A Scintillator-Based Range Telescope for Quality Assurance in Proton Therapy

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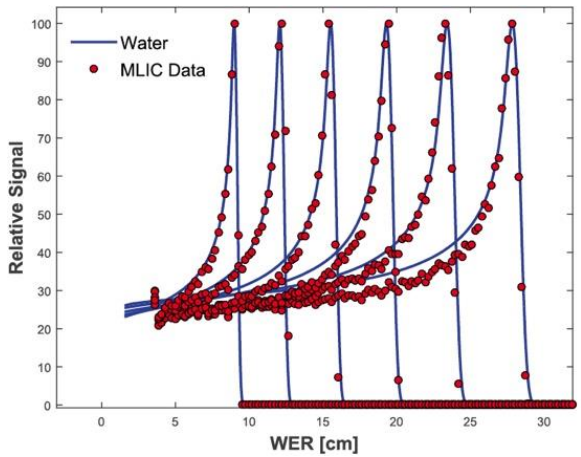
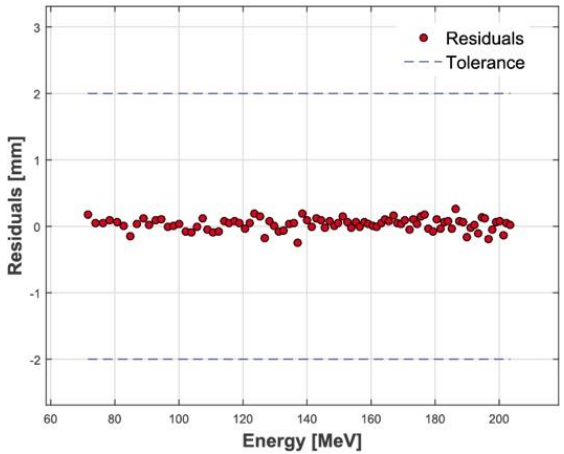
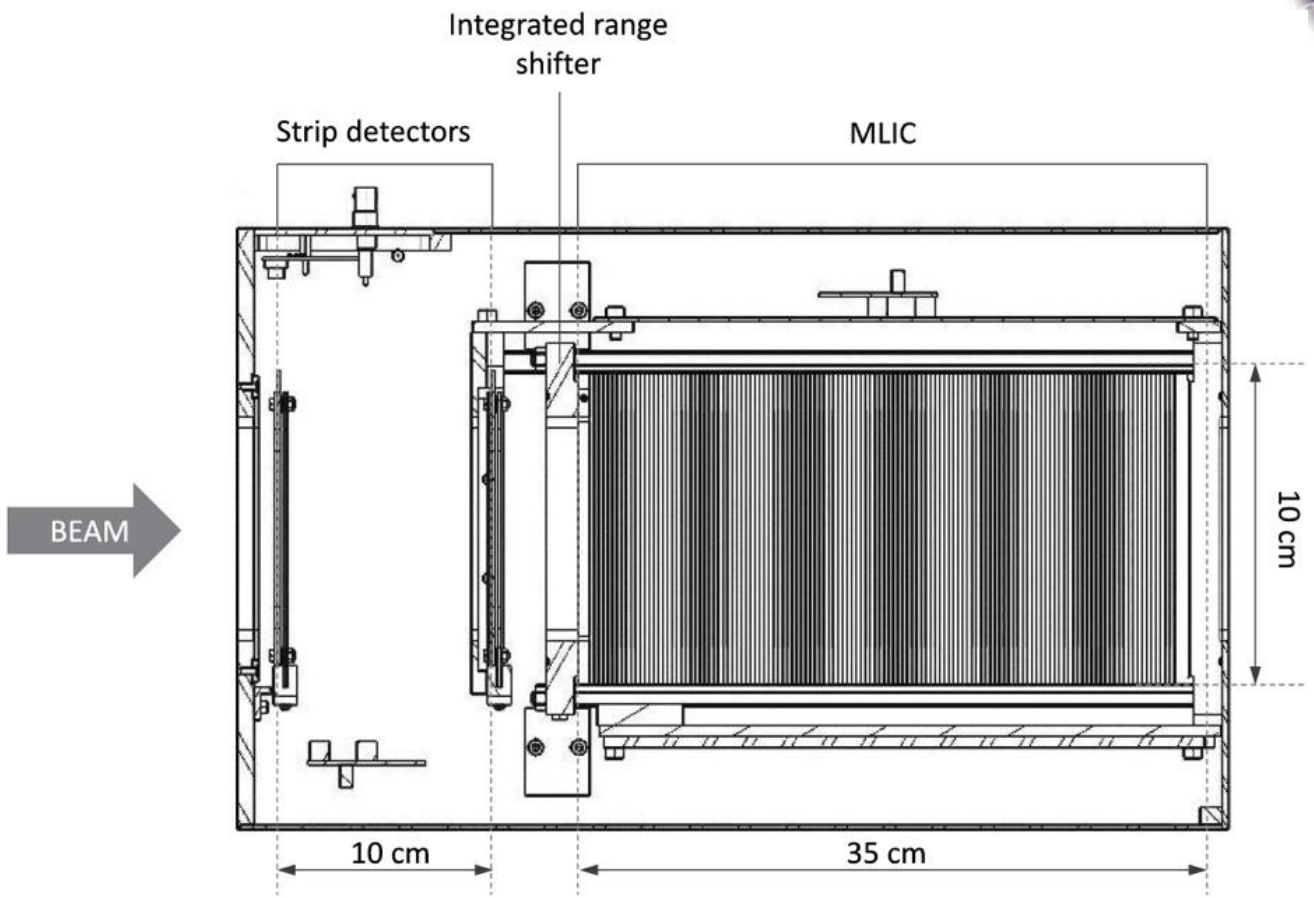
Range Quality Assurance in Proton Therapy





O. Actis *et al.* 2017 *Phys. Med Biol.* **62** 1661

Range Quality Assurance in Proton Therapy



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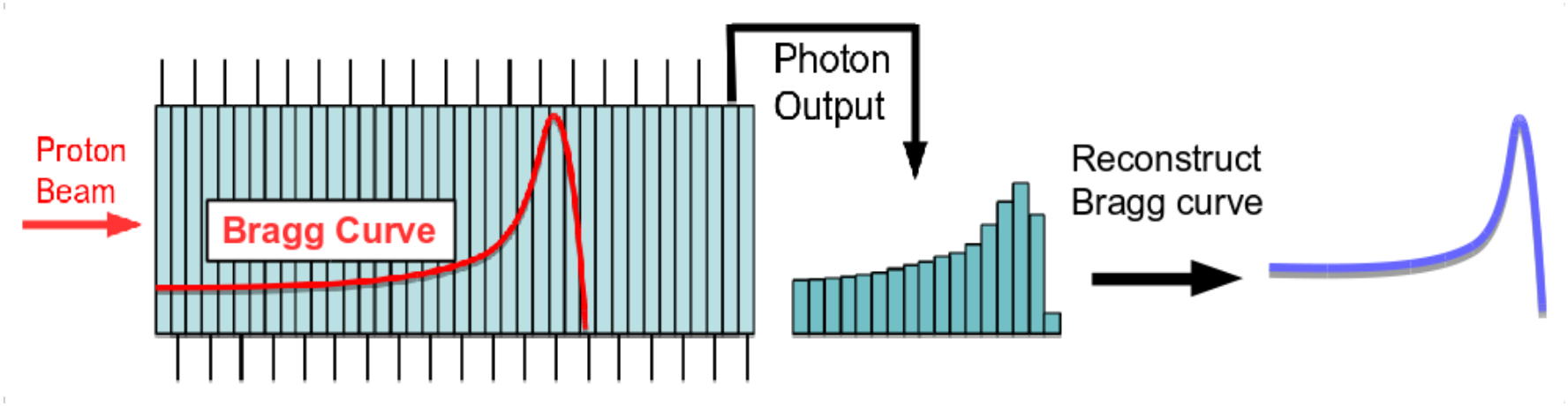
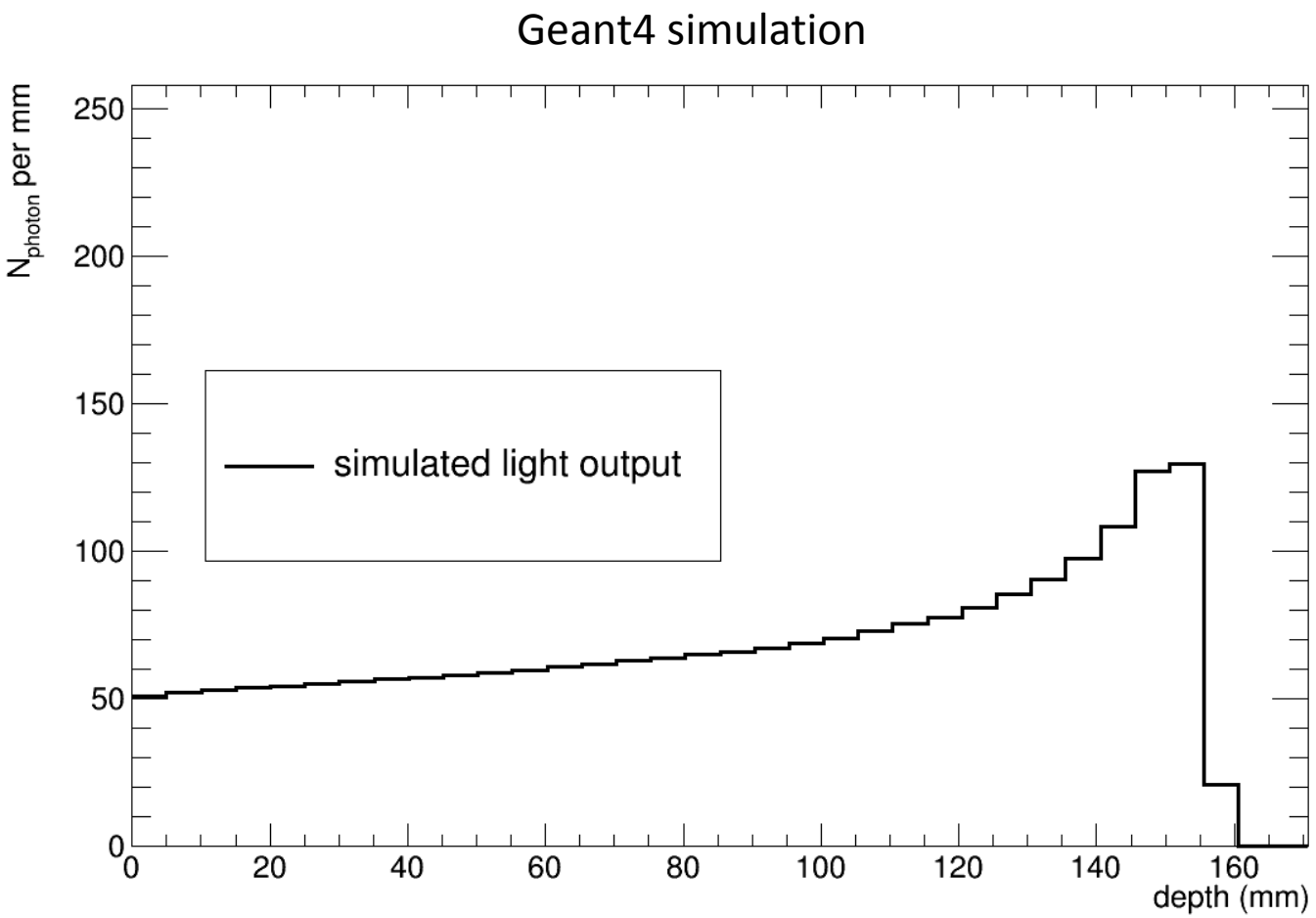
Range Telescope: Principle



Proton Range Reconstruction



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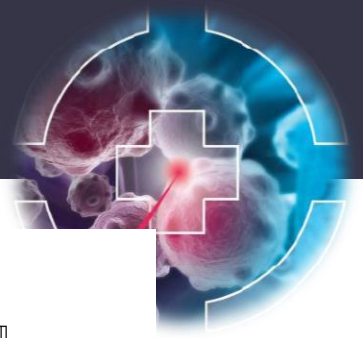
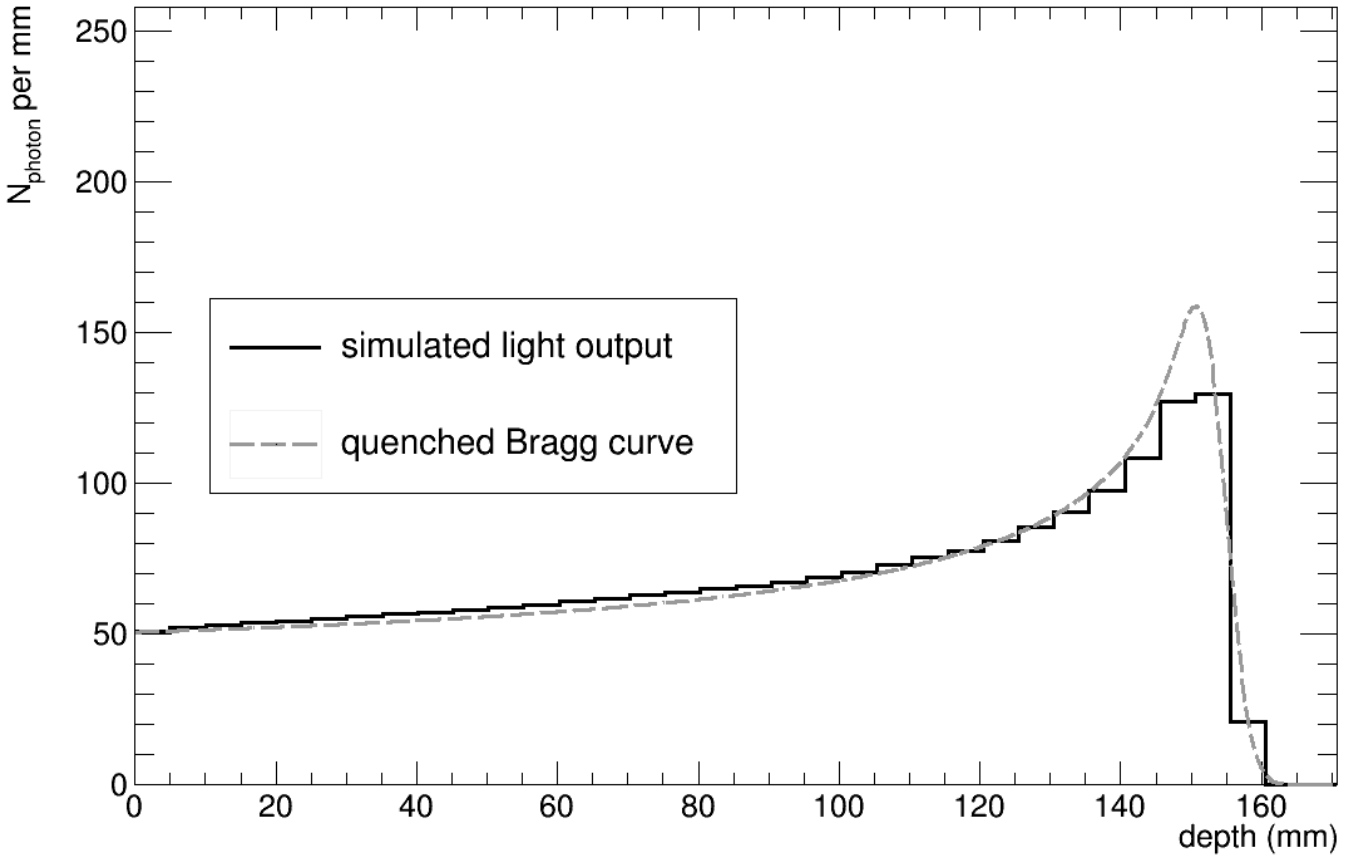
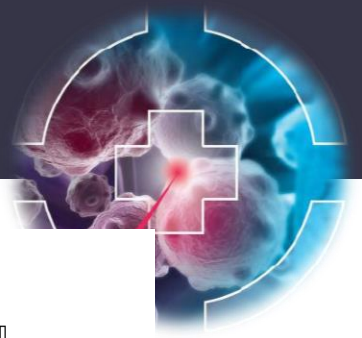


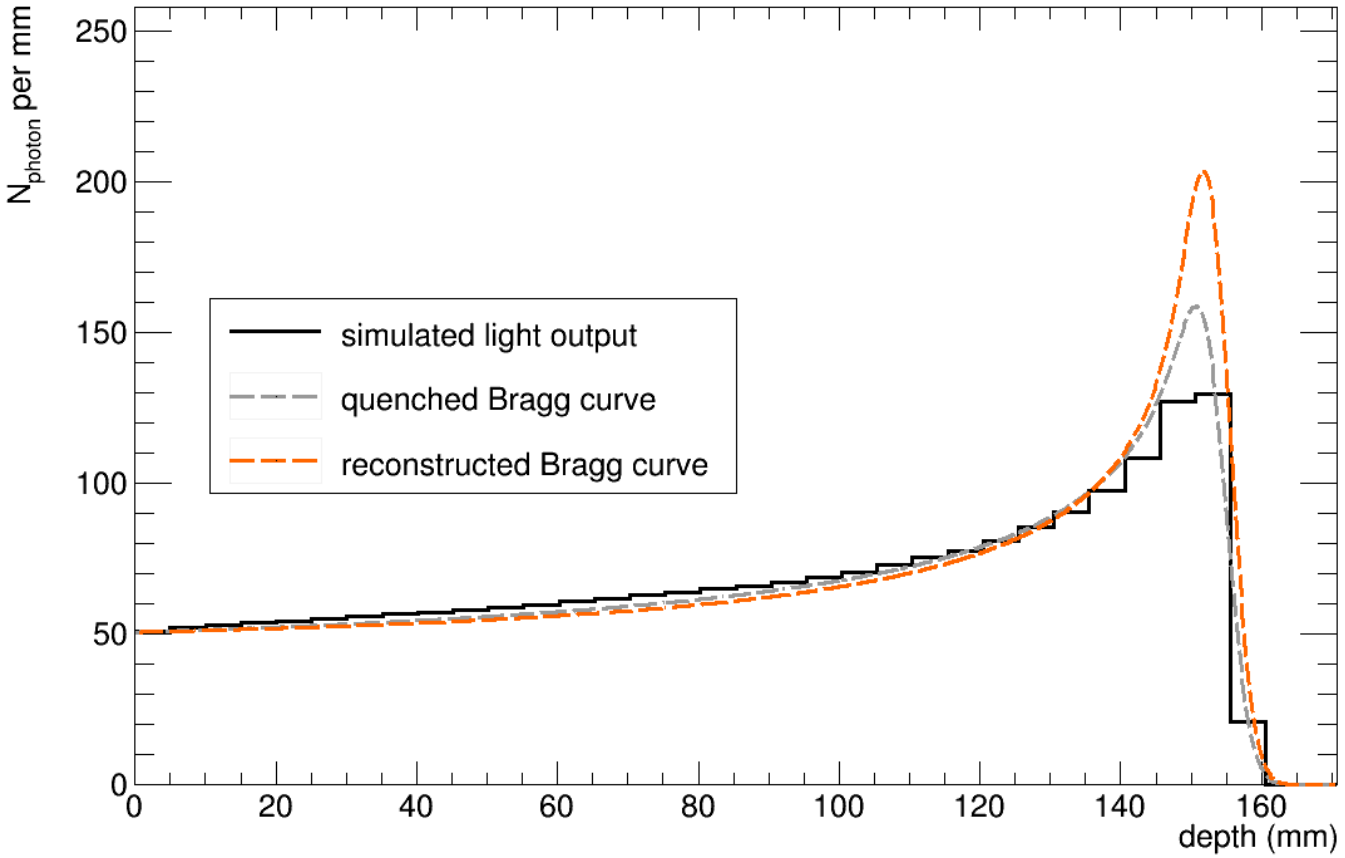
Geant4 simulation



Proton Range Reconstruction

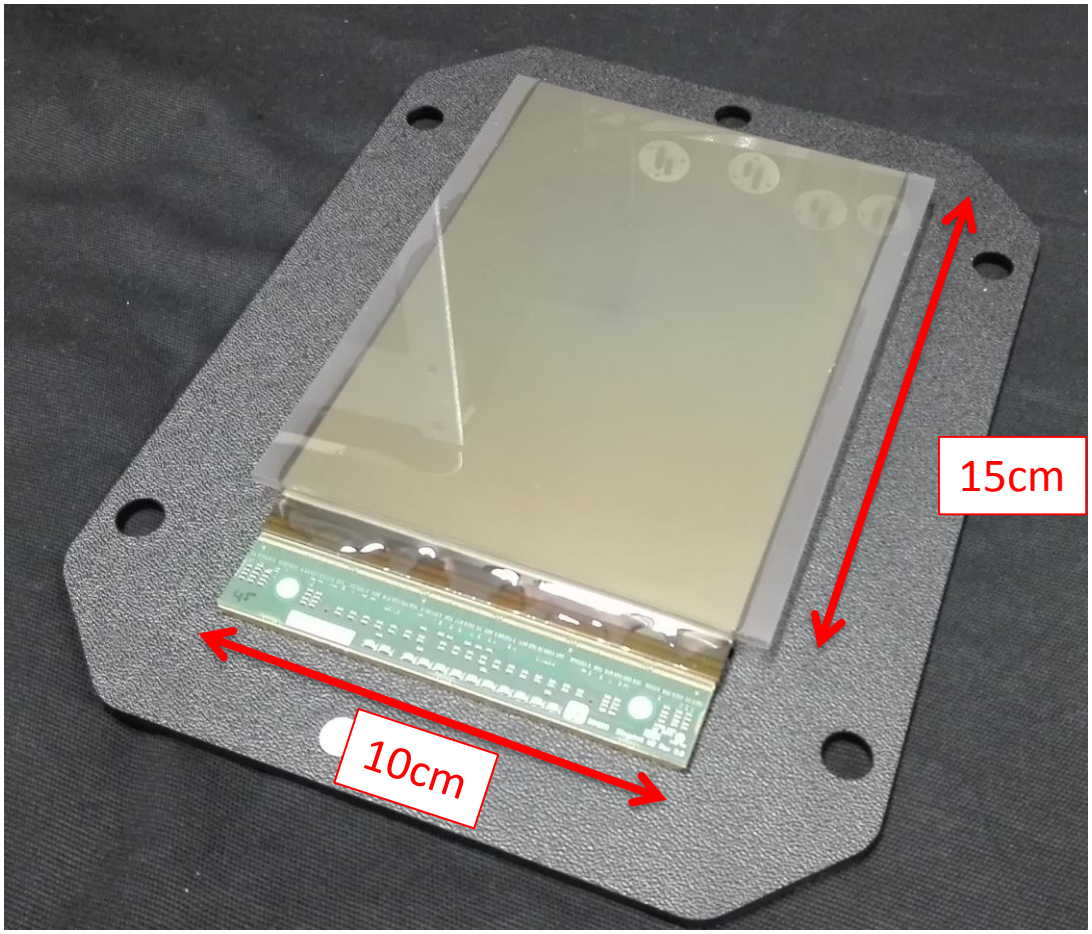


Geant4 simulation

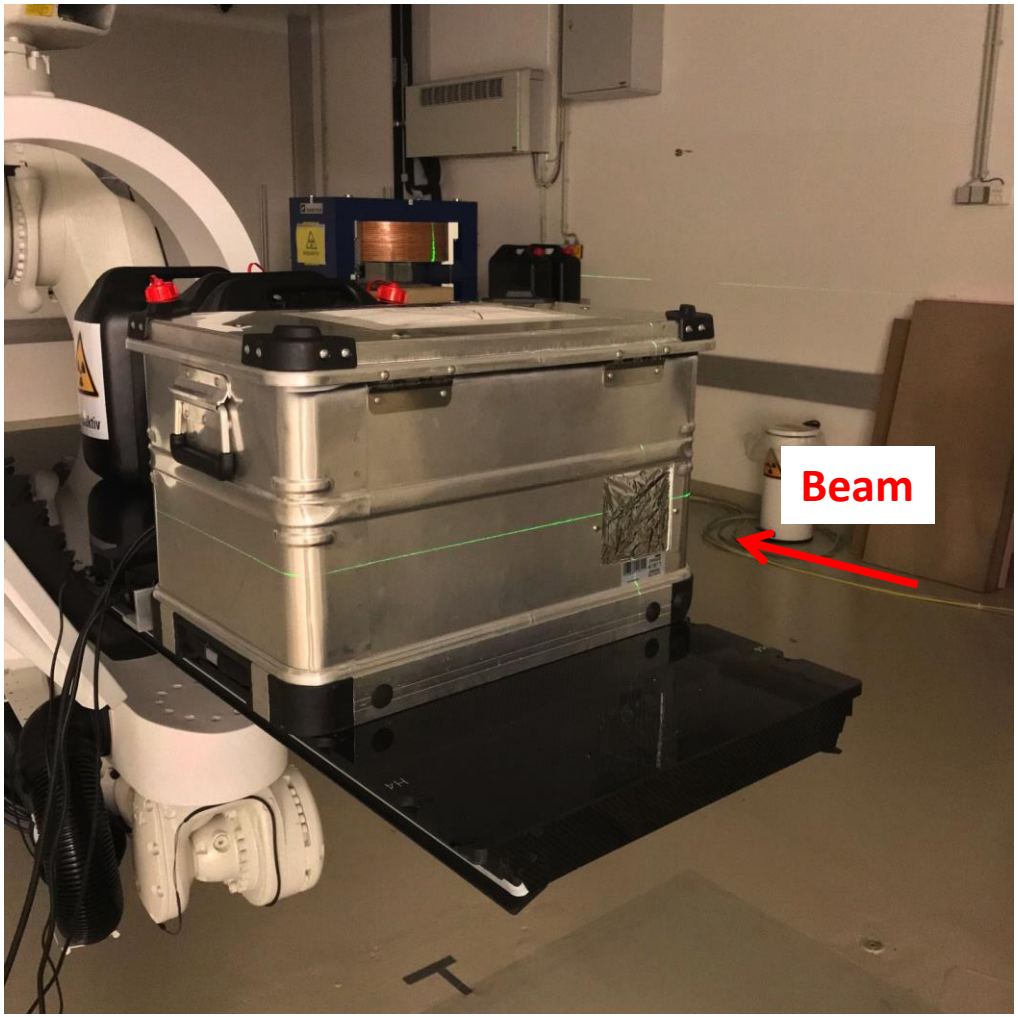


Scintillator Sheets

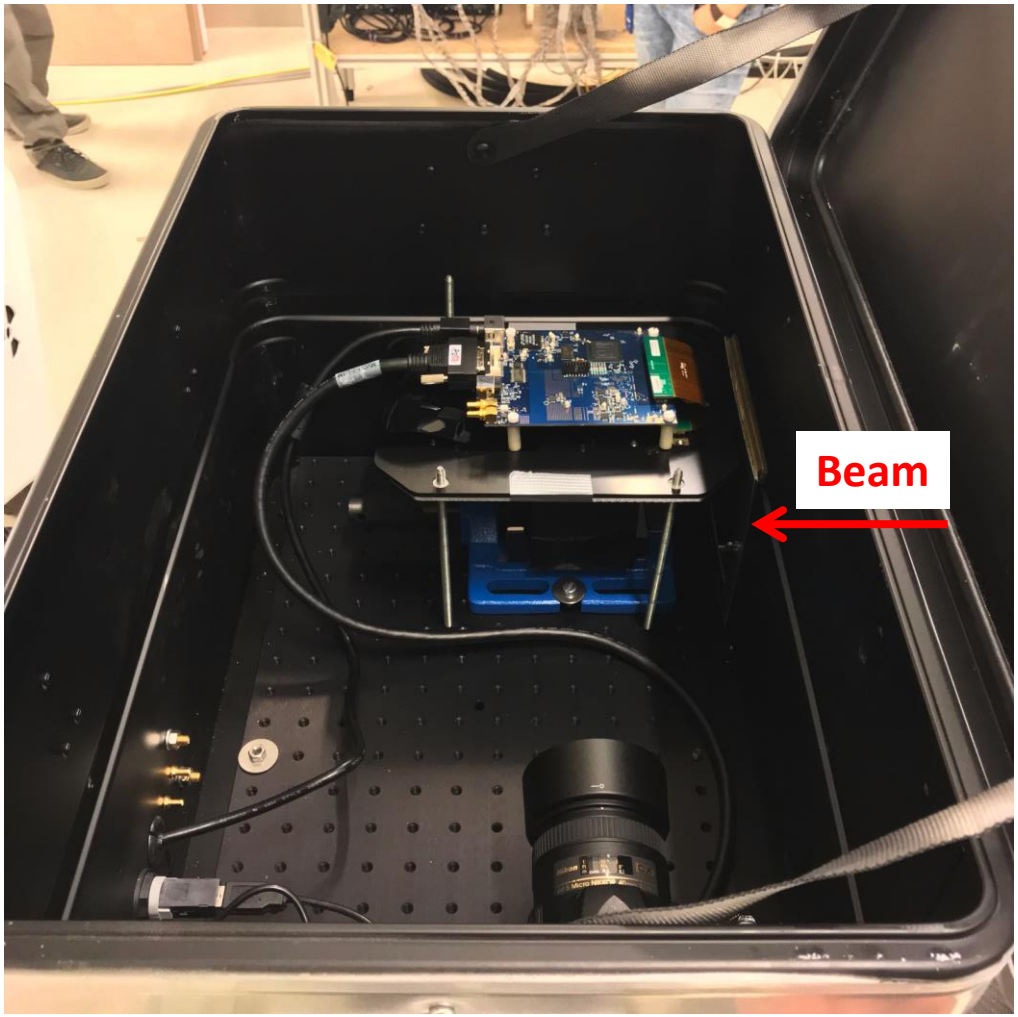
Readout: Pixel Sensor



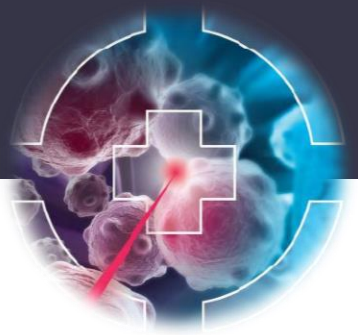
MedAustron Beam Test



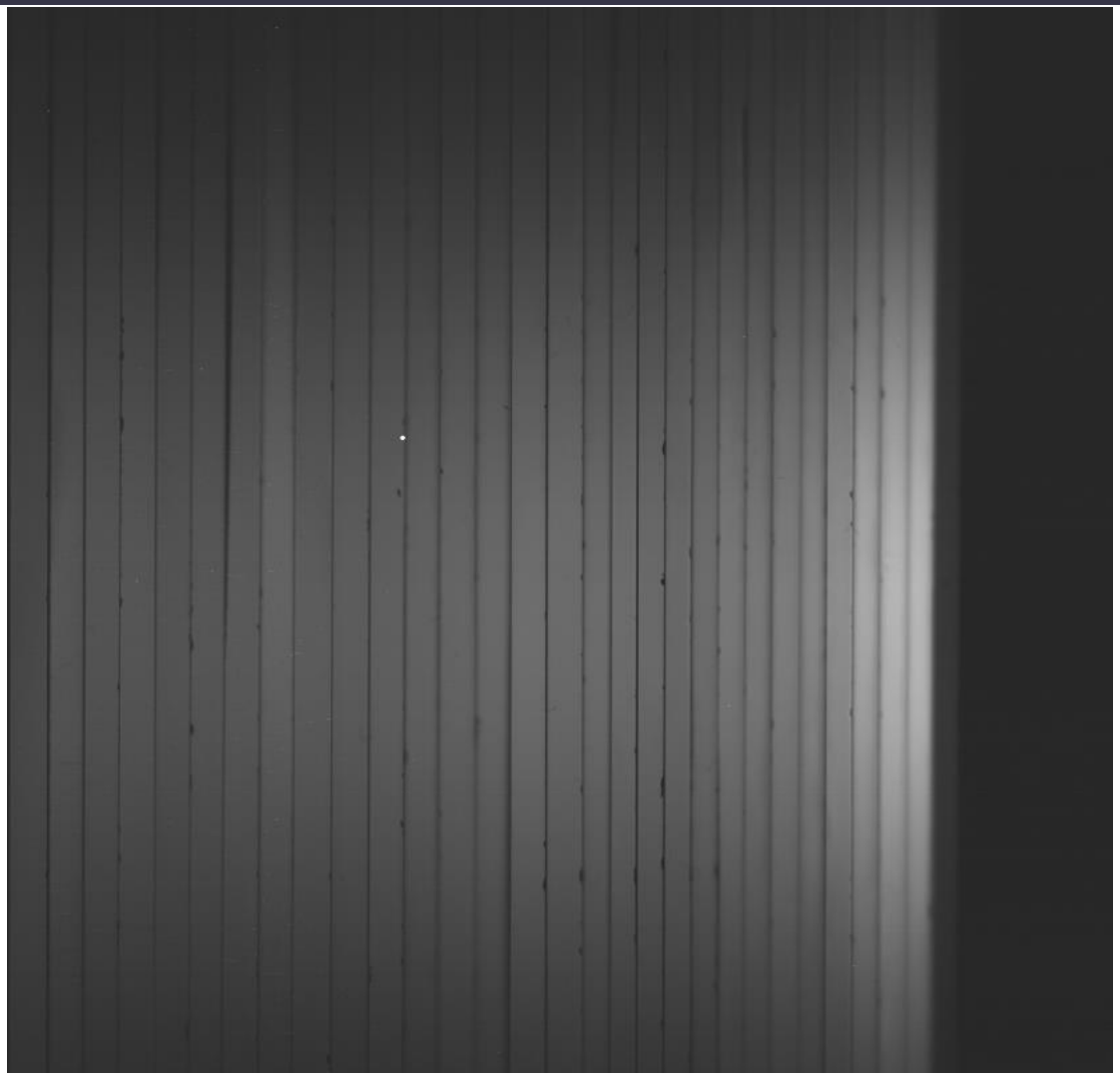
MedAustron Beam Test



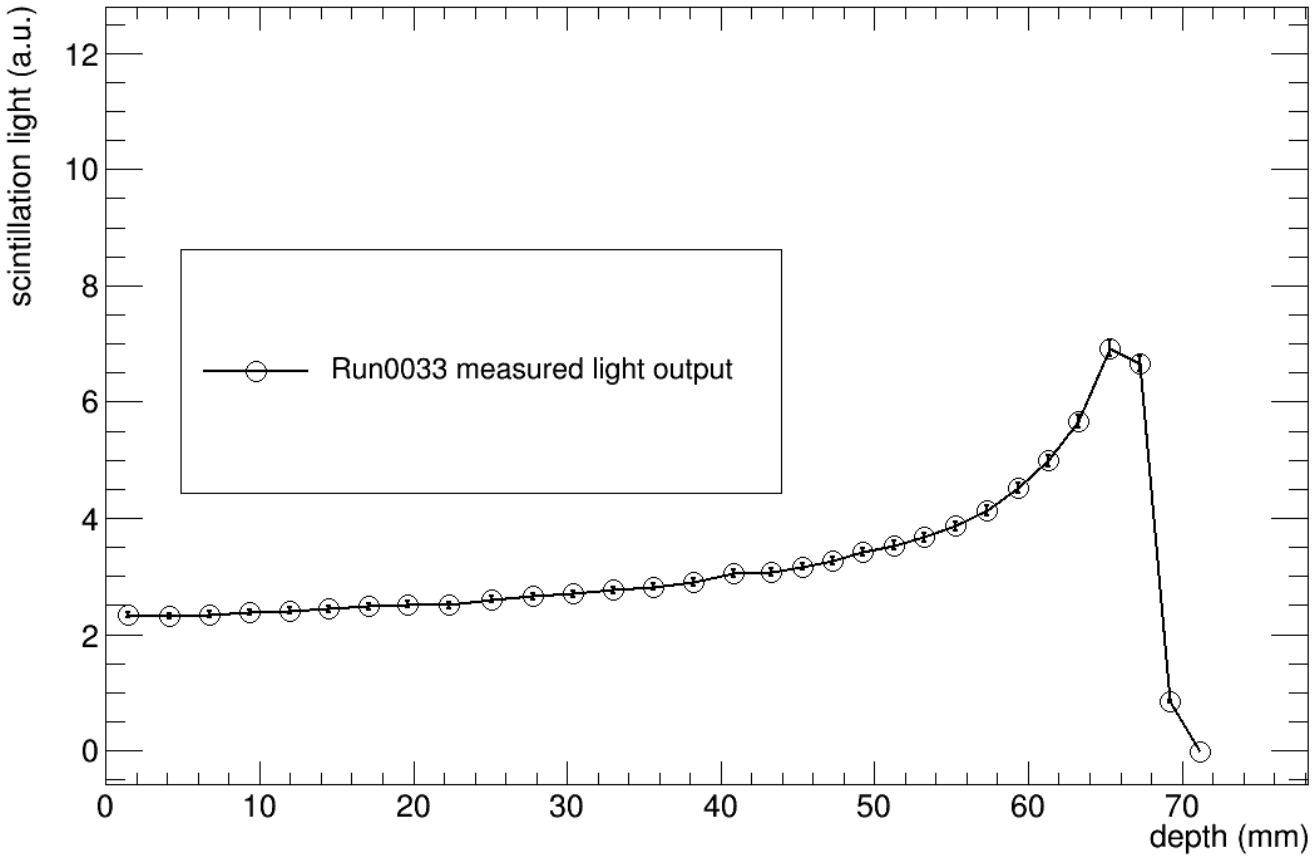
Run at 97.4 MeV



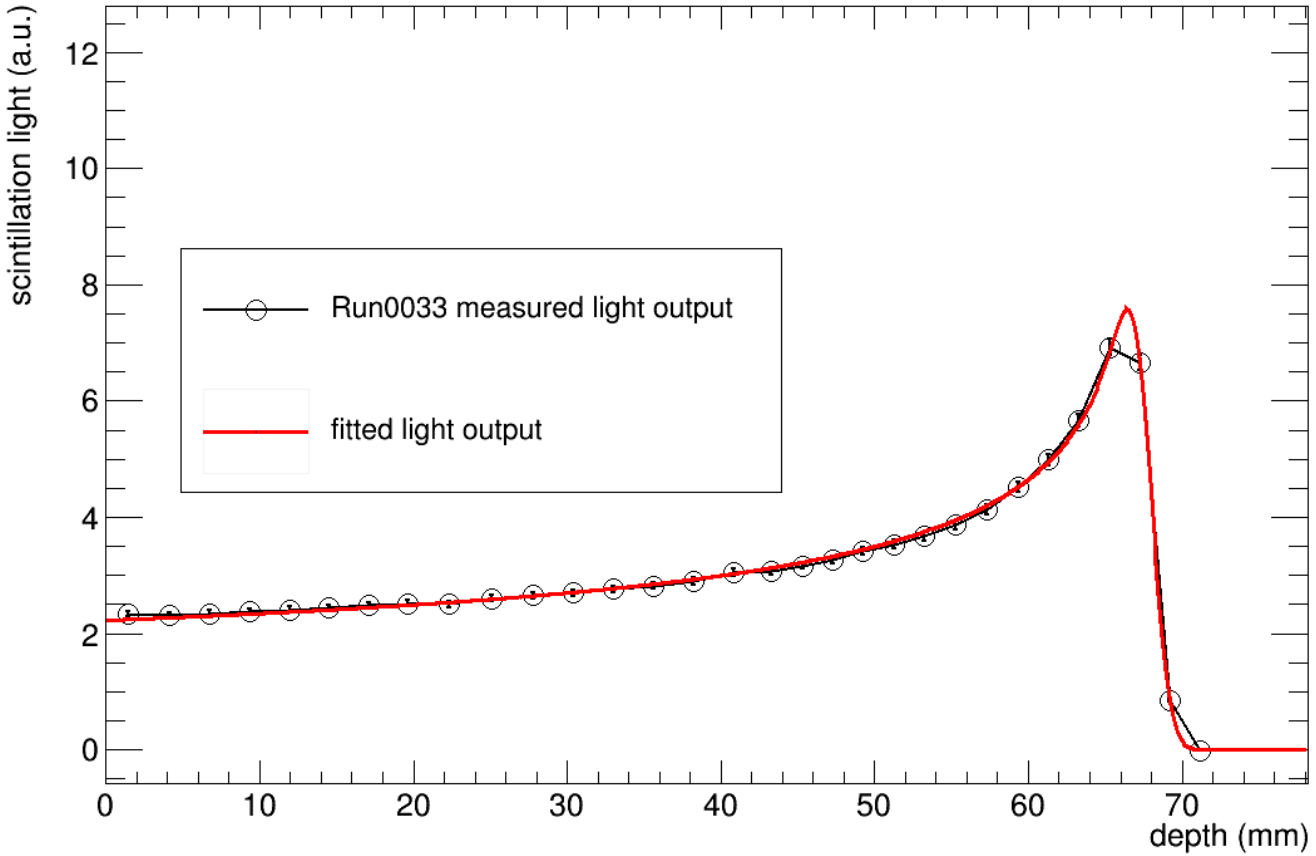
Beam



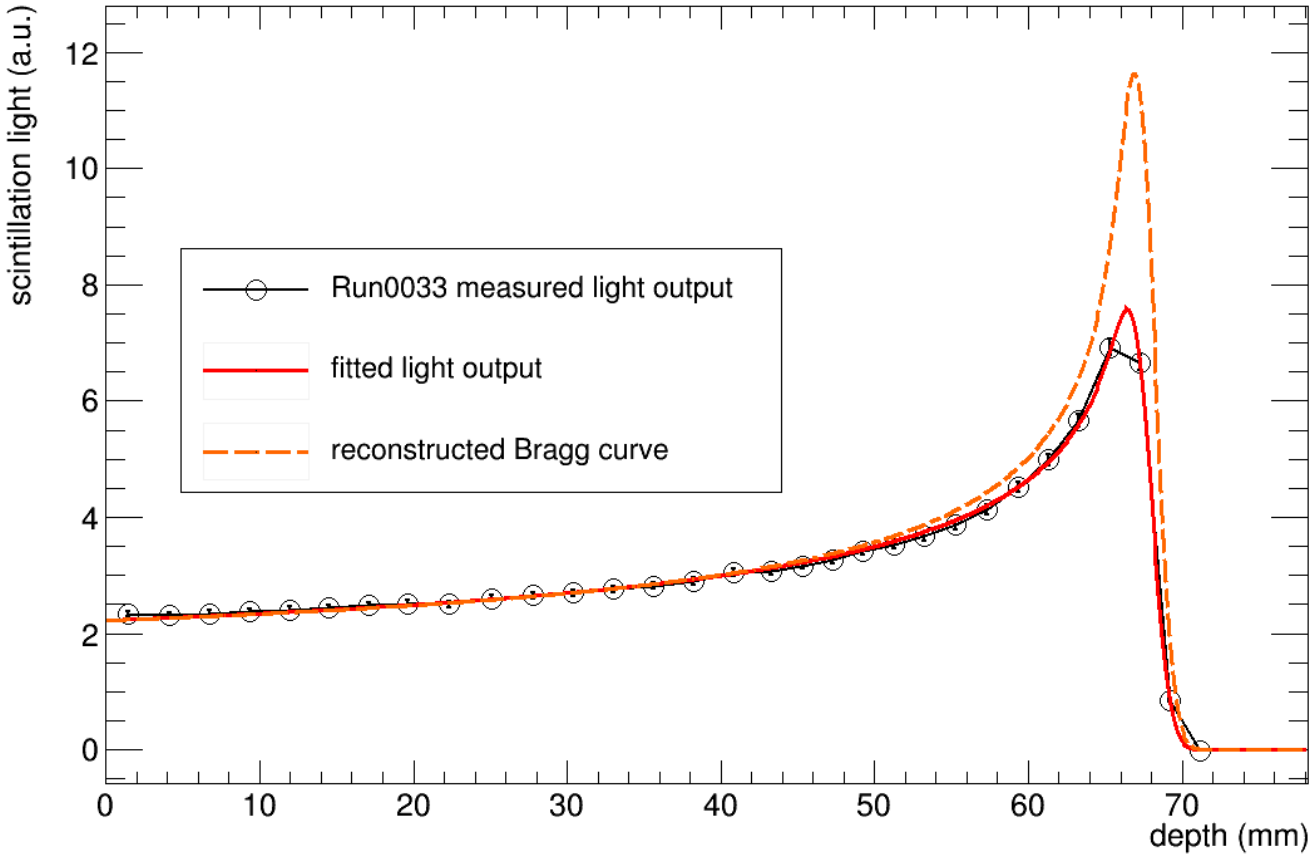
Range reconstruction



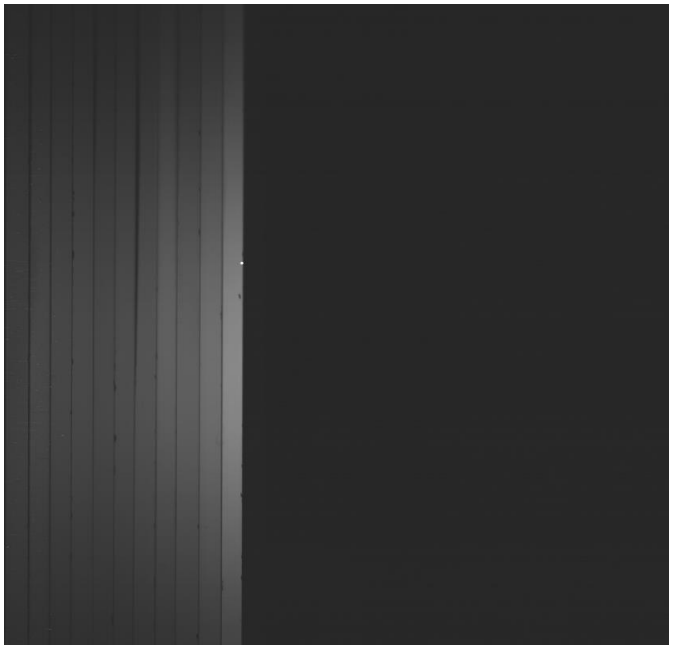
Range reconstruction

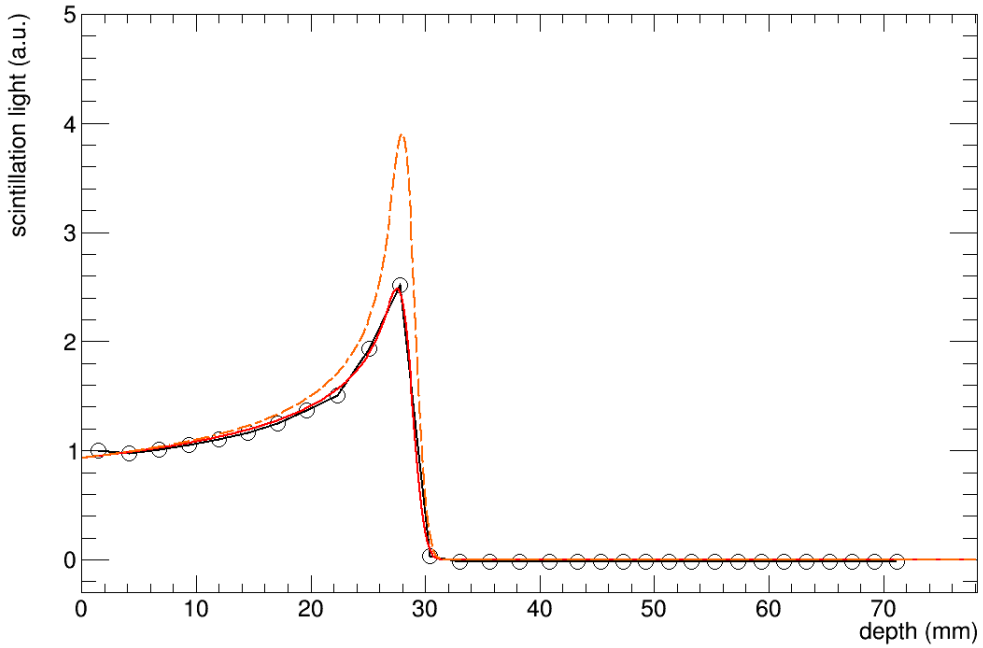


Range reconstruction

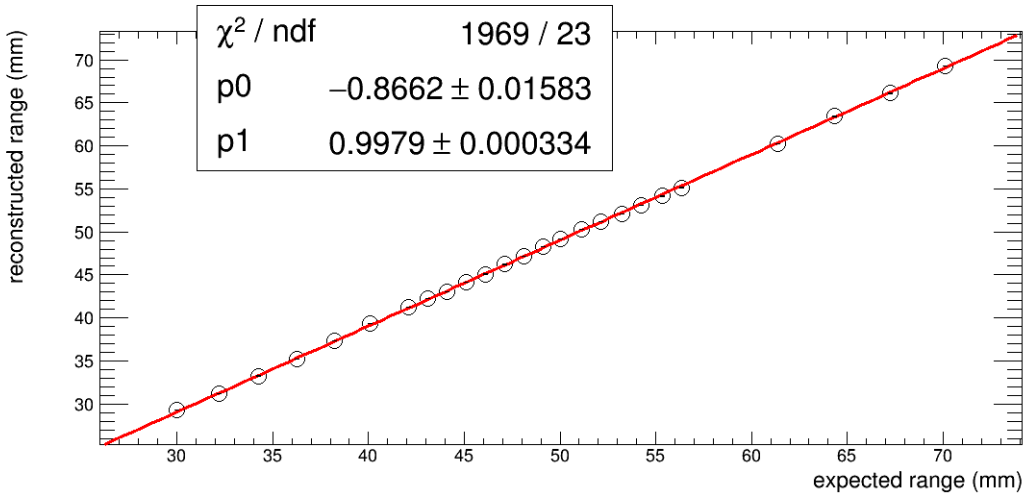


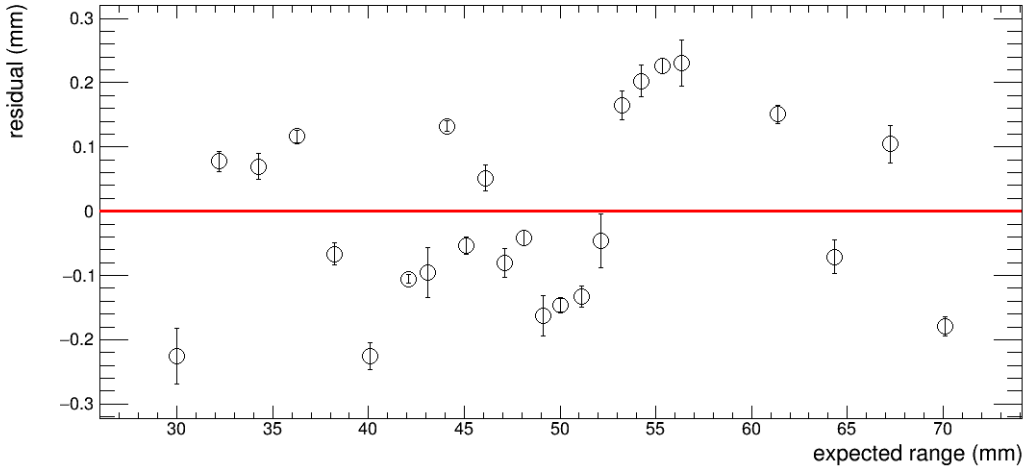
Range Scan





Range Scan: Range Linearity





Clatterbridge Beam Test: Radiation Damage

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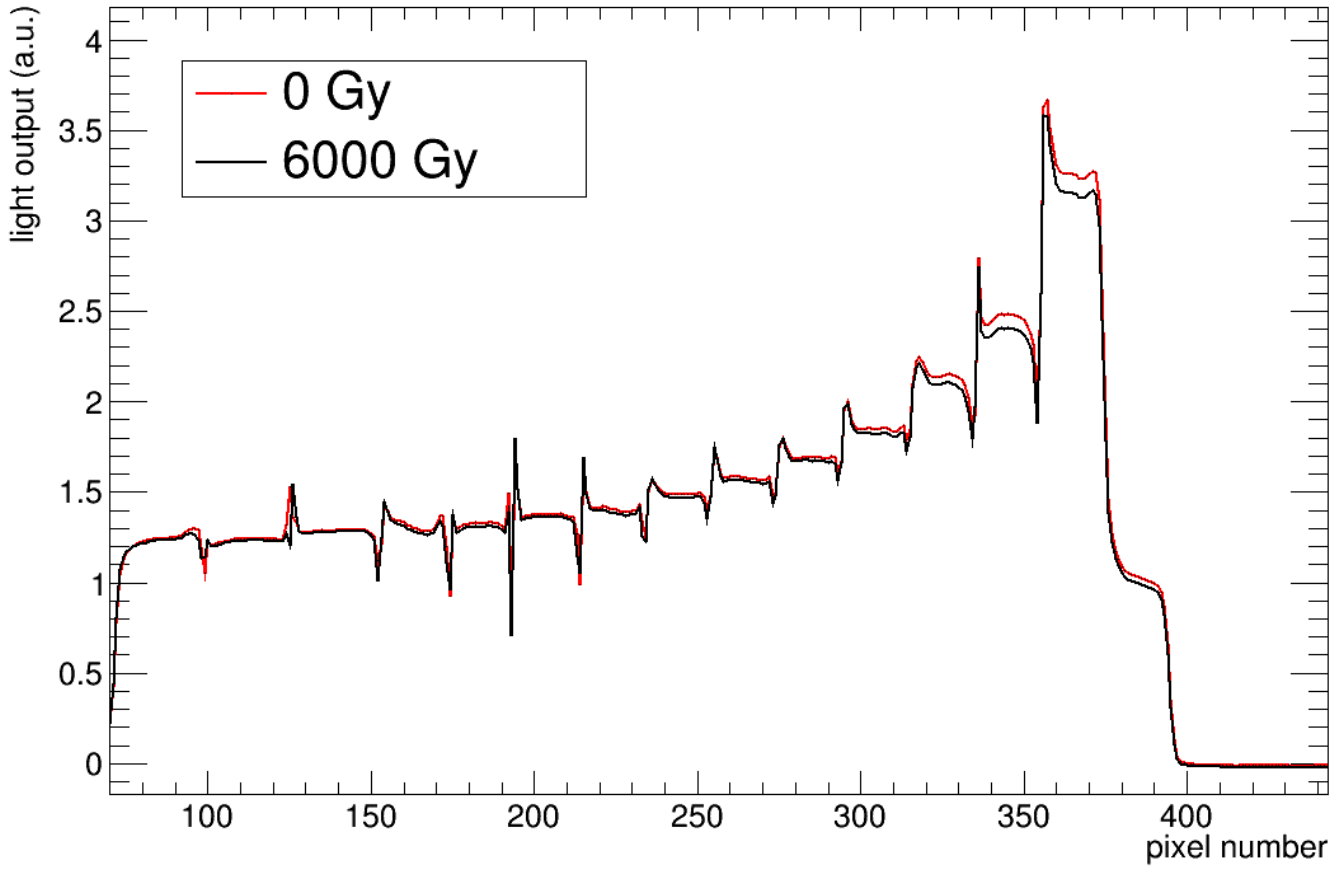
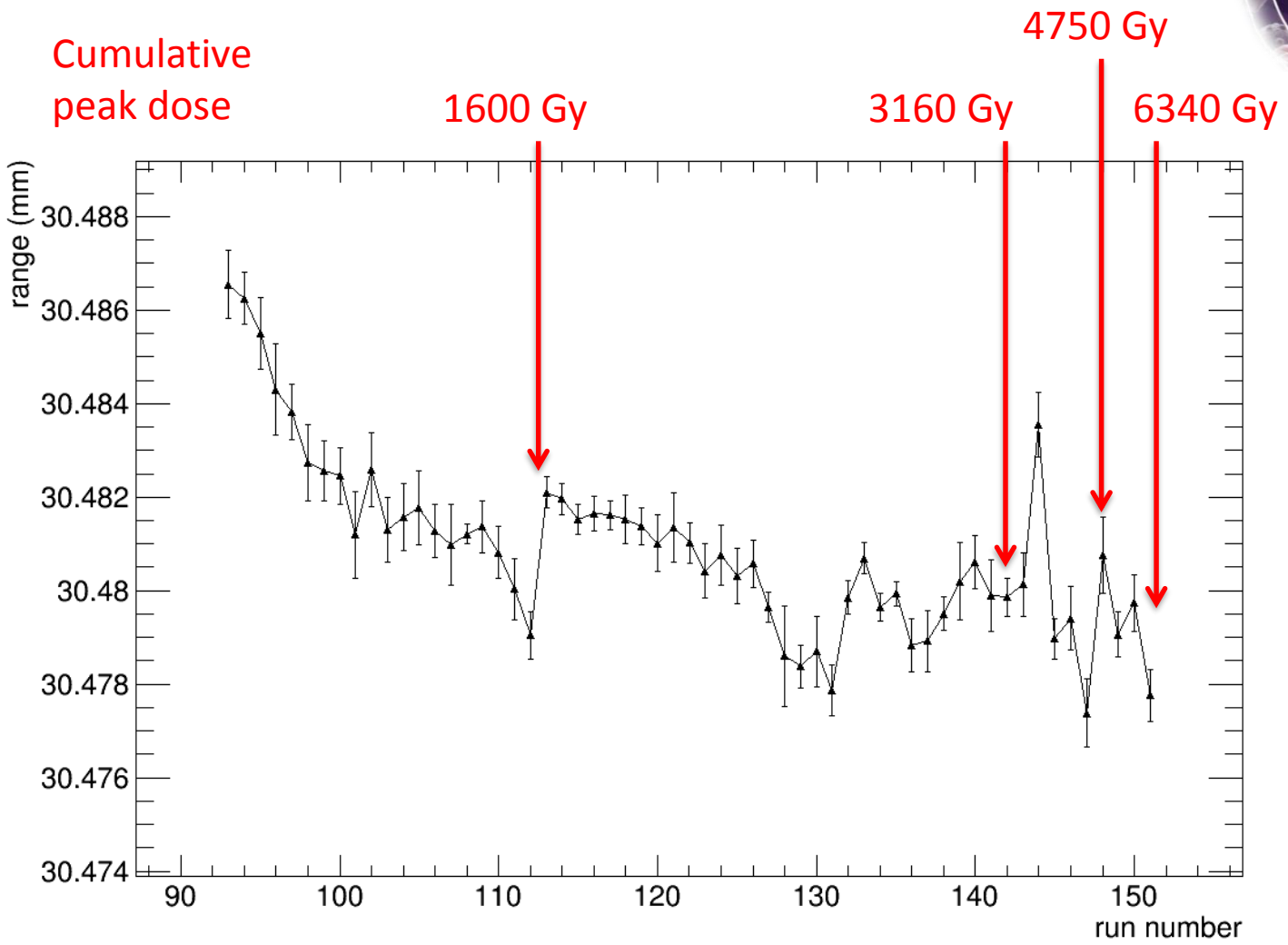
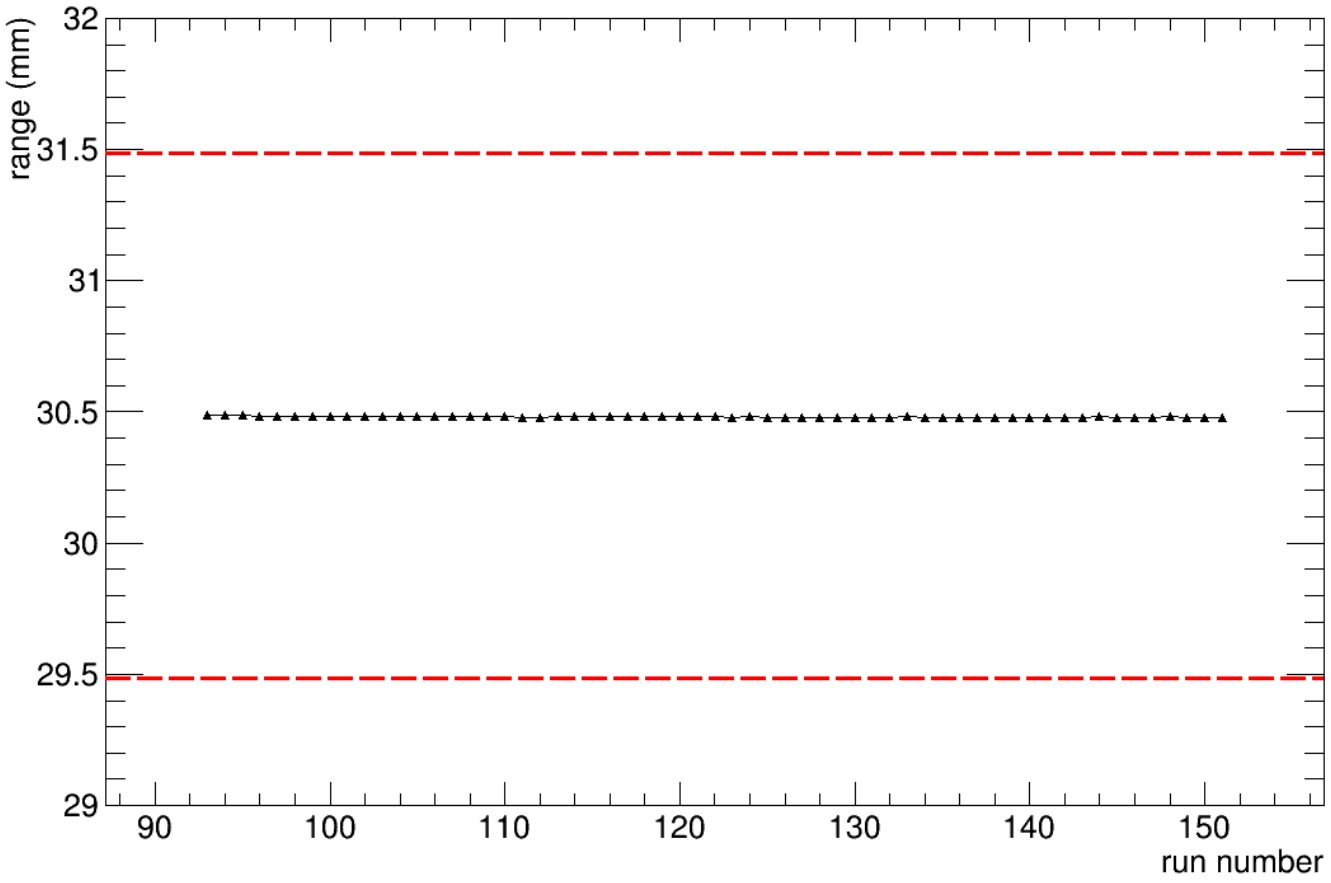


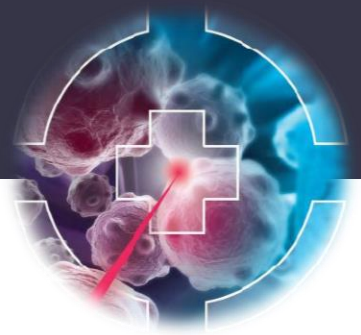
Clatterbridge Beam Test: Radiation Damage



Clatterbridge Beam Test: Radiation Damage

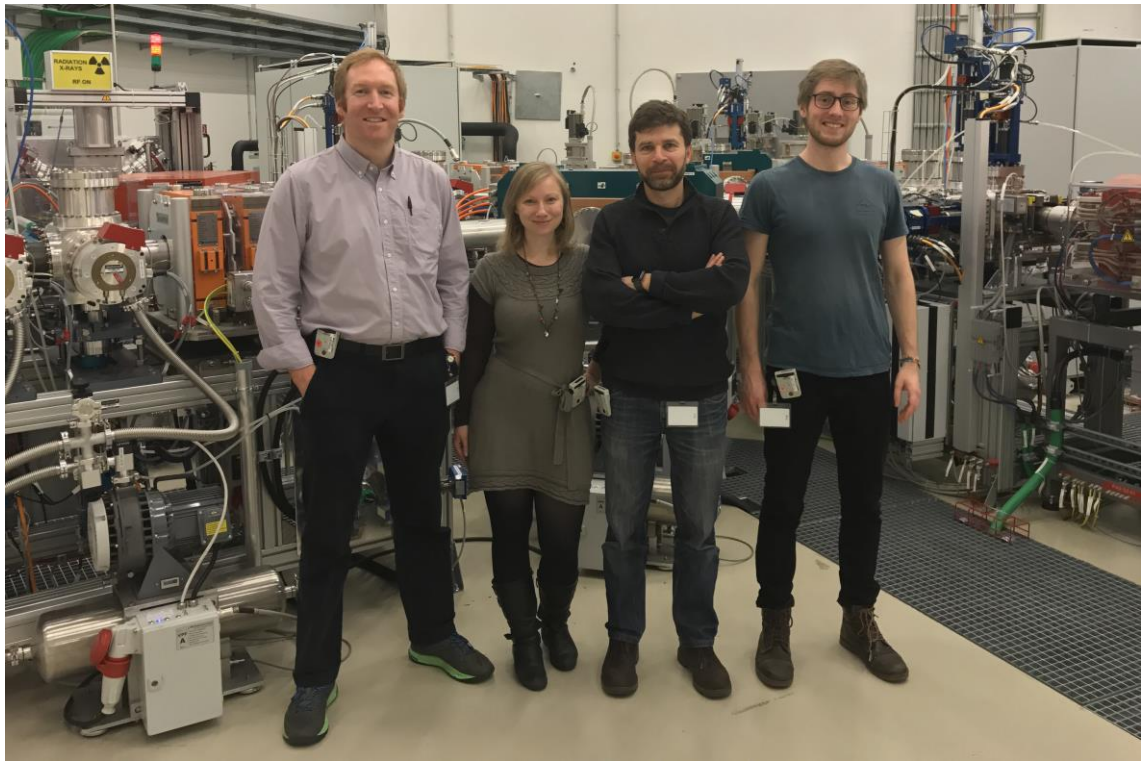


Conclusion

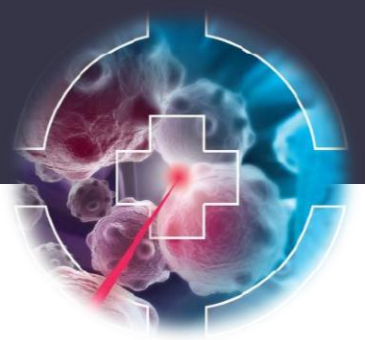


- Results
  - Developed model for range reconstruction
  - Build a prototype with image sensor
  - Beam test results:
    - Range reconstruction uncertainty ~0.15mm
    - Negligible deterioration of range reconstruction after 6,000 Gy
- Outlook
  - Image sensor is overkill. Build customized readout with photodiodes
  - Build large prototype for full clinical proton beam range
  - Open postdoctoral position in our group: Innovation Fellowship in Proton Beam Therapy Diagnostics Development. Deadline 6th July! http://www.hep.ucl.ac.uk/positions/PBT_InnovationFellow_June2018.shtml

Thank you for your attention

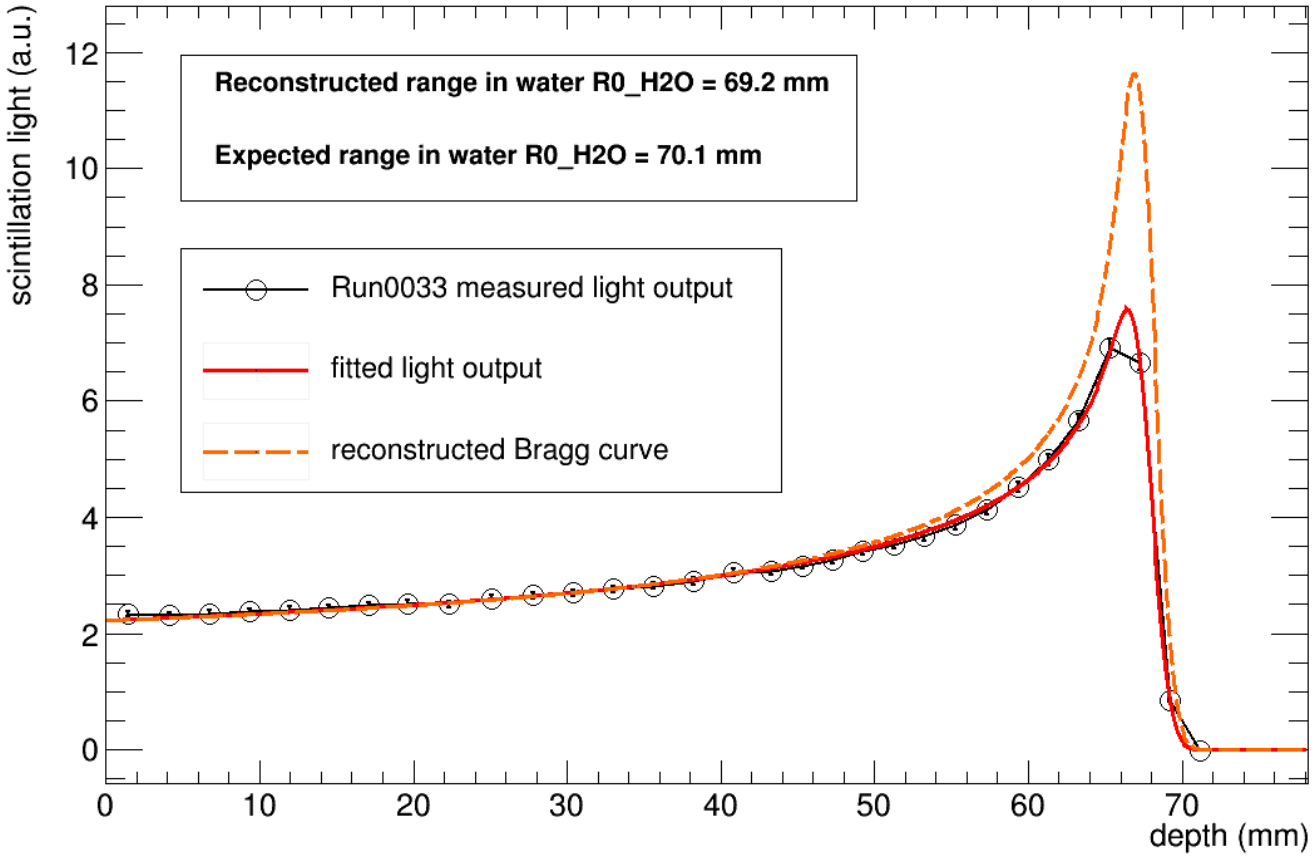


This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 675265, OMA – Optimization of Medical Accelerators.

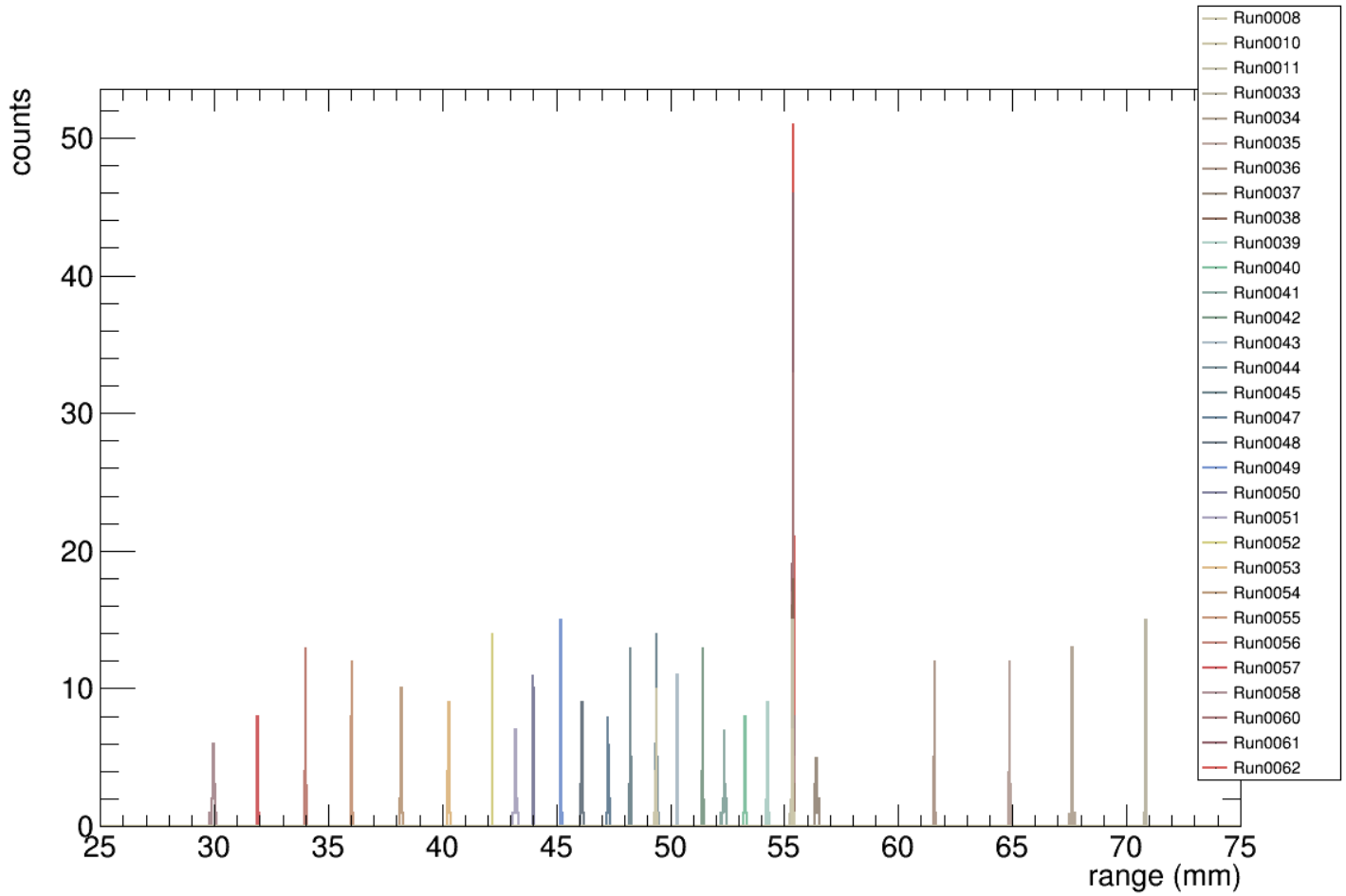


Backup

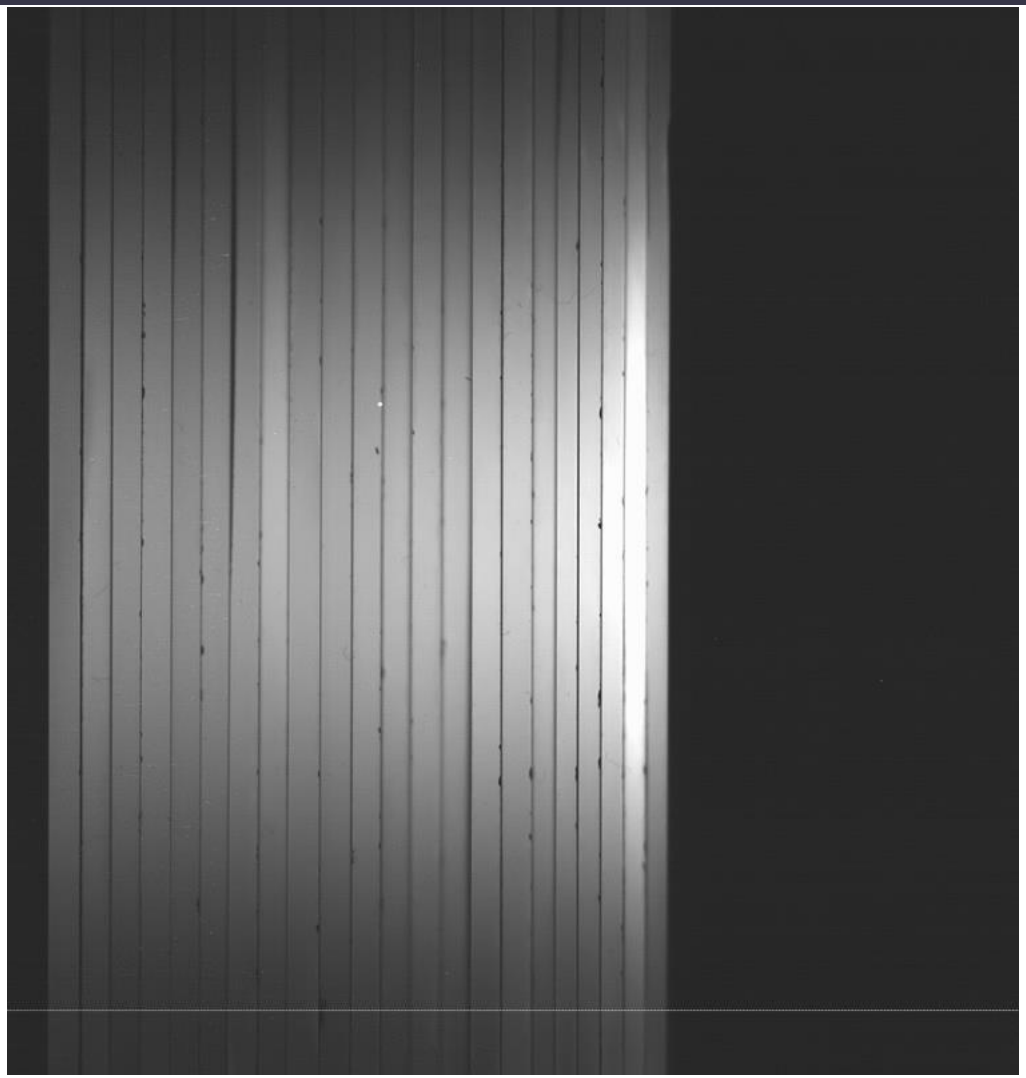
Range reconstruction



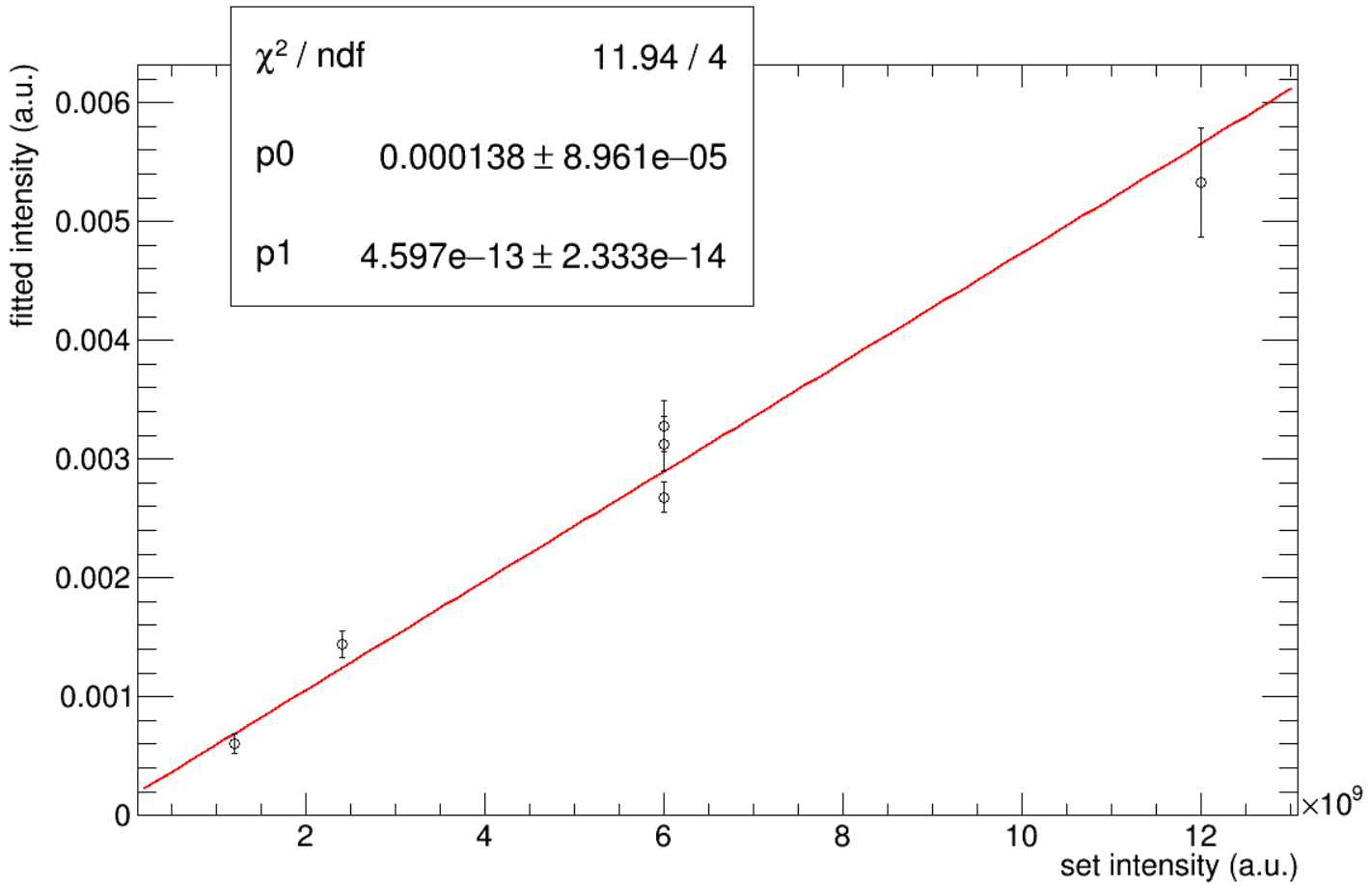
Range Scan: Reproducibility



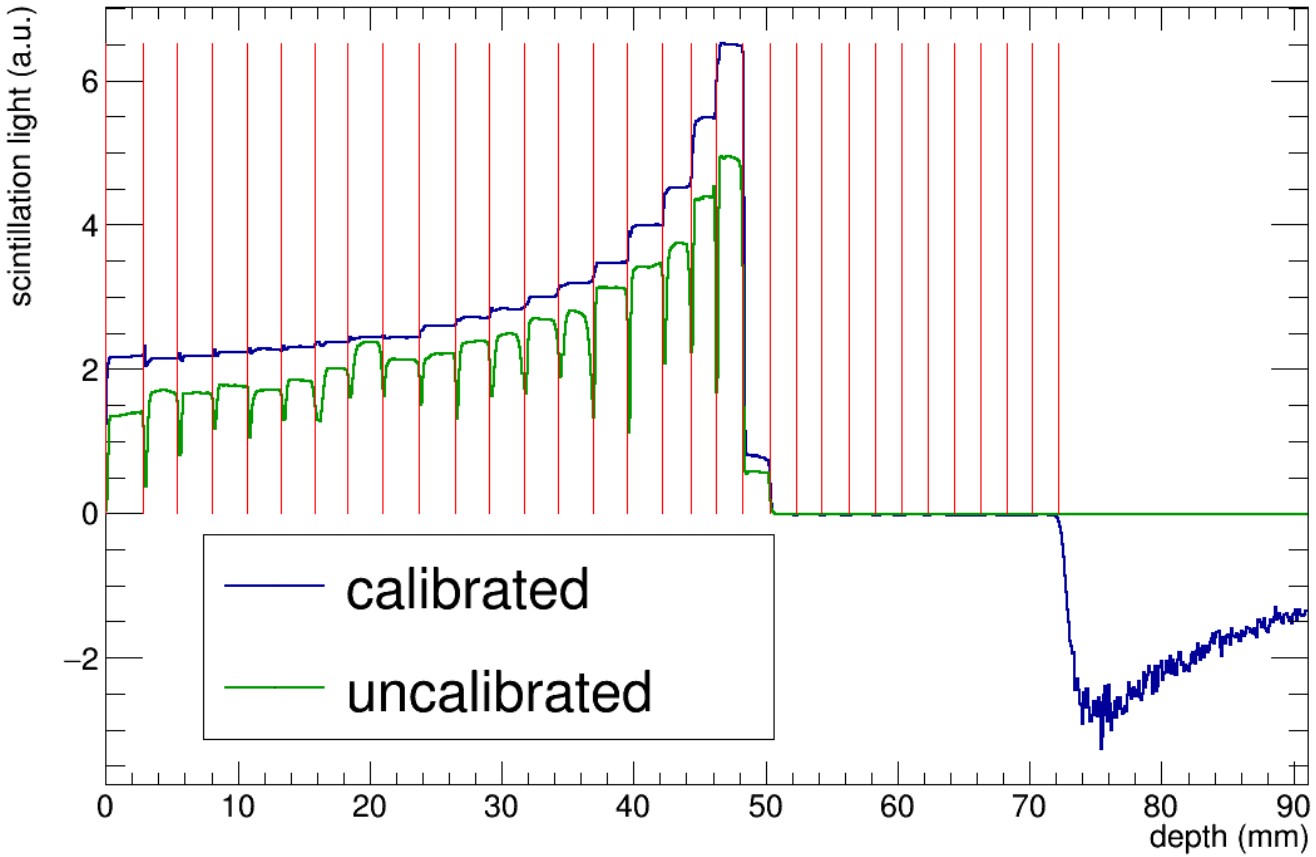
Intensity Scan



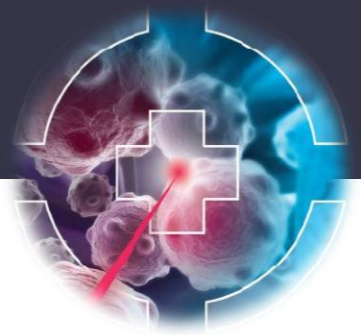
Intensity Scan

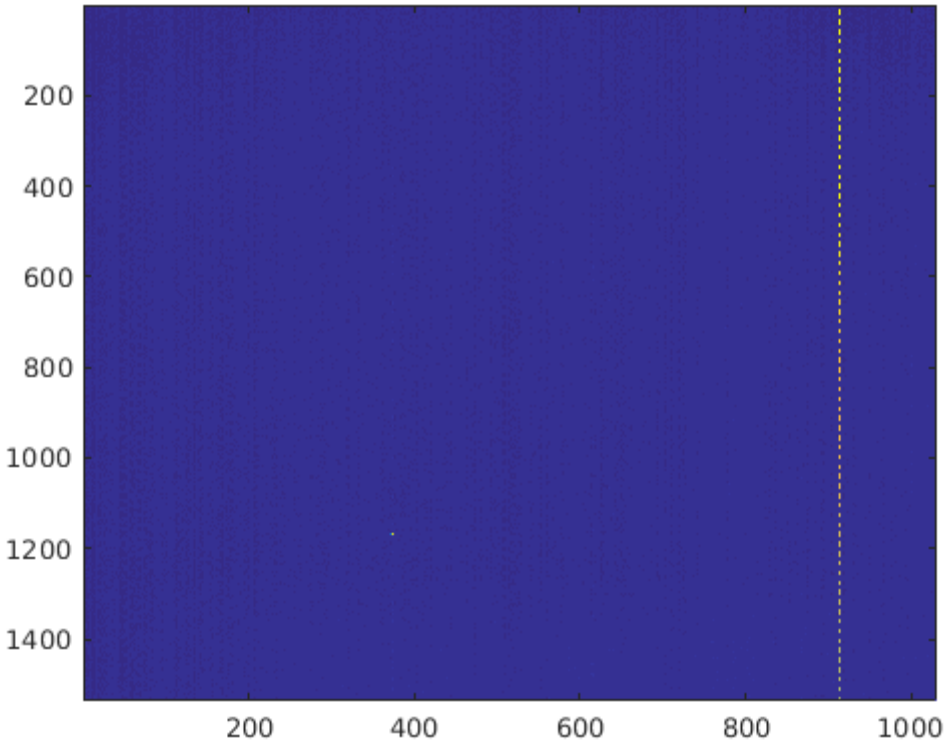


Calibration

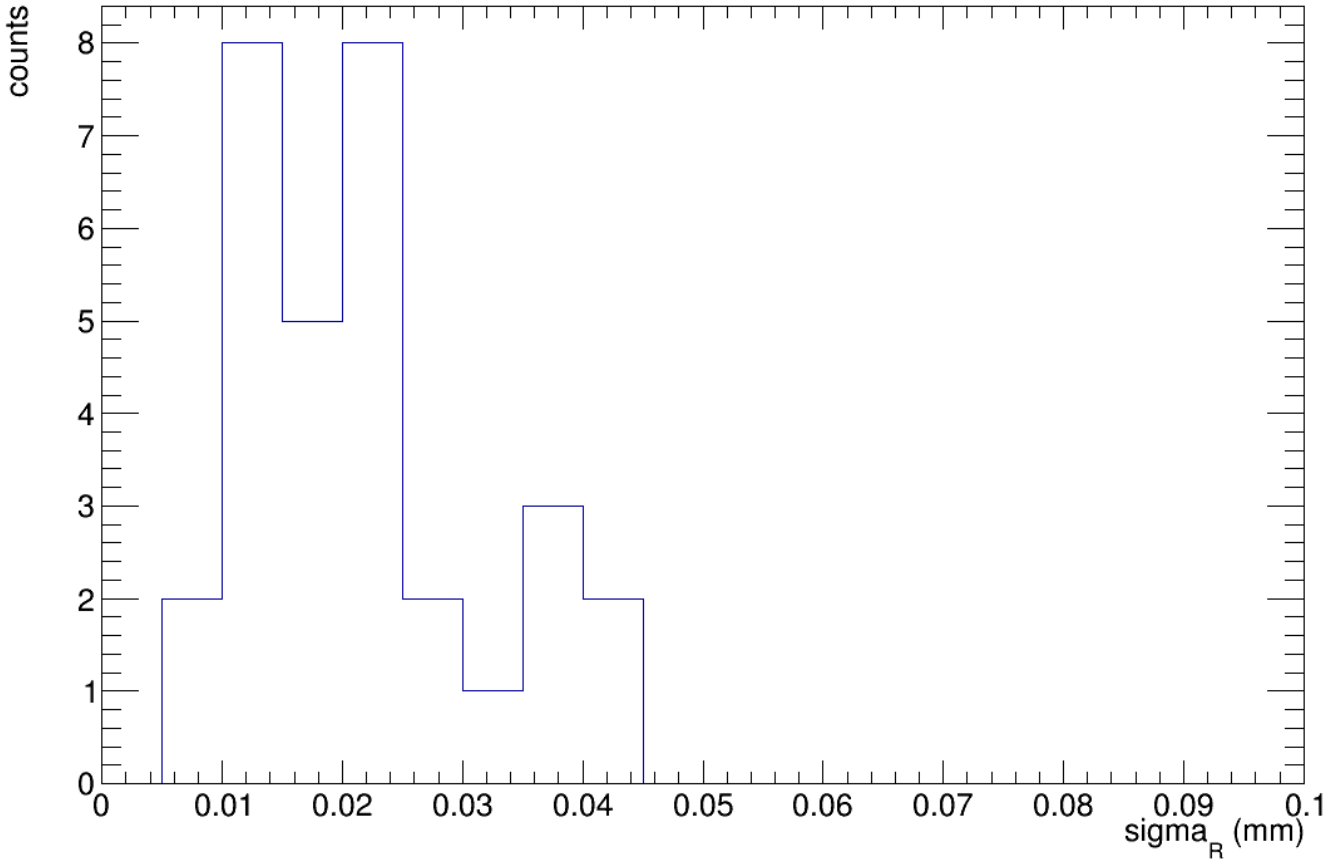


Background

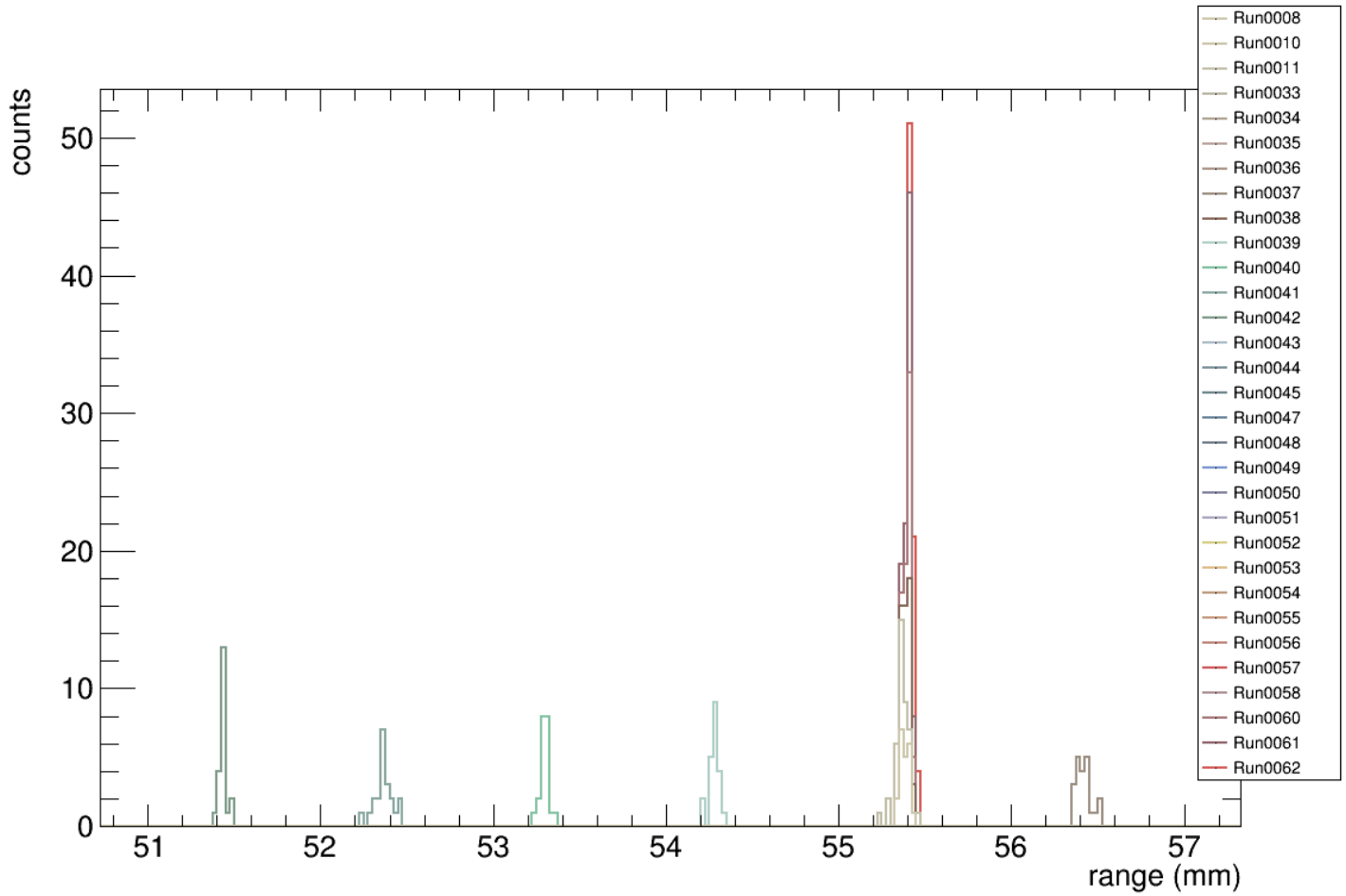




Range reconstruction Uncertainty

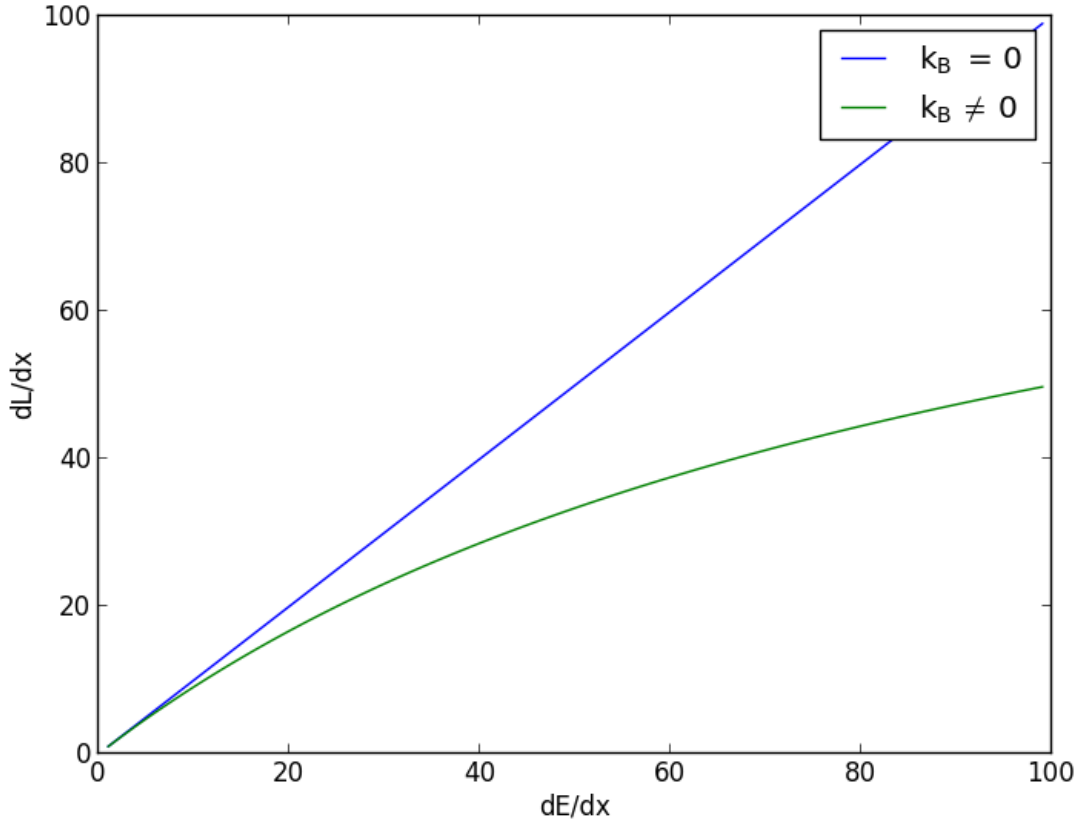


Range Scan: Reproducibility



Quenching: Birk's Law

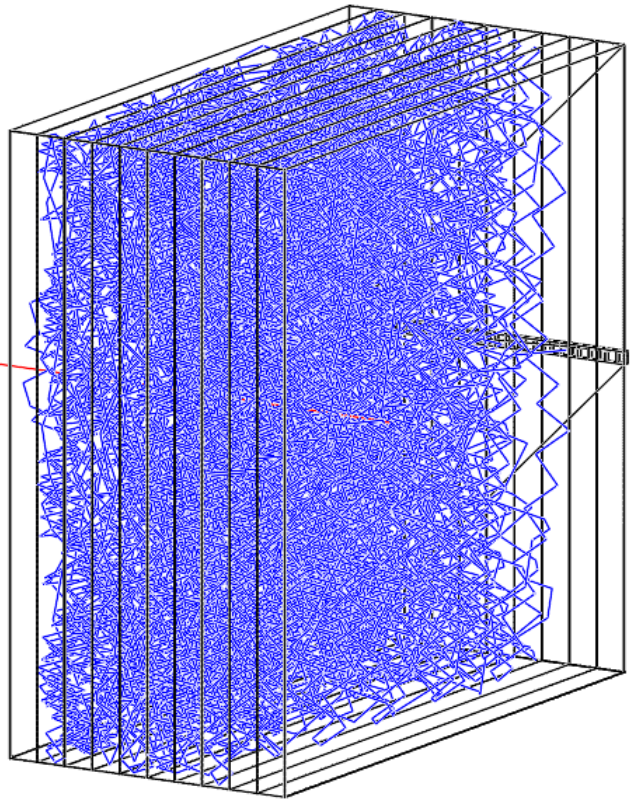
$$\frac{dL}{dx} = S\frac{\frac{dE}{dx}}{1 + k_B\frac{dE}{dx}}$$



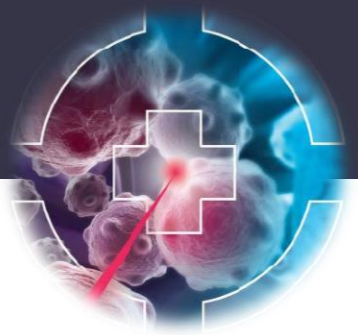
Range Telescope: Simulation

Geant4 simulation

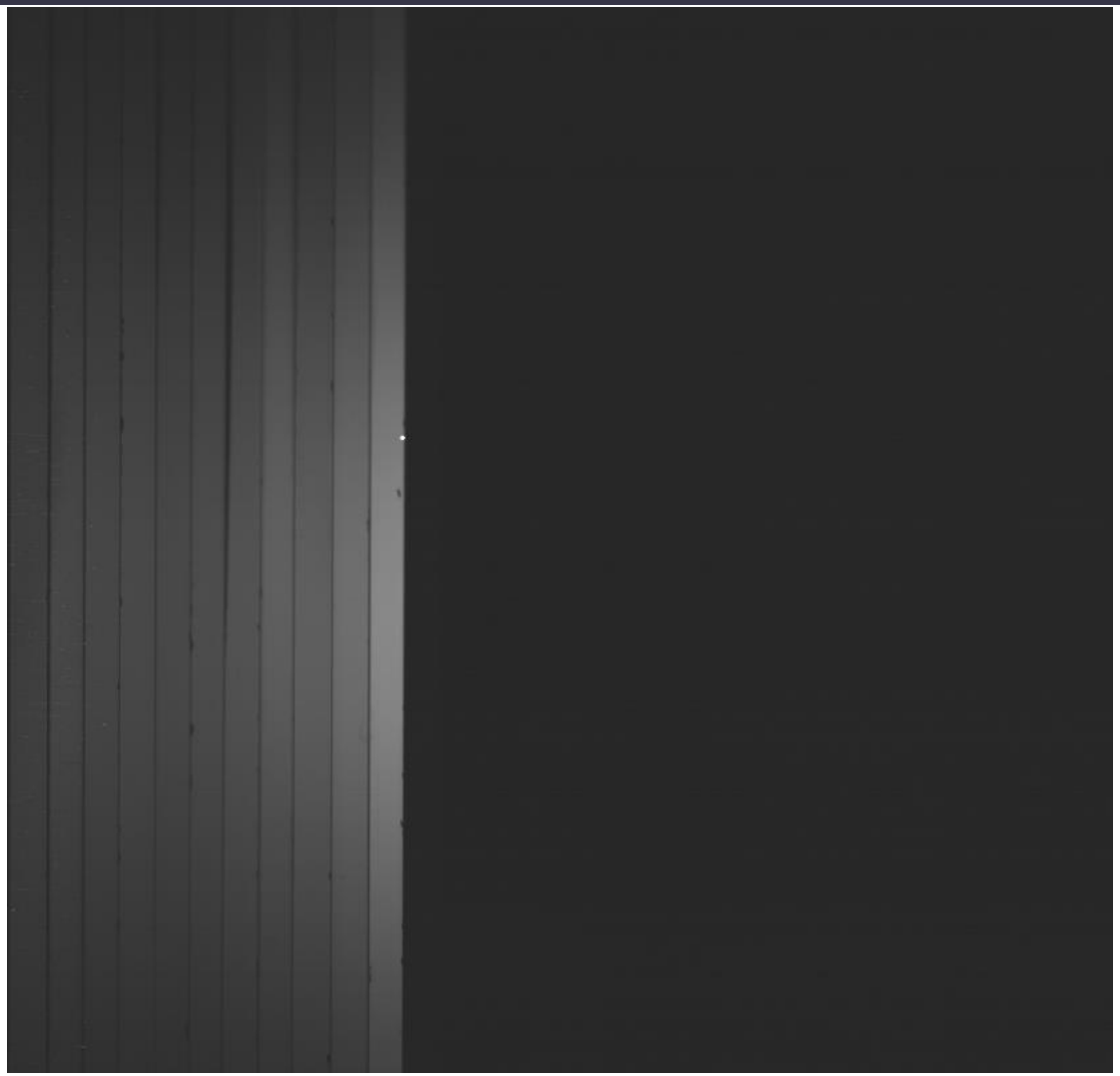
Proton beam



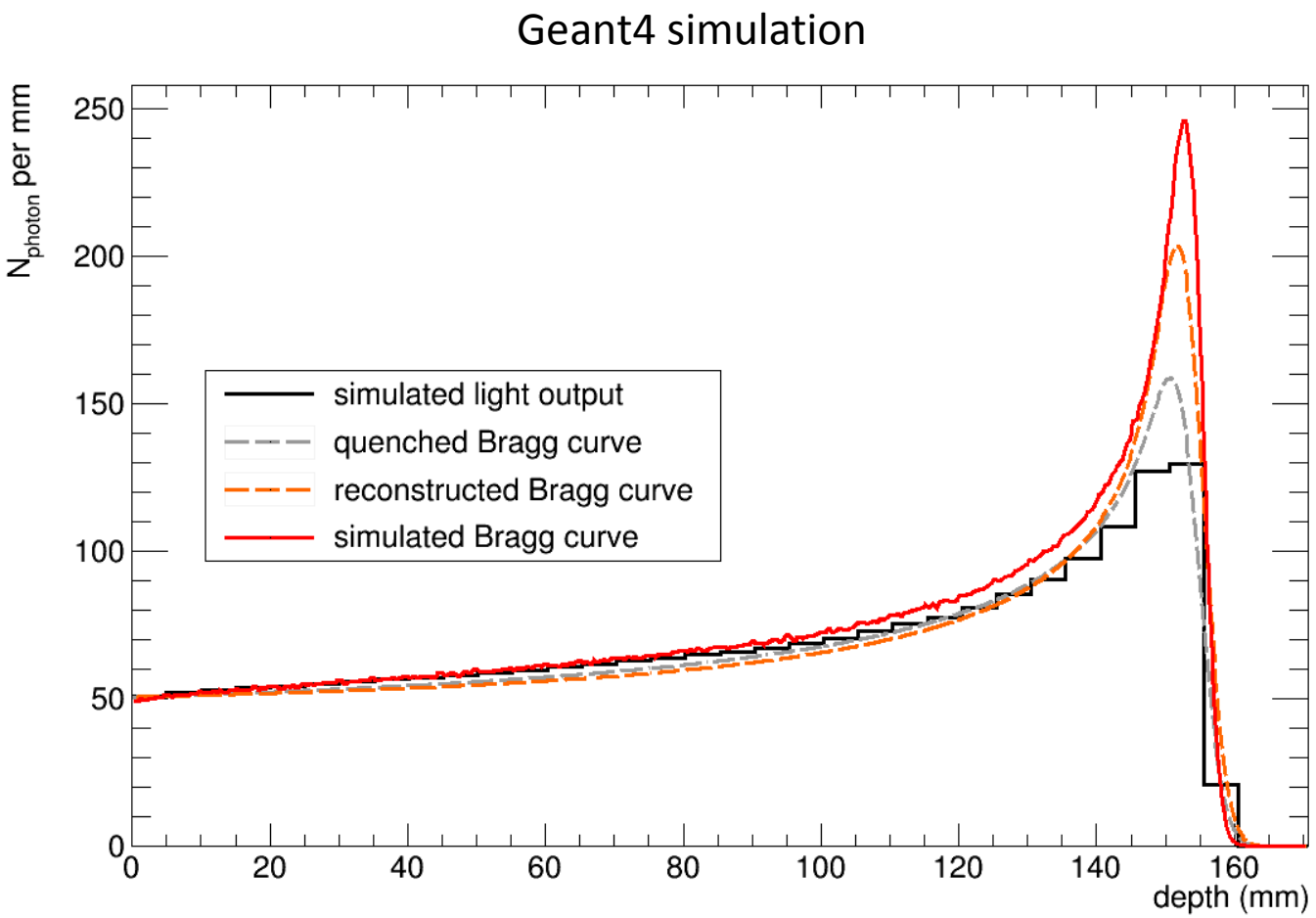
Range Scan



Beam



Proton Range Reconstruction



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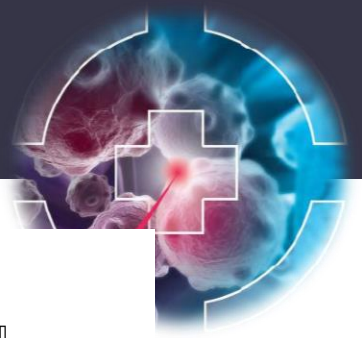

Geant4 simulation