Laboratoire de Physique de Clermont

Evaluation of RBE in protontherapy

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Context

Development of tools for biological effects calculation in 2D/3D cell populations

Last GATE meeting results and perspectives

- TEPCActor for the calculation of the lineal energy distribution at the micrometric scale

  → **Validated and available in GATE 8.0**

- Microkinetic model (MKM) for the estimation of cell survival/RBE

  → **Preliminary results for melanoma cancer cells in 2D/3D configurations**

  → **To be implemented in GATE**

MKM needs to be fed with measured biological data

Context

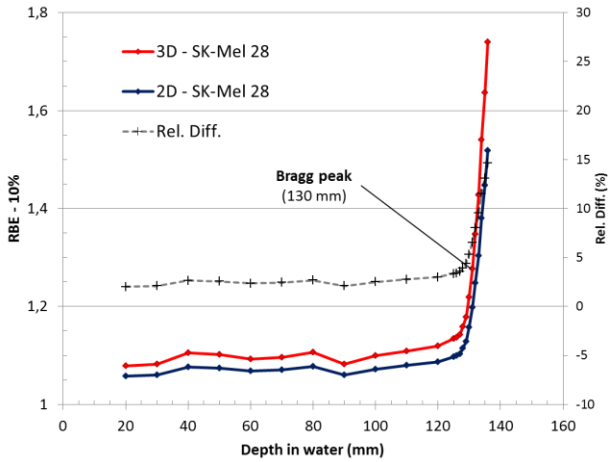
Microkinetic model – prediction of the RBE

- Based on physical data: **LET distribution** (TEPCActor)
- Based on biological data: measured **survival curves**
- Setting of the parameters using a **low and a high LET radiation**

Melanoma cancer cells (SK-Mel 28) in 2D and 3D configurations (155 MeV protons)

- Only based on a low LET survival curves
  (250 kV X-ray PAVIRMA plateform)

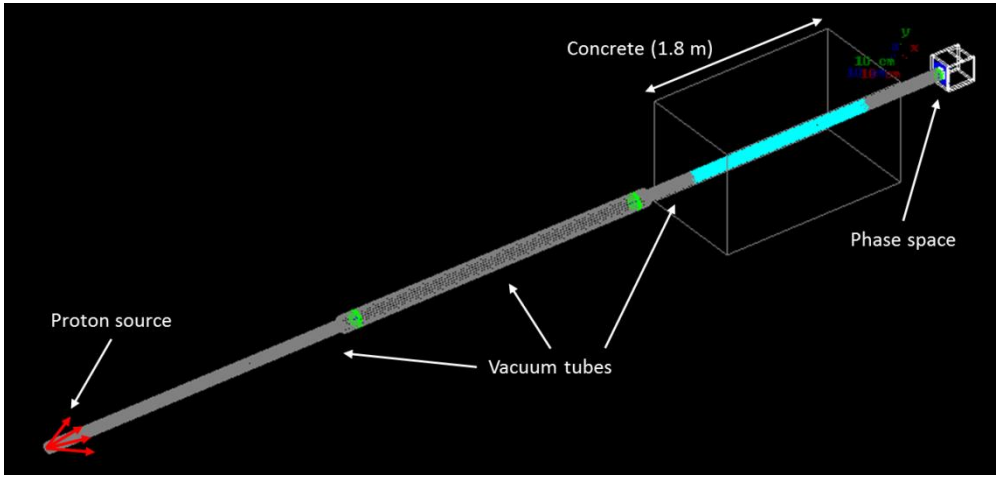
	2D	3D	Rel. Diff.
Plat.	1.07	1.09	2.4%
Peak	1.16	1.22	**5.3%**
Max	1.52	1.74	**14.6%**



→ Collaboration with the centre Antoine Lacassagne (CAL) in order to mesure the survival curves for 65 MeV protons

Simulation of the 65 MeV proton line (CAL, Nice)

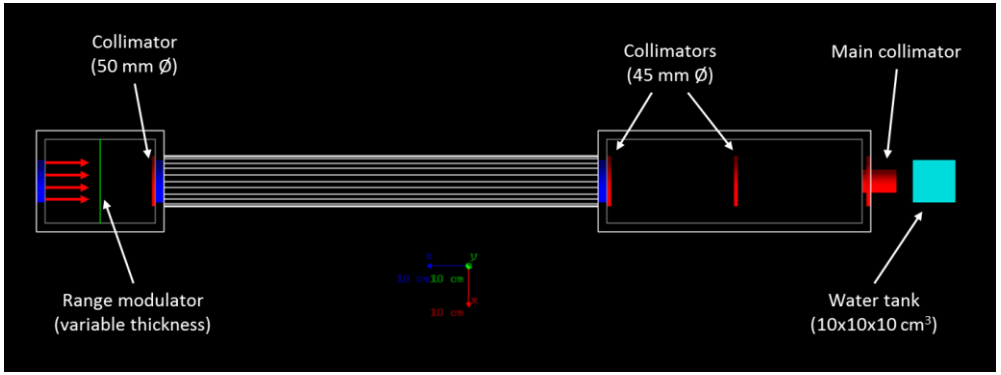
1/ From the cyclotron to the treatment room



Phase space file at the entrance of the optical bench

- Circle of 40 mm radius
- $2x10^8$ particles (90 % of protons)
- Random angle option

2/ Through the optical bench

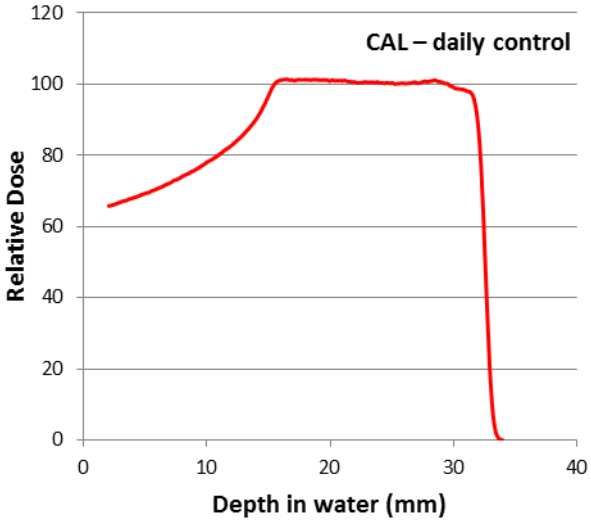


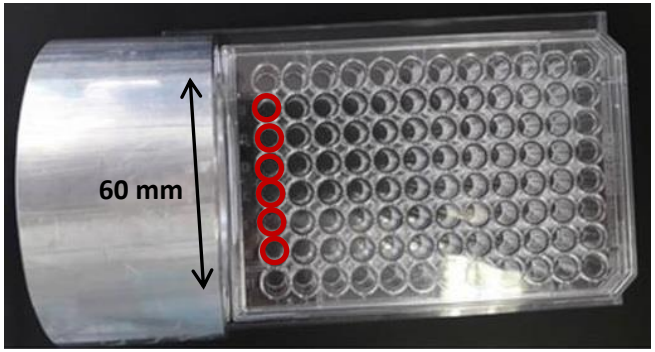
DoseActor/TEPCActor attached to the experimental area

Experimental setting

First test of the irradiation protocol

- Spread-Out Bragg Peak (SOBP) of reference
- Range of 32 mm with a modulation of 16 mm
- Collimator 60 mm of diameter
- Prescription of 0, 1, 2, 5 and 10 Gy for the survival fraction
- Cell containers in the air in front of the collimator





3D configuration – spheroids in the first line of a 96-well plate

2D configuration – cells on the inner surface of a T25 flask

Perspectives

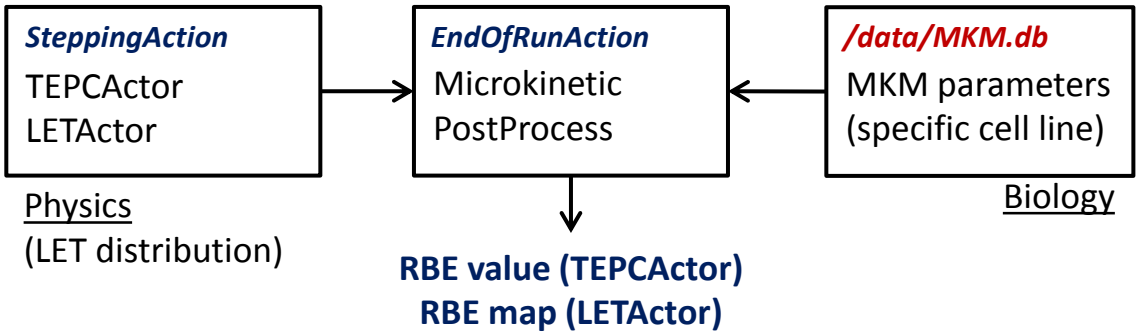
Measurement of SK-Mel 28 cell survival curves (in progress)

- Validation of the 65 MeV proton line simulations against daily control performed at the CAL
  - Monoenergetic peak of reference
  - SOBP of reference

- First irradiation of 2D and 3D cell configurations in june 2017
- Exploration of the survival fraction as a function of depth after september 2017

Microkinetic model in GATE (in progress)

- To be implemented as a 'PostProcess' actor



Thank you