Scintillating array for real-time high-resolution dosimetry

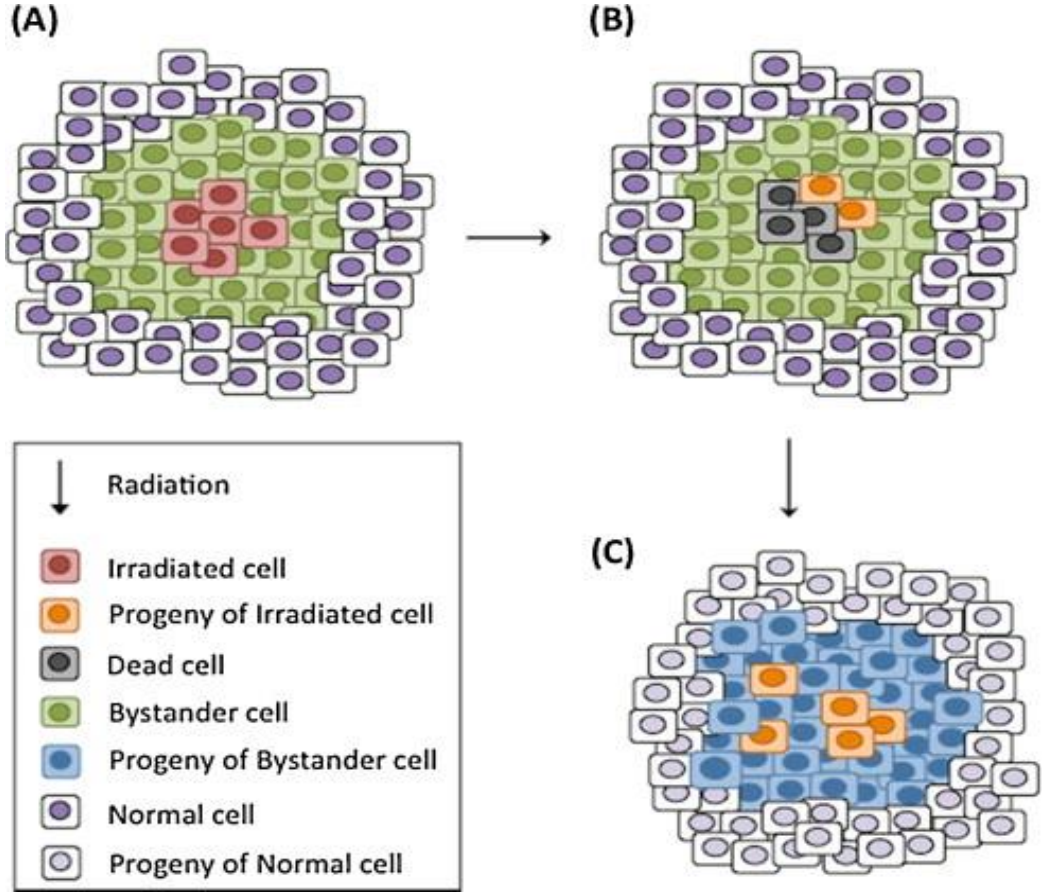
Duarte Guerreiro
PhD Engineering Physics
Supervisors: Prof. Jorge Sampaio, Prof. Luis Peralta

SFRH/BD/150786/2020

RADIOBIOLOGY

Radiobiology is used to study how cells and organs react to being irradiated.

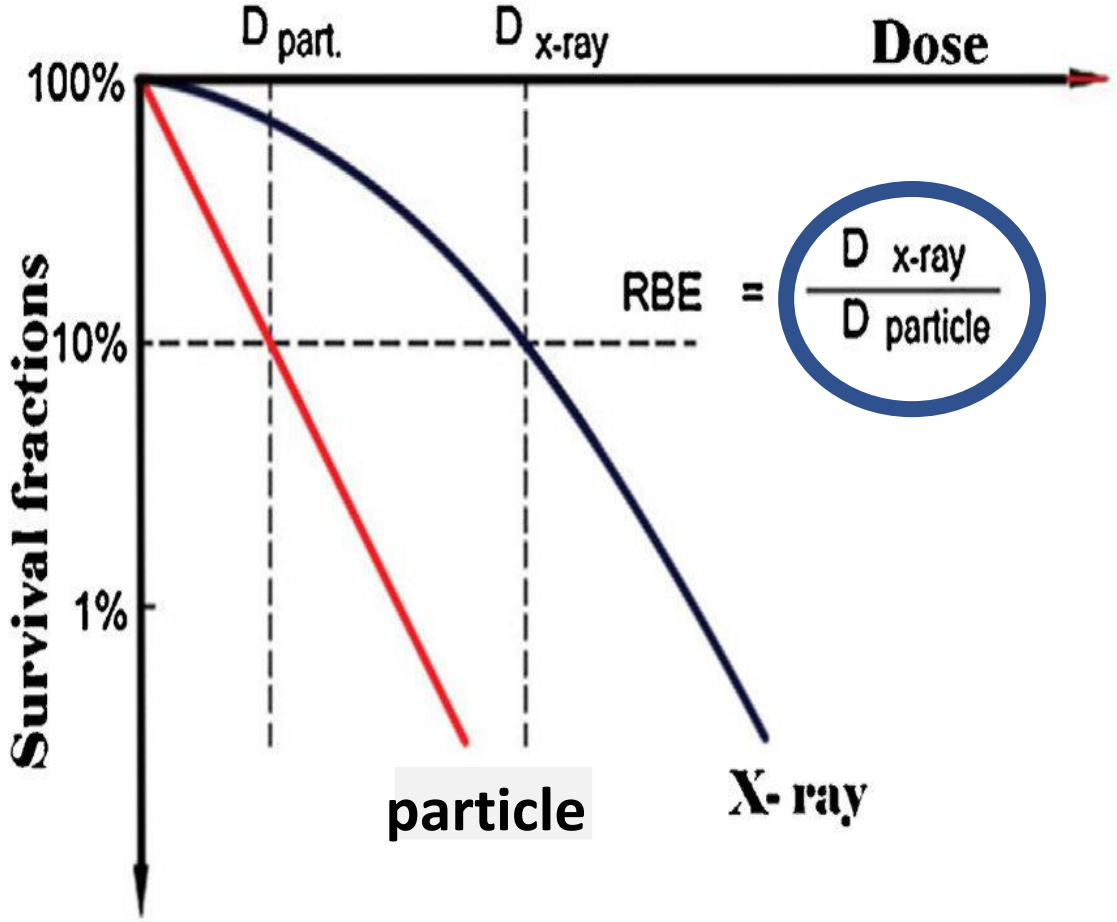
This information is important to plan radiotherapy sessions.



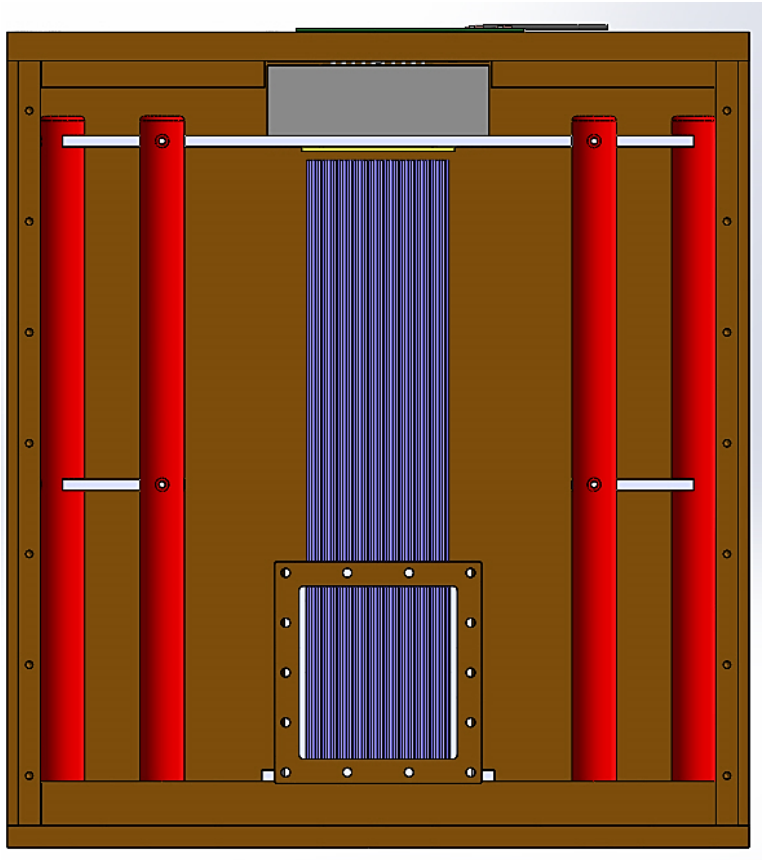
Project overview - radiobiology

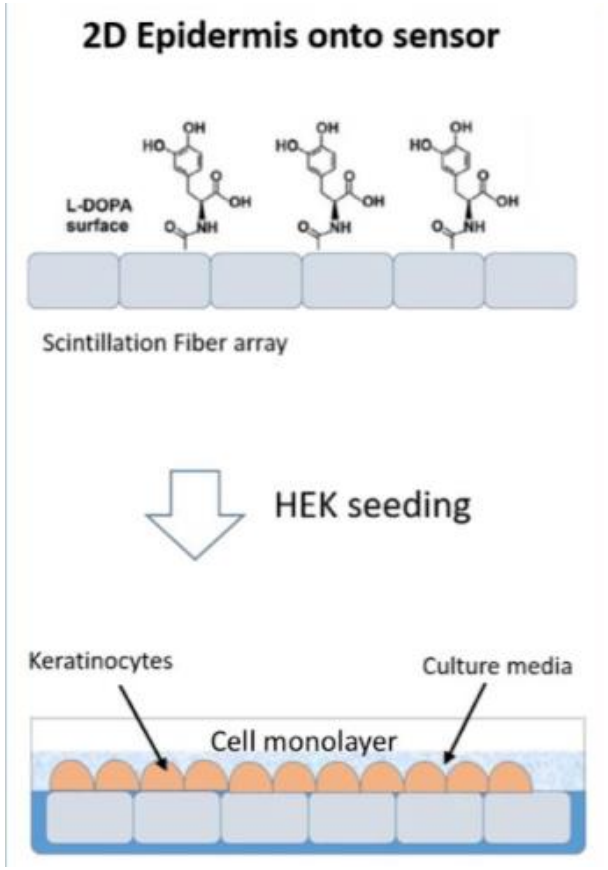
It is possible to have different RBEs for particles with the same LET, depending on the particle's track structure (distribution of the ionizations produced by the particle).

Because of this, it is necessary of have a dose map at a microscale in order to be able to relate biological effects with dosimetric parameters on a cellular scale.

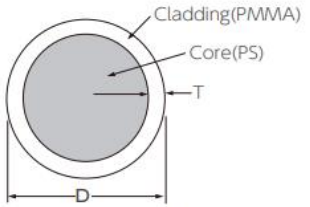


Project overview - Radiobiology



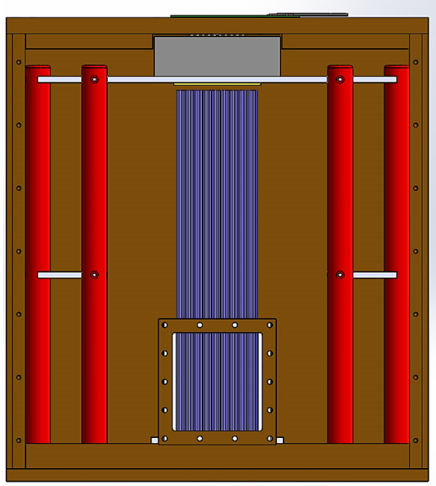


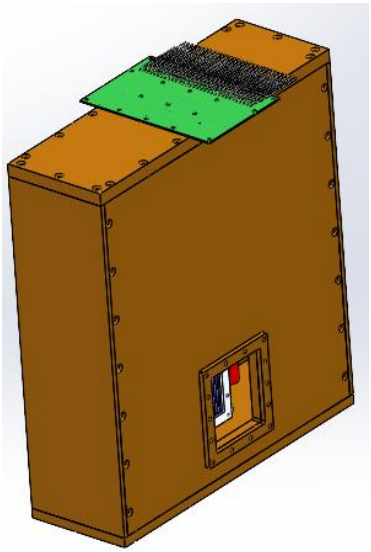
- The aim is to develop a detector with real time dose measurement, good spatial resolution and tissue equivalence.
- The possibility of placing a cell culture directly on top of the optical fibres is being explored.
- This seeks to reduce the errors introduced by the cell culture plates.

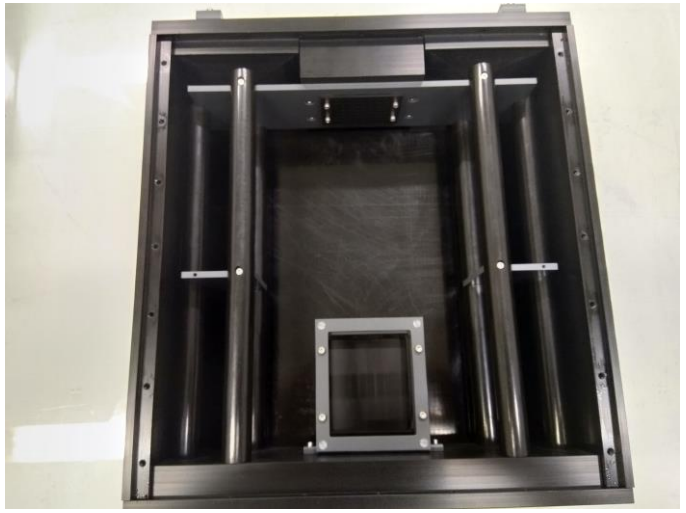


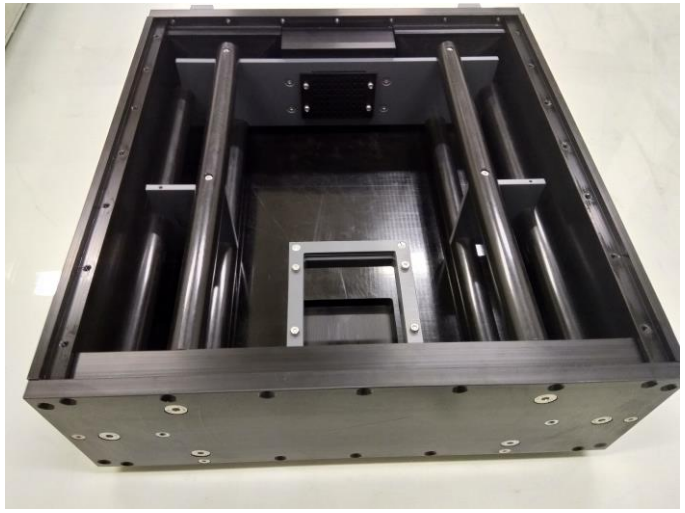
Cladding Thickness[1]: T=2% of D
Numerical Aperture: NA=0.55
Trapping Efficiency : 3.1%

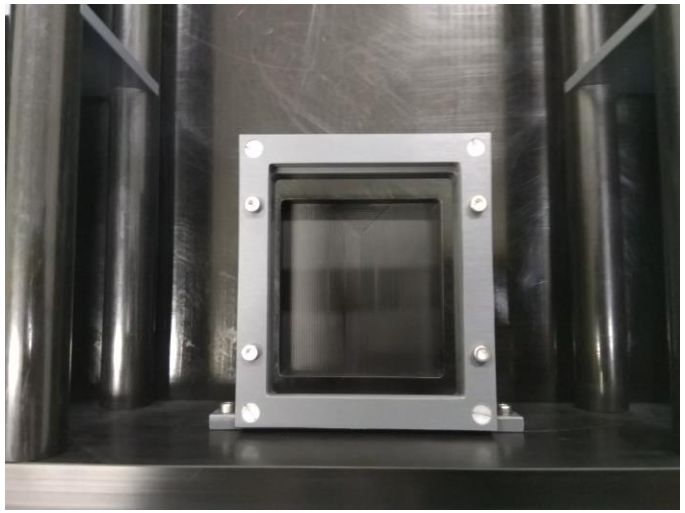
Irradiation box production - concluded





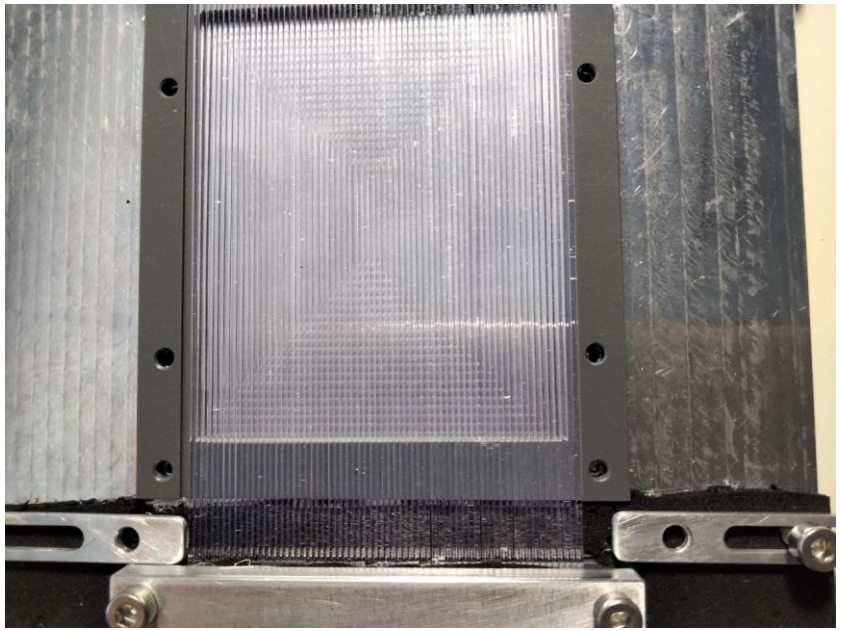


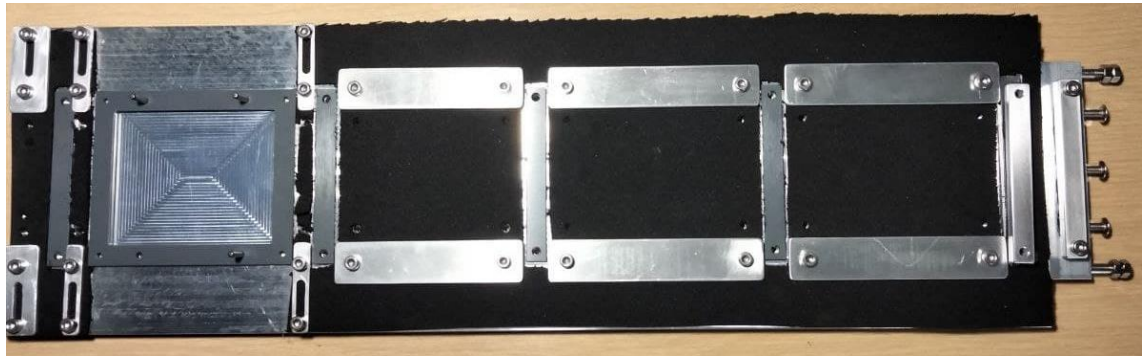




Produced at the Mechanical Workshop of LIP - Coimbra

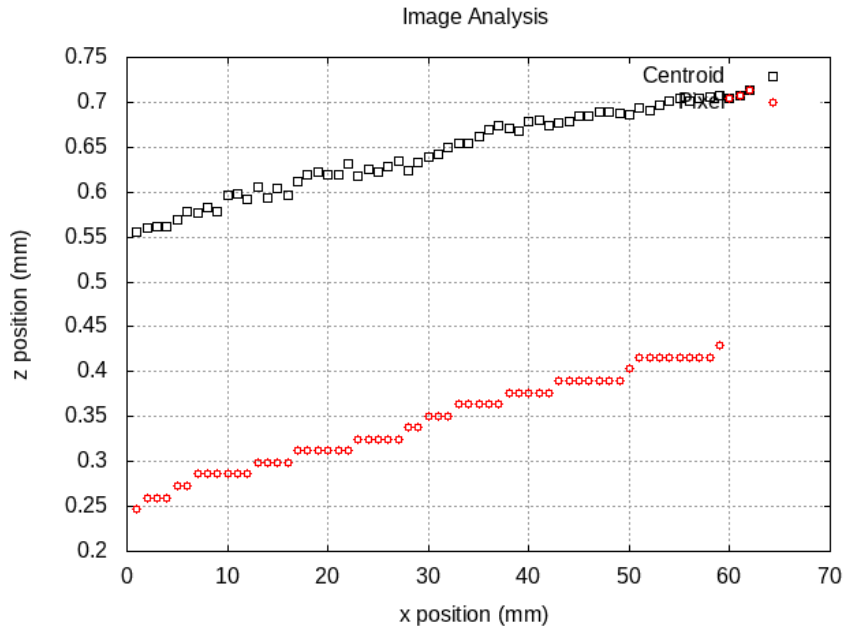
Optical Fibre Array Assembly and QA





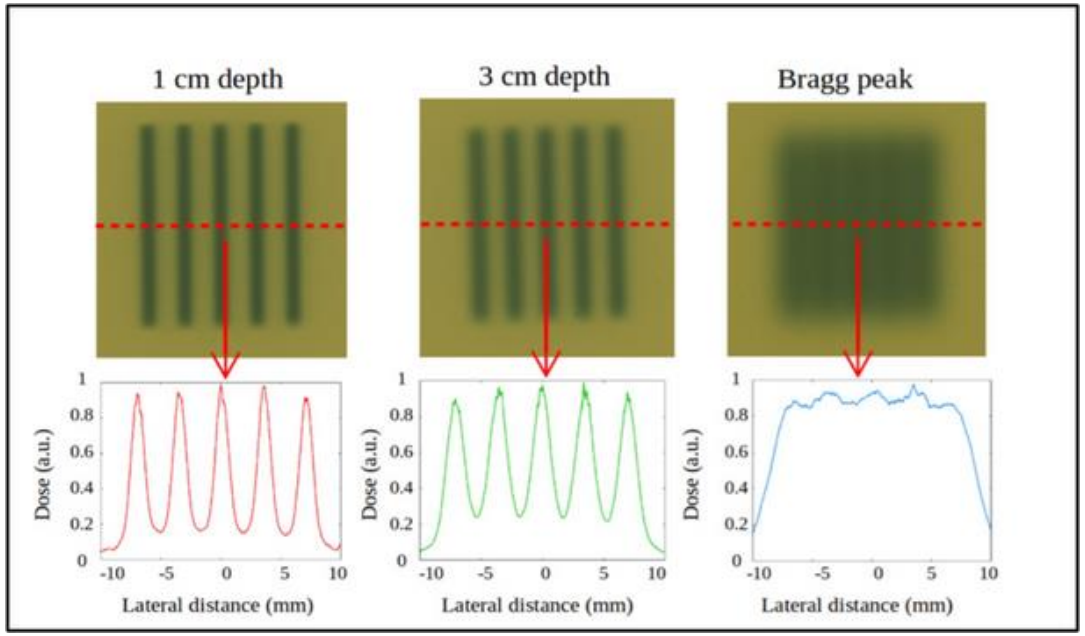
Produced at the Mechanical Workshop of LIP - Coimbra

Images produced at FCUL Microscopy Facility



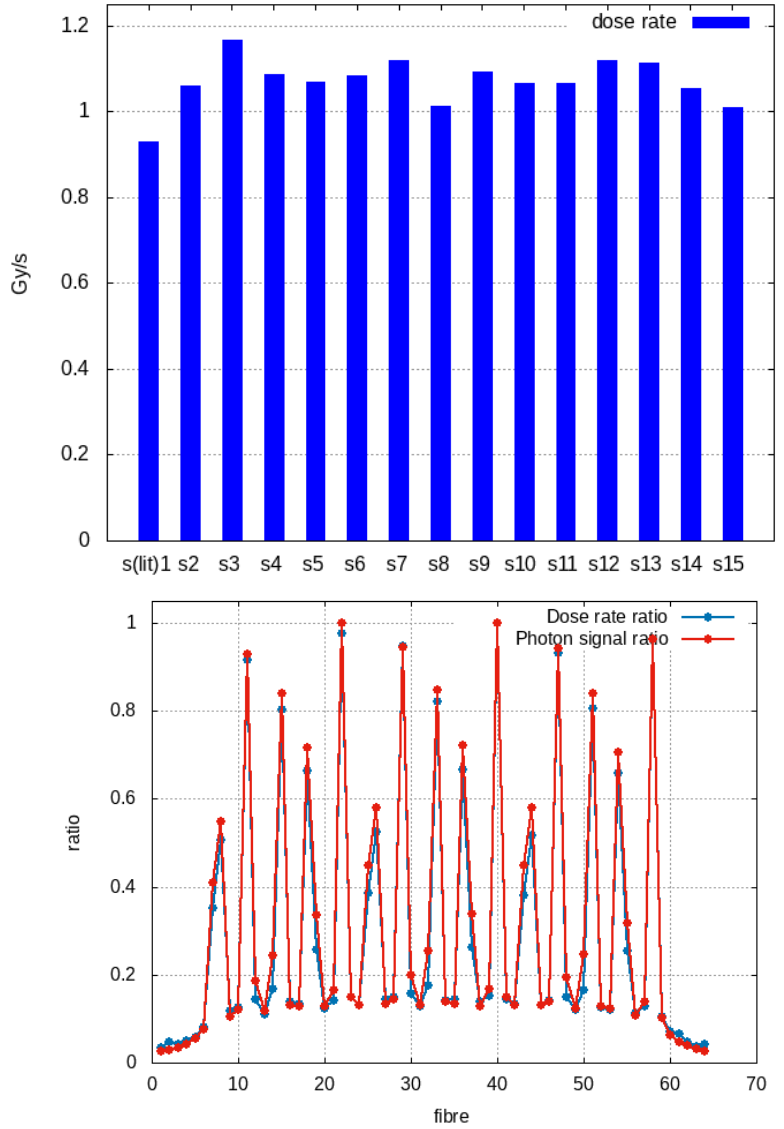
Simulations – Minibeams example

Published experimental and simulation results [1].



[1] A M M Leite, M G Ronga, M Giorgi, Y Ristic, Y Perrot, F Trompier, Y Prezado, G Crehange, and L De Marzi. Secondary neutron dose contribution from pencil beam scanning, scattered and spatially fractionated proton therapy. Physics in Medicine &amp Biology, 66(22):225010, nov 2021.

Simulations of the detector's response to a minibeam radiation field



Future work

- Integration of the detector with the MARTA-DAQ developed at LIP
- X-Ray, electron and ion beam tests
- Beam time proposal submited to GSI (possibilty of testing the detector with minibeams)

Jorge Sampaio, LIP FCUL
Luis Peralta, LIP FCUL
João Gentil, LIP
Duarte Guerreiro, LIP FCUL
Matilde Santos, LIP FCUL
Daniel Salgueiro, LIP FCUL
Luis Lopes, LIP FCTUC
Pamela Teubig, LIP FCUL
Pedro Assis, LIP IST
Miguel Ferreira, LIP
José Carlos Nogueira, LIP
Luis Gurriana, LIP
Guiomar Evans, LIP FCUL

Abel Oliva, ITQB

Federico Herrera, BioISI

Francisco Alves, ICNAS
Sérgio do Carmo, ICNAS

Principal Investigator: Jorge Sampaio jmsampaio@fc.ul.pt