

Summary of Low Energy Hadronics Session

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Geant4 Collaboration Meeting
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- Focus on the low energy hadronic and nuclear physics aspects of Geant4
- Reports on new features and validations
- Collect requirements
- Discussion of possible low energy/nuclear sub-group

Radioactive Decay of Super-heavy Nuclei

- Luis Sarmiento (Pico)
- Extending Geant4 to deal with super-heavy elements ($Z > 103$)
- Problem: to identify some SHEs decay of ions not sufficient
- Best way to identify these is by characteristic X-rays
 - $E_{K\alpha} \sim (Z - 1)^2$
- Need correct X-ray energies and Auger energies
 - not currently available in Geant4 for high Z

Radioactive Decay of Super-heavy Nuclei

- Obstacle to extending Geant4: different hard-coded limits on Z throughout code
 - processes/electromagnetic
 - materials/
 - particles/management
 - processes/hadronic/cross_sections
 - processes/hadronic/models

Radioactive Decay of Super-heavy Nuclei

processes/electromagnetic



G4PixeCrossSectionHandler	default value maxZ = 92 related to data loading
G4MuBremsstrahlungModel	sets <code>if(iz > 92) iz = 92;</code> at ComputeDMicroscopicCrossSection
G4hZiegler1985p G4hSRIM2000p G4hICRU49He G4hICRU49p G4BraggIonModel G4BraggModel	<code>if(i > 91) i = 91 ;</code> in the parameterization
G4OrlicLiXsModel	analyticalFunction's have parameters only up to $Z = 92$
G4PenelopeGammaConversionModel	<code>if (intZ > 99) intZ = 99;</code> to compute effective charge
G4hIonEffChargeSquare	<code>if(iz > 91) iz = 91 ;</code> for ion effective charge
G4MottCoefficients	Coeff. only up to $Z = 92$
G4ICRU73Q0Model	<code>if(Z > 97) Z = 97;</code> SubShellOccupation and ShellEnergy have values up to $Z = 92$. factorBethe up to $Z = 98$

Radioactive Decay of Super-heavy Nuclei

- Plan:
 - coordinate with relevant category coordinators
 - raise Z limits to consistent value across all code
 - start with modification of G4AtomicShells

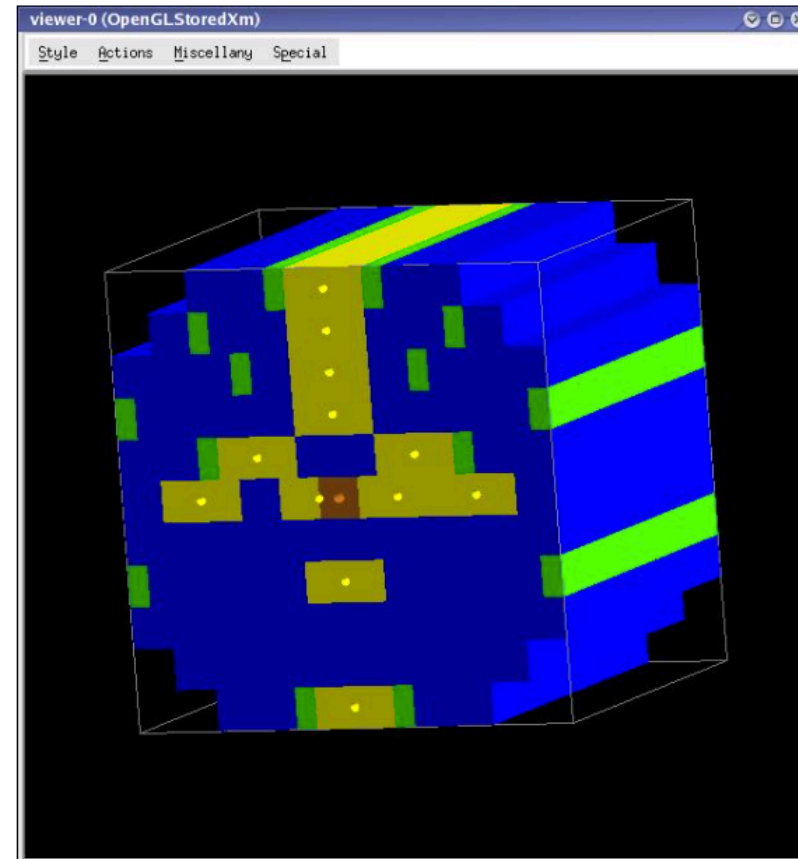
TARC Validation

- Alex Howard
- Resurrected effort of 2008 TARC validation project
 - study production, interaction and transport of neutrons
 - important for background radiation studies, radiation effects (SEUs), background and spill-over (LHC experiments)
- A test of Geant4 Binary, Bertini, Precompound, neutron models
 - neutron production from \sim GeV protons
 - secondary neutron production
 - thermalization and capture
 - absolute fluence measurement

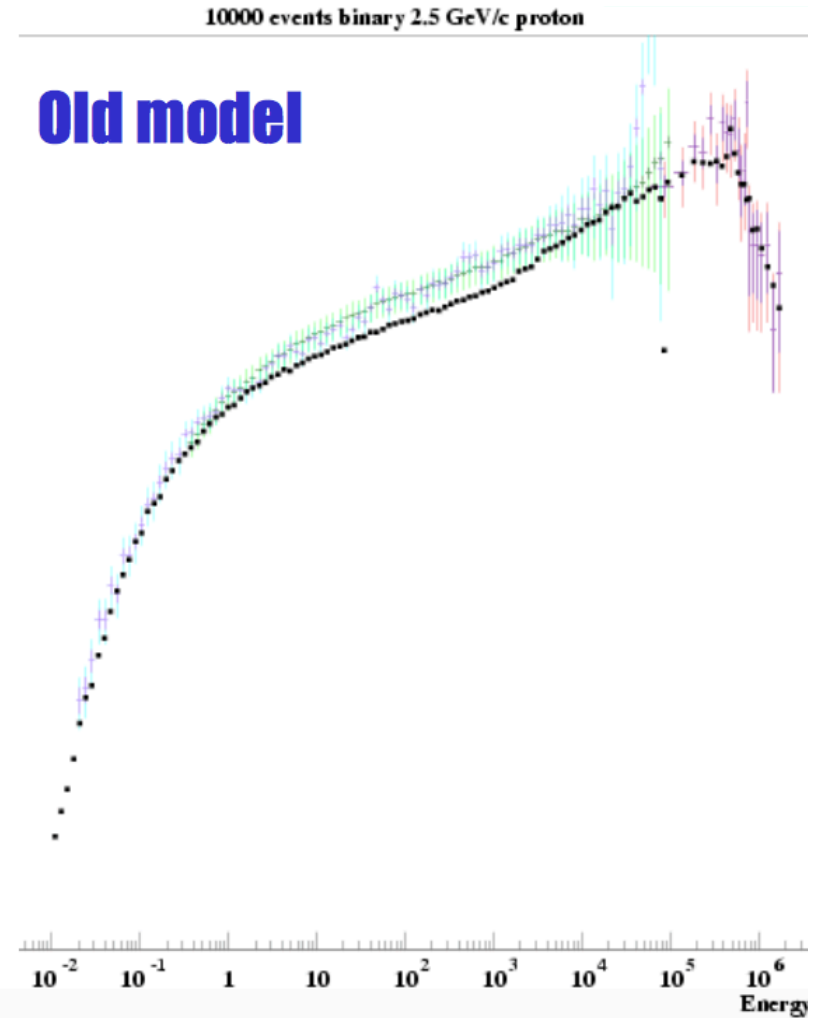
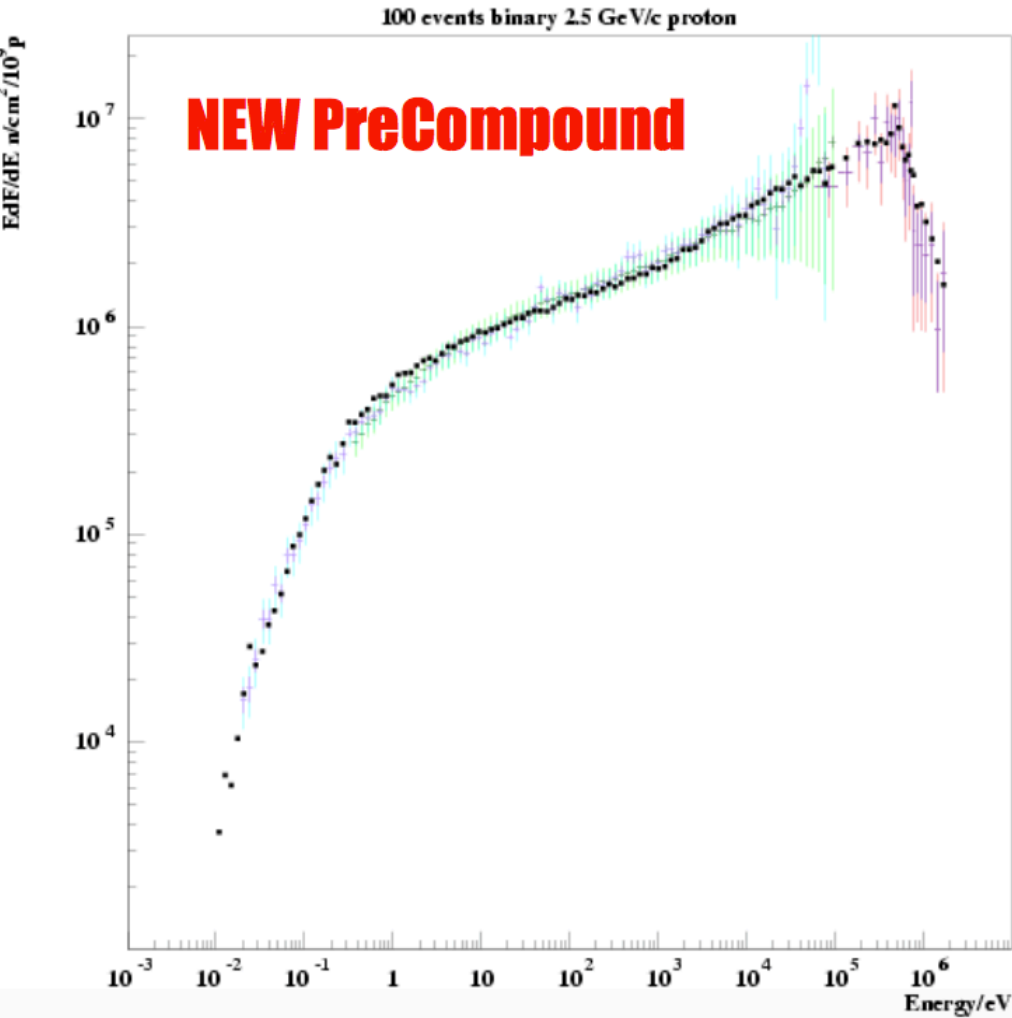
The TARC Experiment

2008

- Neutron Driven Nuclear Transmutation by **A**diabatic **R**esonance **C**rossing (Cern 96-97)
- 2.5 or 3.5 GeV/c **p**roton beam.
- 334 tons of **Pb** in cylindrical 3.3m x 3.3m x 3m block.
- The lead is 99.99% pure.
- Beam enters through a 77.2mm diameter blind hole, 1.2m long.
- 12 sample holes are located inside the volume to measure capture cross-sections on some isotopes.



TARC Validation



TARC Validation

- Selected comments and conclusions
 - Fluence vs. energy simulation in agreement with data, including systematic errors
 - Improved Precompound model right on the money
 - Bertini and Binary cascades appear on either side of fluence data: Bertini high, Binary low, differ by 50%
 - Neutron energy-time distributions slightly short but within experimental errors
 - On the whole TARC simulation agrees very well with data

Neutron_HP, Particle_HP Merger

- Tatsumi Koi
- Neutron_HP and Particle_HP have been merged
 - talks discussed technical issues of merger
- Reproducibility problems remain (but physics is OK)
- Merged code and databases available for 10.2
 - this was contingent upon equivalent physics behavior between neutrons in Particle_HP and neutrons in Neutron_HP
 - demonstrated by Pedro Arce and Tatsumi
- Reference physics lists using Neutron_HP have been converted to use Particle_HP
- Neutron_HP code to be deleted by 10.3 if no problems arise

Low Energy and Nuclear Requirements

- Nucleus-nucleus collisions < 50 MeV/N
- A number of ideas/requests from Michael Taylor
 - see talk in parallel session 4A
- Validation of electro-nuclear, muon-nuclear models
- Detailed models of gamma-induced neutron production

- Detailed models of proton or neutron-induced particle production < 200 MeV
- Competing models for photon evaporation (from existing Fortran code)
- Hadronic physics below the Coulomb barrier

A Low Energy/Nuclear Group?

- Discussed the possibility of forming a low energy hadronic/nuclear physics sub-group
 - demand from space and medical communities
 - present requirements at future Technical Forum
 - funding?