Summary

Session 4A "New EM physics validation results"

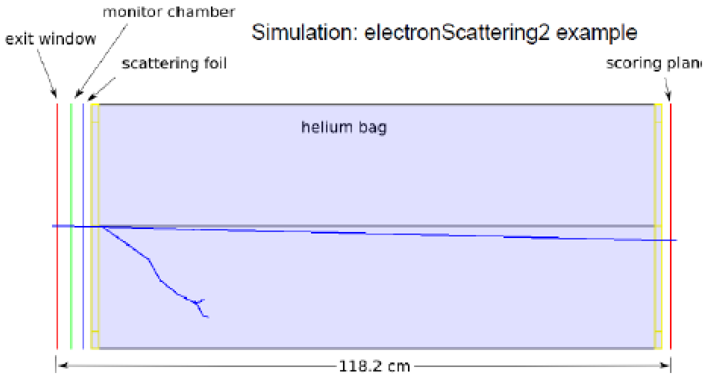
Chairs: S. Guatelli and L. Pandola

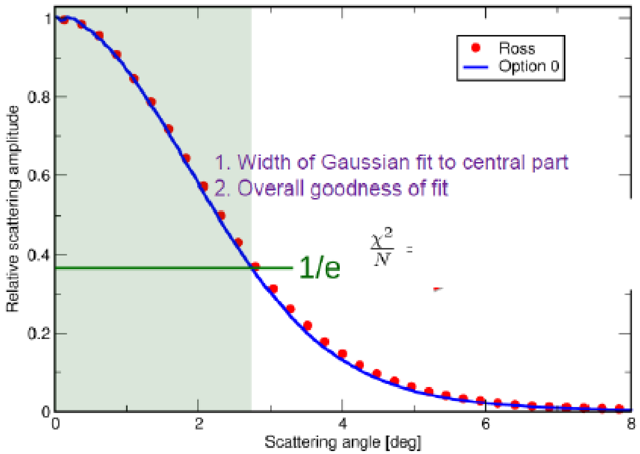
21st Geant4 Collaboration Meeting, Ferrara, September 2016

Electron scattering benchmarking

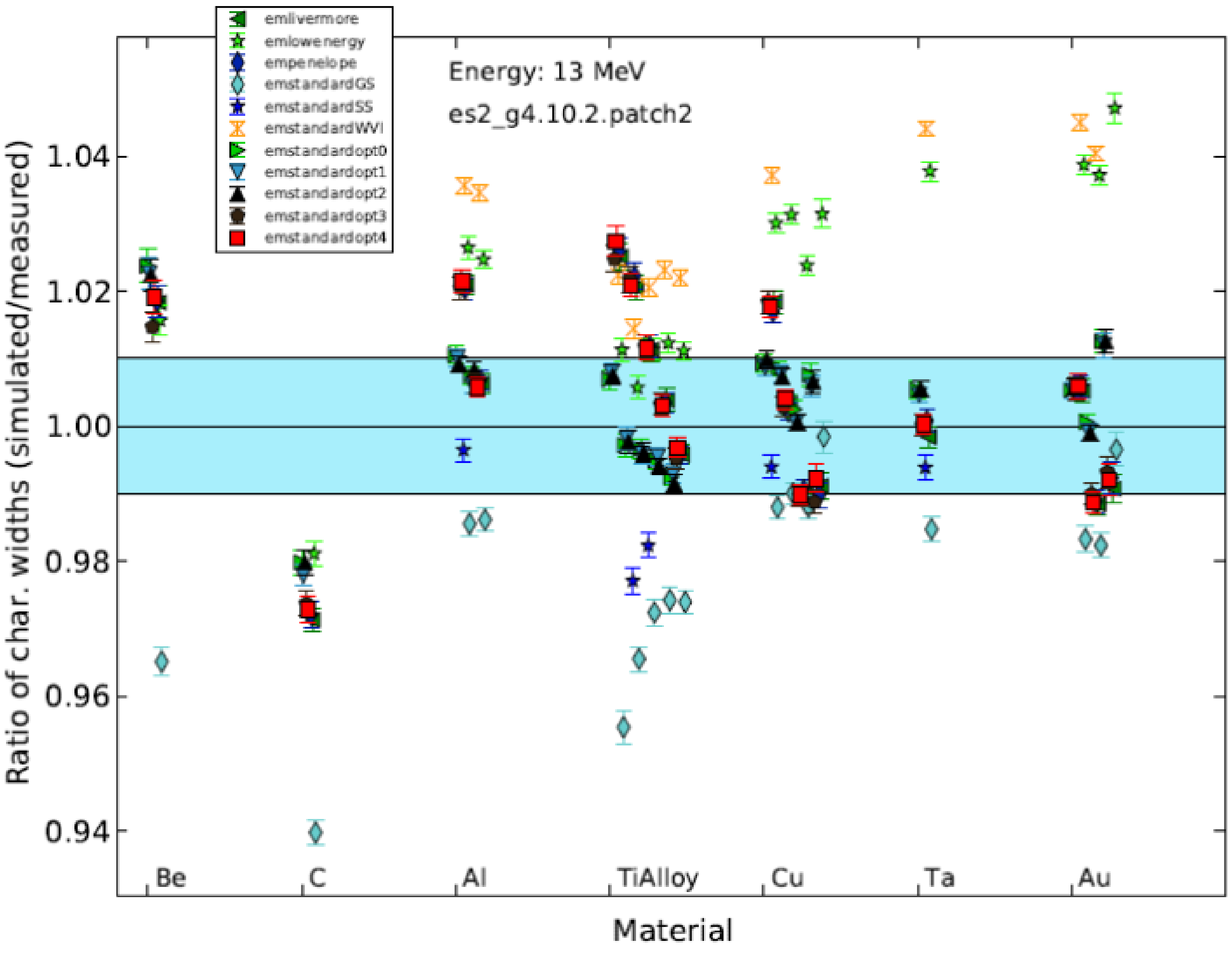
- Daren Sawkey

The experimental set-up





Width of central peak



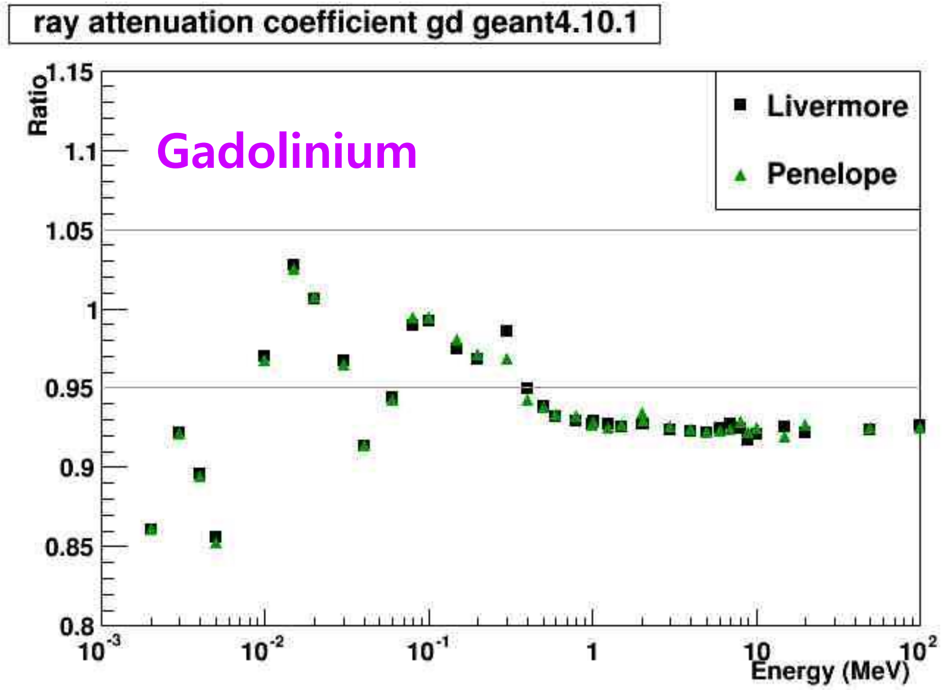
Validation of photon cross sections against NIST

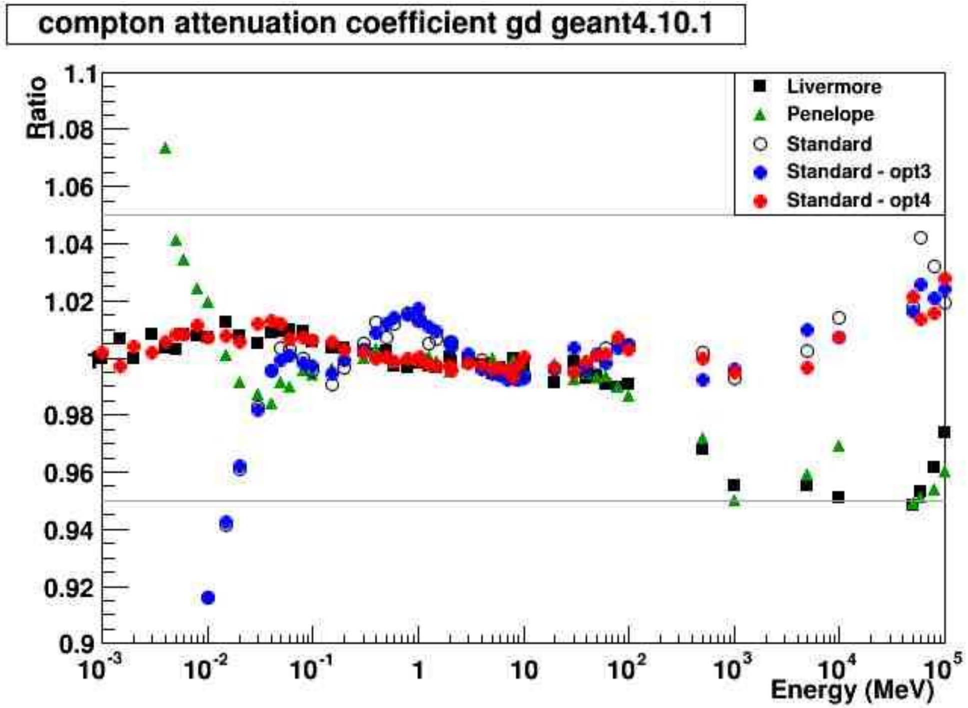
CMRP: S. Guatelli and J. Davis

Swhard: A. Mantero and P. Dondero

- Systematic validation
    - For elements Z=4-92
    - Compounds of interest for medical physics and space science: tissue, bone, PMMA, kevlar, mylar, kevlar, polyethylene, etc.
- EMPhysicsList, EMPhysicsList option 3 and 4, Livermore and Penelope Physics lists
- Overall very good agreement (< 5%)
- Differences in Rayleigh scattering and Compton Scattering
- Test integrated in the G4MedPhysTestSuite

CENTRE FOR MEDICAL RADIATION PHYSICS | UNIVERSITY OF WOLLONGONG AUSTRALIA | SWHARD Cuttin'Edge Technology





Validation for brachytherapy

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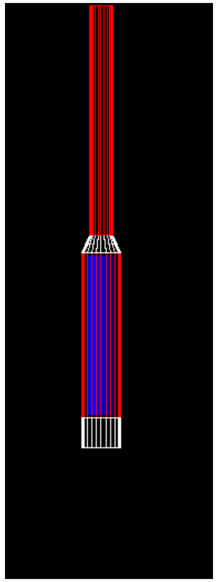
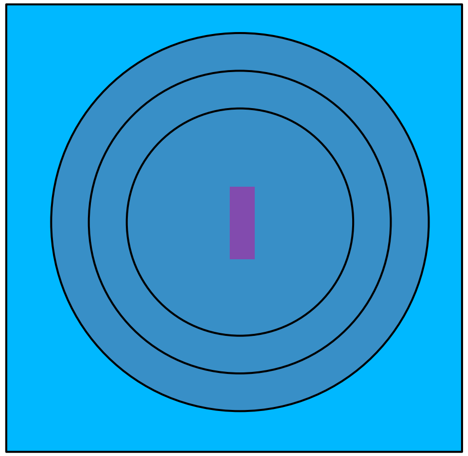
UNIVERSITY OF WOLLONGONG AUSTRALIA
D. Cutajar, J. Poder, S. Guatelli

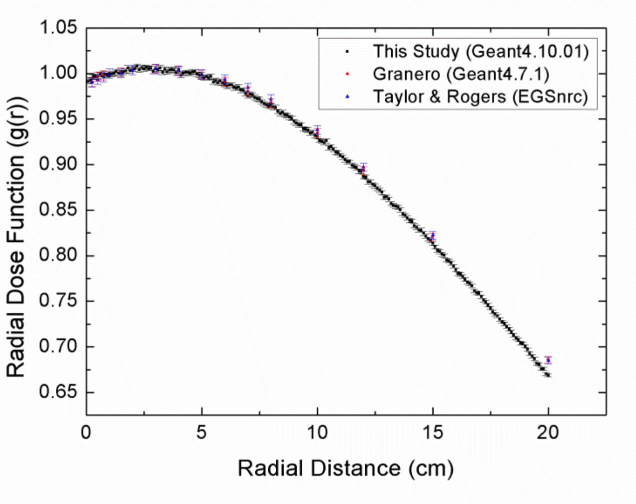


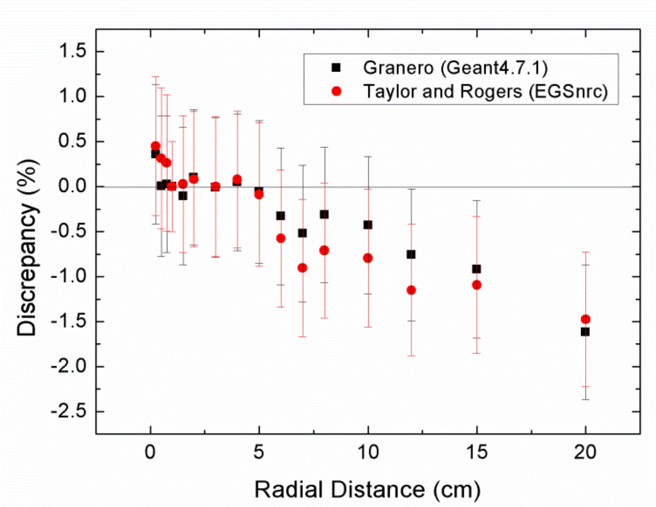


Flexisource Ir-192 Brachytherapy Source

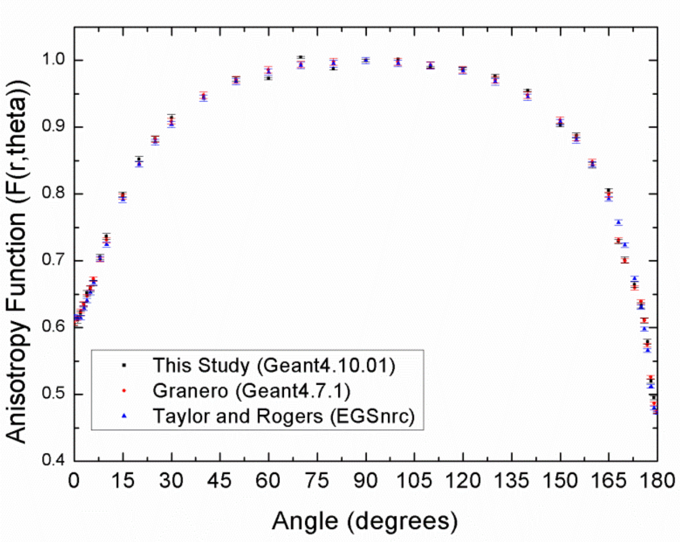
- To be integrated in the Geant4 advanced example Brachy and G4MedPhysTestSuite
- To be extended to other brachy sources
- Test radioactive decay

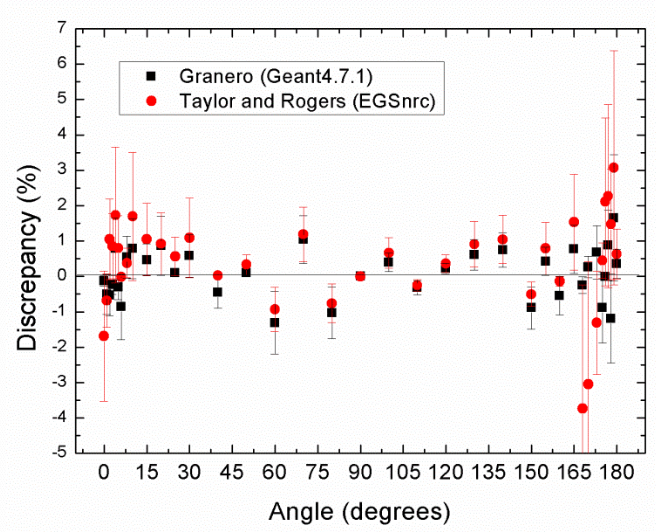
Radial dose function $g(r) = \frac{\dot{D}(r,\theta_0)G(r_0,\theta_0)}{\dot{D}(r_0,\theta_0)G(r,\theta_0)}$



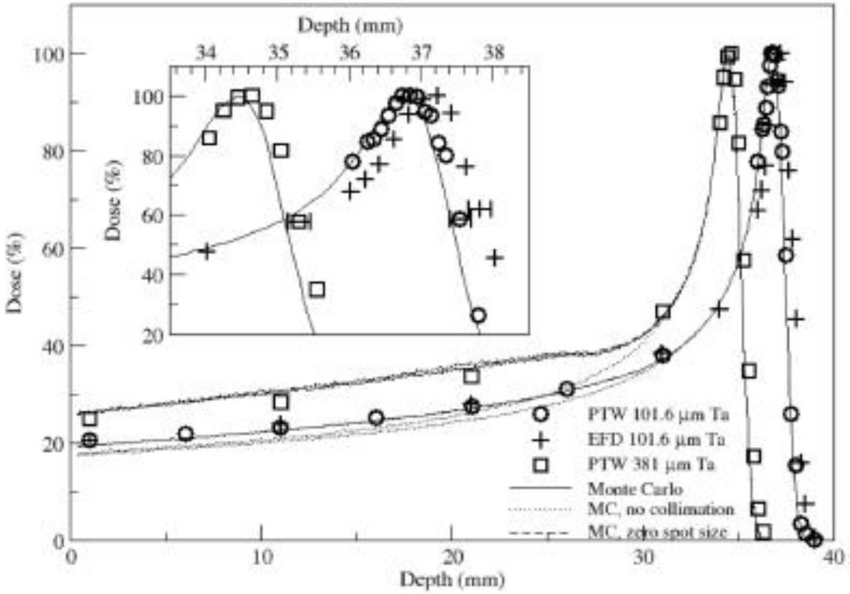


Anisotropy function $F(r,\theta) = \frac{\dot{D}(r,\theta)G(r,\theta_0)}{\dot{D}(r,\theta_0)G(r,\theta)}$





Bragg Curves in water for 67.5 MeV protons
Bruce Faddegon and José Ramos-Méndez



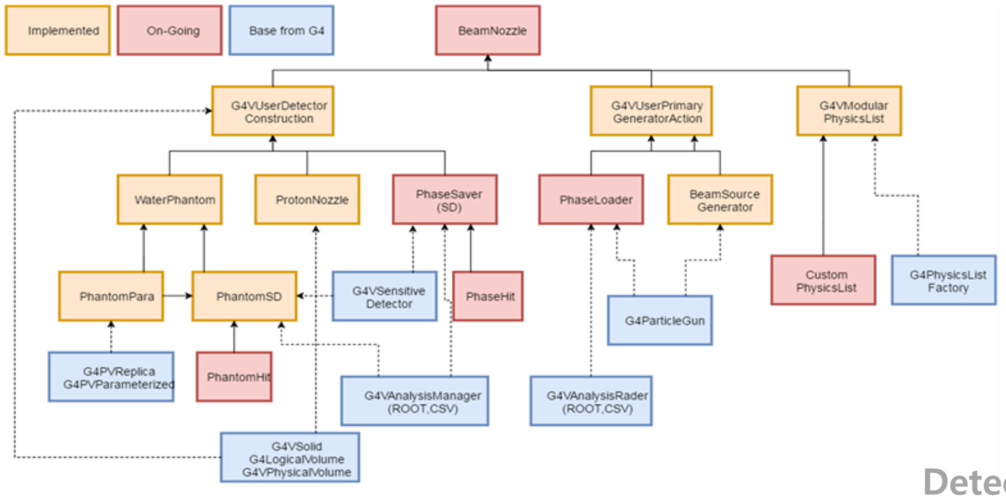
- Benchmarks were measured for a 67.5±0.1 MeV proton beam incident on 2 different thicknesses of Ta foil with 0.15 mm accuracy in depth and 4% accuracy in the peak-to-valley ratio.
- The beam penetration was less in the simulation fell than the measurement, suggesting the mean ionization potential of water is 2–5 eV higher than the 78 eV used in the simulation.

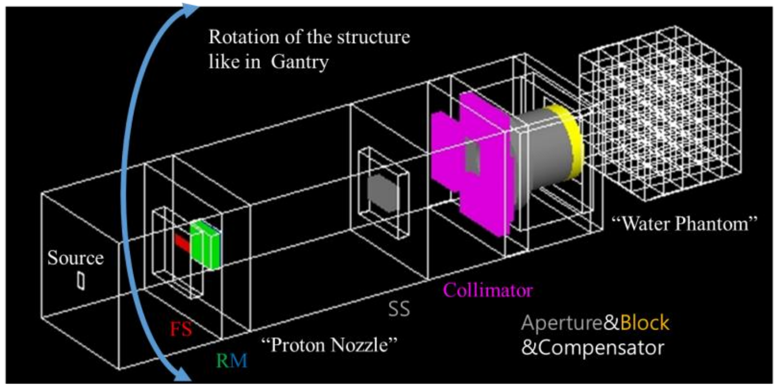
UCSF

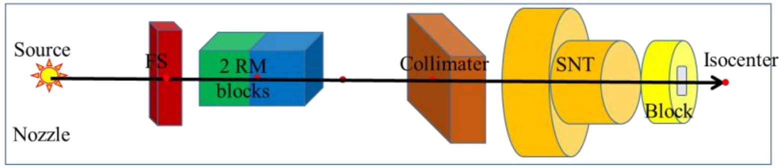
Validation of Proton Nozzle (Jae-ik Shin, KIRAMS,NCC)

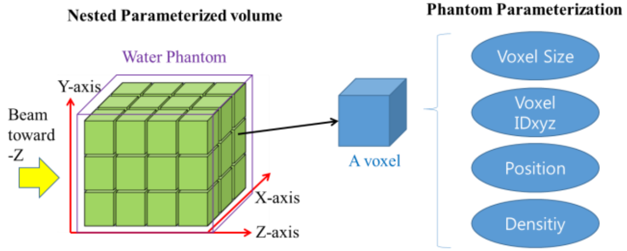
"BeamNozzle" example

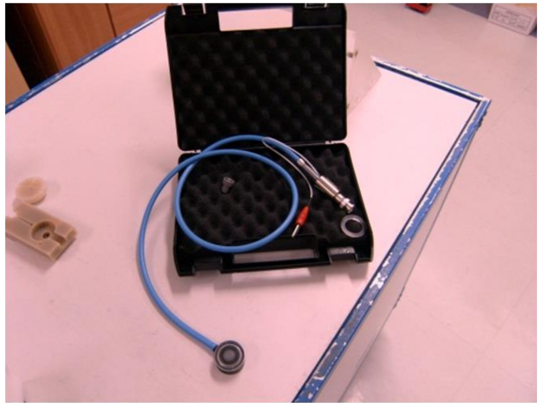
Migration from 9.6 to 10.02 MT-compatible









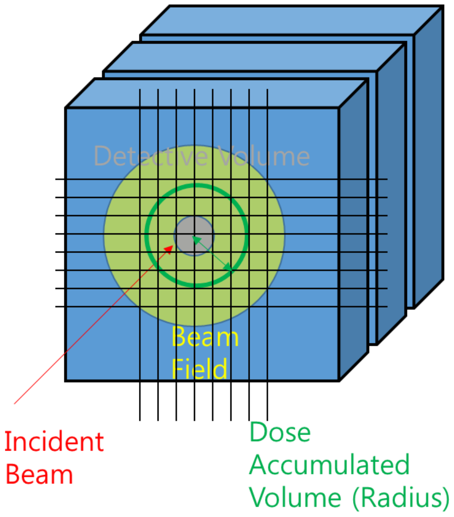


PTW Markus Chamber (23343)

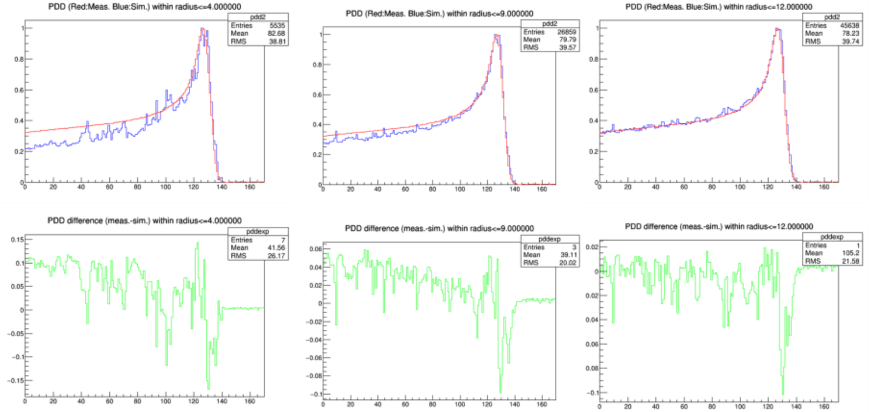
- Sensitive volume
- Radius 2.65mm, depth 2mm

Detective Volume

=,~ Dose Accumulated Volume



PDD depending on Radius (QGSP_BIC_EMV)



On-going Validation between simulation and measurement about Bragg Peak and SOBP

New Data on Fragmentation cross section of alpha particles in water from GSI

Miguel A. Cortés-Giraldo[1], M. Rovituso[2,3], C. Schuy[2]

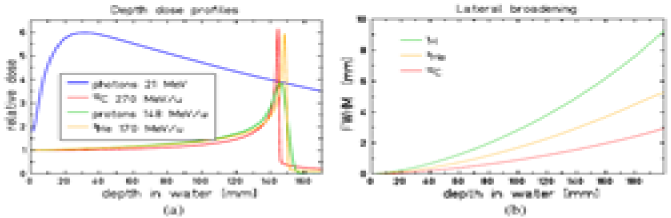
1) *Universidad de Sevilla (Seville, Spain)*
2) *GSI Helmholtz Centre for Heavy Ion Research (Darmstadt, Germany)*
3) *TIFPA (Trento, Italy)*

21st Geant4 Collaboration Meeting

Ferrara (Italy), September 13th, 2016

Introduction

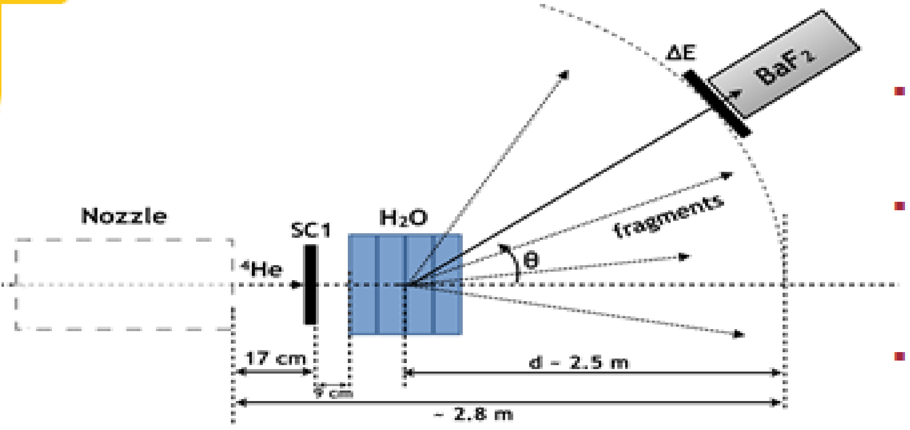
- Growing interest in assessing physical properties of helium beams at therapeutic materials and energies.
- Helium beams show intermediate physical properties when compared with proton and carbon ion beams. M. Krämer et al., *Med. Phys.* 43 (2016)
  - Lateral Spread.
  - Peak width.
  - Fragmentation tail.



- In this talk, I will briefly present the experimental Ph.D. Project finished very recently (june 2016) by Marta Rovituso at GSI, producing very interesting data to benchmark against.

Experimental Setups

Angular Distribution & Kinetic Energy Spectra of Fragments

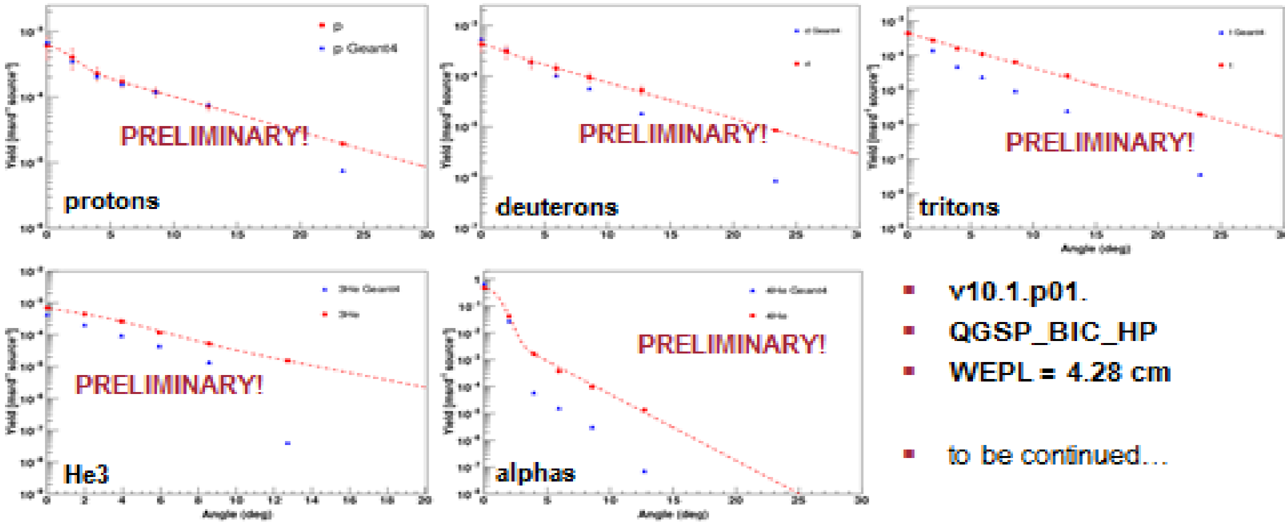


M. Rovituso, *Ph.D. Thesis*, TU Darmstadt (2016)
http://tuprints.ulb.tu-darmstadt.de/5566/

- 120 & 200 MeV/u ^{4}He beam.
- 0, 2, 4, 6, 8, 12 and 23 deg w.r.t. beam incidence direction.
- 4.28 & 13.96 cm thick water targets.

Preliminary Results

Angular Distribution of Secondary Fragments (120 MeV/u)



- v10.1.p01.
- QGSP_BIC_HP
- WEPL = 4.28 cm
- to be continued…

Ion Range Validation in Water

- Á. Perales[1,*], M. A. Cortés-Giraldo[1], J. M. Quesada[1], M. I. Gallardo[1], and D. Schardt[2]
- 1. Dept. Atomic, Molecular and Nuclear Physics. Universidad de Sevilla, Seville (Spain).
  - 2. Biophysics Division. GSI, Darmstadt (Germany).

Geant 4
21st Collaboration Meeting
12-16 September 2016
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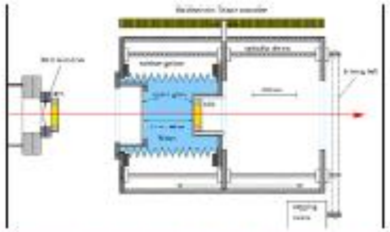
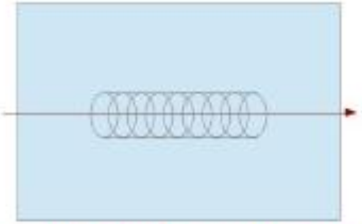
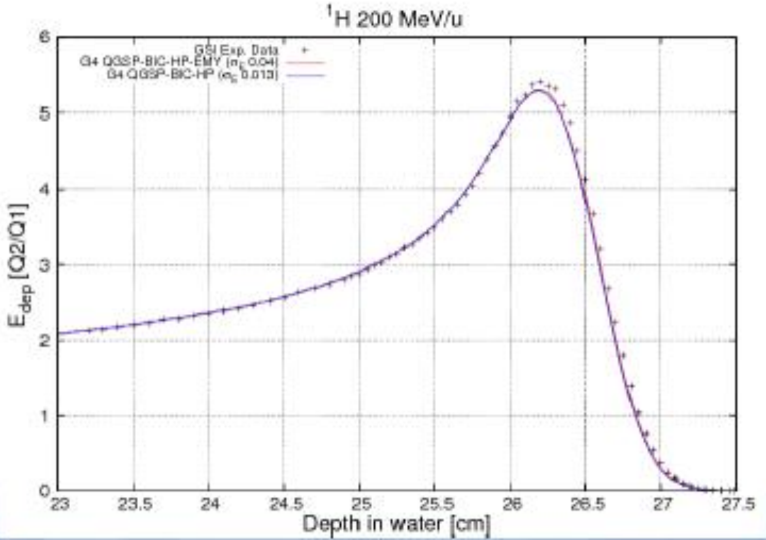


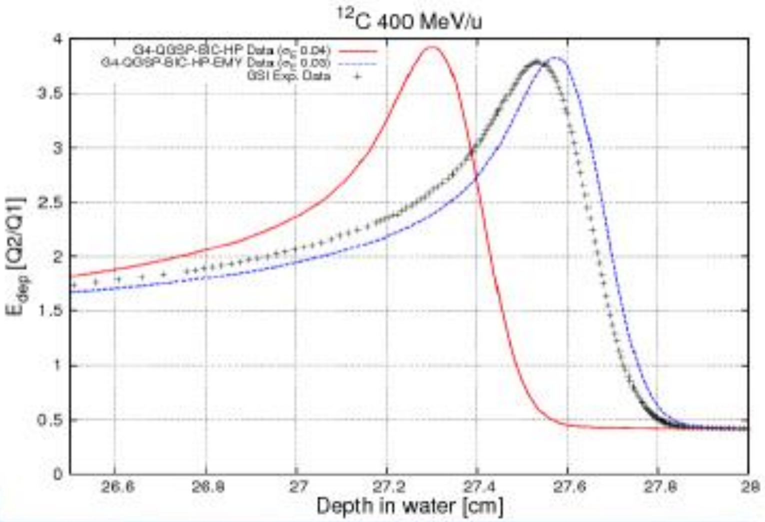
D. Schardt *et al.*, GSI Scientific Report 2007



Geometry Model Geant4 Simulation

- **Set the beam energy spread in best agreement with experimental measurements, using the penumbra as figure of merit, for protons and carbon ions.**
- **The idea is to create a beam data library for the testing tool of the Medical Simulations Benchmarking Group.**





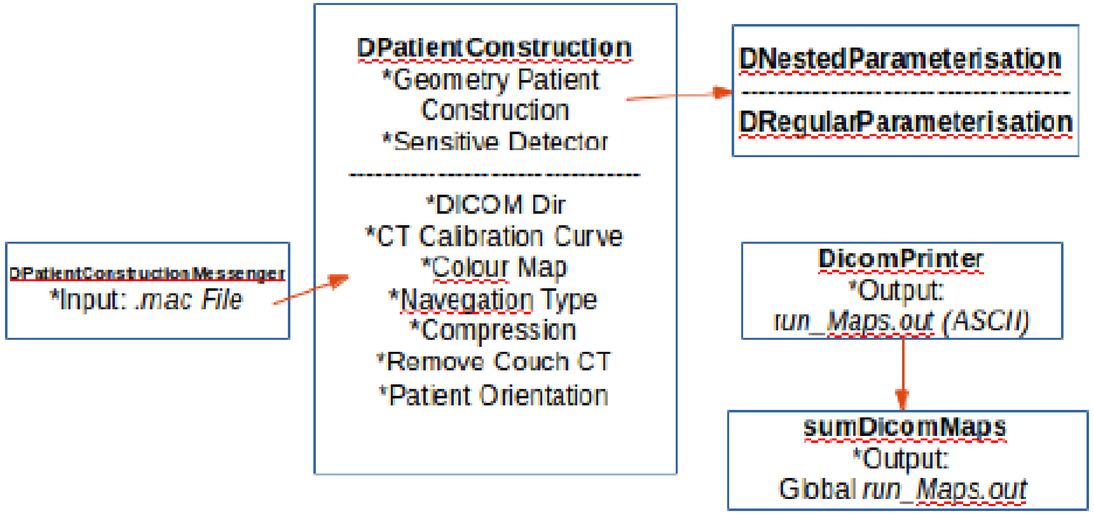
A Universal Class in Geant4 For The Patient Geometry Model Construction from DICOM files

Á. Perales[1,*], M. A. Cortés-Giraldo[1], M. I. Gallardo[1], R. Arráns[2]

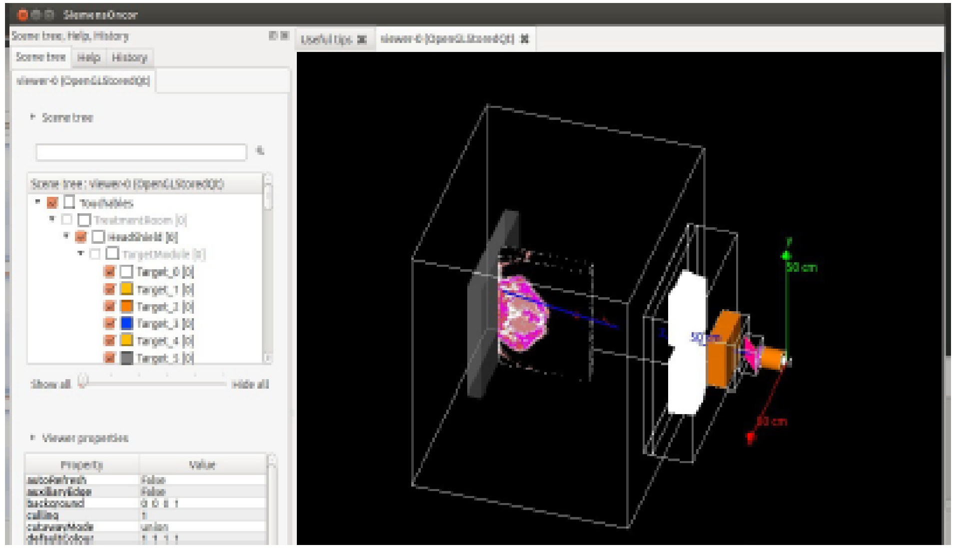
1. Dept. Atomic, Molecular and Nuclear Physics. Universidad de Sevilla, Seville (Spain).
2. Dept. Medical Physics. Hospital Universitario Virgen Macarena, Seville (Spain).

Implementation in the clinical routine of a tool which can establish the patient anatomy in the Geant4 simulation.

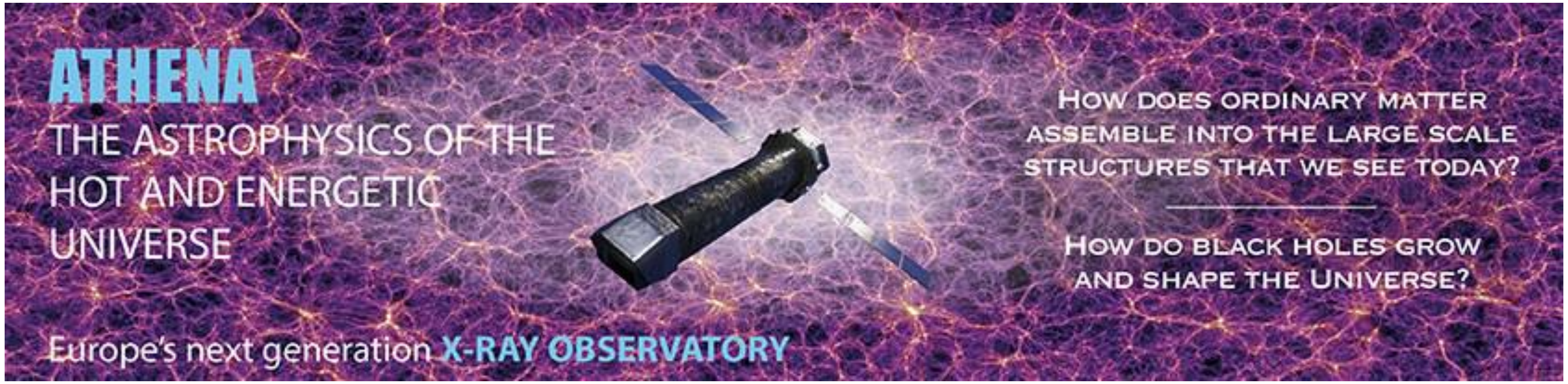
Diagram of the DICOM Class



Graphical Representation using Qt



Space background simulation for ATHENA mission



WHARD Cuttin'Edge Technology

A. Mantero and P. Dondero

Space dedicated physics list

Strategy: start from a physics list and add changes for target processes

In progress:

- Start with emstandard_opt3 or emstandard_opt4
- emstandardGS for electrons below 100 MeV
- For photons use opt4 or Livermore
- For bremsstrahlung use Penelope or opt3/Livermore
- Minor tunings: in target regions use PAI (ionization), full cascade simulation (Auger) and form factor cross sections (PIXE).