The Henryk Niewodniczański
Institute of Nuclear Physics
Polish Academy of Sciences
Poland, Kraków

NEUTRON AND ION DOSIMETRY SYMPOSIUM

NEUDOS13

PROGRAMME

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12:50 - 14:00 *Lunch*

CHARACTERIZATION OF THE GAMMA DOSE COMPONENT IN THE NEUTRON FIELD OF A BNCT IRRADIATION FACILITY

S.Altieri[1,2] , S.Bortolussi[1,2], S.Fatemi[1,2], M.Ferrari[1,2], I.Postuma[1,2], M.Prata[1,3], N.Protti[1,2], S.Gallo[4,5], M.Marrale[4,5,6]

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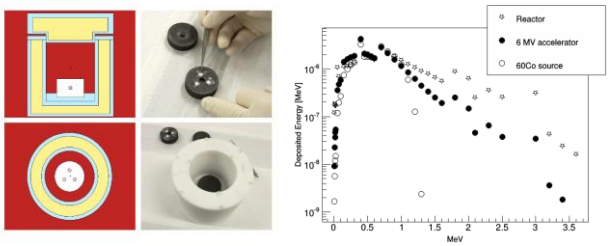
At the University of Pavia, a neutron irradiation facility has been constructed for preclinical *in vitro* and *in vivo* studies for BNCT. The facility is a wide channel (40 x 20 x 100 cm^3) inside the graphite Thermal Column of the 250 KW research reactor TRIGA Mark II. The neutron field consists in a thermal component ranging from about 10^{10} and 10^9 $cm^{-2}s^{-1}$ along the longitudinal axis of the channel and it is uniform within 10% along the transversal axes. The fast neutron contamination (E_n > 1.58 keV) is more than 2 orders of magnitude lower. The gamma background coming from the core has been reduced with a 20 cm thick bismuth shield, however in the facility a gamma component is still present due to neutron capture reactions in Bi and C. A set of simulations with the Monte Carlo code MCNP has been conducted together with measurements using alanine dosimeters to determine the gamma background during irradiation. Attention has been put in the choice of the material surrounding the alanine dosimeters (r = 2.4 mm and height h = 30 mm) in order to ensure electronic equilibrium: hydrogenated materials have been discarded to avoid additional dose due to the (n, γ) reactions in H: graphite holders have been used to this end. Simulations have been performed to choose the calibration gamma source: the gamma spectrum present in the facility has been calculated as well as the spectra of energy deposition in alanine due to the charged secondary radiation (electrons). A photon source produced in a 6 MV electrons linear accelerator was found to be much more suitable than the ^{60}Co source typically employed to calibrate dosimeters. To determine the thermal neutron contribution to the alanine response a lithium carbonate (Li-6 enrichment: 95%) shield (attenuation factor of about three orders of magnitude) was prepared to host the dosimeters during irradiation; measurements with and without shield were done; gamma dose rates were between 6.0 ± 0.3 Gy/h and 1.5 ± 0.1 Gy/h along the longitudinal axis of the Column. The comparison between the experimental results and the simulations allowed determining a sensitivity factor of alanine to thermal and fast neutron dose equal to 0.4.



Irradiation set-up in the thermal column (left) and simulated spectra of the energy deposits (*F8 tally) in alanine exposed at the reactor gamma spectrum, at the 6 MV electron accelerator and at the ^{60}Co source (right).