

$$p \rightarrow K^+ \bar{\nu}$$

# Atmospheric $\nu$ Backgrounds, and Production Group Progress

...or lack thereof...

## *A Very Short Update*

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DUNE NDK/HEP WORKING GROUP MEETING, NOVEMBER 13<sup>TH</sup>, 2019



# Single Kaon Issues

A single event threw off my initial high statistics generation of oscillated atmospheric neutrino events

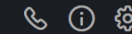
- Was considering energies  $\{0.1, 100\}$  GeV
- An event  $\sim 24$  GeV seemed to show an issue in the underlying strangeness violating SingleKaon production generator
- May be remedied by running many smaller samples (50,000-100,000 events)
  - Throw away ones where this problem is encountered

I've alerted GENIE developers to this problem

- They don't have time to fix it**
- It was an experimental add-in, not well tested
- Seems to work on some lower energy events...

Marco Roda

☆ | 🔔 notifications snoozed | marcoroda



🔍 Search



Tuesday, October 29th



Joshua Barrow 2:18 PM

Hi Marco,

It seems I'm having some issues with the kaon production model

I'm trying to run a large production of 3.5 million atmospheric and I'm seeing some issues arise toward the end of the production with a kaon spline, I think...

If you look in `/genie/app/users/jbarrow/genie-v3/Generator/atmospherics/PDKAtm/hA_BodekRitchie/largeproduction/tmp.txt` below line 4949, you may see the issue...

The event involves a  $\sim 24$  GeV muon neutrino

Untitled ▾

```
1 1572350553 WARN SKHadron : [n] <SKHadronicSystemGenerator.cxx::CalculateHadronicSystem_AtharSingleKaon (137)> : Invalid selected kinematics; Attempt
  regenerating
2 1572350553 FATAL EventGenerator : [n] <EventGenerator.cxx::ProcessEventRecord (131)> : Caught max allowed number (350) of EVGThreadExceptions/thread.
  Aborting
3 1572350553 FATAL EventGenerator : [n] <EventGenerator.cxx::ProcessEventRecord (134)> : Event :
4
5
6 |-----|
7 |GENIE GHEP Event Record [print level:  1]|
8 |-----|
9 | Idx |      Name | Ist |      PDG | Mother | Daughter | Px | Py | Pz | E | m |
10 |-----|
11 |  0 |      nu_mu |  0 |      14 |  -1 |  -1 |  4 |  4 |  4.416 | -18.991 | -13.868 | 23.926 | 0.000 |
12 |  1 |      Ar40 |  0 | 1000180400 |  -1 |  -1 |  2 |  3 |  0.000 |  0.000 |  0.000 | 37.216 | 37.216 |
13 |  2 |      neutron | 11 |      2112 |  1 |  -1 |  -1 |  -1 |  0.103 |  0.104 |  0.205 |  0.973 |  0.940 |
14 |  3 |      Ar39 |  1 | 1000180390 |  1 |  -1 |  -1 |  -1 | -0.103 | -0.104 | -0.205 | 36.243 | *36.286 | M = 36.242
15 |  4 |      mu- |  1 |      13 |  0 |  -1 |  -1 |  -1 | -10.218 |  5.580 | 22.139 | 25.014 | 0.106 | P = (0.409, -0.223, -0.885)
16 |-----|
17 |      Fin-Init: | -14.738 | 24.467 | 35.802 | 0.115 |
18 |-----|
19 |      Vertex:      nu_mu @ (x =  0.00000 m, y =  0.00000 m, z =  0.00000 m, t =  0.00000e+00 s) |
20 |-----|
21 | Err flag [bits:15->0] : 000000000010000 | 1st set:      Generic error in kinematic generation |
22 | Err mask [bits:15->0] : 111111111111111 | Is unphysical: YES | Accepted: NO |
23 |-----|
```



Marco Roda 2:20 PM

Hi Joshua. I'm in Madrid right now about to take a train. I'll try to have a look tomorrow. If you don't hear from me ping me again next week. As I have a lot of traveling to do.



Joshua Barrow 2:21 PM

🔔 Marco Roda has notifications turned off

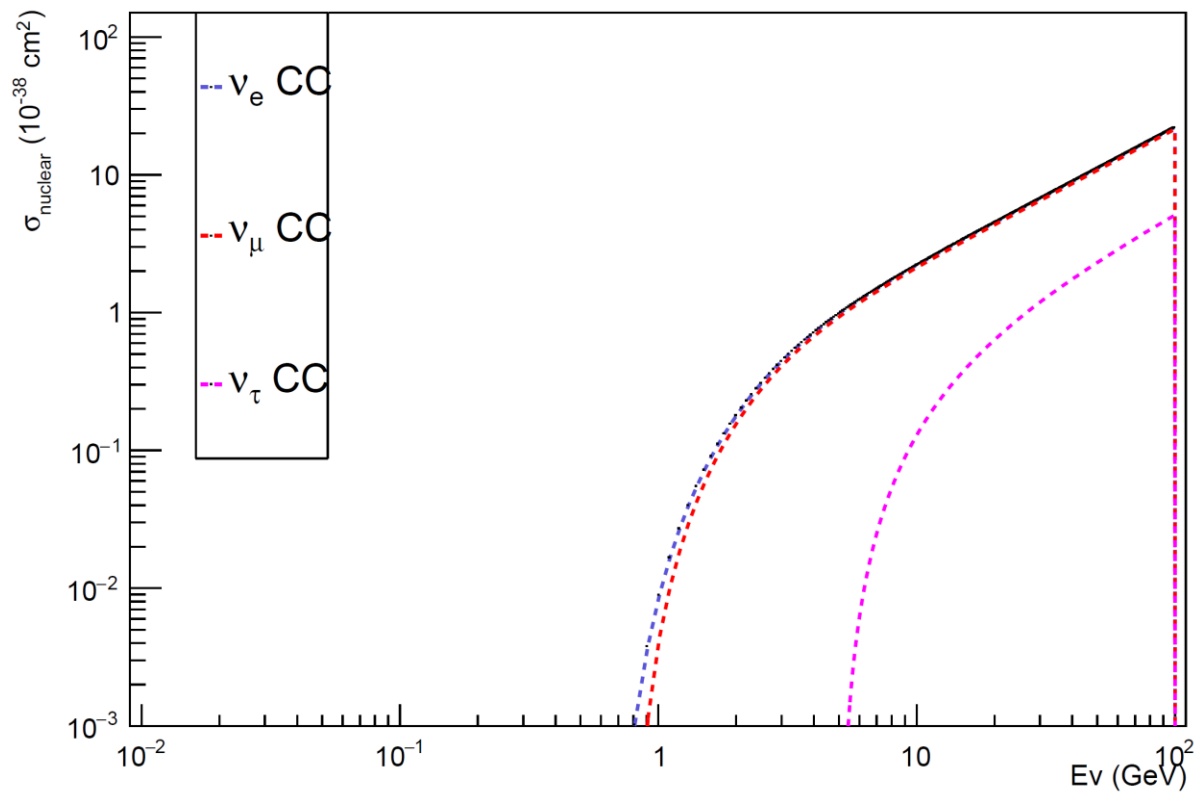
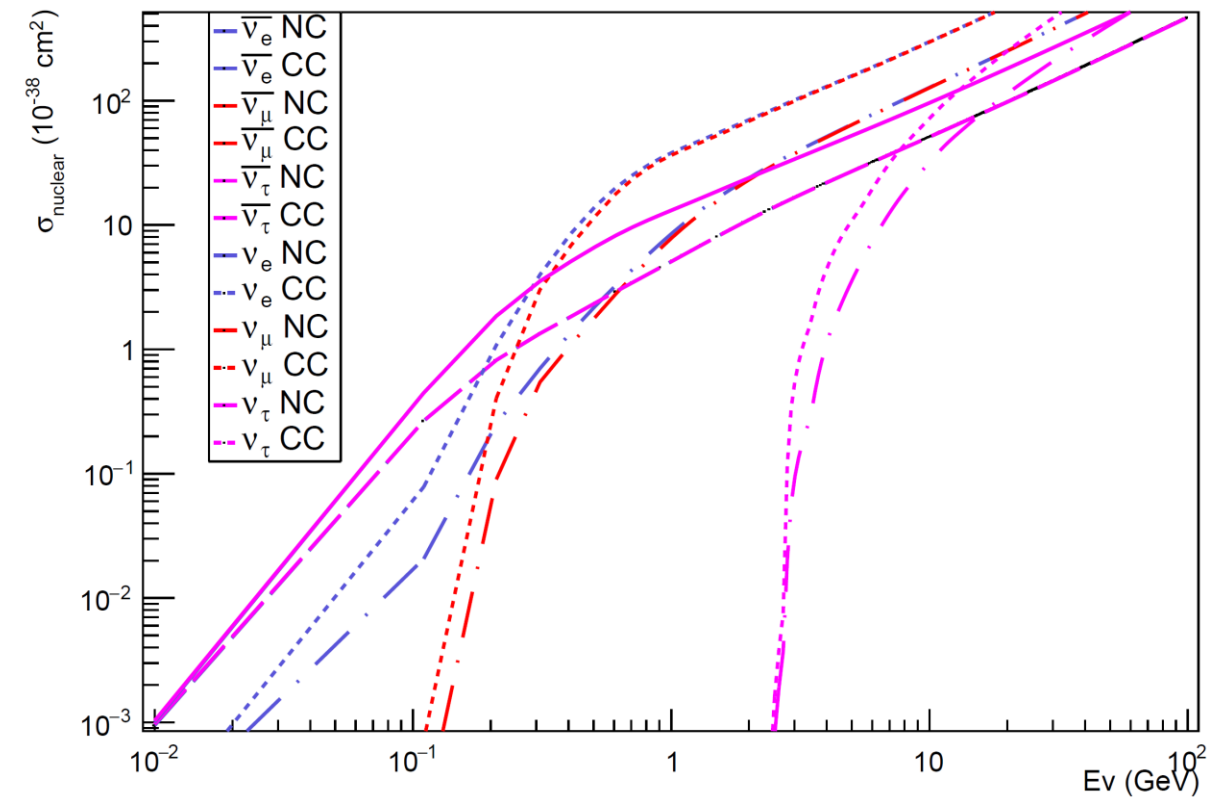
📎 Message Marco Roda



GENIE GHEP Event Record [print level: 1]

Idx	Name	Ist	PDG	Mother	Daughter	Px	Py	Pz	E	m			
0	nu_e	0	12	-1	-1	4	4	0.537	-0.935	-0.437	1.163	0.000	
1	Ar40	0	1000180400	-1	-1	2	3	0.000	0.000	0.000	37.216	37.216	
2	proton	11	2212	1	-1	5	6	-0.158	-0.127	-0.005	0.960	0.938	
3	C139	2	1000170390	1	-1	9	9	0.158	0.127	0.005	36.256	*36.290	M = 36.255
4	e-	1	11	0	-1	-1	-1	-0.174	-0.171	-0.154	0.288	0.001	P = (0.605,0.592,0.533)
5	proton	14	2212	2	-1	7	7	0.345	-0.491	-0.019	1.114	0.938	FSI = 1
6	K+	14	321	2	-1	8	8	0.209	-0.400	-0.270	0.721	0.494	FSI = 1
7	proton	1	2212	5	-1	-1	-1	0.345	-0.491	-0.019	1.114	0.938	
8	K+	1	321	6	-1	-1	-1	0.209	-0.400	-0.270	0.721	0.494	
9	HadrBlob	15	2000000002	3	-1	-1	-1	0.158	0.127	0.005	36.256	**0.000	M = 36.255
Fin-Init:						-0.000	-0.000	-0.000	-0.000				
Err flag [bits:15->0] : 0000000000000000				1st set:				none					
Err mask [bits:15->0] : 1111111111111111				Is unphysical: NO		Accepted: YES							

An event that worked...**AND produced a relatively low energy  $K^+$**



# Total CC vs. SingleKaon Cross Sections

Is ignoring the DIS-CC-SINGLEK production cross section good enough for a  $10^{-6}$  measurement?!?

As for Production Group  
progress for large  
reconstruction jobs for  
already generated GENIE  
events?

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NONE...YET...

I'M STILL WAITING TO HEAR FROM KEN HERNER...