G4NuPhysicsLists & g4numi

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Intro to G4NuPhysicsLists

- A new package to make interfacing to Geant4 PhysicsLists more accessible / extensible
  - a interface for getting lists by name (string)

```
std::string plname = “FTFP_BERT”;
g4nu::G4PhysListFactory* factory = new ...
                // FTFP_BERT* physicsList = new FTFP_BERT;
G4VModularPhysicsList* physicsList =
      factory->GetReferencePhysList(plname);
runManager->SetUserInitialization(physicsList);
```

  - a way to easily add new physics lists - self-register w/ factory
    - e.g. in NuBeam.cc (or somewhere equivalent) add:

```
#include "G4NuPhysicsLists/G4PhysListFactorySingleton.hh"
PHYSLISTREG(NuBeam)
```

    - when the library containing physics list code is loaded, the class gets registered with the factory - no other user calls need be made

Source Code + Build Notes

- In nutools SVN repository like “dk2nu”
  - intended to be used as a source of G4 PhysicsLists for both beam and detector simulations
- Instructions of checking out code & building
  - https://cdcvs.fnal.gov/redmine/projects/nusoftart/wiki/G4NuPhysicsLists

As a UPS Product

- Packaged up for convenience

```
source /nusoft/app/externals/setup
setup G4NuPhysicsLists v0_0_1 -q e2:nu:debug # or e4:nu:debug
```

  - say what? don't I have to setup Geant4?
    - no. odd dependency tree:
      - G4NuPhysicsLists "depends" on ROOT
      - ROOT depends on Geant4 (via a VMC coupling)
      - Geant4 depends on a version of gcc

```
G4NuPhysicsLists v0_0_1 -q debug:e2:nu
|__root v5_34_05 -q debug:e2:nu
  |__geant4 v4_9_6_p01a -q debug:e2
    |__gcc v4_7_1
```

```
G4NuPhysicsLists v0_0_1 -q debug:e4:nu
|__root v5_34_09b -q debug:e4:nu
  |__geant4 v4_9_6_p02 -q debug:e4
    |__gcc v4_8_1
```

Building g4numi w/ G4Nu

- Alternate instructions for building g4numi
  - https://cdcvs.fnal.gov/redmine/projects/numi-beam-sim/wiki/How_to_build_the_code#Building-against-the-G4NuPhysicsList-package

```
source /nusoft/app/externals/setup
setup cmake
setup G4NuPhysicsLists  v0_0_1    -q debug:e2:nu    # or debug:e4:nu

cd /$EXPT/app/users/$USER/g4numi_work_area/cmakebuild

WHICH_G4=`ls -d ${GEANT4_FQ_DIR}/lib64/Geant4-*`
WHICH_CLHEP=`ls -d ${CLHEP_LIB_DIR}/CLHEP-*`

# use -DWITH_G4NU=ON when building against G4NuPhysicsLists
#     external product as well
cmake -DGeant4_DIR=${WHICH_G4} -DCLHEP_DIR=${WHICH_CLHEP} \
      -DWITH_G4NU=ON ../g4numi

gmake
```

Running g4numi w/ G4Nu

- Easy choice of G4 Physics List

```
export PHYSICSLIST=XYZZY
./g4numi config.mac

G4VModularPhysicsLists in G4PhysicsProcessFactorySingleton are:
 [ 0] "CHIPS"
 [ 1] "FTFP_BERT"
 [ 2] "FTFP_BERT_EMV"
 [ 3] "FTFP_BERT_EMX"
 [ 4] "FTFP_BERT_TRV"
 [ 5] "FTF_BIC"
 [ 6] "LBE"
 [ 7] "LHEP"
 [ 8] "LHEP_EMV"
 [ 9] "NuBeam"
 [10] "QBBC"
 [11] "QGSC_BERT"
 [12] "QGSP"
 [13] "QGSP_BERT"
 [14] "QGSP_BERT_CHIPS"
 [15] "QGSP_BERT_EMV"
 [16] "QGSP_BERT_EMX"
 [17] "QGSP_BERT_HP"
 [18] "QGSP_BERT_NOLEP"
 [19] "QGSP_BERT_TRV"
 [20] "QGSP_BIC"
 [21] "QGSP_BIC_EMY"
 [22] "QGSP_BIC_HP"
 [23] "QGSP_FTFP_BERT"
 [24] "QGS_BIC"
 [25] "Shielding"

G4PhysicsProcessFactorySingleton supports variants of the above
with physics process replacements:
     _EMV  ==>  G4EmStandardPhysics_option1  known
     _EMX  ==>  G4EmStandardPhysics_option2  known
     _EMY  ==>  G4EmStandardPhysics_option3  known
     _LIV  ==>  G4EmLivermorePhysics         known
     _PEN  ==>  G4EmPenelopePhysics          known
```

- if PHYSICSLIST unset, default to “FTFP_BERT”

NuBeam

- Julia Yarba's initial offering of a reconfigured PhysicsList
  - intended to be used for 120GeV protons on Carbon
  - compared to FTFP_BERT:
    - many K/pi Inelastic FTFP/BertiniCascade transition regions change from [4:5] to [7:10]
    - also:

```
FTFP_BERT:
   ProtonInelastic  Models:                    FTFP: Emin(GeV)=   4  Emax(GeV)= 100000
                                   BertiniCascade: Emin(GeV)=   0  Emax(GeV)= 5

NuBeam:
   ProtonInelastic  Models:                    QGSP: Emin(GeV)=  100  Emax(GeV)= 100000
                                               FTFP: Emin(GeV)=   7  Emax(GeV)= 101
                                   BertiniCascade: Emin(GeV)=   0  Emax(GeV)= 10
   ProtonInelastic  Crs sctns:
                         Barashenkov-Glauber: Emin(GeV)=   0  Emax(GeV)= 100000
```