MicroBooNE NuMI Update

Douglas Davis
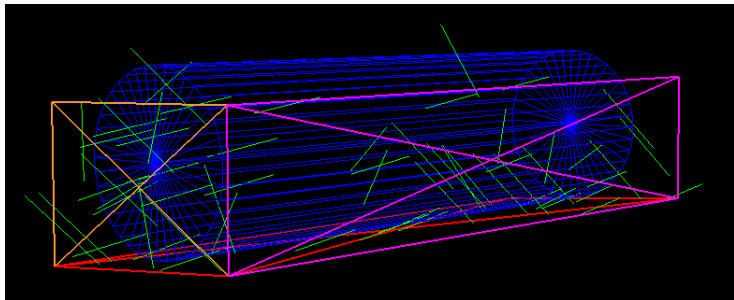
The University of Texas at Austin

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Outline

- Quick reminder of our process for NuMI MC in MicroBooNE.
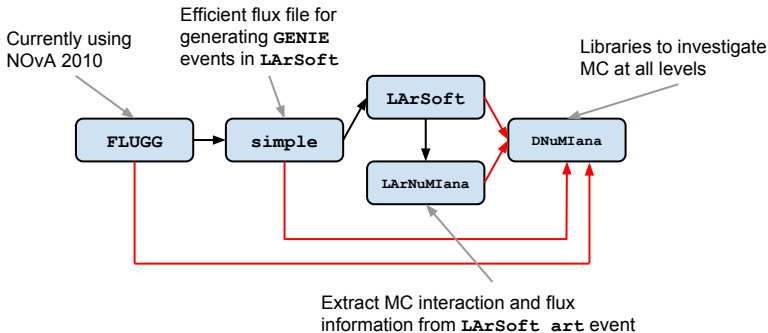- Current work status (neutrino ancestry).
- Direction we're headed in.

Quick Reminder

Three windows used to receive neutrino flux from NuMI and generate neutrino events in MicroBooNE.


- Bottom window (red): $\sim 1924 \ \nu/10^8 \ \text{POT}/m^2$
- Length window (magenta): $\sim 1937 \ \nu/10^8 \ \text{POT}/m^2$
- Normal window (orange): $\sim 1845 \ \nu/10^8 \ \text{POT}/m^2$

Currently using NOvA 2010

Efficient flux file for generating **GENIE** events in **LArSoft**

Libraries to investigate MC at all levels

FLUGG → **simple** → **LArSoft** → **DNuMIana**

LArNuMIana

Extract MC interaction and flux information from **LArSoft art** event

- At large off-axis angles parents produced in shielding contribute significantly
- Roughly 50% of events from parents producted outside target
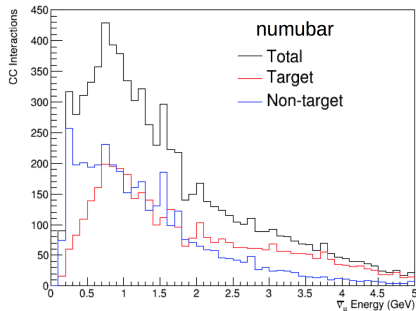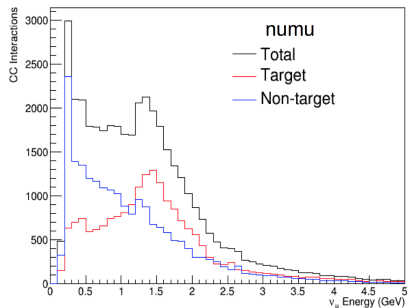
Hadron Production Media

- We've started investigating more specific hadron production information.
- On the interaction level (i.e. from `LArSoft` events).
- Medium is immediately available (deeper ancestry invesetigation in the works).

Table : Normal window, 3000 events; Decay, Hadron Production Media %'s

Decay (%)	Carbon	Concrete	Helium	Iron	Aluminum
$K^+ \to \mu^+ \nu_\mu$ (47.17)	55.69, 1.34	0.84	0.92	22.76	17.88, 0.28
$K^- \to \mu^- \overline{\nu}_\mu$ (8.73)	49.24, 1.91	0.38	1.14	24.05	23.28
$\pi^+ \to \mu^+ \nu_\mu$ (27.73)	40.02, 2.88	0.96	5.17	26.8	23.07, 0.60
$\pi^- \to \mu^- \overline{\nu}_\mu$ (8.27)	56.45, 0.4	1.21	2.02	21.37	17.74, 0.81

Table : Bottom window, 3000 events; Decay, Hadron Production Media %'s

Decay (%)	Carbon	Concrete	Helium	Iron	Aluminum
$K^+ \to \mu^+ \nu_\mu$ (50.07)	43.07, 1.39	2.92	1.59	30.29, 1.46	17.51, 0.2
$K^- \to \mu^- \overline{\nu}_\mu$ (8.0)	43.51, 1.67	2.09	1.26	34.31, 0.41	15.48, 0.83
$\pi^+ \to \mu^+ \nu_\mu$ (26.1)	30.14, 3.44	1.66	4.85	43.8	14.94, 0.89
$\pi^- \to \mu^- \overline{\nu}_\mu$ (8.9)	38.58, 4.49	2.62	6.0	34.08	13.48, 0.75

Where we're headed

- Tools developed using 2010 MC, we're going to move to late 2013 MC from Adam.
- Continue investigating ancestry, hadron production positions w.r.t. NuMI geometry.
- Compare to/Update the following table using windows and `LArSoft`
- Compare CC interaction plot from raw flux to statistics from `LArSoft` events.

Events	BNB	NuMI
Total	145k	60k
ν_μ CCQE	68k	25k
NC π^0	8k	3k
ν_e CCQE	0.4k	1.2k
POT	6×10^{20}	8×20^{20}

Table : Current table quoted by μB
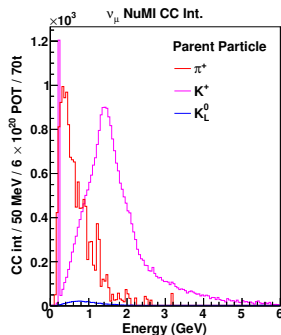
- Another collaborator has also worked with NuMI events, breadth of information in the near future.

Backup