Session 7A
New EM validations

V. Ivanchenko

Outline:

Loic Martin, France

Sacha Schwarz, Switzerland

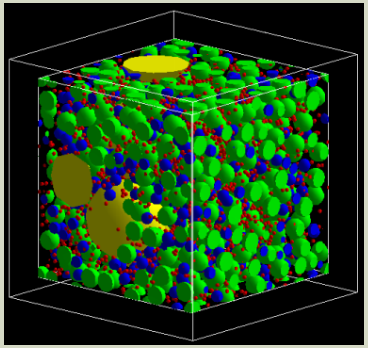
Jee ik Shin, Korea

Daren Sawkey, USA

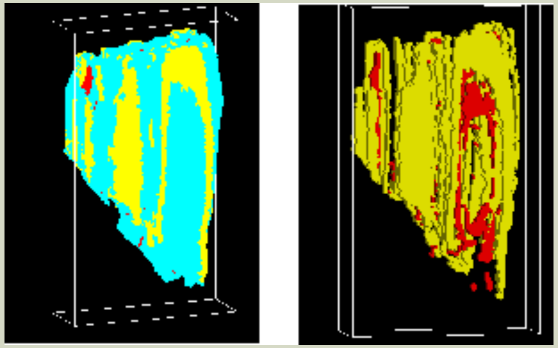
MICRO-DOSIMETRIC GEANT4 SETUPS FOR ARCHAEOLOGICAL SAMPLES

Paleo-dosimectric dating requires dose rate calculation in natural dosimeters, such as sedimentary grains and teeth. In case of complex geometry of archeological sample, this calculation can be studied by simulating setups with the Geant4 toolkit.

Random packings of G4Orb have been realized to represent sedimentary quartz grains in a clay matrix. Simulations with alpha emissions from natural alpha emitters in the matrix provide attenuation factors of dose in grain for different grain sizes and compacities



A geometric model of tooth has been constructed by voxelisation, from a 3D material mapping provided by XRF analysis of the tooth slices and image processing. Simulations with this setup give dose distribution in tooth enamel.

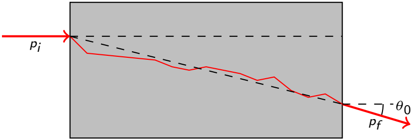


MICRO-DOSIMETRIC GEANT4 SETUPS FOR ARCHAEOLOGICAL SAMPLES

- **Geant4 toolkit has a strong potential to resolve dose rate calculation in case of complex archeological sample**
- **Simulation setups can be adapted to geometry and physico-chemical properties of each sample**
- **These setups have to be validated on real paleo-dosimetric dating to confirm their reliability**
- **The more useful setups could be delivered as an advanced example in Geant4 toolkit, to be accessed by the archeometrical community**

Multiple Scattering in Geant4

Due to repeated scattering on atoms, charged particles get deflected when traversing matter.



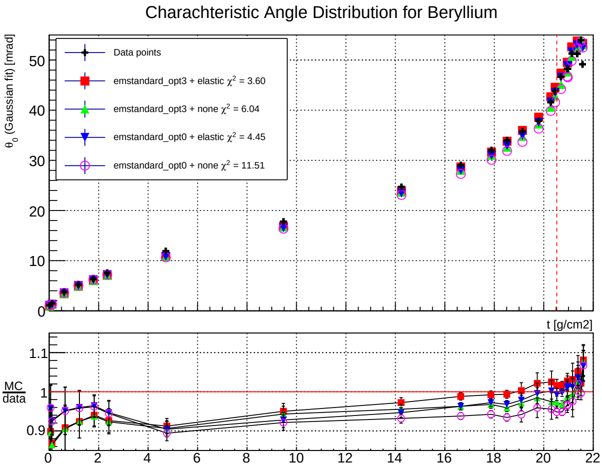
Different EM Algorithms

- **Urban Model** (opt3)
  - Based on Lewis Theory of MSC and phenomenological approximations
- **Wenzel-VI Model** (opt0)
  - Multiple scattering for small θ
  - Single scattering for large θ
  - Wentzel cross section

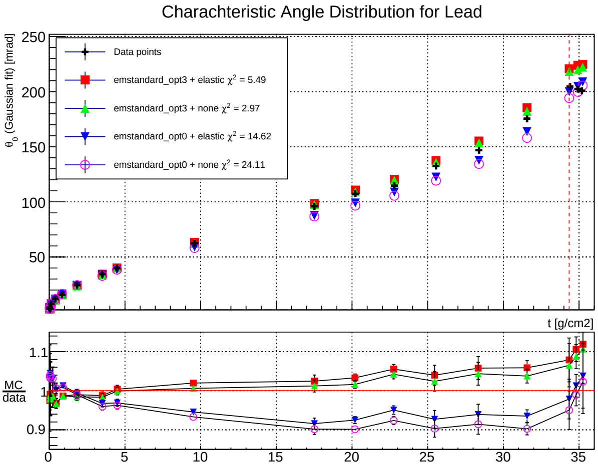
Different HAD Algorithms

- **Chips Elastic Model** (elastic)
- **Hadron Elastic Diffuse Model** (DElastic)
- **Glauber Hadron Elastic Model** (HElastic)

Electromagnetic PhysicsList Comparison



Adding hadron elastic PhysicsList yields improvements

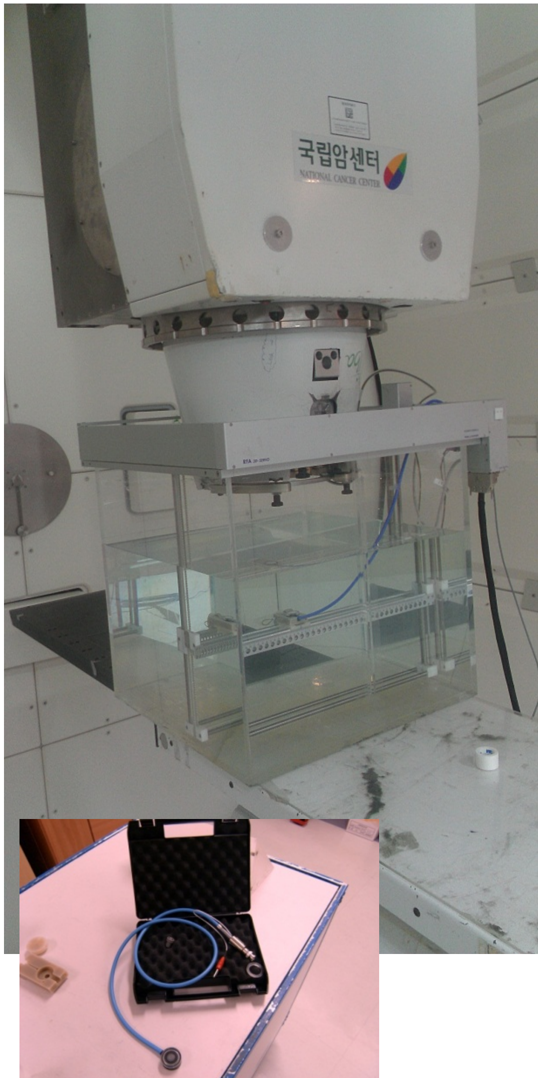


But shows an overestimating for more dense materials in the case of opt3

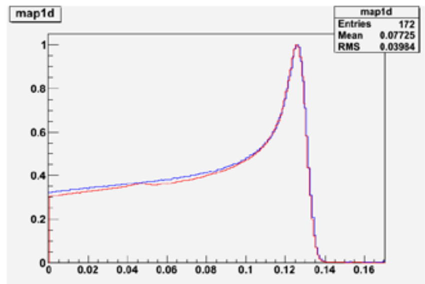
Summary III (StepLimit = 1mm)

χ^2 values	opt3				opt0			
Material	**no**	**el**	**DE**	**HE**	**no**	**el**	**DE**	**HE**
Beryllium	7.52	3.09	2.76	2.98	3.39	2.08	1.91	2.80
Polystyrene	26.95	21.66	21.31	20.73	11.13	8.50	8.24	7.87
Carbon	3.86	3.66	3.79	3.71	1.54	1.48	1.47	1.55
Lexan	11.79	11.09	11.30	11.14	3.24	3.10	3.23	3.23
Nylon	0.98	0.92	0.94	0.96	0.09	0.10	0.09	0.09
Lucite	11.76	12.65	12.38	12.35	3.58	3.33	2.93	3.05
Teflon	11.46	4.31	3.20	2.86	6.27	1.50	1.02	0.89
Aluminium	8.86	4.88	4.11	3.96	5.20	2.55	2.40	2.18
Copper	12.15	6.75	5.99	5.57	15.48	6.64	6.18	5.44
Zinc	2.75	2.88	2.87	2.85	0.14	0.13	0.13	0.12
Brass	39.70	65.41	76.72	85.82	42.45	23.65	22.52	28.14
Tin	2.10	1.92	1.93	1.92	0.29	0.34	0.34	0.33
Lead	2.85	5.62	4.84	5.55	11.19	4.72	5.36	5.28
Uranium	7.01	13.44	11.63	12.64	32.35	18.15	20.04	19.43

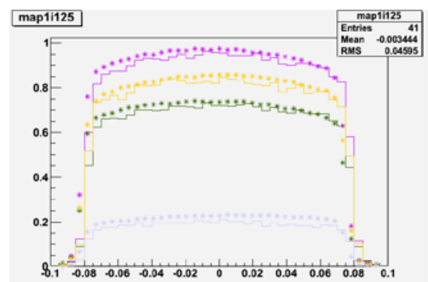
Measurement & Optimzation of ProtonTherapy Physics List



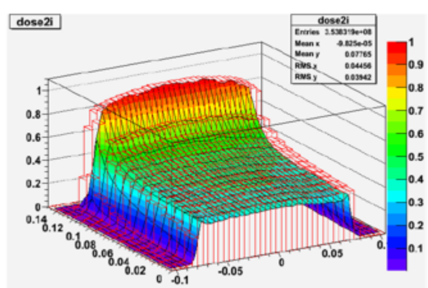
Percent Depth Dose



Lateral profile[m]

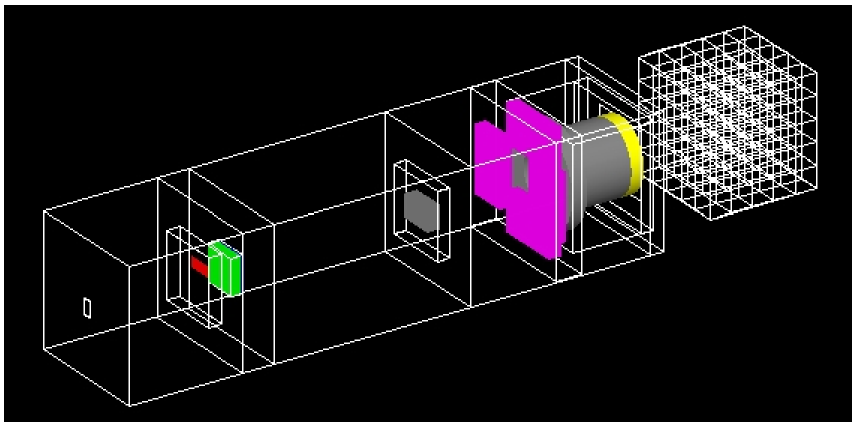


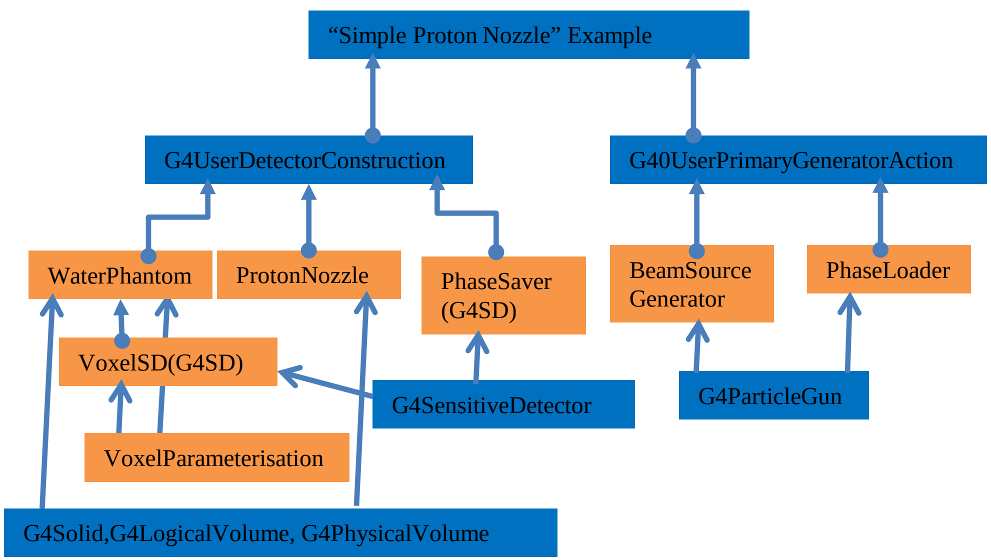
2D dose distribution



- Measurement and simulation of Proton Stopping Range and scattering in Water
- Compare between models of physics list and optimize the physics list for proton therapy

Development of example "Simple Proton Nozzle"

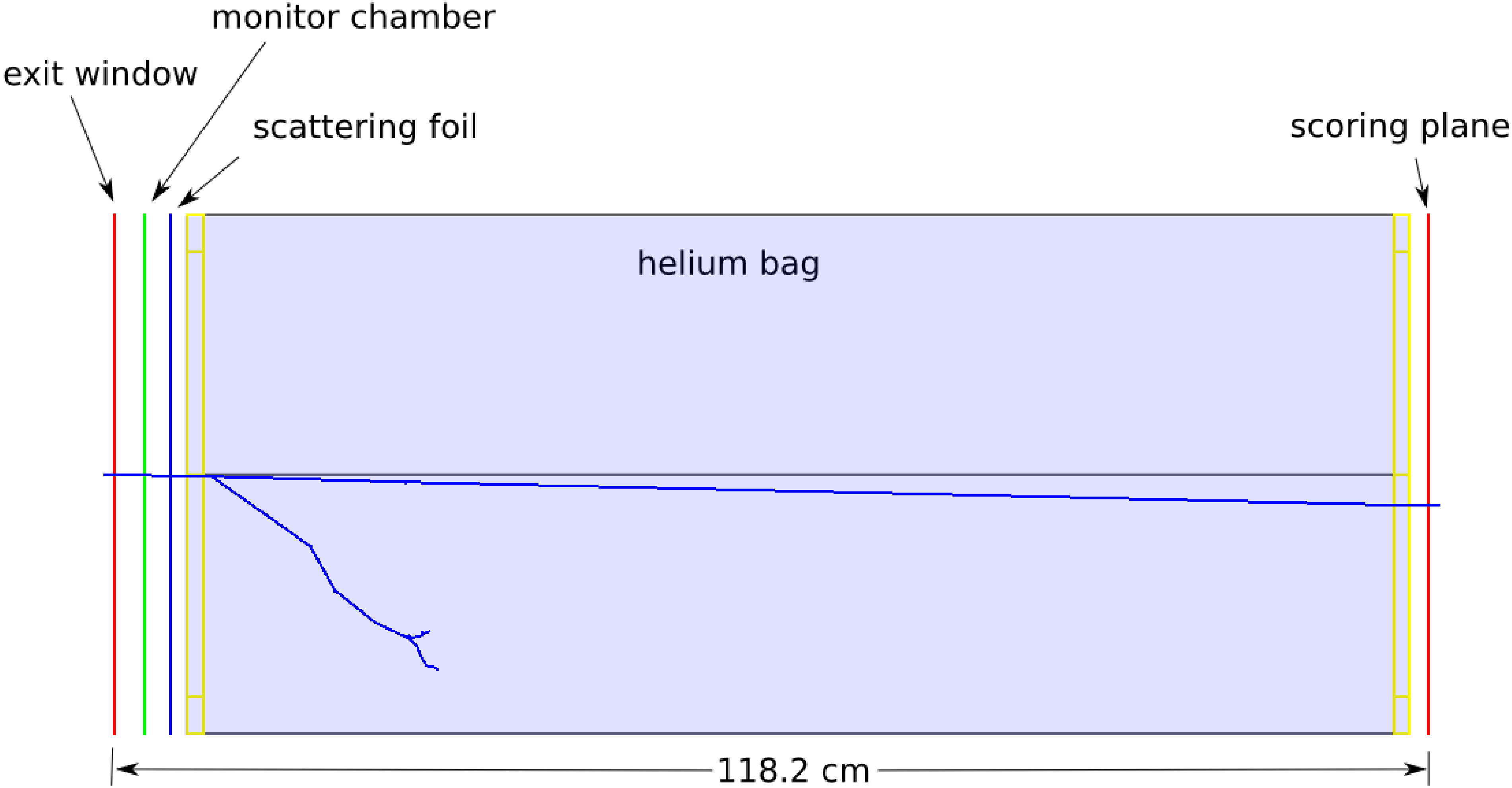




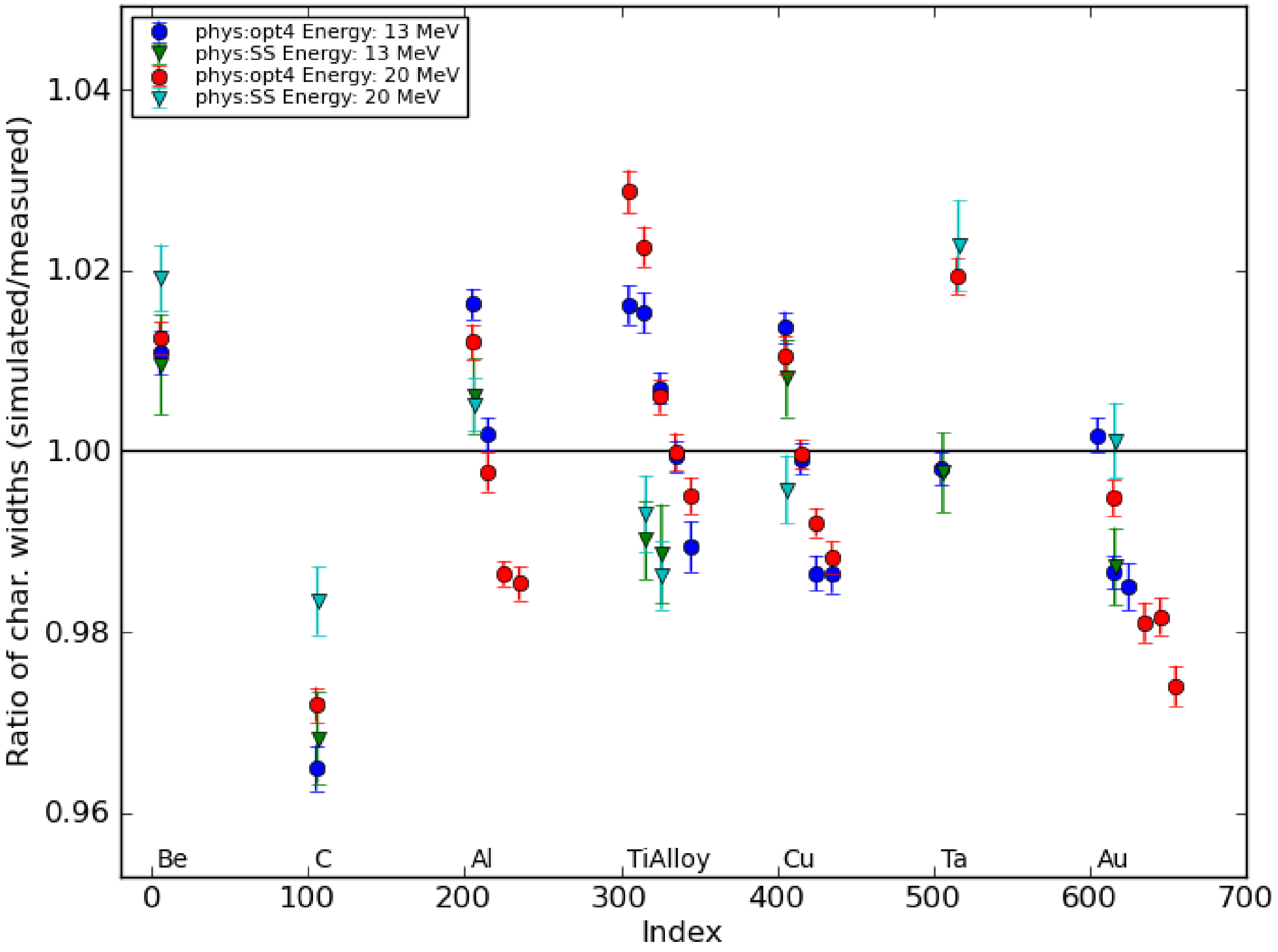
- ➢ New code developed by J.I.Shin (presenter)
- ✓ the application includes minimum information to avoid license of company
- Support the validation date from NCC
- ✓ Hope to delivery example for medical users

Experiment: Ross et al., Med. Phys. **35**, 4121 (2008)

7 materials, various thickness, 13 and 20 MeV



Electron scattering benchmark
D. Sawkey



Summary discussion

- We propose do not use «ApplyCus» option as a default for 10.0
  - We provide stability for many application results
  - The reason: user can easely switch on