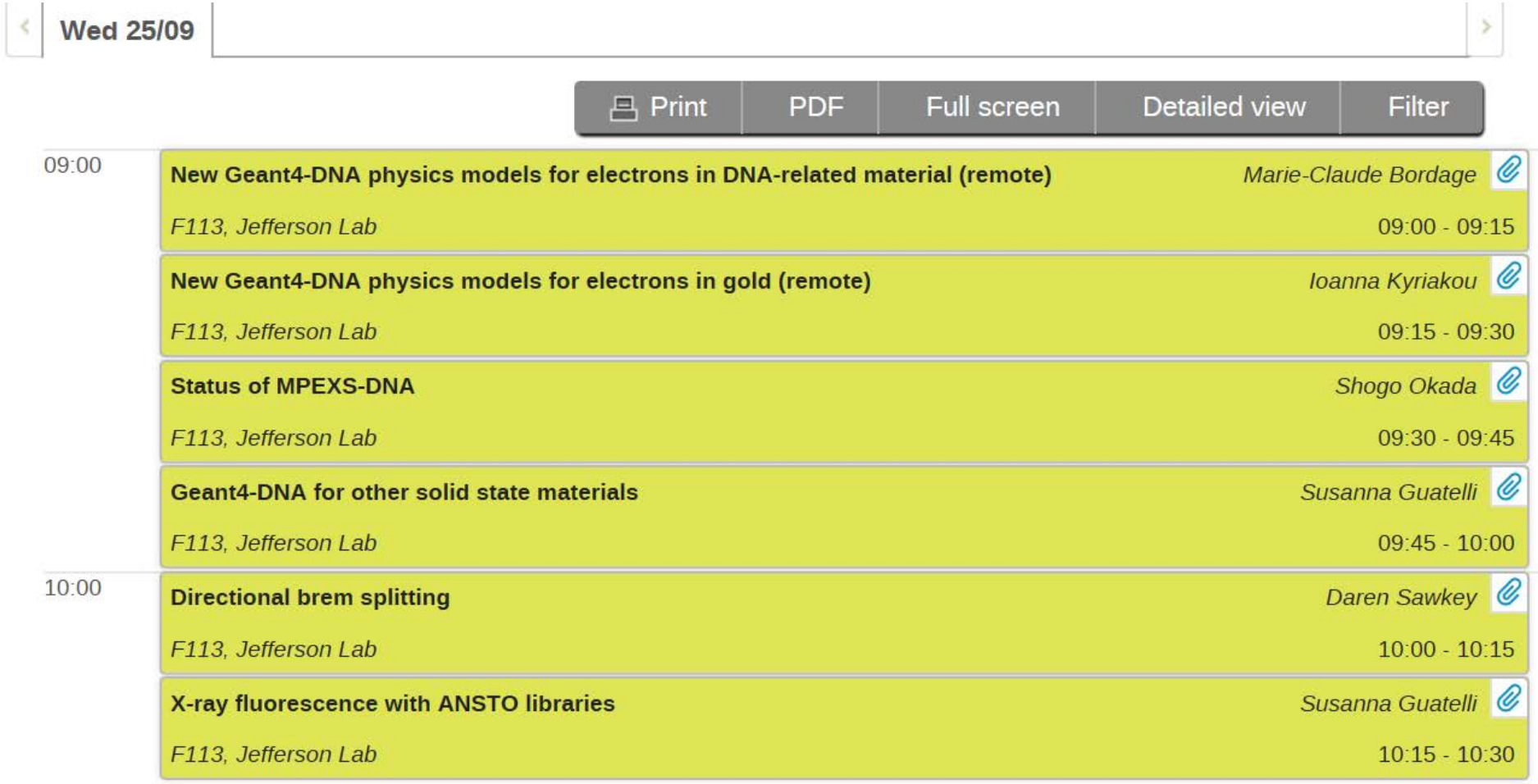
Summary of Parallel session 4A

New EM models and tools

Chairs: V. Ivanchenko and S. Guatelli



Recent developments of Geant4-DNA CPA100

- By M.-C. Bordage and S. Incerti
- CPA100 physics models for electrons in liquid water already integrated in Geant4 (Geant4-DNA option 6 physics list)
- Currently extension of the Geant4-DNA CPA100-based models to DNA bases

Electron ionisation total cross section

Geant4-DNA extensions to gold

- I. Kyriakou, D. Emfietzoglou, D. Sakata, S. Incerti, S. Guatelli
- Models based on the ELF (energy-loss-function) approach

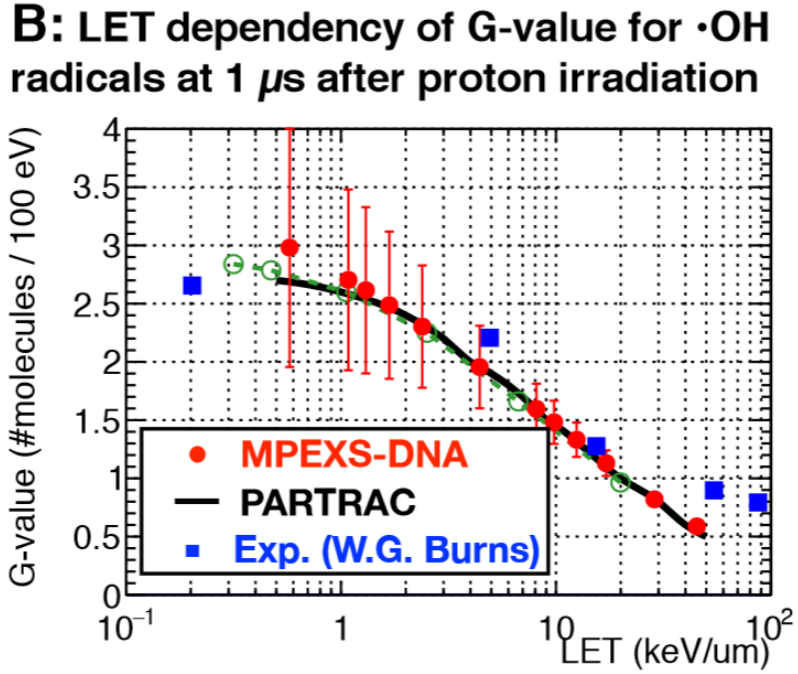
GNP2016 vs. GNP2018 models

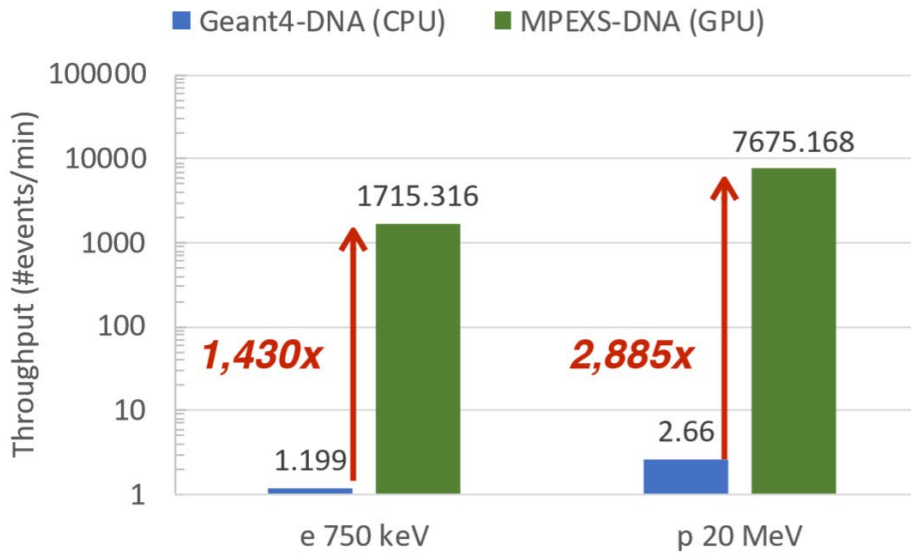
Process	2016 models	2018 models
Elastic	ELSEPA	ELSEPA
Ionization	Rel. Binary Encounter Bethe Vriens	Dielectric
Excitation	Exp.+Dirac B-Spline R Matrix	Dielectric
Plasmon	Quinn	Dielectric
Bremsstrahlung	Seltzer & Berger	Seltzer & Berger

Status of MPEXS-DNA

Reference publication: DOI: 10.1002/mp.13370

- S. Okada, K. Murakami, S. Incerti, K. Amako, T. Sasaki
- MPEXS-DNA: A nanodosimetry simulator running on GPU
  - Most of the physics lists for Geant4-DNA are covered, all Geant4-DNA physico-chemical and chemical processes are implemented
- Current activities:
  - Implementation of an alternative model for Chemistry Stage in Geant4-DNA and MPEXS-DNA
    - Based on I. Plante, DOI: 10.1007/s00411-011-0367-8
  - Quantitative Estimation of DNA Damage Using Clustering Model in Geant4-DNA and MPEXS-DNA

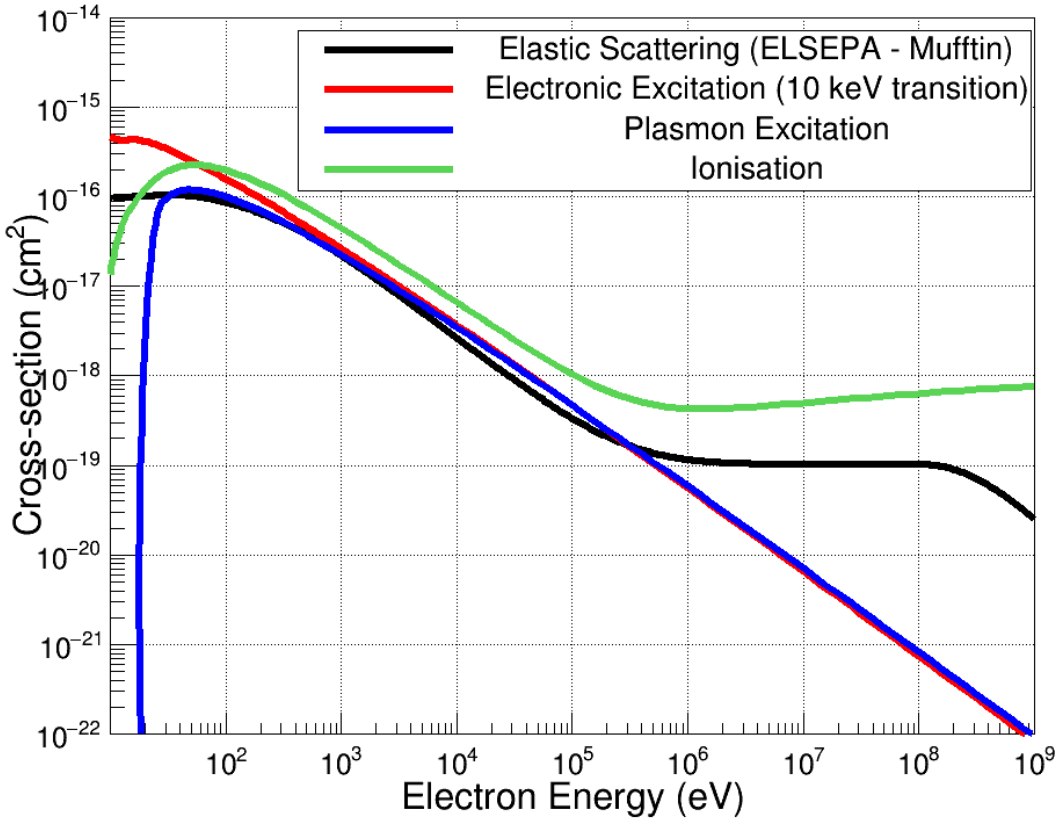




- GPU: NVIDIA, TITAN V
- CPU: Intel, Xeon E5-2643 v2, 3.5 GHz

Geant4-DNA for other solid state materials: graphite

- D. Bolst, D. Sakata, C. Fontes, I. Kyriakou, D. Emfietzoglou, S. Incerti, S. Guatelli
- Elastic scattering: ELSEPA
- Plasmon excitation: Cross section from atomic state using Quinn model
- Ionisation: Relativistic Binary Encounter Bethe Vriens
- Electronic excitation: ACE
- Under development



Same approach of Sakata et al, Journal of Applied Physics, 120 (24), art. no. 244901, 2016

Directional bremsstrahlung splitting in Geant4

- D. Sawkey
- Method:

  For all interactions producing gammas:

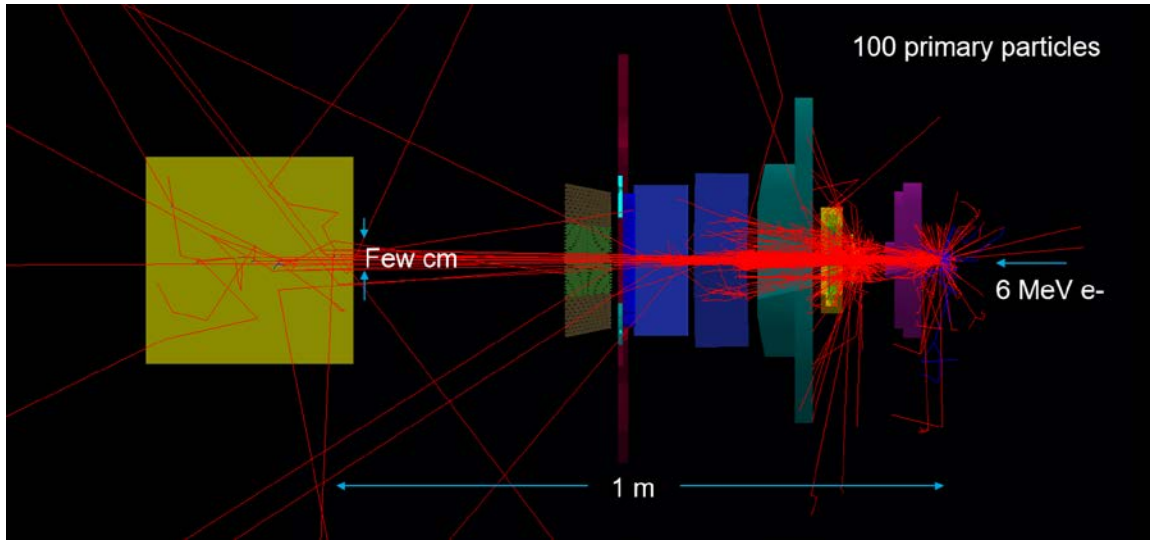
  - Split N times (new weight 1/N)
  - Is the gamma going towards target volume?

    - If yes, keep

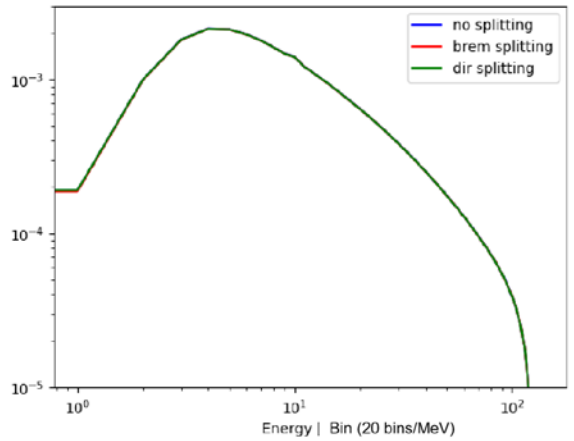
    - If no, play Russian Roulette (survival probability 1/N, weight 1)

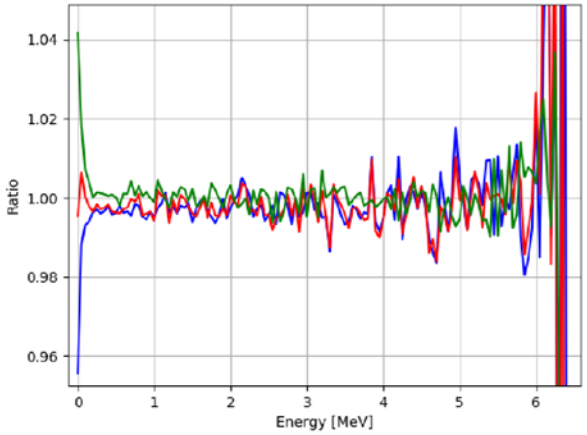
  • All gamma reaching the target volume have weight 1/N

- Work in progress
- Proposal
  - Currently store –list of secondaries (std::vector<G4DynamicParticle*>)
  - Parallel list of weights std::vector<G4double>
  - Find a more efficient to store the weight . Maybe within G4DynamicParticle or G4Track???



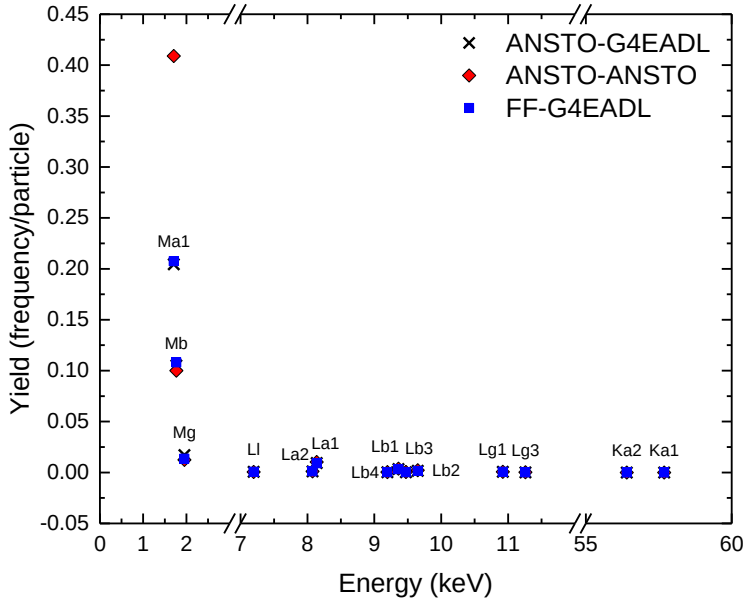
Spectrum at patient plane

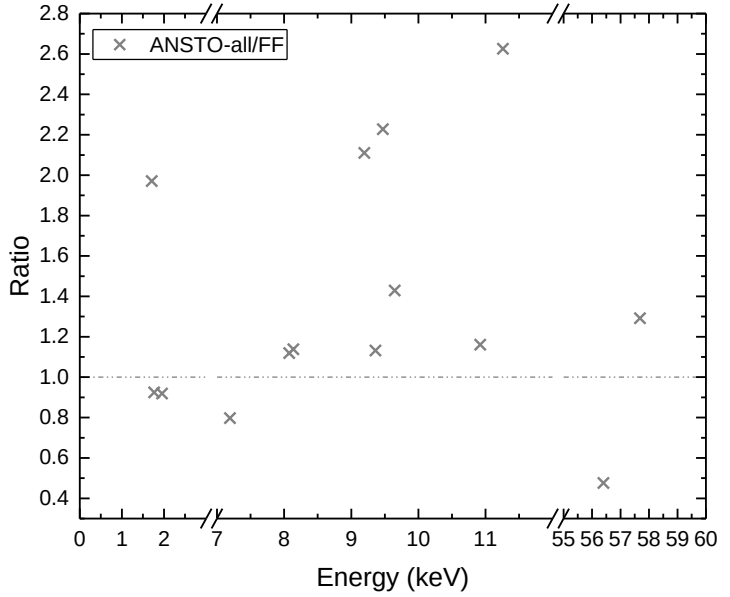




X-ray fluorescence with ANSTO libraries

- S. Bakr, J. Archer, A. Rosenfeld, D.D. Cohen, R. Siegele, S. Incerti, V. Ivanchenko, A. Mantero, S. Guatelli
- ionisation cross-sections:
  - Based on Form Factor (Taborda K, L, M 2011-2013)
  - ANSTO PIXE cross section (next public release)
- Transition probabilities:
  - EADL
  - ANSTO-fluo
    - D. D. Cohen, J. Crawford, and R. Siegele, “K, L, and M shell datasets for PIXE spectrum fitting and analysis,” Nucl. Instruments Methods Phys. Res. Sect. B Beam Interact. with Mater. Atoms, vol. 363, pp. 7–18, 2015.
    - Data library of ANSTO with the same format of EADL (G4EMLOW7.7/fluo)
    - The same binding energies of EADL are adopted
  - The radiative transition probabilities reported in the EADL were calculated according to Hartree Slater (HS) methods, however [Cohen et al 2015] recommends the Hartree-Fock approach for M shell





ANSTO-ANSTO: ANSTO cross section with ANSTO transition probabilities

FF-G4EADL: Form Factor cross sections with EADL (Geant4)

ANSTO-G4EADL: ANSTO cross sections with EADL