Gate activities at

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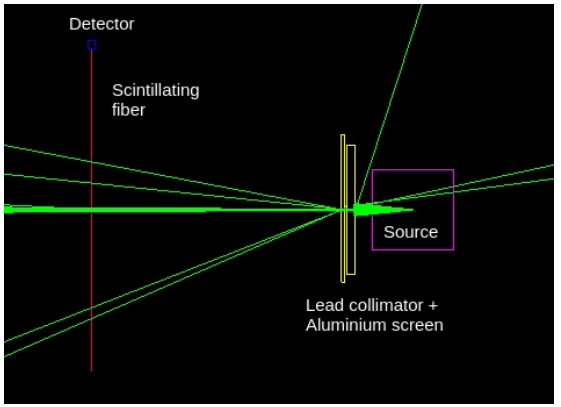
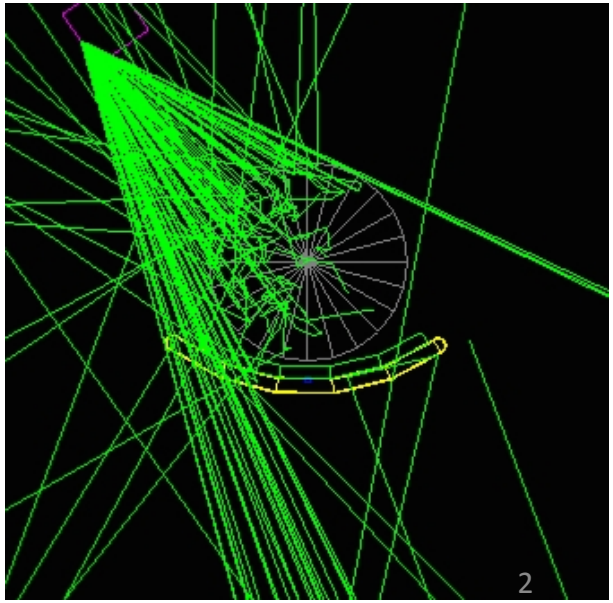
Groupe DeSIs
Dosimétrie, Simulation et Instrumentation

Work of Pierre Gillet (user)

- **PhD student :** *CT dosimetry with a Plastic Scintillator Detector*
- *pierre.gillet@iphc.cnrs.fr*
- **Gate user**
- **Study of the PSD's response in an X-ray generator:**
  - Irradiation from 80 to 140 kV
  - Spectrum acquired using SpekCalc and a CdTe spectrometer

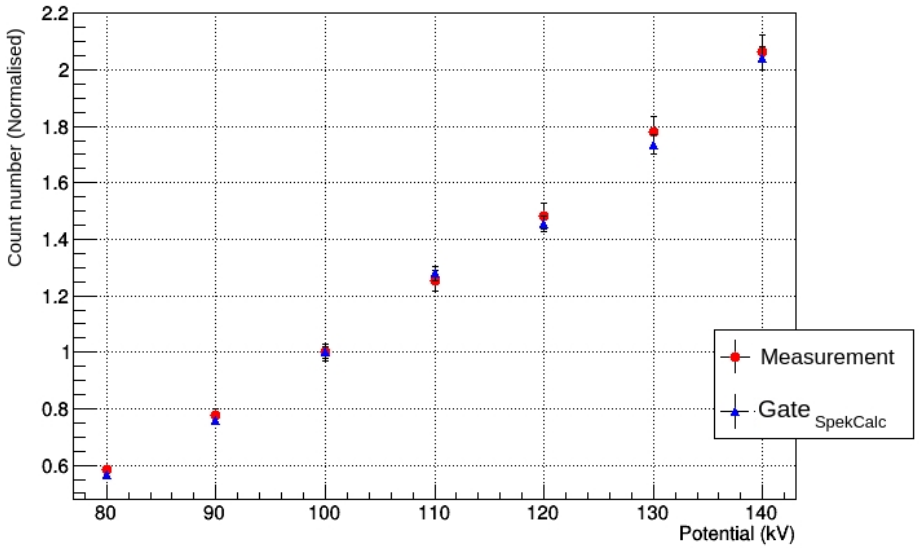


- **CT simulation**
  - The fiber is located under the mattress
  - The goal is to reproduce the scintillating fiber's signal

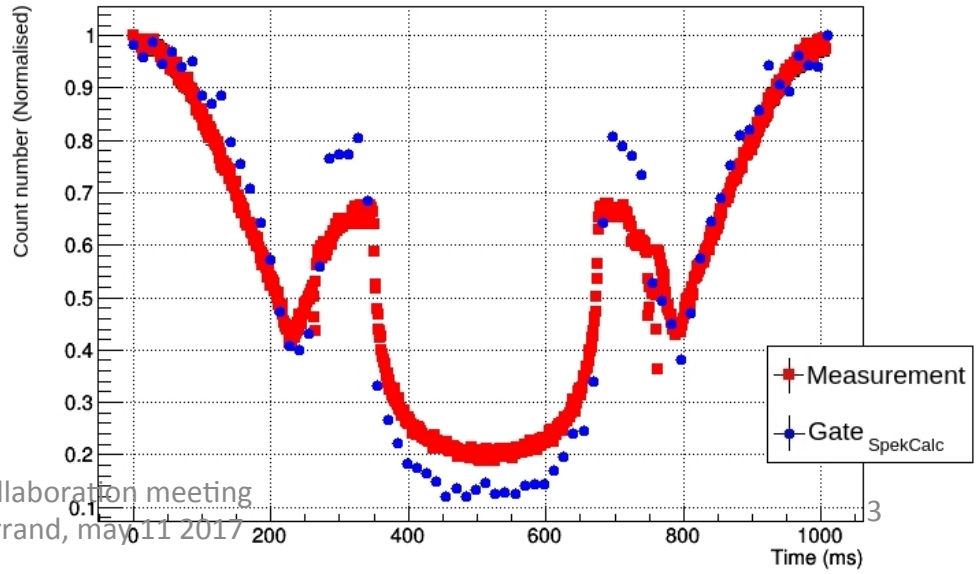


Validation studies

- X-ray generator
  - Normalised at 100 kV
  - Good agreement



- Clinical CT
  - The attenuation due to the phantom is too high in the simulation

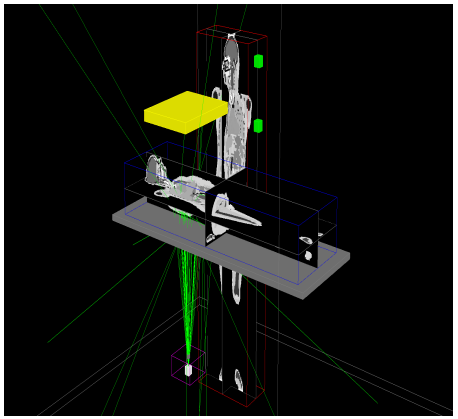


Work of Thomas Deschler (developper)

- **PhD student :** *Dose reconstruction in interventional radiology*
- *thomas.deschler@iphc.cnrs.fr*

- **Contribution to GATE V8.0 :** Support of DICOM images

- **Thesis work :** Development of a Monte Carlo dosimetry software for interventional radiology
  - Generation of patient dosimetry from DICOM files of intervention



Visualisation of intervention

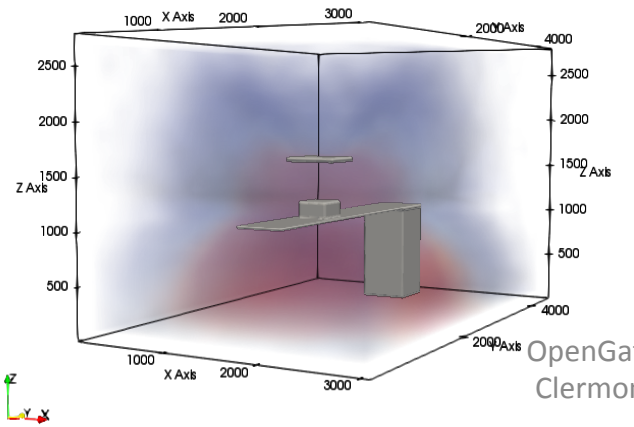
Organs dose:

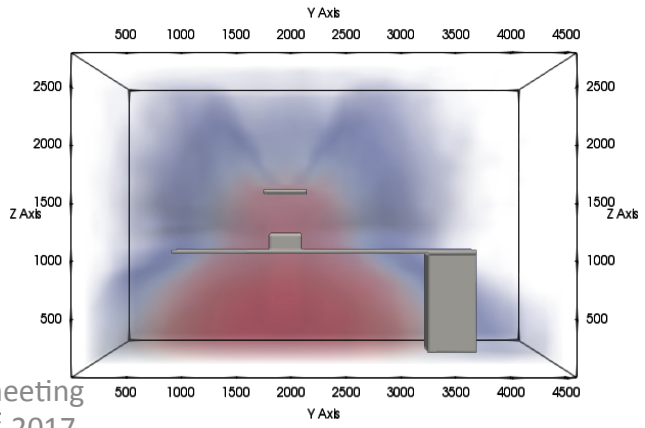
- Heart: 17,96 µGy ±0.3%
- Lungs: 46,66 µGy ±0.1%
- Kidneys: 6,551 µGy ±0.5%
- Liver: 21,87 µGy ±0.1%
- Pancreas: 9,814 µGy ±0.6%
- Brain: 66 nGy ±2.4%
- Thyroid: 2.6 µGy ±2.6%

in 2 min at 70kVp and 1mAs

Skin dose map

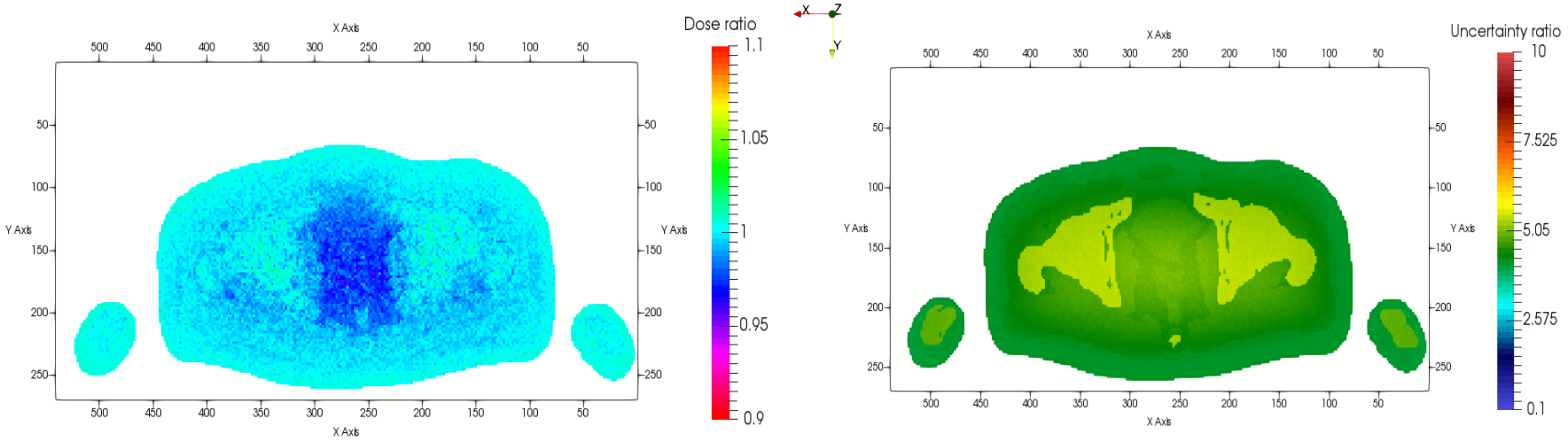
- Generation of room dose map for staff radioprotection





Work of Halima Elazhar (developper)

- ✓ NTLE : Neutron Track Length Estimator (Collaboration with JM Létang – CREATIS)
- ✓ Variance reduction technique for neutron dose calculation in radiotherapy applications inspired on the low-energy X-Ray Track Length Estimator (TLE)
- ✓ Calculation based on neutron kerma factors and photon mass energy absorption coefficient for an accurate neutron dose calculation in human body.

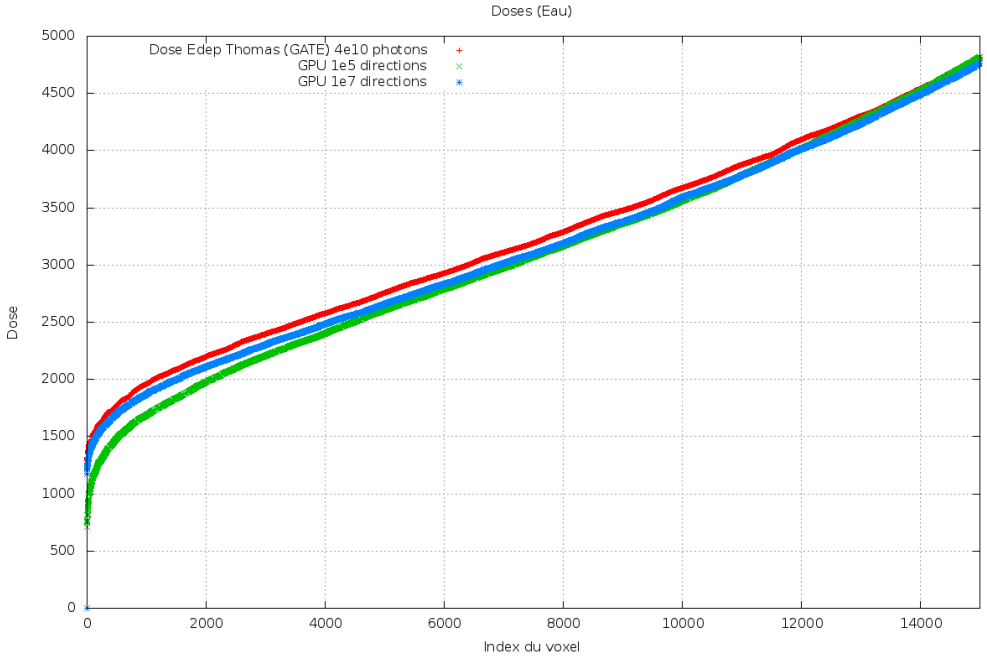


➡ For a typical secondary neutron spectrum (about 10^{-9} MeV to 10 MeV) in Radiotherapy :

- ✓ Less than 5% dose calculation difference with the Dose Actor
- ✓ 25 times less particles needed to achieve same uncertainty as Dose Actor

On going GPU development

- ✓ Adaptation of algorithm presented in (1) for dosimetry calculation
- ✓ Dose deposit in an heterogeneous voxellized phantom (100x100x100 voxels, 3 materials).
- ✓ Centred point source emission in 4 π
- ✓ Photons' tracks are modeled used ray tracing algorithm
- ✓ Speed up factor of 50 compared to CPU is achieved



(1) B. Auer, C. Rey, V. Beakert, J-M. Gallone and Z. El Bitar (2016)
Implementation of a pre-calculated database approach for scatter correction in SPECT
Biomed. Phys. Eng. Express 2, 055014

Thank you for your attention