PMT configuration and beam events (just a small study)

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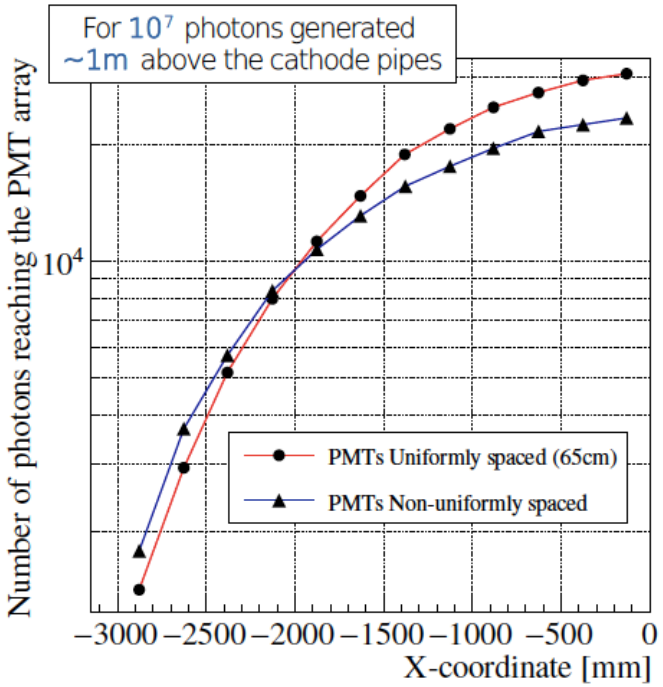
From Anne's presentation at the GM

PMT positioning impact on light signal collection

Reminder: the absorption in LAr is not taken into account



- PMTs uniformly spaced:
  → increases the number of collected photons at the detector center
- PMTs non-uniformly spaced:
  → increases the number of collected photons at detector edges (for low Z)

If we compute the ratio $N_{\text{Non Uniform}}/N_{65cm}$ for each photon generation point, the mean ratio is about ~0.95.

→ Impact on the background induced by cosmic muons ?
(will be discussed at the end of the talk)

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What about the impact on the signal from beam events ?

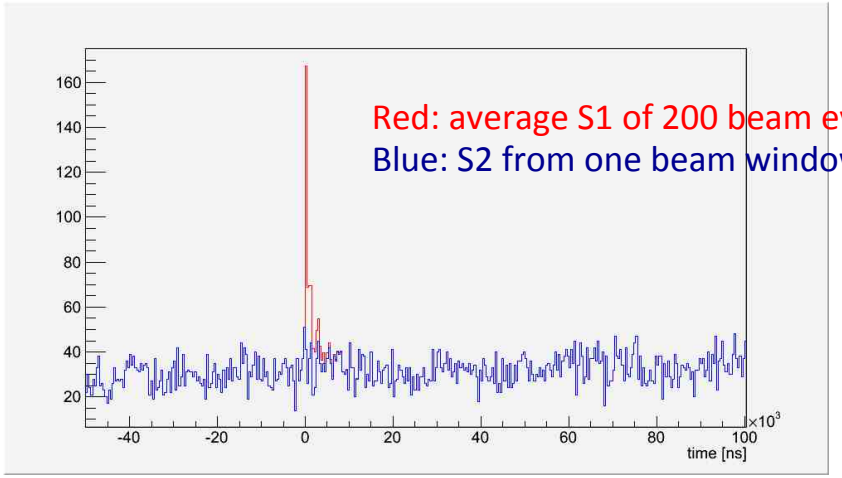
Simulation of beam events

- samples of 200 electrons
- p = 1 GeV and 5 GeV
- Entry point: X=Y=-305cm , Z=+57.5cm
- Direction: THETA= -1.7rad, PHI= 0.7854rad

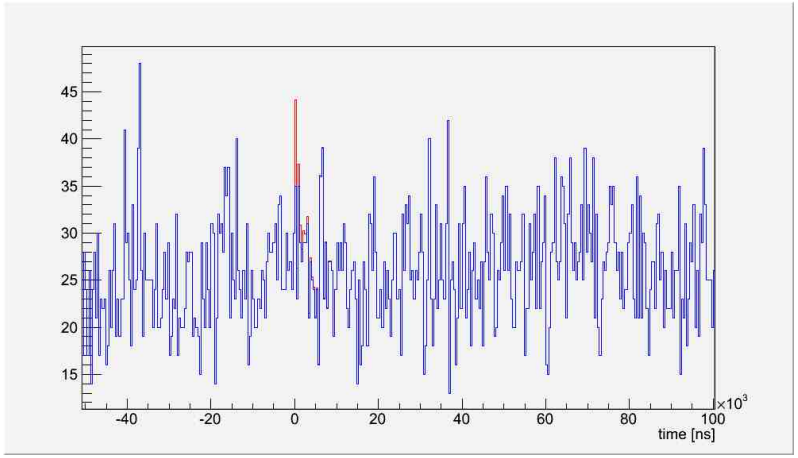
- Latest version of Qscan from svn (warning: this version does not produce plots for light, so I modified lro/src/DLArLRO.cc)
- Light maps provided by Anne in /sps/hep/lbno/dataset/LightMap
  - Uniformly-spaced PMTs: LightMap_6x6x6_PMT6x6_LAr.root and LightMap_6x6x6_PMT6x6_GAr.root for
  - Non-uniformly spaced PMTs: LightMap_6x6x6_PMTNonUni_LAr.root and LightMap_6x6x6_PMTNonUni_GAr.root

Waveforms

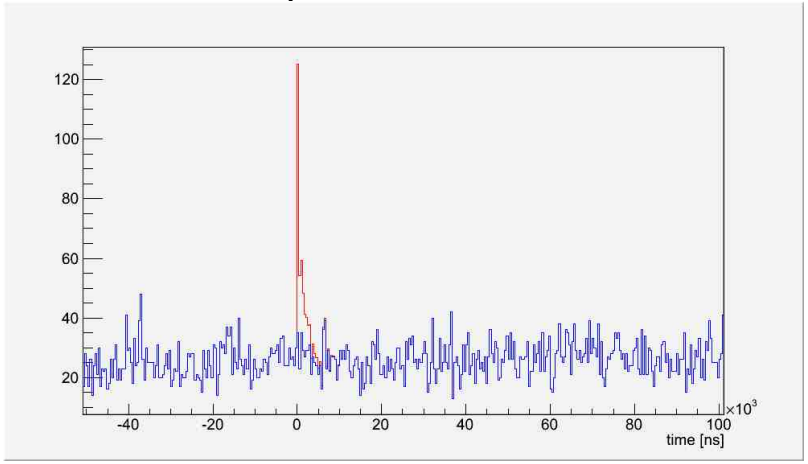
5 GeV e-, PMT uniform



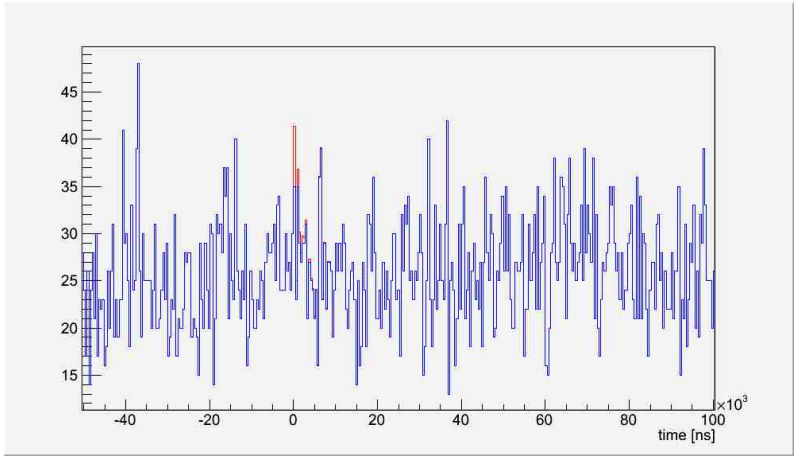
1 GeV e-, PMT uniform



5 GeV e-, PMT non-uniform



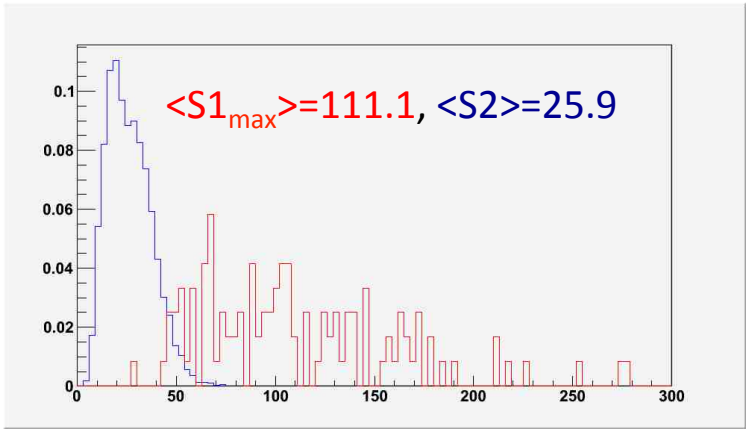
1 GeV e-, PMT non-uniform



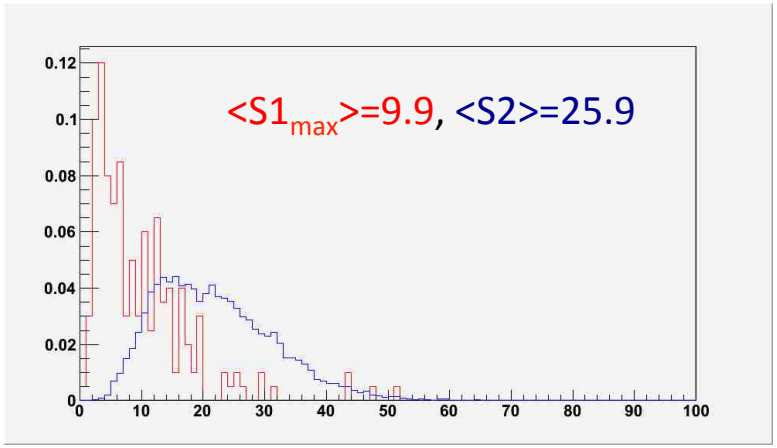
From these plots we already see that it will be very difficult to measure the beam S1, especially at low energy !

S1 and S2 signals

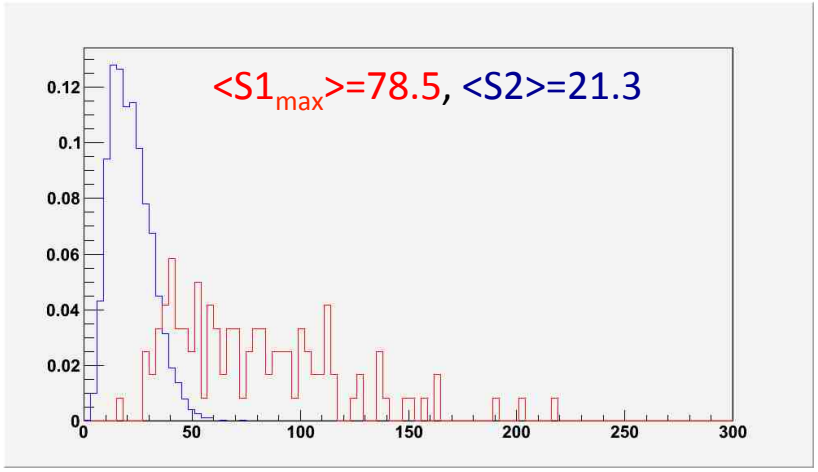
5 GeV e-, PMT uniform



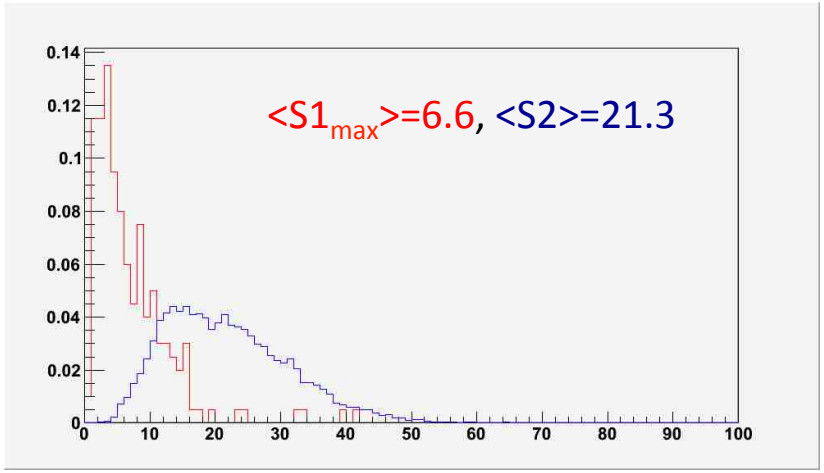
1 GeV e-, PMT uniform



5 GeV e-, PMT non-uniform



1 GeV e-, PMT non-uniform



Summary

From this quick study, it seems that

- the beam S1 will be very difficult to measure (and to use for studies on calorimetry, trigger algorithms, etc.), especially in low energy events
- the configuration with uniform PMTs seems to provide a better separation of beam S1 from the cosmics' S2 (although I would have expected the opposite !).

However, I have some questions :

Questions

After running the beam electron simulations, there are a few things I'm not sure I understand, and I didn't have time to look in detail in the code:

1. The reduction w.r.t. the old light maps quoted in Anne's slides is 60% from the cathode pipes + support structure plus 25% from the ground grid. If I compare my new simulations with the ones of last year, I see an amplitude reduction of about a factor 10 for cosmics S1 and S2 and of more than 20 for beam electrons. Is this consistent ? (I cannot make direct comparisons using the current code and the old maps, because they are not compatible)
2. The geometrical coverage of the cathode pipes + support structure is about 20%. How can the light loss be 60% ? I would expect this if there were multiple reflections, but are there any reflective surfaces apart from PMT TB coating ?
3. I tried to generate pion samples, but I see huge event-by-event fluctuations in the amount of S1 light. What am I doing wrong ? (I can show my datacard files, of course)

Thanks for any clarification/explanation you can provide !