and low cost of the dosimeters.
These features associated with the possibility of recognizing the various components of a mixed radiation fields makes alanine a good candidate for dosimetry in neutron-gamma fields.
In this work we determine the gamma component of the mixed radiation field in thermal column of the Triga Reactor of University of Pavia (which is used for experimental activities on NCT) by means of alanine EPR dosimeters.
Commercial alanine dosimeters produced by Synergy Health (Germany) were exposed in three positions in the thermal column; the irradiations were performed inside graphite holders to avoid use of hydrogenous phantoms for minimizing the gamma contribution due to the plastic holders. EPR measurements were carried out through Bruker ECS106 spectrometer equipped with a TE_{102} rectangular cavity. In order to isolate the gamma components of the mixed field two kinds of irradiations were carried out inside a lithium carbonate box (wherein the thermal neutron component is heavily reduced) and outside of it.
MCNP Monte Carlo simulations of the irradiation set-up were carried out, calculating the contributions of the various components present in the mixed field (thermal and fast neutron and gamma).
The experimental values are compared with the computations of the Monte Carlo simulations and the results are discussed on the basis of the mixed field features and on the response of alanine dosimeters to high and low LET radiations.

#512 - Alanine EPR pellets for dosimetry of clinical proton and carbon ion beams

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Proton and carbon ion beams offer several advantages compared to other radiation fields for therapy such as low lateral scattering and high biological effectiveness (RBE) in the Bragg peak region, making them particularly attractive for the treatment of radio-resistant tumors localized close to organs at risk. Although ion beam radiotherapy ultimately requires dose prescription in terms of biological dose or cell survival, absorbed dose is still the quantity mostly used in clinical quality assurance and to dosimetrically characterize the beam.
Among solid state detectors the alanine EPR detectors present several advantages such as: tissue equivalence, linearity of its dose-response over a wide range, high stability of radiation induced free radicals, no destructive read-out procedure, no sample treatment before EPR signal measurement. These features associated with the possibility of recognizing the various components of a mixed radiation fields makes alanine a good candidate for Quality Assurance of clinical particle beams.
The main goal of the present work is to investigate the response behaviour of alanine EPR pellets in clinical proton and carbon ion beams. Proton irradiations were carried out at PSI (Switzerland) using both passive and active scattering modality, whereas, ^{12}C ions irradiation were performed at GSI (Germany) adopting the raster scanning modality.
Regarding the passive scattering modality, Output Factormeasurements have been carried out at the OPTIS2 facility of PSI and the results are in agreement with Hi-p semiconductor diode up to 10 mmcollimator diameter. Moreover, regarding the active scanning technique (raster scanning for ^{12}C and spot-scanning for protons) the alanine response at selected locations in depth has been measured andcompared with TPS planned dose in different quasi-clinical scenarios. A dosimeter 'quenching' more evident for ^{12}C ions than for protons wasmeasured.
Furthermore, the study of EPR signal stability after irradiation wasperformed for both proton and carbon ion irradiations.

#513 - Fricke gel layer dosimeters for measurements of all dose components in irradiations with epithermal neutrons beams at a research reactor

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Gel dosimeters in form of layer have shown noticeable potential for dosimetry in epithermal or thermal neutron fields with very high fluence rate, as those characteristic of nuclear research reactors that are exploited for boron neutron capture therapy (BNCT), because they give the possibility of attaining the spatial distribution of the various dose components generated by neutron reactions in water-equivalent phantoms.
Wide studies have been carried out utilising laboratory-made Fricke gel dosimeters containing xylenol orange. By suitably adjusting the dosimeter isotopic content, the separation of the dose components having different LET can be achieved. In their standard composition, these dosimeters are water equivalent for neutrons and for all the secondary radiations generated by neutron reactions inside the phantom. In particular, the dose due to the charged particles generated by the reactions of thermal neutrons with ^{10}B can be attained from the dose images obtained with two dosimeters, a standard one and another containing a suitable amount of ^{10}B. From the boron dose images, the thermal neutron fluence images can be attained by means of the kerma factor. The gamma dose and the dose due to fast neutrons, not negligible in the case of epithermal neutron beams, can be separated by suitable elaboration of the dose images measured by means of two other dosimeters, a standard one and an other with the same chemical composition but prepared with heavy water.
Fricke–xylenol–orange gel dosimeters have also shown to be a valid aid for the characterization of the neutron beams from epithermal or the thermal columns of a research reactor.