

EM infrastructure and Physics Lists update

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Outline

- Migration of EM testing suite from Ixbatch to HTCondor
- EM testing suite and Geant-val
- EM Physics Lists constructors evolution

EM testing suite

- EM testing suite:
 - important component for the software process of Geant4
 - is applied monthly for each reference tag or by request
 - consists of around 60 tests
 - <https://test-geant4-tools.web.cern.ch/test-geant4-tools/emtesting/>
- EM testing suite history:
 - started in 2005
 - Modifications in 2018:
 - migration of EM tests (source) to CVMFS
 - EM testing suite (results and web application) moved to EOS
 - Several tests were updated
 - running scripts were divided into 3 stages:
 1. Run test
 2. Analysis of the results with ROOT6
 3. Save results to EOS
- The problem in the beginning of 2019:
LSF batch system is deprecated

HTCondor

- At present – the default batch system at CERN
 - The current batch computing service currently consists of around 190,000 CPU cores - mostly deployed in the HTCondor based service
- To submit a task: to prepare a file with .sub extension

executable = script.sh

arguments = \$(ClusterID) \$(ProclD)

output = output/hello.\$(ClusterId).\$(ProclD).out

error = error/hello.\$(ClusterId).\$(ProclD).err

log = log/hello.\$(ClusterId).log

queue

How submit a job?

- There were problems to migrate to HTCondor because of
 - complexity of some tests
 - features of HTCondor
- Example: test Conversion

.cc file

```
Histo histo;  
G4String hname = "test/conv_" + sz + "_" + se;  
histo.SetFileName(hname);  
histo.Book();
```

.csh script

```
mkdir -p test
```

- **If you submit such task to HTCondor -> no results , no message on errors**
 - only executable is transferred to HTCondor system
 - HTCondor knows nothing about “test” directory
 - you don’t have permissions to create “test” directory
- **Decision: create needed directory structure locally and send HTCondor:**
 - `transfer_input_files = test`
 - `transfer_output_files = test`

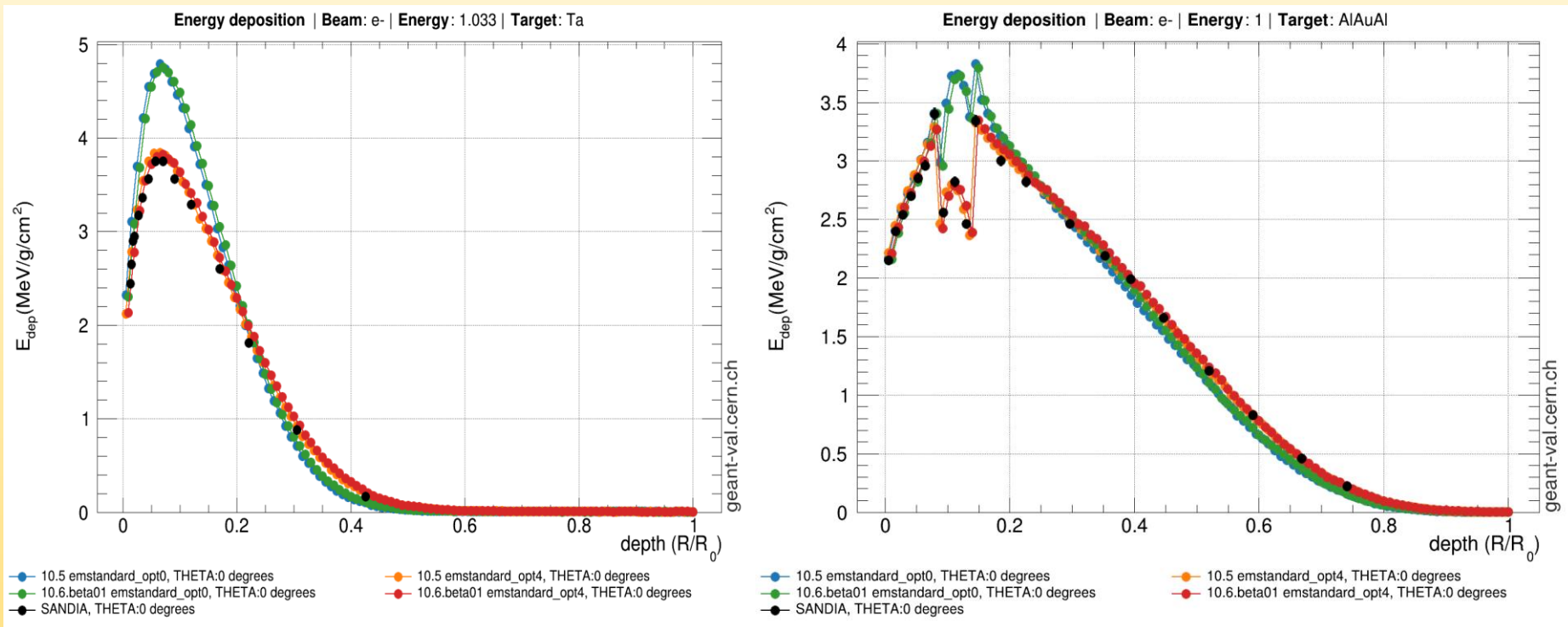
Results of migration to HTCondor

- Individual approach for tests was required
- EM testing suite is migrated from afs to EOS were made
- As a result of migration, productivity significantly increased
 - Astronomic time for full run of all tests requires ~4 hours
 - Was ~24 hours before
 - This is achieved due to submission of many jobs in parallel
- Results are at EOS linked to EM web:
 - <https://test-geant4-tools.web.cern.ch/test-geant4-tools/emtesting/electromagnetic/index.php>
 - Summaries: <https://test-geant4-tools.web.cern.ch/test-geant4-tools/emtesting/>

EM testing suite and Geant-val

- In parallel with EM testing suite development and migration to HTCondor/EOS a good part of EM tests were added to Geant-val
 - (<https://geant-val.cern.ch/layouts>)
 - G4MSBG: <https://twiki.cern.ch/twiki/bin/view/Geant4/G4MSBG>
- It seems to be useful continue support both tools
 - Advantages of the EM testing suite
 - Full testing suite or subset of tests may be started locally by a developer
 - Software is in Geant4 git repository
 - Some of tests include fitting and computation of χ^2
 - Summary page allowing overview of all major test results
 - Advantages of the Geant-Val
 - Much more statistics and number of runs
 - Regression may be performed using on-line selection of Physics Lists and Geant4 versions
 - Since Geant4 10.5 there are cases, when Geant-Val allowed to find problems in EM models, even more effective and useful EM validation for 10.6

Energy profile for semi-infinite media SANDIA Report (Geant4-Val)



- Two plots were the accuracy advantage of the GS model (M. Novak) is emphasized
- In thin layers of heavy absorbers the GS model provides more accurate electron transport

EM Physics Lists constructors evolution

- List of EM physics constructors is stable between 10.5 and 10.6
 - G4EmDNAChecker_option2 is added in 2019
- Our main EM constructors:
 - G4EmStandardPhysics – default
 - G4EmStandardPhysics_option4 (EMZ) is recommended for applications where accurate simulation is required
 - In 2019 few important updates for EMZ:
 - MscRangeFactor is changed from 0.2 to 0.08 to increase precision of tracking
 - 5D gamma conversion model is used
 - Livermore and Penelope physics following option4 (EMZ) in all aspects except specific Livermore or Penelope models
- We drop SetCuts() method in all reference Physics Lists, because they were empty
 - Default implementation from the base class is enough

Summary

- EM testing suite fully migrated to new computing platform
 - HTCondor, ROOT6, EOS
 - It may be used for several years without serious modifications
 - All components are inside Geant4 git repositories
- EM tests in a good part are adopted in Geant-Val
 - The process is continuing
- Our main proposal to users since Geant4 10.5 to choose between the default and Opt4 (EMZ) physics