Preliminary study of the shielding for a CdZnTe based SPECT-BNCT imaging system in an aBNCT treatment room.

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To improve the BNCT efficacy a BNCT-SPECT system has been proposed. SPECT imaging of the 478 keV photon emitted in the 94% of the cases due to the ^{10}B thermal neutron capture reaction would allow for a direct quantification of the dose delivered to the patient, giving a fundamental information in real time during the treatment. Moreover a BNCT-SPECT would be an on-line imaging system, therefore it would be installed inside the treatment room of a BNCT clinical facility. As such it is important to study the mixed neutron and gamma background present in the treatment room during the patient irradiation and the degree to which such background interacts with the BNCT-SPECT system.
The Pavia BNCT group has studied a clinical facility with a proton based accelerator neutron source from a computational point of view, and the feasibility of a BNCT-SPECT imaging system based on a CdZnTe semiconductor detector. We studied the neutron and gamma background inside the treatment room and simulated its interaction with the CdZnTe (CZT) detector deeming necessary to study a proper shielding. Not only the detector needs to be shielded from the gammas due to the hydrogen in the patient and the other materials in the room but also from the thermal neutrons that interact with the cadmium in the CZT detector. In particular the $^{113}Cd(n,\gamma)^{114}Cd$ capture reaction emits photons at different energies which are close to the 478 keV peak of our interest. In the current work we studied the shielding possibilities to reduce the background received by the detector itself and the connected electronics and the possible improvements to the 478 keV signal when such shielding possibilities are applied.

After evaluating, from a computational point of view, the thermal, epithermal and fast neutron

fluences and the gamma background inside the 4x3.3x6 m^3 treatment room equipped with a 5 MeV p,Be neutron source we took into account the interaction of such background with the CZT detector. We implemented in the MCNP6v2 simulations a shielding of the detector itself from thermal neutrons using different lithium based shields and studied the best solution that permits to reduce the Cd capture reaction while avoiding to much weight on the imaging system.
Lastly we studied the gamma shielding for the imaging system considering both the possibility to shield the detector itself using lead and the feasibility and the improvement gained by studying the background coming from the beam port wall in the treatment room an reducing its contribution.
Results of such computational study are presented in this work.

Poster presentation