Pilot run information

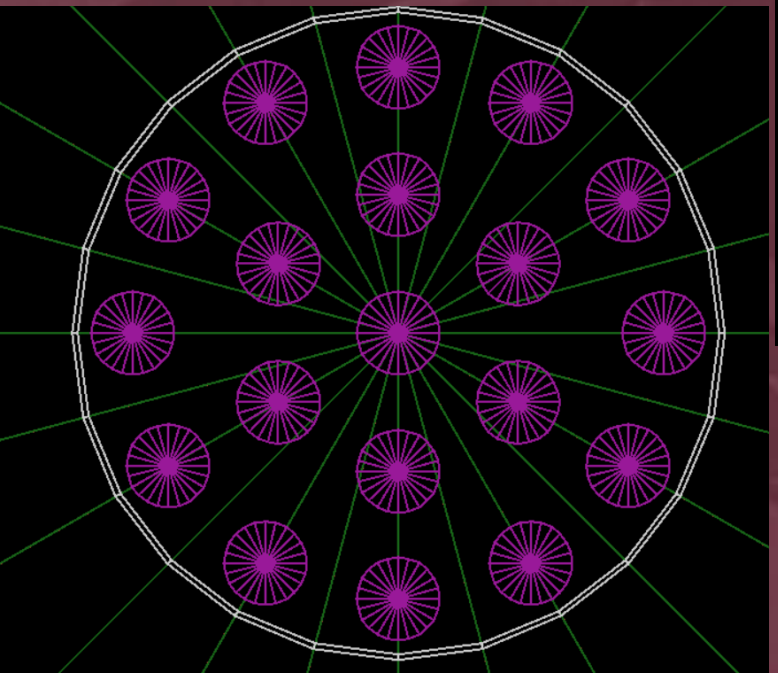
(Hopefully) everything you'll need to know to go over the pilot data I'm sending with these slides

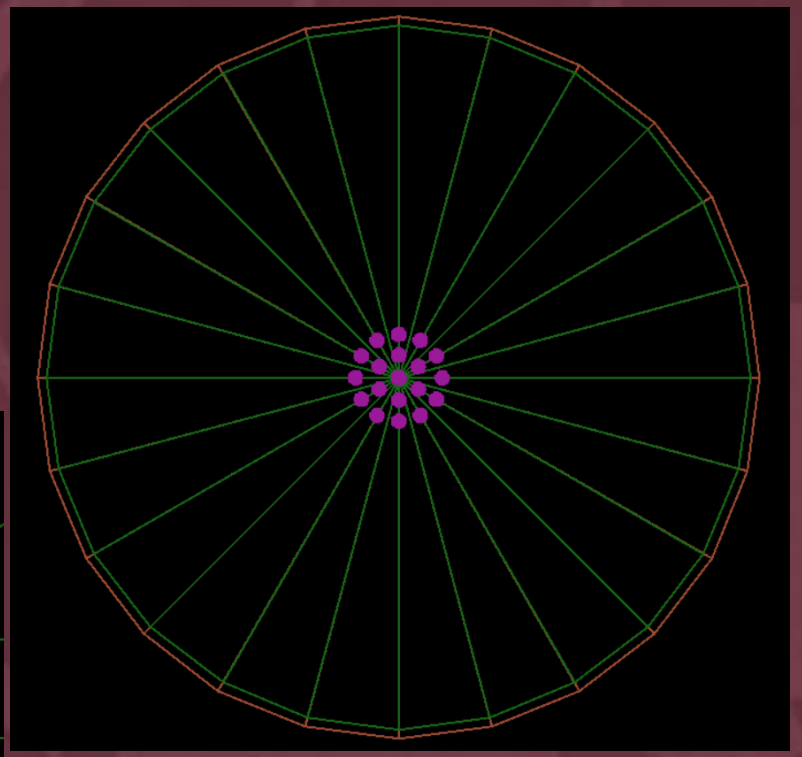
LEGEND-200 like geometry

- I didn’t have one on hand, so I just threw this together
- Used cryostat and LAr dimensions found in MaGe
  - These are very crude… Is someone, somewhere, keeping a more detailed geometry hidden away? ¯_(ツ)_/¯
- Used 19 strings with 6 detectors each, total mass ~196 kg
  - All detectors uniform in size (not very realistic, I know)
- Cables, fibers/shrouds, holders, neck/feeds all not implemented
- I’m not satisfied with this geometry, but it’s at least consistent with the one in MaGe, so working with other groups on scintillation might be easier

LEGEND-200 like geometry

White circle is at the diameter of the WLS fibers for visual-ization purposes, but isn't actually implemented





Top and middle: views from above
Right: view from the side

ROOT data files

- Two files – output######.root and nuclearfile######.root
- Large numbers in filenames are the seed set for the random number engine – normally the seeds are also random, but for the pilot file I input a seed of 123456789
- output: contains G4Step-level data collected about all steps occurring in the liquid argon
- nuclearfile: contains G4Track-level data collected for all nuclear isotopes in every material

Data format specifications

- Geometric center of detector array is the origin coordinate
- Units:
  time – nanoseconds
  length – millimeters
  energy – keV
  momentum - keV/c
- All variables are simple data types (double, string, etc) to make them easier to work with
- The name of the tree in the output file is fTree
- The name of the tree in the nuclearinfo file is nuclearTree

Description of each variable: output

- PID: PDG particle ID (see http://pdg.lbl.gov/2007/reviews/montecarlorpp.pdf for how numbering scheme works)
- ParentTrackID: Track ID (unique marker used by Geant4) for the parent of this particle
- energydeposition: the energy deposited in the liquid argon
- kineticenergy: kinetic energy of the particle which deposited the energy
- time: time of the deposition, relative to when the muon first started motion
- x, y, z: location of the energy deposition
- px, py, pz: momentum of the particle depositing the energy
- muonx, muony, muonz: starting position of the primary particle muon
- muonpx, muonpy, muonpz: starting momentum of the muon
- muonenergy: starting energy of the muon
- eventnumber: unique marker used by Geant4 for each G4event in a simulation
- stepnumber: unique marker used for each step in a G4Track

output variables cont.

- steplength: distance particle has travelled since last step completed
- tracknumber: unique marker used by Geant4 for each track in one G4Event
- detectornumber: obsolete for the purposes of this simulation, can be removed
- creatorprocess: shorthand name for the physics process which created this particle
- startx, starty, startz: Position at which particle leaving the deposition was created
- randomseed: same as the number in the filename. Kind of redundant
- parentnucleusPID: if particle was emitted by a nucleus (or is a nucleus), this contains the PID of the nucleus which emitted it (if particle is a nucleus, will be its own PID)
  - This variable is 0 for any particle that isn't a nucleus, or wasn't created by a nucleus
  - This variable is persistent (if a nucleus emits a photon which converts to electron/positron, electron/positron will still have this variable set)
- nuclearx,y,z: Location of the nucleus which emitted this particle (if the particle is already a nucleus, this should be the same as x, y, z)

Description of each nuclearinfo variable

- material: Name of material the nucleus is in
- PID, x, y, z, muonpx, muonpy, muonpz, tracknumber, randomseed, creatorprocess, time: same definitions as previous file
- primaryPID: if nucleus is a radioactive decay daughter, this is the PID of its parent
- startingkineticenergy: Just what it sounds like, kind of useless though

Other things to know

- The muon energy/angular spectrum for this sample is not reflective of the conditions at LNGS. In the interest of quickly providing a test sample I've just used the average muon energy at LNGS for every muon, and pointed them straight downwards at the liquid argon
- The variables in the files are simply the ones I use for my own analysis; if they're insufficient, or if the redundant ones bother you, let me know what information you'd like added or removed and I can see to it
  - Keep in mind the sorts of information available at the G4Step and G4Track level, though
- This data has not been cleaned or reconstructed in any way. Therefore it has some extraneous information, like data for steps where no energy was deposited, and information about low-energy nuclear recoils, in addition to the useful data. I can clean it beforehand if you'd like, but I didn't want to assume what sort of information you would like to be included
- The output file is rather large (25 MB) considering it's only for 100 muons. If you allow me to cut all energy depositions that occur <1 microsecond after the muon's creation, it would reduce filesize to an estimated 0.2% of its current size