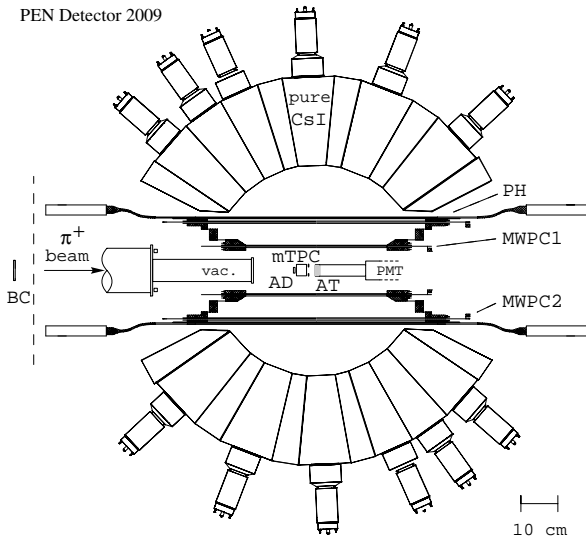
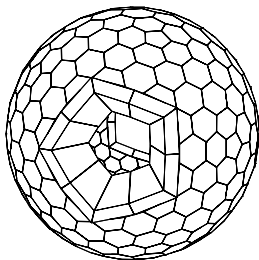


The PEN Apparatus

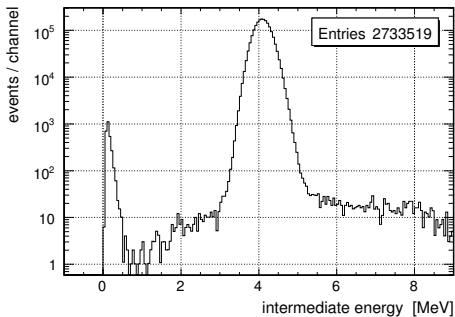
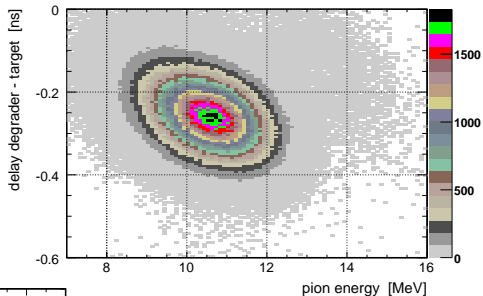
stopped π^+ beam
 active target counter
 240-det. CsI calorimeter
 central tracking
 digitized waveforms
 stable temp./humidity



Target detector time and energy resolutions

Inputs for waveform fitting:

$$\left. \begin{array}{l} \text{Pion stop time in TGT} \\ \sigma_t^{\text{DEG-TGT}} = 62 \text{ ps} \end{array} \right\} \Rightarrow$$

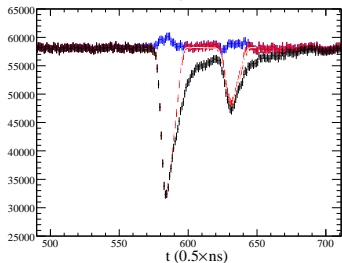


\Leftarrow $\left\{ \begin{array}{l} 4.1 \text{ MeV Muon signal in TGT} \\ \sigma_E/E_{\text{TGT}} \simeq 0.046 \end{array} \right.$

Target waveform fitting:

- (1) Shape (filter) wf signals,
- (2) Use predicted $\pi_{\text{stop}}(\text{DEG})$ and $e^+(\text{PH})$ wf's,
- (3) Fit with 2 and 3-peak wf's; compare χ^2 values.

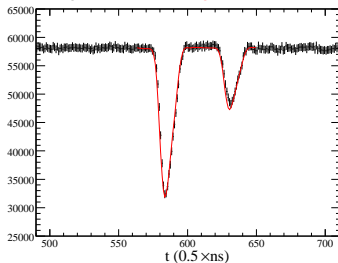
Raw + shaped wf's



Typical 2-peak
 $\pi \rightarrow e$ event

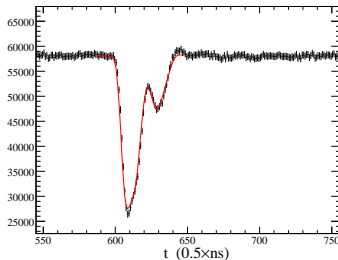
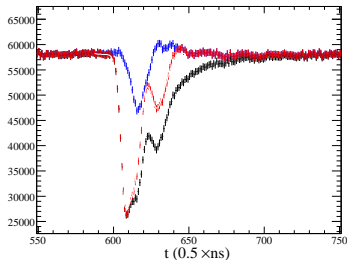
Blue trace: no
"third" (muon)
signal

Shaped wf's + predicted fits



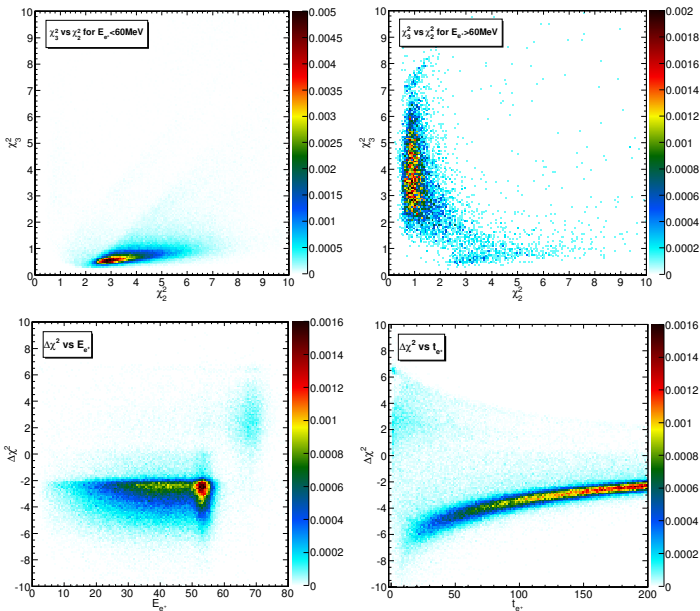
Typical 3-peak
 $\pi \rightarrow \mu \rightarrow e$ event

Blue trace:
putative "third"
(muon) signal



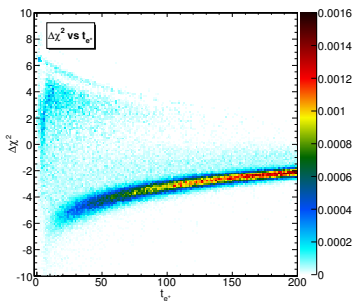
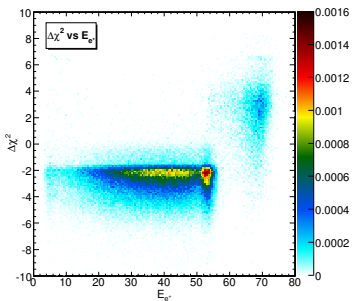
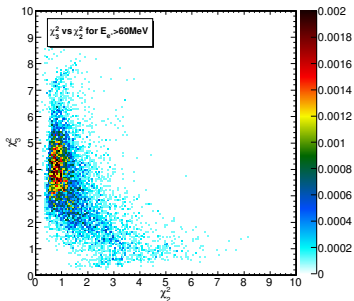
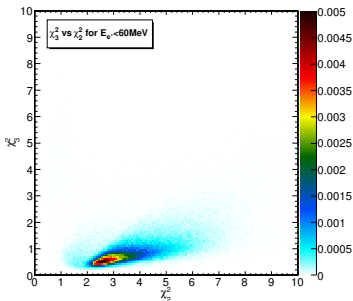
PEN: distinguishing $\pi \rightarrow e$ and $\pi \rightarrow \mu \rightarrow e$ decays (measurement)

[A. Palladino & L.P. Alonzi]



PEN: distinguishing $\pi \rightarrow e$ and $\pi \rightarrow \mu \rightarrow e$ decays (simulation)

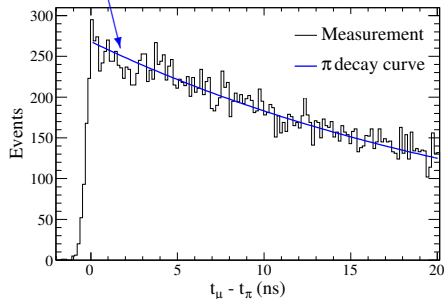
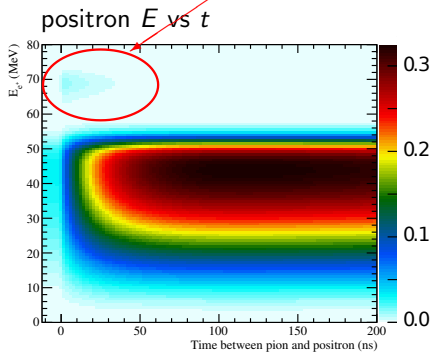
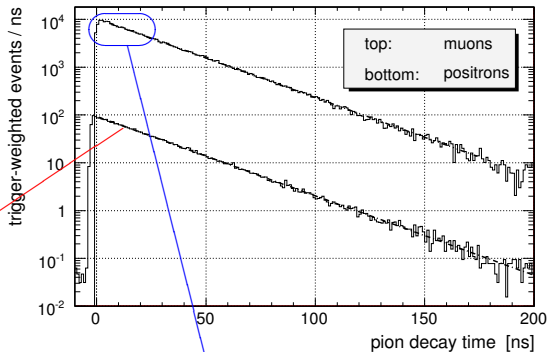
[A. Palladino & L.P. Alonzi]



Pion decays in TGT

$$\tau_{\pi \rightarrow \mu} = 26.21(5) \text{ ns} \Rightarrow$$

$$\tau_{\pi \rightarrow e} = 26.02(8) \text{ ns} \Rightarrow$$



Current status

- ▶ Development runs in 2007 and 2008.
- ▶ Data acquisition runs in 2008, 2009, 2010.
- ▶ Collected:
 - $\geq 22\text{M } \pi \rightarrow e$ events,
 - $> 200\text{M } \pi \rightarrow \mu \rightarrow e$ events,
 - resulting statistical uncertainty: $\Delta B/B \approx 0.02\%$.
- ▶ In progress: a comprehensive maximum likelihood analysis in a multidimensional parameter space. We plan to determine the full likelihood distribution for the branching ratio which has the advantage that the error distribution comes out for free.
- ▶ Analysis is blinded; we aim to have first results in 2012.