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 1999 we have successfully completed the final commissioning of the PIBETA detector system and initiated production data taking. Specifically, we have: (i) redesigned the trigger electronics around a new PSI-built fast LB500 logic module, (ii) introduced new trigger classes for beam diagnostics and monitoring, (iii) improved the beam passive and active collimation and tagging, as well as added the top plane of the cosmic veto house, (iv) implemented the domino sampling chip readout for the beam detectors, and (v) realized almost 100 % experiment automation, having the system run virtually free of human intervention.

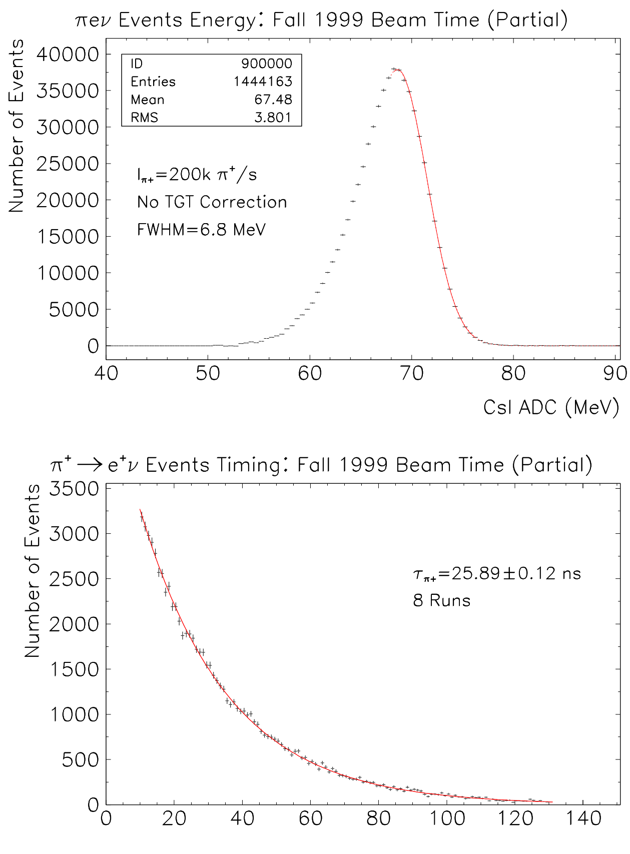

Figure 1: Typical preliminary $\pi \to e\nu$ calorimeter energy (top) and timing (bottom) spectra from our 1999 data.

Typical energy and timing spectra for the $\pi \to e\nu$ events used for the absolute π^+ beam normalization are displayed in Fig. 1.

The most important results of 1999 year's running period concern our pion beta ($\pi\beta$) decay data.

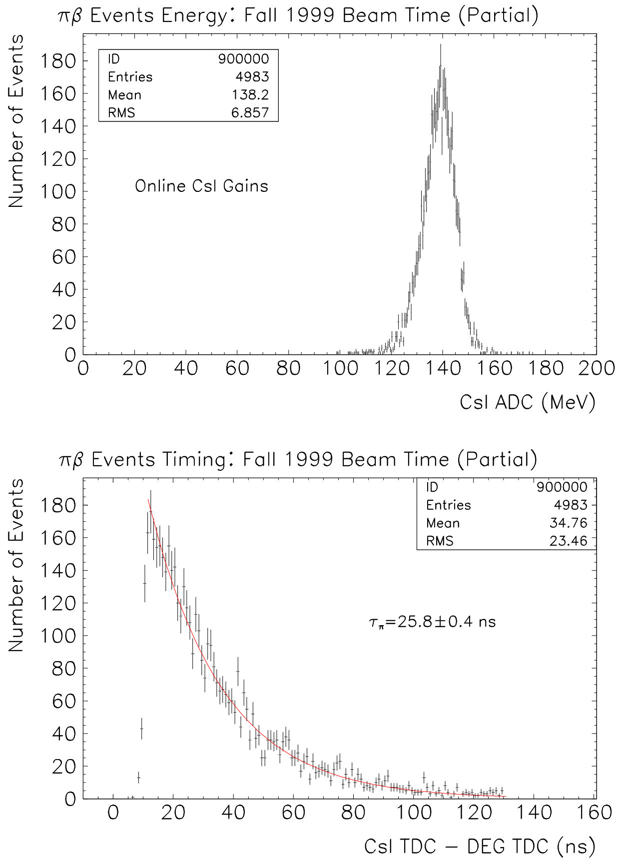

Figure 2: $\pi\beta$ calorimeter energy (top) and timing (bottom) spectra from about one half of the 1999 data set.

Top panel in Fig. 2 shows the spectrum of energy deposited in the CsI calorimeter by the two photons following the π^0 decay from $\pi^+ \to \pi^0 e^+ \nu$.

Bottom panel in Fig. 2 shows the timing difference spectrum between the CsI calorimeter hit and the π^+ stop. The spectrum is a clean exponential function consistent with the π^+ lifetime. At the statistical level of the current analysis there is no evidence of a non-pion decay background in the above histograms.

In summary, we have demonstrated that we can detect background free $\pi\beta$ events. The apparatus easily handled pion stopping rates of 1 MHz and lower, as designed. During 1999 we have recorded $\sim$10,000 $\pi\beta$ events which should enable us to extract the $\pi\beta$ branching ratio with about 1 % uncertainty, as was originally planned after the first year of operation.