



Updates
on requirements
from previous TF meetings

Geant4 Technical Forum
March 28th, 2007

J. Apostolakis, M. Asai (SLAC)
on behalf of Geant4 collaboration

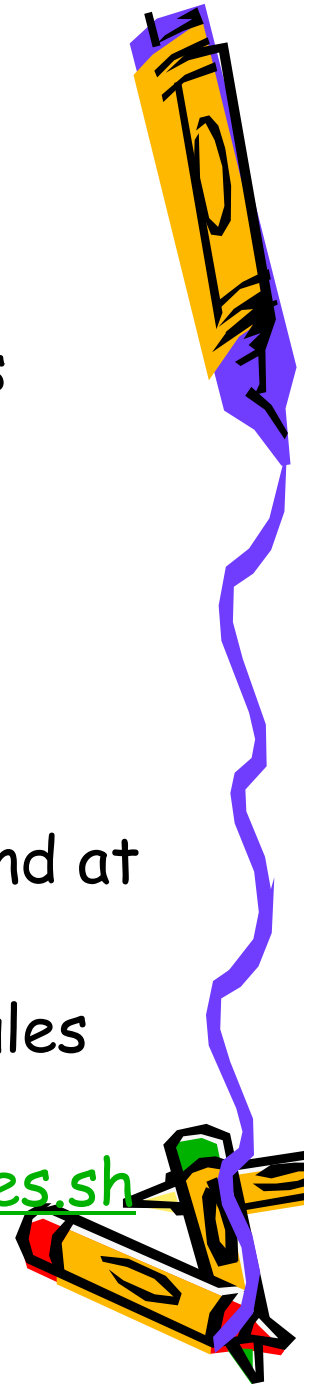
Outline and links

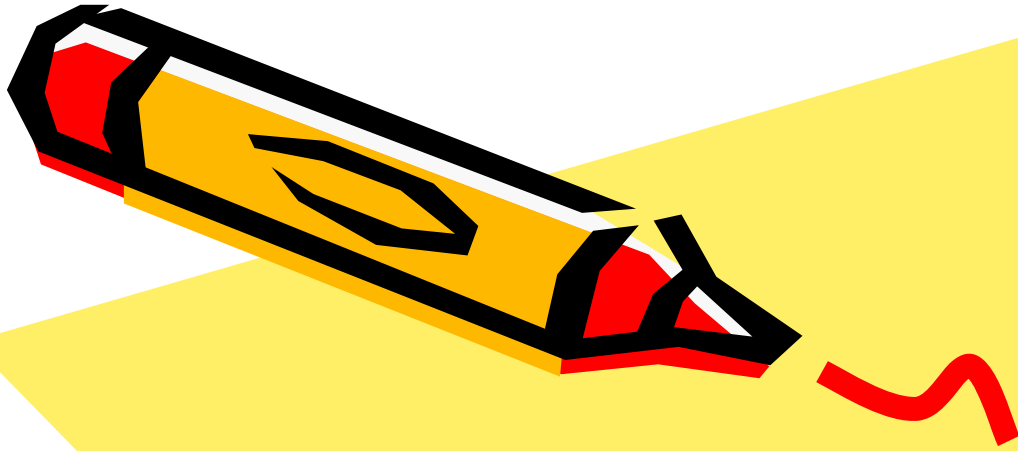
Outline

- Update on requirements for which the status has recently changed
- Open requirements
- Long-term requirements

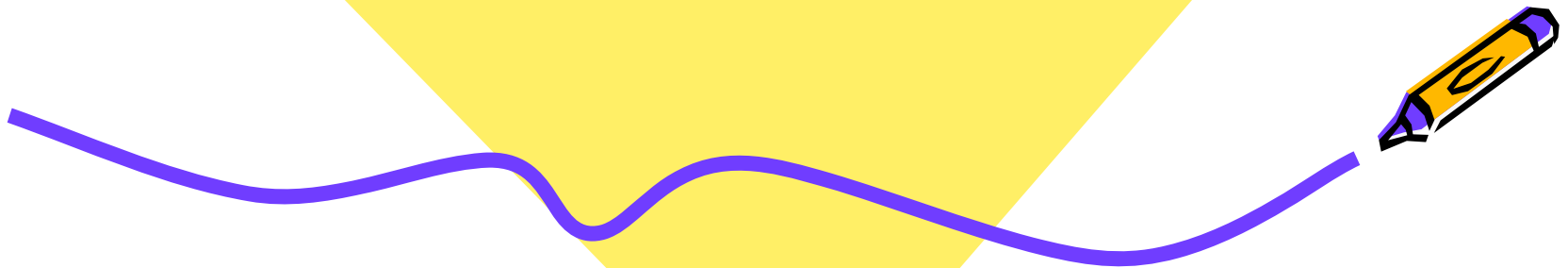
Some links

- Previous updates at Technical Forums can be found at http://cern.ch/geant4/technical_forum/
- Updated work plans and expected release schedules will be made available at http://cern.ch/geant4/support/planned_features.shtml





Latest updates



1603: Build system for physics lists

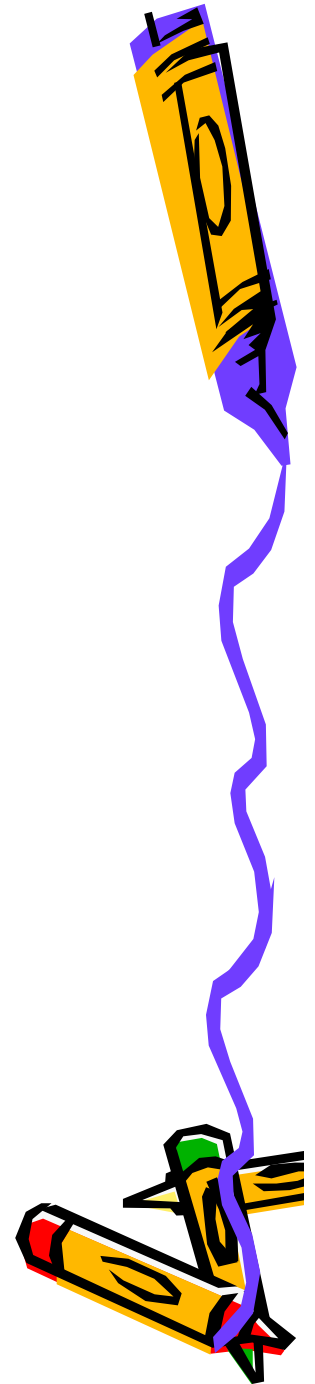
Requestor: CMS (M. Stavrianaou)

- Allow build of granular shared libraries
- Allow automatic installation in standard library directory

Status:

- Physics lists incorporated into source directory (Geant4 8.2)
- Believe this addresses the issues.
- Propose to **close this issue**

Requests / requirements Nov 2006 (cont.)



1601: Further refinements for TGeo Interface

Requestor: Andreas Morsch for ALICE

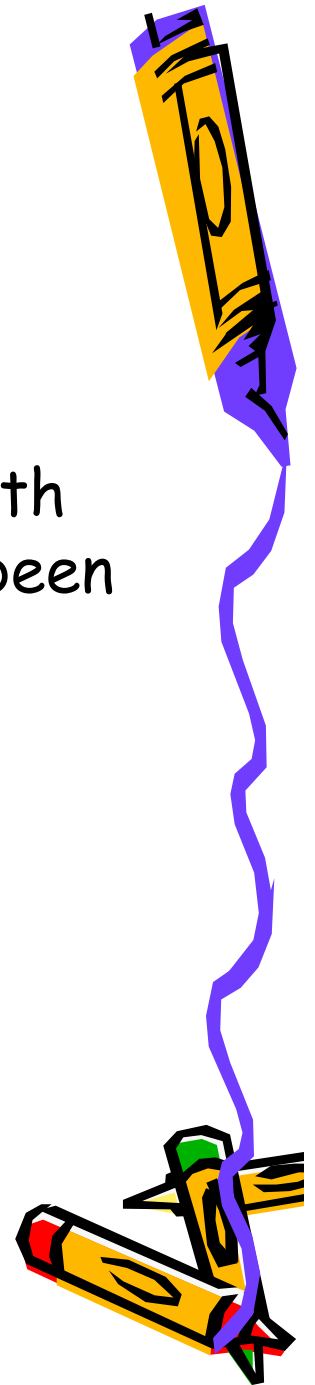
Responsible: G. Cosmo

- the modification needed to interface Geant4 with TGeo as a geometry modeler. The details have been already communicated by Andrei Gheata

Status

- Delivered in Geant4 8.2 (Dec 2006)
- **Propose to close**

Requests / requirements Nov 2006 (cont.)



1501: Categorize deposited energy by process.

Requesters: Vanderbilt Univ., seconded by ESA and NASA - for Single Event Effects.

Categorize deposited energy in *G4Step* by process or separate energy into ionizing and non-ionizing parts

Context: Convert energy deposition into electron-hole pairs and simulate the output pulse from semiconductor devices in the space environment.

- *G4Step* had total energy deposition for step, for loss that is not
 - Note that energy lost by post step actions are not contributing to electron-hole pairs.

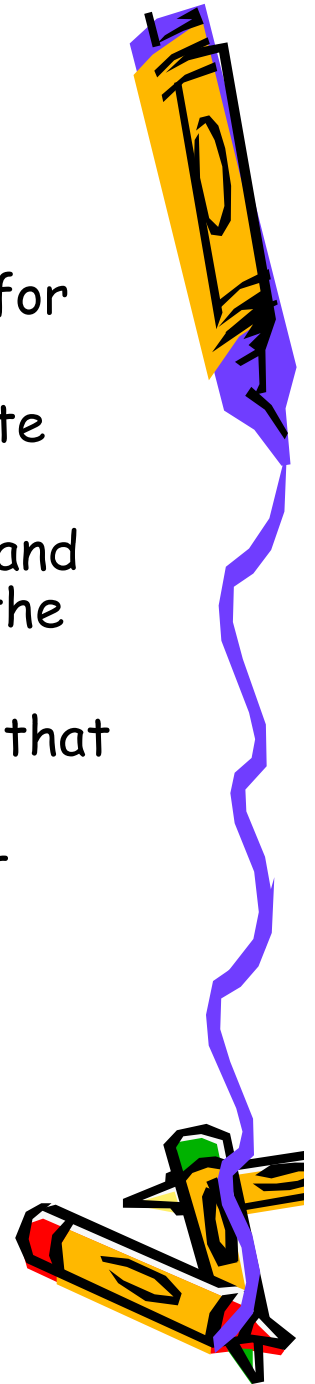
NEW

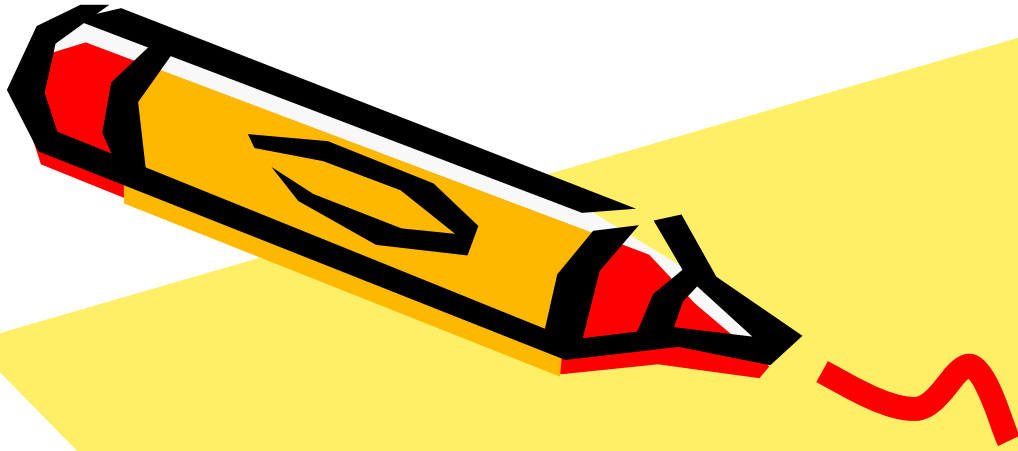
In v9.0, added non-ionizing energy loss to *G4Step* and *G4VParticleChange*.

- This is defined as a part of the total energy loss

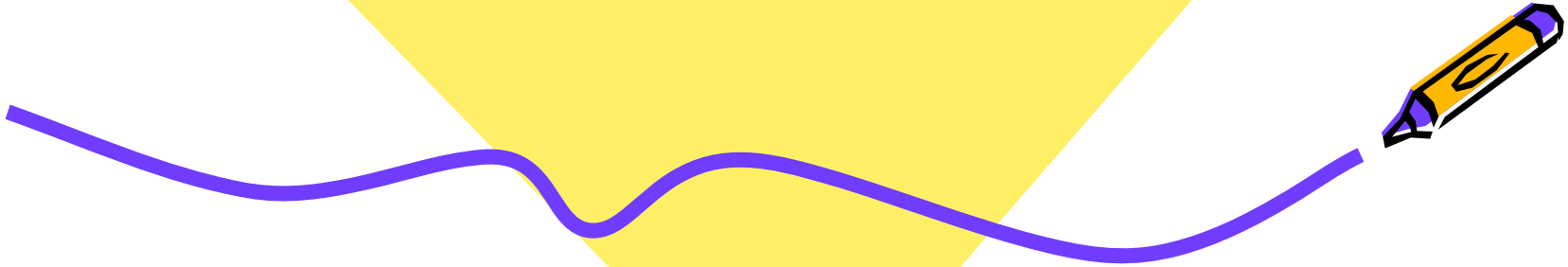
Future: revise physics process(es) to contribute to this.

From Space Users meeting (Nov 2006), Pasadena





Latest requirements / requests



1602: Primary ionisations

Requestor: Andreas Morsch for ALICE

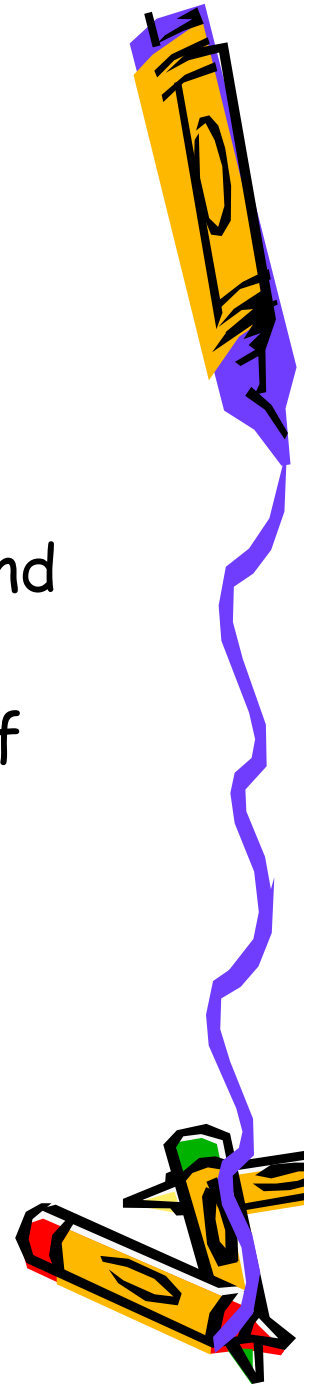
Responsible: V. Ivantchenko

- Having the possibility to get for each step the number of primary ionisations, their locations and the kinetic energy of the electrons.
 - This is needed for the accurate simulation of the TPC resolution.

Status:

- Included in 2007 work plans

Requests / requirements Nov 2006 (cont.)

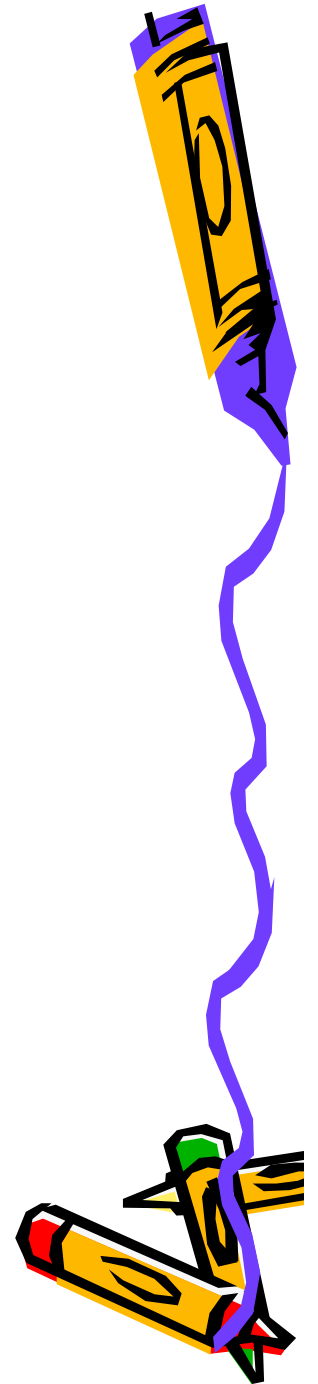


1604: Performance improvement

Requester from CMS (J. Yarba)

- Visualization of boolean solids - Y. Osborne
- Address numerical instabilities - J. Yarba
 - Address issues that create(d) NaN's
- Performance improvement - J. Yarba
 - See Julia's presentation

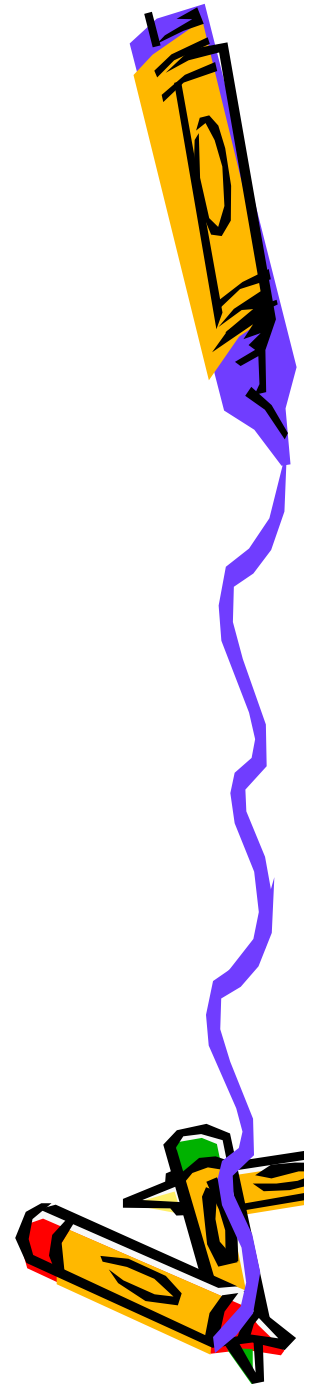
Requests / requirements Nov 2006 (cont.)



Other requests/requirements of 21 Nov 2006

Requests from CMS

- Visualization of boolean solids - Y. Osborne
 - Already tracked (1301)
- Address numerical instabilities - J. Yarba
 - Address issues that create(d) NaN's



1502 - Support multi-core processing

Requested by Francisco Garcia (HIP).

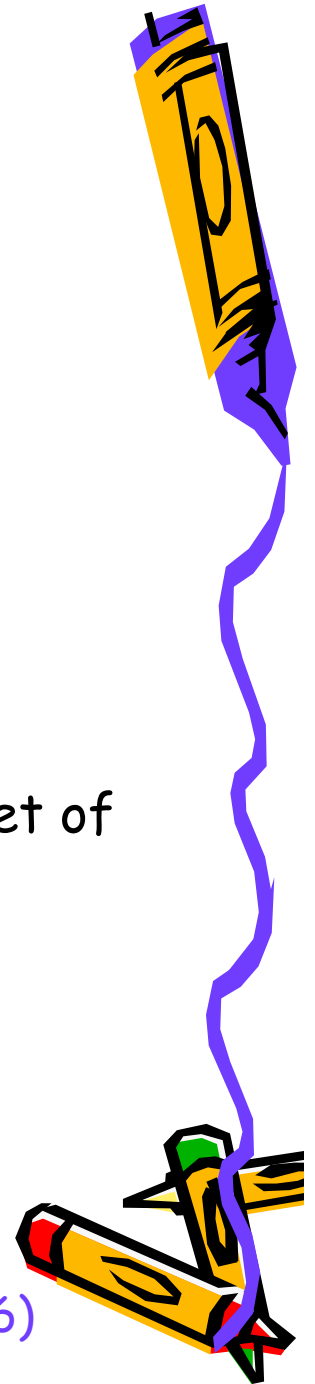
Responsible: G. Cooperman

- He wants to exploit new machines.
- We interpret this as support for running multiple events simultaneously utilising two or more cores, utilising fewer resources (memory) than two separate processes.

Status

- Analysis has identified potential approaches, and a first set of issues that would need to be addressed
 - Impact on a number of critical areas is foreseen
 - First pre-prototyping study starting
 - This requirement remains under study.

From Space Users meeting (Nov 2006)

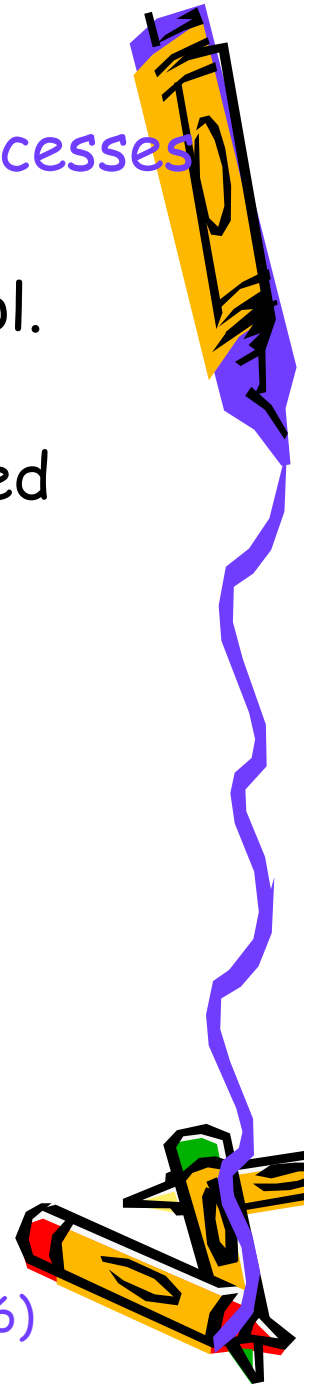


1503: Packaged physics lists with low energy EM processes

Requester: Dennis Haggerty (Johns Hopkins U. Appl. Phys. Lab.)

- Suggestion to based them on the ones in advanced examples

From Space Users meeting (Nov 2006)



1504: Improved final-state isotope spectrum

Requester: Scott Messenger (SFA Inc. and US Naval Research Lab)

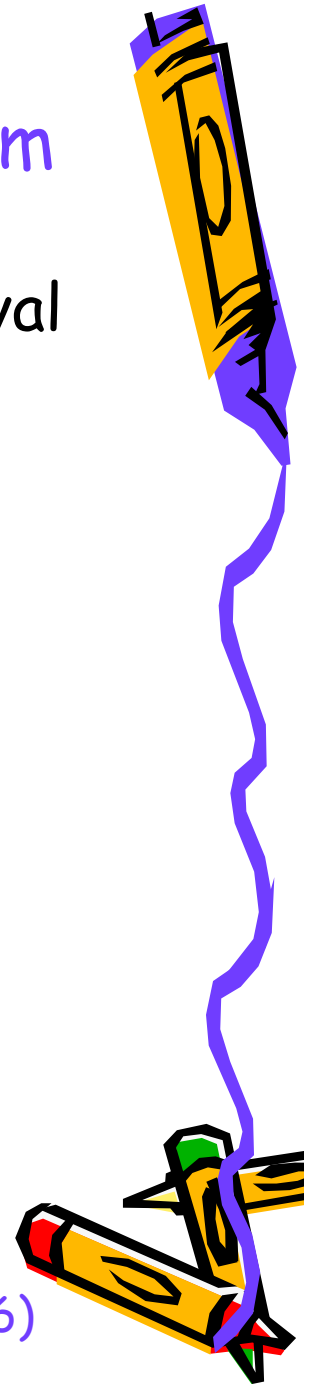
Responsible: A. Heikinnen / G. Folger (tbc)

Use case: neutron induced radiation on photo-cells.

- Request to improve final state isotope mass spectrum in Bertini and binary cascade models

Status

From Space Users meeting (Nov 2006)



1505: Process for x-ray specular reflection

Requestor: N/A (communicated by G. Santin)

Responsible: V. Ivantchenko

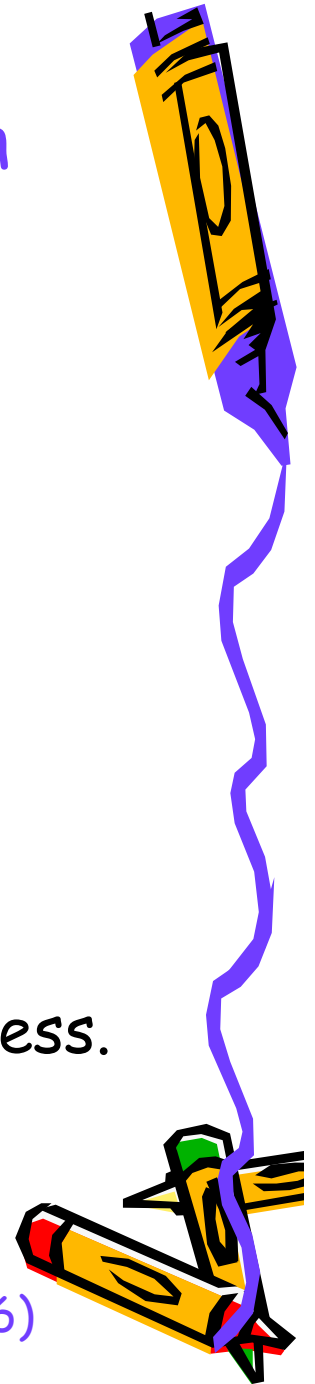
Add process for x-ray specular reflection

- Notes:
 - More information likely required
 - Can capabilities be borrowed from optical package?

Status

- Willing to review and integrate contributed process.

From Space Users meeting (Nov 2006)



1506: Documentation of physics lists.

Requestor(s): Space users, HEP users

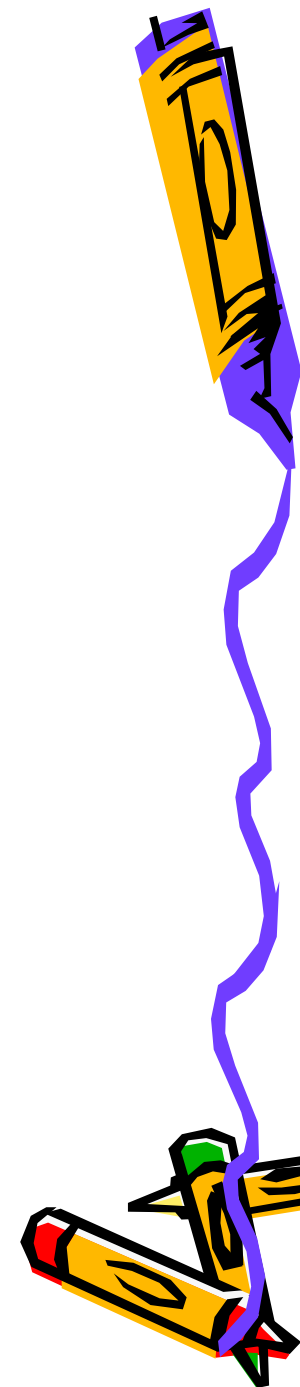
Responsible: G. Folger / PL 'task-force'

- Note: this is in progress, but more effort is required.
- What physics list (PL) should I be using ?
 - How do you go from use case to PL ?
 - Can dialog with users (online forum) aid this?

Analysis

- Given diversity of application domains, need to involve and work with users to document requirements from use cases

From Space Users mtg (Nov 06) & G4 Workshop (Oct 06)

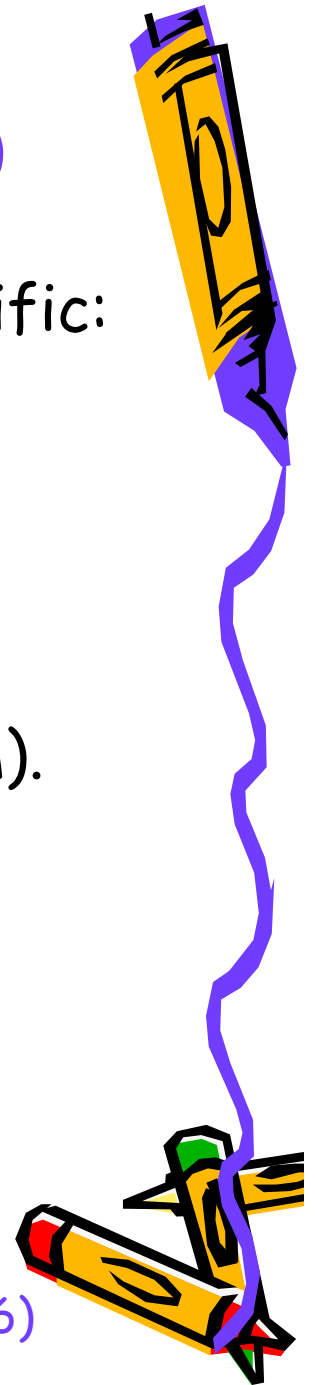


Further - from Space Users meeting (Nov 2006)

Additional, currently not sufficiently clear or specific:

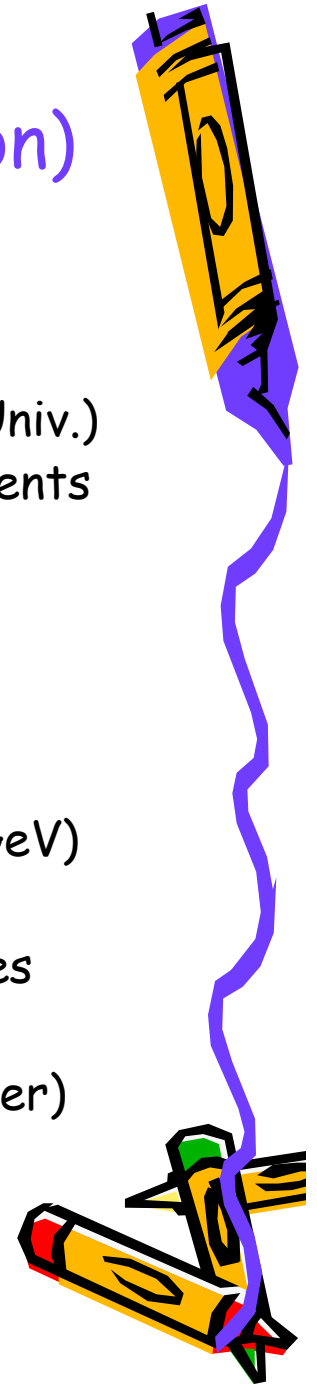
- Add more isotopes to G4NDL.
 - Requester Scott Messenger (SFA Inc & NRL)
- More documentation, everywhere (no specifics mentioned)
 - Requester Bart Quaghebeur (BIRA in Belgium).

From Space Users meeting (Nov 2006)



Meeting at G4 workshop (Oct 2006, Lisbon)

- Relayed from Leuven Space Wrk, Fall 2005)
 - 1401: Producing recoil ions (G. Santin)
 - Contribution of existing scattering process (Vanderbilt Univ.)
- Requests/feedback relayed from meeting with neutrino experiments (M. Verderi, Oct 2006)
 - 1402 Improve scintillation process (with mean material the correct description is lost)
 - 1403 Ability to force decay of pions in decay tunnel
 - Need more information on
 - Issue with pion production from proton on Pb (at 10-50 GeV)
 - Problems encountered with Boolean solids
 - Wish to see smooth surfaces without additional edges
- Other
 - 1404 Request for 'composite' external fields (Peter Gumplinger)
- Notes do not include any others.



1401 Recoil ions

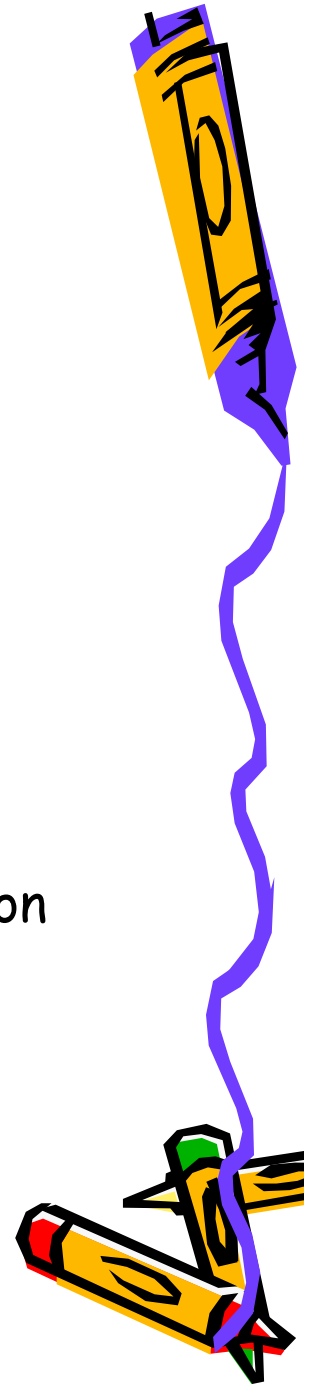
Requester: G. Santin - relaying from Leuven Space Wrk, Fall 2005

Responsible: V. Ivantchenko

- Producing recoil ions

Status

- Existing process *G4CoulombScattering* process
 - Tested for electrons, muons
 - Recommended for use in very low density material
- Working implementation of single scattering process for ion incident exists, from Vanderbilt Univ.
 - Contribution is foreseen, and welcomed



1402: Scintillation

Requester: GDR neutrino experiments (via Marc V., Oct 2006)

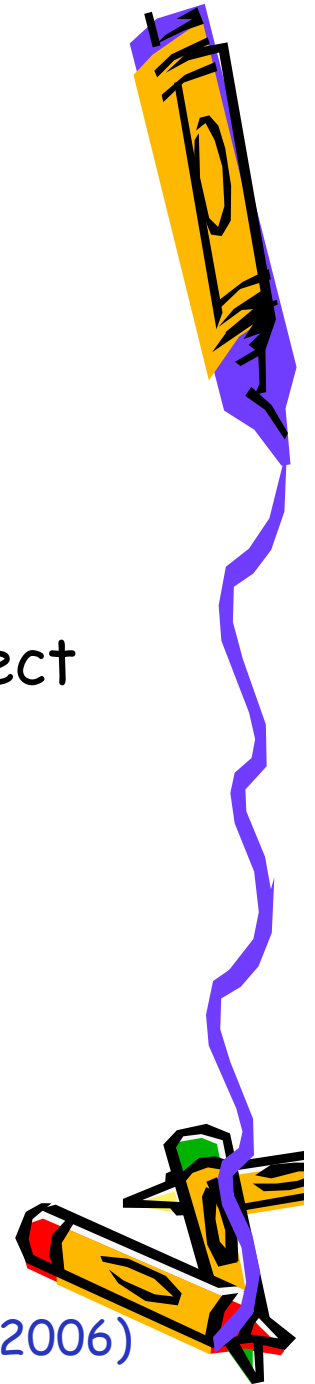
Responsible(s):

- Improve scintillation process
 - Currently when using mean material, the correct description of the process is lost

Status

- Need more information
 - Scintillation properties can be attached to materials

•Relayed from mtg with neutrino experiments (M. Verderi, Oct 2006)



1403: Forcing decay in tunnel

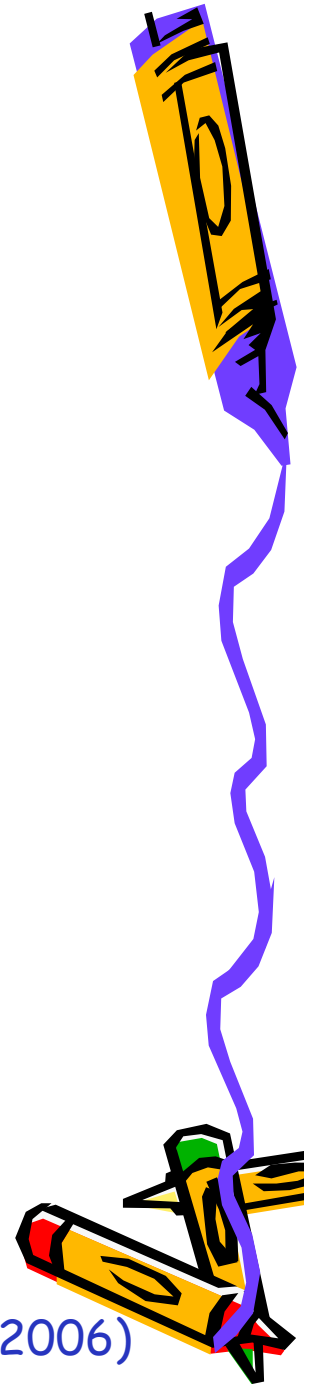
Requester: GDR neutrino experiments (via Marc V., Oct 2006)

Responsible(s):

- Ability to force decay of pions in decay tunnel

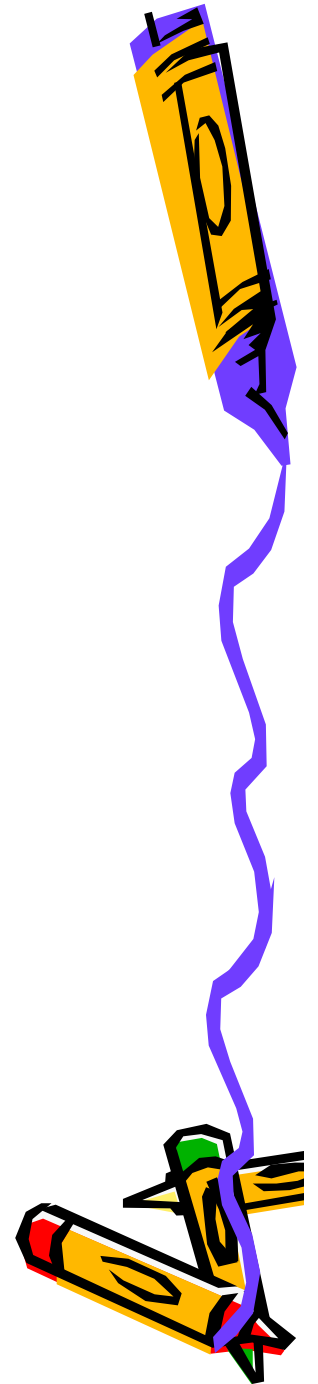
Status:

•Relayed from mtg with neutrino experiments (M. Verderi, Oct 2006)



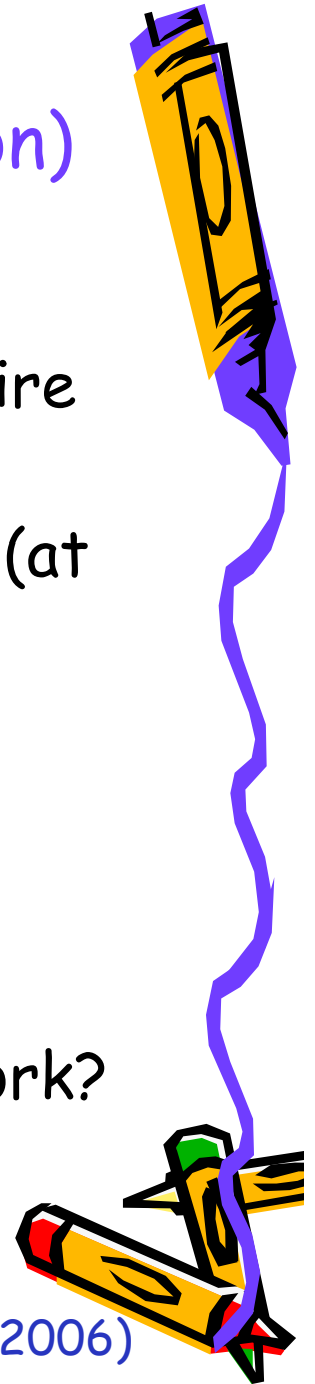
1404: Composite external fields

- Request for 'composite' external fields (Peter Gumplinger)
 - Ability to add multiple 'sources' of fields
 - Gravitational field



Meeting at G4 workshop (Oct 2006, Lisbon)

- Issues reported from meeting with neutrino experiments (M. Verderi, Oct 2006), which require clarification:
 - Issue with pion production from proton on Pb (at 10-50 GeV)
 - Problems encountered with Boolean solids
 - Wish to see smooth surfaces without additional edges
 - Issues discussed:
 - How to communicate the ongoing validation work?
- Relayed from mtg with neutrino experiments (M. Verderi, Oct 2006)



Meeting at G4 workshop (Oct 2006) - cont.

- Issues discussed:
 - How to communicate the ongoing validation work?
- User question:
 - What physics list (PL) should I be using ?
 - How do you go from use case to PL
 - Can dialog with users (online forum) aid this?
 - Need to involve users to document requirements from Use Case(s)

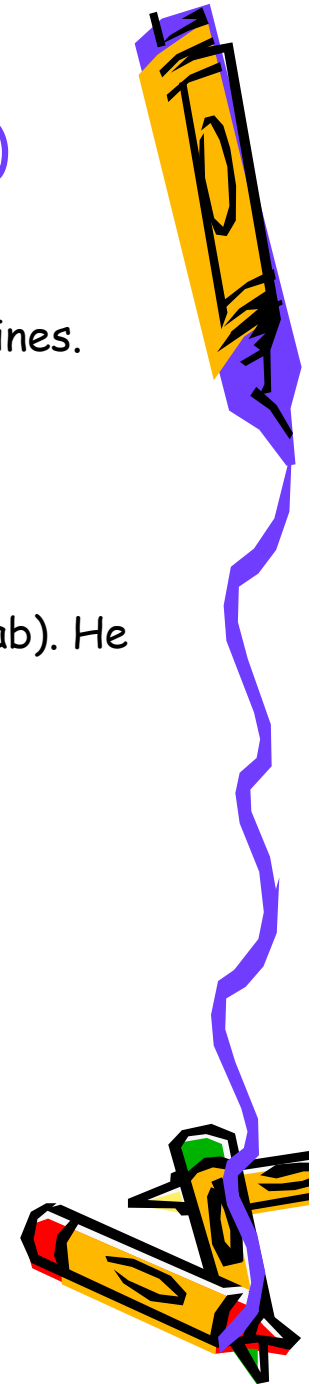


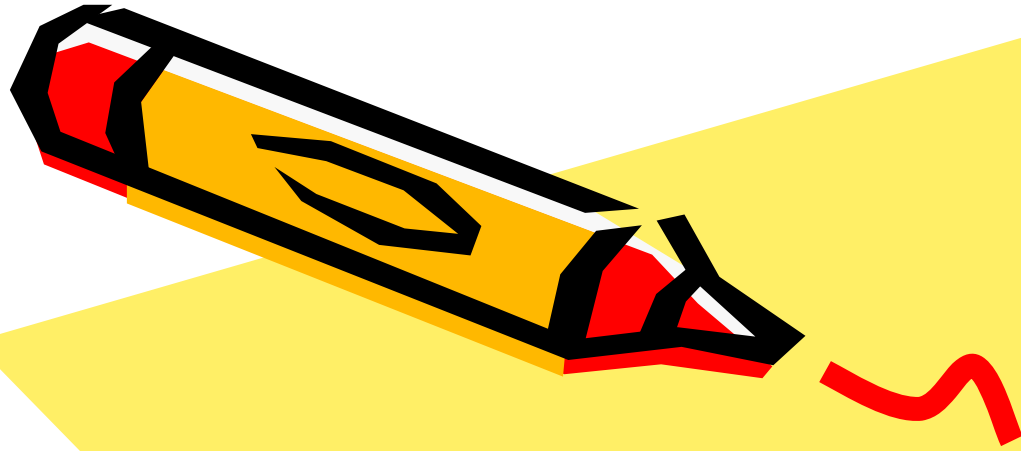
Further - from Space Users meeting (Nov 2006)

1. Support multiple core processing.
 - Requested by Francisco Garcia (HIP). He wants to exploit new machines.
2. Packaged physics lists using low energy electromagnetic processes,
 - Requested by Dennis Haggerty (Johns Hopkins U. Appl. Phys. Lab.)
 - Could be based on those found in examples.
3. Improve final state isotope mass spectrum in Bertini and binary cascade models.
 - Requested by Scott Messenger (SFA Inc. and US Naval Research Lab). He is studying neutron induced radiation on photo-cells.
4. Add x-ray specular reflection
 - Can optical package handle this?

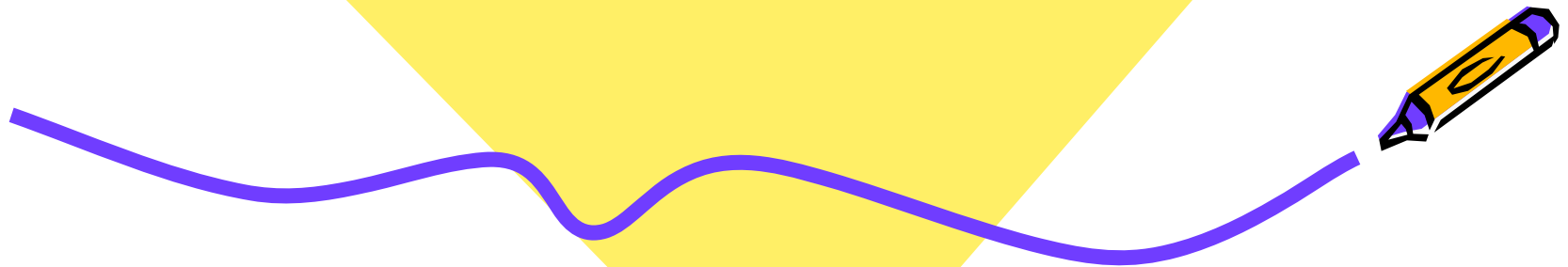
Additional which are currently not sufficiently clear or specific

- Add more isotopes to G4NDL.
 - Also requested by Scott Messenger (SFA Inc & NRL)
- Documentation of physics lists.
 - Note: this is in progress, but more effort is required.
- More documentation, everywhere (no specifics mentioned)
 - Requested by Bart Quaghebeur (BIRA in Belgium).



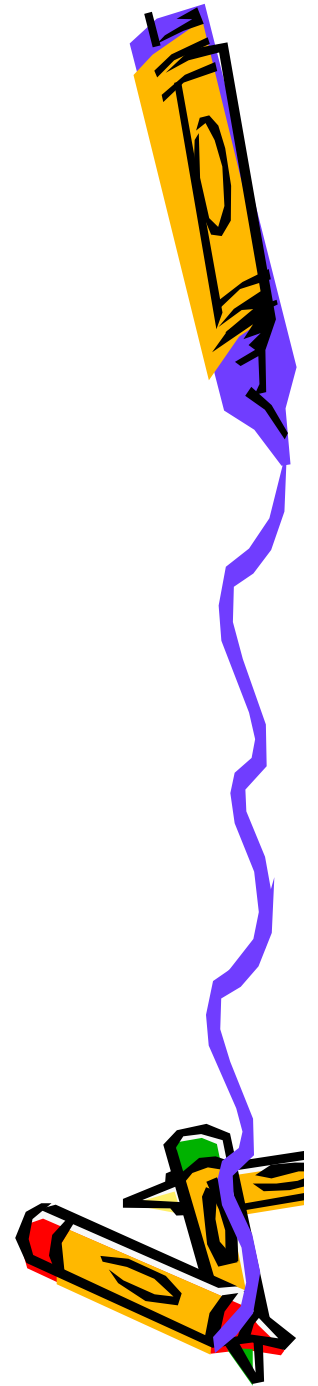


Requiring user feedback



Awaiting user feedback

- Req.702: Selective verbosity
- Req.707: Python UI



Req.702: Selective verbosity

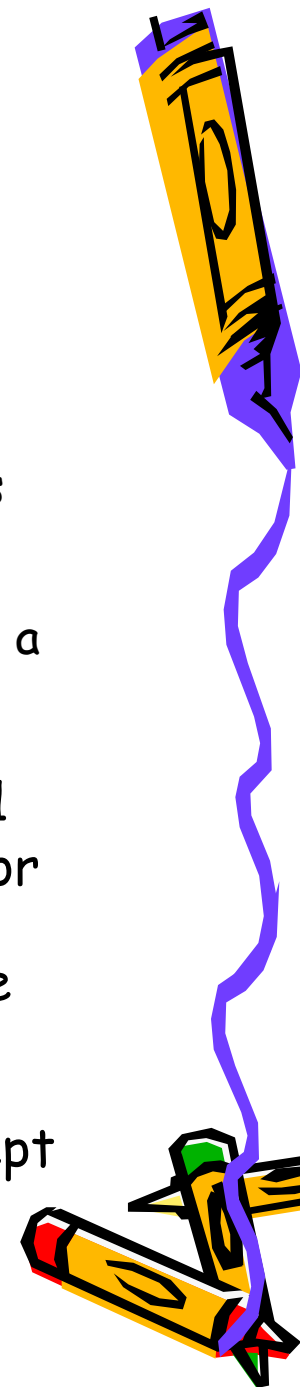
Originator: LHCb (G. Corti)

Responsible : T. Sasaki

- "We would like more configurable debugging features.
 - It is possible to follow in details various aspects of the simulation by setting verbose levels.
 - This is very hard to use when tracking complete pp events because millions of *G4Track* are produced.
- It would be very useful to be able to selectively turn on such verbose for a single *G4Track*, a single region of the detector, a combination of the two."

Status

- New flag in *G4VSteppingVerbose* was introduced in v8.1
 - allows the user to toggle the verbosity on and off for each track and/or step
 - the user has to create his/her own stepping verbose class deriving from *G4SteppingVerbose* default verbosity class and implement this toggling.
 - Other virtual methods of actual verbosity can be kept unchanged.
- If this satisfies the requirement, we propose to close this.



Req.707: Python UI

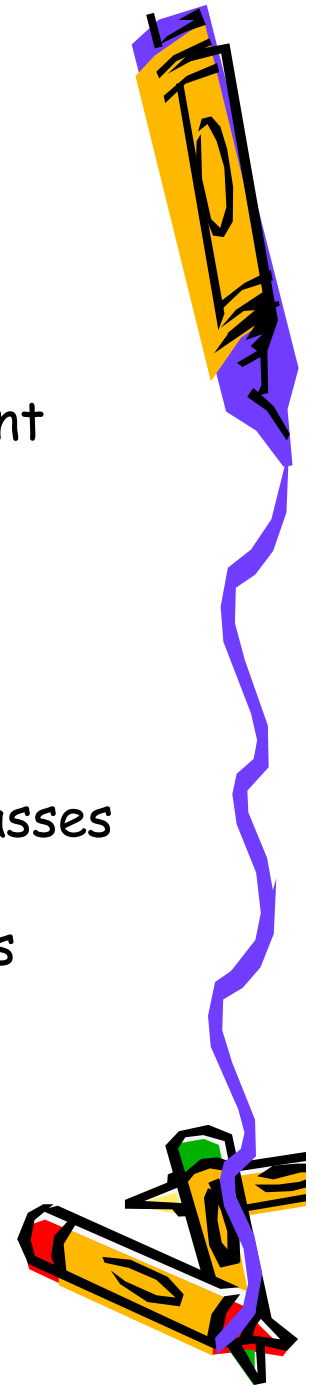
Originator : ATLAS (A. Dell'Acqua, A. Nairz)

Responsible: H. Yoshida

- More support for a python UI in G4 (not only the current UI/macro version).

Status

- A development version now includes the a G4-Python interface
 - First implementation was released at v8.1
- Python classes provide access public methods of key classes (implementation uses Boost)
 - Currently evaluating the protection of key quantities during a run from being changed.
- **User's feedback requested.**



Req 1203: Document which particle properties can be changed

Responsible: H. Kurashige

Requestors: Atlas, LHCb (followup from reading particle properties)

Context: The capability is now enabled to change particle properties. Need guidelines on what changes can be made for which particles, without impacting Geant4 internal consistency and results.

Current assessment / proposal on priorities

- Open to change properties of heavy particles, for which there are no physics processes in Geant4 (and so expect no impact)
 - B, C, T meson/baryon, W/Z bosons,...
- For mesons/baryons:
 - Properties of resonance must be maintained.
 - in particular need stability for Δ , N^*
 - some changes are safe for light stable particles (pion, Kaon)
 - But impact to be studied
- For light leptons (e, μ), there is little foreseeable benefit to changing properties
 - And potential impact to check effects if masses are modified

Request feedback on this proposal (April 2006). If it adequate for now, propose to close this requirement, copying this to appropriate docs.



Req.0502: Treatment of particles that get stuck during simulation

Responsible: G. Cosmo, J. Apostolakis

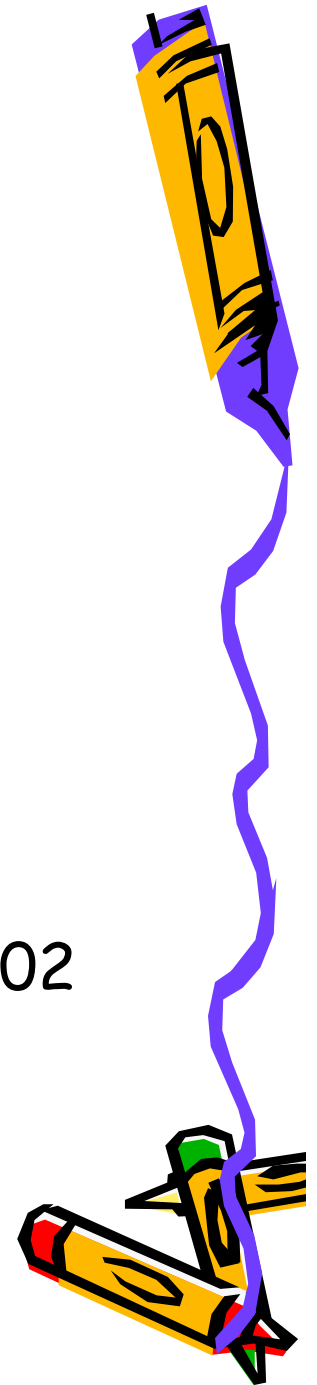
Requestor: CMS, LHCb

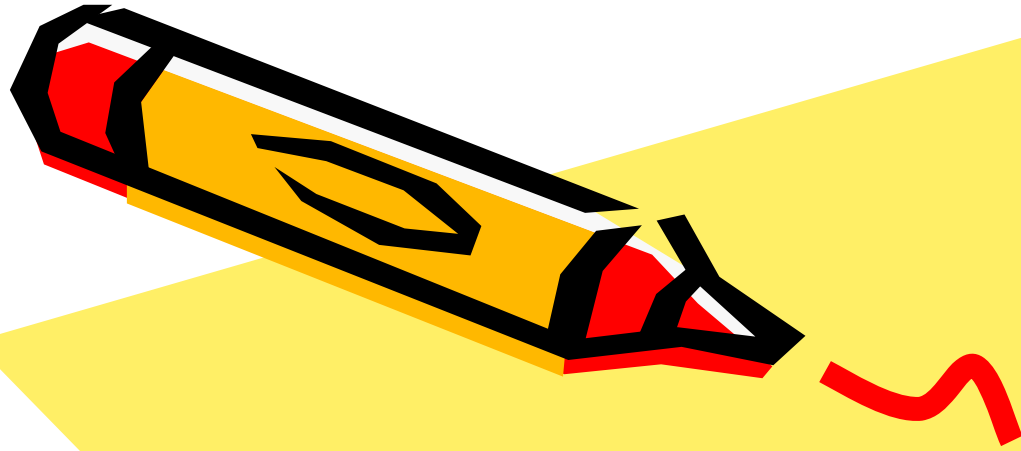
Description: "CMS drops a track if it is stuck and continues the event. G4 by default abandons the event. Neither is good."

Status

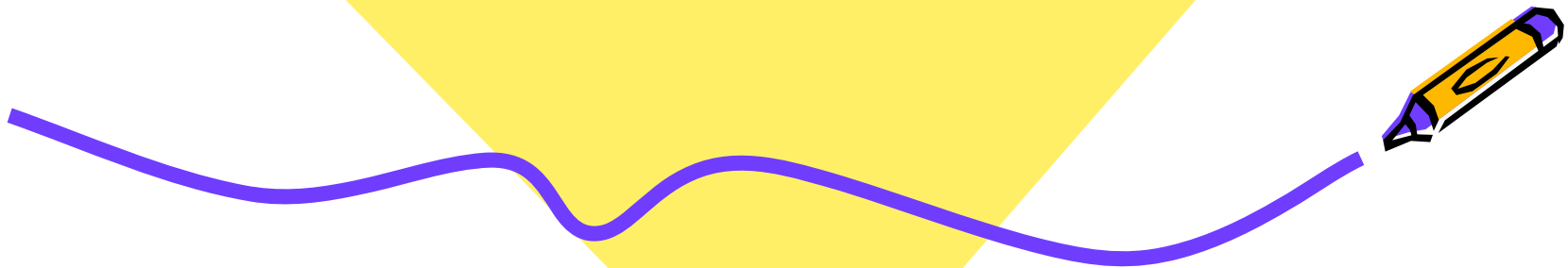
- Since Geant4 7.0 a stuck track is given additional kicks and chances to continue
 - only most problematic 'stuck' track is killed.
- Related requirement for tracking in field is Req.602

Open issue for final resolution: what is acceptable behavior for truly stuck tracks ?





Requirements with previous
news



703. Treat particles with dipole moments

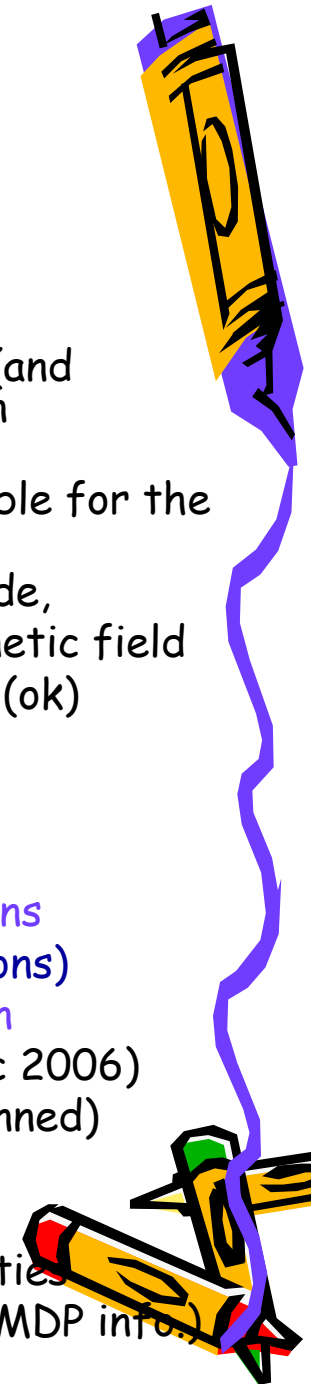
Originator: AD (Bertalan Juhasz)

Responsible: J. Apostolakis, H. Kurashige

- The user should be able to calculate the force acting on the magnetic (and possibly electric) dipole moment of a (neutral or charged) particle in an inhomogeneous magnetic (electric) field [$F = \mu * \text{grad } B$]
 - for this, the magnetic dipole moment of a particle should be available for the equation of motion;
- Note: the magnetic moment is not always a vector of constant magnitude,
 - In magnitude and direction it can depend on e.g. the external magnetic field
- the force will be calculated by a user-derived equation of motion class (ok)

Comments/Status: Open

- First proposal for a working solution was communicated (Sept 2006)
- **NEW (Dec 2006)**
 - User created prototype implementation - improved after discussions
 - A first working solution now exists (but has toolkit modifications)
 - Further toolkit improvements planned, to enable better integration
- For a solution 'integrated' in the toolkit: second design study done (Dec 2006)
 - Particle properties for magnetic dipole moment (MDP) needed (planned)
 - Revised field-track to carry MDP (done, June 2006)
 - A revised or derived transportation (tdc)
 - Identify neutral particles with MDP (or EDP), and pass properties
 - A revised equation of motion is needed (user can do - missing only MDP info.)



1301 Fixing visualization of boolean solids

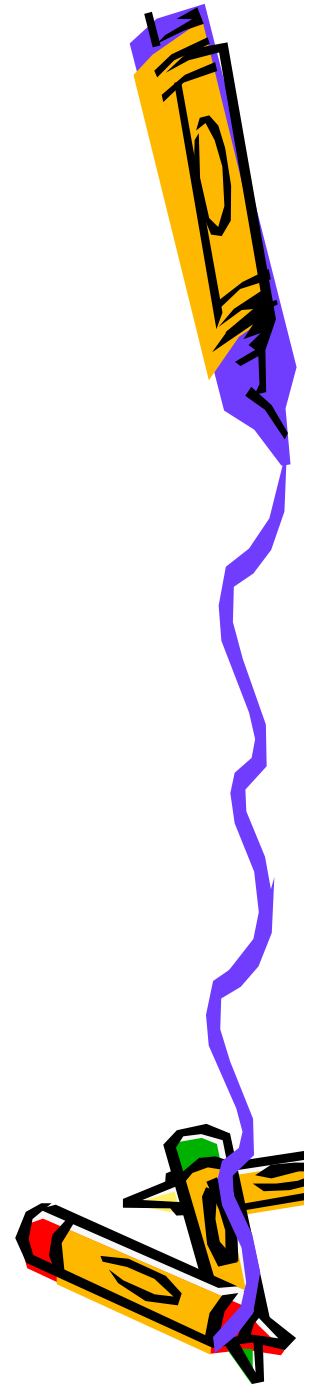
Requestor: CMS / Y. Osborne

Responsible: J. Perl

Context: G4 Boolean Processor fails to create G4 subtraction solid out of shapes sharing surfaces

Status:

- Understood issues.
- Identified potential implementers. Funding to support this not yet found.



Req.704: Neutron data for additional elements

Originators: (BaBar, Vanderbilt)

Responsible: T. Koi (was D. Wright)

- BaBar needs Nd (Neodymium) and Sm (Samarium) added to neutron data library.
- Vanderbilt ask for As, In, Ge, Ga, Sb, Hg, Cd, Te, and Gd.

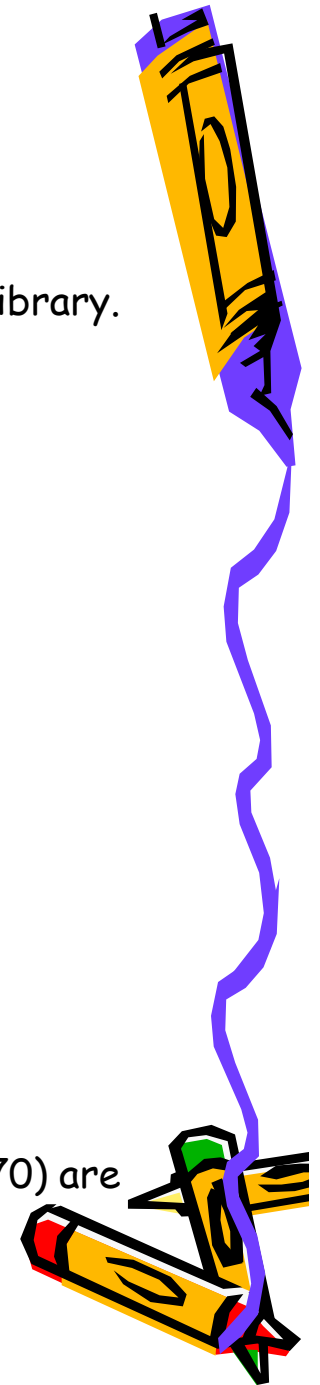
Seconded by ESA.

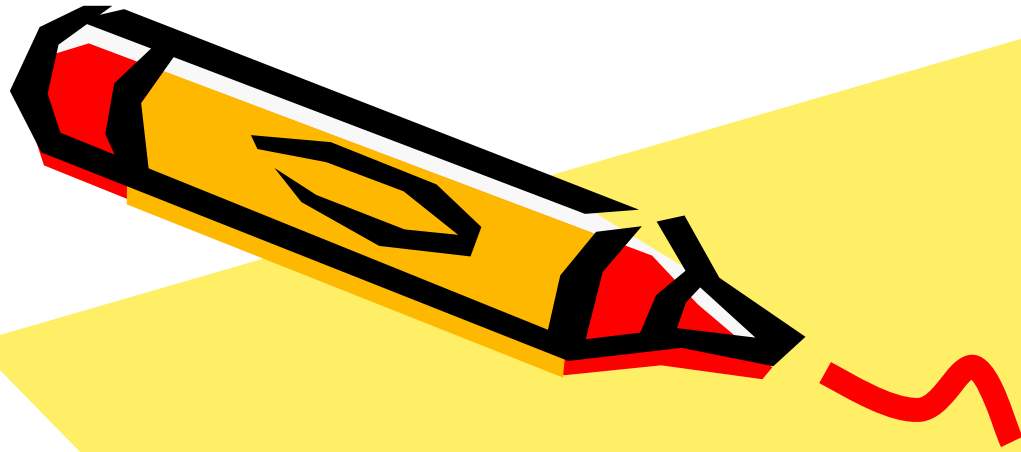
Status

- Already existed in G4NDL3.7
 - As, In, Ge (replaced at G4NDL3.8), Ga, Cd, Te
- Added in G4NDL3.8 (Feb 2006)
 - Gd
- Added in G4NDL3.9 (June 2006, with G4 8.1)
 - Nd, Sm, Sb (Tc and Hf are also added)
- Data for Hg is not available from ENDF/B-VI
 - (The data exists in JENDL 3.3, but not introduced in G4NDL yet.)

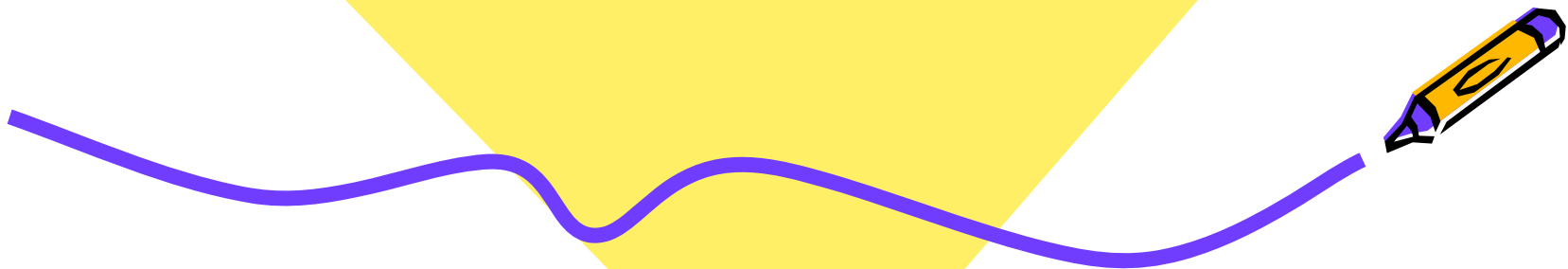
Included in release 8.2:

- Thermal Scattering files
 - H within H₂O, Graphite H within Polyethylene are prepared
- JENDL High Energy files
 - H(1), C(12,13), O(16), Mg(24,25,26), Al(27), Si(28,29,30), K(39,41), Ca(40,42,43,44,46,48), Fe(54,56,57,58), Cu(63,65), Zn(64,66,67,68,70) are prepared for neutron-induced reaction cross sections.





Recent or revised
requirements / requests



1302: Message processes in physics list

Requestor: M. Stavrianakou, CMS

Responsible: G. Folger (tbc)

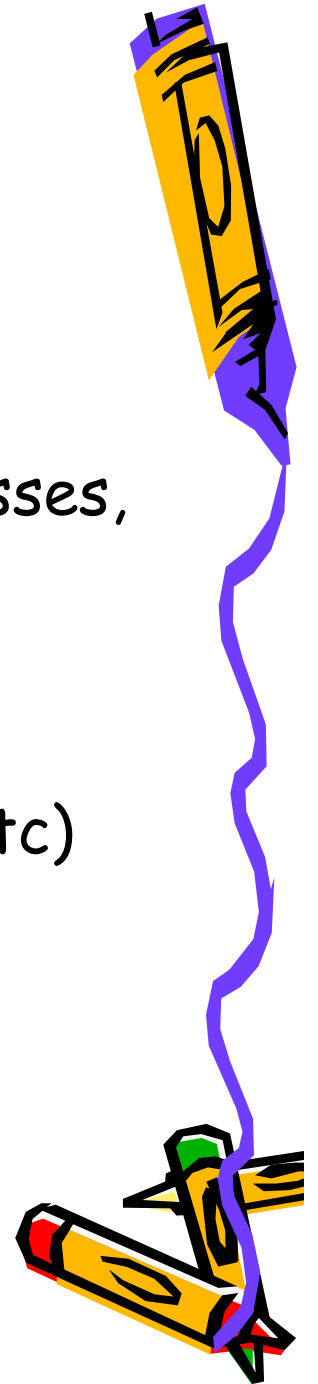
Context: Wish to message physics list or its processes, to control some aspect.

- Control via messenger handles is not enough.
- Example: verbosity control in hadronics. Provide ability to tune controls (threshold, cut setting etc)

Old title: Making available process/physics lists "controls".

Status:

- Under study

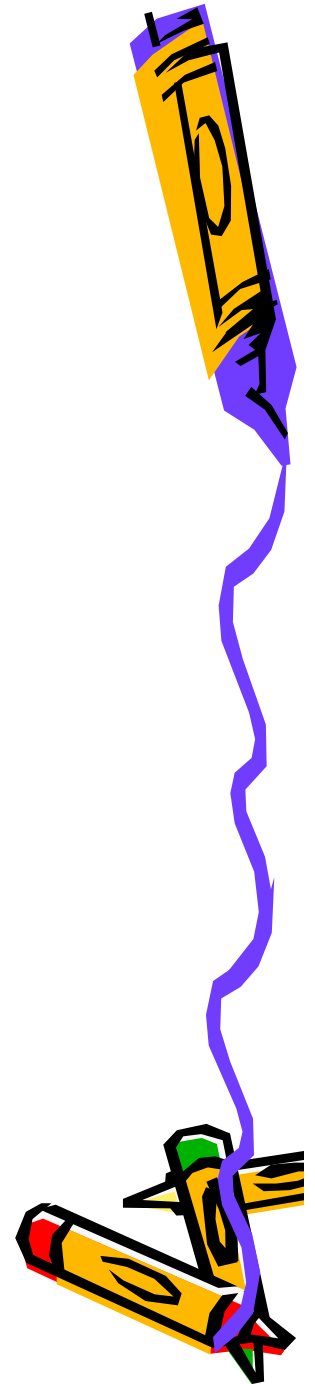


Other requests / requirements from Mar 2006

- AUTOCAD input - (CMS / D. Stickland)
 - Input of CAD file geometry
 - potential additional issue for level of detail

UNCLEAR

- Neutron shower parameterization



Req 1102: Identifying a process efficiently

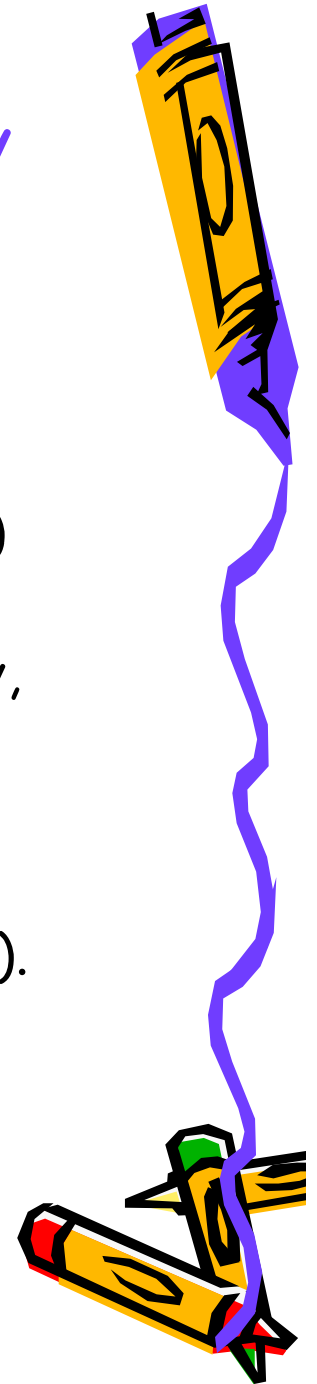
Requestor: Atlas, CMS, LHCb (W. Pokorski)

Responsible: H. Kurashige

- A process (physical or 'general') must hold an identity (id) that can be used to determine
 - To which class of process (EM, hadronic, optical, decay, 'transport', biasing, ..) it belongs
 - which physical process it models (eg Compton, photoelectric, Bremsstrahlung, ..)
 - The identity the particular process (G4Transportation).

Status:

- Under Analysis



Req 1103: Composite User Actions

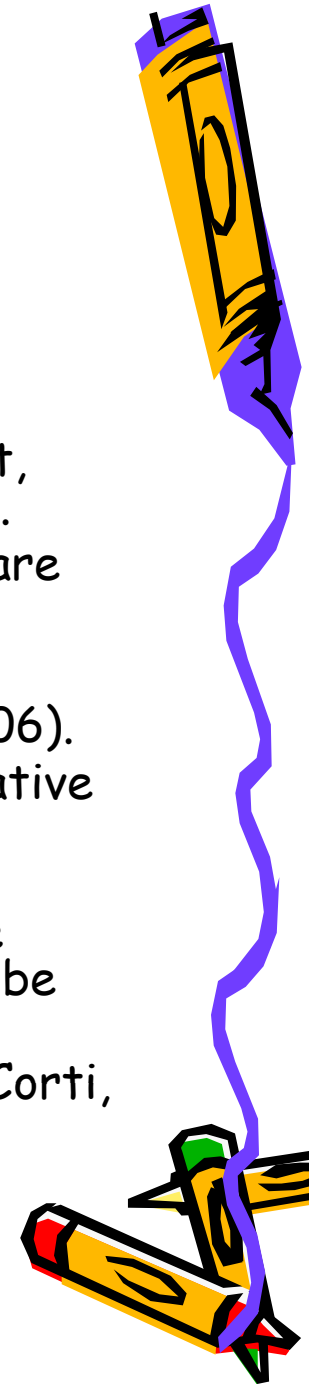
Requestor: Atlas (A. Dell'Acqua), LHCb (G. Corti)

Responsible: M. Asai

- Provide a 'composite' action of each user action type (Run, Event, Tracking, Stepping) that can call a set of registered sub-actions.
 - These sub-actions shall be called in the order in which they are registered.

Status

- Asked for feedback & more information on requirements (April 06).
 - for the stepping action, instead of making it modular, alternative design could be allowing each *G4Region* to have a dedicated stepping action.
 - For event and tracking action, one modular action can kill the event/track. We need Subsequent actions likely should not be called.
- After new communication, first feedback recently obtained (G. Corti, A. Dell'Acqua)
 - Stepping action per region probably not ideal
 - Propose for calling of event/tracking action to depend on boolean return flag.

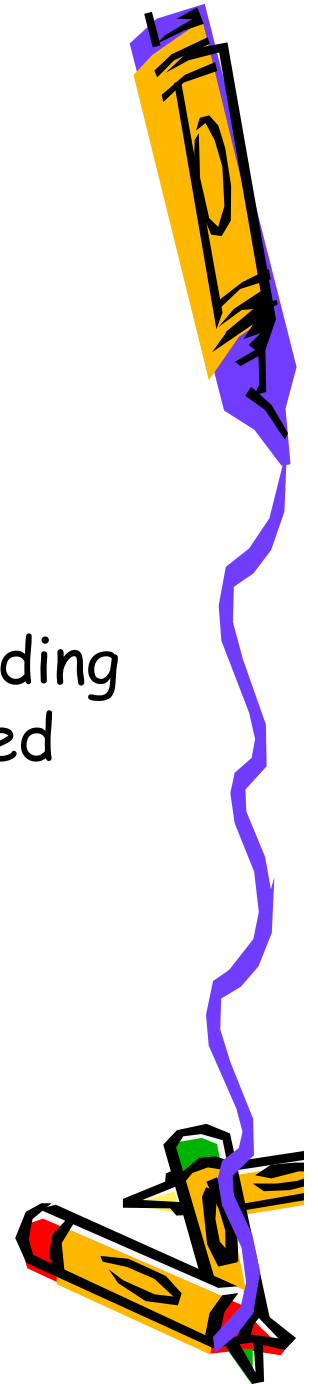


Req. 1104 Providing interaction snapshot

Requestor: Atlas, CMS, LHCb (W. Pokorski)

Responsible: T Sasaki (tbc)

- The simulation system shall provide to a "truth holder" class a snapshot of the interaction, including position, incoming particle, all secondaries created (available as single entity, eg vector)
 - Requestor: Atlas, CMS, LHCb (W. Pokorski)
- **Status**
 - Under study
 - Further clarification, discussion likely needed

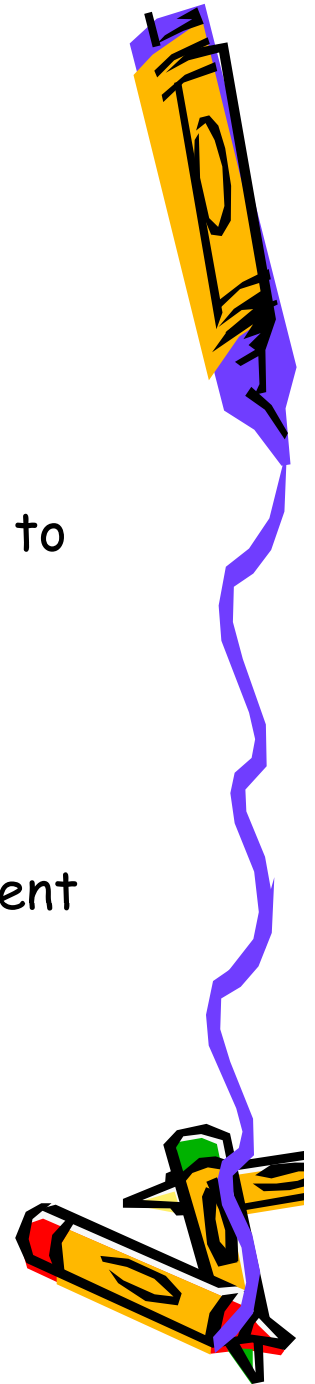


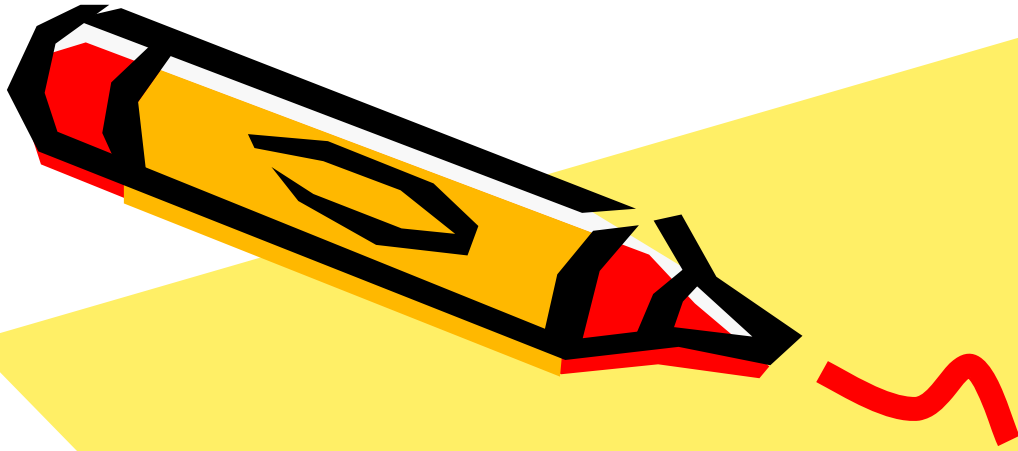
Req. 1105 Global verbosity

Requestor: LHCb (F. Ranjard), other?

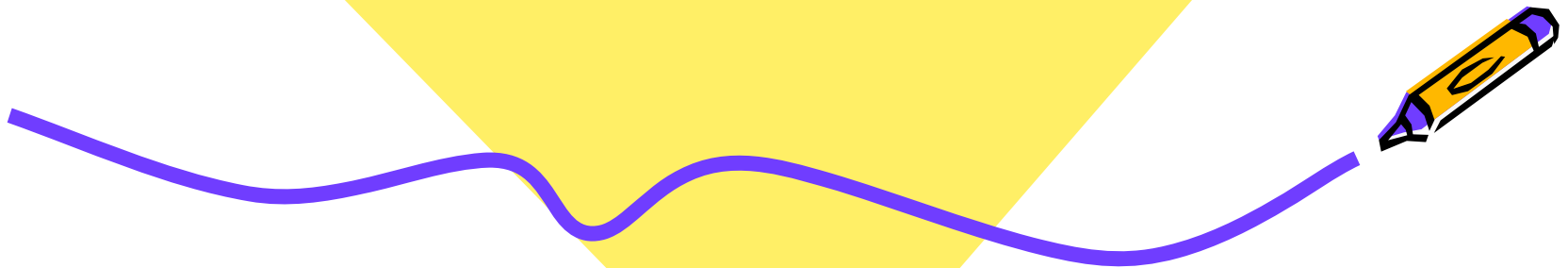
Responsible: M Asai

- Provide a 'global' verbosity setting, which the user can use to request minimum verbosity from all verbose Geant4 components.
- New information
 - Key interest is to avoid printing during Initialisation
 - Want to keep information on difficulties, warning in event simulation
- Status
 - Under study.





Other open requirements



Req.0601: More details in error messages

Responsible: J. Apostolakis, M. Asai, G. Cosmo

Requestor: LHCb (G. Corti), seconded by CMS

- To help in debugging problems in the production environment we wish to have detailed message when there is a problem. This already occurs for the hadronic physics and we have found it very useful. It would nice to have similar detailed message from the other parts of Geant4.

Information:

Typical message from *G4HadronicProcess* is

"Unrecoverable error for:

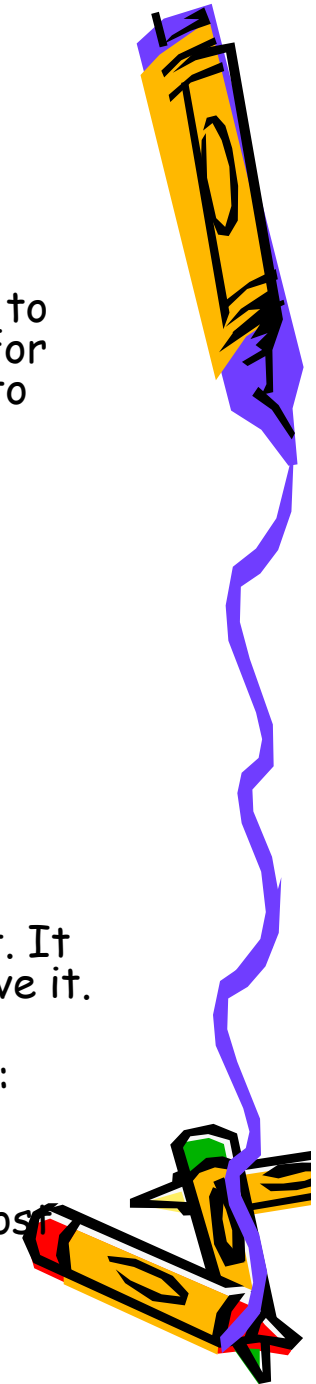
- Particle energy[GeV] = 2.452
- Material = Aluminium ;
- Particle type = proton

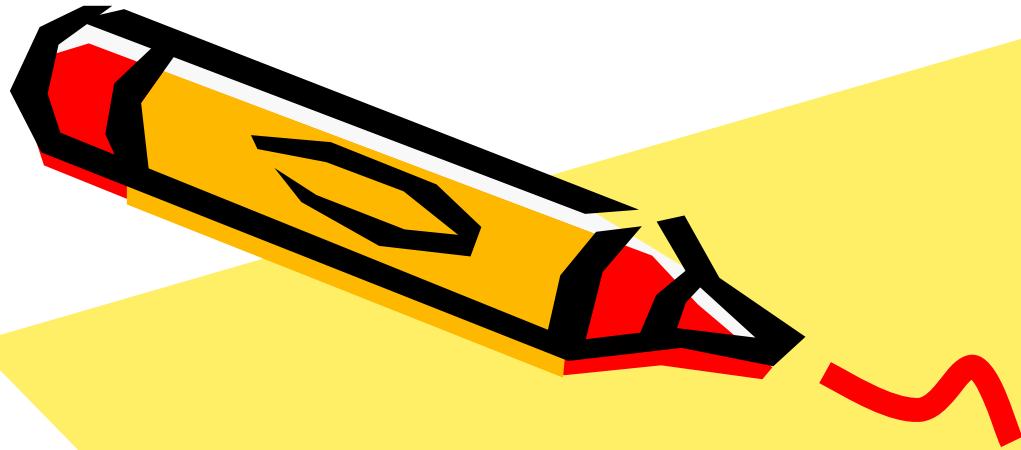
EXCEPTION: Fatal Exception number 007 in *G4HadronicProcess*:
GeneralPostStepDoIt() failed on element selection."

This enables easy reporting of problem, and enables developers to find it. It makes it simpler to identify the cause, and therefore faster to resolve it.

Yet the conditions that allow this in hadronics (few calls and thus small overhead in terms of CPU time) do not exist in other key components: geometry and EM physics.

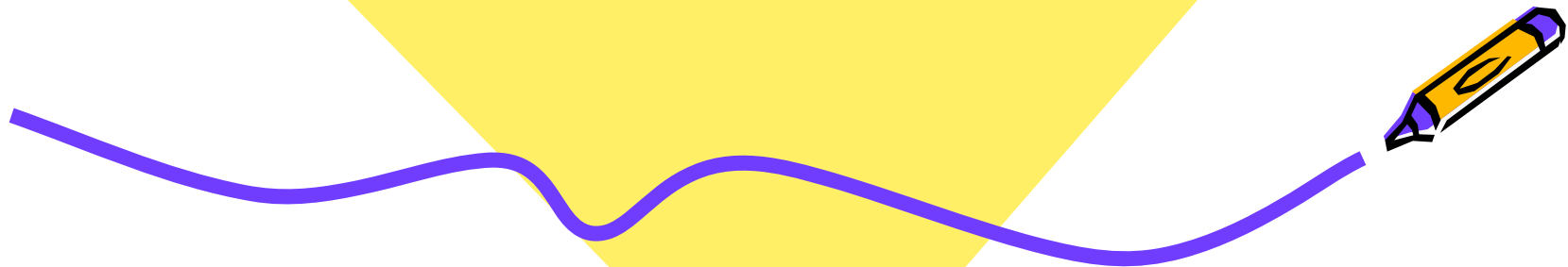
Discussion: What key areas and types of additional information are of most interest ? How much of performance overhead is acceptable ?





Longer term requirements
- Under development
- Under study

1. New additions to 'longer term'



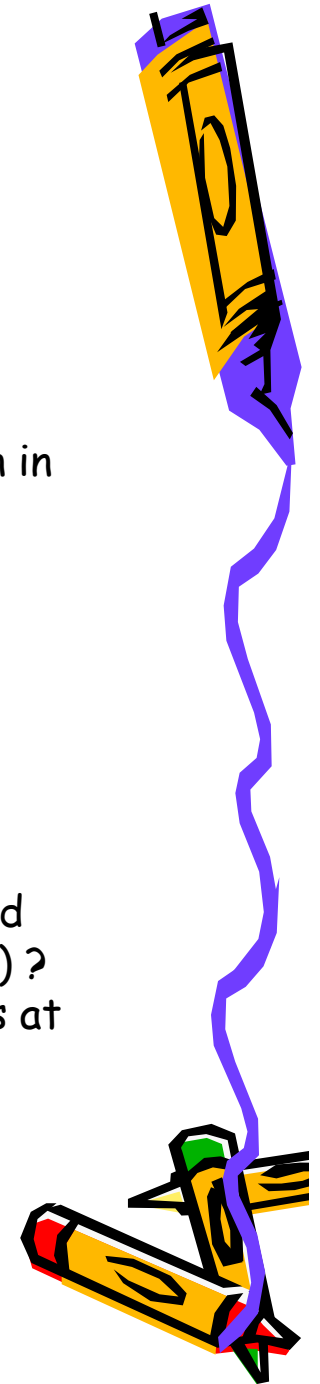
Req.0605: Adding touchable to secondaries

Responsibles: T. Sasaki and P. Gumplinger

- Touchable should be always attached for all secondaries.

Status

- Since 7.0, hadronic processes add a touchable handle to secondaries.
- Dec 2005: Found a few which do not assign a touchable (in case of position in current volume).
 - G4OpWLS (Optical process for wavelength shifting)
 - G4Cerenkov, G4Scintillation
 - Further study XrayTR radiation (issue regarding active volume)
- Open Questions
 - Are users affected by this behaviour ?
 - Have we documented difference between
 - end-point (and along) secondaries which are in the same volume, and
 - secondaries that leave the volume (eg refracted, leaks in fast sim.) ?
 - Should tracking set the touchable (instead of process) for secondaries at end-point ? [G4 internal issue]



Req.1201: Improvements QGSP angular distributions

Responsible (new): G. Folger

Requestor: HARP (V. Ivantchenko)

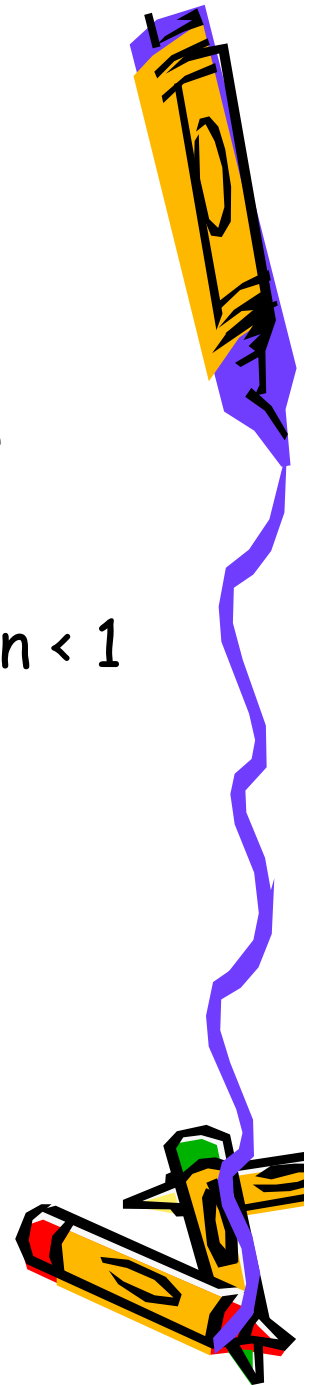
Description: "HARP needs following improvements in the energy range of 1-15 GeV."

- QGS model improvement to provide a smooth inclusive theta distribution in forward direction < 1 degree

Status

- Difficulty due to model applicability which starts around 15 GeV
 - Issue under investigation

Note: created to replace sub-issue of #505



Req.1202: Alternative models for intermediate energies

Responsible (new): D.Wright / A. Heikkinen (hadronics)

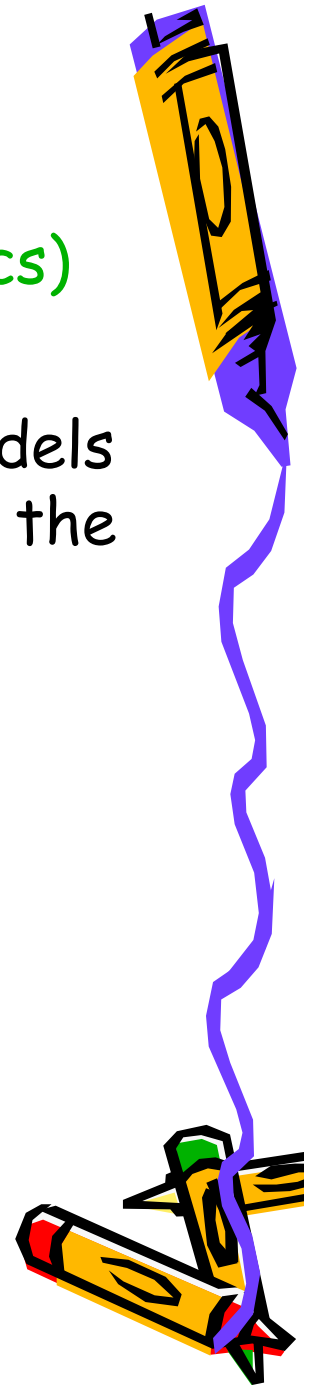
Requestor: HARP

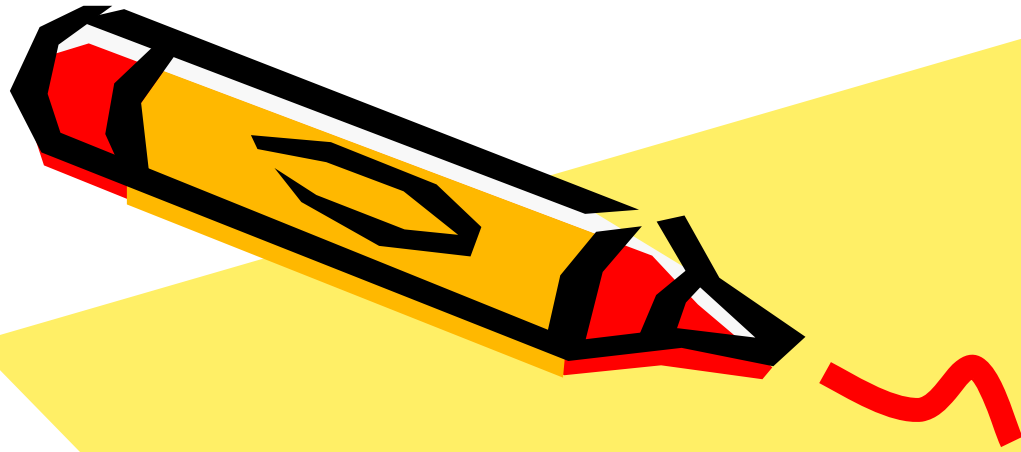
Description: "HARP requests additional hadronic models in the energy range of 1-15 GeV, as alternative to the parameterised (LEP) models.

Status

- Under study

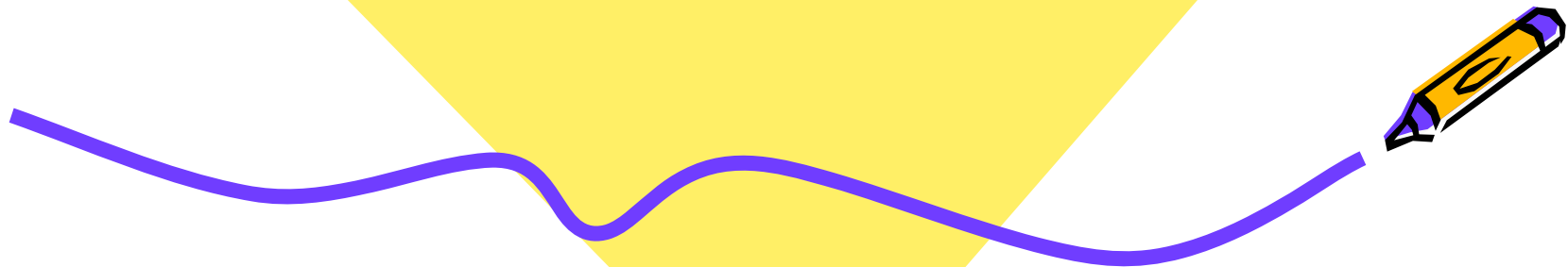
Note: created to replace sub-issue of #505





Longer term requirements
- Under development
- Under study

2. Existing long-term requirements



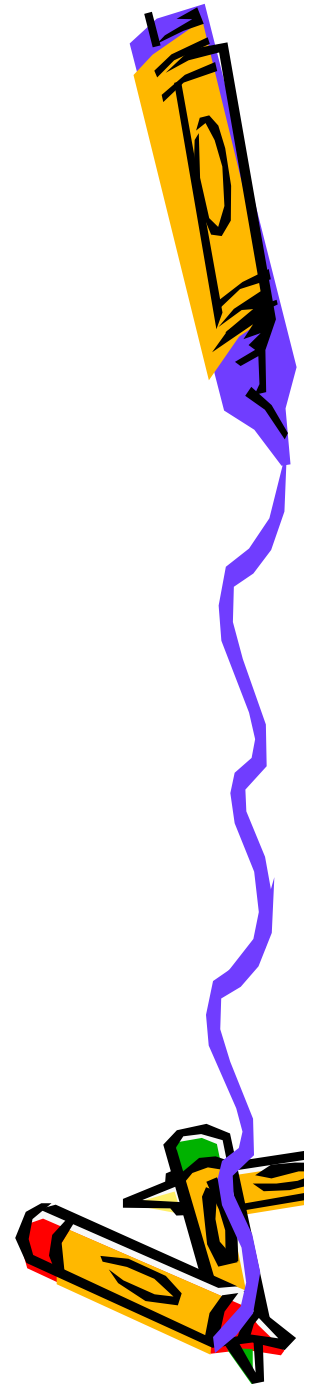
Req.0103 part 2: Geometry construction - input from external models

Responsible: G. Cosmo

Additional ways to input the description of the geometry of a setup via GDML and CAD-input.

Two aspects were identified:

- GDML moved to Req.0304 and closed
- CAD interface:
 - in the process of identifying objectives for
 - BREPs extensions and interface to CAD
 - We are discussing with NASA/GSFC and ESA for taking care of this.



Req.0106 : Setup statistical test suites for most sensitive physics quantities

Responsible: J. Apostolakis, A. Ribon

Status:

- A first test suite for calorimetry quantities has been created. It measures longitudinal and lateral shower profiles for hadronics.
 - For several materials taken from LHC calorimeters.
- SLAC is continuously monitoring some variables most sensitive to BaBar and GLAST experiments.



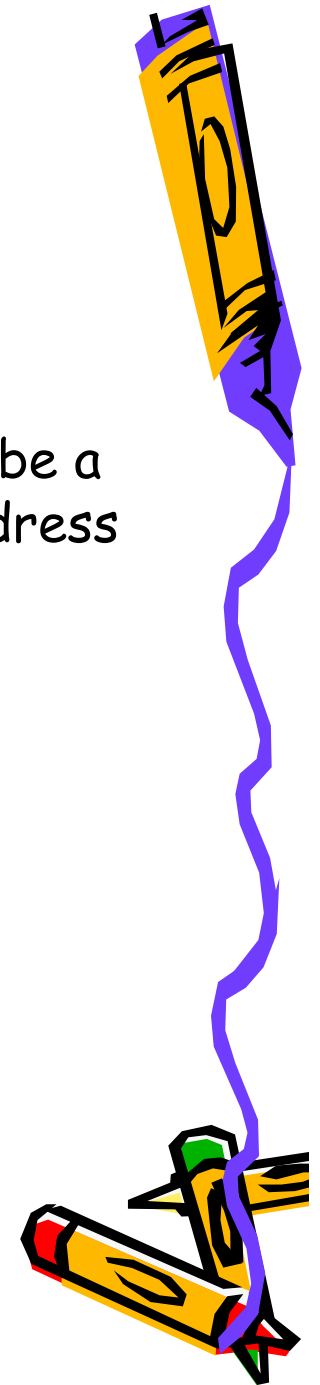
Req.0303: Performance of G4

Responsible: J. Apostolakis / G. Cosmo

Description: "Compared to G3 simulation, under similar circumstances G4 is reported by the LHC experiments, to be a factor 1.5-2 slower. A study group started last year to address this issue, and should continue with more priority. This is expected to be a collaboration between G4 and the users."

Status

- Simple setup benchmarking is part of release process
- Propose regular meetings to address this issue, and other continuing issues (eg identifying hard to find problems).



Req.0309: Provide documentation on the technical aspects of all available physics processes

Responsible: M. Maire/ M.G. Pia/ A.Heikinen/ D. Wright

Description: "All available physics processes, models, cross-sections, etc., should provide documentation of the technical aspects of the implementation: details of the expected behavior of a model should be provided (for example how incoming and outgoing particles are handled). This applies to both hadronic and electromagnetic processes."

- Concrete requirement for behavior of secondaries of hadronic process was fulfilled (Req.??).
- Physics group coordinators are open to suggestion of concrete issues and potential improvements.

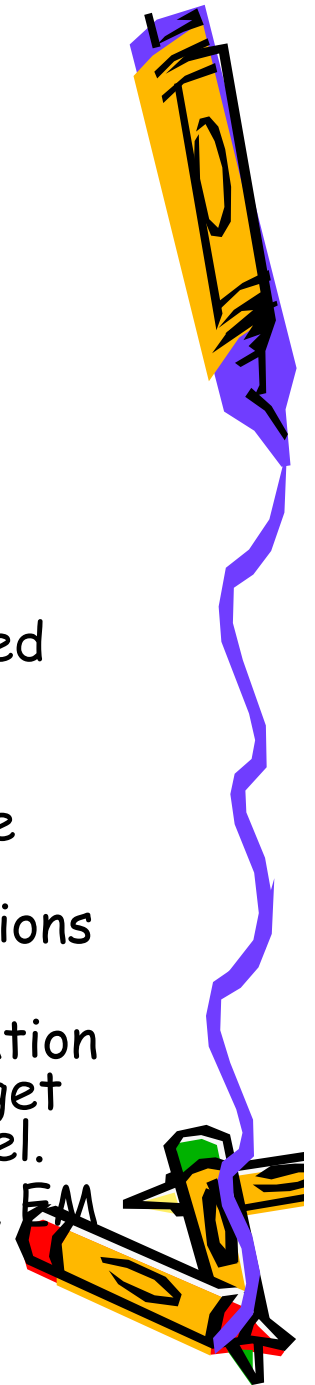


Req.0401: Extension of Ion hadronics interaction to cover a good part of the cosmic ray range in (A,Z) and energy

Responsible: A.Heikinen/ D. Wright

Requestor: ESA (G. Santin)

- EM dissociation: Released in G4 6.2
- Inelastic reactions
 - Below 10 GeV per nucleon: Released Xsec in 6.0, extended models in 6.1 for light ions ($\leq C$)
 - Above 10GeV/nucleon
 - Evaluated existing Xsec parameterisations - they are now good to about 20%. Extended QGSM to predict these Xsec and made a systematics of these predictions at $O(1\%)$ level.
 - Prototype extension of QGSM for final state generation in central rapidity for all ions and projectile and target fragmentation based on exciton pre-equilibrium model.
 - Work to be done: radioactive decay for relativistic ions, EM dissociation for higher excitations than quadropole resonance.



Req.0402: "Intuitive" documentation of the physics lists

Responsible(s): D. Wright / G. Folger

Requestor: ESA (G. Santin)

Description: "Intuitive documentation (maybe in graphical form) for each physics list to show, for a given particle, which model is active over which energy range. It could also be printed out by the list in ASCII format, with a loop over inserted models."

Hadronics: accepted, open.



Req.0506: Optical photon transport in setups with repeated volumes

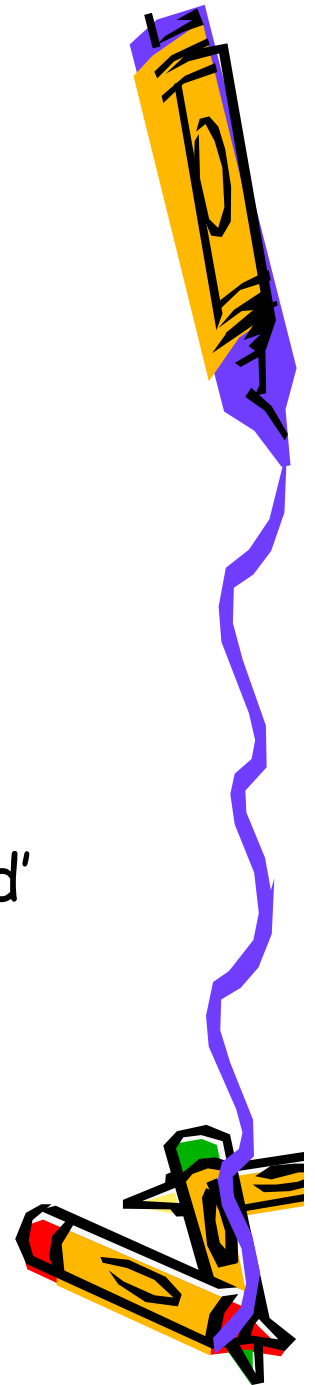
Responsible: P. Gumplinger

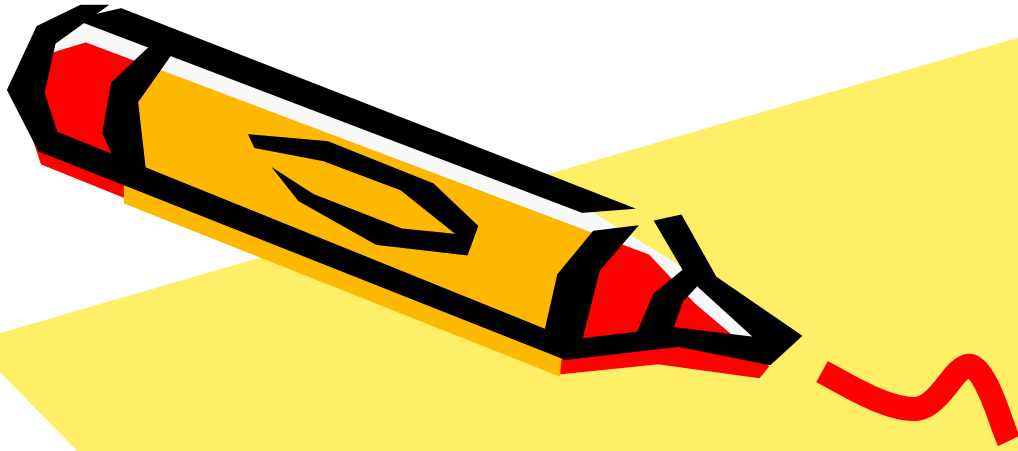
Requestor: TRIUMF (P. Gumplinger)

Enable optical photon transport in setups with parameterized/replicated/divided volume

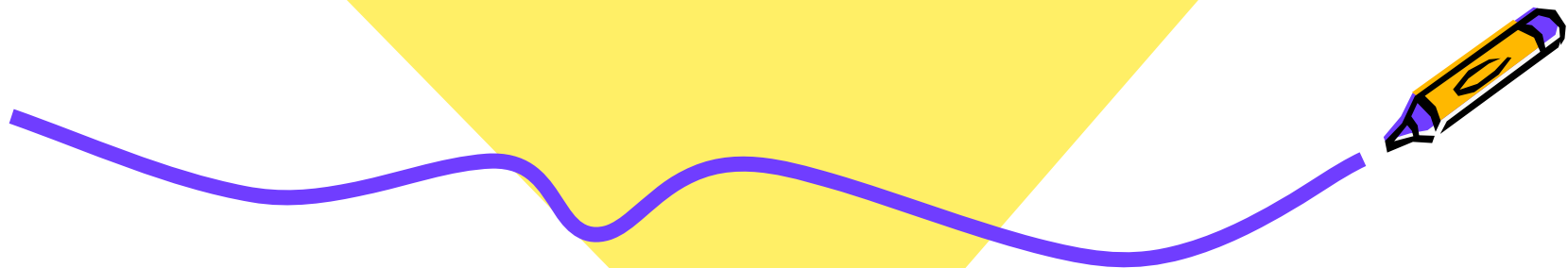
Status

Revisions being prepared to enable use of 'replicated' volumes in optical processes.





Requirements closed/replaced
after Jan/Mar 2007 meetings



Req.0603: Option not to suspend tracks

Requirement from BaBar (D. Wright)

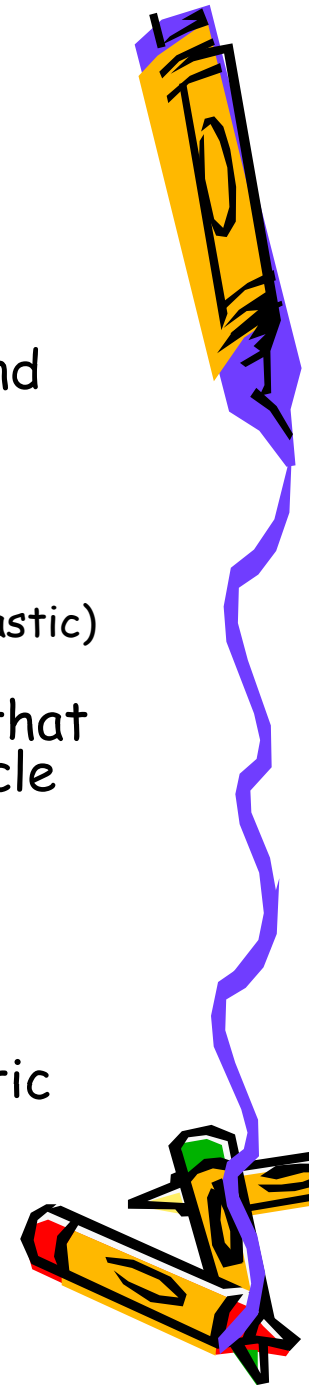
Responsibles : D.Wright / A. Heikkinen (hadronics)

- Currently few processes which suspend particles.
- For BaBar applications, it would be very useful not to suspend the particle (at least in the hadronic processes).
- Details:
 - Processes involved are *G4Cerenkov*, *G4Scintillation*, *G4FastSimulationManagerProcess*, *G4HadronicProcess*
 - For *G4HadronicProcess*, only one hadronic model (*G4NeutronHPElastic*) invokes the suspension.

Discussion: An option adding a switch to a suspending process that enables the user to turn off/on the suspension of the particle could be a solution.

Status/Update:

- Optical and Fast simulation processes had switches.
- Released in v8.1 :
 - Created option to turn off neutron suspension in HPElastic models: added method `DoNotSuspend()` to *G4NeutronHPElastic* and *G4NeutronHPorLElastic*.
- So this is satisfied
- We propose to close this request Nov 2006.



Closed

Req.0604: Nested parameterizations

Originator: M. Asai (on behalf of medical users)

Responsible: J. Apostolakis

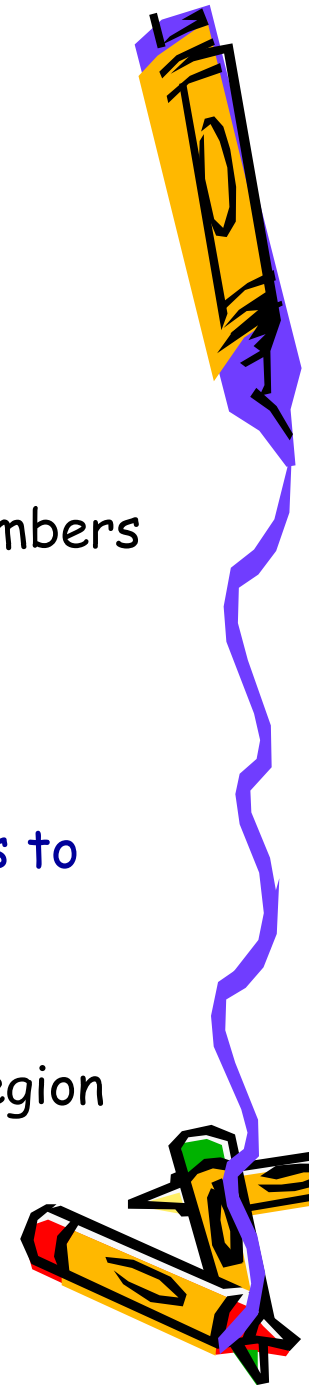
Access to a touchable from "Compute" methods in
G4VPVParameterisation class

- Position, material, etc., could be parameterized with copy numbers of parent volumes (mother/ancestors) in addition to its own.

Status:

Delivered G4 release 8.0

- Interface enables use of 'parent' touchable providing access to full volume tree information
- Parameterization must specify materials (new methods)
 - Corrected **problem** in accounting for these material in region scanning. Fix is **included** in Geant4 release 8.1
- Requirement SATISFIED.
- Proposed to close this completed requirement (Nov 2006)



Req 1101: Secondaries created this step

Requestors: Atlas, CMS, LHCb (W. Pokorski)

Responsible: M. Asai / T. Sasaki

For processing of "truth" information, Geant4 needs to provide

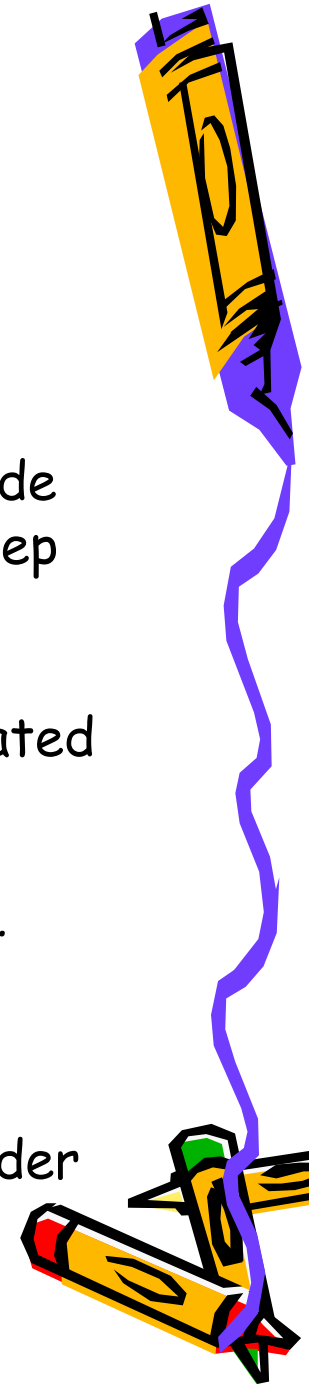
- the number of secondary tracks created in the current step
- a way to access these secondaries

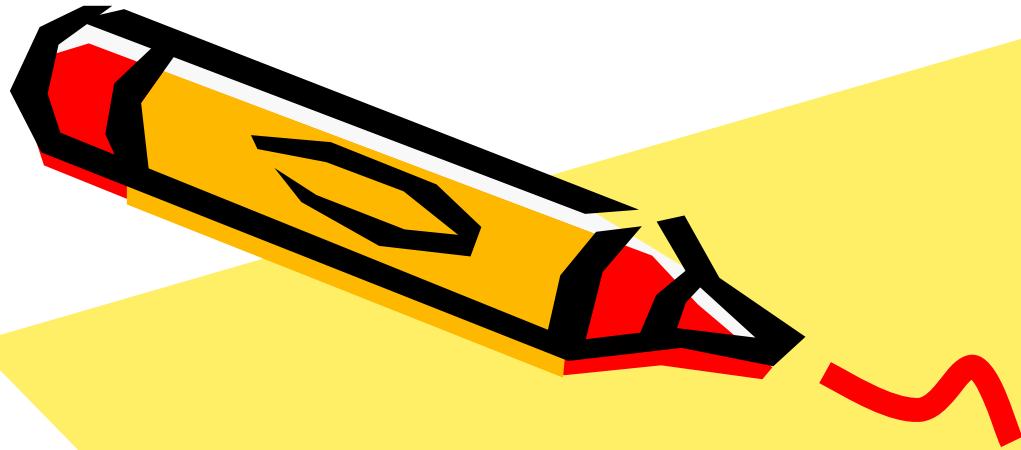
Update:

With 8.2 release, G4Step has a vector of secondaries generated in the particular step

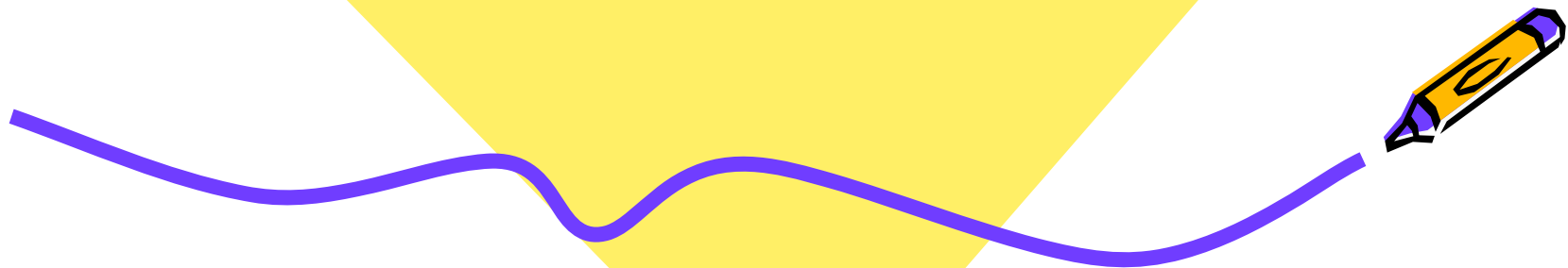
- This vector is unprotected - but do not modify it!
 - Reason is that it is also used by G4TrackingManager, ...
 - Users **must not modify** the contents
 - the stacking action is available to decide which are tracked, their priority, ...
 - We may revise this implementation in the future, in order to protect the vector.

We propose to close this request (Nov 2006).





Requirements closed/replaced
after Nov 2006 meeting



Recently closed

- Req.0313: Particle properties from an external source (**LHC**)
- Req.0403: Unique set of physics lists (**ESA - G. Santin**)
 - Unify physics lists, EM and hadronic
- Req.0501: Print-out of created processes should be optional (**LHCb, Atlas**)
- Req.0505: Improvements in hadronics (**HARP**)
 - Remaining sub-items have been split (1201, 1202).
- Req.0602: Protect high energy particles from loop killing (**CMS**)

Closed



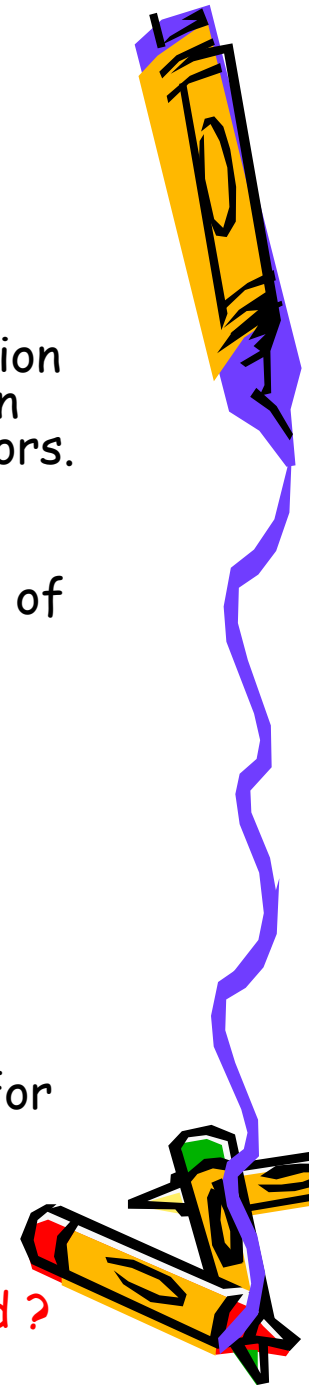
Req.0313: Particle properties from an external source

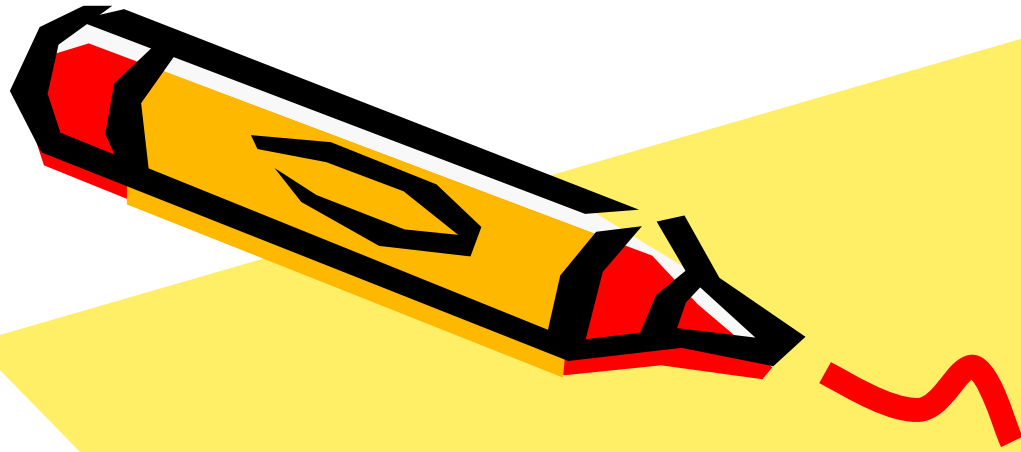
Responsible: M. Asai, H. Kurashige

Requestor: LHC

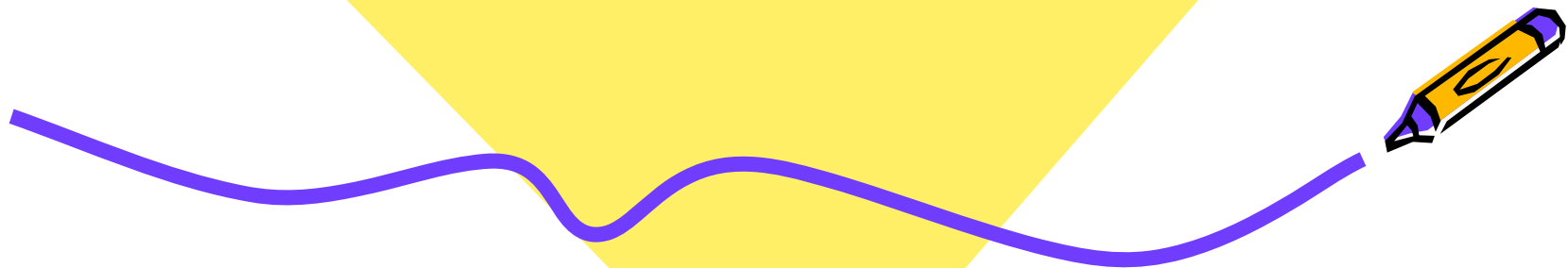
Description: "Request to study whether one can have a unique definition of the particle properties throughout all the physics models within G4 and preferably also consistent with the values used in generators. A candidate catalogue can be HepPDT, extracted from the PDG tables."

- Design study, implementation, performance tests, and assessment of effects on user code achieved 1H2005.
 - Refinements and resulting changes in G4 source, 2H2005.
- Latest (Nov 2005)
 - Developments scheduled for inclusion in Geant4 ver 8.0.
 - "non-static particle definition
 - revised hadronic physics lists.
- Restriction: Use for resonances is not foreseen now - would need studying
 - some physics models require particular values of mass/width for particular resonances (in general poorly measured).
- Note: gcc 2.95.X is not supported.
- Req. 1203 follows up the documentation issue.
- A concrete example/implementation was discussed - is one needed ?





Requirements closed/replaced in
April 2006 (Geant4 8.0 or 8.1)



Req.0403: Unique set of physics lists

Responsibles: V. Ivantchenko / G. Folger / M.G. Pia

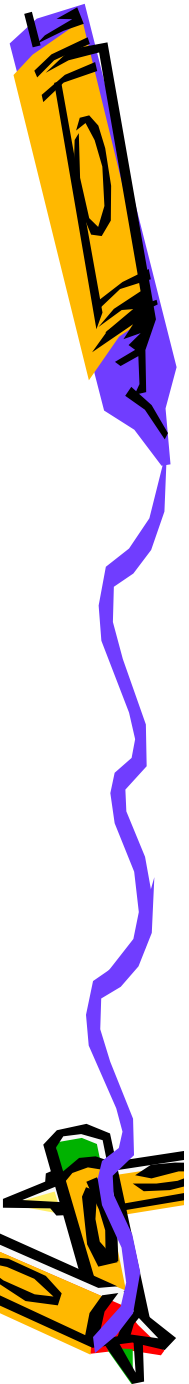
Requestor: ESA (G. Santin)

Description: "Unique set of physics lists (by use-case) and not two sets as now, one for EM and one for hadronics."

Latest

Physics lists (for hadronic use cases) in release Geant4 8.0 use the EM physics builder from EM(std).

Propose to close this - and **create new requirement**, if needed, for remaining issues with updated, precise information.



Req.0501: Print-out of created processes should be optional

Responsible: M. Maire / M.G. Pia

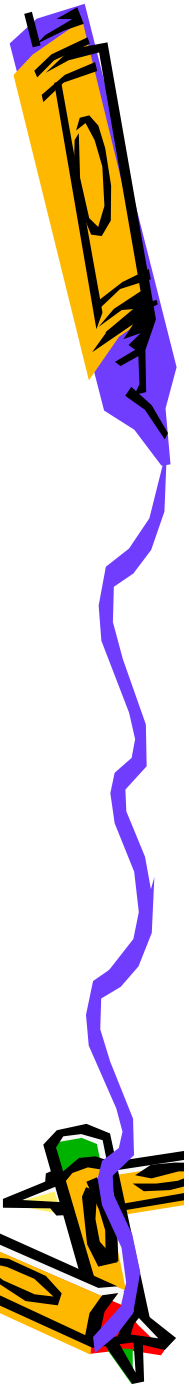
Requestor: LHCb, Atlas

Description: "The list of created processes is printed out at the beginning. Though it is useful for development and verification, it should be possible to switch-off for mass production run."

Status:

- Option in EM(std), verbose level -1 stops print-out.
- Identified need for 'PreInit' actions to trigger this
 - LHCb has agreed to try this soon.

Closed, as it confirmed OK by LHCb.



Req.0505: Improvements in hadronics

Responsible (new): D.Wright / A. Heikkinen (hadronics)

Requestor: HARP

Description: "HARP needs following improvements in the energy range of 1-15 GeV."

- Bertini Cascade robustness for production - OK
- Binary Cascade extension to pion incident - Done to 1.5 GeV
- CHIPS be available as alternative
- QGS model improvement to provide a smooth inclusive theta distribution in forward direction < 1 degree

Status

- G4 6.2 patch 2 included fix for a Bertini problem.
- Pion projectiles for Binary Cascade enabled in 6.0
 - Approach limited up to 1.5 GeV due to resonance data
- Improvements to QGS model theta distributions in forward direction (< 1 degree) underway.

Creating new single-issue requirement for different parts.



Req.0313: Particle properties from an external source

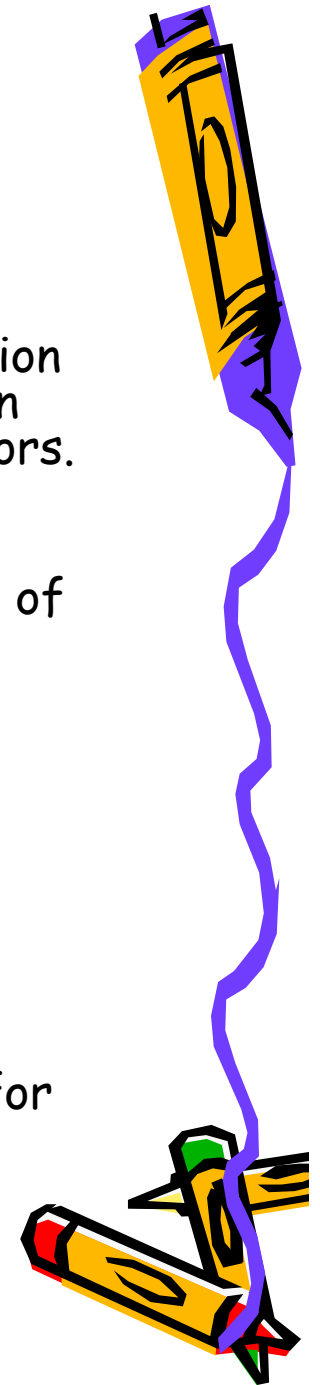
Responsible: M. Asai, H. Kurashige

Requestor: LHC

Description: "Request to study whether one can have a unique definition of the particle properties throughout all the physics models within G4 and preferably also consistent with the values used in generators. A candidate catalogue can be HepPDT, extracted from the PDG tables."

- Design study, implementation, performance tests, and assessment of effects on user code achieved 1H2005.
 - Refinements and resulting changes in G4 source, 2H2005.
- Latest (Nov 2005)
 - Developments scheduled for inclusion in Geant4 ver 8.0.
 - "non-static particle definition
 - revised hadronic physics lists.
- Restriction: Use for resonances is not foreseen now - would need studying
 - some physics models require particular values of mass/width for particular resonances (in general poorly measured).
- Note: gcc 2.95.X is not supported.
- Req. 1203 follows up the documentation issue.

closed



Req.0602: Protect high energy particles from loop killing

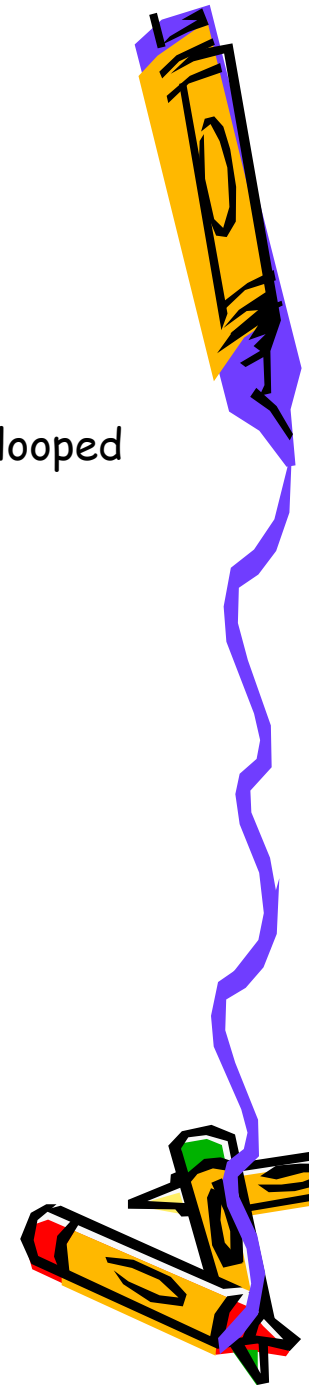
Originator: CMS: (P. Arce) Old title: Tracks killed by G4Transportation

Responsible: J. Apostolakis

- G4Transportation kills a particle if during an step in magnetic field it has looped more than 1000 times without finding the boundary
 - In CMS min-bias events in CMS saw this 58.1 times per event
 - Average energy lost is ~ 1 GeV per event
- Some tracks have $E > 1$ GeV (in 7K events highest was 13.7 GeV)

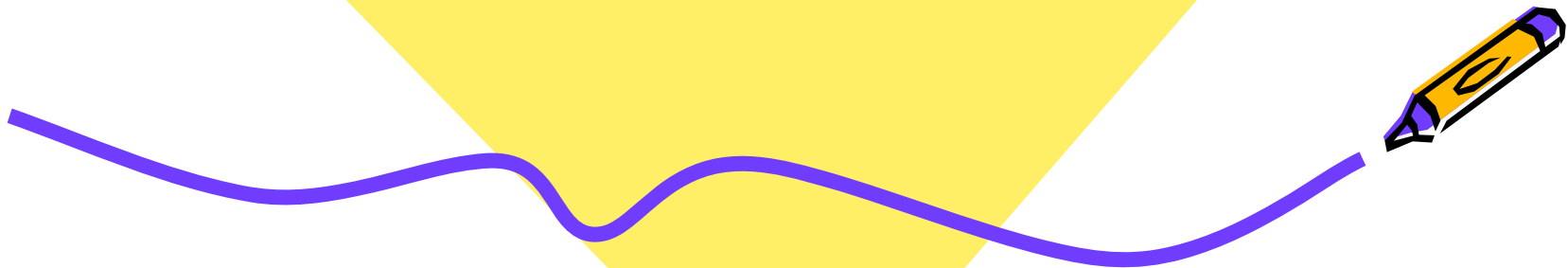
Updated status:

- Protection avoiding to kill particles above 100 MeV (unless stuck 10 times) added to Geant4 7.0
 - CMS now sees ~ 5 tracks killed per min-bias event (7.1p01, Nov05),
 - When using cuts for particles at around $100 \text{ MeV} < E < 250 \text{ MeV}$
 - Report also seeing same number with G4 6.2 for these conditions.
- Resolution of underlying issues needs further joint study.
 - What are the key characteristic of killed tracks?





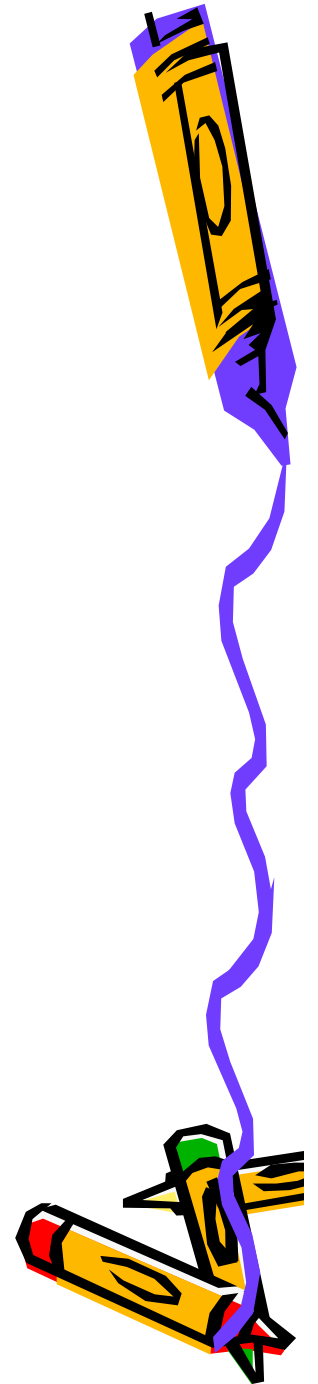
Requirements closed by
December 1st, 2005



Requirements addressed before G4 release 8.0

Requirements closed by G4 v7.1

- Req. 0701: Polarised Rayleigh scattering
- Req.0705: User Limits per region



706. Example for new particles

Originator : Atlas/CMS

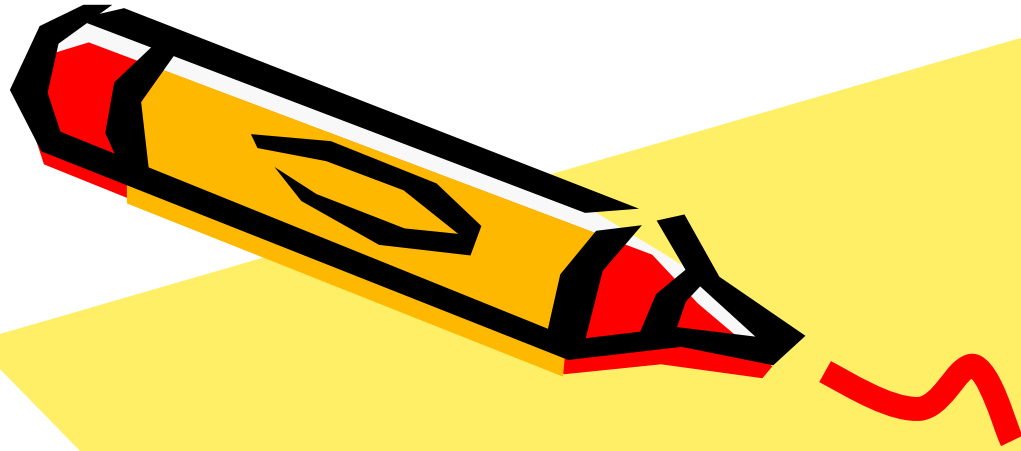
Responsible: J. Apostolakis, M. Asm

Example for creating new type of particles: creating a new particle and a modified primary transformer that creates tracks

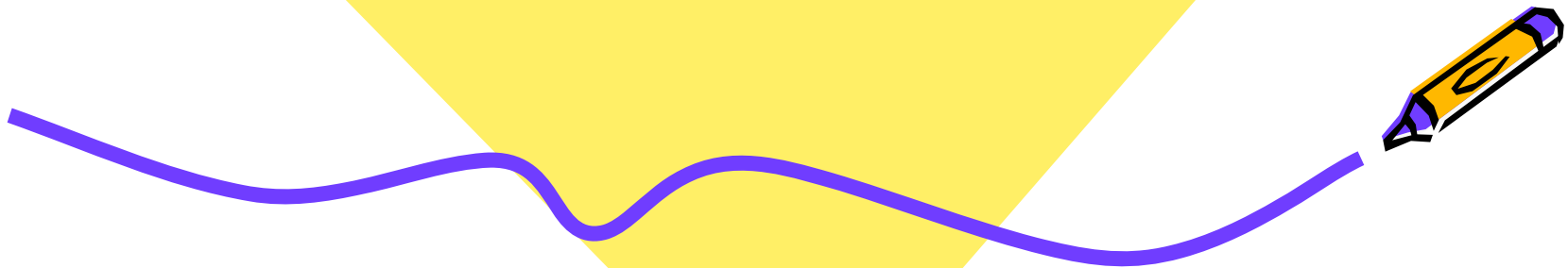
Use case: creating new heavy sleptons particles, to investigate potential new physics in LHC experiment detectors.

- Requestors have their own working codes. Thus they do not still request this.
- **Suspended**



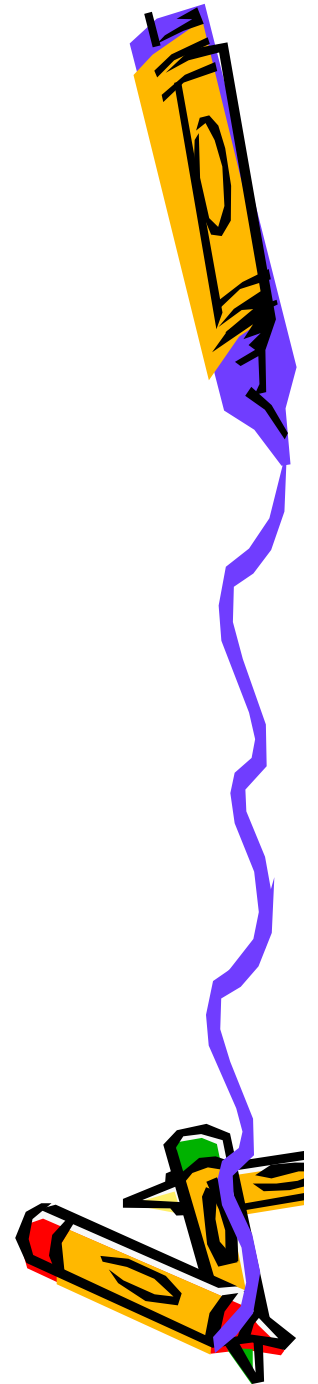


Requirements closed by
September 2005



Requirements closed by G4 v7.1

- Req. 0701: Polarised Rayleigh scattering
- Req.0705: User Limits per region



701. Polarised Rayleigh scattering

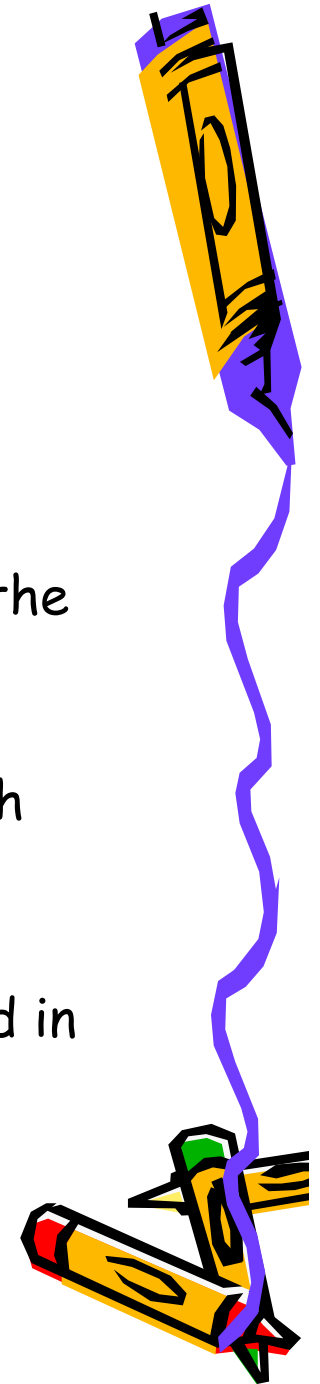
Originator: PoGO (Tsunefumi Mizuno)

Responsible : M.G. Pia

- Need Rayleigh scattering process that includes photon polarization, as neglecting it gives an artificially small modulation.
 - Rayleigh scattering cross section is not negligible in the energy of our interest, this needs to be solved to simulate accurately.
- Request to implement the polarization process in Rayleigh Scattering

Status

- A LowEnergy Polarised Rayleigh process was released in Geant4 7.1 (June 2005).
- Feedback from users would be appreciated.



705. User Limits per region

Originator: EXO experiment (SLAC)

Responsible: M. Asai

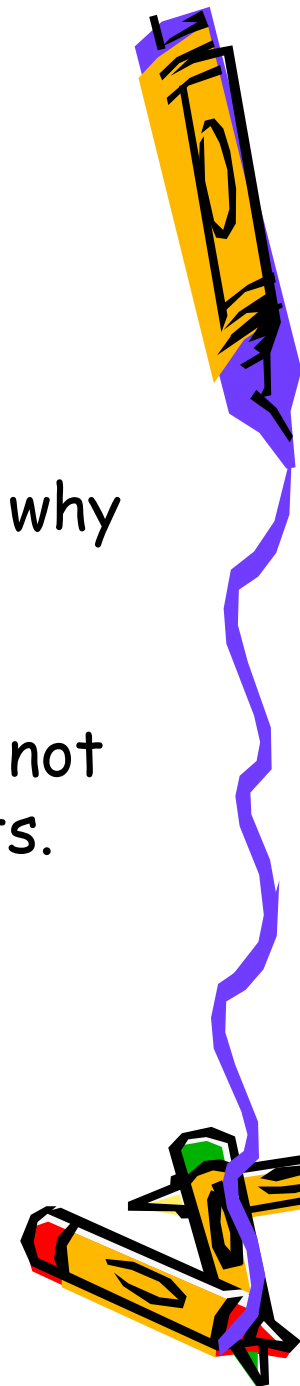
- Enable choice of User Limits per region
- "Given Geant4 allows defining cuts per region, why it does not allow defining `g4UserLimits` to a region?"

Notes: A first examination showed that this will not conflict with existing use cases for User Limits.

Status

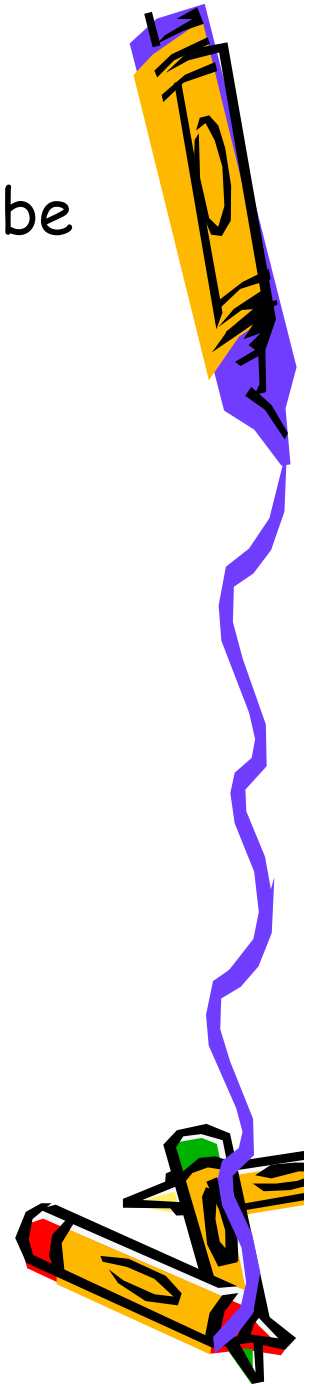
- Delivered with 7.1.
- To be closed.

Closed



Requirements closed by March 2005

- Req.0311: Parameters used in physics list should be well document and under user control.
- Req.0504: Geant4 release should be tested by Valgrind



Requirements closed by G4 v7.0

- Req.0208 : Enhanced saving and restoring of selected processes' cross-section tables AND Req.0306: Storage retrieval of cuts/physics-tables
- Req.0304: Exchange format for the geometry
- Req.0307: Region settings in reflected geometries
- Req.0312: Possibility of customizing volume/solid creation step
- Req.0503: Possibility of adding new particles for searches of new physics

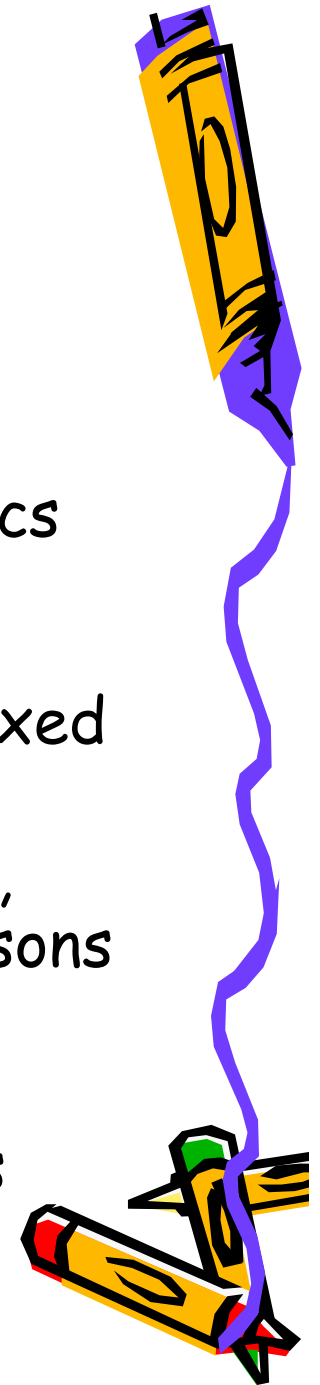


list should be well document and under user control

Responsible: H.-P. Wellisch

Description: "When the behavior of a specific physics list depends on parameters (for example on a momentum threshold) this should be clearly documented, specifying if such parameters are fixed or under user control."

- Note (from discussion): Major user modifications, such as these, would reduce the value of comparisons of the same physics list between users and experiments.
 - Physics list is free of user-tunable parameters except production thresholds.
- To be closed.



Req.0504: Geant4 release should be tested by Valgrind

Responsible: G. Cosmo, S. Sadilov

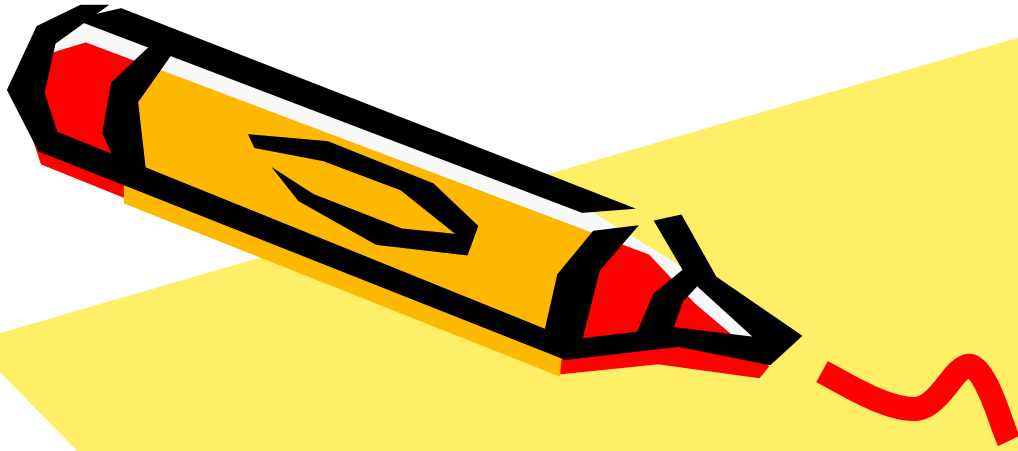
Requestor: LHCb

- Usage of Valgrind has been part of the release procedure since over two years
 - previously Insure++ was used for memory leaks & runtime error reports.
 - Selected system tests are checked.

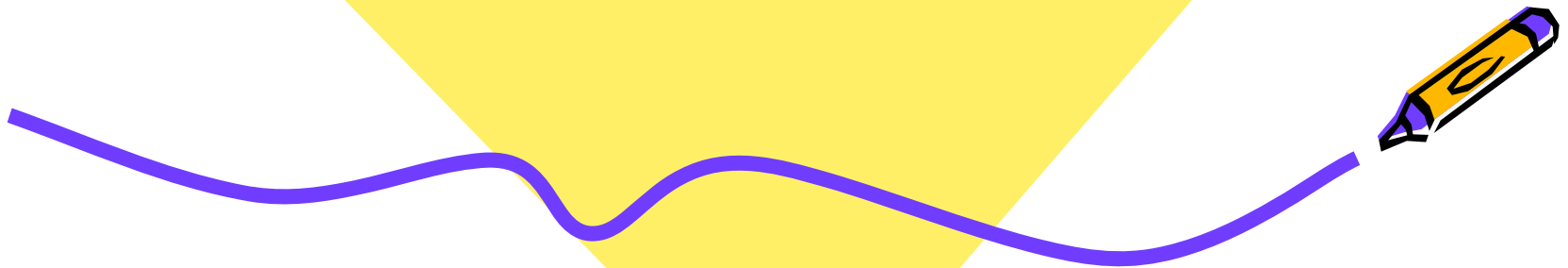
Problems are reported to developers.

- Developers are requested to fix the reported problems
 - in particular those reported by Valgrind involving errors at runtime.
- To be closed.





Requirements closed by
March 2005



Recently-closed requirements

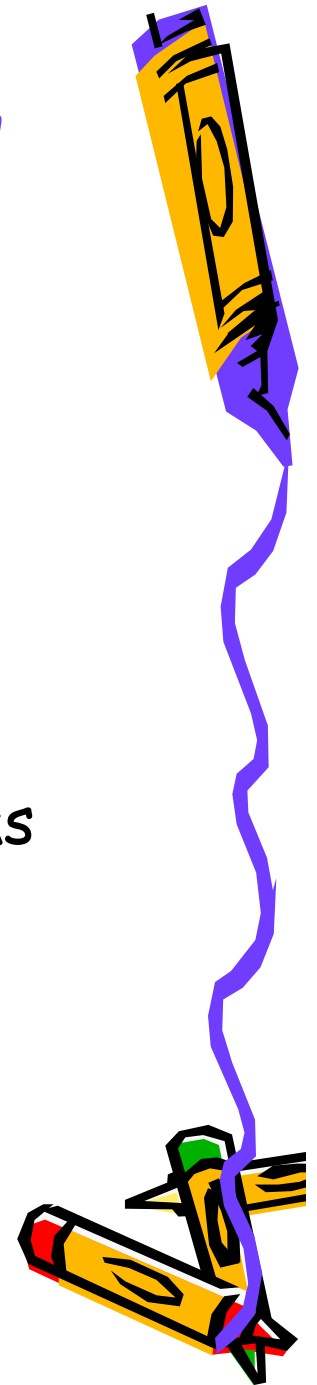
- Req.0201 : Killing the primary in (electron) Bremsstrahlung
 - Feature released with G4 6.2
- Req.0301: Robustness of G4 and improved diagnostics to give more handles to solve problems
 - Feature released with G4 6.1
- Req.0302: Reproducibility when resuming of runs at an event different from the first one
 - Fix has been made at G4 6.1
- Req.0305: Ability to release the memory of an Allocator 'stack' on request
 - Feature released with G4 6.2
- Req.0308: Creating a new daughter particle AND Req.0310: Consistent behavior across use cases
 - Feature released with G4 6.2



Req.0208 : Enhanced saving and restoring of selected processes' cross-section tables

Responsible: M. Asai, H. Kurashige

- Some enhanced verbiages have already been released with Geant4 6.0 and 6.1.
 - Reshuffling of the order of materials/cuts is included in 6.1.
- Design study and some partial implementation has been done.
 - Picking up some usable tables from a file and calculate only unavailable tables.
 - Work is in progress and expect to be released at 7.0.
- Requirement to be closed.

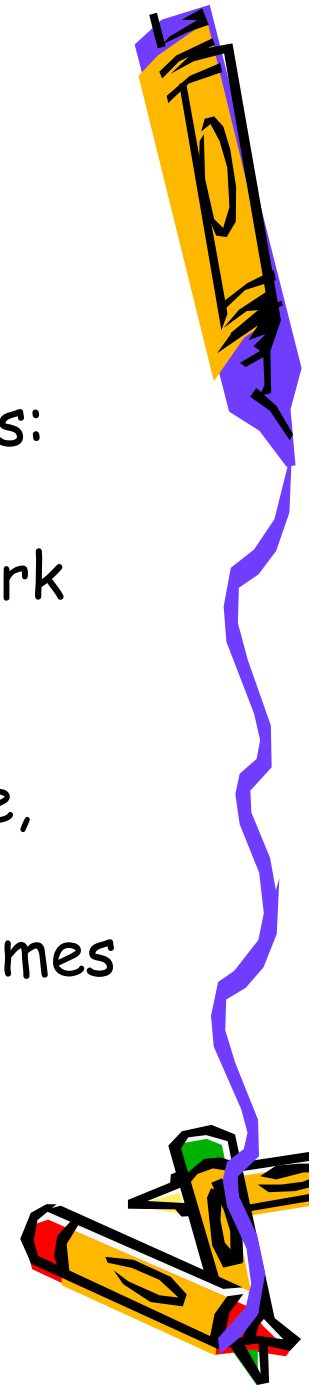


Req.0304: Exchange format for the geometry

Responsible: G. Cosmo

Description: Enable use of an external file for exchanging geometry description. Potential options: GDML, DDD, other (?).

- The solution G4 proposes is GDML in the framework of the LCG project. The GDML implementation is already partially done (the input part).
- First version of the GDML writer released in June, and available with GDML 2.0.0.
- Data model extended to cover parameterized volumes and replicas.
 - Currently under testing.
- Model has been extended to cover missing solids (polycone, polyhedra,...).
- Coming with 7.0.

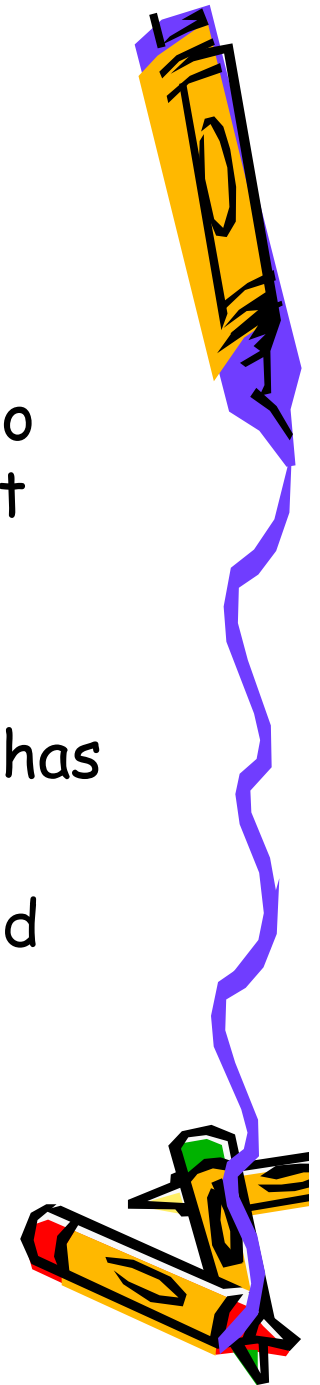


Req.0306: Storage retrieval of cuts/physics-tables

Responsible: M. Asai, H. Kurashige

Description: Extend retrieval of physics tables to case where the geometry is built in a different order than at storage.

- Note: this is related to Req.0208
- Design study and some partial implementation has been done.
 - Picking up some usable tables from a file and calculate only unavailable tables.
 - Work is in progress and expect to be released at 7.0 with an example.
- Requirement to be closed.

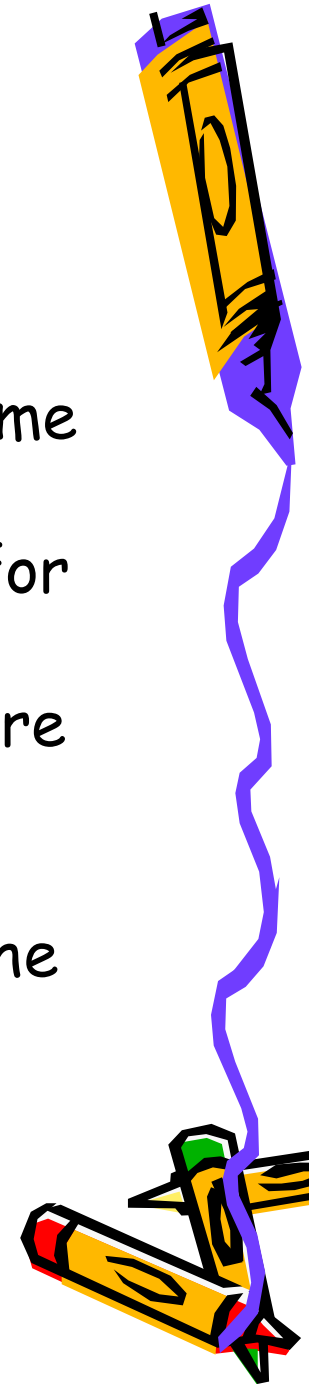


Req.0307: Region settings in reflected geometries

Responsible: G. Cosmo

Description: "If a region is assigned to a logical-volume and the volume is placed n-times in the detector, the region cuts are applied to all n regions (valid for all daughter volumes recursively). If the same volume is reflected m-times, the region settings are not applied to the reflected volumes." Example: when reflecting a whole endcap of a subdetector, we need to have the same region cuts applied to the reflected volume hierarchy (same physics in both endcaps).

- It has been implemented and to be released with 7.0.



Req.0312: Possibility of customizing volume/solid creation step

Responsible: G. Cosmo

Description: "E.g. add a call to a user routine when a volume is created in order to add attributes to the volume (detectorName::, other?)"

- It has been implemented and to be released with 7.0.

Closed



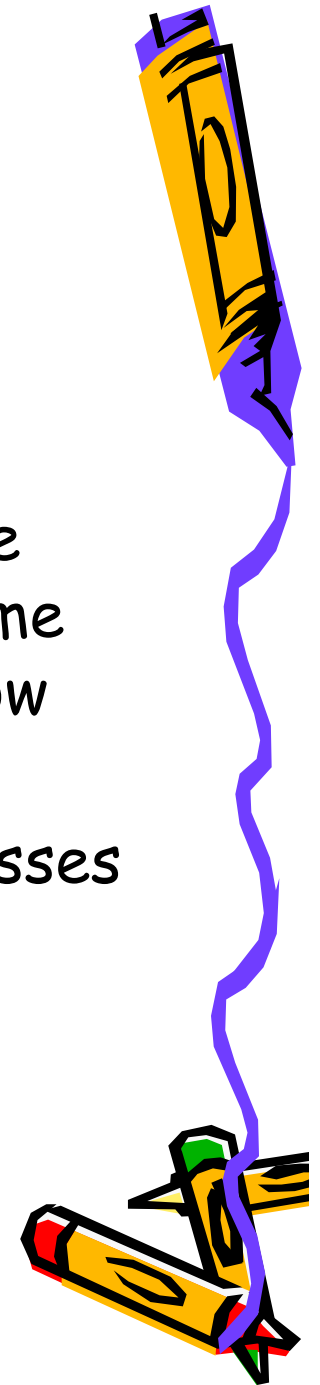
Req.0503: Possibility of adding new particles for searches of new physics

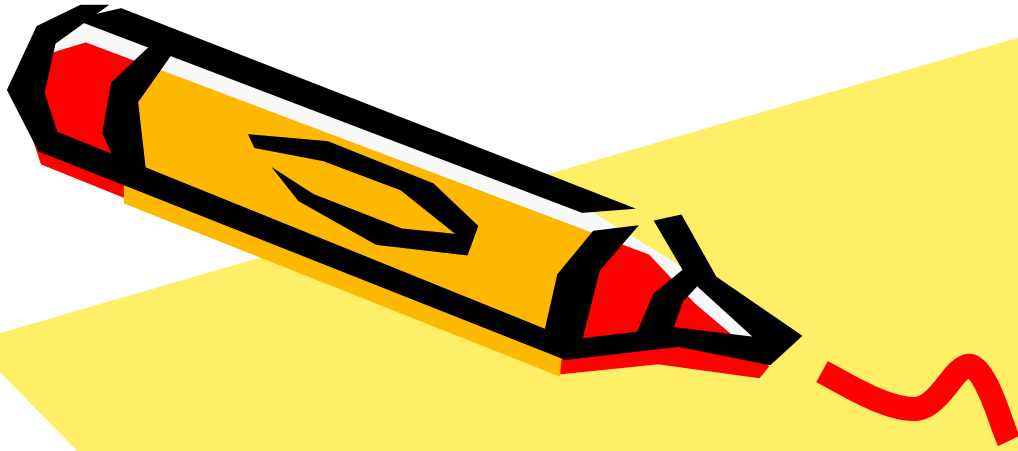
Responsible: M. Asai

Requestor: ILC, CMS, Atlas

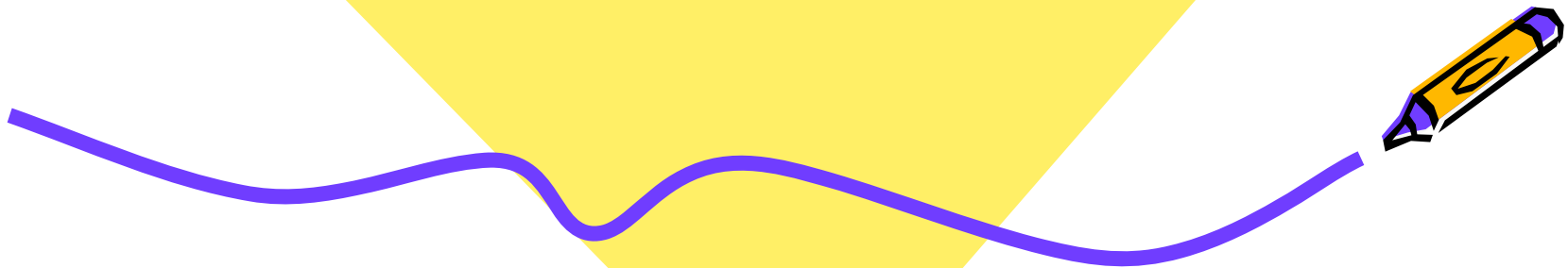
Description: "In searches for new physics where the particles have peculiar interactions (e.g. SUSY), some of these new models need to be benchmarked. How can we modify G4 to do this?"

- `G4UnknownParticle`, `G4UnknownParticleDecay` classes are introduced. `G4PrimaryTransformer` class becomes abstract to enable the user to add new particle types which are exotic to G4.
- Features are to be released at 7.0 with a new extended example.





Requirements closed by
October 2004

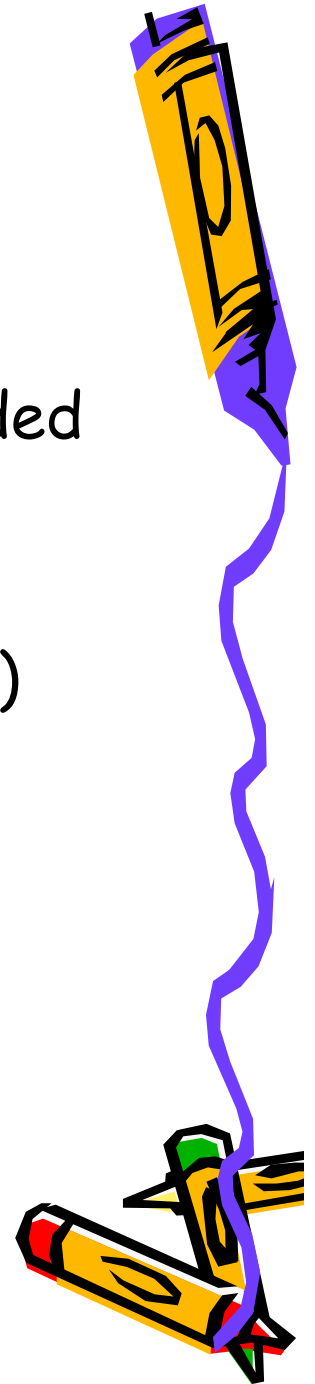


Req.0201 - Killing the primary in (electron) Bremsstrahlung

Responsible: V. Ivantchenko

- Concrete process for this purpose has been provided to the requestor.
 - And being publicly released with 6.2.
- For potential 'general case', an example (TestEm1) includes the implementation class.

Closed

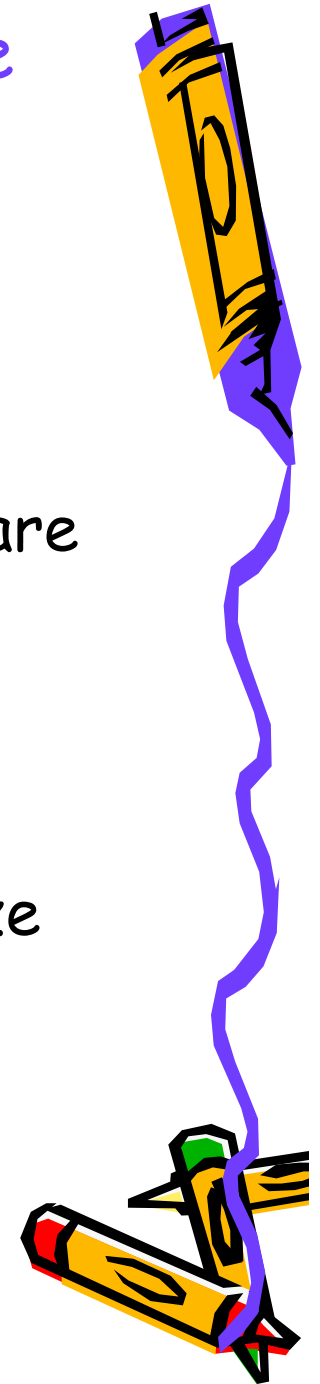


diagnostics to give more handles to solve problems

Responsible: H.-P. Wellisch / G. Cosmo

Description: The LHC experiments CMS and LHCb are entering production now. Occasional crashes are seen in simulations of files containing several hundred events. These problems will have to be tackled and removed. Additional information given/printed during the abort will help to localize the problem.

- Some enhancements have been released at 6.1.
- Proposed to be closed.

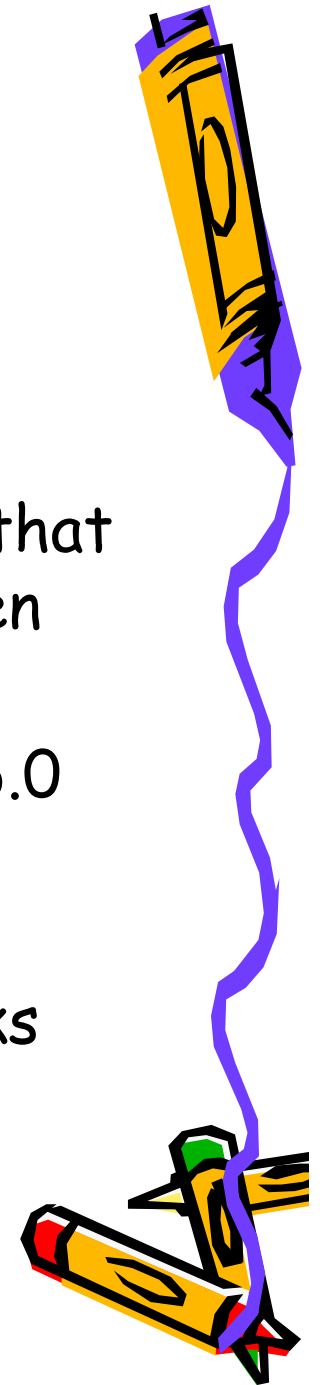


of runs at an event different from the first one

Responsible: G. Cosmo

Description: For debugging purposes, it is required that one can reproduce a particular event exactly, when one starts the simulation from that event.

- Some fixes for uninitialized variable were in G4 6.0 and experiment programs.
- It should be checked again, in a common effort between the experiments and G4 whether it works with the present G4 6.1.



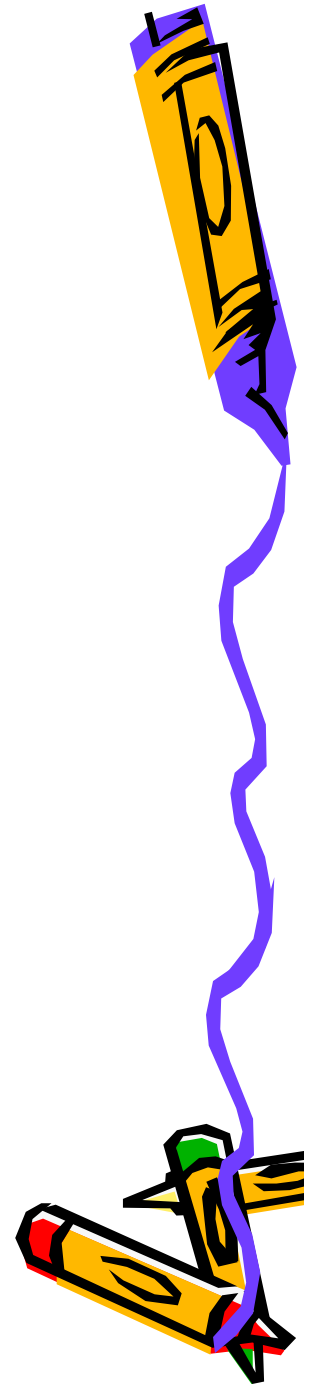
Req.0305: Ability to release the memory of an Allocator 'stack' on request

Responsible: G. Cosmo

Use case: "Step behavior is seen in the memory usage during event file simulation"

- New G4Allocator and related classes have been worked out and released with 6.2 p01.
- Requirements to be closed

Closed



req.0000: creating a new daughter particle

Responsible: H.-P. Wellisch

Description: The possibility to assign a new track ID (creating new particle) to a hadron undergoing inelastic scattering, in all physics lists, and steerable from the physics lists. The choice should be under user control since it depends on specific studies. This is necessary to understand the behavior of the tracking for example where in the leading outgoing particle has very different kinematics from the incoming particle it can be misleading [to reconstruction programs to see this] as a single particle.

- New feature is released with 6.2.
- Requirements to be closed after verification.

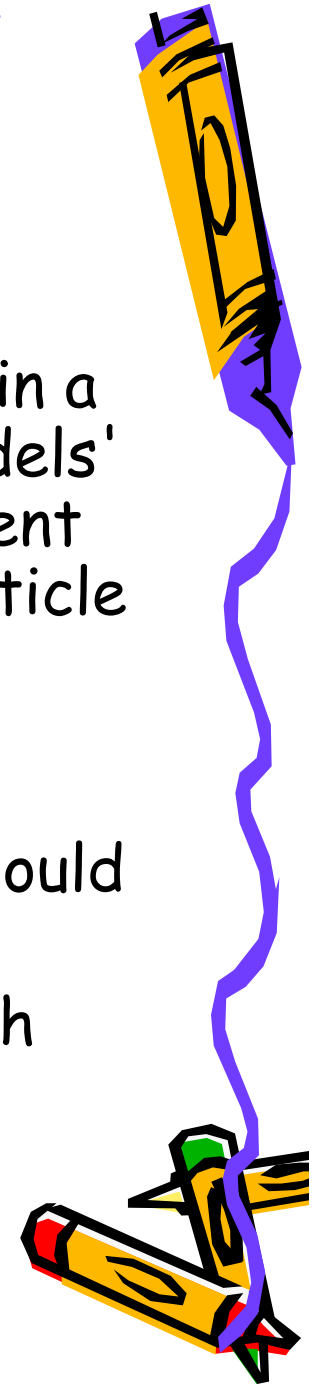


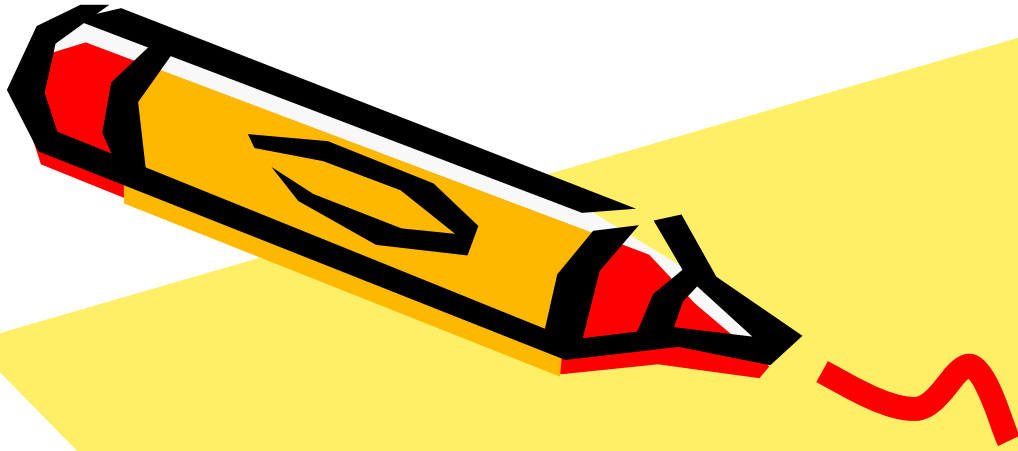
Req.0310. CONSISTENT BEHAVIOR ACROSS USE cases

Responsible: H.-P. Wellisch

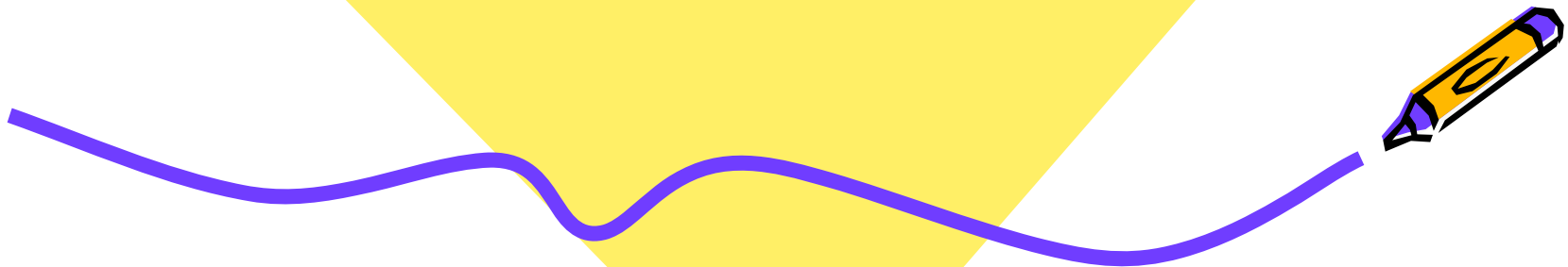
Description: "A physics list should be implemented in a coordinated way regarding the output of the models' behavior, so that such behavior would be consistent as much as possible. For example an incoming particle should always be (or not be) killed in all inelastic scattering models of a given physics list. In the cases where this is not possible (due to specific characteristics of the models) the difference should be clearly described."

- This requirement is identified to be identical with Req.0308.
- New feature is released with 6.2.
- Requirements to be closed after verification.



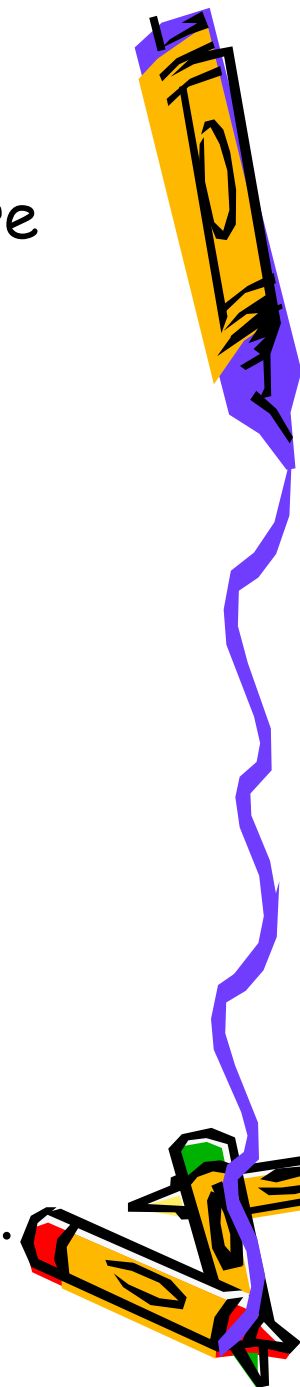


Requirements closed by May 2004



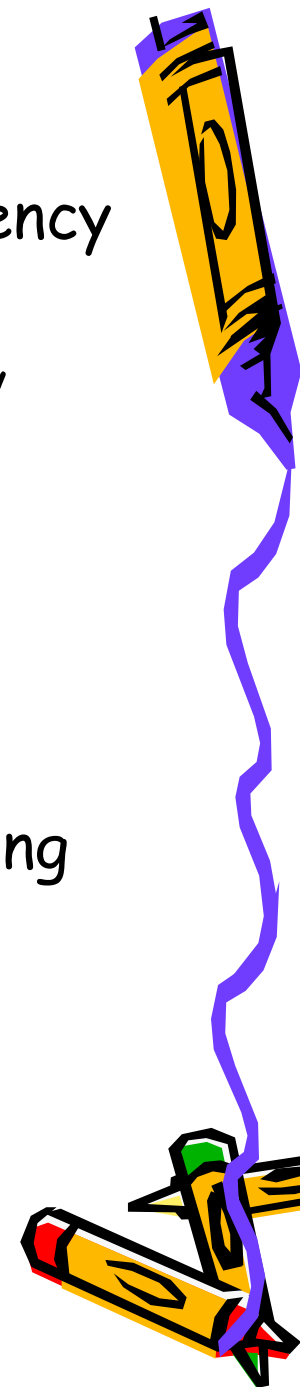
Recently closed requirements

- Req.0101 : Access to the Track properties before hadronic processes are invoked
 - Feature released with G4 6.1
- Req.0107 : Installation kit which contains all packages
 - <http://geant4.slac.stanford.edu/g4cd/>
- Req.0203 : Pre-defined decay products
- Req.0204 : User-defined MC truth
- Req.0205 : Maintaining event generator information
- Req.0207 : Depositing additional information in calorimeter hit
 - All of required features released with G4 6.0.



Recently closed requirements

- Req.0206 : Physics modeling options and consistency
 - Feature released with G4 6.1
- Req.0202 : Abstraction of geometry navigation / modeling
 - Feature released with G4 6.0
 - Further requirements awaited
- Req.0209 : Physics lists capabilities and choices
 - Since G4 6.0, physics lists are distributed along the public release.



Req.0101 : Access to the Track properties before hadronic processes are invoked

Responsible: H. Kurashige, H.P. Wellisch

- The solution proposed is to add a new user hook in the hadronics processes to enable the user to inspect the final state for the hadronic processes.
- Design iteration to enable the placement of such a hook implies removal of ParticleChange and G4Track from hadronics except for level 1 framework. This was done in 6.0.
- The user hook is to be seen in the context of new needs of CMS for monitoring, and interests to do microscopic NIEL calculations. The requirement will be closed in the next minor release.

Closed

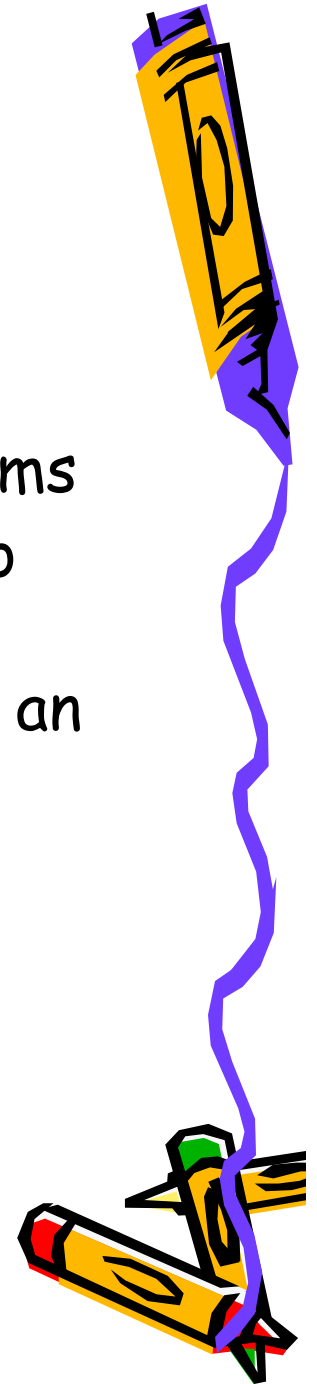


Req.0107 : Installation kit which contains all packages

Responsible: G. Cosmo / G. Folger

- We could offer it on a best-effort basis
 - as many customers require only current systems
 - new packaging will require additional effort to maintain, document, etc.
- For example, at the moment SLAC is maintaining an installation kit for Linux and Windows
<http://geant4.slac.stanford.edu/g4cd/>

Closed

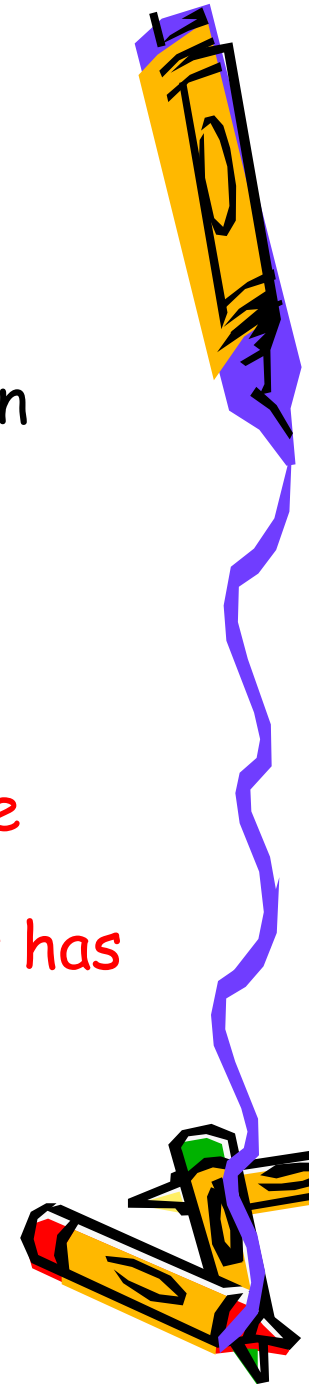


Req.UZUZ : ABSTRACTION OF geometry navigation / modeling

Responsible: G. Cosmo

- First version of abstract G4Navigator provided in Geant4 6.0
 - first simplification/consolidation of interface
 - virtual methods for key functions
 - Feedback awaited (A. Gheata, BaBar)
- The integration of the BaBar transportation code into Geant4 as an alternative to the standard transportation is not yet started. Some progress has been made here, but there are still significant differences between the two codes that prevent them from being packaged together.
- Discussion between G4 Geometry WG and BaBar at workshop.

To be verified
by user



Req.0203 : Pre-defined decay products

Req.0204 : User-defined MC truth

Req.0205 : Maintaining event generator
information

Req.0207 : Depositing additional information in
calorimeter hit

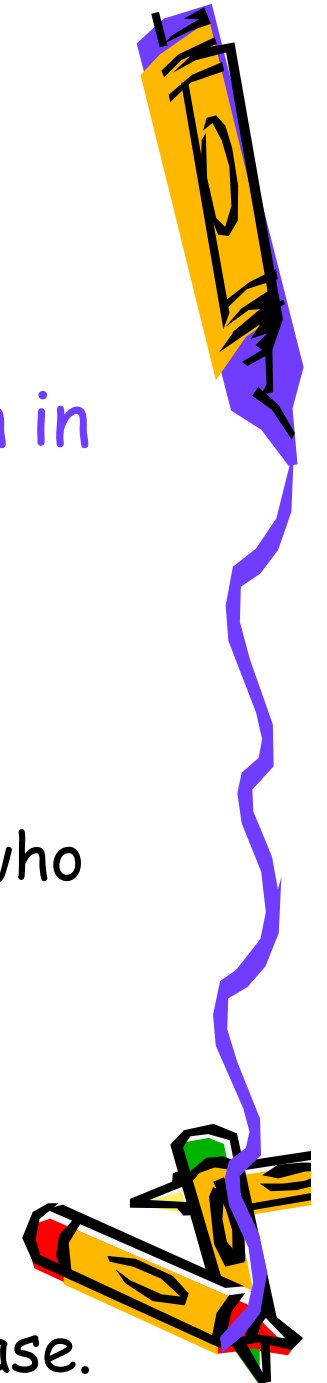
Responsible: M. Asai

- All of required functionalities have already been released with Geant4 6.0.
- A sample code had been distributed to the users who requested these requirements and who expressed interests.

<http://www.slac.stanford.edu/~asai/NLD1.tar.gz>

- A new example (exampleN08) derived from this sample code is under construction and it is expected to be released with the next public release.

Closed



Req.0200 : physics modeling options and consistency

Responsible H.P. Wellisch

- New set of physics lists based on Geant4 6.0 will be available by the end of March 2004.
- If time permits, at that time the steering of the tailoring will be (optionally) independent of the G4UI (CMS request).

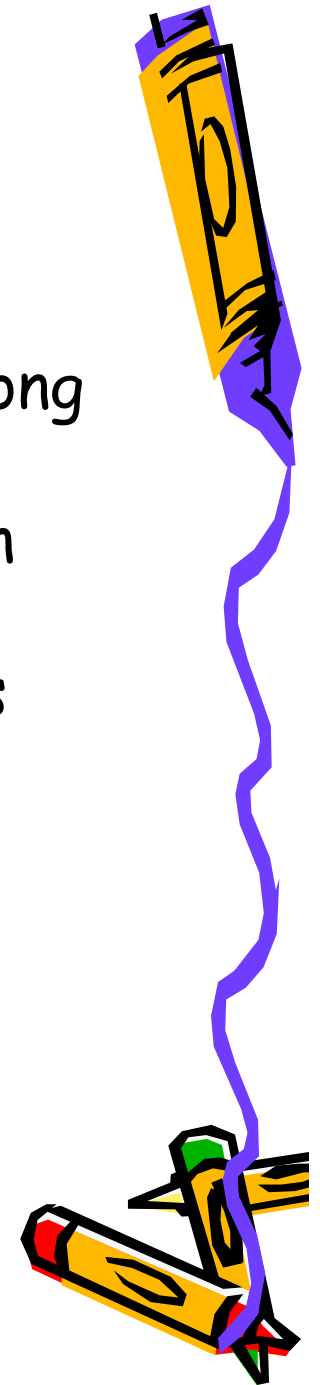
Closed



Req.0207 - Physics lists capabilities and choices

Responsible: H.P. Wellisch

- Since Geant4 6.0, physics lists are distributed along the public release.
- The physics lists will continue to be distributed in major geant4 releases.
 - Release notes were included in the last physics lists update and will be part of the 'standard' maintenance process.
- A physics list, when it is created, will print
 - information as to what physics is included,
 - it will be in the next revision
 - what use-cases it can be used for
 - it will be done once maintenance concerns for correctness are resolved.

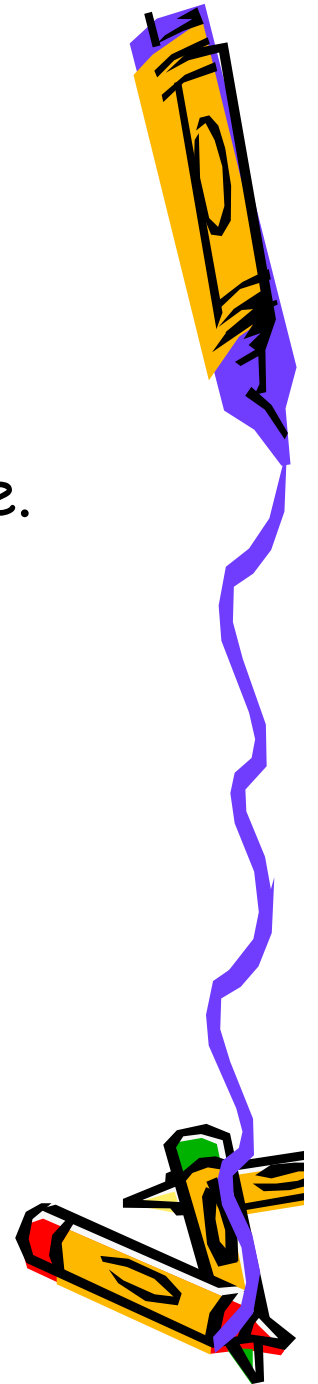


Req.0210 : Correction of known problems

Responsible: J. Apostolakis

- Agreement was reached at the previous meeting
 - to address open issues, to the degree possible.

Closed

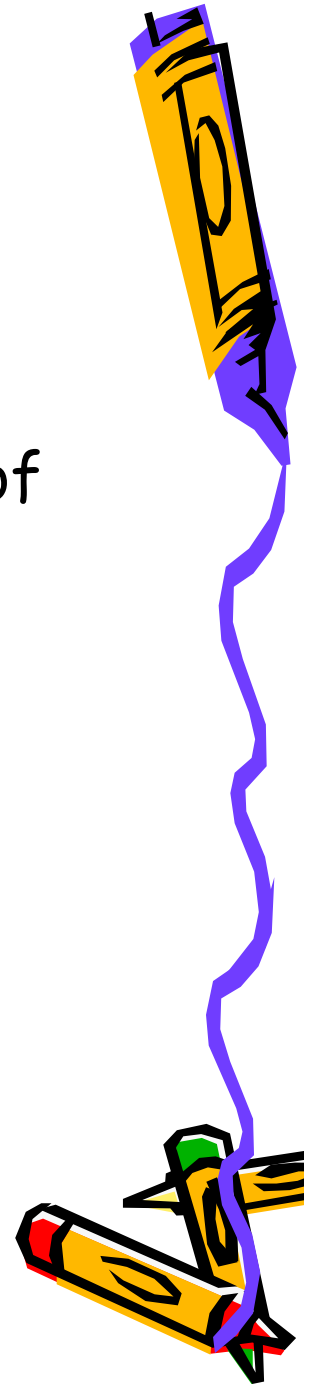


Req.0211 : Geant4 release type and frequency

Responsible: J. Apostolakis / G. Cosmo

- The proposal was discussed only briefly at last meeting, by common agreement. An explanation of current practice was made.
- G4 is requested early communication of major change requests.
- No further action is currently foreseen.

Closed



New proposed 'platforms': gcc 3.4.3

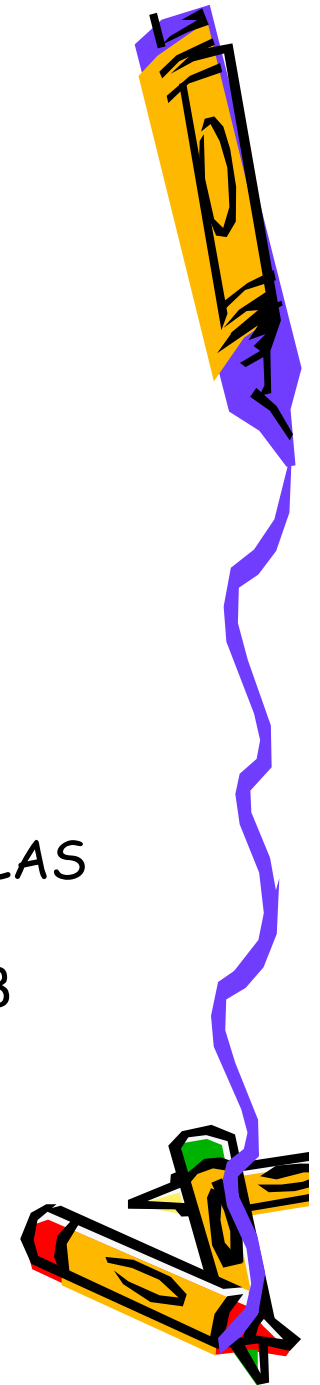
Originator: ATLAS (D. Quarrie, A. Nairz)

Time: March 2005

- ATLAS, and the other LCH experiments, intend for the next two supported platforms to be:
 - gcc 3.4.3 with SLC3 in 32-bit mode (IA32)
 - gcc 3.4.3 with SLC3 in 64-bit mode (AMD64)
- It is believed that these are binary compatible
 - with both Intel & AMD 32-bit platforms,
 - and EM64T Intel 64-bit platforms (correspondingly).
- The [requested] time slot is in time for a prototype ATLAS [software] port [to be] available in Sept 2005.
- Also interested to maintain compatibility with CLHEP 1.8 for approximately until July 2005.

Status:

- Gcc 3.4.x ported, and it is checked regularly
- CLHEP 1.8 maintained until 8.0 (Dec 2005)
- Propose to be closed (Mar 2006)



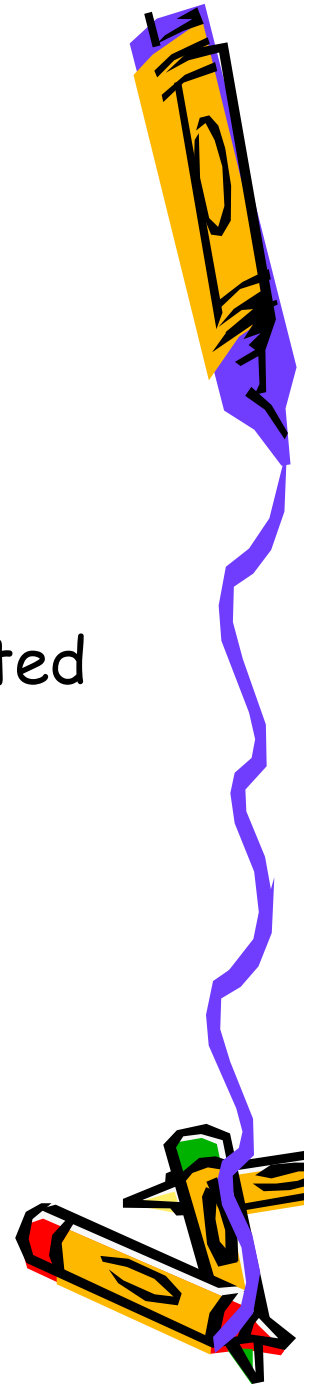
Req 1101: Secondaries created in a step

Requestor: Atlas, CMS, LHCb (W. Pokorski)

Responsible:

To enable the holding of "truth" information, the toolkit must

- Provide the number of secondary tracks created in the current step.



Req 1102: Identifying a process

Requestor: Atlas, CMS, LHCb (W. Pokorski)

Responsible:

A process (physical or 'general') must hold an identity (id) that the user can use to determine

- which class of process (EM, hadronic, optical, decay, 'transport', biasing, ..);
- which physical process it models (eg Compton, photoelectric, Bremsstrahlung, ..), if any;
- the unique Geant4 process (G4Transportation)



Req 1103: New requirements (Dec 2005)

Requestors: Atlas, CMS, LHCb (A. Dell'Acqua, W. Pokorski, M. Stavrianakou)

To provide to a user class implementing "truth holding" a snapshot of the current interaction, including position, incoming particle, all secondaries created (as single entity).

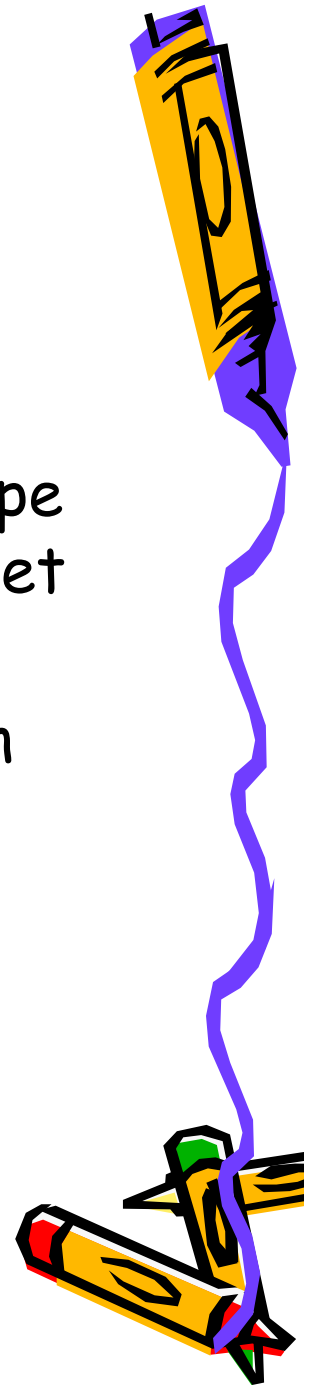


Req 1104: Composite User actions

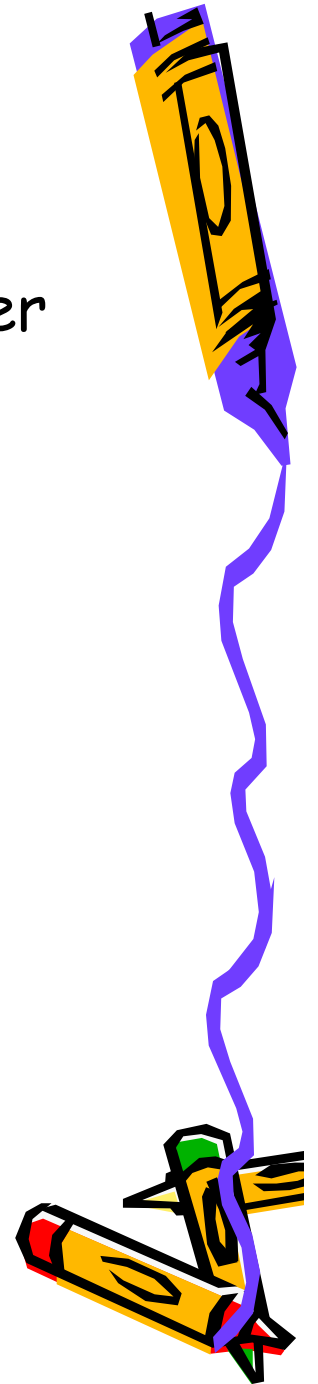
Requestors: Atlas, CMS, LHCb.

Provide a 'composite' action of each user action type (Run, Event, Tracking, Stepping) that can call a set of registered sub-actions.

- These sub-actions shall be called by Geant4 in the order in which they are registered.



- Provide a 'global' verbosity setting, which the user can use to request minimum verbosity from all verbose Geant4 components.
 - Requestor: LHCb (F. Ranjard)



Requirements addressed in G4 release 8.0

- Req. #: Title
- Req 0313: Particle properties from an external source
- Req.0604: Nested parameterizations

Other actions

- Req.0602: Protect high energy particles from loop killing

