Instructions for background benchmarks

v0.1

May 14, 2015

Getting and compiling the LZSim

- LZSim codes, with the benchmark source location can be downloaded from

  https://drive.google.com/drive/folders/0By5fsgVyD-m2YVI0c2QwQUFyQ1U/0B78hucv6TzbjbzJzS2dHX0k5Szg/0B6alFQnXFxARanRpb1g1MWwxeDQ

- It works w/ GEANT4.9.5
  - Make sure your CLHEP are linked, i.e. do not use the one which comes by default
- To make the executable

  $> make clean

  $> make

  bla bla until you see that LUXSimExecutable is created

Running the LZSim

- The macros to be used are in LUXSimMacros folder and are named LZ_benchmark_<phyiscs_process>.mac
- The default ones have the point-like source located at 0 0 0 mm, corresponding to the center of the cathode grid.
- If you use a cluster, you can submit the job to a queue system, running different locations and/or different phyiscs_process in parallel

Running the LZSim

Before submitting the job try with

LUXSimExecutable LUXSimMacros/LZ_benchmark_test.mac

commenting/uncommenting the part you are interested in.

This will also give a visual representation of the particles.

The new command

To use the command you can do

/LUXSim/source/set <source name> <positionX> <positionY> <positionZ>

<extra arguments>

- The coordinates x, y, z are in mm.
- <extra arguments> refers to any additional parameters as normally in the /LUXSim/source/set command
- Only one position and one isotope can be simulated in the same macro

ER background generation

- U238 and Th232
  - These use the DecayChain method
  - The age of the source is set in a way to reach the secular equilibrium
  - The radioactivity is set to 1 mBq, which is then assumed to be the radioactivity of the point-like source
- K40 and Co60
  - These use the SingleDecay method
  - The radioactivity is set to 1 mBq, which is then assumed to be the radioactivity of the point-like source

NR background generation

- U238 and Th232
  - These use the SingleParticle method
  - The spectrum comes from the Cu evaluated with SOURCES and the early and late parts of the chain are considered at equilibrium
  - The spectrum includes both S.F. and (α,n)
  - The spectrum is in energy bin of 0.1 MeV and the rate for each is in Bq (i.e. in cts/second)

ER background analysis

- The output .bin file the name and the directory can be changed within the macro with the commands

  /LUXSim/io/outputDir

  /LUXSim/io/outputName

- To convert the .bin into .root use

  LUXRootReader.cc

  i.e. make the executable and run

  LUXRootReader /path_to_binfiles/file_name.bin

ER and NR analyses

- For ER you may like to look at as a template

  cryoti_electronic.cc

- For NR ou may like to look at as a template

  cryoti_nuclear.cc

However, if you build your own code that will be better.

ER and NR analyses

- The key outputs are the dru [cts/kg/day/keV] histograms
  - kg is the mass of the LXe considered, i.e. of your fiducial volume (the current one is given in gr_fidvol_5.6ton.root)
  - day correspond to the simulated live days
  - keV means that you practically divide but the bin width of the histogram

ER and NR analyses

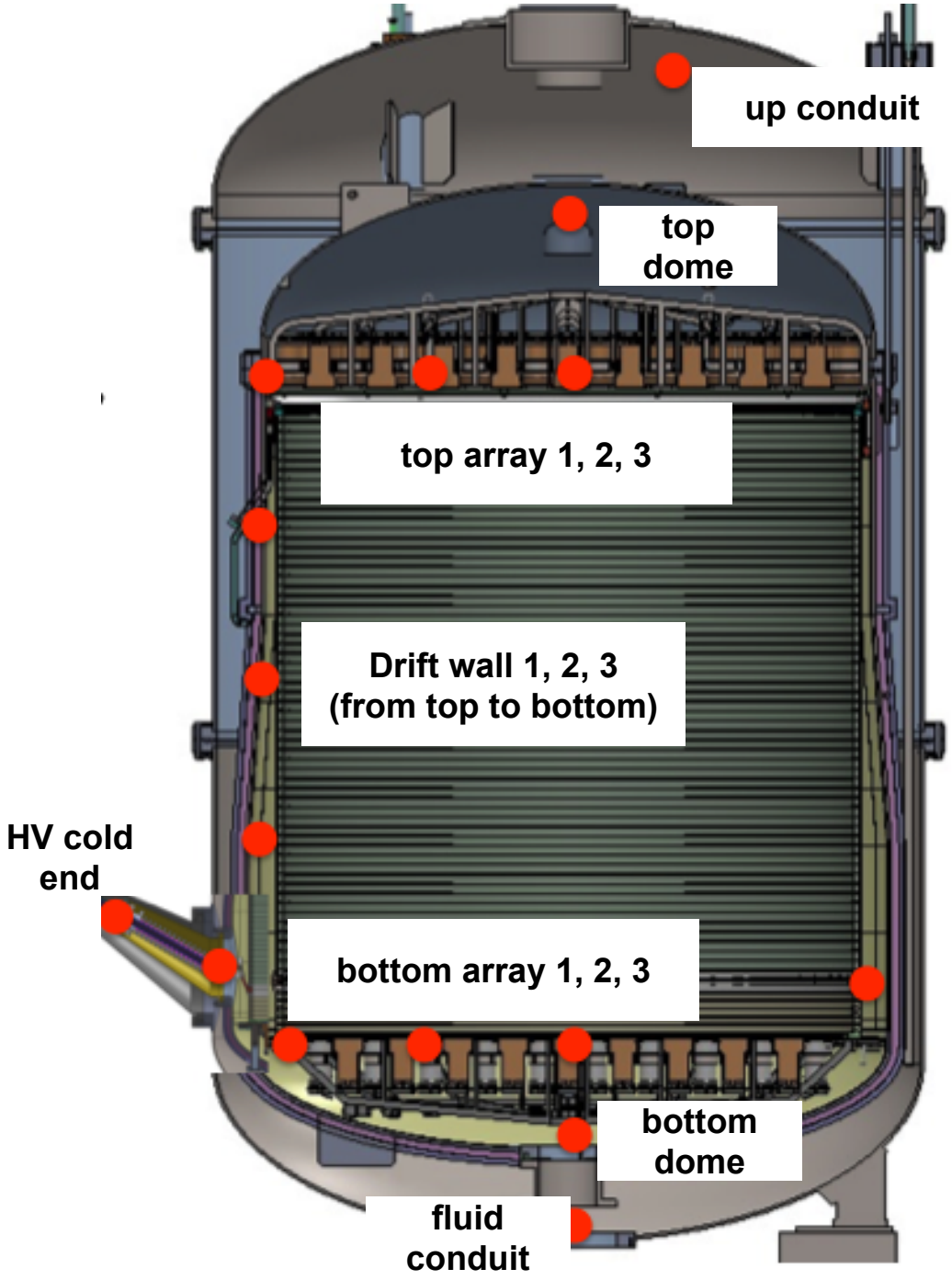
- day correspond to the simulated live days
  - For ER these are calculated as

    (time_last - time_first)/1e9 /60./60./24

    where time_first is the time of the first decay and time_last the one of the last decay, both in ns. Those info are stored in the .root TTree.
  - For NR these are calculated as

    iEvtN/ neutron_yield/Bq /60./60./24.;

    where iEvtN is the number of generated events in the simulation, neutron_yield is the n/s, i.e. the integral of the spectrum used in the macro (this value is also reported in the macro itself), Bq is the radioactivity of the source volume


up conduit
top dome
top array 1, 2, 3
Drift wall 1, 2, 3 (from top to bottom)
HV cold end
bottom array 1, 2, 3
bottom dome
fluid conduit

Benchmark points

Benchmark point	x	y	z	Name	Status	ER cts/exp	NR cts/exp
Up conduit				Tom/Paolo			
Top dome				Kelsey/Slava(?)			
Top array (1, 2, 3)				Kelsey/Slava(?)			
Drift wall (1, 2, 3)				Jim, Elena, Sally			
HV cold end				Jim, Elena, Sally			
Bottom array (1, 2, 3)				Bhawna			
Bottom dome				Bhawna			
Fluid conduit				Tom/Paolo			