

follow-up on Michele's LBNE cosmogenics R&D report for uB

Eric Church, Yale
15-May-2014
R & D group

LBNE docdb attached to this uB docdb entry

- LBNE docdb 8485
- This is the most recent (as of today, May, 2014) report from the LBNE cosmogenics group, led by Vitaly Krudyavtsev and Martin Richardson (Sheffield) and Chao Zhang and Dongming Mei (South Dakota)
- The two studies produce results that are within a factor of 5 of each other after all cuts: ~ 5 evts/yr/10kT
- I remember this as about 1.5 yrs of effort of 2 grad students/scientists working at least at 50% effort + Chao and Vitaly too at some level. Also Jeff de Jong produced muons at the surface.

LBNE concern

- The concern with LBNE was whether the proposed 10 ktonne surface detector could even do beam physics — let alone SN, nucleon decay in the presence of ~ 30 muon/sec/m²
- So, the signal is ν_e CC evts in their $E_{\nu} \sim 1.5$ GeV beam.
- The bkgnd under study is cosmogenic particles of any kind that may fake that signal: photon showers that go sorta forward and are isolated by themselves

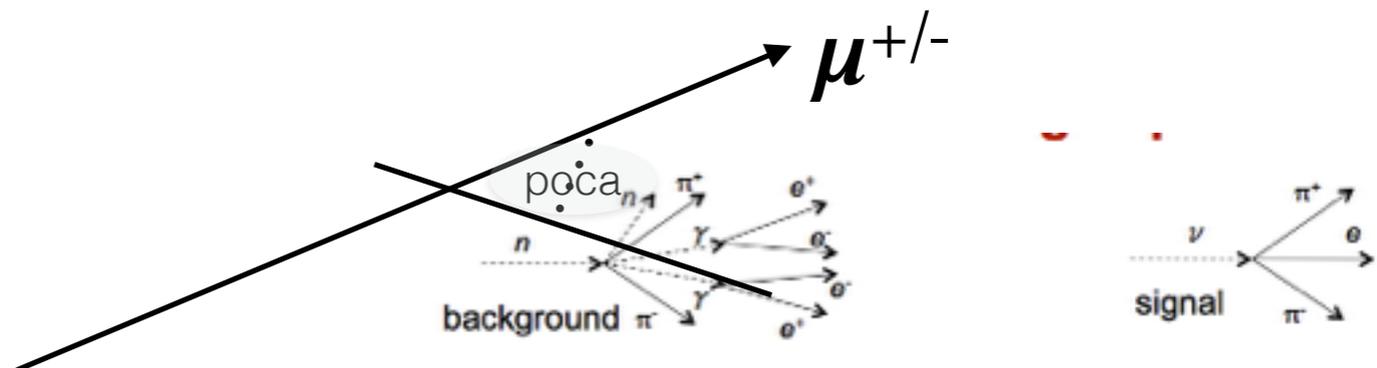
salient facts

Michele showed this in microboone docdb 3441

Processes	$E > 0.25 \text{ GeV}$	PoCA/D > 30 cm	Beam angle	PoCA(c.p.) > 10 cm	e/γ	10 μs
$\pi^0 \rightarrow \gamma \rightarrow e^\pm$	2.3×10^6	6.0×10^4	2.6×10^4	820	82	0.58
$\mu \rightarrow \gamma \rightarrow e^\pm$	5.9×10^6	41	0	0	0	0
Ext $\gamma \rightarrow e^\pm$	4.7×10^6	5.0×10^3	2.4×10^3	622	62.2	0.44
$\pi^0, K^0 \rightarrow e^\pm$	8.1×10^3	~ 520	~ 180	~ 10	~ 10	~ 0.1
Missing μ	7.1×10^3	1.7×10^3	580	Not applied	58	0.41
Total μ	1.3×10^7	6.8×10^4	2.9×10^4	$\sim 1.5 \times 10^3$	200	1.5
Atm n	7.7×10^4	5.3×10^4	1.8×10^4	2.9×10^3	290	2.1
Atm p	1.1×10^5	7.3×10^4	2.8×10^4	3.1×10^3	310	2.2
Atm γ	10	5	2		0.05	0.0004
Total	1.3×10^7	1.8×10^5	7.5×10^4	7.5×10^3	800	5.7

not produced by CRY

Assumes 90% for e/gamma rejection, with 90 % efficiency



What changes for us?

- Well, they're at 1500 ft, so I think that's
 - less than $\sim x2$ higher flux
- They use a 30 cm fiducial vol cut. We'd planned on about half that.
 - $x2$ (from text in lbne docdb)
- our 100 tons active vs LBNE's 10000 tons active
 - $x 0.01$
- NuMI is 10 musec, BNB is only 1.6 music
 - $x 0.16$
- They only count primary gammas with $E > 250$ MeV. We might like to go down to say 150 MeV.
 - $x 3$ (from plots in the lbne docdb)

Conclusions

- **This is sub-event level per year,** as compared to a 0.1% nue appearance oscillation of **~hundred events expected.**
 - The pernicious Compton gammas are x0.02 of pair production (assumed in lbne note) so this is probably negligible — if the POCA cuts take them out, which I think they will, per the lbne note.
- **We'd seem to be fine.**
- We will need to demonstrate POCA cuts work to achieve this bgd.

