2.1 The ANKE Spectrometer at COSY-Jülich

by I.Zychor for the ANKE collaboration

PL0101309

The magnetic spectrometer ANKE, installed in the COSY-Jülich ring in 1998, is used to detect products from proton induced reactions at internal targets. ANKE (Apparatus for Nucleonic and Kaonic Ejectiles) consists of three magnets, which allow the separation of ejectiles emitted from thin targets, and of a detection system placed around the magnets [1].

The first ANKE experimental program on K^+ meson production in proton-nucleus collisions close and far below the free nucleon-nucleon threshold at 1.58 GeV was continued in 2000. Measurements of inclusive kaon momentum spectra in the forward direction performed with carbon, copper and gold targets at beam energies from 1.0 to 2.3 GeV are now being analyzed [2].

In 2001 an investigation of the nature of $a_0(980)$ mesons in the reaction $pp \rightarrow da^+_0$ is the main experiment with the participation of the IPJ group. The branching ratio $a^+_0 \rightarrow \pi^+\eta/K^+\bar{K}^0$ will be measured with a cluster jet target (luminosity ~3×10^{30}) [3].

More information about ANKE can be found on the WWW page:
http://ikpd15.ikp.kfa-juelich.de:8085/doc/Anke.html

[1] S.Barsov et al., Nucl.Instr. Meth. A (in press)
[2] M.Buescher, IKP Annual Report 2000 (2001)
[3] M.Buescher et al., "Study of a+0 mesons at ANKE - beam time request for COSY experiment #55" (2000)

2.2 Search for Muon-Electron Conversion on Gold

by T.Kozłowski and I.Zychor for SINDRUM Collaboration

PL0101310

Observation on solar and atmospheric neutrinos indicate that neutrinos mix so that lepton flavor would not be conserved. SINDRUMII tests lepton-flavor conservation by a search for μ-e conversion in muonic atoms. This process would result in electrons of fixed momentum (depending on atomic number) around 100 MeV/c.

In recent years a dedicated beam line was brought into operation in the πE5 area of PSI. The major element is a 9 m long superconducting magnet. In spring 2000, after a long series of modifications, reliable operation of this PMC beam solenoid was obtained. In the following months data were taken on gold target.

See Fig.1 for a description of the experimental setup.

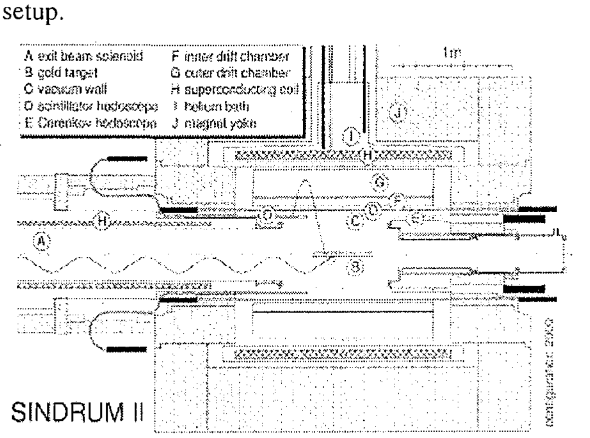

Fig. 1 The SINDRUMII spectrometer during the year 2000 measurements. Muons are transported (from the left) to the target with the help of a solenoid coupled directly to the spectrometer magnet.

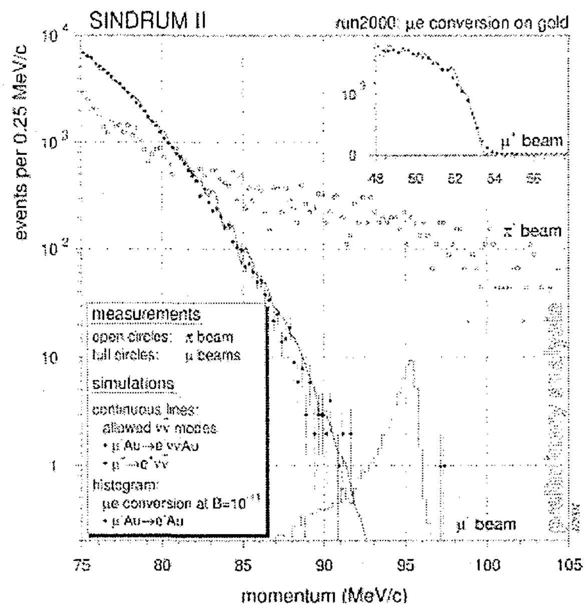

Fig. 2 Momentum distribution for three different beam momenta and polarities: (i) 53 MeV/c negative, optimized for μ^- stops, (ii) 63MeV/c negative, optimized for π^-stops, and (iii) 48 MeV/c positive for μ^+ stops. The μ^+ data were taken at the reduced magnetic field.

Radiative pion capture (RPC), followed by an e^+e^- pair production, can be a major source of background. A pion reaching the gold target has a chance of $O(10^{-4})$ to produce an electron in the energy region of interest, so the pion stop rate has to be kept below one every ten minutes. At the PMC entrance the beam contains similar amounts of muons and pions. Since the pion range in matter is about half as large as the range of muon of the same momentum the pion contamination can be reduced strongly with the help of a moderator at the PMC entrance. Only one out of 10^6 pions may cross this moderator and then 99.9% will decay before reaching the target. This arrangement required a very careful adjustment.

During an effective measuring period of 81 days $4x10^{13}$ muons stopped in the gold target. Fig. 2 shows preliminary electron momentum distributions. The main spectrum, taken at 53 MeV/c, shows the steeply falling distribution from muon decay in orbit. Two events were found at higher momenta, but just outside the region of interest. They might be induced by cosmic rays or RPC, because both processes result in flat momentum distribution as shown by the data taken at 63 MeV/c. The agreement between measured and simulated positron distributions from μ^+ decay gives us confidence in the momentum calibration.

Presently we are still studying the various rates and efficiencies that enter the calculation of the branching ratio. As a preliminary result we obtain a 90% C.L. upper limit below $5x10^{-13}$. This constitutes an improvement by two orders of magnitude of our previous best result on a heavy target.

PL0101311

2.3 A Precise Measurement of the $\pi^+ \rightarrow \pi^0 e^+ \nu$ Pion Beta Decay Rate

by T.Kozłowski for PIBETA Collaboration

The PIBETA experiment at PSI Villigen (Switzerland) aims to measure the rare pion beta decay ($\pi^+ \rightarrow \pi^0 e^+ \nu$) branching ratio with an accuracy of about 0.5% in the current phase of the project. Owing to low theoretical uncertainties the result will determine the Vud element of the CKM matrix and test the "new" physics beyond the SM.

The PIBETA detector system assembly was finished in 1998. The heart of the detector is a 3π spherical calorimeter consisting of 240 pure CsI crystals. Pions are slowdowned in the active degrader and stopped in the active target at the center of the sphere, surrounded by a charged particle tracking system consisting of 20-bar scintillator hodoscope and two concentric cylindrical wire chambers. Two-photon rate from the π^0 decay is normalized to the positron rate from the $\pi^+ \rightarrow e^+ \nu$.

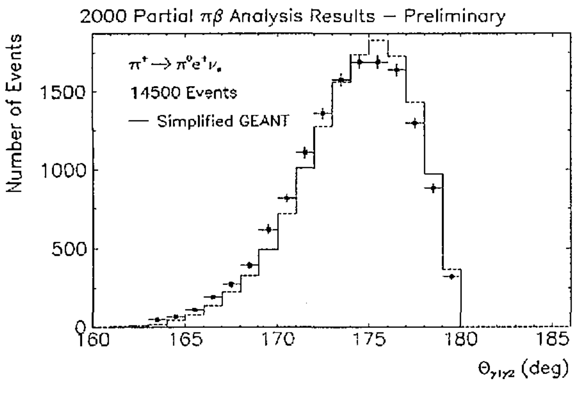

Fig. 1 γ-γ opening angle distribution projected from the analyzed fraction of our 2000 data set.

During the year 2000 we successfully continued taking data at a pion stop rate of ~$9x10^5$/s. We have also: (i) fully automatized 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.

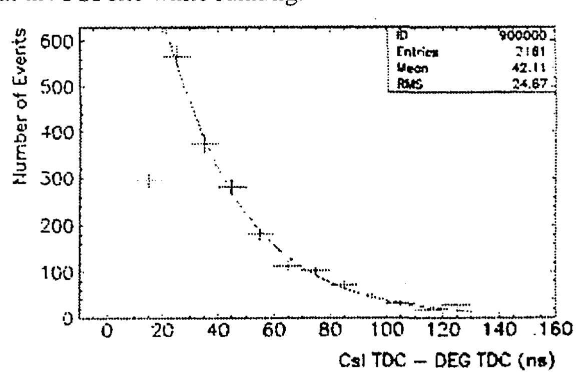

Fig. 2 Distribution of time difference between pion stops and CsI calorimeter for pion beta events. The decay time of the exponential curve is 26 ns.

Our most important accomplishment in 2000 is the acquired statistics of clean pion beta events, keeping the experiment on schedule. With <40% of the data replayed and the most stringent off-line cuts we find >14,000 clean events. Relaxing the software cuts (under study) results in ~20% more final events in the current sample. Typical energy, timing and opening angle spectra are shown in Fig. 1-3. We found that signal to background ratio is safely larger than 250.

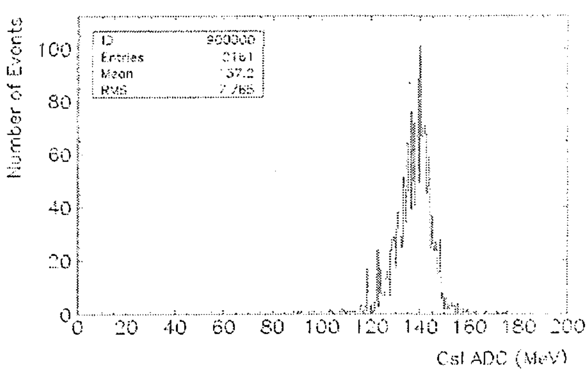

Fig. 3 Distribution of energy deposited in the CsI calorimeter for pion beta events.