COMMISSIONING OF THE PIBETA DETECTOR

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The PIBETA experiment at PSI proposes to measure the pion beta decay ($\pi^+ \to \pi^0 e^+ \nu$) branching ratio with an accuracy of about 0.5 % in the current phase of the project. Owing to low theoretical uncertainties stemming mainly from axial vector loop corrections, this is one of the most precisely calculated observables in the Standard Model. The best experimental value at present has error limits of 4 %, far exceeding the theoretical uncertainty of < 0.15 %.

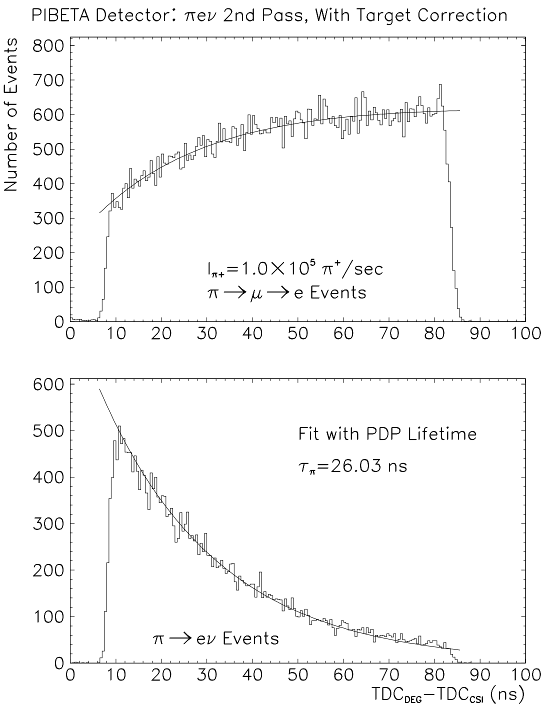

Figure 1: Timing spectra for $\pi \to \mu \to e$ events (top panel) and $\pi \to e\nu$ events (bottom panel). Fitting functions using the Particle Data Group values for the μ and π lifetimes are superimposed on the data histograms.

The PIBETA detector system was assembled during the first half of 1998. The heart of the detector is a 3π spherical calorimeter consisting of 240 pure CsI crystals. The central part of the apparatus contains active beam degrader and pion stopping target counters, surrounded by a charged particle (CP) tracking system consisting of a 20-bar scintillator hodoscope and a pair of concentric cylindrical wire chambers. All detector components, including trigger electronics and front-end DAQ computers, are mounted on a compact platform. Details of the detector design and construction can be seen at the experiment URL site `http://psw340.psi.ch/~pibeta/`.

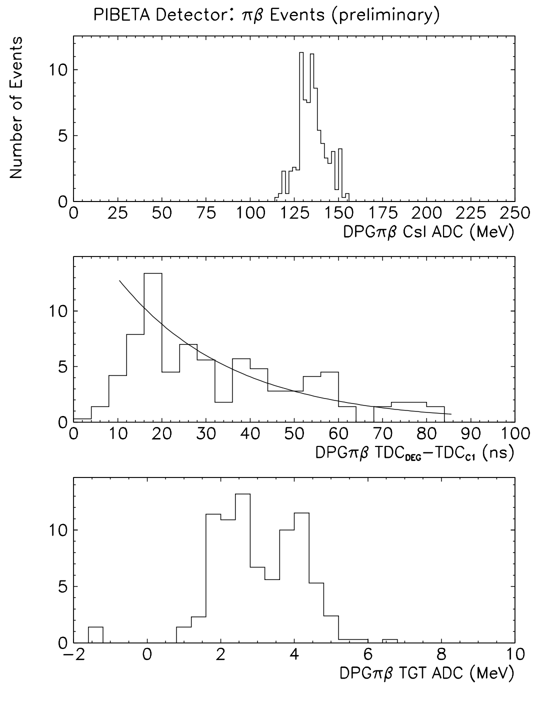

Figure 2: $\pi\beta$ spectra from the 1998 data: CsI calorimeter energy spectrum (top), timing histogram for events that pass $\pi\beta$ cuts (middle), and active target energy spectrum (bottom panel).

First calibration and commissioning data with the whole detector were taken during a six-week long summer 1998 run. After a lengthy initial setup and calibration, the response of all detector components to five different π^+ stopping rates between 0.3×10^5 and 8×10^5 π^+/s was studied. The total number of pions stopped in the active target was 5.6×10^{10}. The CP detection inefficiency was less than 3×10^{-5}. The DAQ live time was 85 % and higher, enabling us to collect ~ 80 k $\pi \to e\nu$ events (Fig. 1) and ~ 120 $\pi\beta$ events (Fig. 2). Further analysis of the commissioning run data, as well as instrumental improvements and fixes are under way.