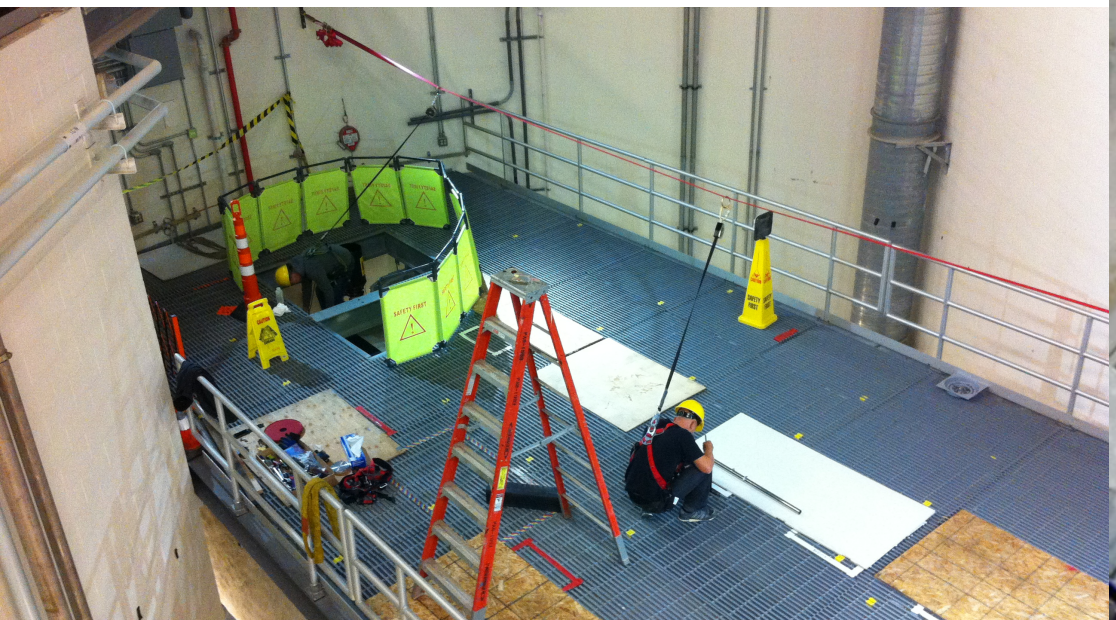
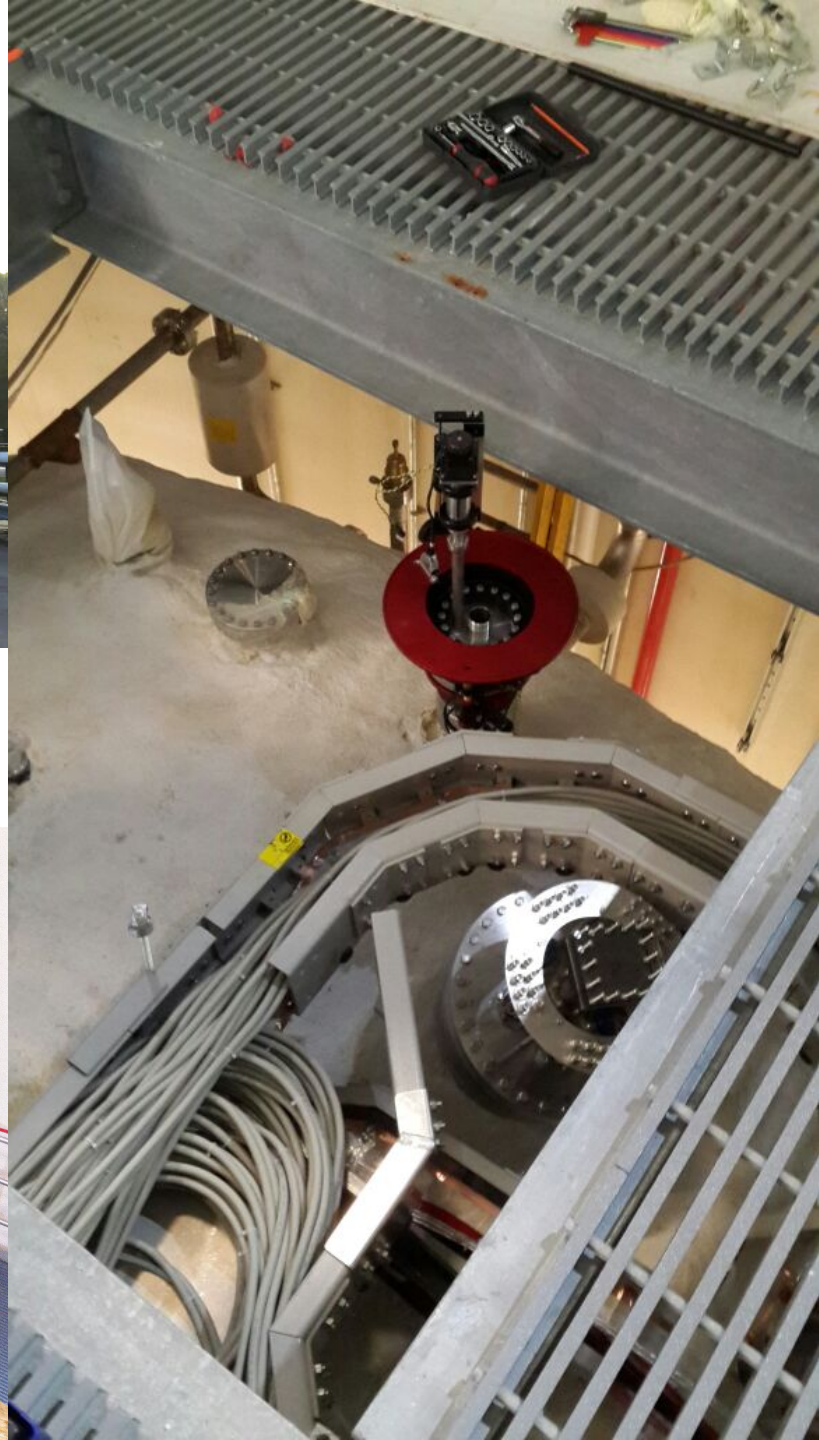
Cosmogenics
MicroBooNE

We have a building
We have a detector





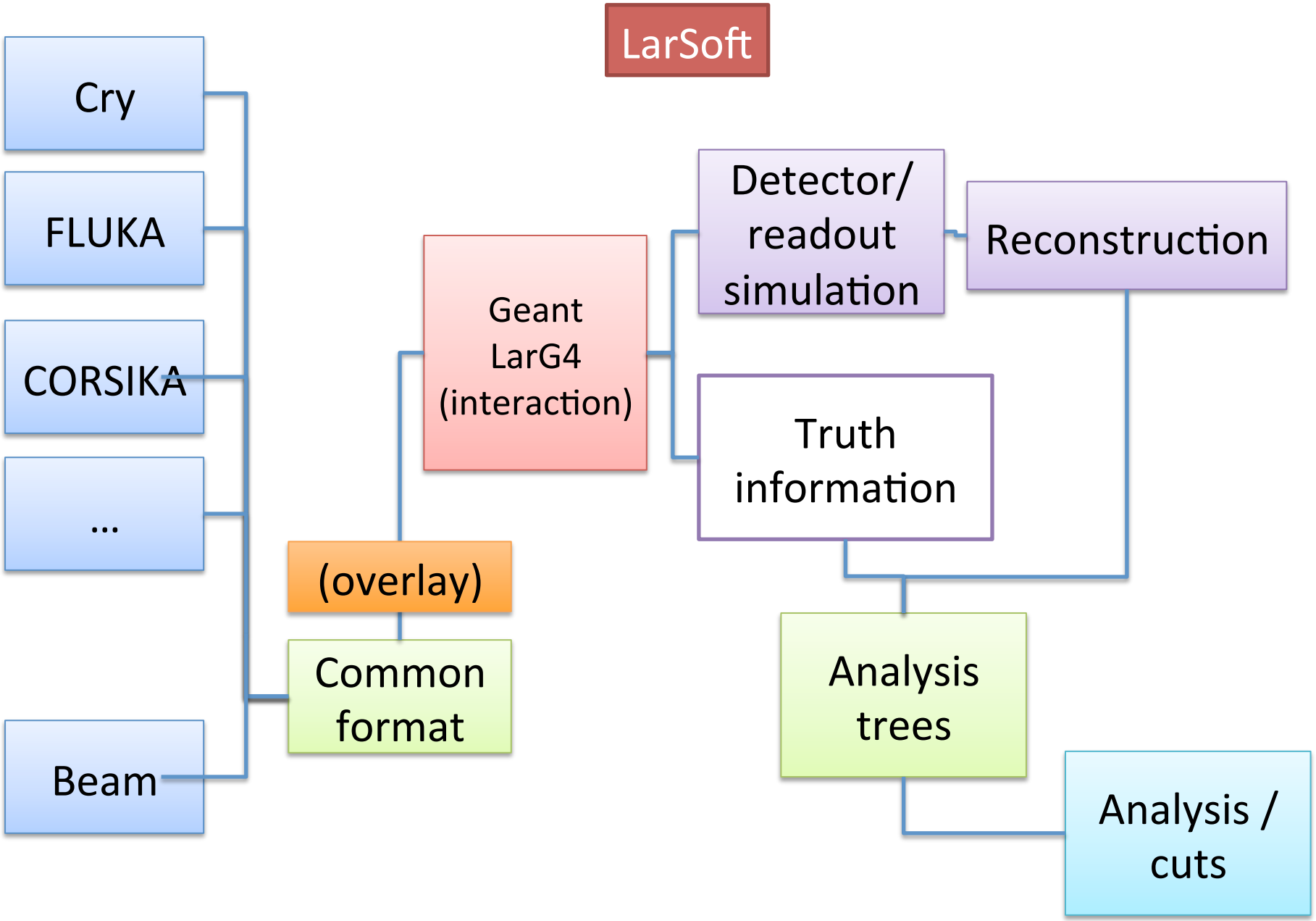
MicroBooNE work on Cosmogenics

- First measurements with cosmic rays
- Cosmic ray removal tools
- Task Force to address the over-burden decision (foreseen option for uB)

- Use LarSoft
  - considerable effort went/going to set up the infrastructure, good investment in the future

Work WG1 (from end of July talk)

- Simulation
  - Detailed FLUKA studies for ICARUS available (aim at higher statistics)
  - Profit from LBNE support and expertise
  - Better interaction simulation for uB / LAr1ND (re-interactions in dirt and detector)
- Cuts
  - Electron / photon separation (Compton + Pair)
  - Study a list of cuts with efficiencies (in close collaboration with WG2 for the signal). See slide.
- In spill / in drift time
  - Additional background in data sample
  - Overlap, reconstruction issues (energy , topology, …)
  - Possibility of “veto” (external/internal)
  - Light system performance

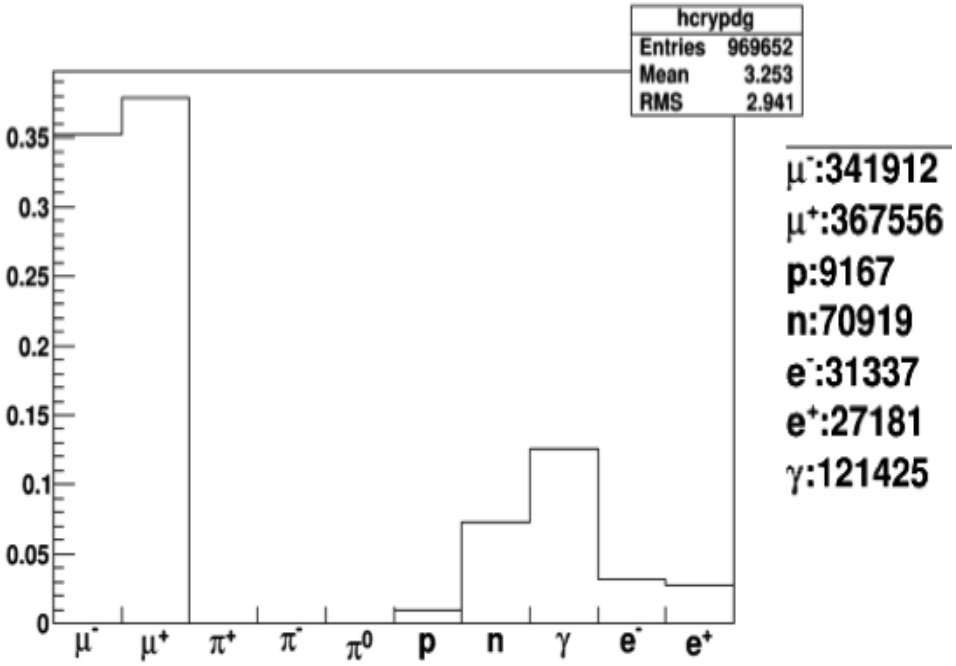

LarSoft
Cry
FLUKA
CORSIKA
…
Beam
Geant
LarG4
(interaction)
Detector/
readout
simulation
Reconstruction
Truth
information
(overlay)
Common
format
Analysis
trees
Analysis /
cuts

M. Bass

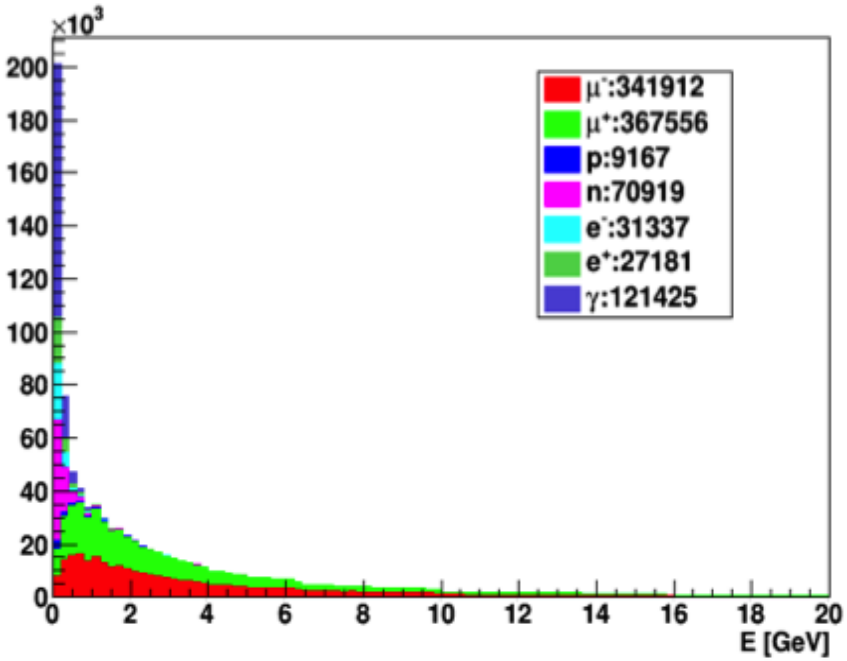
Sorted CRY Particles spectra

(rates for Cryostat+TPC)

Initial sample size = 19900 events



μ⁻:341912
μ⁺:367556
p:9167
n:70919
e⁻:31337
e⁺:27181
γ:121425



Known CRY undercounting issue:

No corrections for Neutrons/Protons/Photon applied!

Geant physics processes

B. Eberly

Fraction of daughter particles, by species, created by each physics process

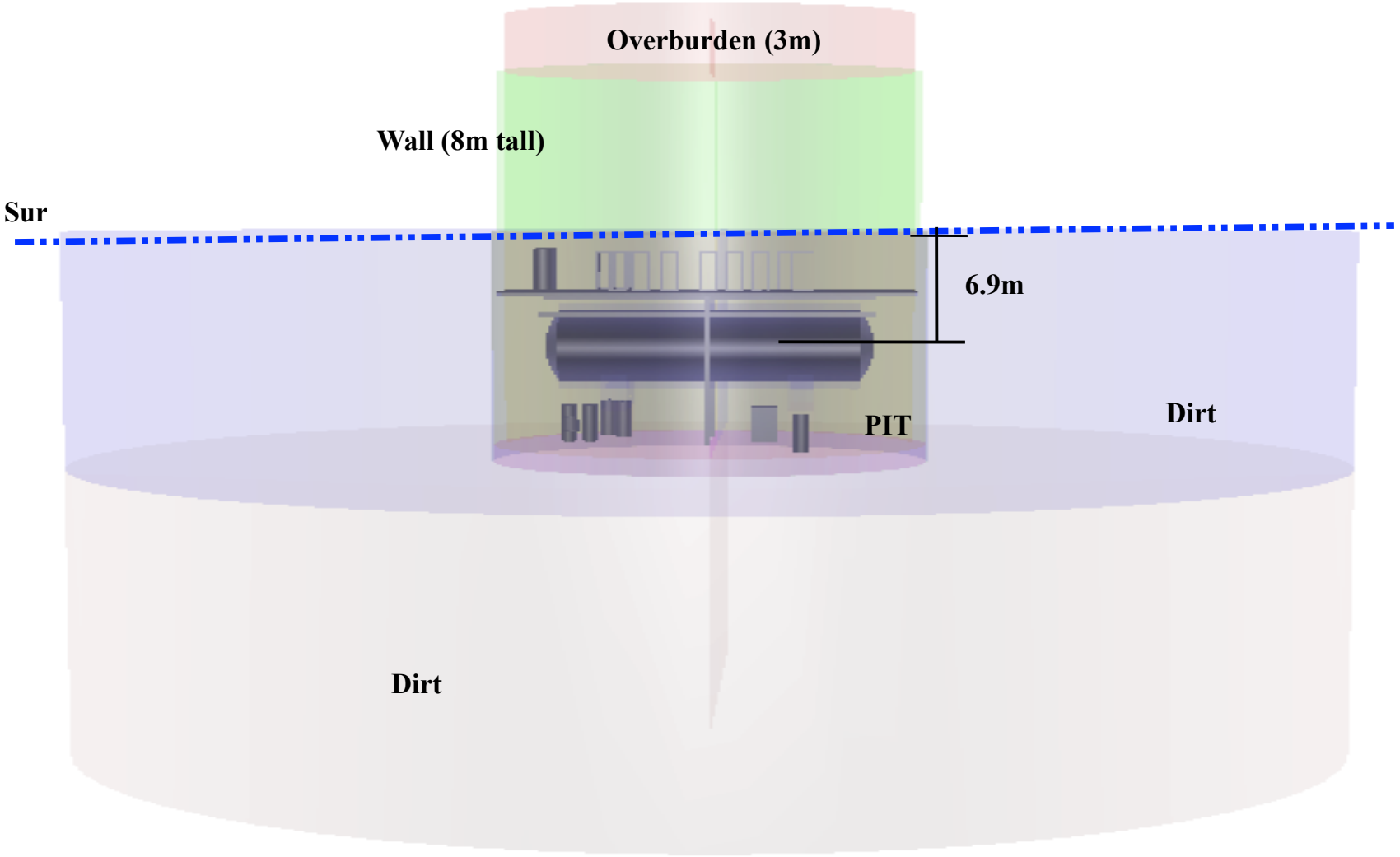
Interaction	μ-	μ+	e-	e+	γ	n	p	π-	π+	π0
Ionization			69.7							
Bremsstrahlung					89.6					
Compton			22.0							
Photoelectric			7.8							
Annihilation					9.2					
Pair Production			0.4	95.5						
μ- capture			0.02		0.6	27.2	7.6			
Hadron Elastic							6.2			
Decays	100	100	0.002	4.5	0.005					0.06
Inelastic					0.5	72.4	85.7	100	100	94.3
n Capture					0.2					
ElectroNuclear					0.001	0.08	0.3			
CHIPS Nuclear Capture						0.3	0.3			

NUMBERS AS ILLUSTRATION ONLY !

All GEANT particles (no TPC fiducial check!)

S. Gollapinni

Overburden Geometry



Effect of 3m overburden

S. Gollapinni

Initial sample size = 19300 events

All rates shown below are for particles that pass the TPC fiducial volume

	W/o overburden	W/ 3m overburden
All	308955	259585
All Primary	207122	193267
All Secondary	101833	66318

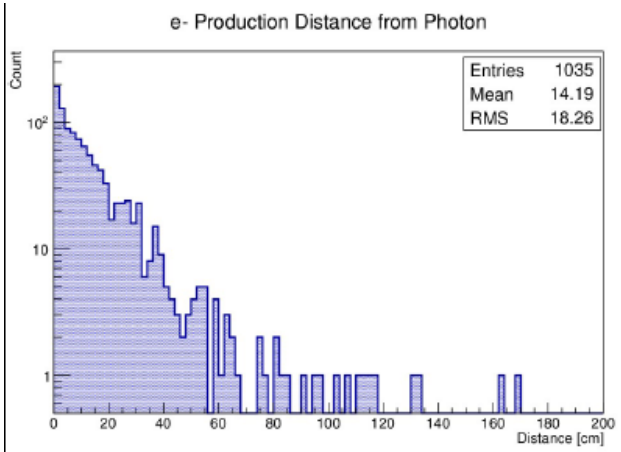
	Primary noOB	Primary 3mOB	% less	Secondary noOB	Secondary 3mOB	% less
mu-	101215	95346	-6%	16	8	-50%
mu+	104383	97687	-7%	27	12	-55%
N	446	108	-76%	19332	7701	-60%
P	112	9	-92%	3922	1382	-65%
γ	869	113	-87%	29842	18161	-39%
e-	54	2	-96%	1094	1030	-6%
e+	41	2	-95%	1948	2183	12%

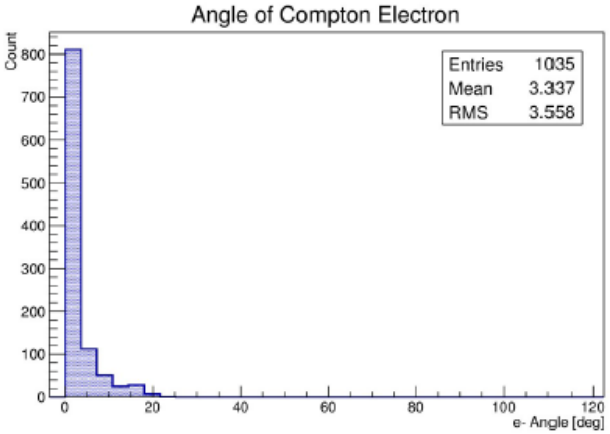
NUMBERS AS ILLUSTRATION ONLY !

More analyses using the framework

- E.g. Muons with Brem -> Compton

D. Caratelli

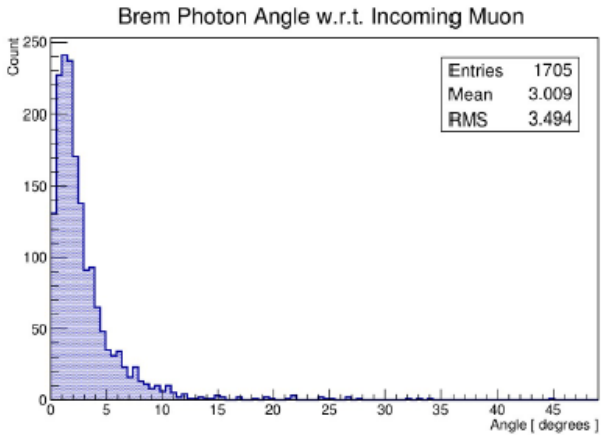




Top left: Distance from 200 MeV photon production and compton e- production

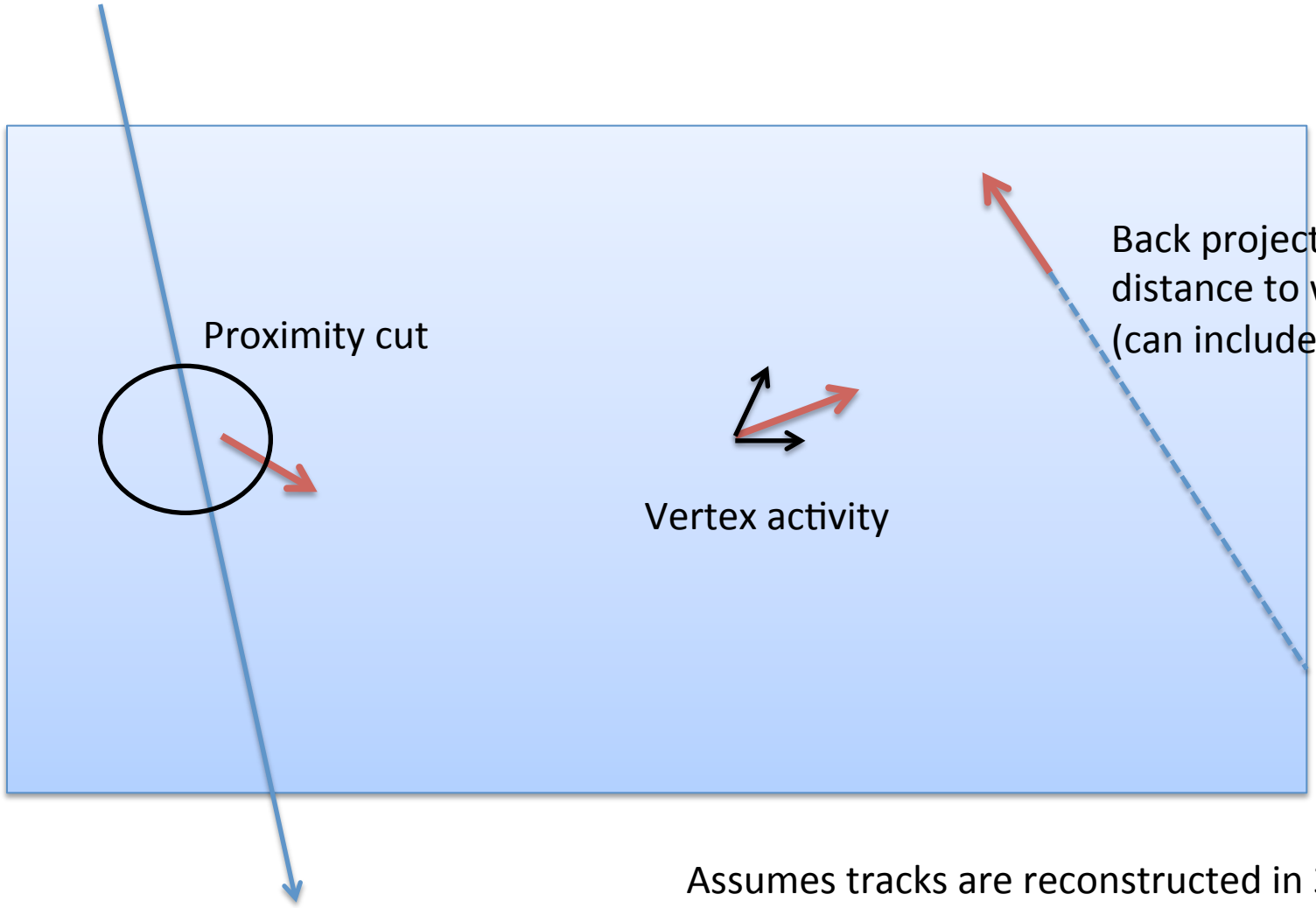
Top right: Angle between compton e- direction and photon's original direction

Bottom right: Angle between mu- and bremsstrahlung photon's direction

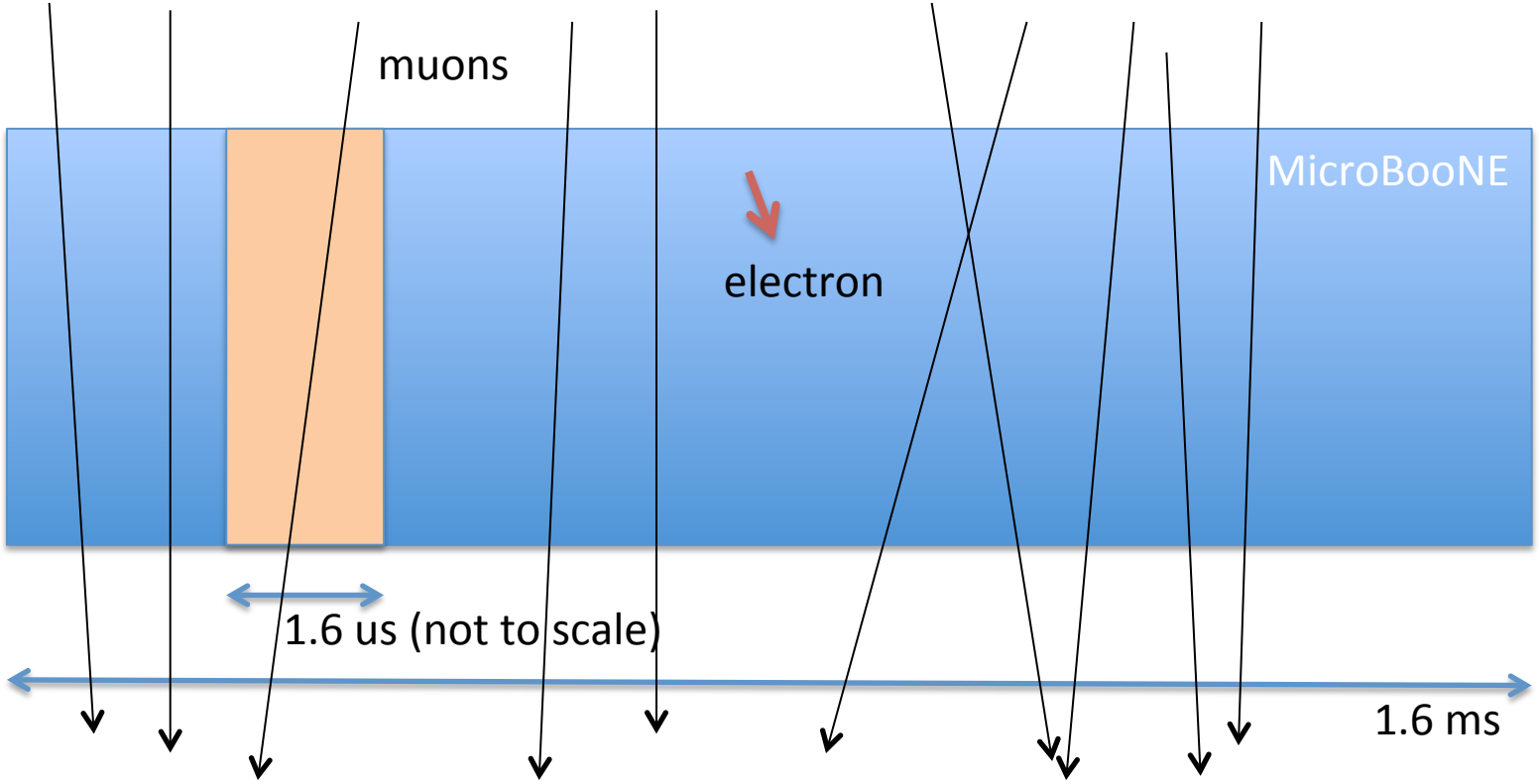


BACKUP

Cuts, some ideas



Assumes tracks are reconstructed in 3D
(2D plus unique time association)



- Electron (light pulse) outside the spill time (alone) will not be selected for analysis
- Without any attempt to cut them, the electrons in the spill time are of the same order as the intrinsic nue (~600 for 6.6E20 pot)
- Additional contribution from other activity in the event that gets in the spill time window (overlap and ambiguity because of multiple light pulses)
  - Probability in uB to have a muon in the beam spill is ~10 muons in 1.6 ms -> 1/100 muons in 1.6 us
    -> At most a factor of 1.6ms/1.6us/100=10 times more electrons entering the analysis, which needs to be resolved by the optical system timing and position (or an external muon veto)
- For other beam related tracks (in the beam time: numuCC) we can remove the events if it overlaps with a cosmic electron. It removes 1 / 200 beam events or accept e.g. as numuCC. More careful studies for dirt interactions needed.