HEAVY QUARK PHYSICS AT UNK
(Project «Hyperon»)

Leningrad Nuclear Physics Institute, Gatchina
Institute of High Energy Physics, Serpukhov
Moscow State University, Moscow

The project «Hyperon» is designed for the UNK hyperon beam now under construction at IHEP. For LNPI this will be a further continuation of the program being carried out now using the FNAL hyperon beam in a series of experiments E715, E761, E781.

UNK hyperon beam

The high energy (3 TeV) and the high intensity (over 10^{13} p/s) of the UNK proton beam, the large decay length for the produced hyperons (50 — 100 m) allowed to design [1] a hyperon beam of the quality which is close to that of the usual hadron beams. For example, with a primary proton beam of 10^{12} s^{-1}, the hyperon flux should be 10^7 s^{-1} at $p = 2.8$ TeV/c (fig. 1) in a beam spot less than 1 cm^2 and in the momentum gap $\Delta p/p = 5\%$. At this momentum, the N_Σ/N_π ratio should be around 10. The muon background could be reduced down to $N_\mu/N_\Sigma \cong 0.01$. At lower energies, one can obtain an intense pion beam and it is possible also to have a high quality proton beam of an energy up to 3 TeV.

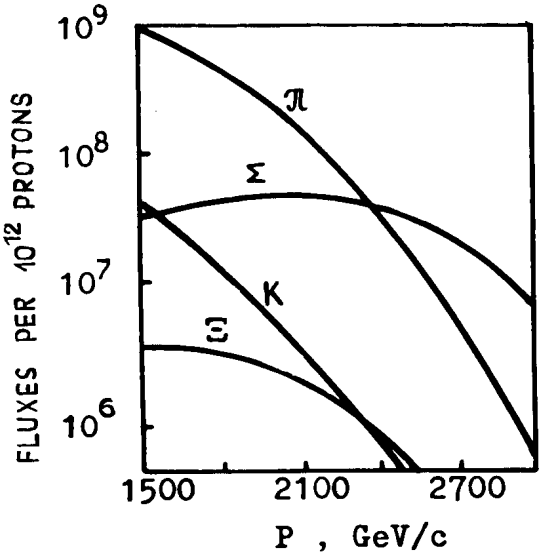

Fig. 1. Fluxes in hyperon channel per 10^{12} incident protons

Experimental setup

This experiment should assure the registration, identification, and measurement of the momenta of the charged particles (as well as measurement of the energies of the γ-quanta) produced within an angular range of ±150 mrad. Fig. 2 shows the provisional design of the experimental setup. A multi-plane Si-strip vertex detector is used as an 'active target'. The vertex detector makes it

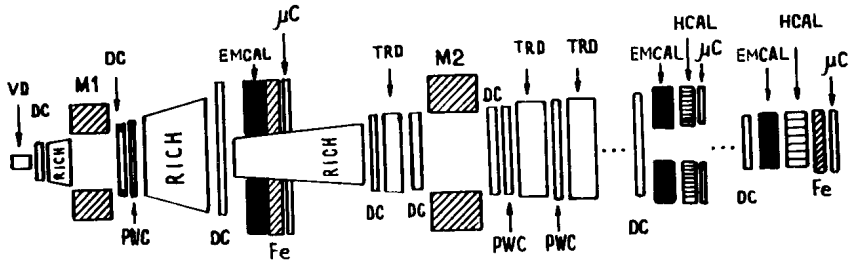

Fig. 2. Setup layout. VD — vertex detector, M1-M2 — magnets, DC — drift chambers, RICH — Cherenkov counters, EMCAL — electromagnetic calorimeter, HCAL — hadron calorimeter, TRD — transition radiation detector, μC — muon chambers

possible to reconstruct the decay vertices of the shortlived mesons and baryons. The decay products are registered by the spectrometer that contains magnets, SSDs, MWPCs, drift chambers, electromagnetic and hadron calorimeters, Cherenkov counters, transition radiation detectors, muon chambers. The total number of signal channels will be about 200 thousands. The detectors and the electronics are designed for at least 10^6 s^{-1} interactions in the target.

Physical goals

Heavy quark physics (in particular, b-quark physics) is expected to play a dominant role in this program. Fig. 3 presents the cross sections for the bb-pairs production. One can see that the SPS energy finds inself just above the threshold of the B-particle production. The cross section increases up to 20 nb at the energy of the FNAL Tevatron, while it reaches 300 nb at the UNK energy. The ratio $\sigma_{b\bar{b}}/\sigma_{inel} = 3 \cdot 10^{-5}$ at this energy. This means that about 10^8 bb-pairs could be produced in a 100 day run in an experiment with 10^6 s^{-1} interactions in the target. In such an experiment the decay lengths of the B particles are relatively large (~2 cm) which makes it easier to measure the lifetimes and the spatial oscillations.

The research program includes the following basic items:

— search and investigation of heavy flavor baryons containing various combinations of the s-, c-, b-quarks, study of the week decays of these baryons, measurement of their lifetimes, search for the excited states of heavy flavor baryons,

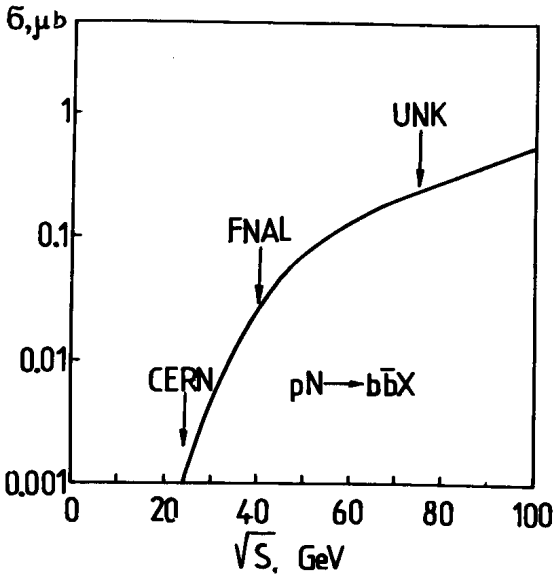

Fig. 3. Cross section for $b\bar{b}$-pair production in pp interaction

— search for «exotic states» (4-quark and 5-quark systems),
— high precision measurements of B-meson lifetimes,
— study of spatial oscillations in the $B_d \leftrightarrow \bar{B}_d$ and $B_s \leftrightarrow \bar{B}_s$ systems,
— search for rare decays of the type $b \to s + \gamma$, $b \to s + g$ ($B \to \Phi k$, $B \to Ke^+e^-$, $B \to K\nu\bar{\nu}$, $B \to K^*\nu$, etc),
— search for B meson decays into CP-eigenstates ($B_d \to \Psi K_s$, $B_d \to \pi^+\pi^-$, $B_s \to \omega K_s$, etc),
— experiments with τ-leptons, search for decays $\tau \to 3\mu$, 3e, μee, eμμ.
The experiment is scheduled for 1996.

REFERENCE

1. *Garkusha V. I. et al.* Preprint IPHE 88-188, Serpukhov, 1988.