State of art of the BNCT-SPECT project at Pavia University and INFN

Nicoletta Protti
National Institute of Nuclear Physics INFN, Pavia Unit, Italy
Email: nicoletta.protti@unipv.it

Chunhui Gong
National Institute of Nuclear Physics INFN, Pavia Unit, Italy

Setareh Fatemi
National Institute of Nuclear Physics INFN, Pavia Unit, Italy

Giacomo Benassi
due2lab s.r.l., Parma, Italy

Manuele Bettelli
IMEM-CNR Parma, Italy

Nicola Zambelli
due2lab s.r.l. Parma, Italy

Silvia Zanettini
due2lab s.rl. Parma & IMEM-CNR Parma, Italy

Silva
Bortolussi
National Institute of Nuclear Physics INFN, Pavia Unit & Pavia University, Physics Department, Italy

Chiara Magni
National Institute of Nuclear Physics INFN, Pavia Unit & Pavia University, Physics Department, Italy

Ian Postuma
National Institute of Nuclear Physics INFN, Pavia Unit, Italy

Andrea Zappettini
IMEM-CNR Parma, Italy

Saverio Altieri
National Institute of Nuclear Physics INFN, Pavia Unit & Pavia University, Physics Department, Italy

We report on the results and on-going studies of the BNCT-SPECT project carried out at Pavia University and Pavia-INFN. The project wants to evaluate the development of a SPECT system to monitor in vivo the dose delivered in patients during BNCT.

CdZnTe (CZT) semiconductor detectors are presently under scrutiny for diagnostic and molecular imaging [1,2]. For the named BNCT-dedicated SPECT, CZT technology has been chosen thanks to its high detection efficiency even using small sensitive volumes together with its extremely good energy resolution, greatly valuable inside the mixed (n+γ)-radiation field of a BNCT facility [3]. In

addition, the possibility of working at room temperature avoids a cumbersome cooling system thus facilitating patient positioning despite the close proximity of the photon sensor.

After a preliminary characterisation of the first CZT prototype [4], we evaluated the capability of a 5x5x20 mm^3 detector to discriminate the 478 keV peak from the activation signals at 558 and 651 keV induced by thermal neutrons in Cd-113. These studies, carried out inside inside the Thermal Column (T.C.) of Pavia University reactor, confirmed the proper identification of the BNCT peak even when a significant neutron background is accounted. Anyway, the presence of a huge amount of boronated compounds inside the T.C. for radio-protection reasons denied the clear proof of the CZT capability of recording the BNCT signal coming from B-10 enriched samples exposed to collimated neutron fields. Thus, we went through new tests which exploited the recently built Prompt Gamma Neutron Activation Analysis (PGNAA) facility of the LENA laboratory. Due to its main application, this facility is characterised by a very low photon background and by an almost complete absence of B-10 in the shielding structure. After some Monte Carlo simulations to know the neutron and photon backgrounds and from which we evaluated the necessity of proper shields around the detector, we carried out the first spectroscopic measurements of B-10 enriched materials and tissue equivalent samples, together with some sensitivity studies focusing on the lowest B-10 detectable threshold.

In parallel, a second CZT prototype has been developed and built with the aim of being the detecting unit of the future BNCT-SPECT. In particular, the sensitive volumes increased to 20x20x5 mm^3 and the detector is now capable of 3D spatial sensitivity thanks to the orthogonal pattern of the striped electrodes. First preliminary measurements at Pavia reactor are presently on-going and will be briefly presented.

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