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PhysicsLists in Geant4
Advanced Examples

http://www.ge.infn.it/geant4/examples

M.G. Pia
On behalf of the Advanced Examples Working Group

Geant4 Space User Workshop
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Mission

Investigate, **evaluate** and **demonstrate**
Geant4 capabilities
in various **experimental environments**

Provide **guidance** to Geant4 **users**
in **realistic experimental applications**

Provide **feedback** to Geant4 **developers**
about successful results, problems etc.

Identify **requirements** for further Geant4
improvements and **extensions** to address
new experimental domains

Advanced Examples

1. air_shower
2. brachytherapy
3. *cell_irradiation*
4. composite_calorimeter
5. cosmicray_charging
6. gammaray_telescope
7. hadrontherapy
8. *human_phantom*
9. lAr_calorimeter
10. medical_linac
11. microbeam
12. *nanotechnology*
13. purging_magnet
14. *radiation_monitor*
15. radioprotection
16. raredecay_calorimetry
17. Rich
18. Tiara
19. underground_physics
20. xray_fluorescence
21. xray_telescope

- Released
- *In preparation*
- Orphan

- Wide experimental coverage
  - HEP
  - Space science/astrophysics
  - Medical physics
  - Radiobiology
  - Detector technologies
- Wide Geant4 coverage
  - Geometry features
  - Magnetic field
  - Physics (EM and hadronic)
  - Biological processes
  - Hits & Digis
  - Analysis
  - Visualisation, UI

Physics in Advanced Examples

of interest for space applications

- Brachytherapy
- Cell_irradiation
- Cosmicray_charging
- Gammaray_telescope
- Hadrontherapy
- Microbeam
- Nanotechnology
- Radiation_monitor
- Radioprotection
- Underground physics
- Xray_fluorescence
- Xray_telescope

- LowE EM for e, γ
- Biological processes
- LISA (space charging)
- Standard EM physics
- Optimised EM/hadronic for p up to ~100 MeV
- For TRIM/SRIM fans
- EM physics at the 100 nm scale
- Effects on components: packaging
- GCR and SPE environments
- LowE EM processes, radioactive decay, neutrons
- Fluorescence, Auger electrons
- XMM-Newton/Chandra like

Other examples may be relevant to space applications too

Physics Lists in Advanced Examples

- PhysicsLists
  - Ad hoc in most examples: **transparent**, **easy to understand**
  - A couple of examples use pre-packaged Geant4 PhysicsLists
- **Goal:** document quantitatively the validation of the physics selections of all advanced examples
  - Objectively supported physics options rather than "educated guess" PhysicsLists
- Strategy
  - **Generic** validation studies of processes/models used
  - **Specific** validation studies with ad hoc experimental data

Validation

Orphan
Under development

1.	air_shower	
2.	brachytherapy	Generic + Specific
3.	*cell_irradiation*	Specific
4.	composite_calorimeter	
5.	cosmicray_charging	
6.	gammaray_telescope	
7.	hadrontherapy	Generic + Specific
8.	*human_phantom*	*Not pertinent*
9.	lAr_calorimeter	
10.	medical_linac	Generic + Generic + Specific
11.	microbeam	Generic + Specific
12.	*nanotechnology*	Specific
13.	purging_magnet	
14.	*radiation_monitor*	Specific
15.	radioprotection	Generic (EM, partly hadronic)
16.	raredecay_calorimetry	
17.	Rich	*TNS?*
18.	Tiara	*NSS 2006?*
19.	underground_physics	
20.	xray_fluorescence	Generic + Specific
21.	xray_telescope	

Published

Existing, to be published

In preparation

Apologies for any omissions
Please let me know of other pertinent validation results

This lecture

- brachytherapy
  - LowE EM processes for e, g
  - How to use them below 1 keV for precise dosimetry
- hadrontherapy
  - LowE EM processes for p (ICRU49 model)
  - Hadronic physics optimised and validated up to 100 MeV
- radioprotection
  - LowE EM processes for e, g, p, ions
  - Hadronic processes relevant to GCR/SPE environments