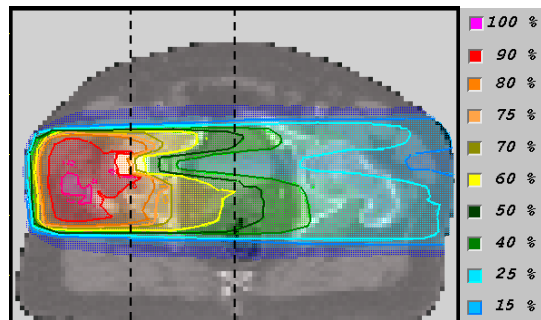
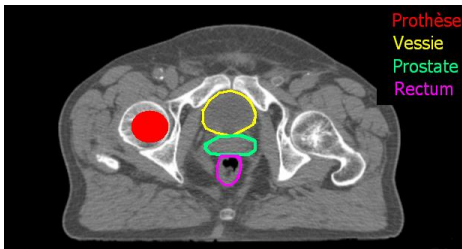
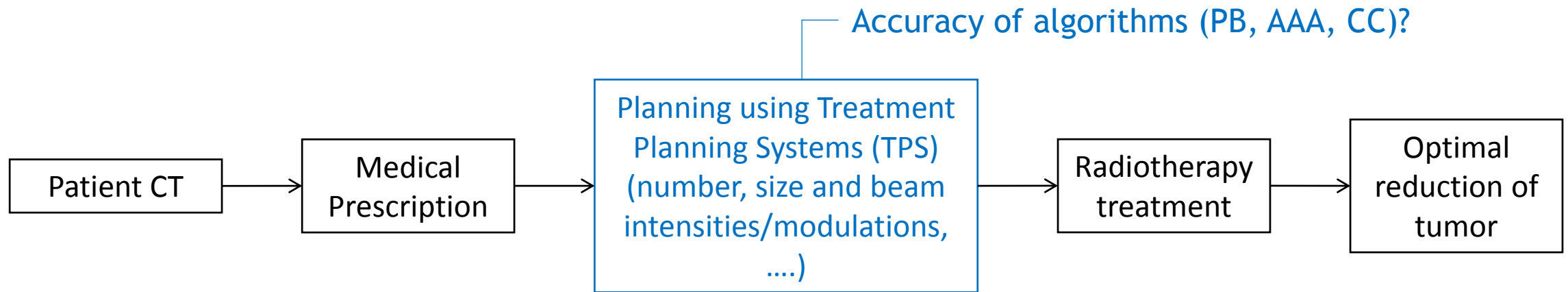


# Neural network and dose computation

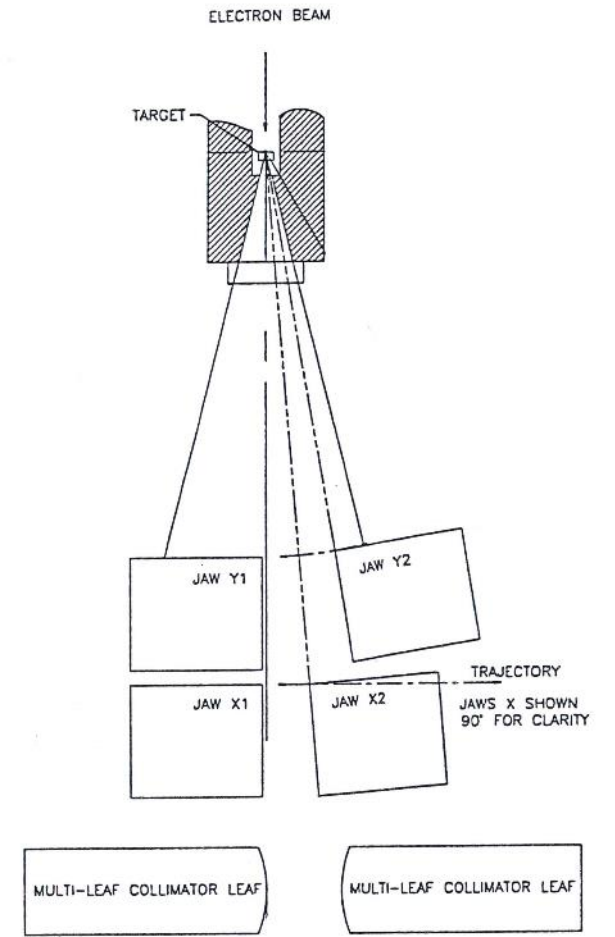
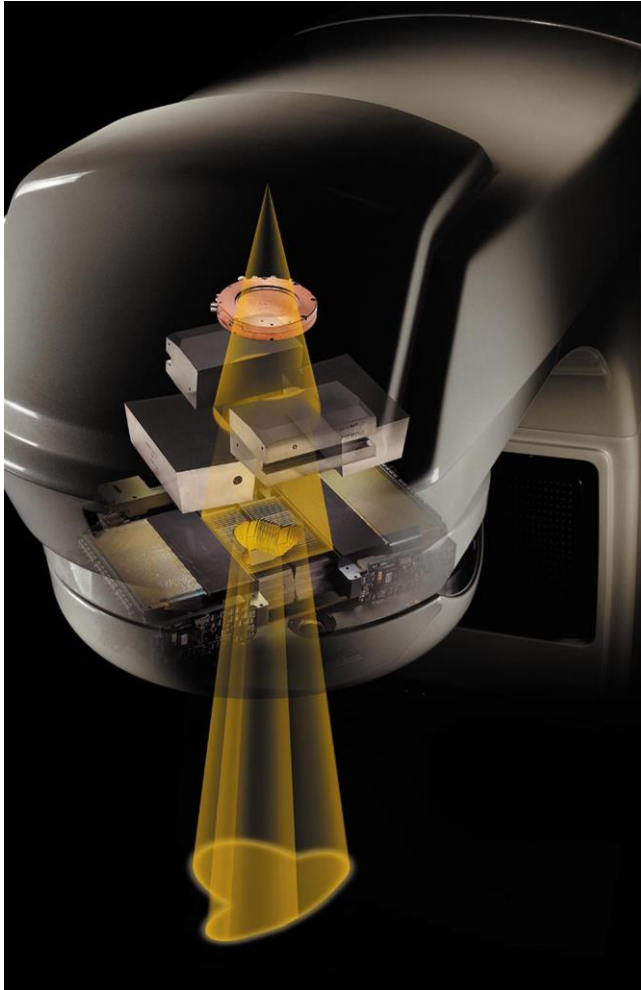
Pierre-Emmanuel Leni, Régine Gschwind, Libor Makovicka

Gate Technical Meeting  
Lyon, 4 Juillet 2019

# Radiotherapy main procedures

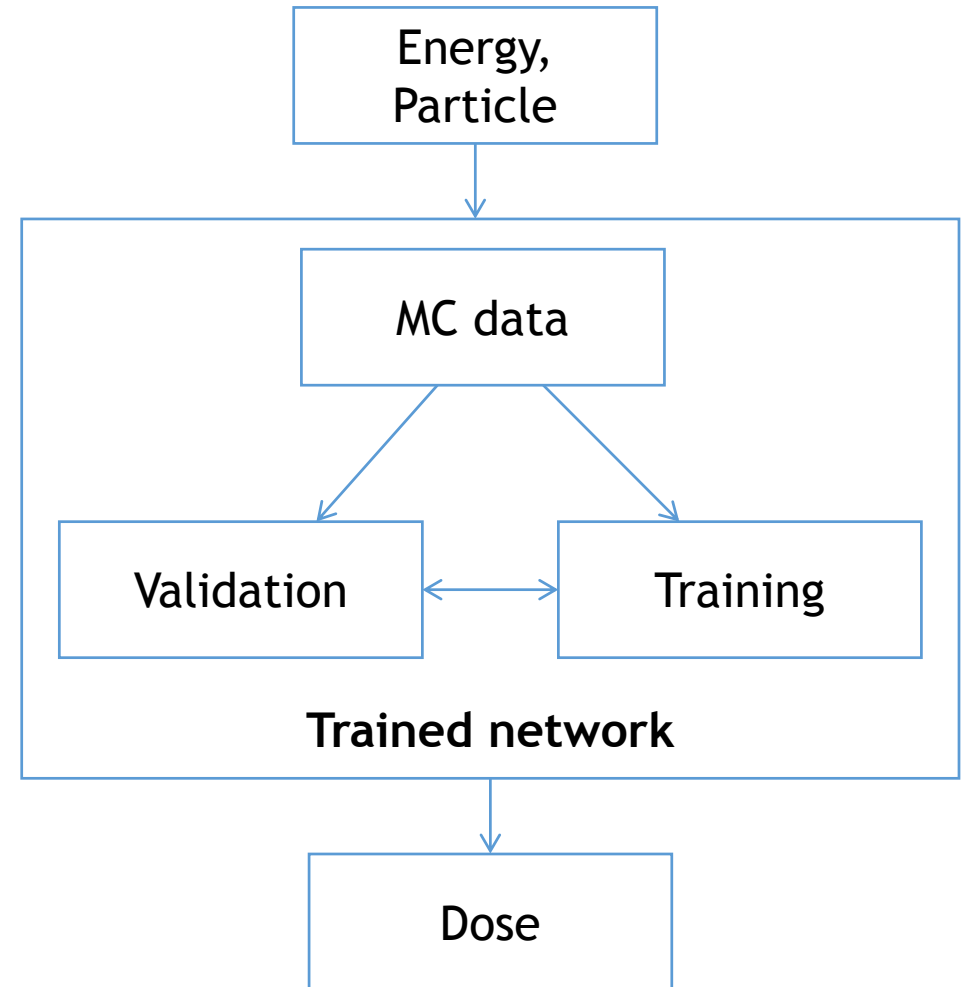


# Linear accelerator



# ANN for dosimetry

- TPS independent quality control.
  - Combine:
    - One hidden-layer neural networks
- and
- Monte-Carlo simulations (EGSnrc/BEAMnrc)

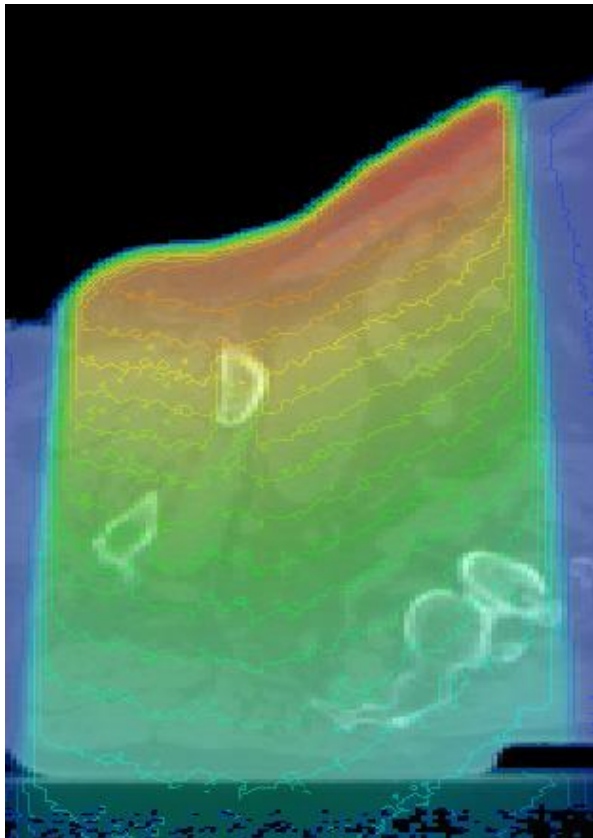


# Material and Method

- One ANN to compute 20cm x 20cm square fields:
  - per energy,
  - per Linac,
- Training data:
  - MC dose distribution in reference media,
  - Voxel selection (according to dose gradient).
- Fluence computations using DICOM RP.
- Validation using Gamma index MC/ANN on voxelized heterogeneous phantoms from DICOM CT.

# Truncated beam, Prostate

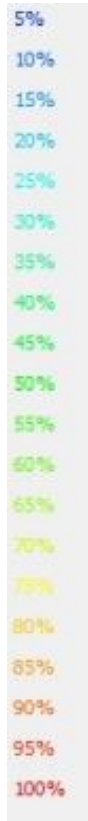
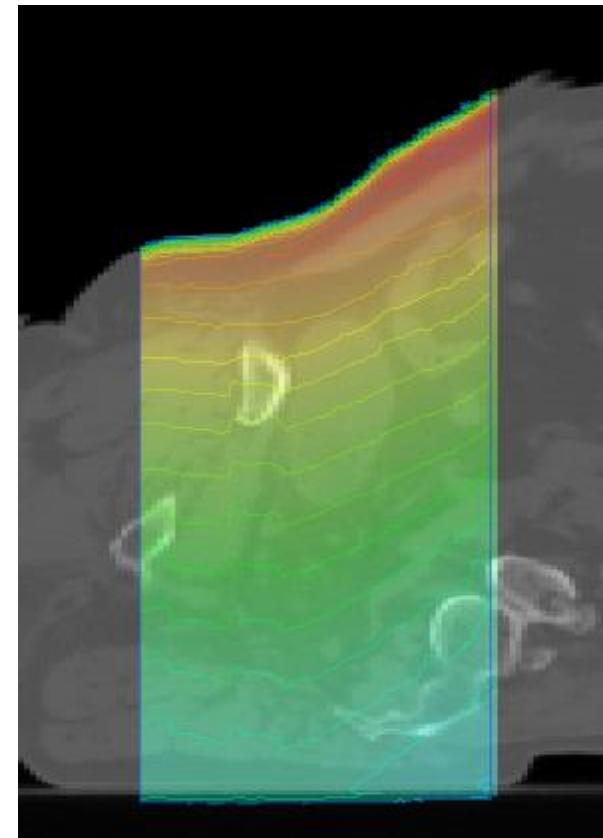
MC



X6 photon beam,  
Varian Clinac 2100C

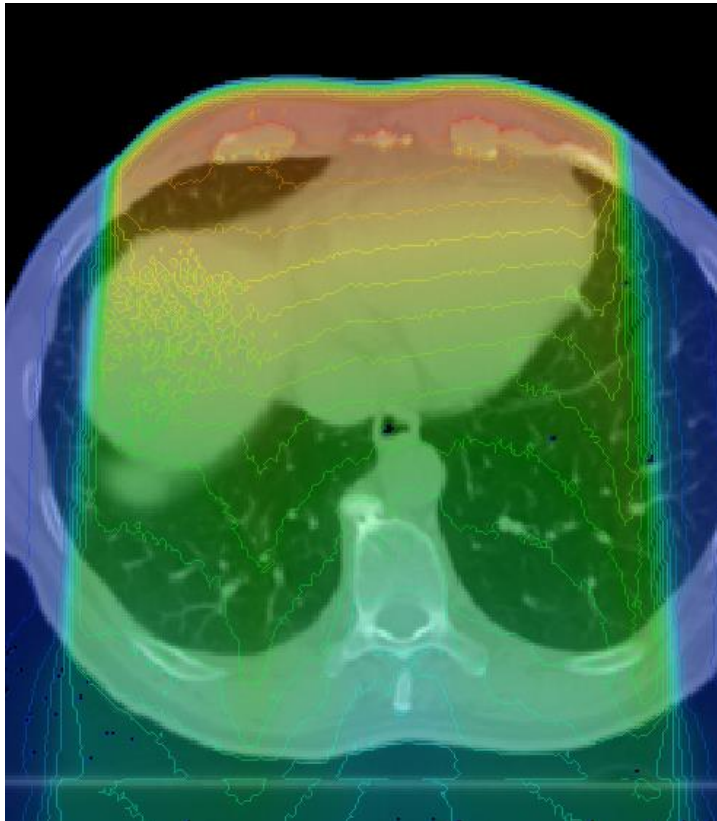
$$\gamma_{3\%/3mm} = 96.4\%$$

ANN



# Truncated beam, Lungs

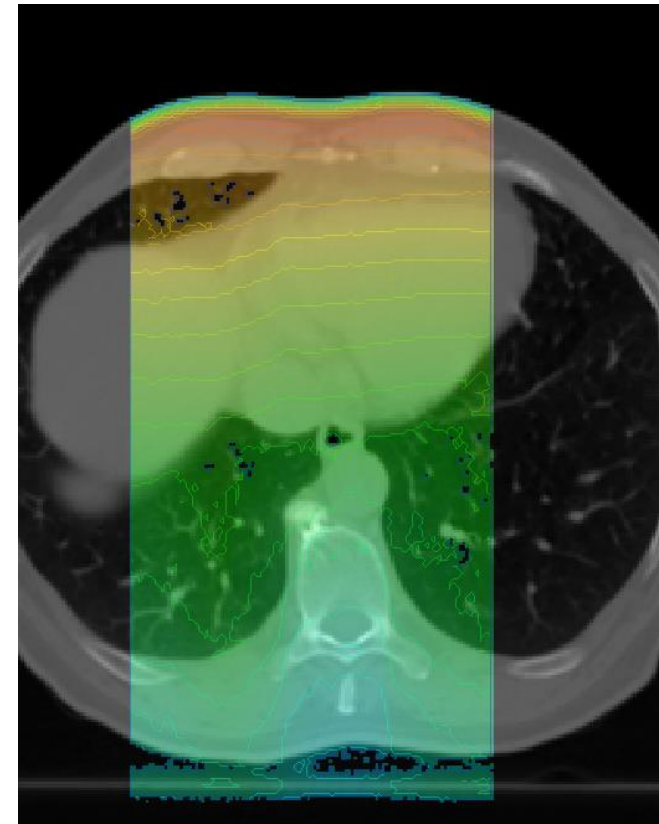
MC



X6 photon beam,  
Varian Clinac 2100C

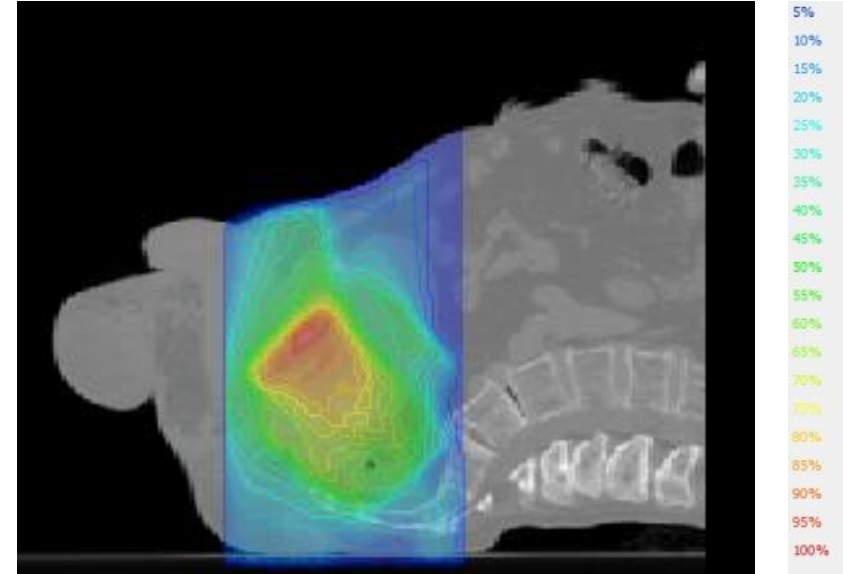
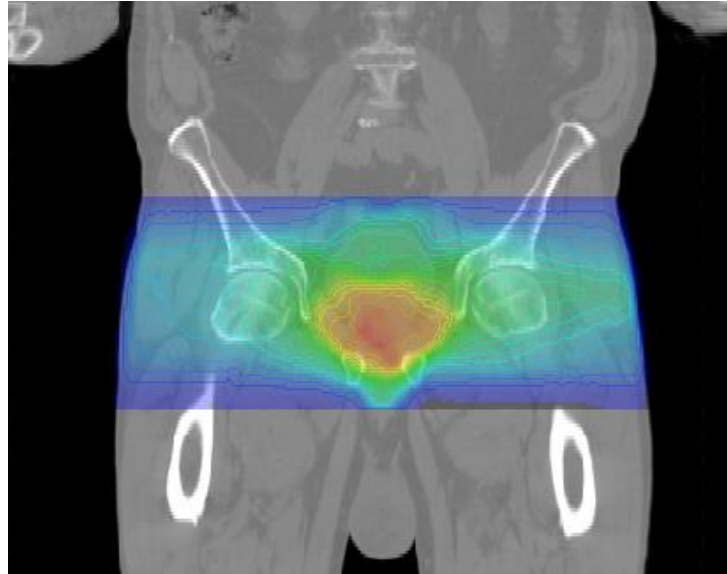
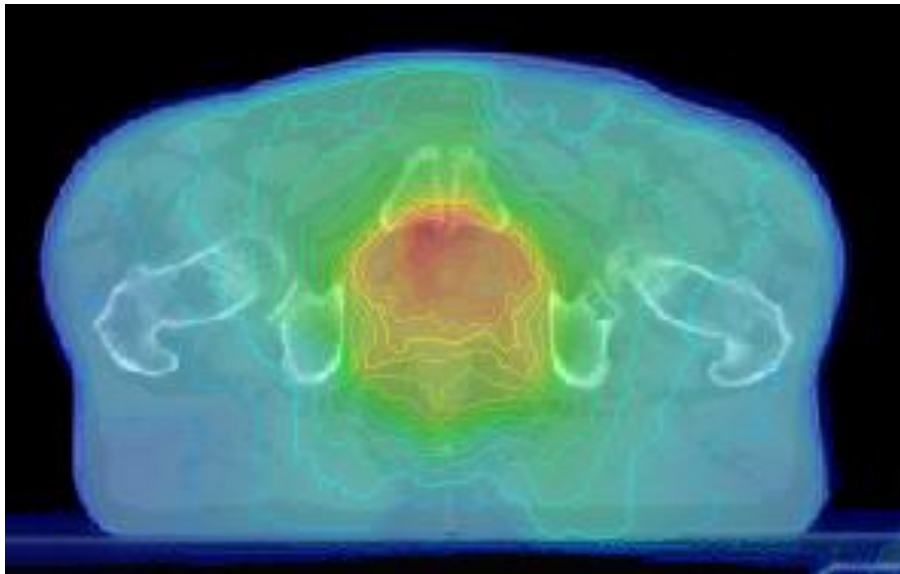
$$\gamma_{3\%/3mm} = 87.9\%$$

ANN



# VMAT treatment example

- X6 photon beam, Varian Clinac 2100C



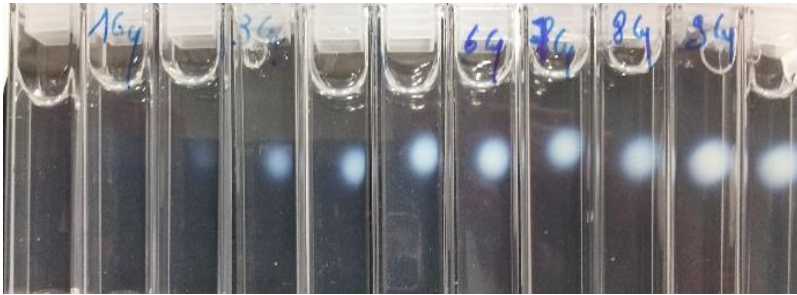


# Conclusions and Perspectives

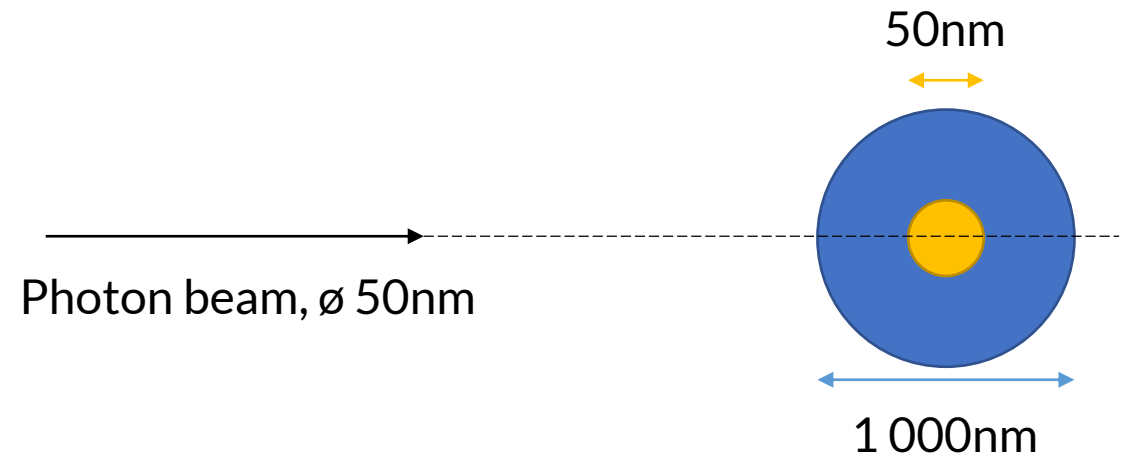
- 3D dosimetry computations for Elekta Synergy, Varian Clinac 2100C, and Novalis TrueBeam STX.
- Fast: using a grid of 2.5mm x 2.5mm x 2.5mm
  - For IMRT: 1 minute
  - For VMAT: 12 minutes
- Work in progress:
  - Validation of fluence computations,
  - Comparisons MC/AAA/CC for IMRT and VMAT treatments.
- Perspective: Stereotactic treatments.

# One more thing...

- Gate simulations (Geant4DNA):
  - gold nanoparticles in dosimetry gels,
  - irradiated by photon beams,
  - low energy (50-250 keV).

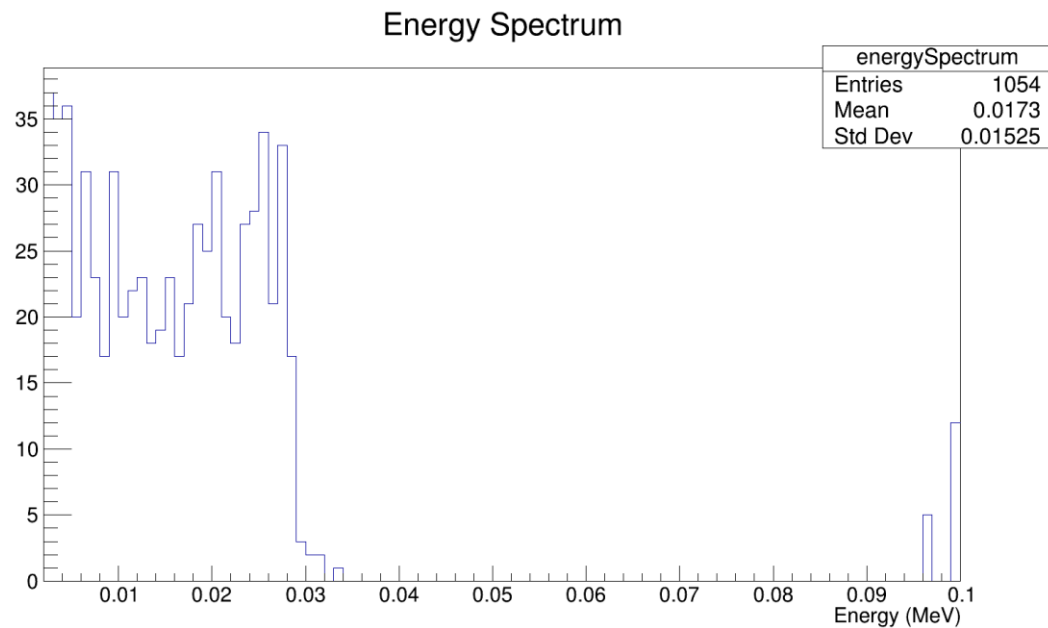


Polymer gels irradiated by Cyberknife, 0 Gy - 10 Gy

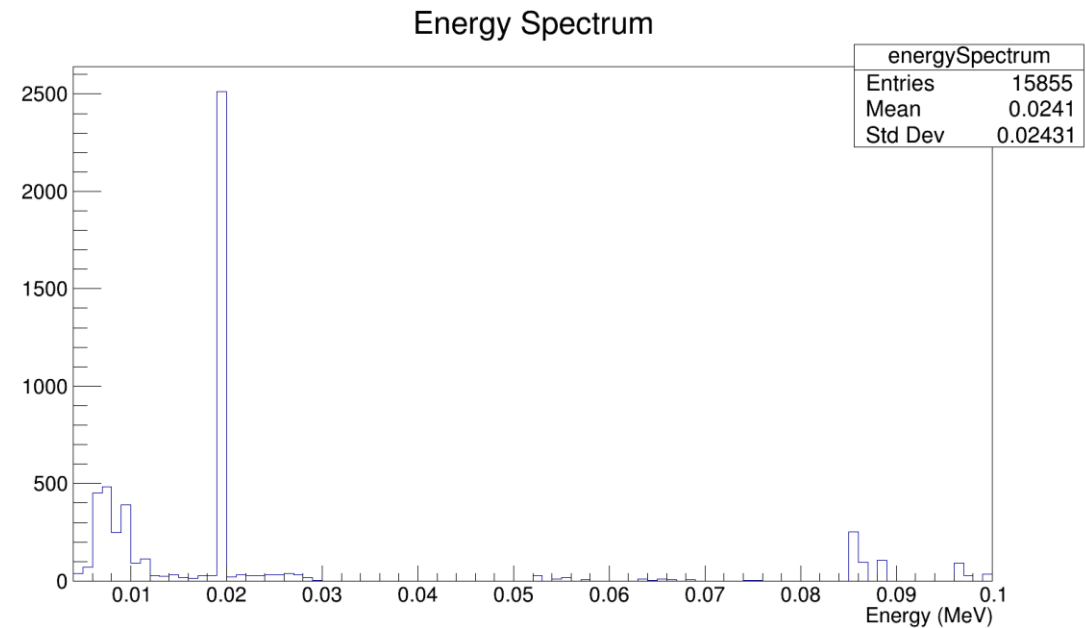


# Preliminary results

- Disclaimer: not enough particles!
- Secondary electron spectrums for a 100keV photon beam.



without GNP (replaced by water)



with GNP

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Thank you!

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