Some thoughts about triggers for PIONEER

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Purpose of this presentation

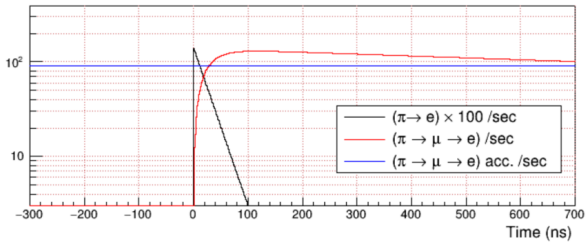
- Stimulate a discussion of general principles for PIONEER triggers,
- Look back on experience from previous experiments,
- Make sure decisions made in the near future do not limit final choices.

Note: put together on very short notice, with little available time.

Excellent starting point: the PIONEER proposal

6. Trigger and Data Acquisition System

All triggers will start with a PI signal, which is a loose condition for an incident beam particle defined as a coincidence of the beam detectors upstream of the ATAR. The key point is that this trigger must not introduce any bias between $\pi \to e\nu$ and $\pi \to \mu \to e$ events. The main time distributions in the vicinity of the PI signal are sketched in Fig. 10. After an initial build-up with the pion lifetime, positron rates from $\pi \to \mu \to e$ reach their maximum before decreasing with the muon lifetime. The constant accidental rate from muon decays of other pions stopped in ATAR is high.



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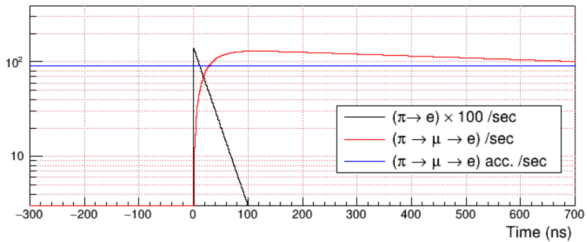
we also need non-pion-stop based triggers!



Key principles governing triggers

- minimum/no bias between $\pi \to e\nu$ and $\pi \to \mu\nu$ channels in MAIN trigger(s);
- generous inclusion of **pre-PiStop times** (accidental background);
- minimum bias for including radiative decays in the main triggers;
- dedicated triggers for radiative decays with detected photons: $\pi \to e\nu\gamma$, $\mu \to e\nu\bar{\nu}\gamma$;
- dedicated prescaled triggers timed with arrival of **beam muons** and **beam electrons** in ATAR;
- **a dedicated trigger for $\pi \to e\nu$ TAIL events**;
- a prescaled RANDOM trigger;
- a prescaled COSMIC μ trigger.

To accomplish these goals must have FAST, well TIMED digital processing in real time.

[In 1998-99 we did this with fast analog electronics, sub-ns timing & programmable FPGA.]

A look at the PIONEER geometry