RADART group
Research topics

LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS

Jorge Miguel Sampaio

Motivation

Biological response depends on

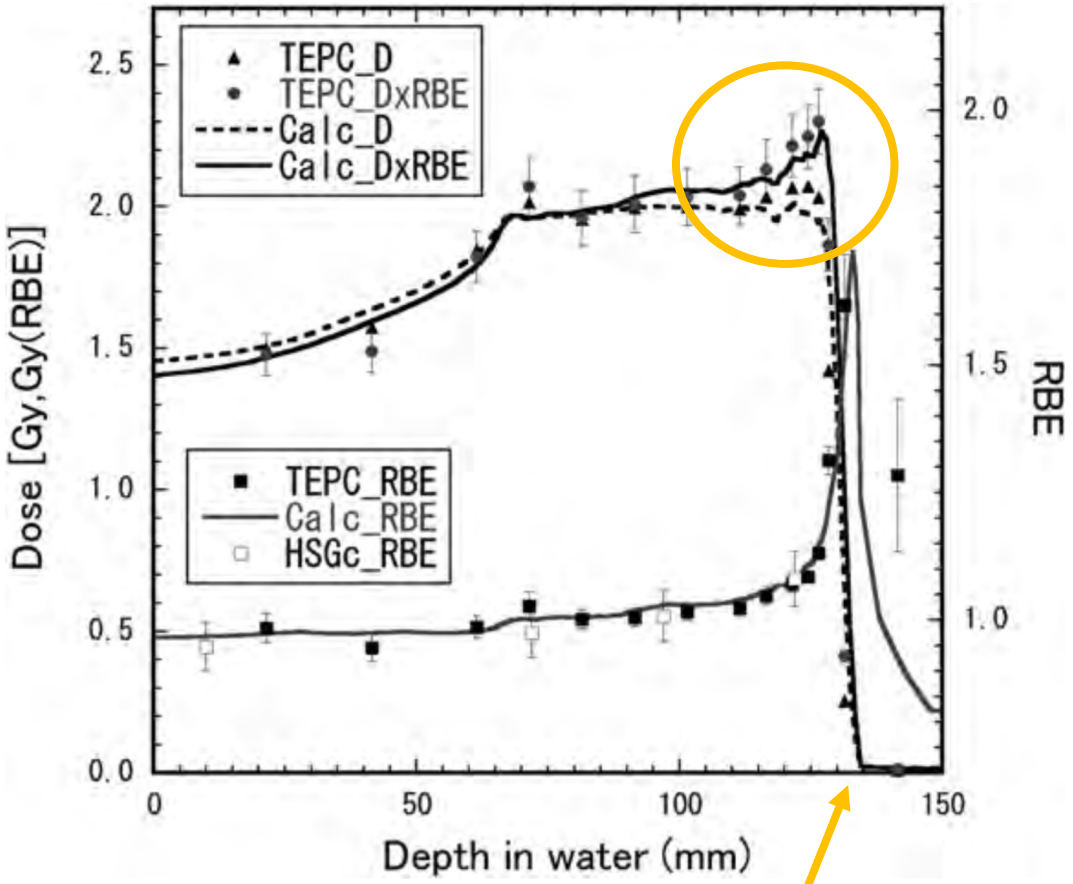
// Particle energy deposition track-structure.

// Dose and dose rate (fractioning)

// Beam shape (spatial fractioning)

// Tissue type

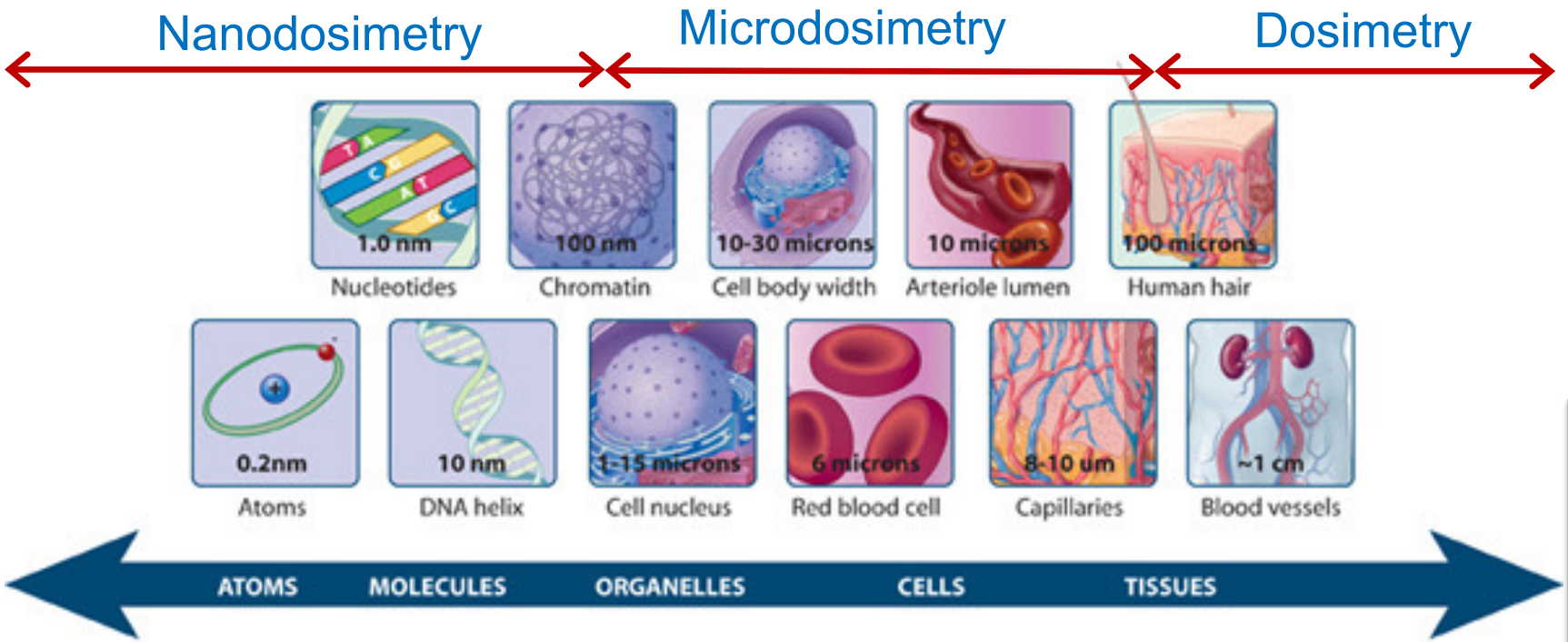
// Presence of radioenhancers



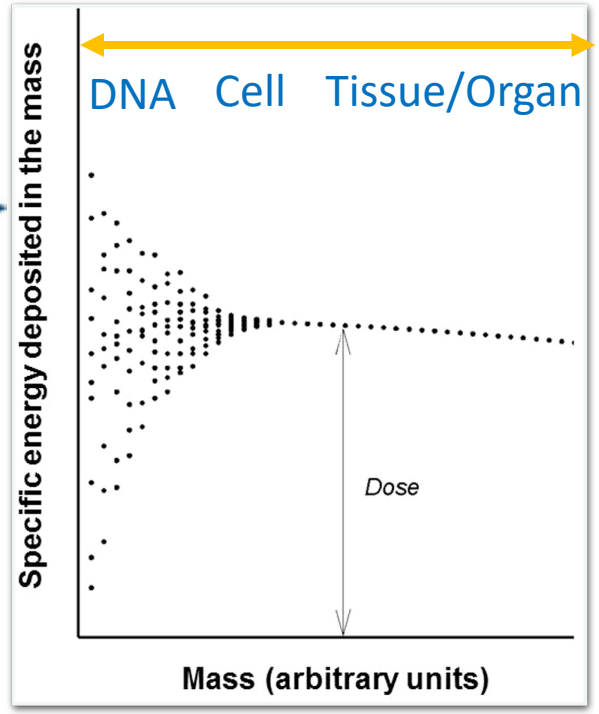
Kato et al., J. Radiat. Res. 54, 2013

Range accuracy is critical!

Motivation



// Dosimetric quantities become stochastic



// Measure energy deposition structure at subcellular scale;

// Model and simulate radiation effects in biological systems;

// Relate physical quantities with biological effects.

Thematic lines

High-res-dosimetry instrumentation

// SPOF array for high-res. dosimetry

// Development of materials for micro and nanodosimetry

New modalities and applications in RT

// Modelling radiobilogical effects of NPs

// Advance charged-particle MBRT

// Advance FLASH-RT

// Effcets of PT NDDs

C²TN

institut Curie

THE UNIVERSITY OF TEXAS MD Anderson Cancer Center

CMAM

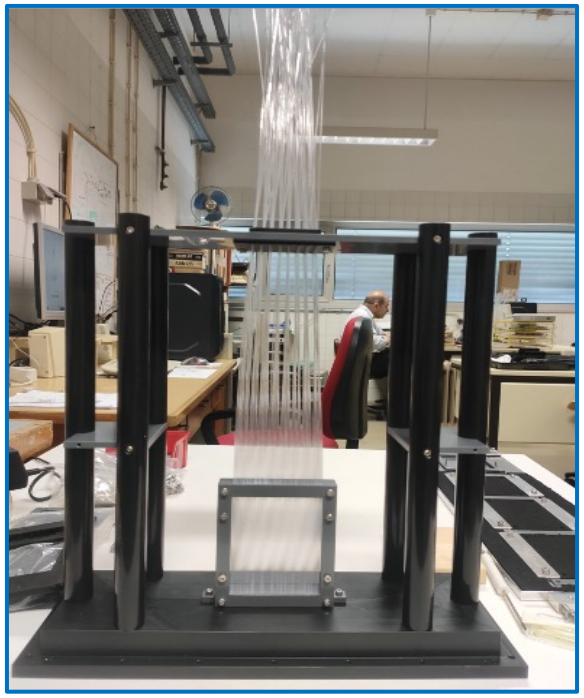
dkfz. GERMAN CANCER RESEARCH CENTER IN THE HELMHOLTZ ASSOCIATION

IBEB Instituto de Biofísica e Engenharia Biomédica

HollandPTC Proton Therapy Centre

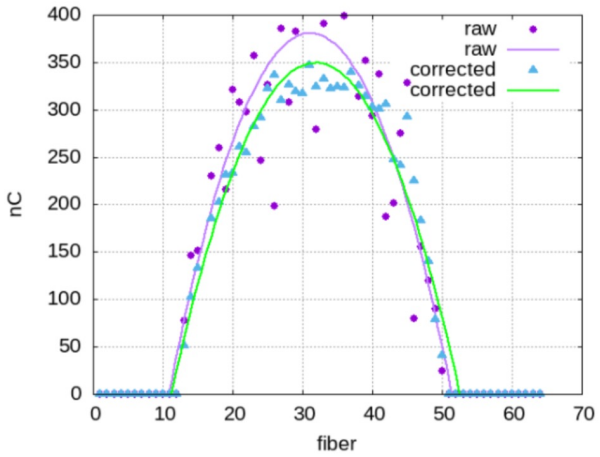
Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

SPOF array for high-res. dosimetry

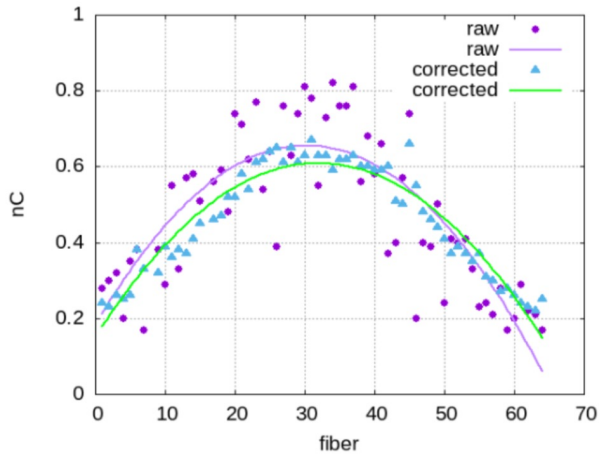


- Construction and testing
- Cell growth on the detector surface
- Improved electronics
- Radiobiology experiments

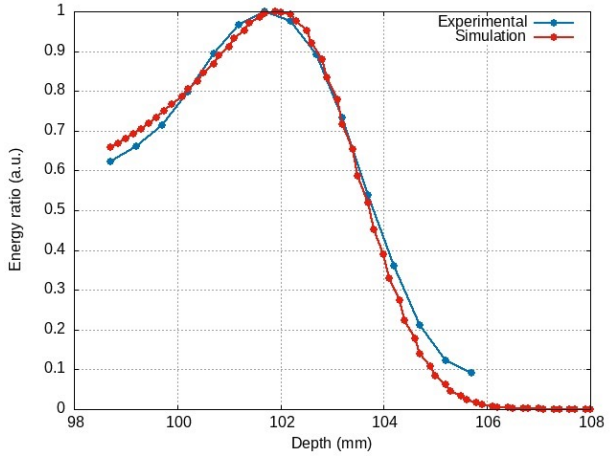
X-ray generator

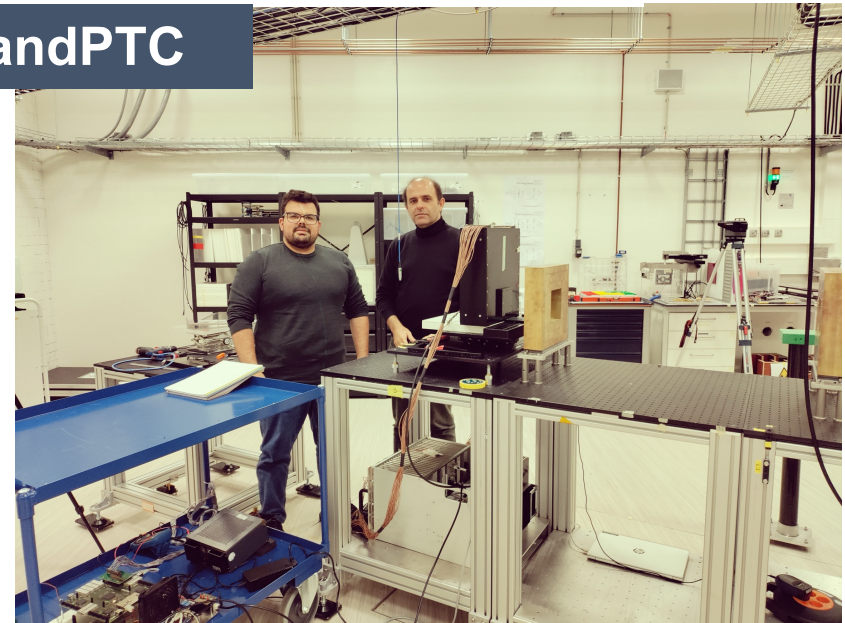


^{90}Sr source



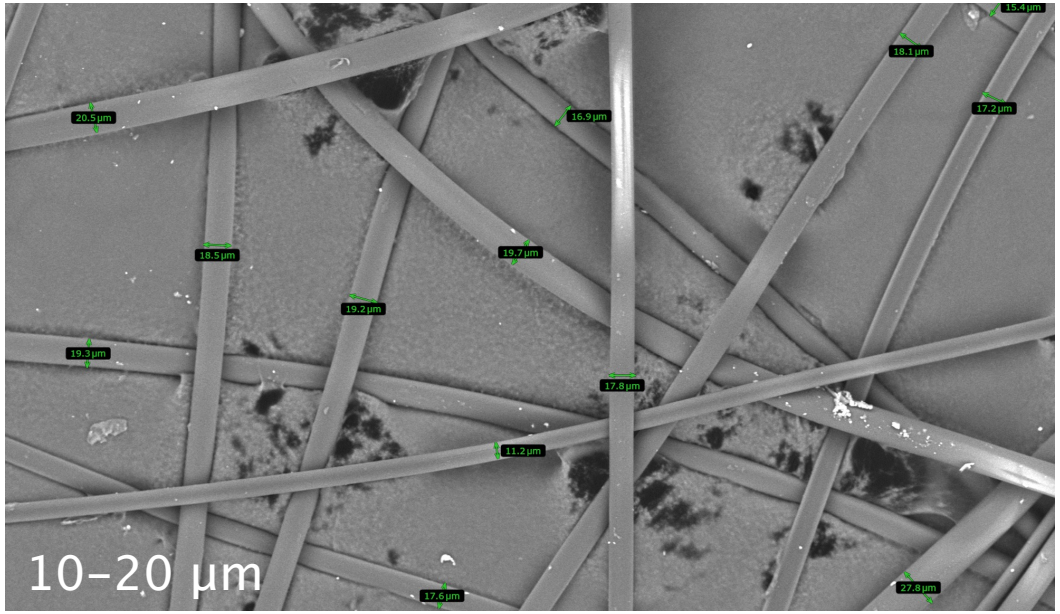
Clinical protons @ HollandPTC



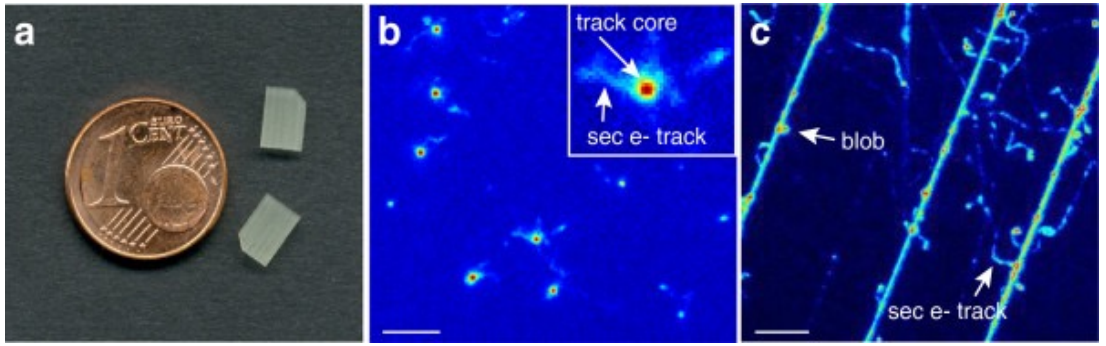


New materials for micro and nanodosimetry

Micrometric fibers

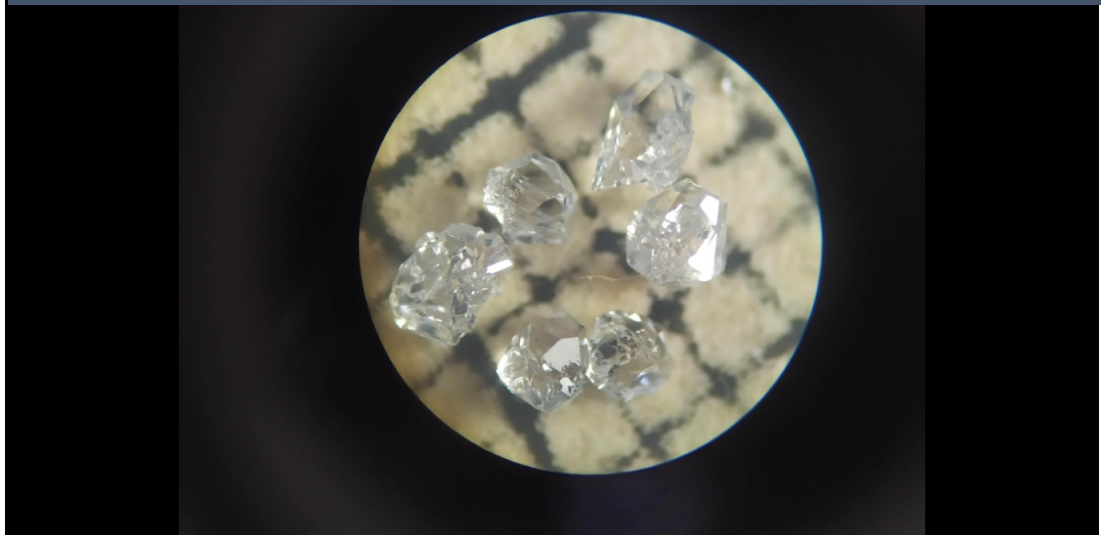


FNTD nanodosimetry



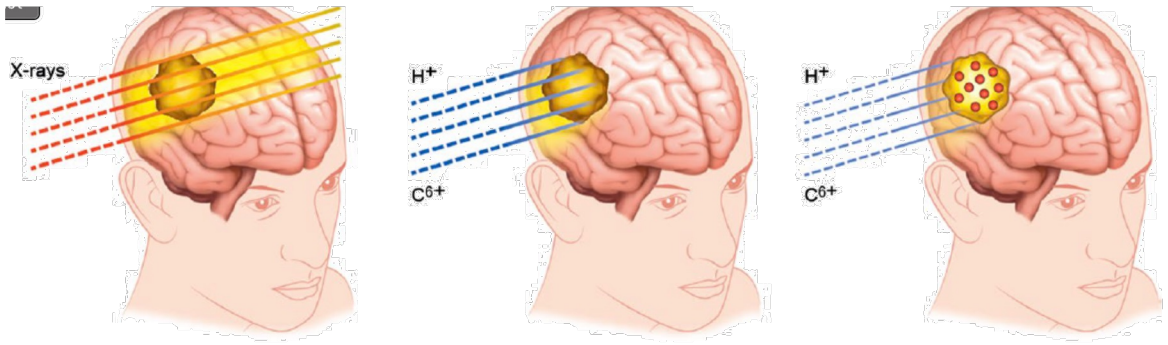
M. Niklas et al. Radiat. Oncol 8 (2013)

First batch of AlO_2 crystals produced!



Nanoparticles RT

// Combine external RT (photons or particles) with high-Z NPs

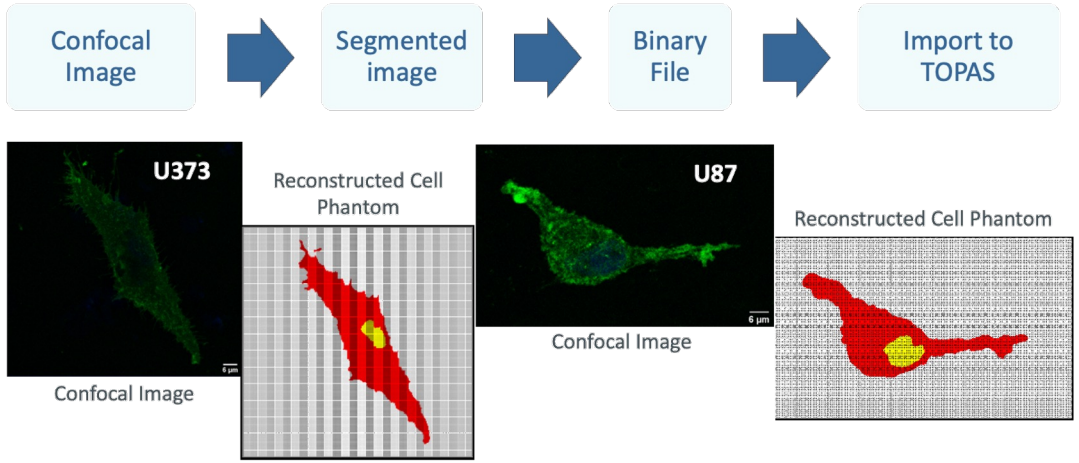


S. Lacombe et al. Cancer Nanotechnol. 8(1) (2017)

- Increase production of secondary particles
- Increase production of ROS

Enhnancement of the therapeutic effect

// Modeling radiobiological effects



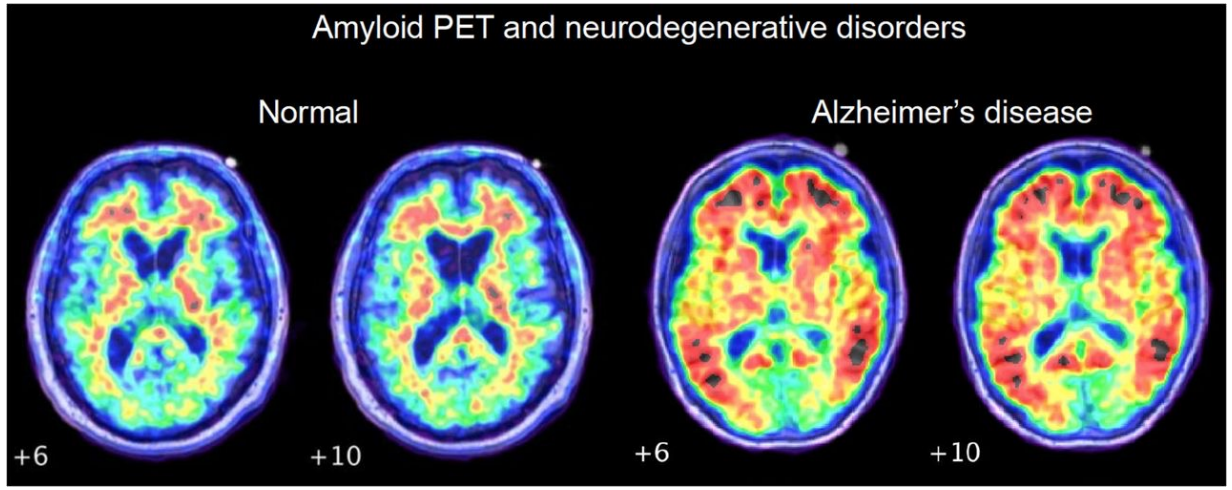
- Monte Carlo simulations
- Radiobiological models
- Compare with experimental data

J. Antunes et al. Biomed. Phys. Eng. Express. Accepted (2024)

Use of radiation to control NDD

Effects of low-dose (< 0.1 Gy) in neurodegenerative disorders (NDDs)

- Irradiation of brain cells with different types of radiation
- Assess the production of ROS
- Effects on the destruction of protein aggregates (amyloidosis)
- Model based on Monte Carlo simulations (TOPAS nBio)



M. Chapleau et al. J. Nuc. Med. 63 (2022)

International Journal of *Molecular Sciences*
MDPI

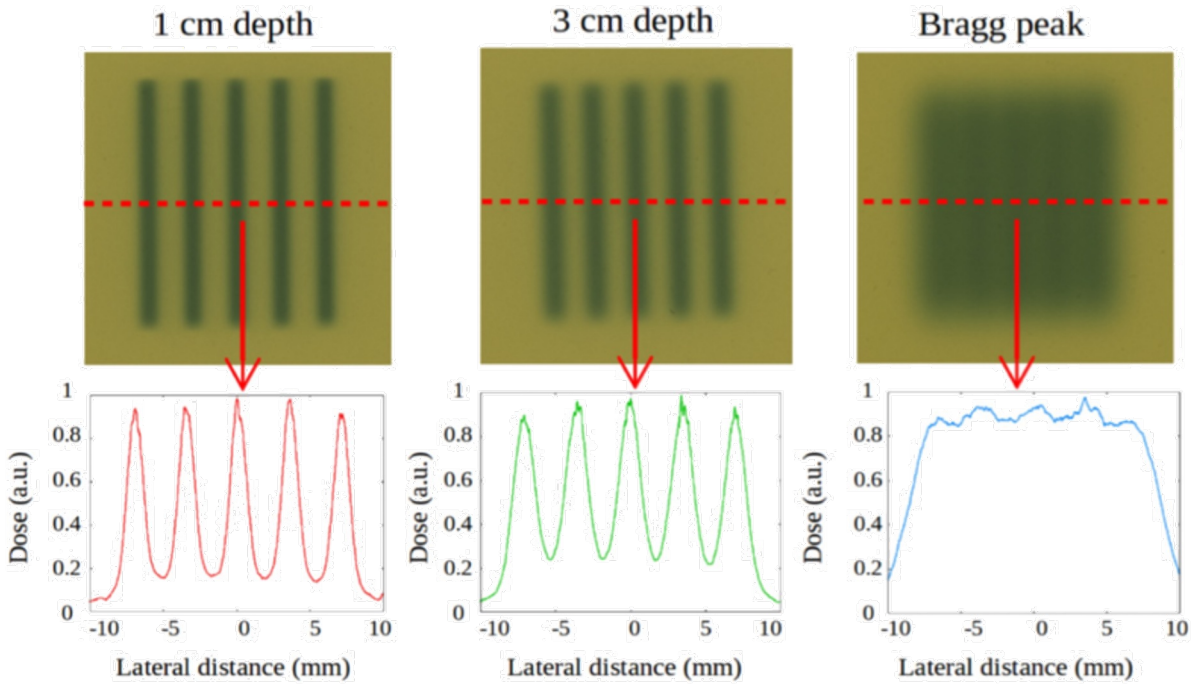
Review

Radiation as a Tool against Neurodegeneration—A Potential Treatment for Amyloidosis in the Central Nervous System

Carina Marques Coelho [1,2,†], Lia Pereira [1,2,†], Pamela Teubig [1], Pedro Santos [3], Filipa Mendes [3,4], Sílvia Viñals [5], Daniel Galaviz [1,6] and Federico Herrera [2,7,*]

NDD are associated with increased protein aggregations (amyloidosis)

Advance charged particle minibeam RT



- Obtain calibration factors for MBRT dosimetry (TOPAS)
- Simulation of MBRT treatment plans from CT images (TOPAS)
- Fast GPU-based MC simulation (MOQUI)

- High peak-to-dose ratio (PVDR) in healthy tissues
- Homogeneous distribution at the Bragg peak

Sparing effect on healthy tissues

Y. Prezado et al. Sci .Rep. 8 (2018)

If you like...

// Computing and simulation

// Design and construction of parts

// Materials sciences

// Electronics development

// Biology lab. work

… come talk with us!

Contacto:

Jorge Miguel Sampaio
jmsampaio@fc.ul.pt