

Discussion on trigger requirements for nucleon decay

September 4, 2019

DAQ Physics Performance WG

1. What selection criteria are used in the anticipated NDK and atmospheric analyses in terms of fiducial volume, reconstructed energy, and PID or other event-quality cuts? This will tell us how our definition of high efficiency maps onto your working group's.
2. How does reconstructed energy map to "visible energy" with existing reconstruction---the trigger will be unlikely to do online reconstruction of events and probably we would not want it to, because we'd like the trigger to be simple.
3. What events are lost entirely (if any) by PID and quality cuts, and are these events that are ultimately "useless", or do we need to trigger on them?
4. How well does the trigger efficiency curve for your events of interest need to be understood, in terms of its impact on physics uncertainties? Clearly this is not an easily-answerable question at this point, but just getting people thinking about this would be worthwhile.
5. How many secondaries are critical to keep (e.g., neutrons) and how far from the interaction or decay do they typically travel?

Nucleon decay

(Thoughts
from
Aaron...)

- $p \rightarrow \nu K$, $K \rightarrow \mu \rightarrow e$
- At least 2 reconstructed tracks, identify kaon by dE/dx and muon by well-defined momentum (237 MeV/c)
- Total visible energy ~ 100 MeV
- Impossible events: low-energy kaons that can't be tracked
 - Our "optimistic" assumption was 2 cm which corresponds to ~ 20 MeV?
- So far we are assuming photon detectors give us t_0 perfectly
- Also assuming no cosmogenic background
- Neutrons are not an issue
- Cosmogenic background: how far can a K_0 travel into the detector to mimic signal and what is visible energy of these events?

Other physics

- N-nbar
 - vertex with several light hadrons with energy twice the nucleon mass and zero net momentum
 - Requirements on secondaries? (FSI induced neutrons)
- Atmospheric neutrinos
 - Requirements should be similar to beam neutrinos