LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS
partículas e tecnologia

Mini-School on Charged Particle Therapy Applications

Lisbon, 4th December 2021

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ProtoTera Grants (started in October 2021)

PhD Thesis:

"Dosimetry evaluation to advance charged particle minibeam radiotherapy"

PhD Student:

Maria Giorgi

Supervisors:

Dr. Jorge Sampaio (FCUL-LIP)

Dr. Yolanda Prezado (Insitut Curie)

What is MBRT?

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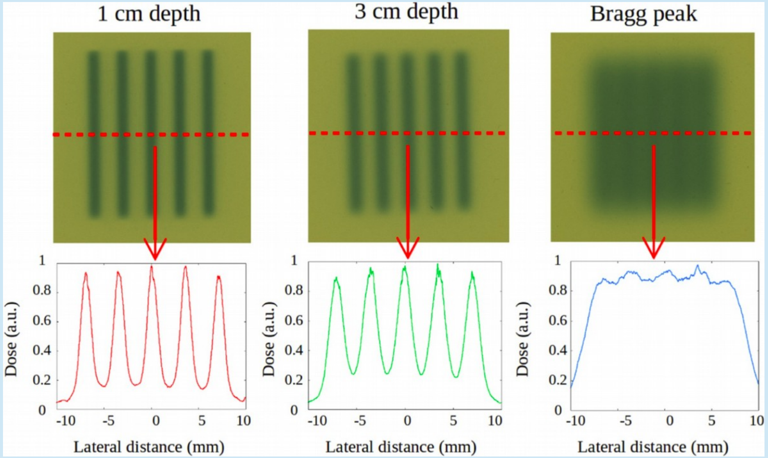
A new technique of RT, which provides a spatial fractionation of the dose.

Very narrow beams (diameter ≤1 mm) spaced by a few millimeters are used to modulate the dose, to obtain an homogeneous dose distribution in the tumour region and a succession of areas of high (peaks) and low (valleys) dose in the healthy tissue.



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- First results show an high tumour control even in case of radio-resistant tumours such as high-grade glioma

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- Measurement of charged particle MBRT irradiation parameters using available high-resolution dosimeters at institut Curie (Paris), GSI (Darmstadt), etc.

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- Measurement of charged particle MBRT irradiation parameters using available high-resolution dosimeters at institut Curie (Paris), GSI (Darmstadt), etc.

- Development of GPU-based MC simulations of the biophysics processes in charged particle MBRT.

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Implementation of fast MC simulations of charged particle MBRT treatment plans to guide pre-clinical experiments and to perform the first evaluation of treatment plans in anthropomorphic phantoms or in CT images of anonymized patients.

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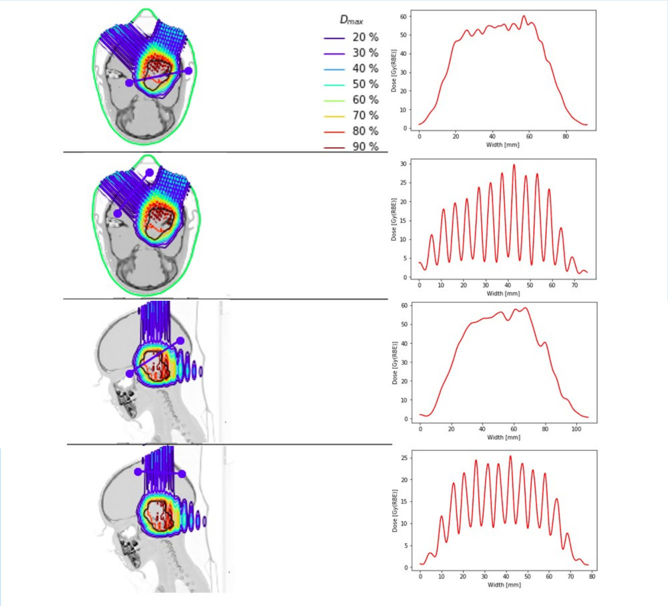

“Monte Carlo assessment of dose and secondary neutron dose in Proton Therapy” - Master Thesis, M. Giorgi

First steps

MC Dose assessment for Carbon ion MBRT

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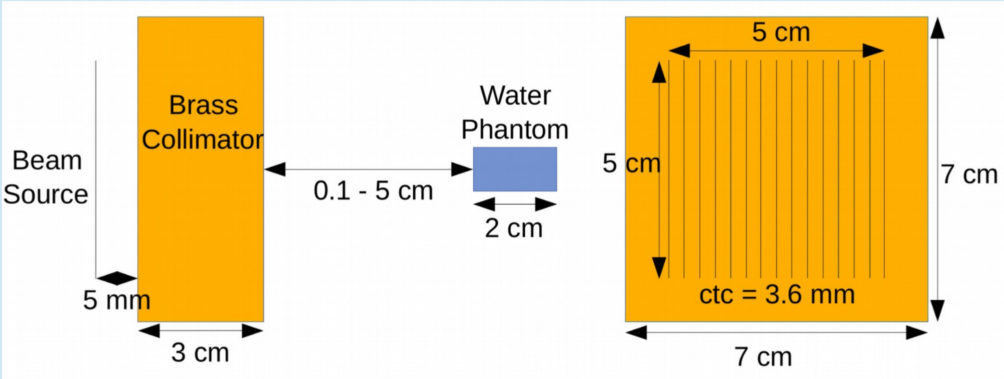
Simulation Setup



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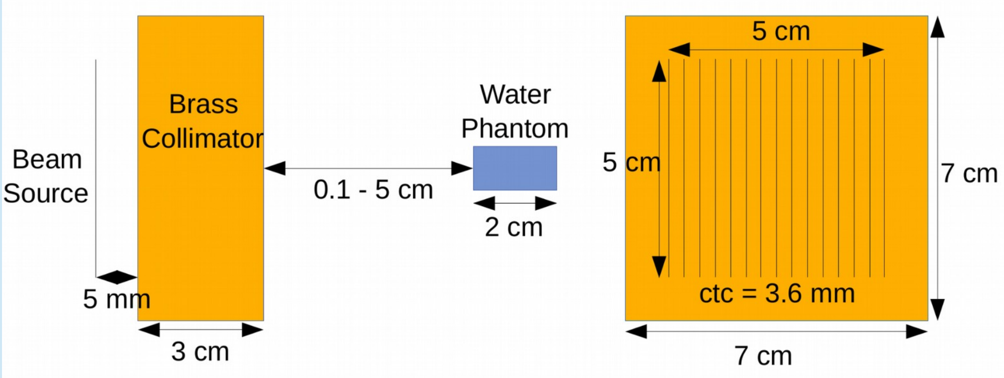

Beam Source Parameters

$Label$	$E\ [MeV/u]$	$\Delta E\ [\%]$	$\sigma_x\ [mm]$	$\sigma_y\ [mm]$	$\sigma_{x'}\ [mrad]$	$\sigma_{y'}\ [mrad]$	$r_{xx'}$	$r_{yy'}$
$Param1$	180	0.1	4.8	5.4	3.6	1.6	0	0
$Param2$	180	0.1	4.8	5.4	0.1	0.1	0	0
$Param3$	180	0.1	4.8	5.4	10	10	0	0
$Param4$	180	5	4.8	5.4	3.6	1.6	0	0

First steps

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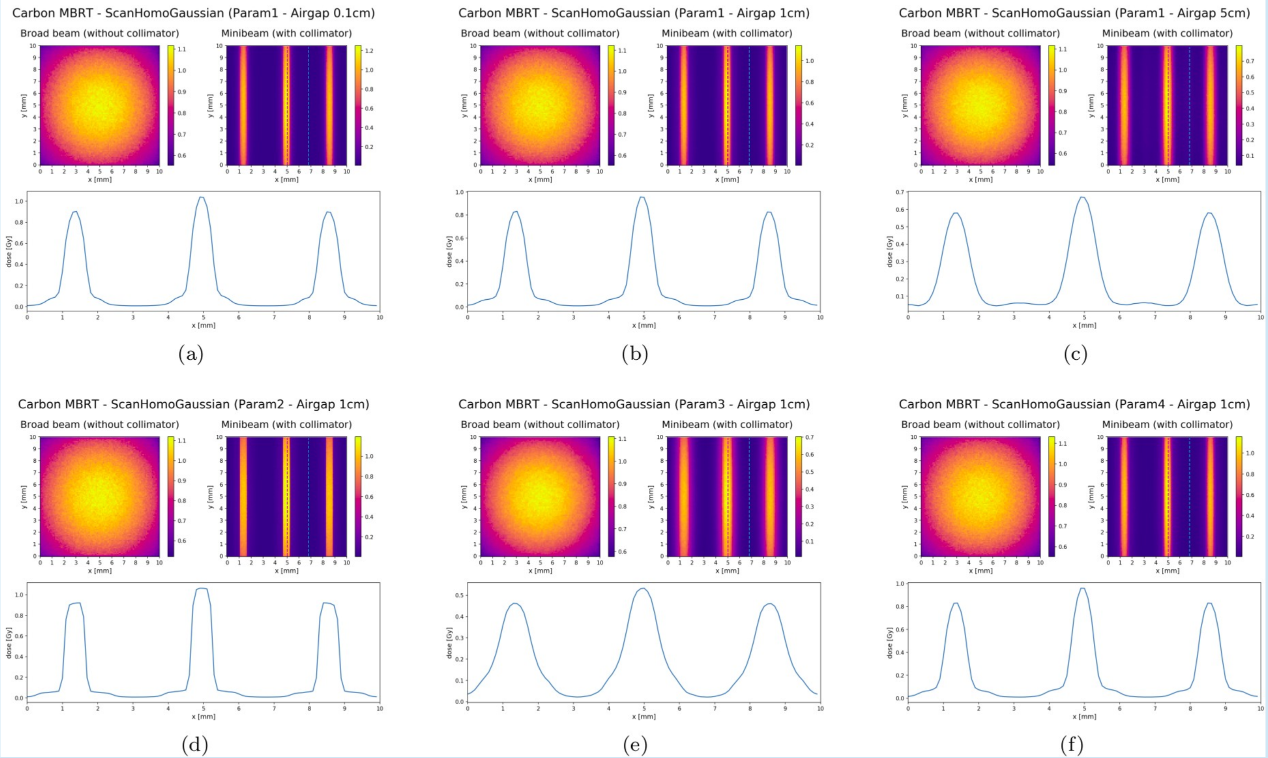

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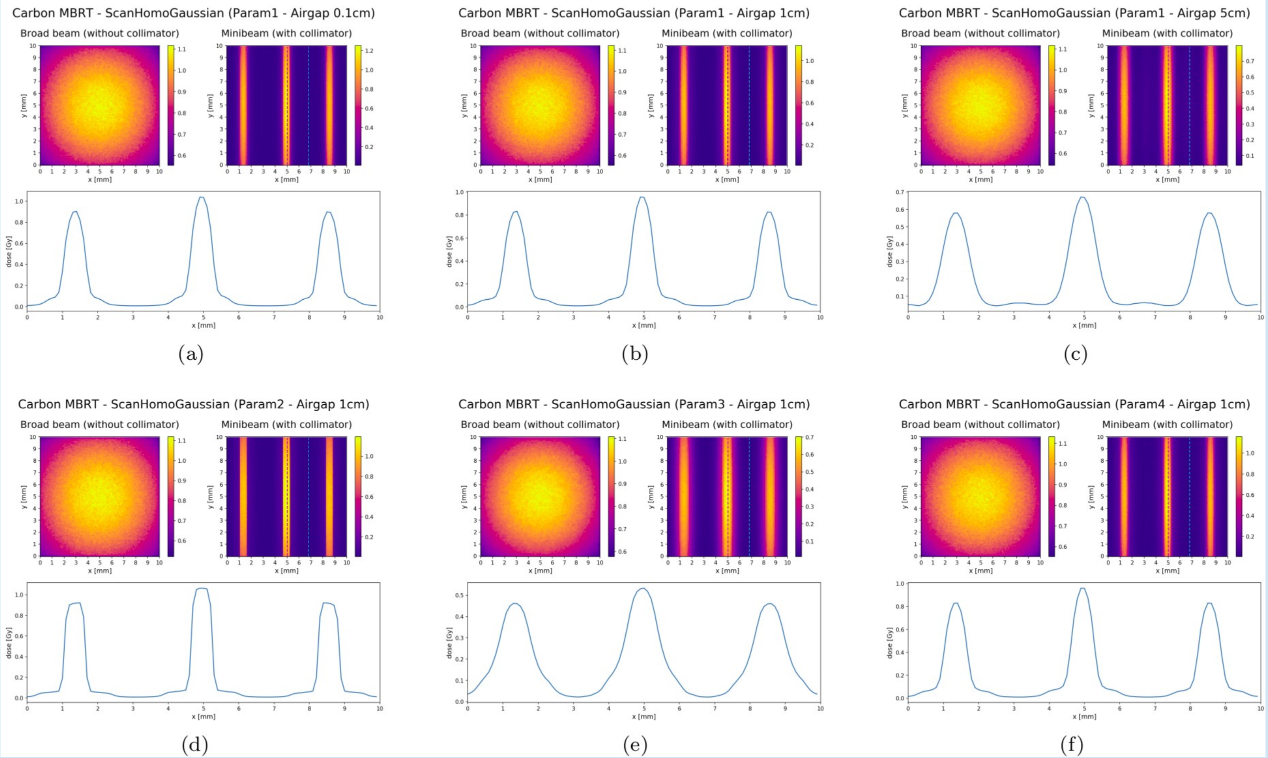

Next steps: secondary particles, LET, other ions…

Thank

This PhD project is supported by the ProtoTera grant ref PRT/BD/151548/2021

Why heavy ions?

- Heavy charged particles exhibit a superior dose distribution compared to all conventionally used beams.
- The small lateral and range straggling, combined with an increase of the dose deposition in depth, enables the production of dose profiles shaped precisely to the contours of the treatment volume.
- Ions heavier than helium exhibit a strong increase of the Linear Energy Transfer (LET) in the Bragg peak as compared to the entrance region.
- First results showed an high tumour control even in case of radio-resistant tumours such as high-grade glioma