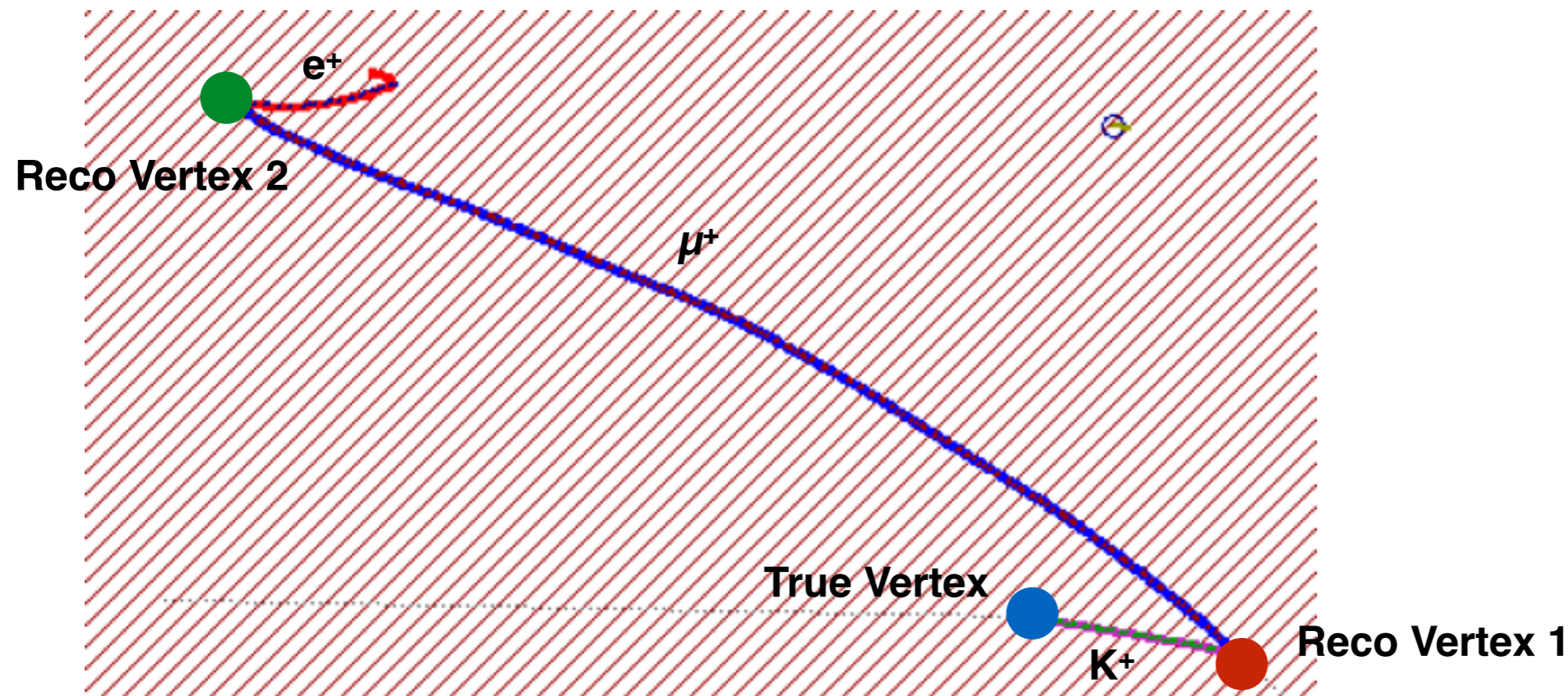


Proton Decay, $p \rightarrow K^+ \bar{\nu}$

*Aaron Higuera
University of Houston*

Proton Decay, $p \rightarrow K^+ \bar{\nu}$

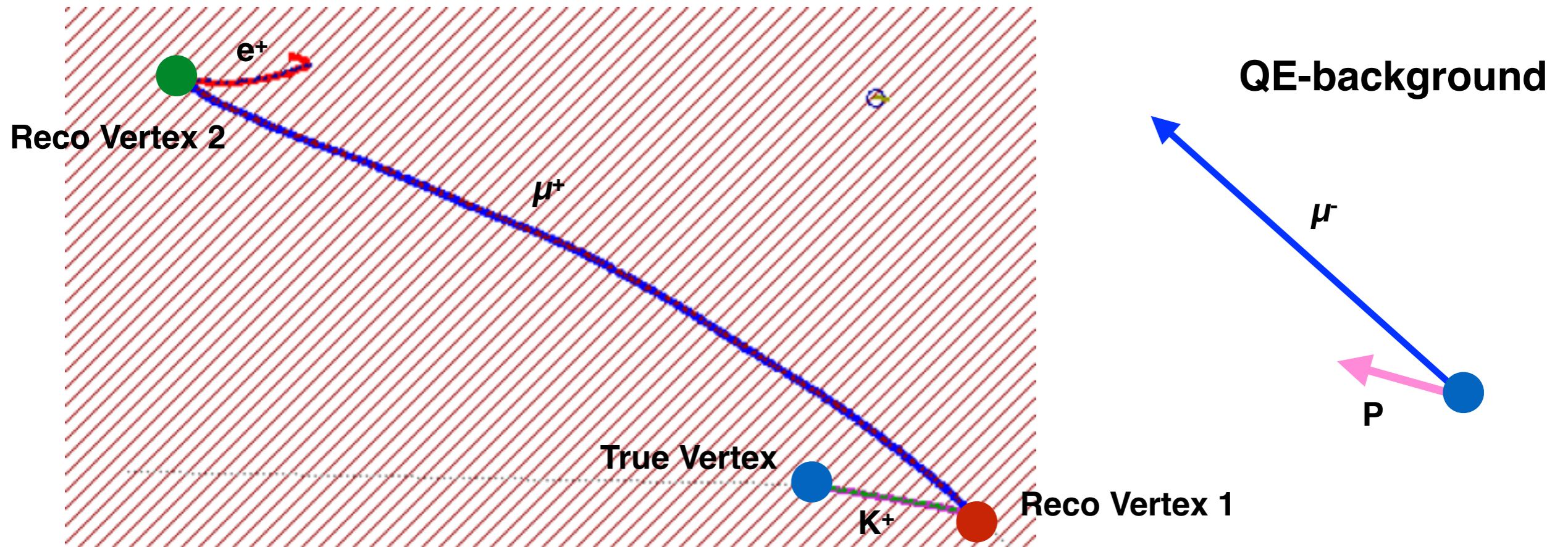


Ideally we can loop over the interaction (true) vertex and ask what is the multiplicity, for $p \rightarrow K^+ \nu$ should be one

However for $p \rightarrow K^+ \nu$ events the reconstruction always anchors the end of the kaon track and the muon track to make a vertex

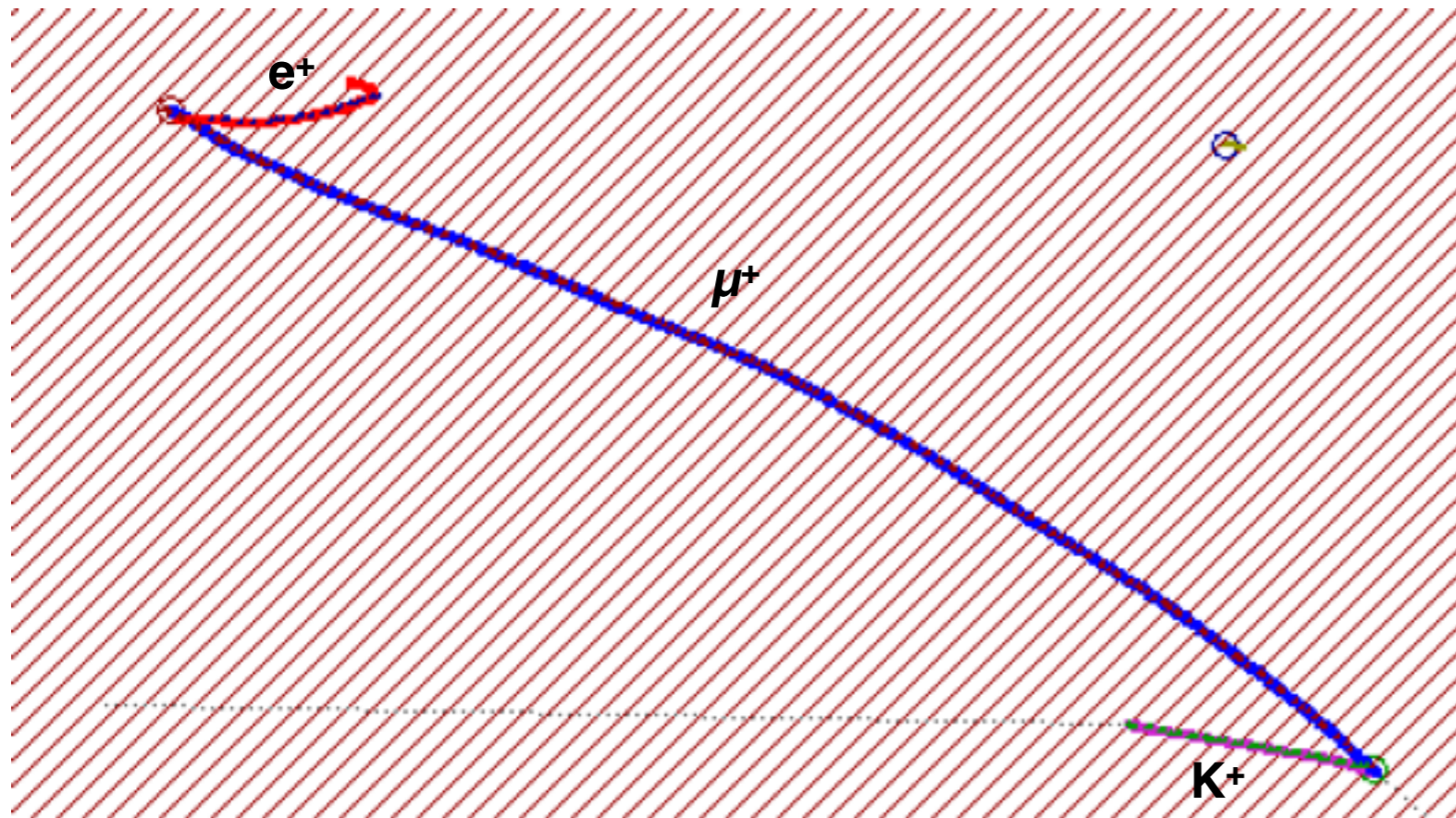
How can we defined the interaction(primary) vertex? PDS can help us?

Proton Decay, $p \rightarrow K^+ \bar{\nu}$



With out a primary vertex, the “work around” is loop over tracks and find a Kaon candidate using PIDA

Proton Decay, $p \rightarrow K^+ \bar{\nu}$



Event selection for Proton decay (Using PMA reconstruction, pmtrack)

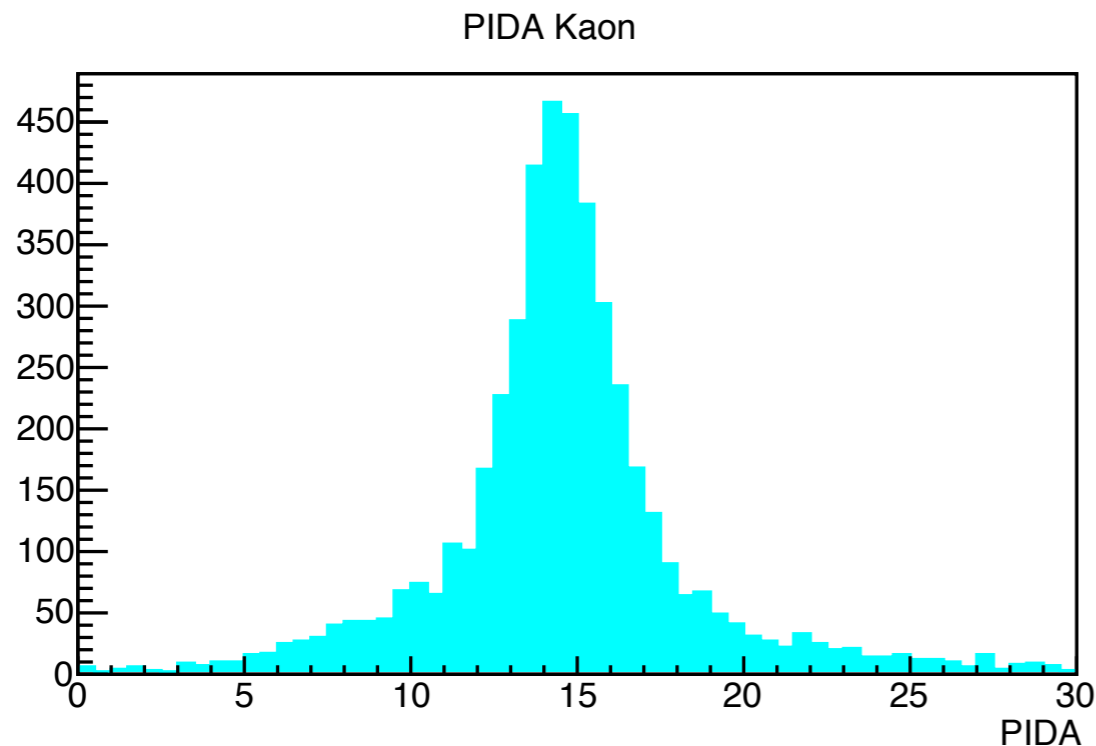
- 1) Event has a track
- 2) Event has Kaon candidate (PIDA)
- 3) Kaon candidate is contained

Disclaimer: very preliminary results, I might missed some useful infrastructure that is already available (like PANDORA, PFParticles) so suggestion are welcome

Kaon PIDA

- **Using calorimetry module, calculate dE/dx and residual range (30 last cm)**
- **Requires 3D track reconstruction**
- **$\mu = 14.5$ RMS =3.5**

$$PIDA = \frac{dE}{dx} r_i^{0.42}$$



Event Selection

- 1) **Event has a track**
- 2) **Event has Kaon (PIDA)**
- 3) **Kaon track is contained**

Proton Decay, $p \rightarrow K^+ \bar{\nu}$

	Signal	Background Atmospheric Neutrinos	
All	100%	100%	
Event has a track	87.5%	83.1%	
Kaon candidate	47.5%	26.5%	
Kaon candidate is contained	47.4%	24.5%	34.9% CC ν_μ 12.1 % NC ν_μ 47.2 CC ν_e 5.8% NC ν_e

Kaon ID seems to be very effective, needs to be optimized

To do:

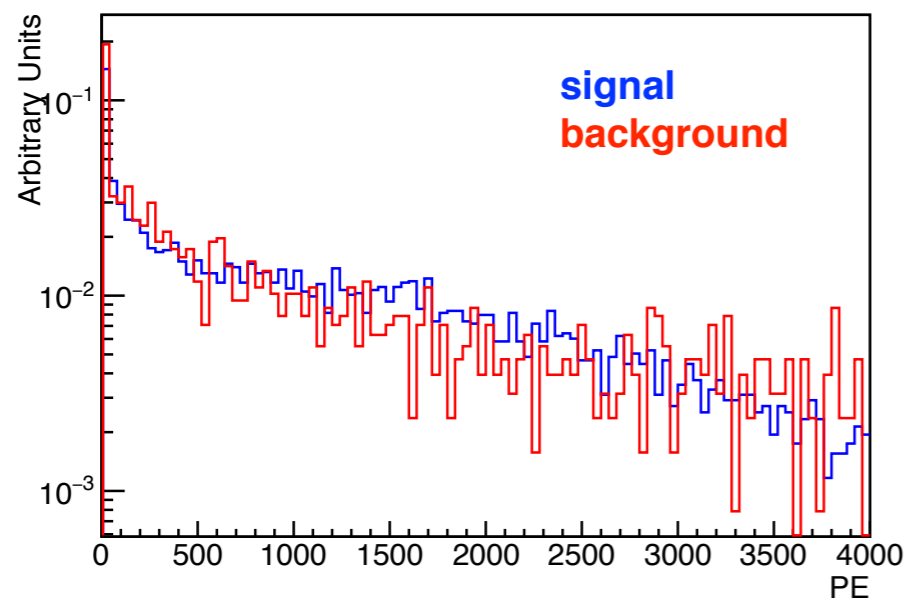
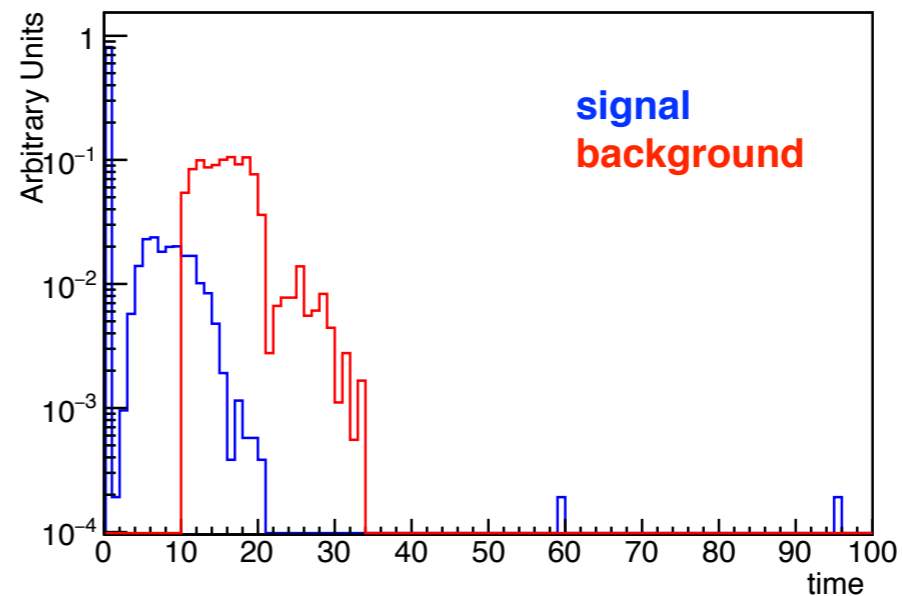
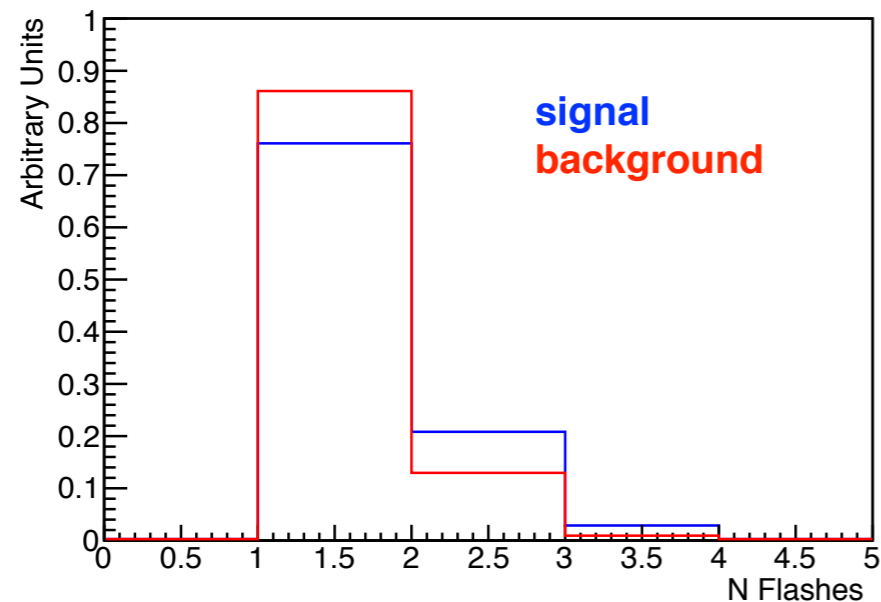
Try MVA using other PIDA hypothesis (i.e. no additional charged hadrons)

Showers?

Proton Decay, $p \rightarrow K^+ \bar{\nu}$ & PDS (OpFlash reco)

How can we defined the interaction(primary) vertex? PDS can help us?

Can we use PDS to reject remaining background?



PDS data for events after all cuts
To do
Matching between flashes and
TPC objects(tracks?)

Comments

Kaon ID, crucial for proton decay search (golden channel)

How we can defined an interaction vertex(primary)

This would reject a lot of background base on multiplicity cut

PDS can help but requires good timing resolution (~ns)?

PDS can also help on PID (early vs late, $K \rightarrow \mu \rightarrow e$)?

Use MVA to improve event selection

The End