CNAO - ARDENT Workshop

Report of Contributions

https://indico.cern.ch/e/209428

Contribution ID: **0** Type: **not specified**

Introduction to CNAO

Friday 19 October 2012 08:45 (10 minutes)

Presenter: Mr ROSSI, Sandro (CNAO)

Contribution ID: **1** Type: **not specified**

Introduction to ARDENT

Friday 19 October 2012 08:55 (15 minutes)

Presenter: SILARI, Marco (CERN)

Contribution ID: **2** Type: **not specified**

Radiation Field Analysis with a multi-element TEPC, W. Matysiak, A. Hanu, A. Waker (UOIT, McMaster University, Ontario, Canada)

Friday 19 October 2012 14:20 (20 minutes)

A multi-element TEPC detector consisting of 61 elongated cylindrical cavities drilled in a 5 cm by 5 cm cylindrical block of A-150 tissue equivalent plastic filled with low pressure tissue equivalent propane gas to simulate a 2 micrometer soft tissue site has been constructed and characterized for radiation protection neutron monitoring in nuclear power plants. However, by operating each active volume of the multi-element detector independently, the detector can be operated in the Coincidence-Anticoincidence Shield (CACS) mode. This operation mode allows the separation of charged and neutral components of a radiation field based on coincidence/anticoincidence events between the central and guard detectors. Further analysis of the neutral component to separate photon and neutron doses can be done based on linear energy transfer (LET) properties of the two radiation types. A theoretical feasibility study has been carried out of the operation of the METEPC in this mode for high energy proton beams typical of radiotherapy and space environments; the next stage in this work would be an experimental investigation and verification of charged-neutral particle discrimination using an METEPC.

Primary authors: HANU, A.; WAKER, A.; MATYSIAK, W.

Session Classification: Talks on proposed experimental activities at CNAO

Contribution ID: **3** Type: **not specified**

A monolithic silicon telescope for hadron beams, S. Agosteo (Politecnico of Milano)

Friday 19 October 2012 10:20 (20 minutes)

A monolithic silicon telescope (MST) consisting of a surface ΔE detector 2 μm in thickness coupled to an E detector about 500 μm in thickness made out of a single silicon wafer was recently proposed for the microdosimetric characterization of hadron beams. The ΔE detector is segmented in a matrix of micrometric cylindrical diodes (about 9 μm in diameter, 2 μm in height).
The silicon microdosimeter was placed within a Lucite phantom at different depths and irradiated with clinical proton beams at the CATANA facility of the Italian Institute of Nuclear Physics (INFN). The microdosimetric spectra were directly compared with the ones measured in the same experimental conditions by a reference Tissue-Equivalent Proportional Counter (TEPC). The same device was also tested with 62 AMeV carbon ions at the INFN Laboratori Nazionali del Sud. The results of these experiments will be discussed in order to propose analogous measurements for assessing the quality of the CNAO therapy beams.

Presenter: AGOSTEO, Stefano (Politecnico di Milano)

Session Classification: Talks on proposed experimental activities at CNAO

Contribution ID: **4** Type: **not specified**

Silicon Sensors Suite (3S) for characterization of hadron therapeutic beams - L. Tran, I. Fuduli, C. Porum, M. Petasecca, S. Guatelli, M. Lerch, M. Reinhard, D. Prokopovich, A. Rozenfeld (CMRP UOW, Wollongong, Australia)

Friday 19 October 2012 14:00 (20 minutes)

Centre for Medical Radiation Physics is developing quality assurance (QA) instrumentation for radiation therapy. Two types of experiments are proposed on C-12 and proton therapeutic beams.
1. High Spatial Resolution SOI Microdosimetry on proton and C-12 beams.
Microdosimetry based RBE study on C-12 and proton therapeutic beams along the Bragg Peak (BP) and SOBP (Spread-Out -BP) using SOI microdosimeters will be carried out. Aim of this experiment is to investigate the relative uniformity of RBE in passively delivered SOBP that never was done earlier experimentally.
RBE will be investigated downstream of the SOBP due to C-12 ions fragmentation with sub-millimetre spatial resolution to predict the effect of high and low LET ions on critical organs close to the targeted tumour.
In addition, the neutron and scattered charged particle total dose equivalent will be investigated out of field in a penumbra region and within 50 cm laterally in a PMMA phantom , to compare C-12 with proton beams for the same RBE weighted dose in SOBP.
The results will be compared with GEANT 4 simulations.

1. High Spatial Resolution Absorbed Dose Dosimetry with "Magic Plates". Experiments will be carried out in a solid water and water phantom using transparent 1D and 2D Magic Plate (MP) dosimetry instruments intensively tested by CMRP in IMRT and SRS X-ray therapy and recently on proton SRS beam. Different modifications of MPs have spatial resolution of dose mapping in a range 0.1-10 mm. MP with areas 11x11 cm2 and 5x5 cm2 will be used for real time penumbra characterization on C-12 and proton collimated therapeutic beams of different sizes using scanning water phantom.

Presenter: AGOSTEO, Stefano (Politecnico di Milano)

Session Classification: Talks on proposed experimental activities at CNAO

Contribution ID: **5** Type: **not specified**

Measurement of pulsed neutron stray radiation - M. Caresana (Politecnico of Milano)

Friday 19 October 2012 10:00 (20 minutes)

The aim of the measurement is to test the instrument prototype LUPIN around the CNAO accelerator. The interest is to measure in the synchrotron hall, in the treatment rooms, in the mazes and outside the shielding walls. The beam delivery should be pulsed with the possibility to vary the beam intensity and the repetition rate. The results will be compared with passive measurements performed with track detectors (or other instruments unaffected by pulsed neutron fields) in the same positions.

Presenter: CARESANA, Marco (Politecnico di Milano)

Session Classification: Talks on proposed experimental activities at CNAO

Contribution ID: **6** Type: **not specified**

Track detector development for neutron and mixed field dosimetry - A. Parravicini (MI.AM)

Friday 19 October 2012 11:00 (20 minutes)

The aim of the measurement program is to test and characterize the CR-39 detectors for environmental and personal dosimetry in high energy neutron and mixed fields. The measurements may also be based on LET spectrometry, and may take place inside the synchrotron hall or the treatment rooms for environmental and personal dosimetry. Some tests may also be performed for LET spectrometry and secondary dose evaluation in proton or carbon therapy.

Presenter: FERRARINI, Michele

Session Classification: Talks on proposed experimental activities at CNAO

Contribution ID: **7** Type: **not specified**

Beam monitoring for beam profile and intensity measurements with GEM detector in-beam and in-phantom - R. Froeschl, S.P. George, F. Murtas, S. Puddu, M. Silari (CERN)

Friday 19 October 2012 11:20 (20 minutes)

The aim of the project is to test a GEM detector for beam monitoring in hadrontherapy facilities, namely to control the characteristics of the beam before entering the patient, its fragmentation and to monitor the non-therapeutic dose to the patient. GEM detectors have already been used for beam monitoring at CERN and at the Frascati INFN Laboratory, for flux measurements of neutrons (n_TOF at CERN and ISIS in England) as well as nuclear fragment monitoring (UA9 experiment at CERN). This detector technology shows good radiation hardness, good spatial resolution and high counting rate capability up to few MHz/mm2. An active area of 100 cm2 makes this type of detector a good candidate for measurements in-phantom and in-beam. Recent results will be shown and discussed, and a proposed experimental program at CNAO will be presented.

Presenter: MURTAS, Fabrizio (Istituto Nazionale Fisica Nucleare (IT))

Session Classification: Talks on proposed experimental activities at CNAO

Contribution ID: **8** Type: **not specified**

Measurements of stray neutron radiation with GEM detector - S. Puddu, E. Aza, R. Froeschl, S.P. George, M. Magistris, F. Murtas, M. Silari (CERN)

Friday 19 October 2012 11:40 (20 minutes)

Neutron production at hadrontherapy facilities is a source of non-therapeutic dose to patients. To study this dose it is necessary to measure the neutron fluence and spectra. Our proposal is to couple a GEM detector with several types of neutron converters. Using this device, we can then characterize components of the neutron spectrum and investigate the detectors reliability as a neutron dosimeter. Measurements will be taken in the synchrotron hall and the patient treatment room. We plan to vary the beam intensity to enable comparison of GEM with other detectors such as LUPIN and track detectors. The same detector coupled to a neutron converter placed in a water phantom may be able to determine the neutron contamination in the therapy field.

Presenter: MURTAS, Fabrizio (Istituto Nazionale Fisica Nucleare (IT))

Session Classification: Talks on proposed experimental activities at CNAO

Contribution ID: **9** Type: **not specified**

Medipix/Timepix for characterization of ion beam passing irradiated sample via tracking of induced secondary radiation –J. Jakubek, S. Pospisil (CTU, Prague, Czech Republic), M. Campbell, S.P. George, F. Murtas, C. Severino, M. Silari (CERN)

Friday 19 October 2012 12:00 (30 minutes)

Semiconductor pixel detector Timepix can be used to measure the geometrical characteristics of the beam, such as the lateral penumbra, the beam flatness and the beam broadening while passing through different samples.
1. Investigations of Secondary Ion Distributions in Carbon Ion Therapy Using the Timepix Detector
The purpose is to investigate the potential for beam monitoring by detecting the prompt secondary ions emerging from a phantom during an irradiation. Using the energy calibration of all 65535 pixels, the detector provides measurements of the energy loss of ions in silicon. The Timepix can act as a digital nuclear emulsion giving a detailed track structure of incident particles. These characteristic tracks are dependent on the particle type, energy and direction. Detailed pattern recognition enables to differentiate between the primary carbon ions and secondary particles such as protons, alphas and heavier fragments. We should also be able to measure the particle fluences, energies and plot their spatial distributions. This capability is of direct relevance to beam monitoring as the range of secondary light ions can be much larger than that of the primary carbon ions and they may leave the patient. Due to the small size of the single detector, the Timepix is suitable for measurements directly within phantoms.
In addition we plan to use a multi-layered array of detectors (a voxel detector) to take similar measurements. The voxel detector allows the 3D reconstruction of fragmentation distribution along the beam path. It can be used with a neutron converter layer to form an anticoincidence detector for neutrons as well.
We also want to investigate the energy deposition characteristics of primary ions and fragments in the Timepix detector. This will allow us to test the inherent resolution of backtracking particle fragments from the Timepix data and also the capability to discriminate between different charged particle fragments based on the measured track profiles.

1. Monte Carlo simulation We plan to undertake a series of Monte Carlo studies to support the proposed experimental plan. The most important priority is to determine the predicted particle fluences and spectra around the room. This will allow us to optimize the exposure time for the Timepix detectors as well as the detection geometry. We plan to make use of MCNP and FLUKA to model the fragmentation of the beam in different materials along its path (air, PMMA and water) and fluencies of secondary particles around the room. The SRIM tool will be used to determine accurate ionization curves for the passage of different nuclear fragments through silicon in combination with GEANT4 and own C++ code for detector response modeling.

Presenter: JAKUBEK, Jan (Czech Technical University (CZ))

Session Classification: Talks on proposed experimental activities at CNAO

Contribution ID: **10** Type: **not specified**

The CNAO accelerator, M. Pullia (CNAO)

Friday 19 October 2012 09:10 (30 minutes)

Presenter: PULLIA, Marco (Fondazione CNAO (IT))

Contribution ID: **11** Type: **not specified**

Commissioning and Quality Assurance of scanned beams produced by a synchrotron for particle therapy –M. Ciocca (CNAO)

Friday 19 October 2012 09:40 (20 minutes)

Presenter: CIOCCA, Mario