Contribution ID: **51** Type: **Talk**

Innovative thin silicon detectors for monitoring of therapeutic proton beams: preliminary beam tests.

Wednesday 6 September 2017 11:20 (20 minutes)

Purpose. A multidisciplinary project (Move-IT) of the Italian National Institute for Nuclear Physics (INFN) aims at translating research in charged particle therapy into clinical outcome. To this scope, new models in the treatment planning system will be developed and validated, using dedicated devices for beam characterization and monitoring in radiobiological and clinical irradiations. Innovative silicon detectors with internal gain layer (LGAD) represent a promising option, overcoming the limits of ionization chambers for on-line monitoring of the dose delivered with active beam scanning. Two devices are being developed: one to directly count individual protons at high rates, exploiting the large signal-to-noise ratio and fast collection time in small thicknesses (1 ns in 50 μm) of LGADs, the second to measure the beam energy with time-of-flight techniques, using LGADs optimized for excellent time resolutions (Ultra Fast Silicon Detectors, UFSDs). The preliminary tests of UFSD sensors with a therapeutic beam will be presented.
Methods. Counting and timing properties of UFSDs are evaluated using two pads (1 mm^2 x 50 μm) aligned to the proton beam (10^9 p/s, FWHM 1 cm). Several algorithms to determine the number of particles and crossing time difference between the sensors are tested via offline analysis of collected waveforms.
Results. The sensors signals show well separated contributions from single particles, with low pile-up probability up to almost 10^9 p/(cm^{2}s), and time resolution of ˜50ps for single crossing. The measured numbers of counts from two aligned detectors are well correlated, and the beam structure is resolved at the nanosecond level. Studies of time resolution, pile-up probability, count linearity vs beam flux, and degradation with dose will be presented.
Conclusion. UFSDs are found to be a viable option for monitoring of therapeutic beams. Based on these results, the design and expected performance of the two devices will be presented and discussed.

Authors: VIGNATI, Anna (INFN - National Institute for Nuclear Physics - Torino (IT)); MONACO, Vincenzo (Universita degli Studi di Torino (UniTo) e INFN Torino (IT)); ATTILI, Andrea (INFN Torino (IT)); CARTIGLIA, Nicolo (INFN Torino (IT)); DONETTI, Marco (Fondazione CNAO); FADAVI MAZINANI, Mohammad (Hakim Sabzevari University, Sabzevar, Iran); FAUSTI, Federico (Polytechnic University of Turin and INFN Torino (IT)); FERRERO, Marco (INFN Torino (IT)); GIORDANENGO, Simona (INFN Torino (IT)); HAMMAD ALÌ, Omar (Università degli Studi di Torino (UniTo) e INFN Torino (IT)); MANDURRINO, Marco (INFN Torino (IT)); MANGANARO, Lorenzo (Università degli Studi di Torino (UniTo) e INFN Torino (IT)); MAZZA, Gianni (INFN Torino (IT)); SACCHI, Roberto (Universita degli Studi di Torino (UniTo) e INFN (IT)); SOLA, Valentina (INFN Torino (IT)); STAIANO, Amedeo (INFN Torino (IT)); CIRIO, Roberto (Universita degli Studi di Torino (UniTo) e INFN Torino (IT))

Presenter: VIGNATI, Anna (INFN - National Institute for Nuclear Physics - Torino (IT))

Session Classification: Applications in life sciences, biology and medicine: Protons