Establishment of microdosimetric procedures in clinical proton and carbon ion beams

Introduction

Microdosimetry is the study of the not uniform, stochastic nature of energy deposition at the microscopic scale.

- **Microdosimetry**
  - The description of how energy is deposited at the cellular and subcellular level and their relations regarding the radiation effects in biological matter, for different radiation qualities.
  - Microdosimetry has been used for the characterization of complex mixed radiation fields and for the assessment of its biological effect in human.

- **Stable research program in microdosimetry inside clinical proton and carbon ion facility**

Theory

- The role of the size of the sensitive volume
- Equivalence of shapes and materials.
- Correlation microdosimetric spectra and LET

Experiment

- Self calibration parameters:
  - Maximum chord
  - Maximum LET
  - Interpolating sigmoid
- Compatibility of the microdosimeters with proton and carbon ion beams

Simulation

A Monte Carlo model of the TEPC and the diamond detector will be generated using Geant4 code.

Measurements with two different types of microdosimeters:

- **Gas TEPC detector:**
  - Spherical cavity in tissue equivalent plastic
  - Determine energy deposition in the wall by measuring in gas
  - Single-event measurements.
  - Lowering the gas pressure.

- **Solid-state diamond detector:**
  - Small square sensitive volume
  - Low capacitance
  - Tissue-equivalent
  - No leakage current and no need for p-n junction

Microdosimetric spectra acquisition in Proton and Carbon ion beams

- **Energy range**
  - Proton: between 60 and 250 MeV/u
  - Carbon ion: between 115 and 400 MeV/u

- **Measurements will be carried out at pristine beam at several positions along the beam axis, covering:**
  - The plateau region
  - The extension of the Bragg curve

- **Off-axis measurements will be performed**
  - A three-dimensional specification of the radiation spectra beyond the axis will be obtained.

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