

# Update on Requirements

**45<sup>th</sup> Geant4 Technical Forum**  
**March 23<sup>rd</sup> 2017**  
**CERN**

Makoto Asai, SLAC  
(for Marc Verderi, LLR, Ecole polytechnique  
On behalf of the Geant4 Collaboration

Requirements Tracking System Page:

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

# New requirements

# 4401 : Synchronization of field related objects

- ◉ Requester:
  - > ATLAS
- ◉ Responsible:
  - > John Apostolakis
- ◉ Issue:
  - > G4FieldManager and G4Stepper own copies of the field pointer
  - > Even for steppers owned by specific managers these are not required to be in sync.
- ◉ Request:
  - > Ensure steppers owned by a given manager are in sync and all share the same field pointers.
- ◉ Status:
  - > **Starting.**

# Open requirements

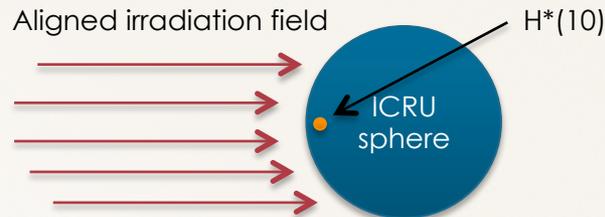
# Requirements from radioprotection and radiophysics : activation and dose calculation

## ○ Requirements from hospital in beam therapy

- > Presentation at 43<sup>rd</sup> TF, May 2016
- > By Laurent Desorgher, Centre hospitalier universitaire vaudois
  - Also main developer of related functionalities
- > <https://indico.cern.ch/event/522574/contributions/2155895/>

## ○ Doses with operational estimator $H^*(10)$

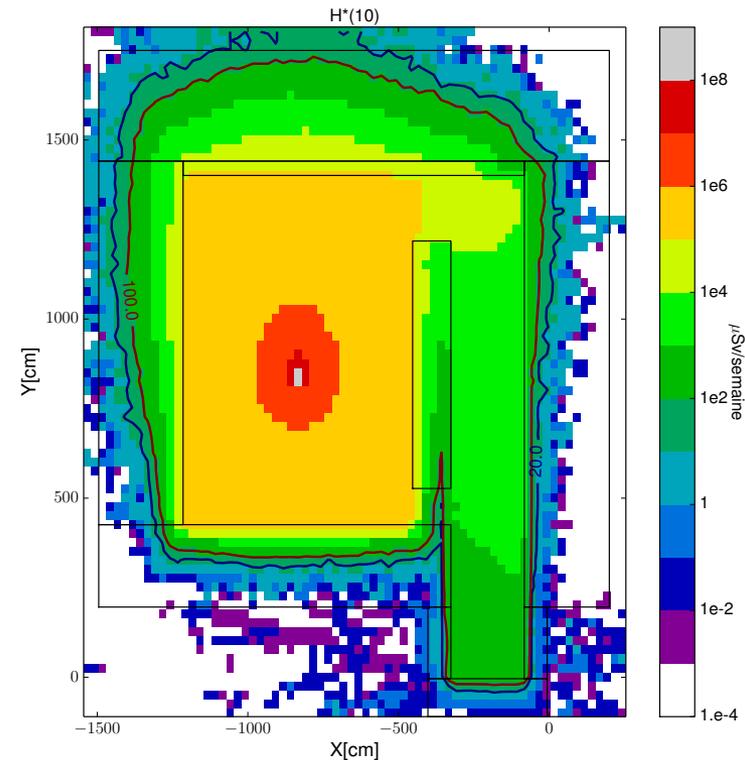
- > Estimate dose at 10 mm depth in a “ICRU sphere”
  - {30 cm  $\varnothing$ , tissue eq., 1 g/cm<sup>3</sup>, mass composition 76.2% O, 11.1% C, 10.1% H, 2.6% N}



## > Conversion coefficients from ICRP74

- Fluence values  $\rightarrow H^*(10)$  ones
- ICRP74 provides coefficients for protons, e-, gammas, neutrons

Example of  $H^*(10)$  map in protontherapy



# 4302 - 4305 : Series of Requirements from Radioprotection and Radiophysics

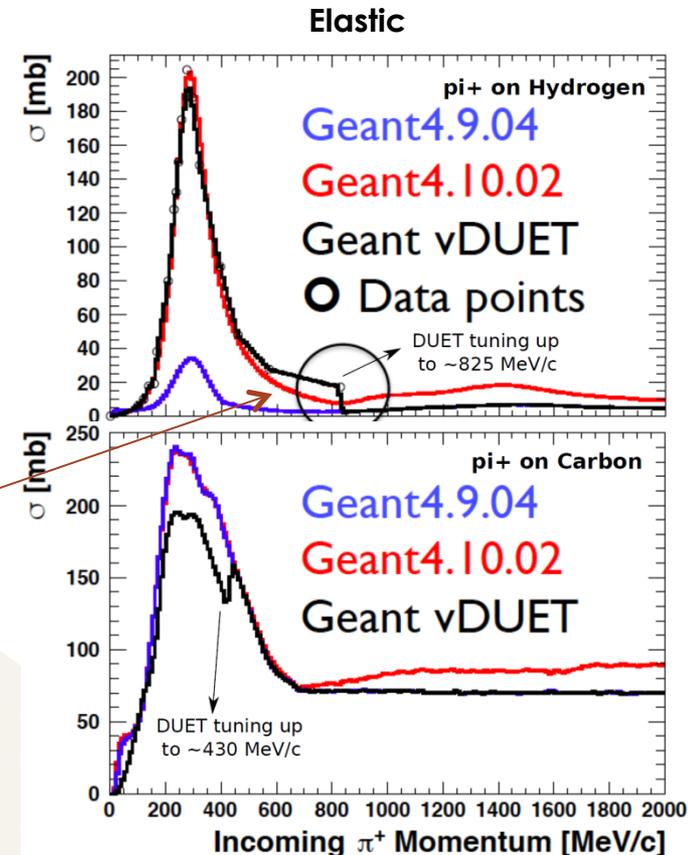
- ◉ Requester: Laurent Desorgher
  - > And is also responsible or co-responsible for responding to these requests.
- ◉ **4302** : *Tallying of the ambient dose equivalent  $H^*(10)$  (value + error or tally)*
  - > Needed in activation and dose calculation studies
  - > **Request for having  $H^*(10)$  tally value and its (stat.) error**
  - > Co-resp: Makoto
- ◉ **4303** : *Requirements from radioprotection and radiophysics : activation and dose calculation*
  - > **Dose  $H^*(10)$  resulting from radioactive decay at different time windows**
  - > Co-resp: Dennis
- ◉ **4304** : *Computation of activation in bunker therapy by protons, neutrons, and gammas*
  - > **Correct production of activated nuclei by nuclear spallation**
  - > Note : Laurent D. agrees to participate to validation
- ◉ **4305** : *Definition of irradiation profile for radiation therapy*
  - > Radiation therapy involves time dependent beam profile
    - Related activation needs to be simulated
  - > Hence request ability for **User defined irradiation profile**
- ◉ Status:
  - > **Prototype solutions for 4302 and 4303 may be committed soon**
  - > **Open**

# 4301 : Need of correct pion elastic model for T2K

- Requester: Tom Feusels for T2K Collaboration
- Responsible:
  - > Dennis Wright
- Context:
  - > T2K Neutrino oscillation experiment uses selections of neutrino interactions based on the number of detected pions (0, 1, or > 1pi).
  - Detailed understanding of final state interactions and secondary of pions crucial.
  - > DUET experiment at TRIUMF performed in order to improve measurements of pion interactions on carbon and water.
- Observation:
  - > pi + H : wrong by factor 5-10 in 9.4
  - > largely improved in 10.1-p-02
    - even if still problems > 600 MeV/c
  - > pi + C : some differences
  - > Phys Rev C 92, 035205 (2015)

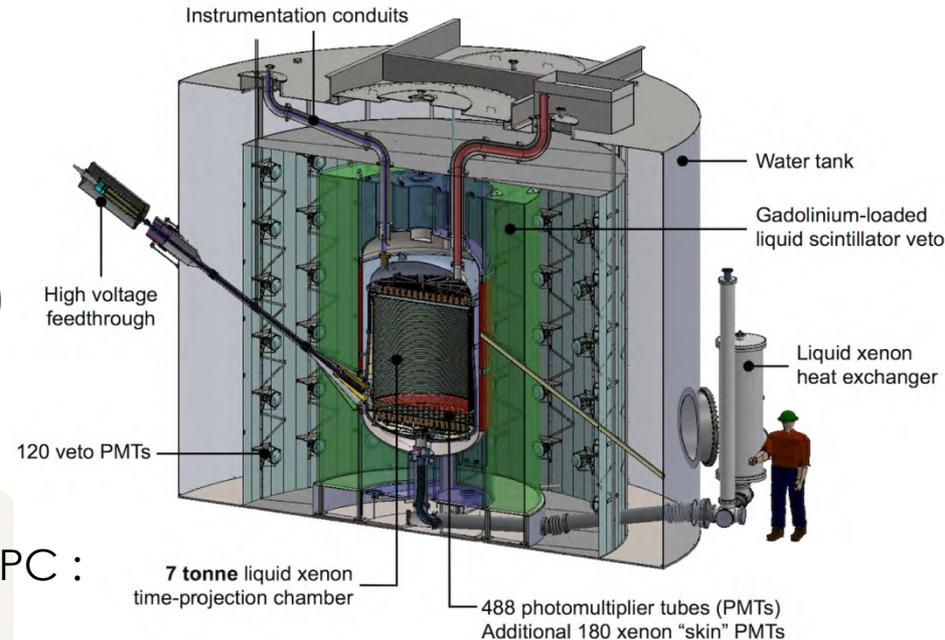
## Requests/questions:

- > **Need correct pion elastic model** [precision not specified]
- > No news from T2K
- > Open



# 4004 : Treatment of gamma cascades after neutron capture (Gd, Xe)

- Requester: LUX-ZEPLIN (LZ)
  - > 2<sup>nd</sup>-generation dark-matter detector
    - WIMPs detection from few GeV/c<sup>2</sup> to several 100 TeV/c<sup>2</sup>.
  - > Request made at 40<sup>th</sup> TF @ FNAL ([link](#))
- Responsibles:
  - > Dennis Wright, Makoto Asai
- Scope:
  - > Gd-loaded liquid scintillator around TPC :
    - Used in veto of background events from PMT themselves
      - that could scatter into detector volume
    - Will be used for detailed understanding of background coming from detector as well
- Status:
  - > Patch 10.2.p01 released on 2016 March 2<sup>nd</sup> should correct.
  - > **Waiting for feed-back from LZ (might use quite old G4 version still).**
  - > **Open.**



# 4003 : Validation of new versions of Geant4

- Requester: Intensity Frontier FNAL experiments

- > Request made at 40<sup>th</sup> TF @ FNAL ([link](#)) , collecting items from:
  - Muon : g-2, Mu2e
  - Neutrino : DUNE, MicroBooNE, MINERvA, MiniBooNE, NOvA
  - Fixed Target : SeaQuest
  - Test Beam : LArIAT

- Responsible:

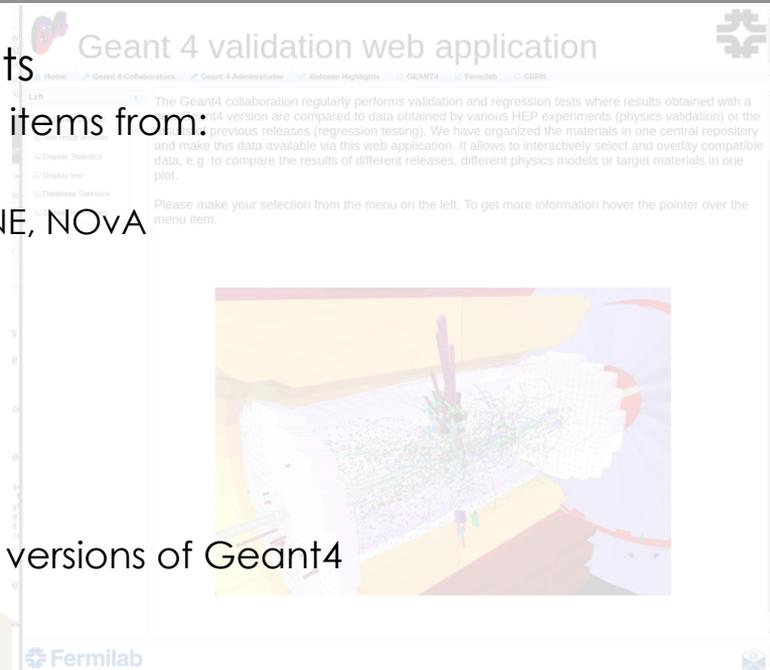
- > Andrea Dotti

- Scope:

- > Tool to understand differences between any two versions of Geant4
  - not just incremental changes of each release

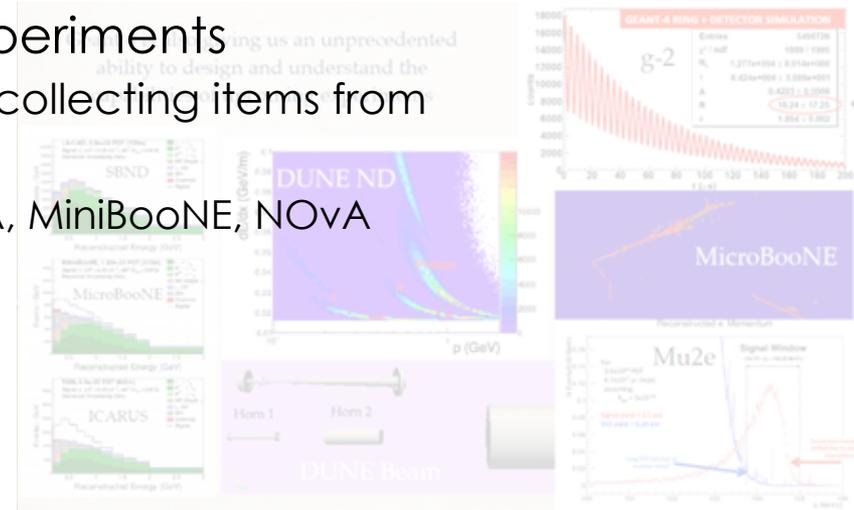
- Status:

- > Reminder : Geant4 validation database and website available at:
  - <http://g4validation.fnal.gov:8080/G4WebAppNG/>
  - Note that a re-design with extension to new data and features is being carried on.
- > First proposal : tool used for regression testing (StatTest) can be provided in a public form
  - Will allow to compare a same plot from an application, using two different versions of G4.
- > Andrea Dotti (SLAC) and Hans Wenzel (FNAL) working on it.
- > Database is up and running, populating it.
- > Open.



# 4002 : Reweightable uncertainties for systematic uncertainties estimation

- Requester: Intensity Frontier FNAL experiments
  - Request made at 40<sup>th</sup> TF @ FNAL ([link](#)) , collecting items from
    - Muon : g-2, Mu2e
    - Neutrino : DUNE, MicroBooNE, MINERvA, MiniBooNE, NOvA
    - Fixed Target : SeaQuest
    - Test Beam : LArIAT
- Responsible:
  - Makoto Asai
- Scope:
  - The technique allows to estimate the effect of model uncertainties on observables with a single MC sample
    - Model uncertainties provided under guidance of experts
    - Suggested from usability of GENIE Neutrino MC Generator
- Status:
  - Work In progress at FNAL and SLAC
  - Open.



# 3901 : Complete destruction of Geant4 objects at exit

- ◉ Originator:
  - > CMS
  - > 39<sup>th</sup> Technical Forum ([link](#))
- ◉ Scope:
  - > Geant4 utilized in framework
    - But Geant4 leaves undeleted objects after completion.
  - > Clean destruction of G4 objects needed
- ◉ Responsible:
  - > Makoto Asai
- ◉ Status:
  - > Progress made in 10.3
  - > Good progress made last weeks, next to completion.
  - > Open.

# Recently closed requirements

# 3301 : Multithreading processing driven by experiment framework

- ◉ Requester: CMS (but now general)
  - > Original request at 33<sup>th</sup> TF ([link](#))
  - > Further information at G4 Collaboration meeting ([link](#))
- ◉ Responsibles:
  - > Andrea Dotti, Makoto Asai, John Apostolakis.
- ◉ Scope:
  - > To process multiple events and process multiple modules in same event (gen., sim./G4, trg., reco., ana.) simultaneously
    - Geant4 = one of the modules
  - > Framework controls modules execution
    - Geant4 to be controlled with proper messages
  - > “Threading Building Blocks” (Intel® TBB) task model adopted
- ◉ Status:
  - > **Closed**
  - > Steering board has an action item to follow-up on / monitor subsequent issues.