A PRECISE MEASUREMENT OF THE $\pi^+ \to \pi^0 e^+ \nu$ DECAY RATE

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R-89-01.1, PIBETA Collab: U. VIRGINIA[1] - PSI[2] - SWIERK[3] - ARIZONA ST.[4] - DUBNA[5] - TBILISI[6] - IRB ZAGREB[7]

The PIBETA experiment aims to measure the pion beta decay ($\pi^+ \to \pi^0 e^+ \nu$) branching ratio to about 0.5 % in its current phase. The best experimental value at present has error limits of ~ 4 %, far exceeding the theoretical uncertainty of < 0.15 %.

During the year 2000 we have successfully continued taking data at the π^+ stopping rate of $\sim 9 \times 10^5$/s. We have also: (i) fully automated the timing offset adjustment and detector gain matching procedures, (ii) implemented the domino sampling chip readout for all PMT signals, and (iii) completed implementation of near-100 % experiment automation, requiring that only a single experimenter be physically present and on call at the PSI site while running.

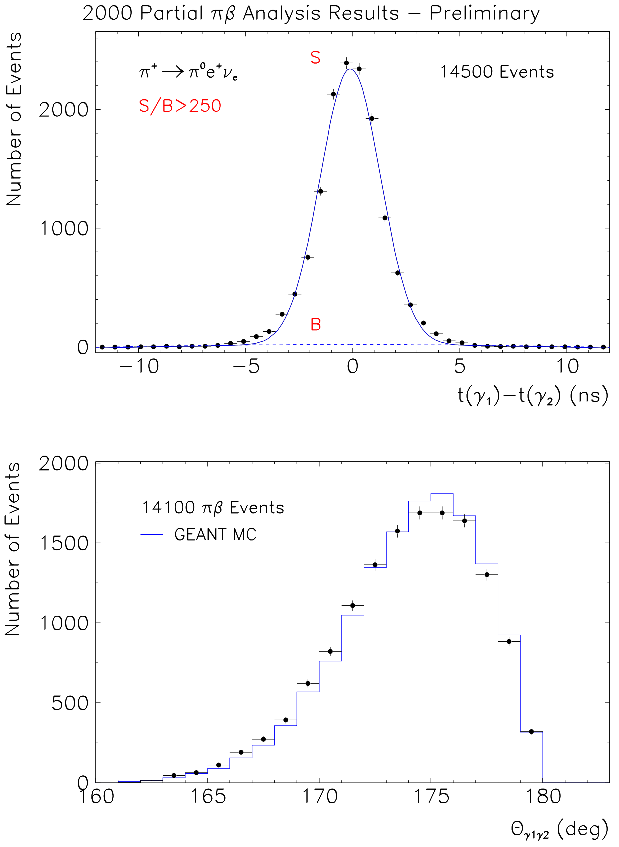

Figure 1: γ-γ time difference for pion beta decay events (top) and γ-γ opening angle distribution (bottom) projected from the analyzed fraction of our 2000 data set. Signal to background ratio exceeds 250.

Our most important accomplishment in 2000 is the acquired statistics of clean pion beta ($\pi\beta$) decay events, keeping the experiment on schedule for the $\sim$ 0.5 % phase. With $<$40 % of the data replayed and the most stringent off-line cuts we find $>$14,000 clean $\pi\beta$ events. Relaxing the software cuts (presently under study) results in ~ 20 % more final events in the current sample. Typical signal-to-background ratio spectra for the $\pi\beta$ events are shown in Fig. 1.

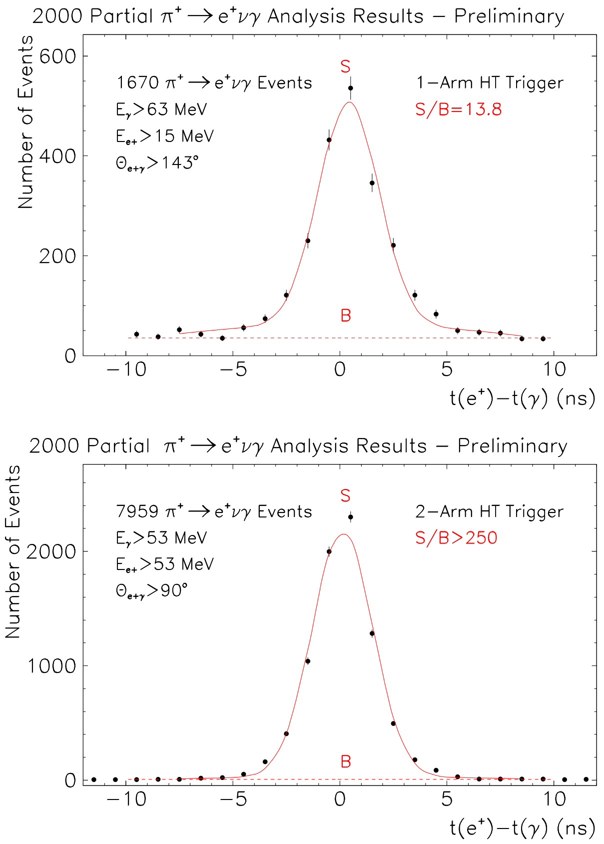

Figure 2: e-γ timing difference in a subset of the 1-arm trigger $\pi^+ \to e^+\nu\gamma$ data (top). Comparable distribution for the 2-arm data is virtually background-free (bottom).

We have simultaneously recorded a large set of radiative decay events for the processes $\pi^+ \to e^+\nu\gamma$ and $\mu^+ \to e^+\nu\nu\gamma$. In its current phase the PIBETA experiment will increase the existing world data set for these processes by more than an order of magnitude. Fig. 2 illustrates the quality of our data by showing preliminary results of the partial data analysis of the radiative pion decay. We anticipate significant physics results from the analysis of these data, addressing issues of non-$(V-A)$ terms in the weak interaction and pion structure (F_A/F_V, polarizability).

In summary, during the year 2000 the apparatus was stable and performed as designed and on schedule. We are currently in the process of evaluating a first ~ 1 % result for the pion beta decay branching ratio.