

Update on Requirements

54th Geant4 Technical Forum
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Virtual Meeting

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On behalf of the Geant4 Collaboration

Requirements Tracking System Page:
<https://jira-geant4.kek.jp/secure/Dashboard.jspa?selectPageId=10000>

Open requirements

4702 : Inclusion of γ polarization effects in the high energy EM models

- ◉ Originator:
 - > CMS
 - > 47th Technical Forum ([link](#))
- ◉ Scope:
 - > Include Linear Polarization into HE γ Models
 - > This has potential usage in the analysis of $H \rightarrow \gamma \gamma$
 - Polarization planes of scalar (pseudo-scalar) particle to γ 's are parallel (perpendicular)
 - Investigate the effect of polarization in the shower shape of photons
 - May give additional handles to distinguish direct γ 's from H decay from BG
- ◉ Responsible:
 - > Vladimir Ivantchenko
- ◉ Status:
 - > In progress, continuing this year.
 - > Open.

5002 : Support for "sub-event" parallelism across G4 threads

- ◉ Originator:
 - > ALICE
 - > Page 6 of [Requirements from energy frontier](#)
- ◉ Scope:
 - > ALICE handles very big events
 - > These would be processed faster if one event could be split into "sub-events" (= {subset of primary tracks}) -each processed on one thread- with merging back of sub-events into the event at the end
- ◉ Responsible:
 - > Makoto Asai
- ◉ Status:
 - > This comes along with the tasking model.
 - > Reproducibility is the main issue
 - > In this year work plan
 - > Open.

5005 : Neutron self-shielding effect

- ◉ Originator:
 - > LZ (LUX-ZEPLIN), SuperCDMS
 - > Page 7 of [Requirements from intensity frontier](#)
- ◉ Scope:
 - > Significant reduction of the neutron flux in material when neutron energy is in the resonance region
 - The capture process can reduce the flux at one position in a crystal creating a kind of shadow in which the downstream atoms see a reduced flux (a ~10% effect)
- ◉ Responsible:
 - > Vladimir Ivanchenko
- ◉ Status:
 - > Valid requirement but big work
 - > Needs theoretician support as well as manpower.
 - > Collection of publications and references on-going.
 - > Not expected to be concluded this year.
 - > Open.

5006 : Improve simulation of gamma induced neutron background

- Originator:
 - > LZ (LUX-ZEPLIN), SuperCDMS
 - > Page 7 of [Requirements from intensity frontier](#)
- Scope:
 - > Low energy gammas producing neutrons in various materials can generate a significant background
 - > But photo-nuclear process does not model this well below 30 MeV
 - > Point that G4LEND gamma models might resolve the issue
- Responsible:
 - > Vladimir Grichine
- Status:
 - > Valid requirement and possible solutions under verification.
 - > Alternative model to treat low-energy gamma-nuclear interactions is available in 10.7. Need to study its effect.
 - > Continuing this year, in program of work.
 - > Open.

5007 : Improve electro-nuclear models

- ◉ Originator:
 - > Markus Diefenthaler (EIC Center, EICUG) for:
 - JLAB 12 GeV Science program
 - Electron-Ion Collider (EIC)
 - > Page 12 of [Requirements from nuclear physics experiments](#)
- ◉ Scope:
 - > Electro-nuclear models rely on Weizsacker-Williams approximation.
 - > Not sufficient for high-intensity and high precision electron scattering.
 - > The full, off-shell electron scattering vertex must be implemented for nucleons within the nuclear target.
- ◉ Responsible:
 - > Vladimir Grichine
- ◉ Status:
 - > Big work, but good progress
 - > Note that new data-sets have been introduced in 10.7 : might bring some improvements also in this area, to be evaluated.
 - > In this year program of work
 - > Open.

5008 : Make EPICS2017 models (electrons, photons) as an alternative to Livermore

- ◉ Originator:
 - > General demand
 - > Page 11 of [Requirements from Medical and bio science](#)
- ◉ Scope:
 - > EPICS2017 : Electron and Photon Interaction Cross Sections
 - Mention : these data supersede all earlier versions of the data libraries EADL, EEDL and EPDL
- ◉ Responsible:
 - > Sébastien Incerti
- ◉ Status:
 - > On-going in framework of thesis of Z. Li (CENBG+CERN EM group)
 - Thesis will end in 2022
 - > Very good progress, needs to be polished for this year release.
 - > Open.

5009 : Extend energy and material coverage of G4-DNA beyond DNA and liquid water

- ◉ Originator:
 - > General demand
 - > Page 11 of [Requirements from Medical and bio science](#)
- ◉ Scope:
 - > Develop track structure models for specific materials (beyond liquid water and DNA)
 - > Extend energy coverage of existing models
 - ex. option4 is limited to 10 keV for electrons
- ◉ Responsible:
 - > Sébastien Incerti
- ◉ Status:
 - > On-going.
 - > Gold G4-DNA model will be included in 2021 beta release.
 - > Open.

5010 : Physics models for ions below 1 MeV/u for Boron Neutron Capture

- ◉ Originator:
 - > General demand
 - > Page 12 of [Requirements from Medical and bio science](#)
- ◉ Scope:
 - > Allows usage of Geant4 in BNC therapy field
- ◉ Responsible:
 - > Jose Ramos-Mendez (University of California, San Francisco)
 - Put Sébastien Incerti temporarily
- ◉ Status:
 - > Work taken care by Naoki Domínguez (Ph.D. student at BUAP, México), and José Ramos (UCSF)
 - > In this year program of work
 - > Open.

5201 : To extend “force collision” biasing to charged particles

- ◉ Originator:
 - > NA62
- ◉ Scope:
 - > A “force collision” biasing scheme exists in Geant4, but is adapted to neutral particles.
 - > NA62 uses a K⁺ beam
 - > A biasing with forced collisions for charged particles would allow for generating samples of useful statistics within a reasonable time to study the rare inelastic interactions in thin material in more detail.
- ◉ Responsible:
 - > Marc Verderi
- ◉ Status:
 - > In 2021 work plan.
 - > On-going
 - > Open.

5202 : To have the Goudsmith-Sanderson MSC model in the default EM option Opt0

- ◉ Originator:
 - > ATLAS, from 2020 LPCC workshop
- ◉ Scope:
 - > Having the GS (Goudsmith-Sanderson) multiple scattering model as precise as in EM Opt4 (_EMZ), or close to this precision, with the default EM Opt0.
 - > EM Opt4 helps to describe EM showers but at price of much slower simulations.
 - > Many things in EM Opt4 (_EMZ) are not necessary for EM showers, whereas the GS multiple scattering model seems the only important piece of physics which is missing in the default, Opt0.
- ◉ Responsible:
 - > Mihaly Novak
- ◉ Status:
 - > In 2021 work plan.
 - > On-going
 - > Open.

5203 : Improve the inelastic cross sections of \bar{d} and anti_He3 at low energies ($< 1-2 \text{ GeV}/c$).

- ◉ Originator:
 - > ALICE, from 2020 LPCC workshop
- ◉ Scope:
 - > Inelastic cross-section of anti-deuteron and anti_He3 is too low at low energies
 - > Likely, the same is needed for anti_triton and anti_alpha cross sections.
- ◉ Responsible:
 - > Vladimir Uzhinsky
- ◉ Status:
 - > In 2021 work plan.
 - > On-going
 - > Open.

Recently closed requirements

5003 : Benefit from VecGeom & VecGeom Navigation

- ◉ Originator:
 - > ALICE
 - > Page 6 of [Requirements from energy frontier](#)
- ◉ Scope:
 - > VecGeom solids already usable in Geant4
 - Under “standard” navigation
 - > Request specialized navigation to be interfaced too
 - Similarly to what exists with TGeo
- ◉ Responsible:
 - > Gabriele Cosmo
- ◉ Status:
 - > Use of VecGeom navigation as option planned for this year.
 - > In the plan of work & addressed.
 - > Closed. VecGeom will be default in 2021