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A time of flight detector for thermal neutrons from radiotherapy Linacs

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Boron Neutron Capture Therapy (BNCT) is a therapeutic technique exploiting the release of dose inside the tumour cell after a fission of a 10B nucleus following the capture of a thermal neutron. BNCT could be the treatment for extended tumours (liver, stomach, lung), radio-resistant ones (melanoma) or tumours surrounded by vital organs (brain). The application of BNCT requires a high thermal neutron flux (>5×10 8 n cm−2s−1) with the correct energy spectrum (neutron energy <10 keV), two requirements that for the moment are fulfilled only by nuclear reactors. Several collaborations (among them the INFN PhoNeS project) are trying to produce such a neutron beam with standard radiotherapy Linacs, maximizing with a dedicated photo-neutron converter the neutrons produced by Giant Dipole Resonance by a high energy (>8 MeV) photon beam. In this framework, we have developed a real time detector to measure the thermal neutron time of flight to compute the flux and the energy spectrum. Given the pulsed nature of Linac beams, the detector is a single neutron counting system made of a scintillator detecting the photon emitted after the neutron capture by the hydrogen nuclei. The scintillator signal is sampled by a dedicated FPGA clock thus obtaining the exact arrival time of the neutron itself. The paper will present the detector and its electronics, the feasibility measurements with a Varian Clinac 1800 and the development status of the final 2D dosimeter.

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