

## OUTLINE

- Latest News
- Geant Simulation
- Some Open Issues

### ■ Mailing list

- ◆ [ship-software@cern.ch](mailto:ship-software@cern.ch) (SHiP Collaboration mailing list dedicated to software )
- ◆ Archive: <https://groups.cern.ch/group/ship-software/default.aspx>

### ■ Biweekly meetings, Thursday 11am

### ■ Web page

- ◆ <http://ship.web.cern.ch/ship/FairShip/default.html>
- ◆ Updated instructions for obtaining a SHiP account: [http://ship.web.cern.ch/ship/FairShip/HowTo\\_SecondAccountCreation.pdf](http://ship.web.cern.ch/ship/FairShip/HowTo_SecondAccountCreation.pdf)

## FairShip

- Short muon shield and pyramidal frustum is now the default geometry
- A SBT with plastic scintillator now full implemented (see later presentation), optional in `shipDet_conf.py`:
  - ◆ `Veto.SetLiquidVeto(1)` # liquid scintillator
  - ◆ `Veto.SetPlasticVeto(0)` # plastic scintillator
- Background productions ongoing (see Physics Session)
- ShipStack, optional: storage of full MC history for MCTracks in sensitive volumes (increase of storage of ~ factor 2, depending on use case)
- Dark photon production from proton bremsstrahlung (Anne-Marie)
- Fixing (many) compiler warnings (by Fons). Some warnings flagged bad code. Impact still needs to be understood.

# Latest News II



## FairSoft/FairRoot

- Install scripts modified (Fons) to work also for macOS
- Moved to more recent version of ROOT v6-08-04

## Computing at CERN

- AFS Phase out (<https://indico.cern.ch/event/579005/>)
  - ◆ Software deployment using CVMFS, SHIPSOFT → </cvmfs/ship.cern.ch/ShipSoft>
  - ◆ Recently added gcc62 libraries: SHIPSOFT → </cvmfs/ship.cern.ch/ShipSoft/gcc62>
  - ◆ AFS still there, </afs/cern.ch/ship/sw/ShipSoft/gcc62> is link to cvmfs
  - ◆ Everybody encouraged to move to gcc62, and cvmfs
- ◆ Home directories, AFS will be replaced by EOS.
  - ▶ Try out CERNBOX, [http://ship.web.cern.ch/ship/FairShip/CERNBox\\_quick\\_tutorial\\_for\\_beginners.pdf](http://ship.web.cern.ch/ship/FairShip/CERNBox_quick_tutorial_for_beginners.pdf)
  - ▶ Access from anywhere, CLOUD service, ~1TB
  - ▶ From lxplus, </eos/user/x/xxx> or <root://eosuser.cern.ch://eos/user/x/xxx>

# GEANT Simulation



## ■ Muon processes switched on

- ◆ `muloni`, `muBrems`, `muonNuclear`, `muMinusCaptureAtRest` and `muPairProd` ( $\rightarrow e^+e^-$ )

## ■ Not switched on:

- ◆ `GammaToMuPair`:  $\gamma \rightarrow \mu^+\mu^-$  Bethe Heitler (Trident)
- ◆ `AnnihiToMuPair`:  $e^+e^-(rest) \rightarrow \mu^+\mu^-$

## ■ Added to G4EmPenelopePhysics, which does the EM part of our physics list: **QGSP\_BERT\_HP\_PEN**

```
GammaToMuPair: gamma->mu+mu- Bethe Heitler process, SubType= 15
                good cross section parametrization from 422.633 MeV to 1e+12 GeV for all Z.

AnnihiToMuPair: e+e->mu+mu- annihilation, atomic e- at rest, SubType=.6
                threshold at 43.6931 GeV good description up to 1000 TeV for all Z.
```

- ◆ In addition, possibility to increase cross section for these processes to get more statistics (>1 spill)

```
if simEngine == "MuonBack":
    mygMC = ROOT.TGeant4.GetMC()
    mygMC.SetCrossSecFactor(1.E4) # increased muon production by gamma and e+
```

# GEANT Simulation

## ■ Muon processes switched on

- ◆ muloni, muBrems, muonNuclear, muMinion, muPairProd ( $\rightarrow e^+e^-$ )

## ■ Not switched on

- ◆ This required small modifications to the source code of G4EmPenelopePhysics and TGeant4.

## ■ A of

- ◆ Compared to writing many lines of C++ code to define a new physics list.
- ◆ Not yet committed, will require rebuilding of FairSoft.
- ◆ With a newer Geant4 version, foreseen by begin of July, process can be switched on together with scaling without changing code. Propose to wait.

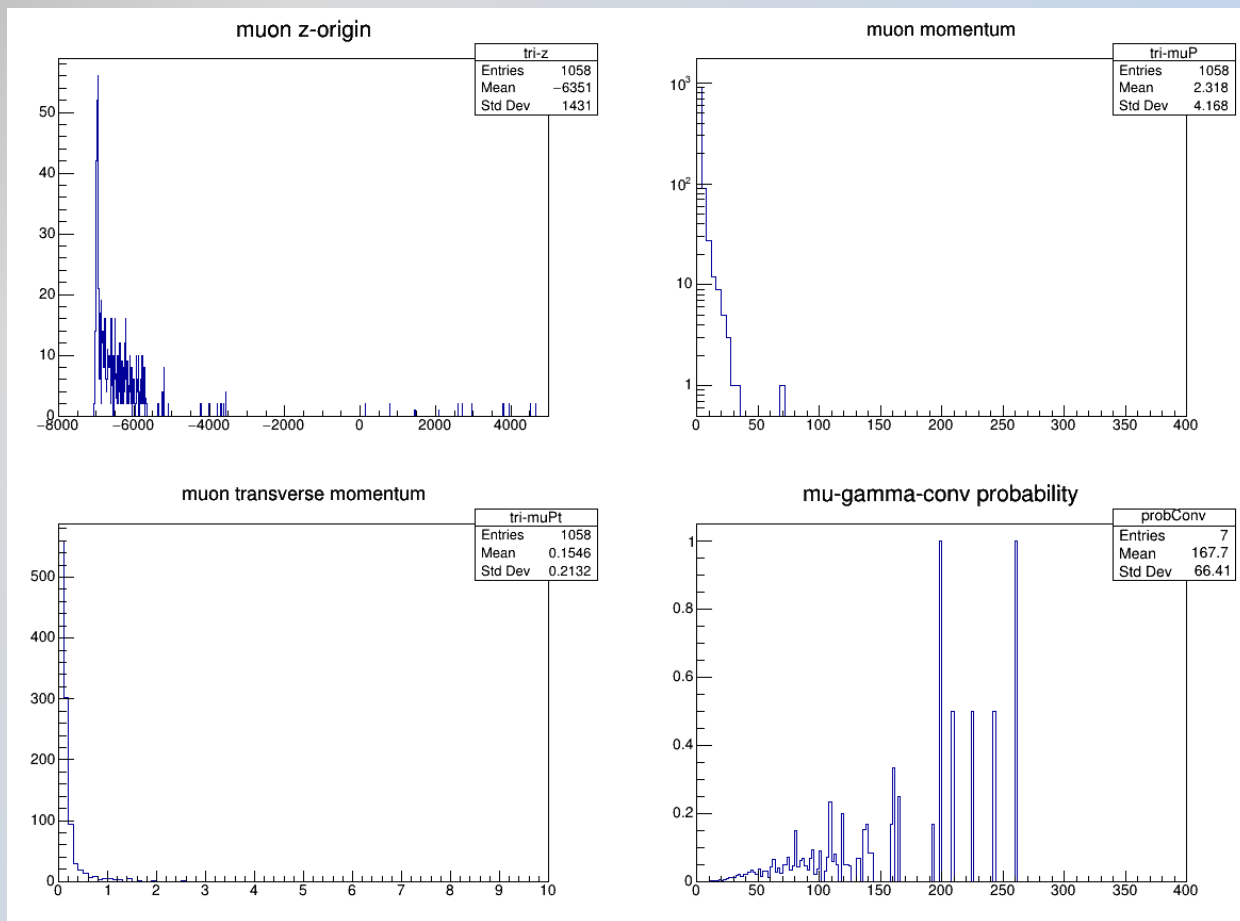
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$$\gamma \rightarrow \mu^+ \mu^-$$

Run with  $10^5$  muons ( $\sim 2 \times 10^{-6} \text{ sec}$ ), cross section boosted by  $10^4$ :

- Boost factor too large, at high momentum almost all muons make such an event
- Good news: Momentum of outgoing muons very low!





# GEANT Simulation II



## ■ Identify and categorize sources of muon production in target

- ◆ Short lived particles below charm threshold, Pythia8:

$$\eta \rightarrow \mu^+ \mu^- (0.001\%), \gamma \mu^+ \mu^- (0.031\%),$$

$$\rho^0 \rightarrow \mu^+ \mu^- (0.005\%),$$

$$\omega \rightarrow \mu^+ \mu^- (0.009\%), \pi^0 \mu^+ \mu^- (0.013\%),$$

$$\eta' \rightarrow \gamma \mu^+ \mu^- (0.011\%),$$

$$\Phi \rightarrow \mu^+ \mu^- (0.029\%)$$

- ◆ These decays do not exist in Geant4!

## ■ Propose to increase BR by a factor of 100, would still be $O(1\%)$ , small compared to the other channels.

- ◆ Inside Geant4, call Pythia8 as external decayer for these particles

## ■ Start new Muon Background production at Yandex

- ◆ Record position and momentum of above particles, would allow to simulate even more statistics in future using forced decays to muons
- ◆ Use latest target design

# Some Open Issues

- Make us of Evtgen. Contains up to date charm and beauty decays. Pythia8 particle table not maintained really, ROOT even worse. Volunteer?
- Investigating CPU bottlenecks in simulation and how to improve, summerstudent.
- Automatic procedure to test software stack to detect problems with committed changes.