



Monte Carlo Modelization and Dosimetric Verification of C beamline components for Radiobiological studies

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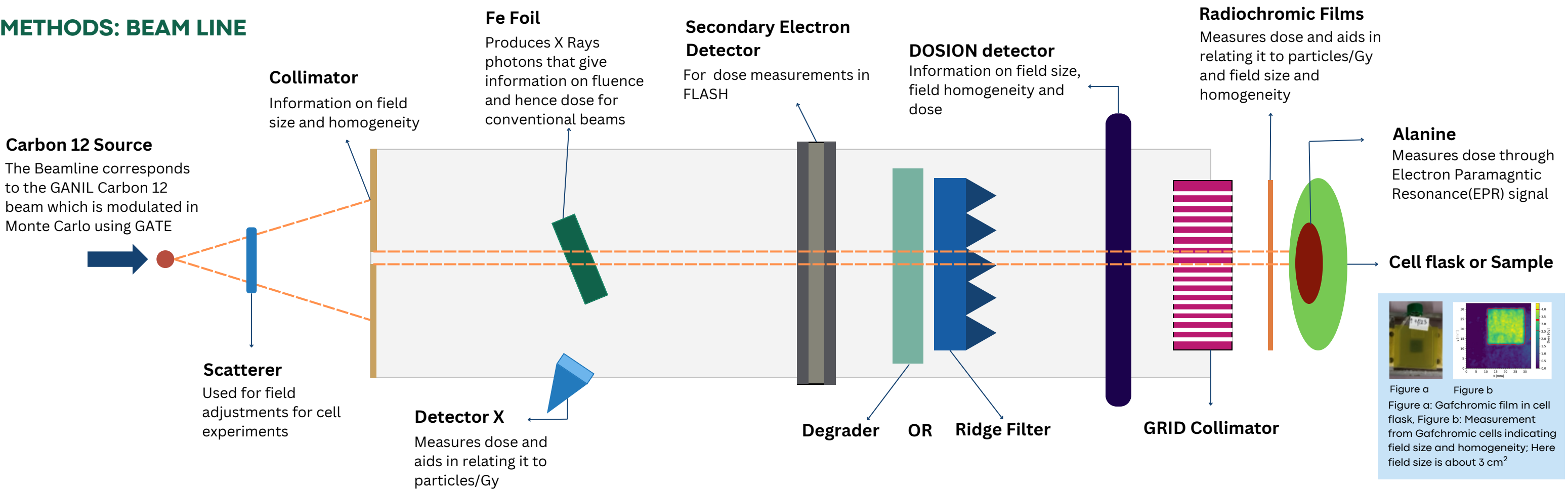
Monte Carlo Modelization and Dosimetric Verification of ¹²C beamline components for Radiobiological studies

The project involves Monte Carlo modelling of beamline components for current and future radiobiological studies with ¹²C ions at GANIL using GATE simulation kit

Objectives

- Modelling and Characterising the Beam
- Design and optimisation of 2-D Range Modular or Ridge Filter and GRID Collimator
- Verification of Dose, LET and beam properties with experimental data

METHODS: BEAM LINE



RIDGE FILTER

- Transforms single energy into Spread Out Bragg Peak(SOBP) : creates conformal dose distribution in a target volume within a very short irradiation time (<<1 s) -> enables FLASH irradiation
- Combination of a range modulator and a ripple filter
- Fluence inhomogeneties in near field - studied against data of Radiochromic films

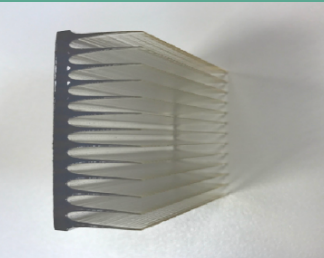


Figure 1

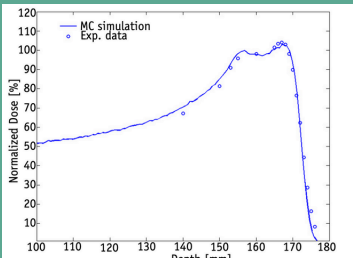


Figure 2

Figure 1: 3D printed Lucite Ridge Filter(RIFI) used to obtain SOBP of 2cm, Figure 2: Depth dose distribution of a 160 MeV proton beam portraying a SOBP using RIFI. Taken from 'Experimental Set-up for FLASH Proton Irradiation of Small Animals Using a Clinical System (2018)' Annalisa Patriarca et al.

GRID COLLIMATOR

- For Spatially Fractionated Radiotherapy
- Study the influence of parameters like Center to Center distance(CTC), Collimator thickness, Beam width, Grid Factor(GF), Throughput, Valley to Peak Dose ratio(VPDR) etc
- To spare healthy tissues

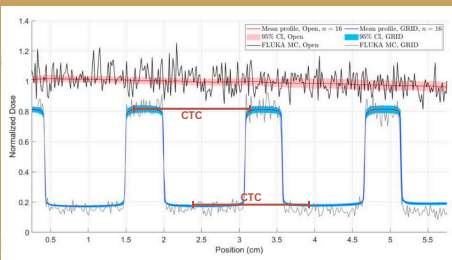


Figure 3

Figure 3: Normalized dose profiles from EBT3 GFD of open and GRID irradiation together with normalized dose profiles from FLUKA MC simulations taken from Delmon Arous et al. , Figure 4: Clinical GRID block commercially available from decimal, LLC, photo provided by decimal, LLC taken from Weisi Yan et al.

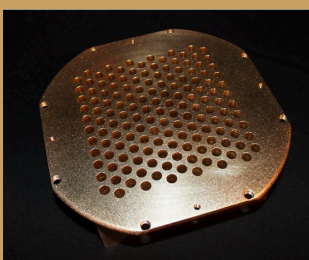


Figure 4

Expected Results

- Preparation and validation of ¹²C beam model
- Design and optimisation of Ridge Filter and Grid Collimator
- Verification with experimental data
- Relate dose with particles/Gy of the beam source using the measurements of Gafchromic/Radiochromic films

Future Scope

- Simulation of pencil beam scanning system
- Patient like radioactivity study
- Nanoparticles enhanced hadrontherapy simulations for in-vitro experiments with ¹²C beam

Group

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