



WIR SCHAFFEN WISSEN – HEUTE FÜR MORGEN

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Radiotherapy with GATE-RTion

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23.10.2021

**GATE Workshop at
the IEEE NSS/MIC**

What is GATE-RTion?

Why do we use GATE-RTion?

How do we use GATE-RTion?

What's next in GATE-RTion?

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What is GATE-RTion?



- **Long-term** version of GATE/Geant4.

Geant4 v10.3.3
Gate v8.1
GATE-RTion v1.0

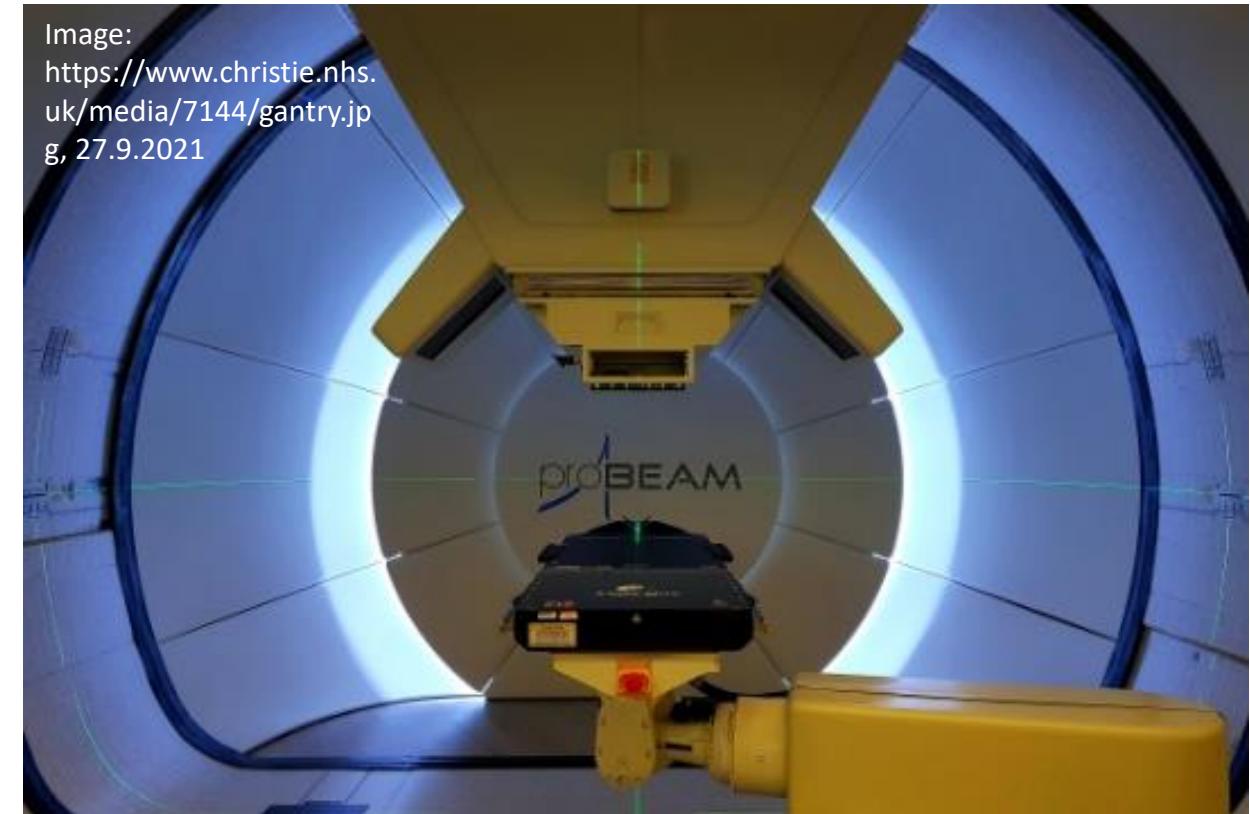
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Image:
<https://www.christie.nhs.uk/media/7144/gantry.jpg>, 27.9.2021

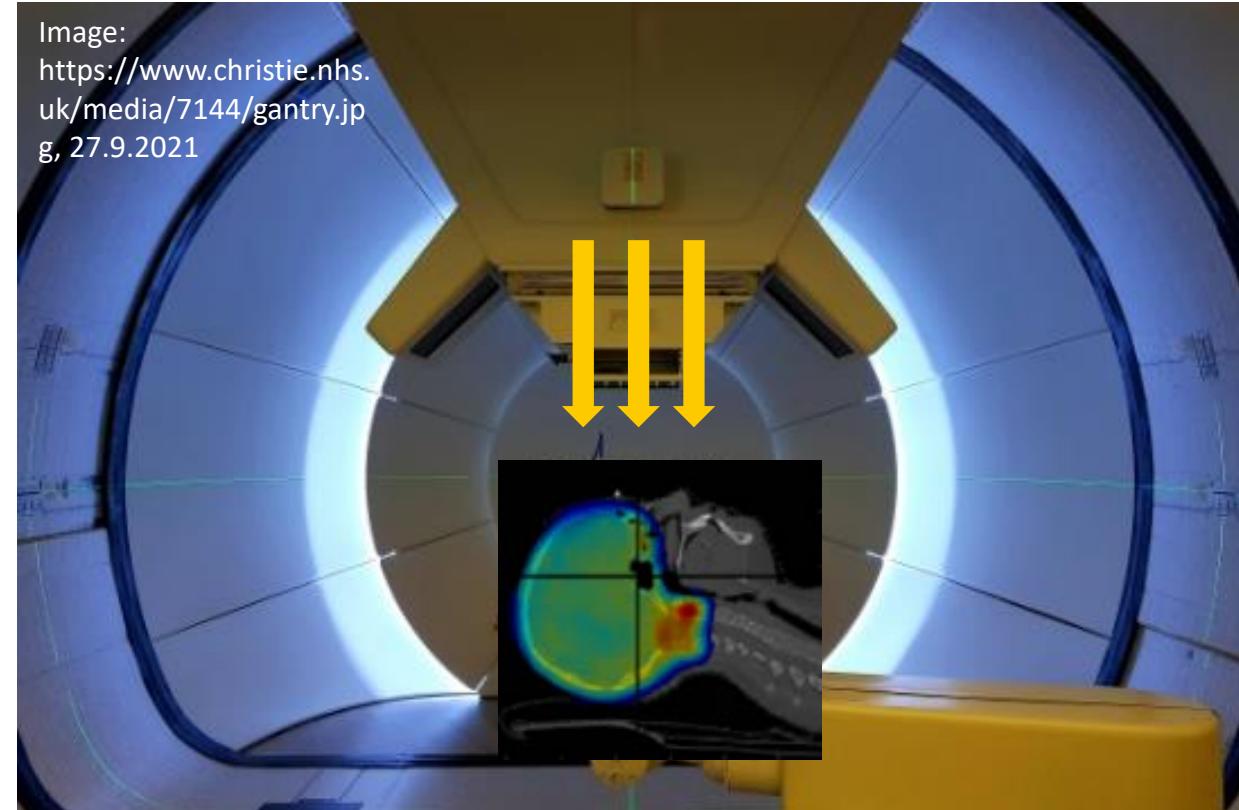


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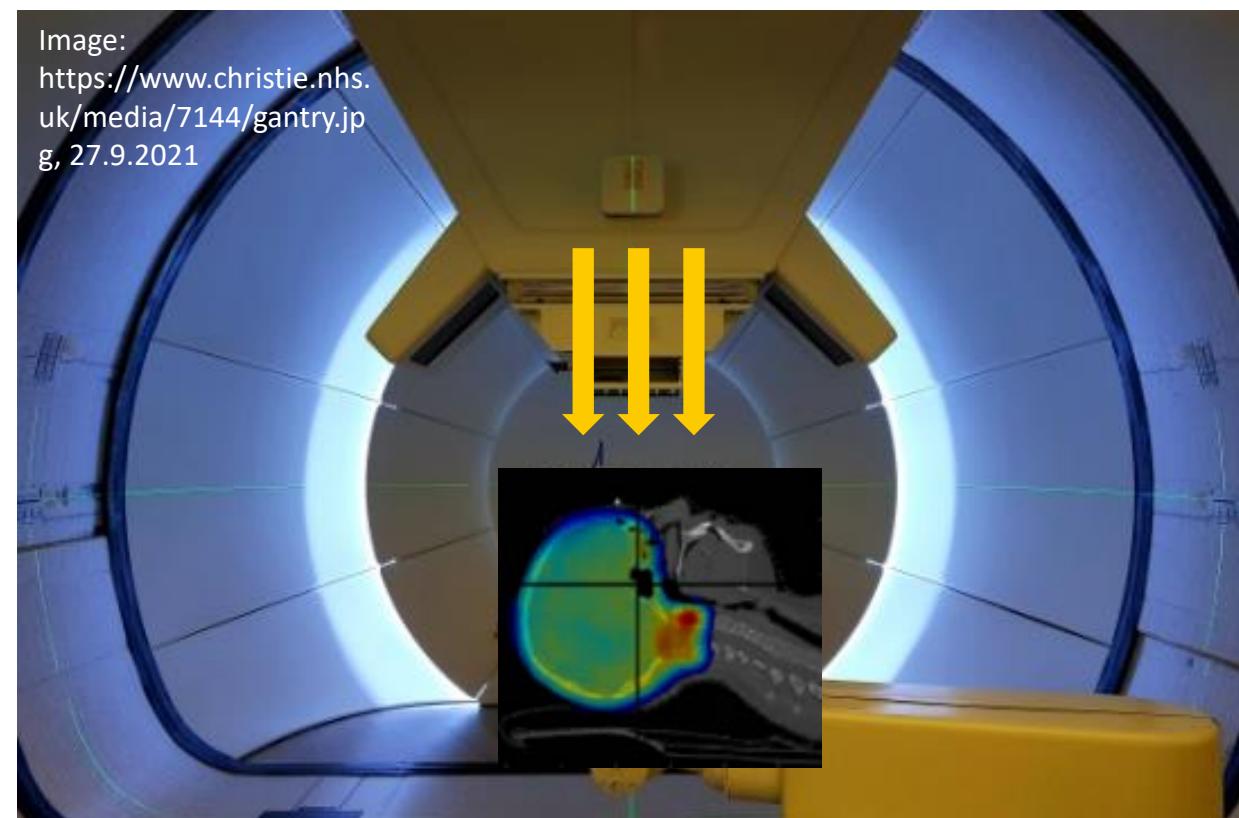


What is GATE-RTion?



- **Long-term** version of GATE/Geant4.
- **Dedicated** version for proton and carbon pencil beam scanning radiotherapy.
- Includes **tools** for institute specific Monte Carlo setups.
- Includes **validation tests**.

Geant4 v10.3.3
Gate v8.1
GATE-RTion v1.0





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This enables **enhanced collaboration** for clinical and/or research-based **radiotherapy applications**.

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Evaluation of GATE-RTion (GATE/Geant4) Monte Carlo simulation settings for proton pencil beam scanning quality assurance

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15 Authors
11 Different Institutes

Outline



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Examples:

- AutoMC dose calculations for proton therapy (**The Christie NHS Foundation Trust, UK**)
- IDEAL dose calculations (proton and carbon ions, **MedAustron, Austria**)
- Proton radiography at the at **Centre Antoine Lacassagne, France**

Disclaimer:
This is only a selected set of projects!

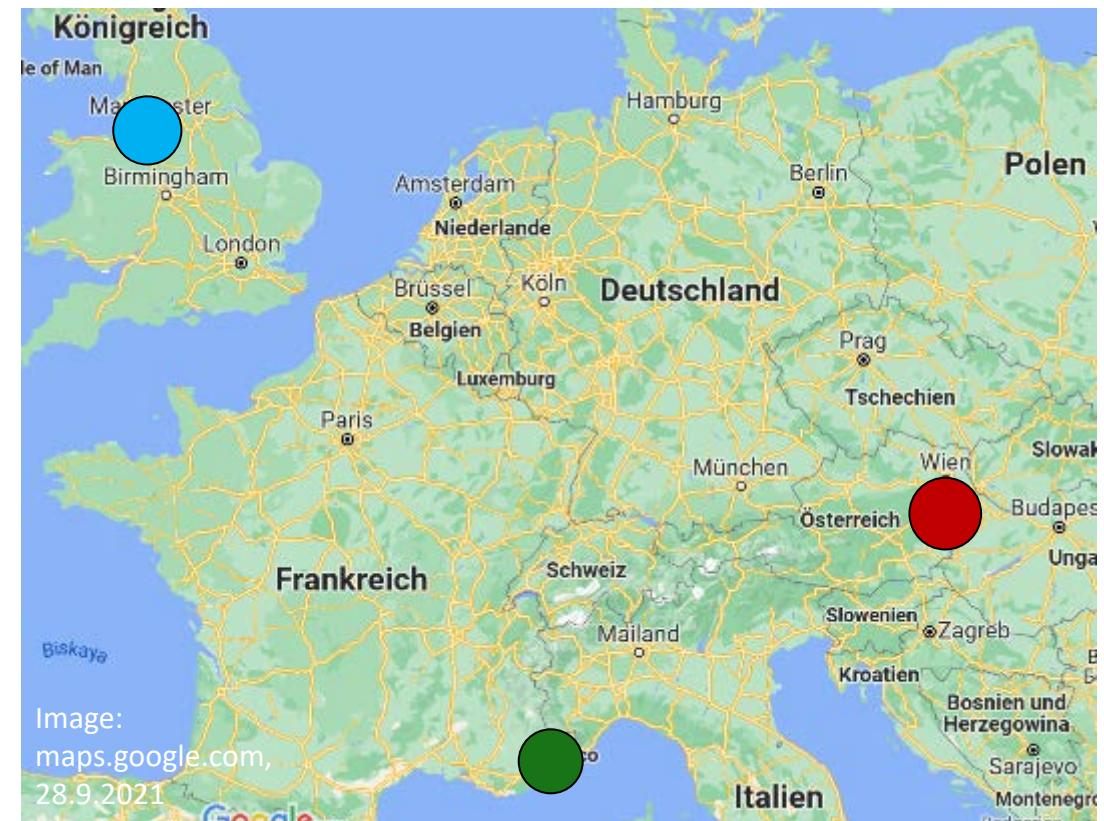


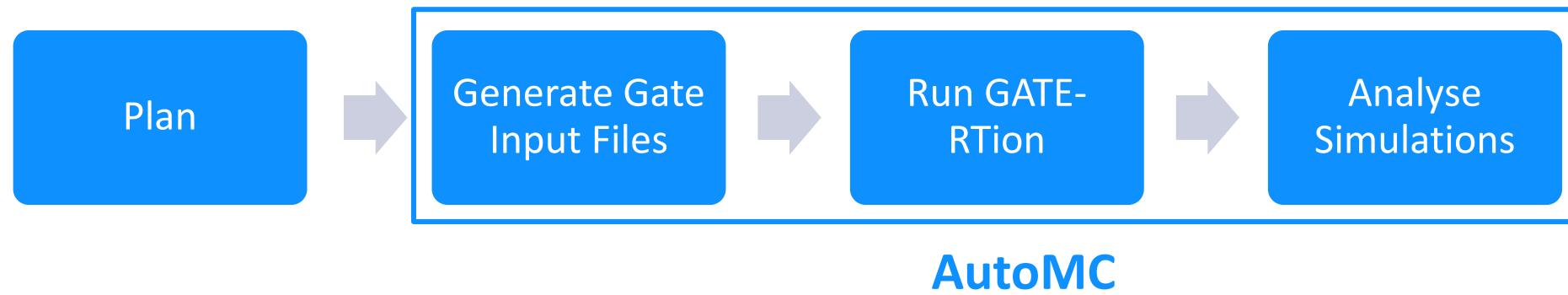
Image:
maps.google.com,
28.9.2021

How do we use GATE-RTion?



The Christie NHS Foundation Trust, UK:

GATE-RTion as the basis for AutoMC dose calculations for proton therapy

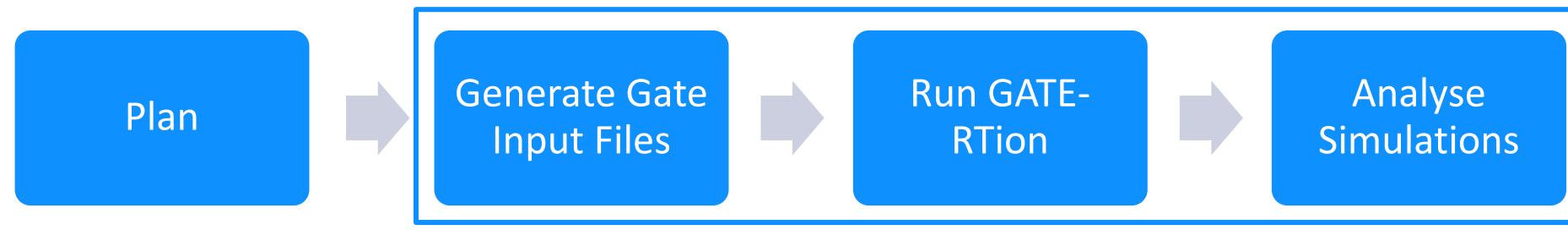


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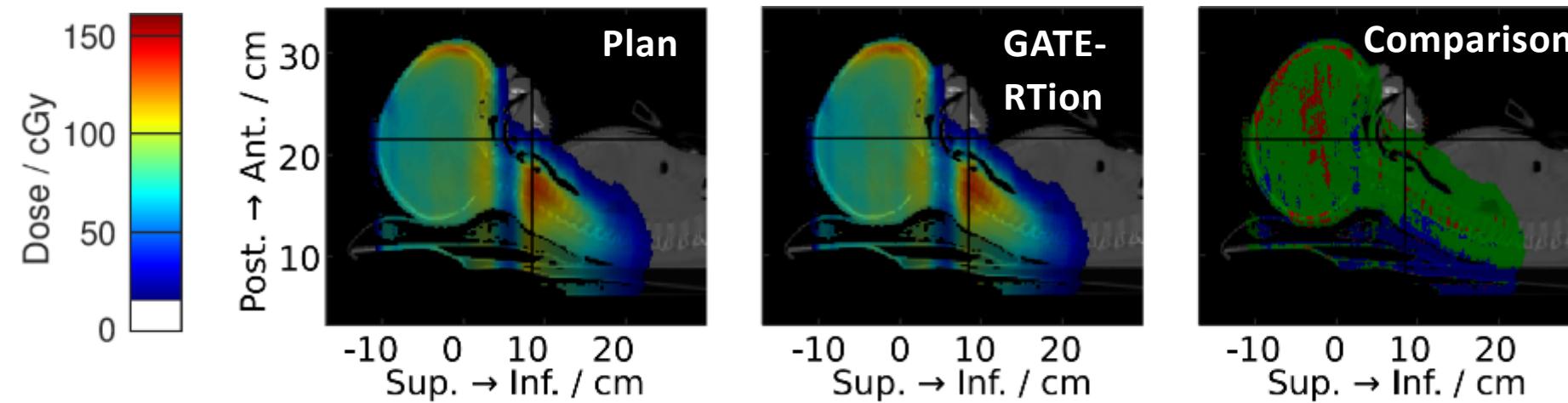


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AutoMC



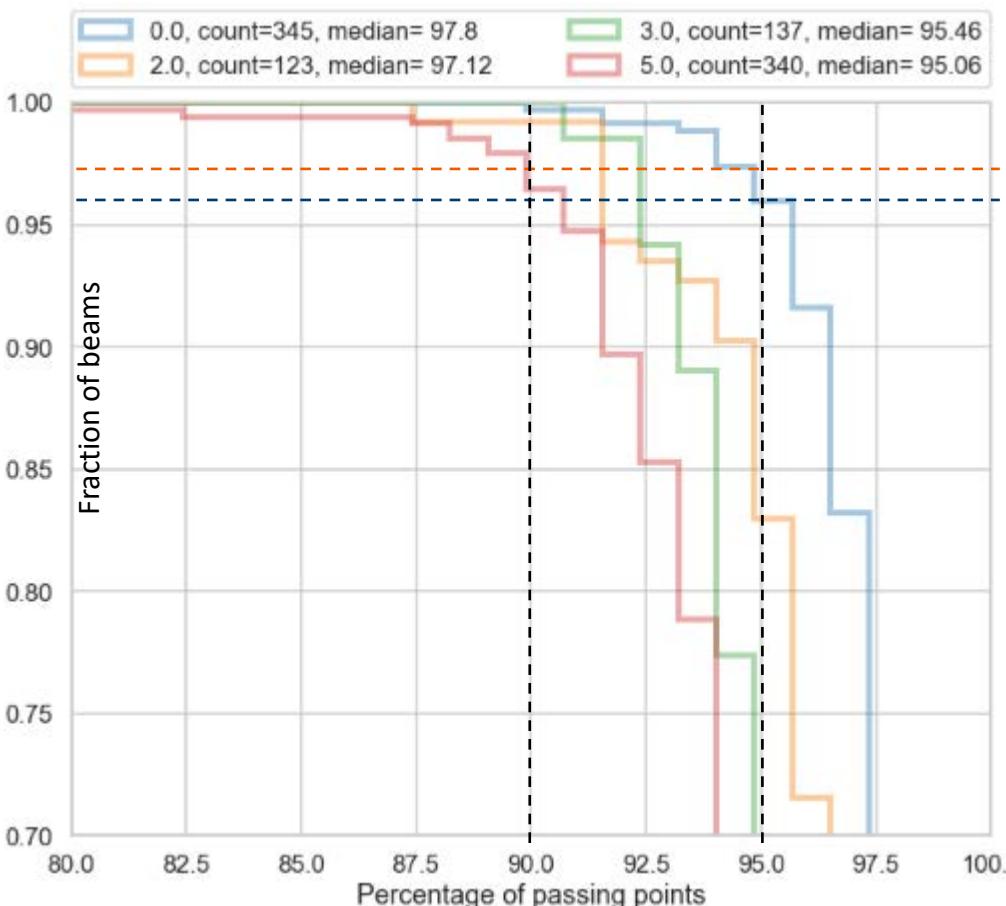
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Gamma 3%/3mm pass %: Cumulative histogram



Implementation data (March 2020):

202 Patients

328 Plans

945 Beams

Impact of AutoMC:

- Reduction of patient specific quality assurance measurements.
- More flexibility in timing of these measurements.

How do we use GATE-RTion?



MedAustron, Austria:

GATE-RTion as the basis for IDEAL dose calculations (proton & **carbon ions**)

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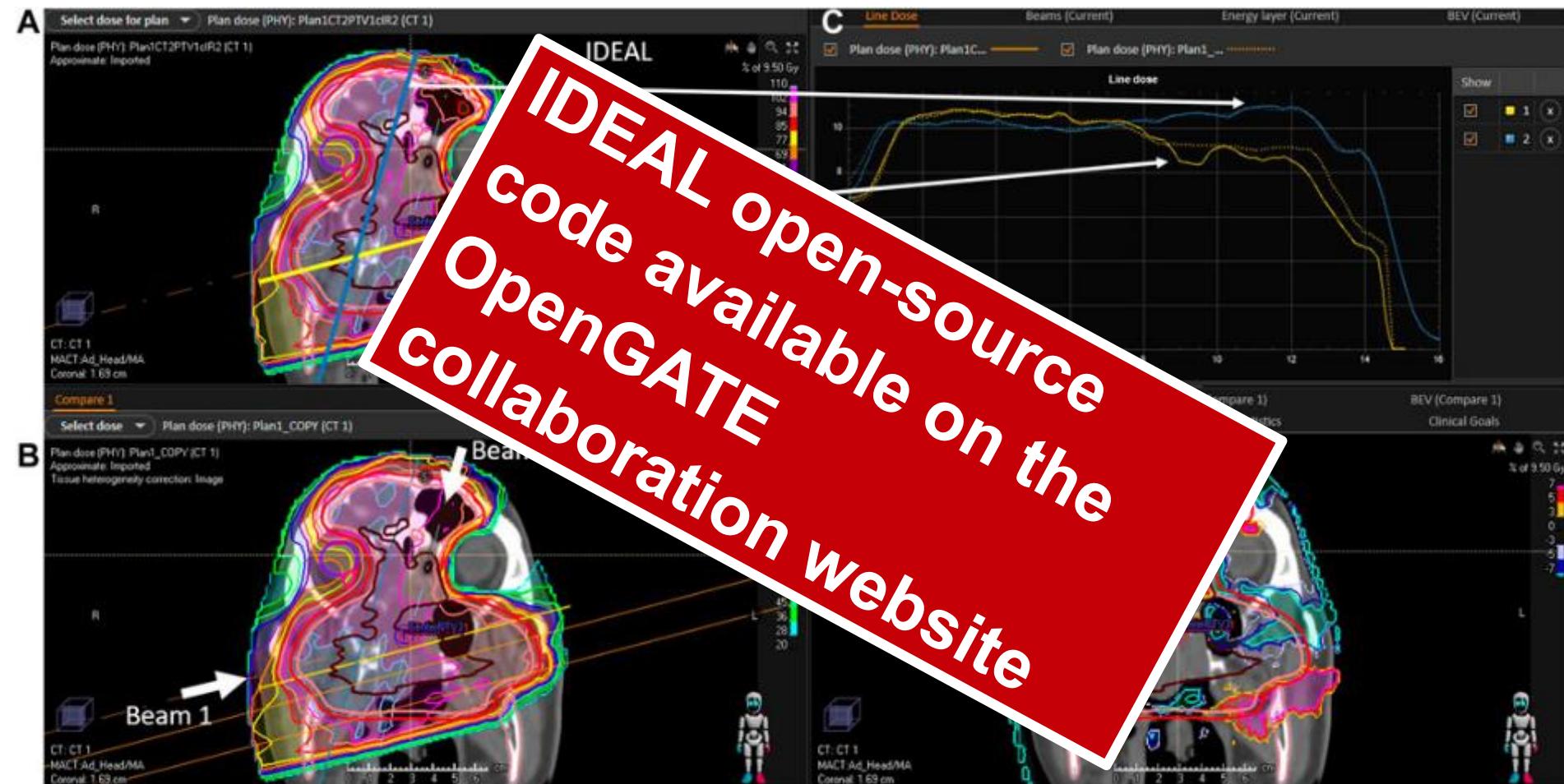


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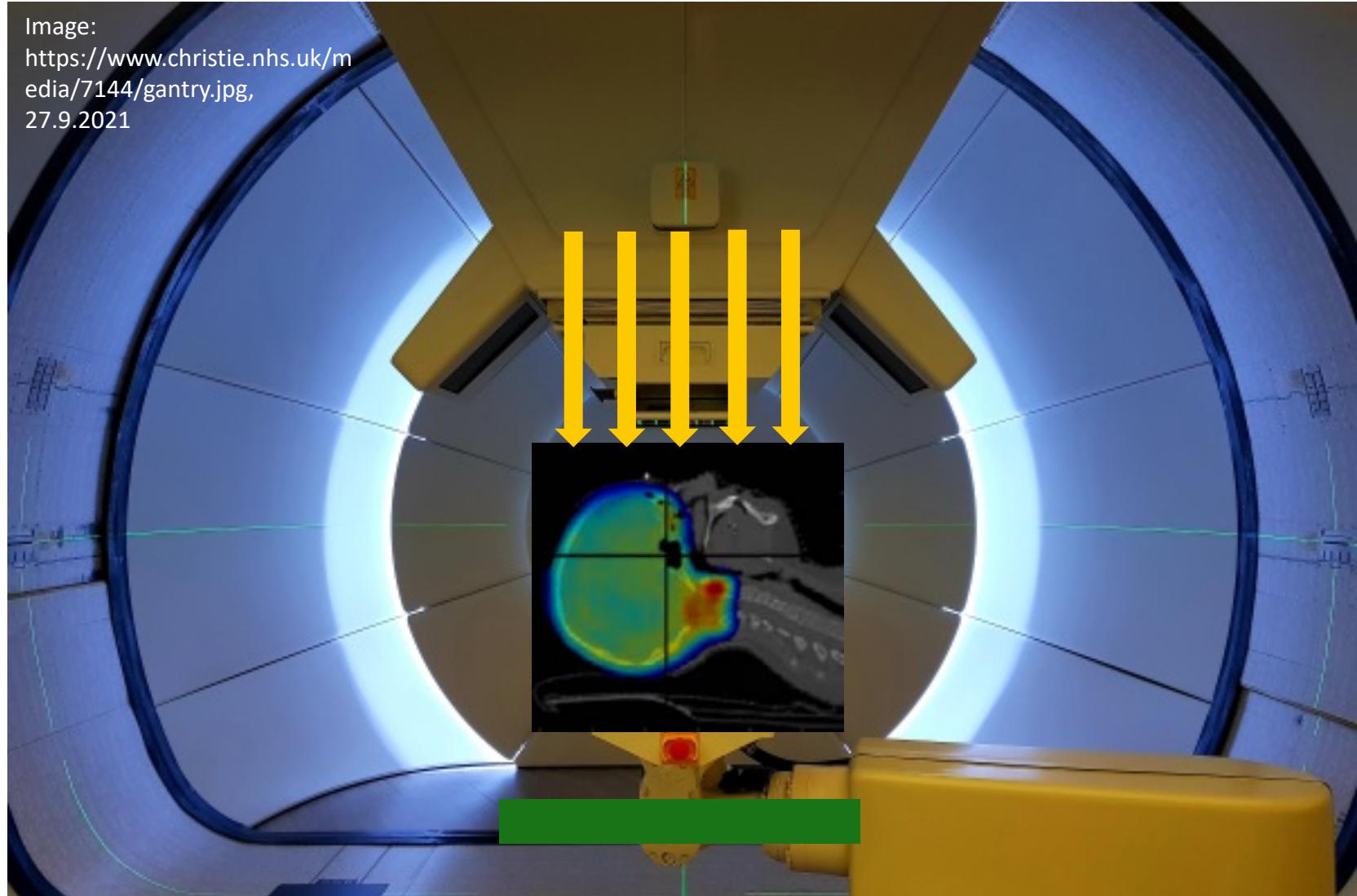


How do we use GATE-RTion?



**Centre Antoine Lacassagne,
France**

GATE-RTion for proton radiography

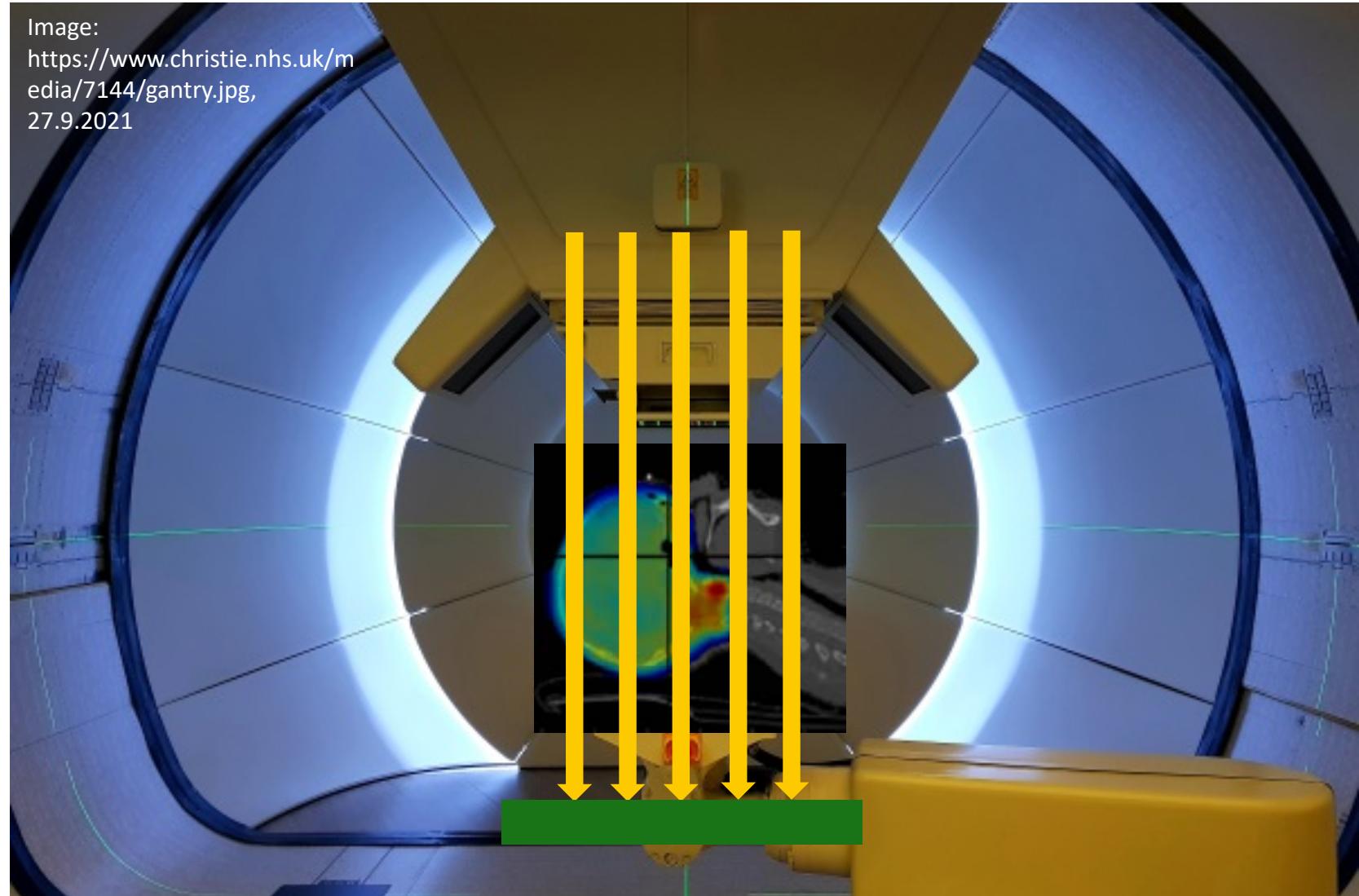


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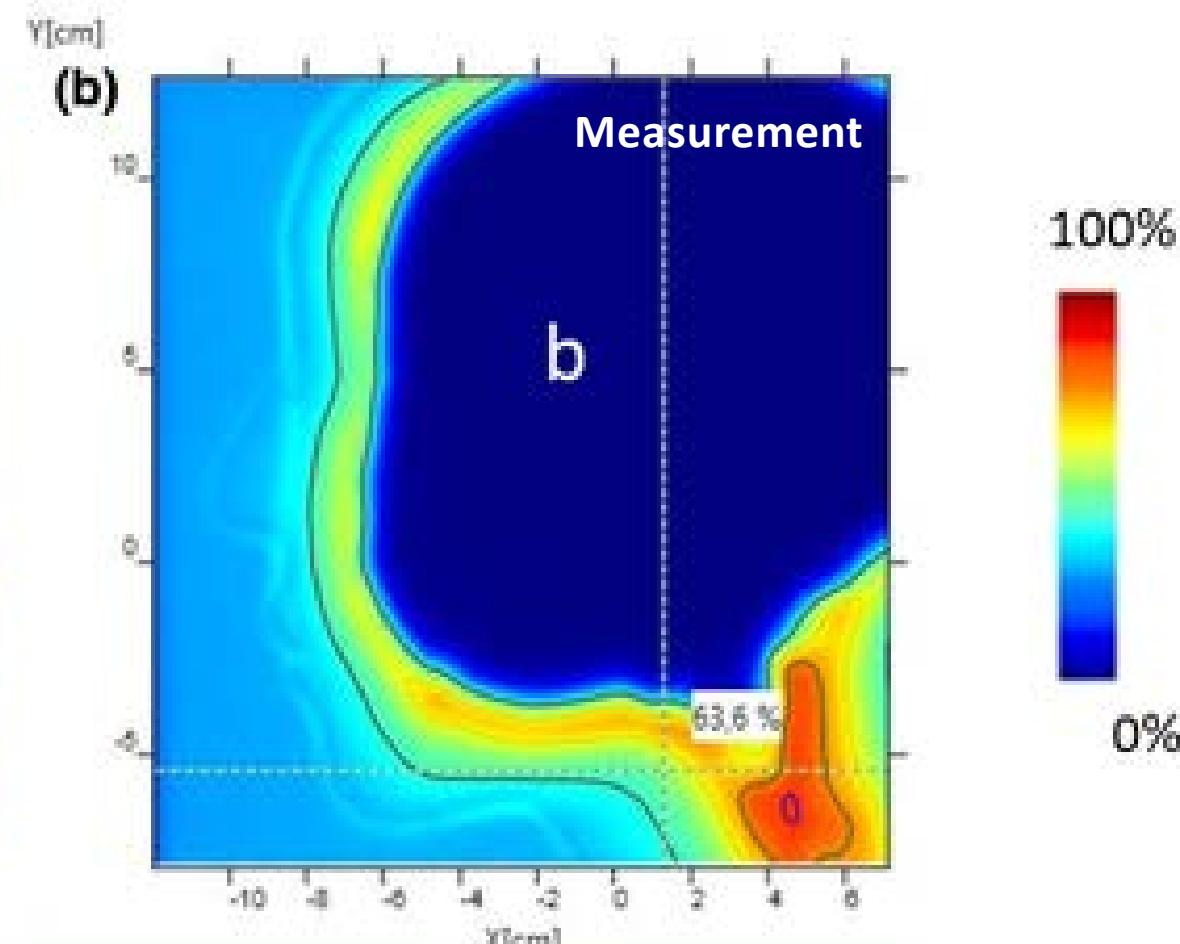
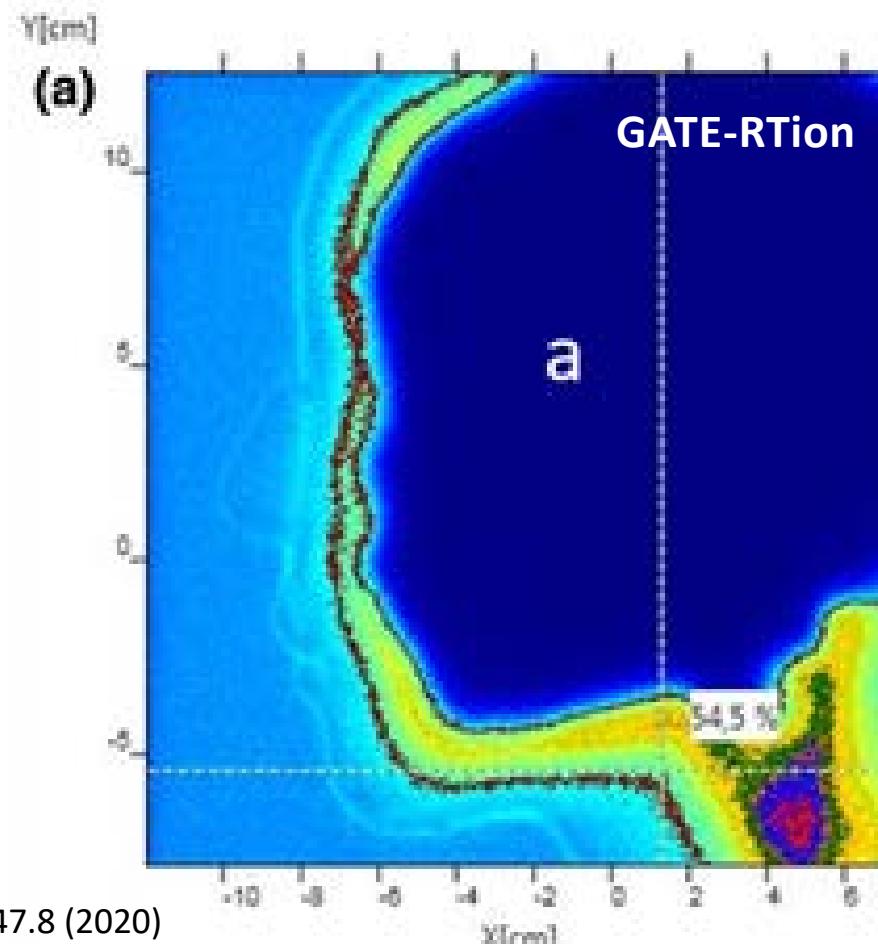


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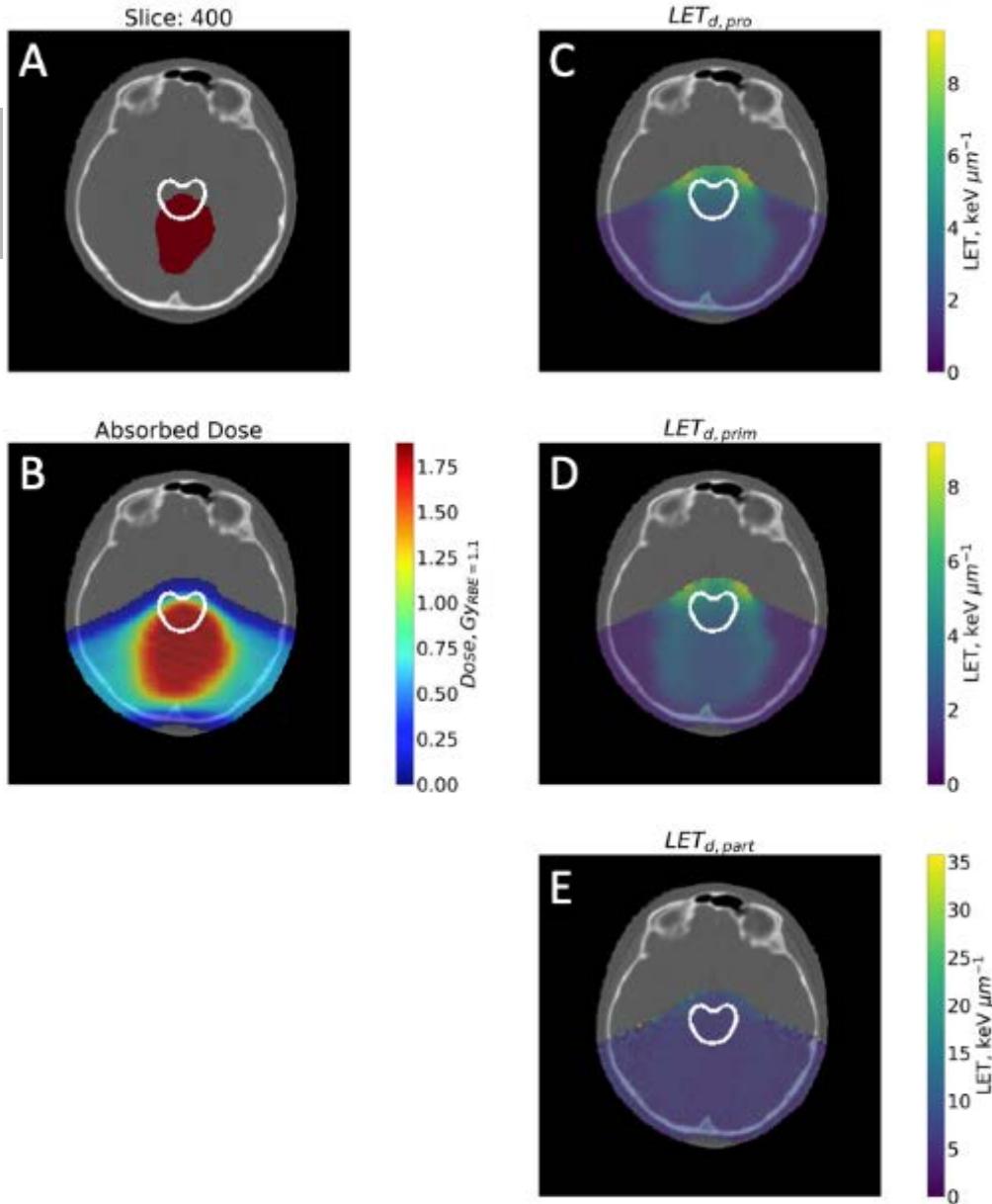
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GATE-RTion/AutoMC for proton LET and variable RBE modelling:

- LET calculation and scoring approaches (Smith et al. under review)
- LET spectra (Smith et al. manuscript in preparation)

GATE-RTion2.0: LET and RBE tools for protons and carbon ions

What's next in GATE-RTion?



GATE-RTion/IDEAL for carbon RBE dose modelling:

- Carbon RBE dose using inputs fragmentation data from GATE-RTion (Resch et al., ESTRO 39 (2020). p. OC-0577, manuscript in preparation).

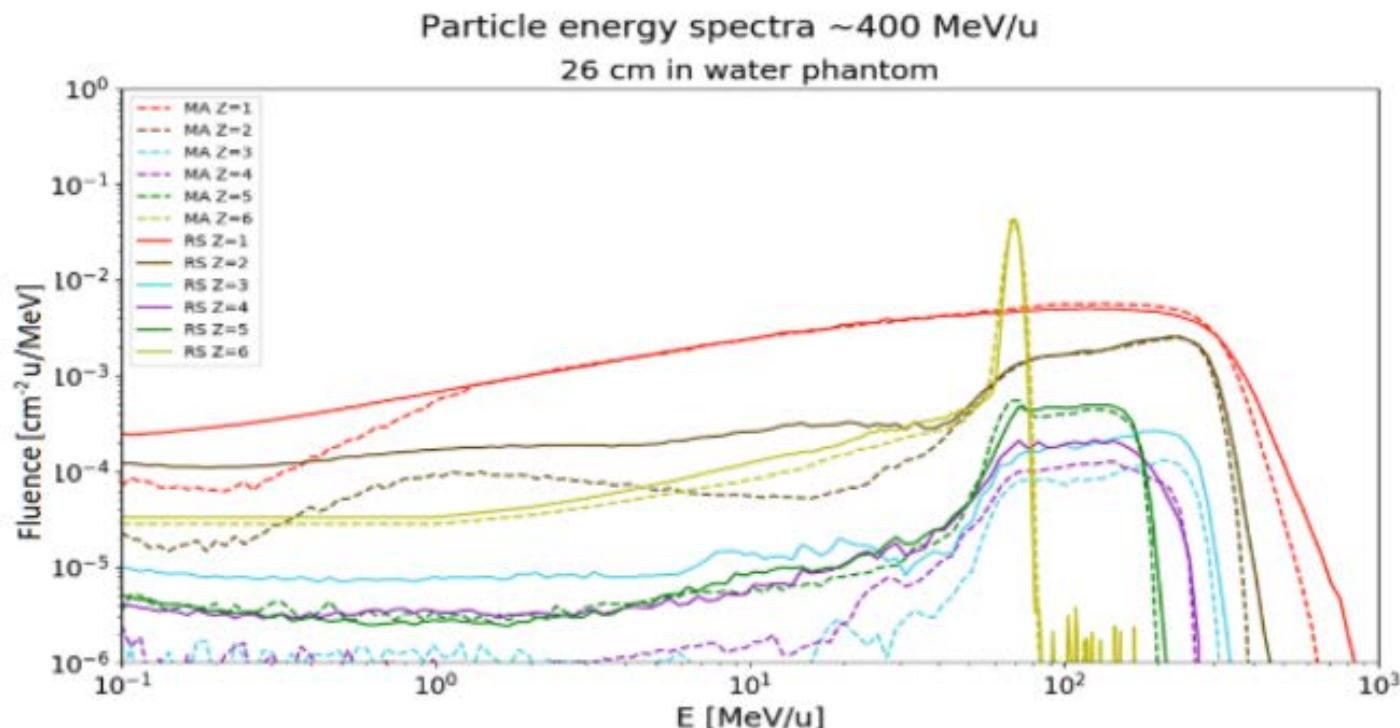


Figure 1: Fluence of a 400 MeV/u carbon ion beam simulated with FLUKA (solid lines) and Geant4 (dashed lines).

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RTion2.0:
LET and RBE
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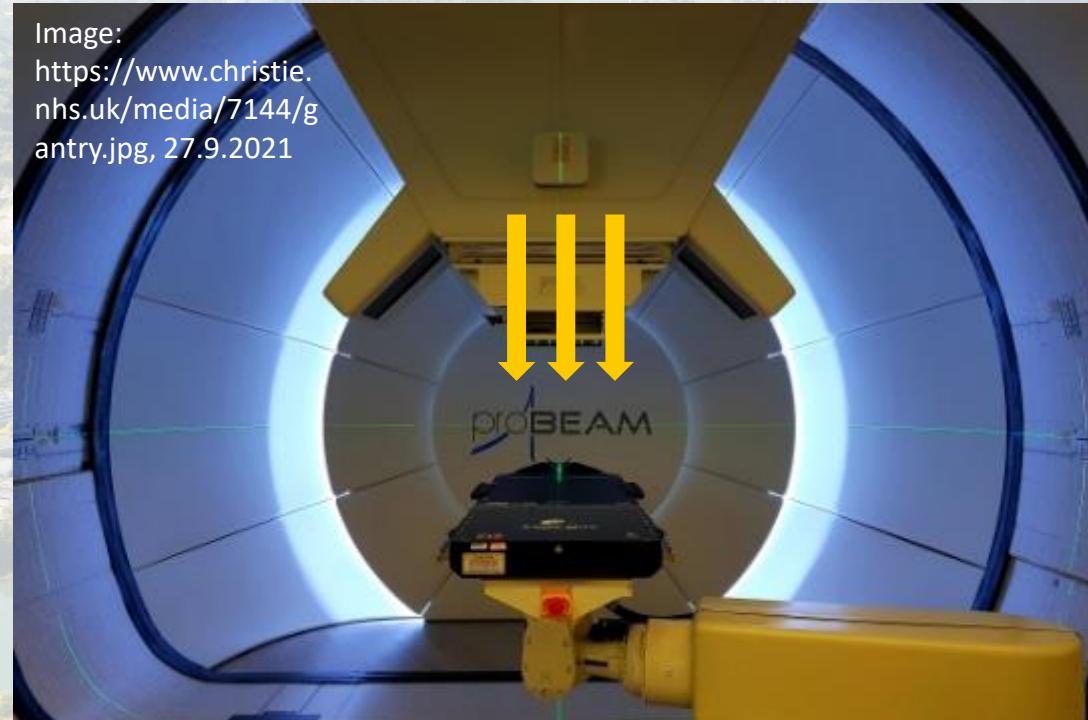


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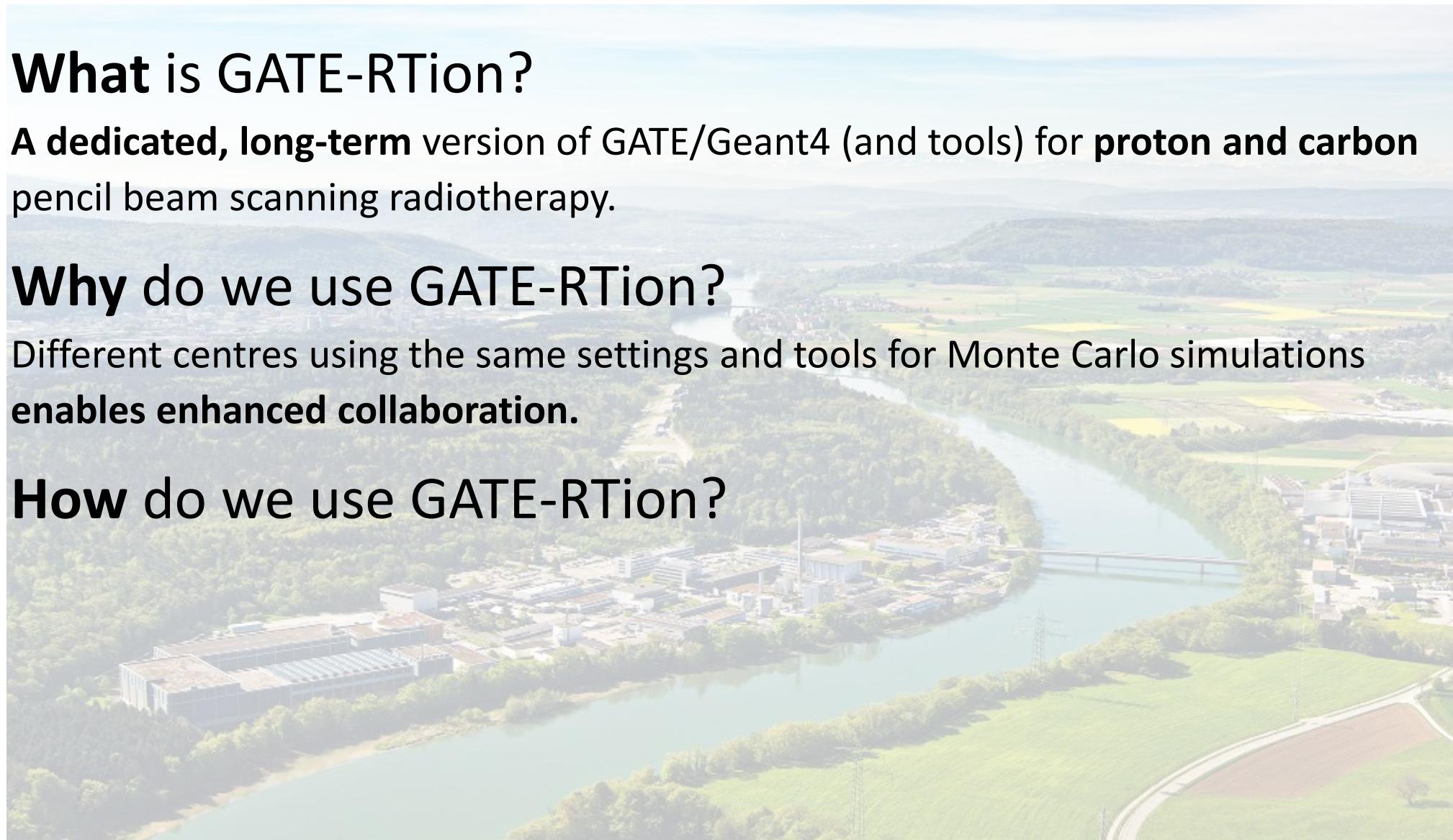
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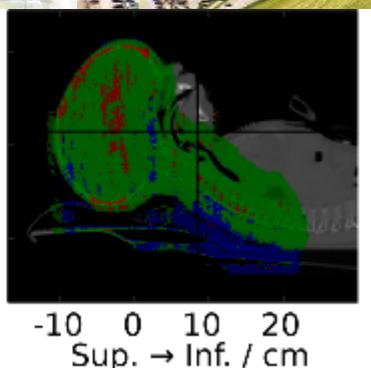
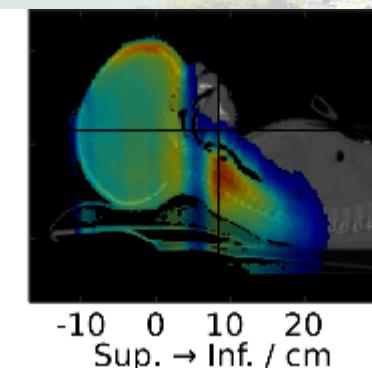
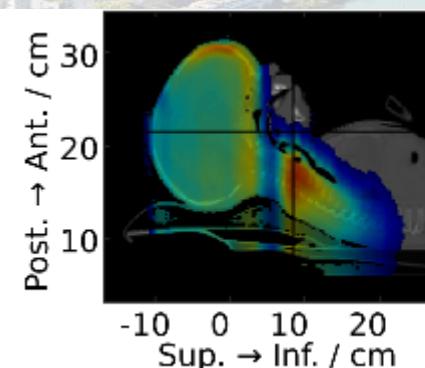
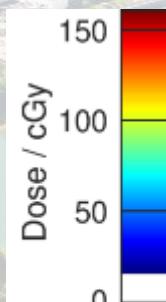
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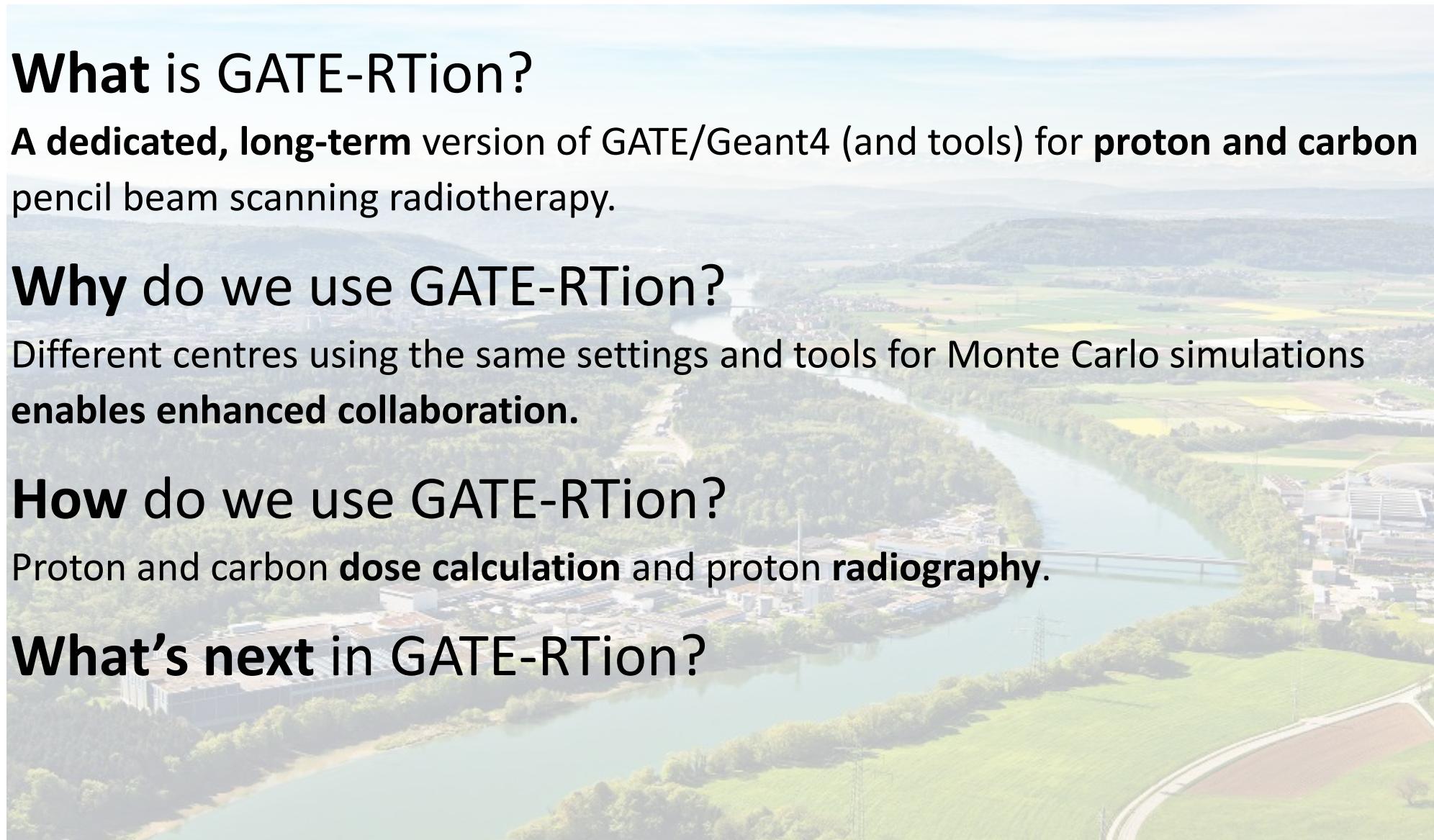
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Improvements in **LET** and **RBE** calculations for proton and carbon ions.

