RAMPEX – AN OVERVIEW AND NEWS FROM THE RECENT TEST RUNS

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A brief review has been given for the main objectives of the forthcoming spin experiment RAMPEX with the polarized proton and deuteron targets struck by the unpolarized 70-GeV proton beam. The results from the recent test runs have been shortly summarized.

1 General

RAMPEX - Russian-AMerican Polarization EXperiment [1] - was planned to study one-spin asymmetries in inclusive hadron reactions

$$p + p_\uparrow(d_\uparrow) \to h + X \tag{1}$$

$$p + p_\uparrow(d_\uparrow) \to h_1 + h_2 + X, \tag{2}$$

mainly for hard and semi-hard hadron production. Here h's denote charged and neutral hadrons: $\pi^\pm$, π^o, $K^\pm$, K^o, $\phi(1020)$, η and other.

The one-spin asymmetry is defined as

$$A_N(x_F, p_T) = -\frac{1}{P}\frac{\mathrm{d}\sigma_\uparrow - \mathrm{d}\sigma_\downarrow}{\mathrm{d}\sigma_\uparrow + \mathrm{d}\sigma_\downarrow},$$

where P is a value of the target transverse polarization.

The reactions (1) and (2) may provide information about the twist-3 chiral-odd quark distribution function in the transversely polarized proton (and also the twist-3 fragmentation function) and the twist-2 chiral-odd distribution function, respectively.

The collaboration includes groups of physicists from IHEP (Protvino), JINR (Dubna), PINP (Petersbourg) and University of Michigan (Ann Arbor, Michigan). Testing the experimental apparatus was performed during the accelerator runs in Fall'98, Spring'99, Fall'99 and Spring'00. The first physics data taking has been scheduled for March'01.

2 Experimental setup

RAMPEX was designed as a two-armed experimetal setup to give an opportunity for measuring the two-particle inclusive production (reaction (2)). Fig. (1)

shows in detail one arm. The second arm has not yet been constructed.

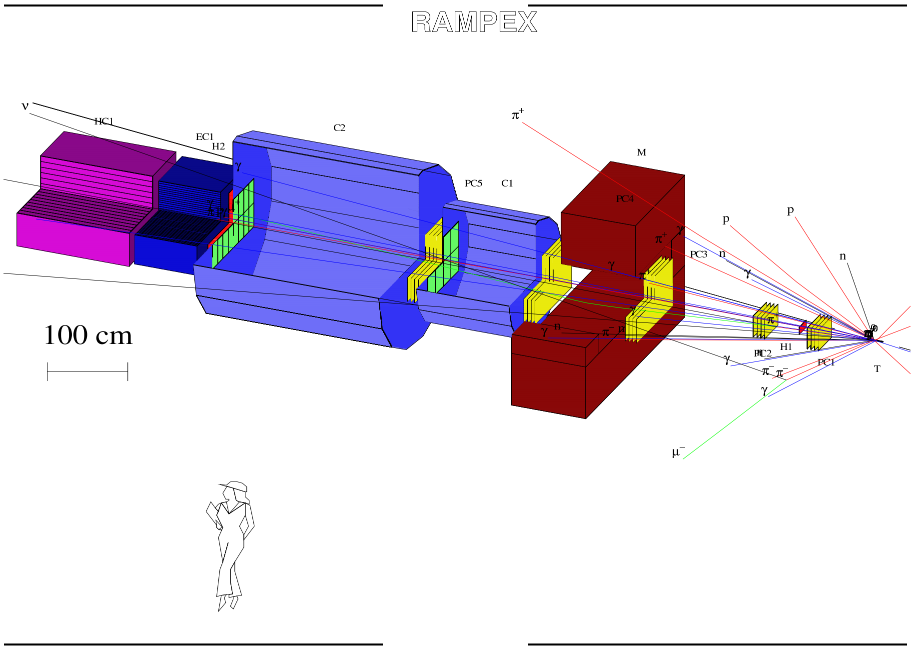

Figure 1: A general view of the RAMPEX setup: T - polarized target, M - magnet, PC1-PC5 - blocks of proportional chambers, H1, H2 - hodoscope counters, C1 and C2 - Cerenkov counters, EC1 and EC2 - electromagnetic calorimeters, HC - hadron calorimeter.

Beam. The unpolarized proton beam at 70 GeV/c has an intensity $5 \cdot 10^6$ protons in the 1-second spill with the 9-second interval between spills. The transverse size of the beam is given by the values $\Delta_x = 4$ mm and $\Delta_y = 3$ mm with the angular divergence less than 0.3 mrad.

Polarized target. Propane-diol $C_3H_8O_2$ fills in a cavity 20 mm in diameter and 200 mm in length. It contains polarized hydrogen nuclei with $P = 80\%$ in average. The target density is equal to $9.3{\cdot}10^23$ nucleons/cm^2 thus producing the luminosity $\mathcal{L} \sim 5 \cdot 10^{31}$ cm^{-2}spill^{-1}.

Magnetic spectrometer. The magnet M and five blocks PC1-PC5 of the proportional chambers (fig. 1) represent the tracking system. The magnet aperture is $1.3{\times}0.62$ cm^2 and the field length is 0.63 m. The integral of the magnetic field is equal to 1 Tm.

Each block of PC's contains 4 coordinate planes: orthogonal x, y and inclined u, v. The latter form the angles $\pm 10^0$ with respect to y-axis. PC1 and PC5 are placed at the distances 0.9 m and 7.2 m, respectively.

The tracking system includes also two scintillator hodoscopes H1 and H2.

The charged particle momentum resolution $\Delta p/p$ allowed by the tracking system varies from 0.5% to 3% with the momentum p changing from 2 to 20 GeV/c.

Charged particle identification. Charged π, K, p and $\bar{p}$ are resolved using two Cherenkov counters Č1 and Č2. The aperture times length (in meters) is $1.2 \times 0.9 \times 1.5$ for Č1 and $1.6 \times 0.88 \times 3.0$ for Č2. The 8-channel Č1 is filled with freon-12 at 1 atm, and the 16-channel Č2 is filled with nitrogen at 1 atm also.

The combination of two different Cherenkov counters allow to identify $\pi^{\pm}$ in the momentum range 3.1 - 20 GeV/c, $K^{\pm}$ and $p^{\pm}$ both in the momentum range 10 - 20 GeV/c.

Calorimetry. The electromagnetic calorimeter EC1 is constructed of modules which are made of the Pb+Sci sandwiches. The peripheral cells have the size 76×76 mm^2 and the thickness of the Pb and Sci layers 2.5 mm and 5 mm, respectively. The inner cells have the size 38×38 mm^2 and the thickness of the Pb and Sci layers 3 mm and 5 mm, respectively. The total length is about 20 X_0. The energy resolution for both cell types is given by $\sigma_E/E = 9\%/\sqrt{E} + const$, where *const* is equal to 0.5% for large cells and it is negligible for small cells.

The coordinate resolution is $\sigma_x \approx 1$ mm for both cell sizes.

The hadron calorimeter HC of compensating type is a matrix of 18×12 modules made of Pb + Sci layers. The transverse size of a module is 10×10 cm^2 and the length is about 6.5 nuclear lengths. The energy resolution is $\sigma_E/E \approx 57\%/\sqrt{E}$.

3 Test runs

The experimental apparatus underwent some test accelerator runs. The last one ended in April'00, in which a complex test was made for proportional chambers, electromagnetic calorimeter EC1 and for the trigger electronics. The first sample of π^0's was selected for the physics analysis.

References

1. S. Akimenko *et al*, A study of one-spin asymmetries in $pp_\uparrow$ and $\pi^- p_\uparrow$ interactions at 70 and 40 GeV/c (Proposal of experiment RAMPEX). Preprint IHEP 97-58, 1997;
   Yu.I. Arestov, *Nucl. Instrum. Methods* A **402**, 298 (1998).