DOSIMETRY + RADON

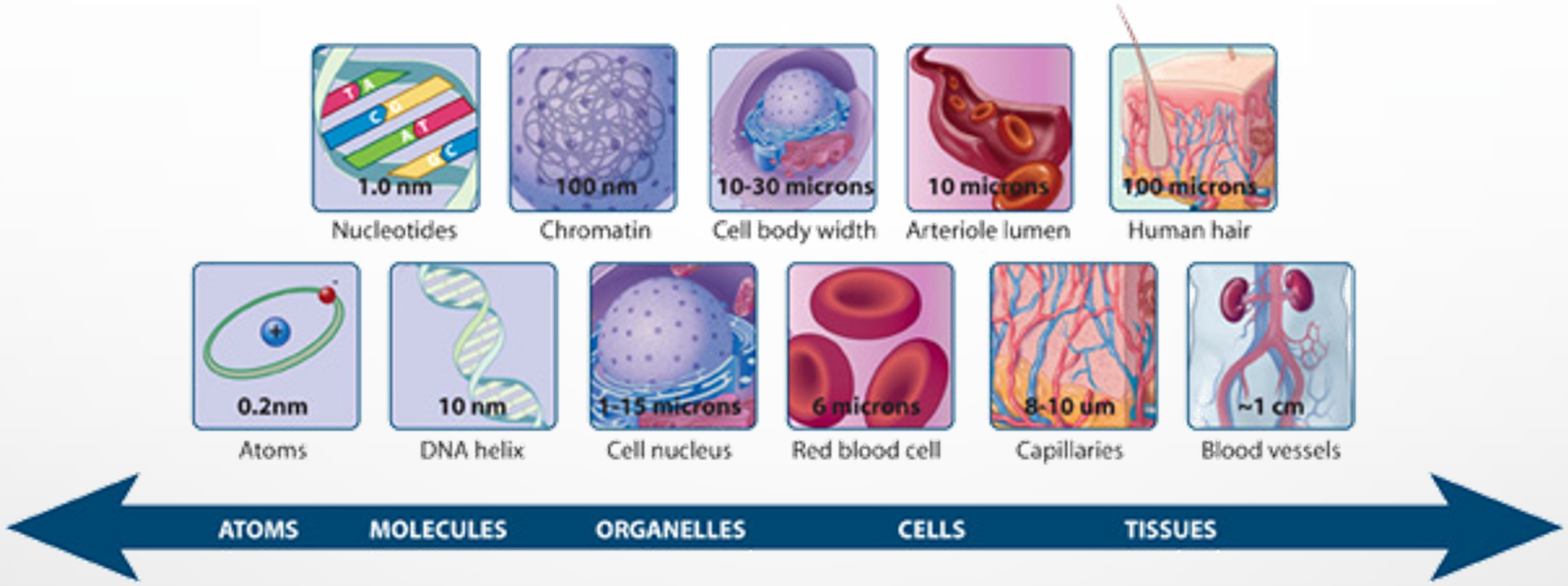
JORGE MIGUEL SAMPAIO

LUÍS PERALTA

SANDRA SOARES

Jornadas do LIP 2022 (Coimbra, 8 de Julho)

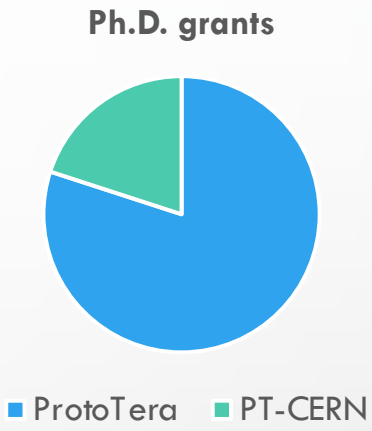
GOALS OF THE DOSIMETRY GROUP



- High-resolution dosimetry for QA in new RT modalities
- Measure energy deposition at subcellular scale
- Relate dosimetric quantities with radiation effects in biological systems

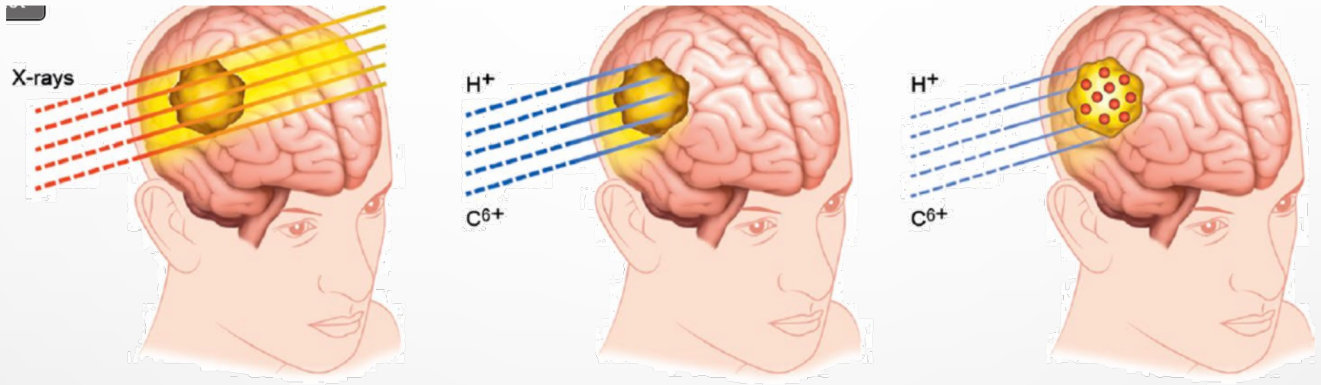
PEOPLE

- **Researchers:** 6 (1.6 FTE)
- **Ph.D. students:** 10
- **Master students:** 10
- **Trainees/undergraduate:** 8



Nanoparticles Radiation Therapy

Combine external RT with high-Z NPs



S. Lacombe at al. *Cancer Nanotechnol* 8(1) (2017)

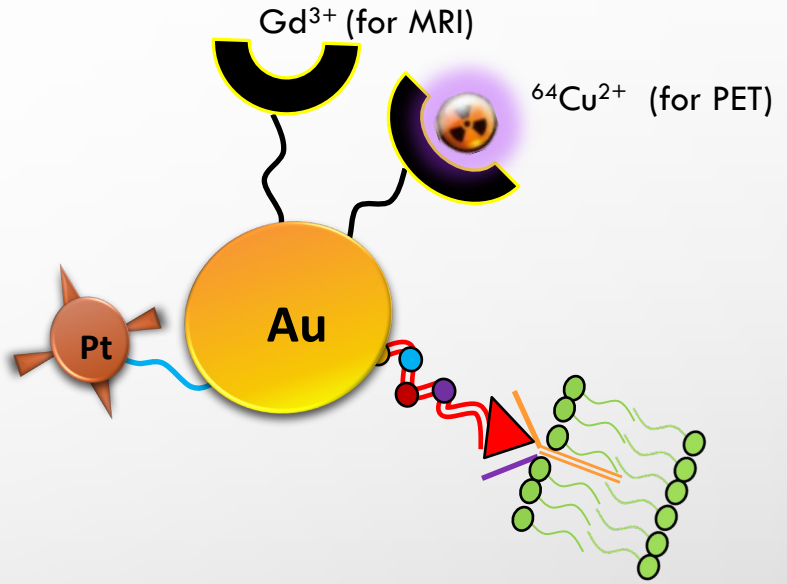
- Increase production of secondary particles
- Increase production of ROS

Enhancement of the therapeutic effect

PARTICIPATION IN THE TPPT PROJECT

To develop, characterize and pre-clinically evaluate multifunctional AuNPs as radiosensitizers in proton therapy of GBMs.

- Cellular uptake
- Irradiation studies (^{60}Co, X-rays, protons)
- Dosimetry studies
- Evaluation and modeling of biological effects



UTAustin Portugal

THE UNIVERSITY OF TEXAS MD Anderson Cancer Center

INSTITUTO DE CIÊNCIAS NUCLEARES APLICADAS À SAÚDE UNIVERSIDADE D COIMBRA

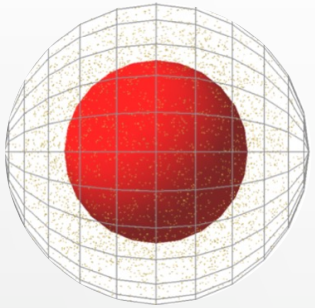
C²TN

LIP

Heavy use of LIP FARM5

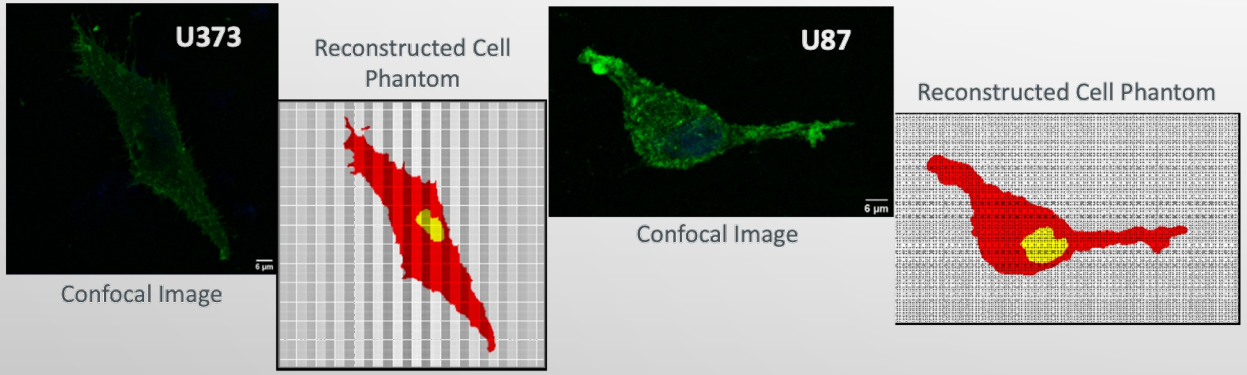
Modeling the Radiobiological Effects of AuNPs in GBMs

Reconstructed computational models

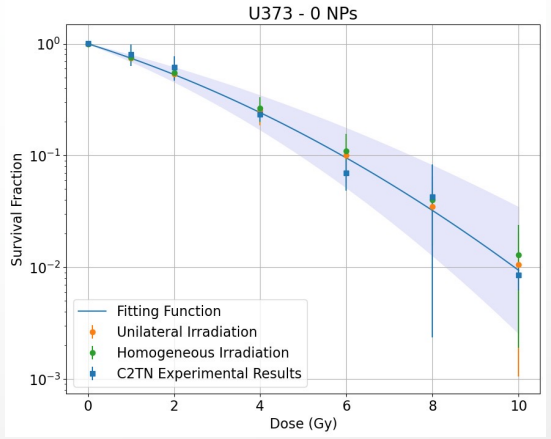


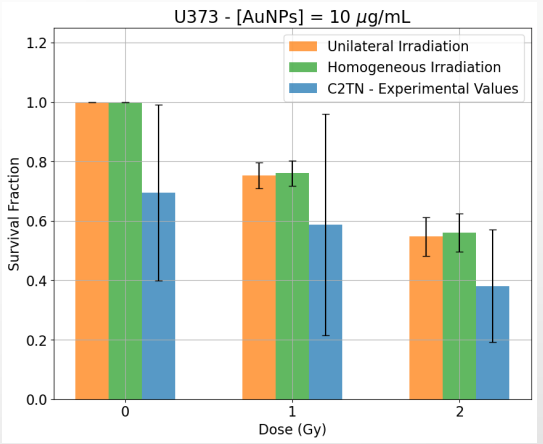
From a spherical cell model to ...

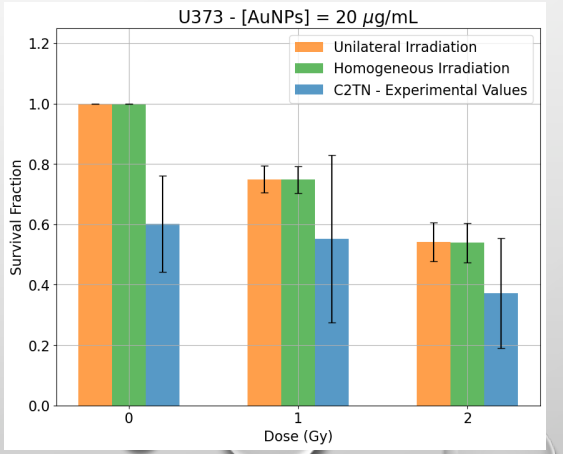
Confocal Image → Segmented image → Binary File → Import to TOPAS

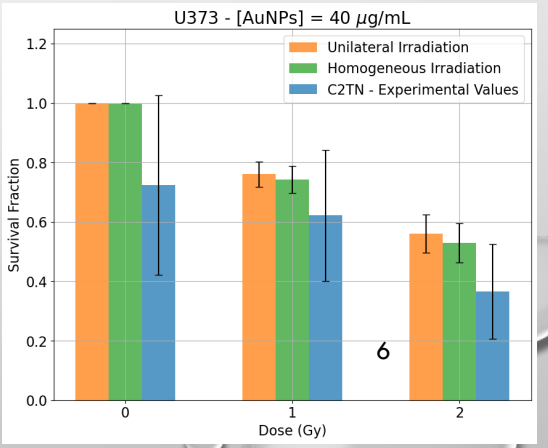


Monte Carlo simulations with TOPAS nBio + Radiobiological models





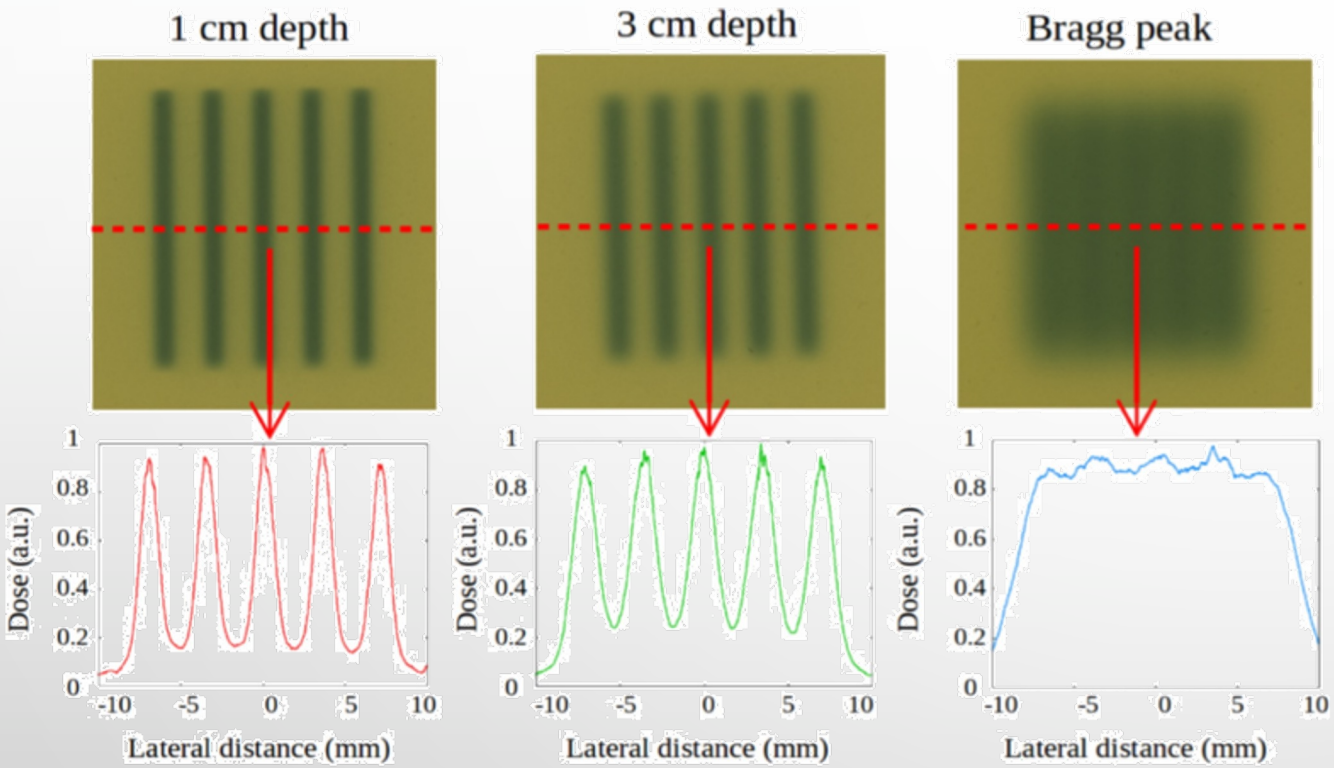




Survival curves for the ^{60}Co irradiation of U373 cell lines

See poster by Joana Antunes (#21)

(Proton) Minibeam Radiotherapy



Peucelle C et al., *Med Phys.* 42(12) 2015

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

Pre-clinical studies with pMBRT show

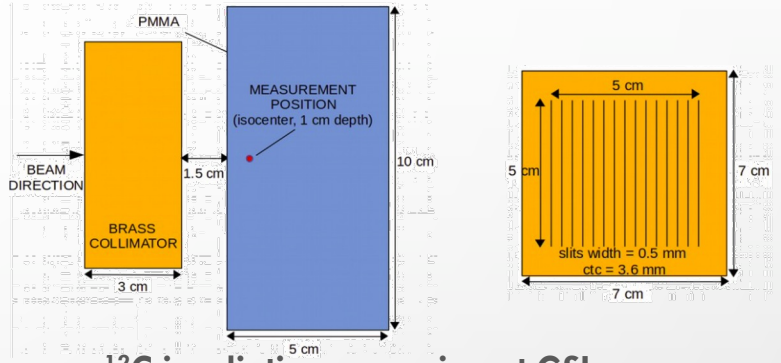
- No/reversible skin damage in rats
- Significant reduction of brain damage
- Higher tumor control and tumor eradication for high-grade gliomas

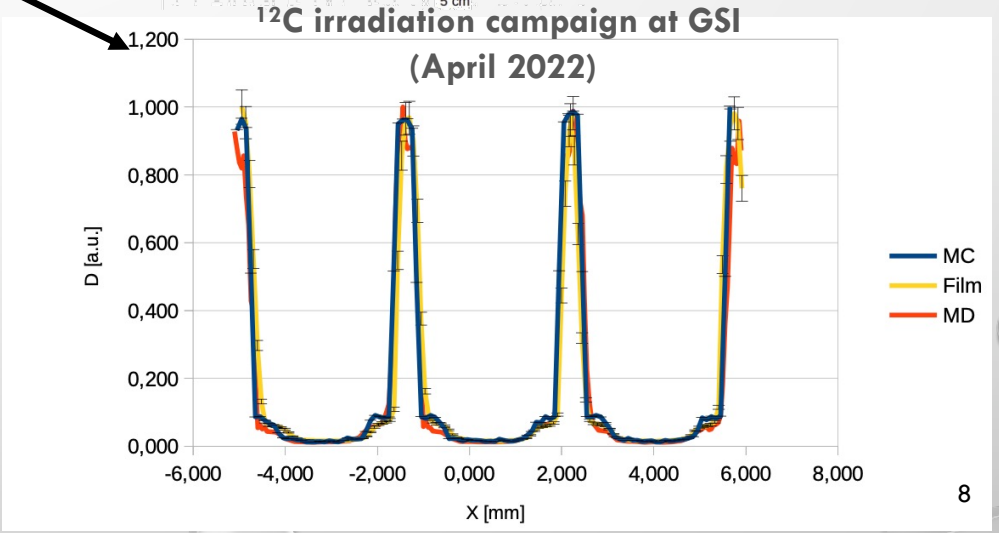
Prezado Y et al., *Sci Rep* 8 (2018)

Dosimetry Protocol for Charged-Particle MBRT

Implementation of fast MC simulation of charged-particle MBRT treatment plans

- Benchmarking of simulations with dosimetry measurements for ^{12}C MBRT
- MC simulations of MBRT treatment plans from CT images
- GPU-based MC simulations



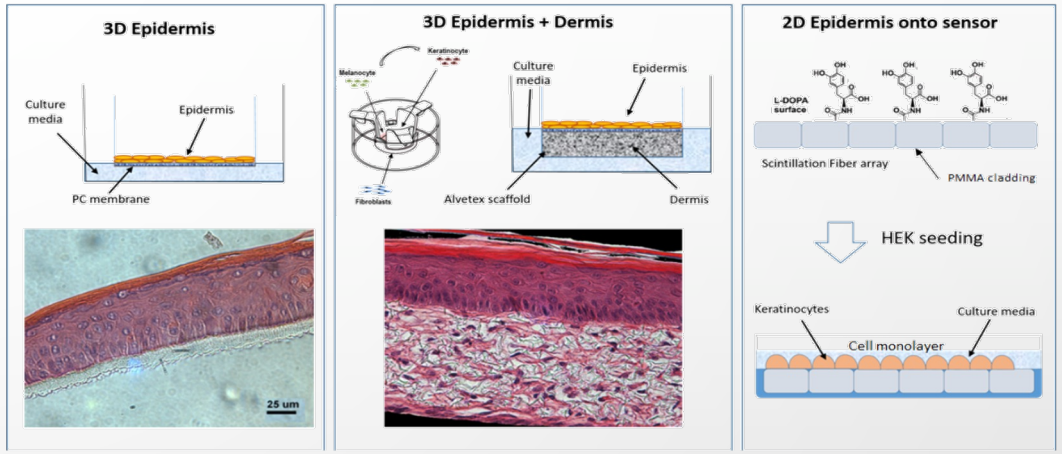


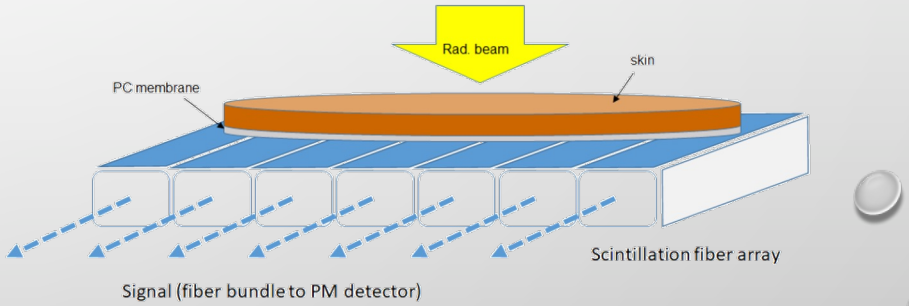
See poster by Maria Giorg (#23)

High Resolution Dosimetry with SPOFs

Relate biological effects of ion with dose measurements at the microscale

- Scintillating detector development
- Cell growth on the detection surface
- Radiobiology experiments

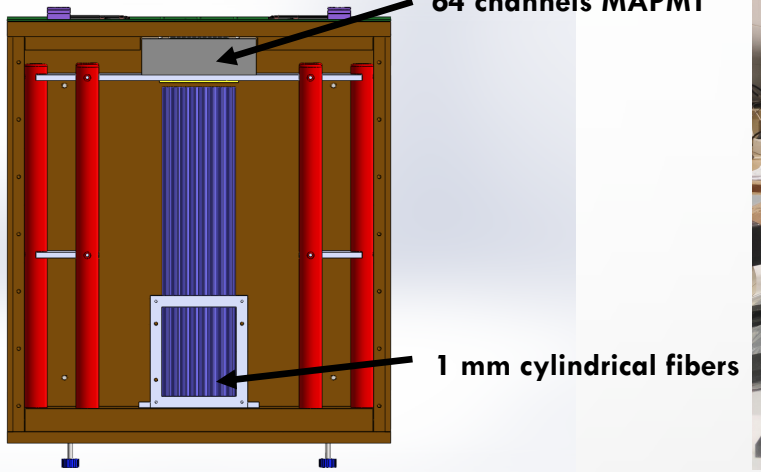


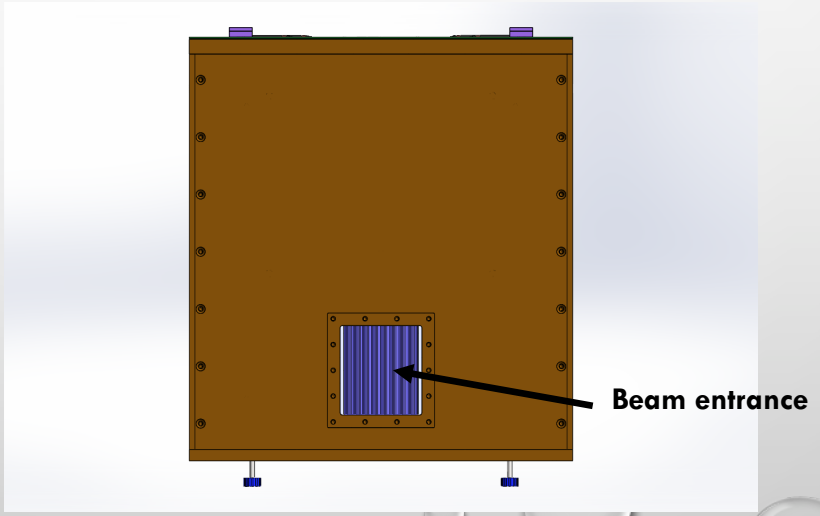


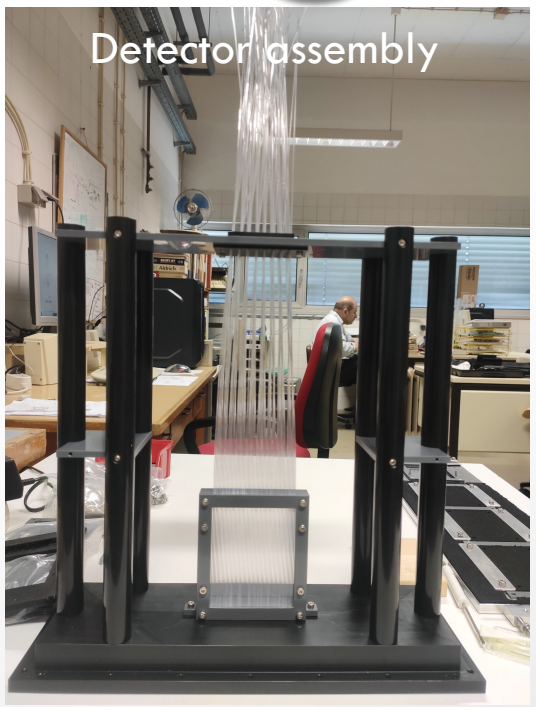
Detector development

Requirements

- Light-tight
- Radiation hard
- Portable/transportable
- Good tissue-equivalence
- Practical use



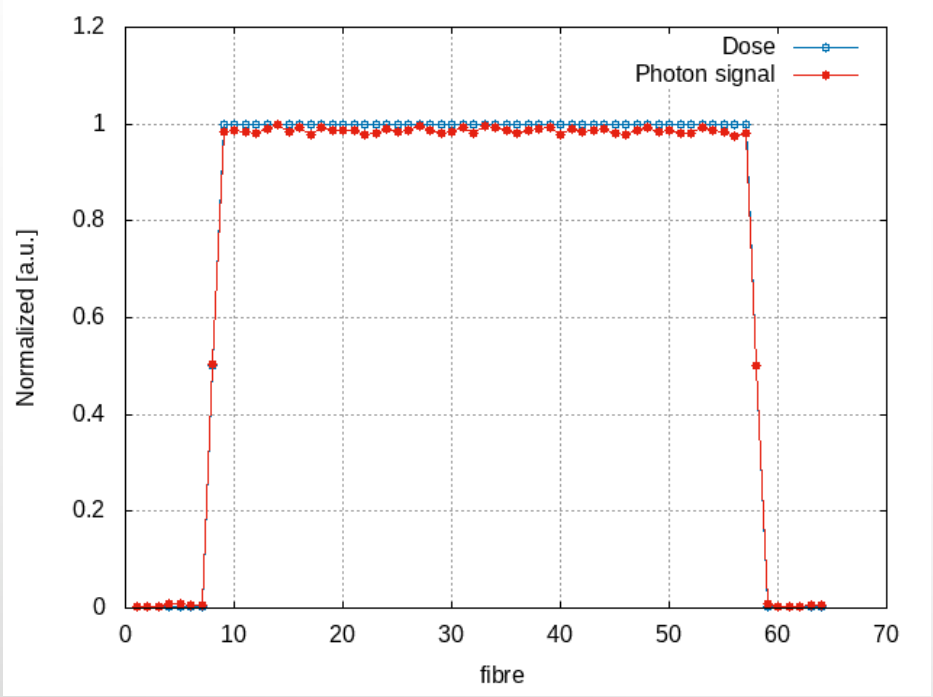




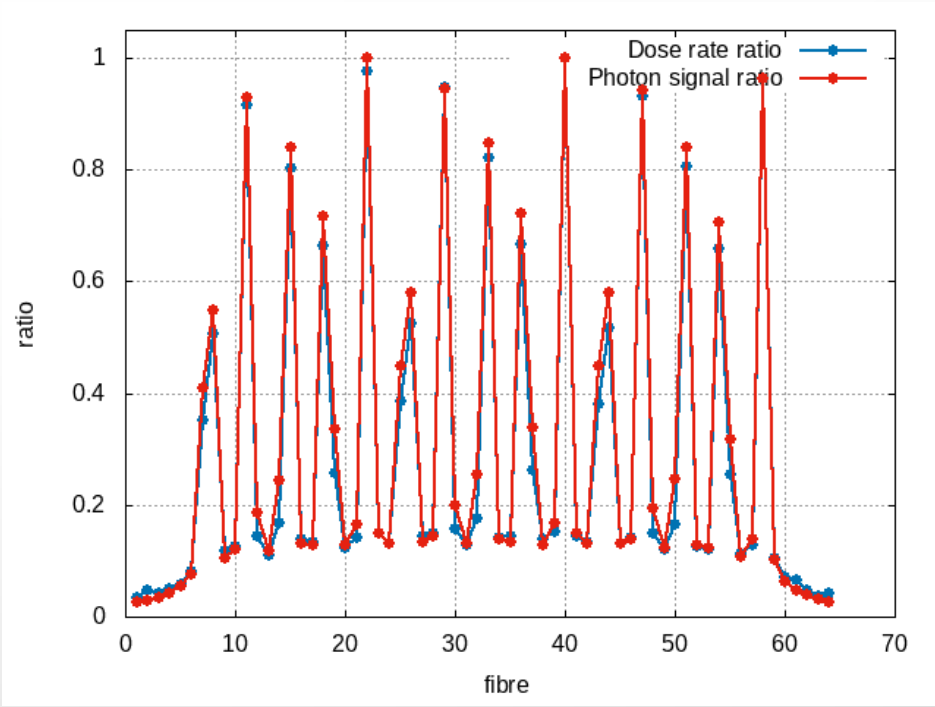
Support from LOMAC, MW, eCR Lab

APPLICATION TO MBRT

Can we use this detector to measure the PVDR in ion MBRT?



180 MeV proton broad beam
(5 cm × 5 cm)



180 MeV proton minibeam
(brass collimator with 15 apertures with 5 cm height and 0.6 mm width)

GSI Bio-PAC proposal for beam time submitted in June 2022

See poster by Bianca and Duarte (#24)

Ph.D. Projects

Research area	Title	Students
High resolution dosimetry	Scintillating array for real-time high-resolution ion therapy dosimetry	Duarte Guerreiro
	Bragg Peak monitoring through prompt-gamma: detection and instrumentation	José Venâncio
	Development of microdosimetric detectors for radiobiology in hadron therapy facilities	Cristiana Rodrigues
Advances in new treatment modalities	Evaluating the Efectiveness of MBRT in Cancer Therapy	Miguel Molina
	Developing Multi-Beam FLASH with Proton Beams	Joana Leitão
	Adaptive dose reconstruction with online in-vivo range verication in particle therapy	Mariana Brás
	Estudos dosimétricos para SBRT/SRT de pequenas lesões do cérebro	Dalila Mateus
	The effects of proton therapy on protein self-organization: potential benefits for neurodegenerative disorders	Carina Coelho
	Modeling the radiobiological effects of gold nanoparticles in proton therapy of glioblastomas	Joana Antunes
	Development of a dosimetry protocol for proton minibeam radiotherapy	Maria Giorgi

Dosimetry Posters

Authors	Title	#
Joana Antunes et *al.*	**Modeling the Radiobiological Effects of Gold Nanoparticles in Proton Therapy of Glioblastomas**	**29**
Maria Giorgi et *al.*	**Dosimetry evaluation to advance charged particle minibeam radiotherapy**	**23**
Duarte Guerreiro e Bianca Alves *et al.*	**Study of the viability of a scintillation detector for minibeams dosimetry**	**24**
Cristiana Rodrigues *et al.*	**Development of microdosimetric detectors for radiobiology in hadron therapy facilities**	**22**
Carina Coelho e Lia Pereira *et al.*	**Proton Therapy Beyond Cancer**	**21**

TEAM

Researchers	Ph.D. students	M.Sc. students (2021)	M.Sc. students (2022)
Jorge Sampaio	Duarte Guerreiro	Cláudia Espinha	Ana Campos
Luís Peralta	José Venâncio	Cristiana Rodrigues	Daniel Salgueiro
Patrícia Gonçalves	Joana Antunes	Filipa Baltazar	Tomás Almeida
João Gentil	Joana Leitão	Matilde Santos	Lia Pereira
Pamela Teubig	Miguel Molina	Nísia Fernandes	Rita Pestana
Daniel Galaviz	Dalila Mateus		
José Pires Marques	Maria Giorgi		
	Carina Coelho		
	Marina Brás		
	Cristiana Rodrigues		

COLLABORATIONS

THE UNIVERSITY OF TEXAS
MD Anderson Cancer Center

institut Curie

CMAM

INSTITUTO DE CIÊNCIAS NUCLEARES APLICADAS À SAÚDE
UNIVERSIDADE D COIMBRA

LIP
Dosimetry

dkfz.
GERMAN CANCER RESEARCH CENTER
IN THE HELMHOLTZ ASSOCIATION

IBEB
Instituto de Biofísica e Engenharia Biomédica

C²TN

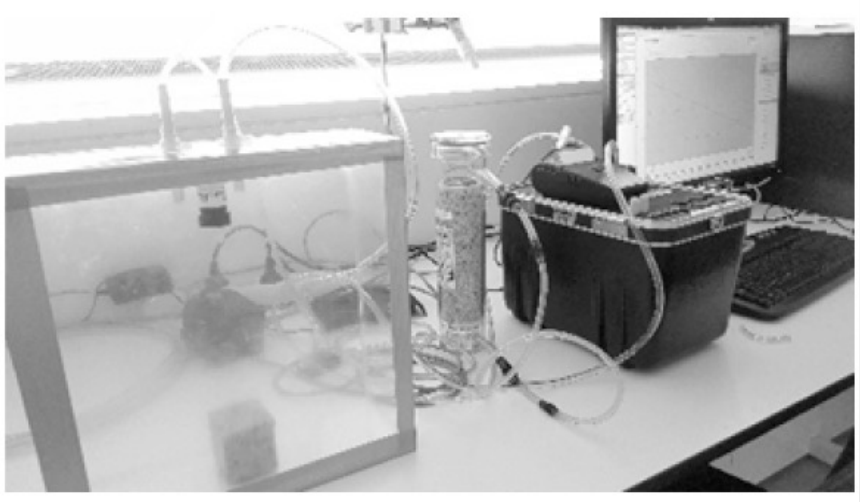
Radiation Health and Environment

- The LabExpoRad laboratory sits in Covilhã, and is equipped for the detection of radon in water and air.

- The group joined the Expression of Interest in the participation of a National Radiological Network which includes main laboratories and institutions like the Cyclotron Center in Coimbra (ICNAS), the Portuguese Environment Agency (APA), etc.

Radiation Health and Environment

- Radon mass exhalation rate measurements from building materials have been made



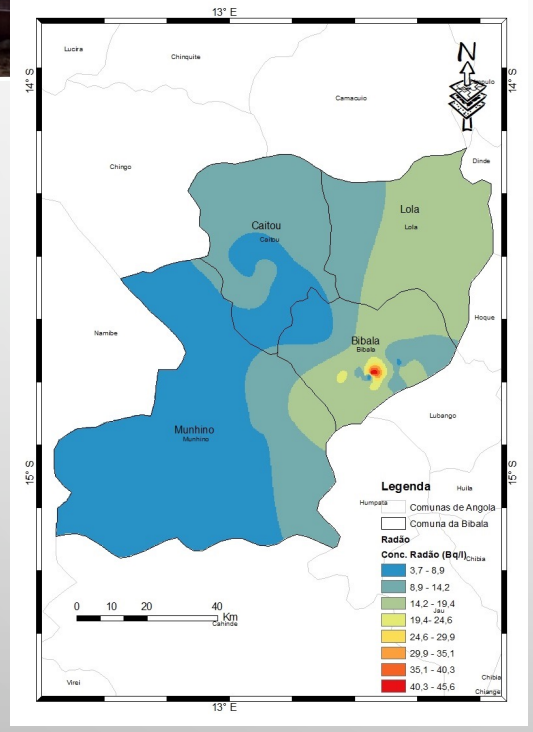
Existing chambers have some leakage, which affects results quality.

In order to improve results a new exhalation chamber with less leakage was build (new chamber under tests)

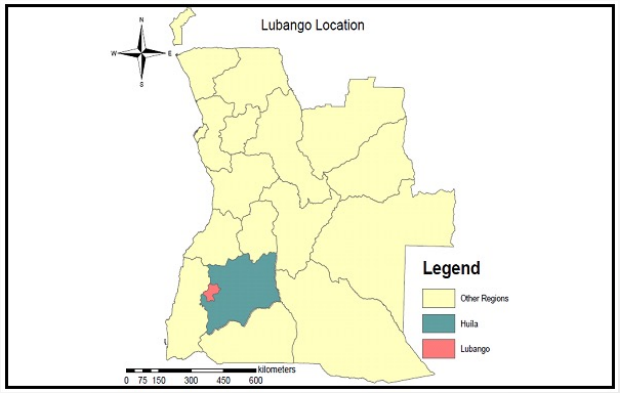
RADIATION HEALTH AND ENVIRONMENT

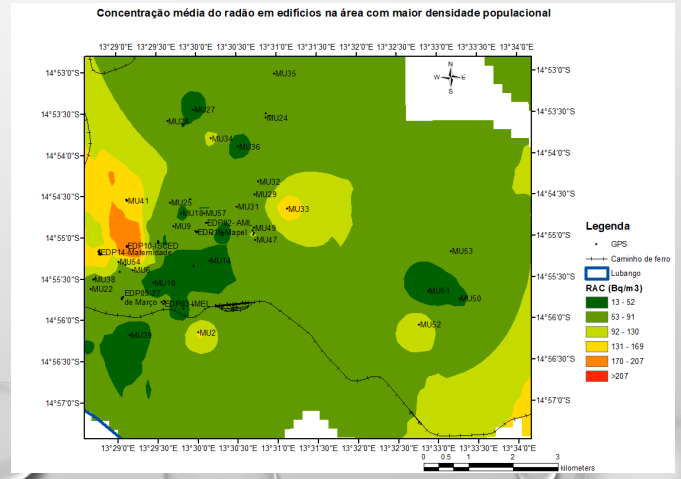
The Angola campaign (concluded)

Radon Concentration Potential in Bibala Municipality Water.



Radon Exposure in Buildings in Lubango city.





THANK YOU!