Running Geant4

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GEANT4 at TUNL

• Installed in /usr/local/geant4/ (ver. geant4-09-02)

• GEANT4 Environment variables should be set by default upon logging on. (To check those variables, issue the command: ‘printenv | grep G4’. For example, verify the followings

✓ G4INSTALL=/usr/local/geant4

✓ G4WORKDIR should be your ‘geant4’ dir in your home dir.

• GEANT4 is not installed on all the TUNL computers. (we’ve picked up four computers with geant4 installed. See the next slide)

• Other related software/library also available at tunl: c++ compiler, CLHEP, GNU make, GEANT4 visualization softwares
Running GEANT4 during tutorial

- Useful info posted on the course web page:
  http://www.tunl.duke.edu/~tajima/geant4
  - software requirements
  - how to verify software installation
- Log onto one of the following TUNL computers from your laptop using ‘ssh’
  - ackbar.tunl.duke.edu
  - obiwan.tunl.duke.edu
  - positron.tunl.duke.edu
  - storm.tunl.duke.edu
Novice Example Programs

- Available at /usr/local/geant4/examples/novice
- Trivial detector with non-interacting particles
- Complex detector with full physics

- One can make use of the online resources such as Cross Reference (LXR) and Software Reference Manual to understand the geant4 code.

- Reminder: all the geant4 resources are at http://cern.ch/geant4
Novice Example N01

- Fixed geometry: Ar gas mother volume with Al cylinder and Pb block with Al slices
- Incident particle is a geantino – no physics interactions
- No magnetic field and only the transportation process is enabled
- Hard coded batch job and verbosity
Novice Example N02

- Pb target, Xe gas chambers
  (parameterized volumes)
- All EM processes + decay included
  for γ, charged leptons and charged
  hadrons
- Detector response
  - Trajectories and chamber hit
    collections may be stored
- Visualization of detector and event
- Command interface introduced
  - Can change target, chamber
    materials, magnetic field,
    incident particle type,
    momentum, etc. at run time
Novice Example N03

- Sampling calorimeter with layers of Pb absorber and liquid Ar detection gaps (replicas)
- Exhaustive material definitions
- Command interface
- Randomization of incident beam
- All EM processes + decay, with separate production cuts for $\gamma$, e+, e- (use for shower studies)
- Detector response: E deposit, track length in absorber and gap
- Visualization tutorial
- Random number seed handling
Novice Example N04

- Simplified collider detector
  - all kinds of volume definitions
- Magnetic field
- PYTHIA primary event generator
  - Higgs decay by Z0, lepton pairs
- Full set of EM + hadronic processes
  - Should use updated hadronic physics lists
- Event filtering by using stacking mechanism

Slide from SLAC Geant4 tutorial course in '06
Novice Example N05

- Fast simulation with parameterized showers
  - EM showers (derived from G4VFastSimulationModel)
  - Pion showers (for illustration only – not used)
- EM physics only
  - Use of G4FastSimulationManagerProcess
- Simplified collider detector geometry
  - Drift chamber
  - EM, hadronic calorimeter
  - Ghost volume

Slide from SLAC Geant4 tutorial course in ‘06
Water Cerenkov detector with air “bubble”

Materials
- Specification of optical properties
- Specification of scintillation spectra

Physics
- Optical processes
- Generation of Cerenkov radiation, energy loss collected to produce scintillation