VOLKOV Alexei

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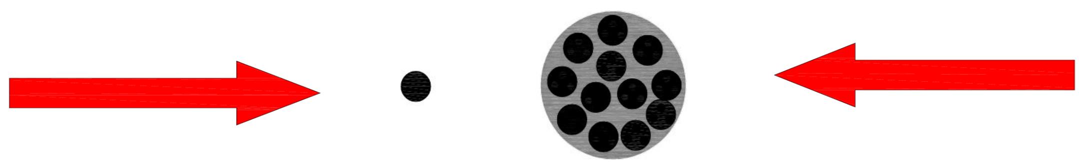
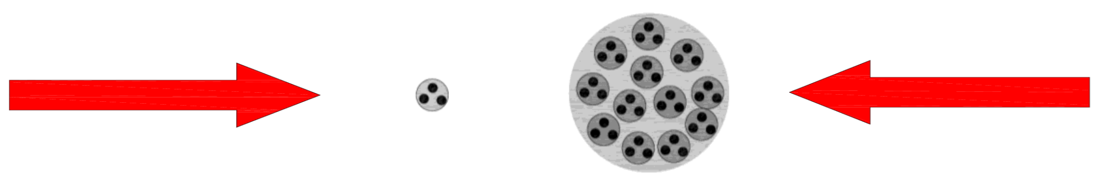
Standard view of *pA*-interaction:

1. Large distances (>1 fm), nucleons in nuclear interacts coherently with colliding nucleon, p_T <1 GeV/c.

2. Distance about ~ 1 fm, nucleons interact independently with colliding nucleon, p_T ~ 1 GeV/c.



3. At distance < 1 fm quark structure of hadron and nuclear starts to manifest. At distance < 0,1 fm (p_T >2 GeV/c) parton interaction starts to dominate. This corresponds to $x_T>0.35$, high x_T physics.



INTRODUCTION

Study of parton-parton interaction is one of the important direction in contemporary physics. The investigations are carried out with collider beams at very high energy where only small *x* physics is accessible. Middle and big *x*, where the main role plays valence quarks, practically is not available to study. The processes with 0,5<x_T<1 can be studied on IHEP accelerator (FODS-2) in the following reactions:

$$\begin{Bmatrix} \pi \\ p \\ A \end{Bmatrix} + \begin{Bmatrix} p \\ A \end{Bmatrix} \Rightarrow \begin{cases} h^{\pm} + X \\ h^{\pm} + h^{\pm} + X \end{cases}$$

where $h^{\pm}$***- is*** $\pi^{\pm}$, $K^{\pm}$, ***p*** **and** $\bar{p}$**. Hadron pairs are particles flying in opposite direction or in the same direction (at c.m.s.).**

The salient feature of the spectrometer realized at design stage are:

- to operate at beam intensity 10^9 ppp;

-wide choice of targets – hydrogen, deuterium and nuclear targets;

-independent detection of single and pair particle production;

-variation of the particle detection threshold;

-identification of two particles in an arm (*μ, π, K, p, d*) both signs.

There was completed upgrade of the spectrometer:

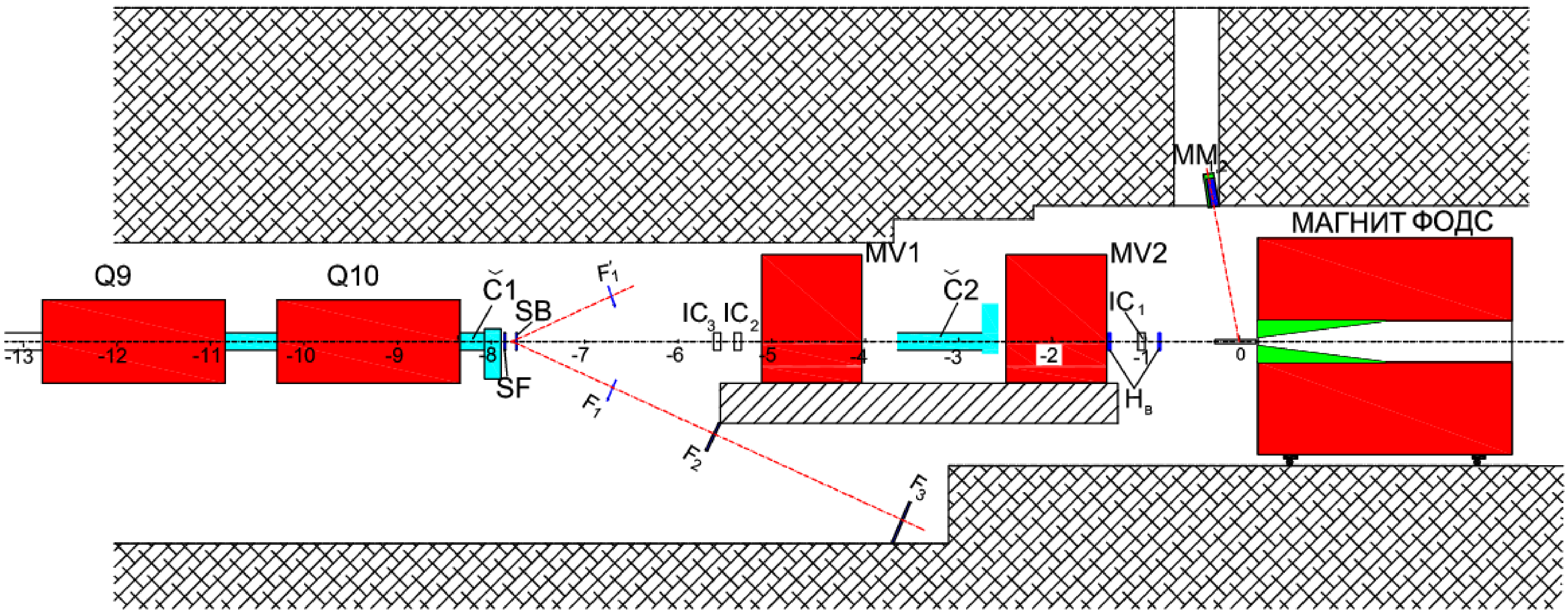
- more than two times increased solid angle for an arm;

- new DAQ and electronics boosted data acquisition;

- trigger system completely changed;

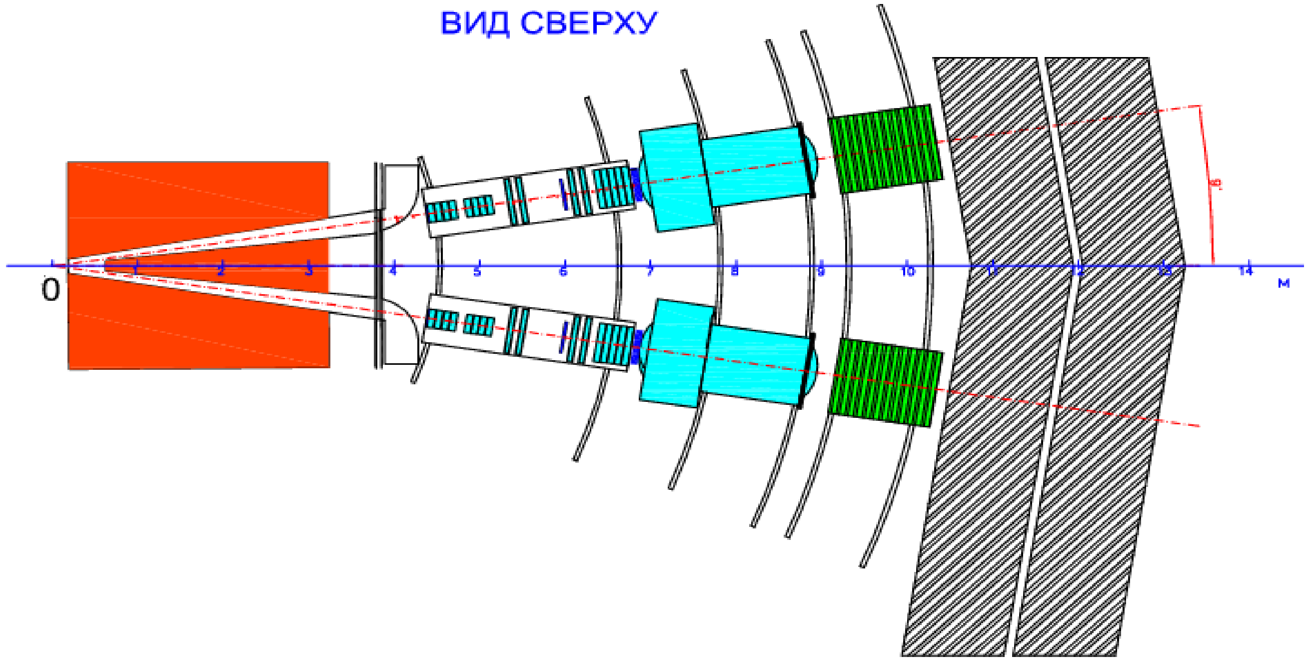
- added number of beam monitors must improve the control of beam characteristics.

BEAM MONITORS

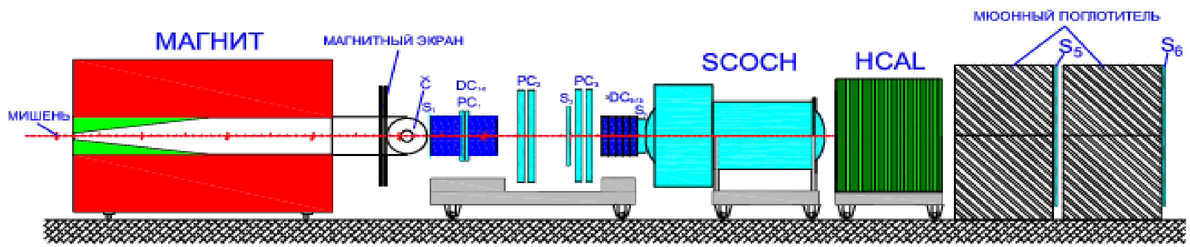


FODS

ВИД СВЕРХУ



ВИД СБОКУ (вдоль оси плеча)



FODS DETECTORS

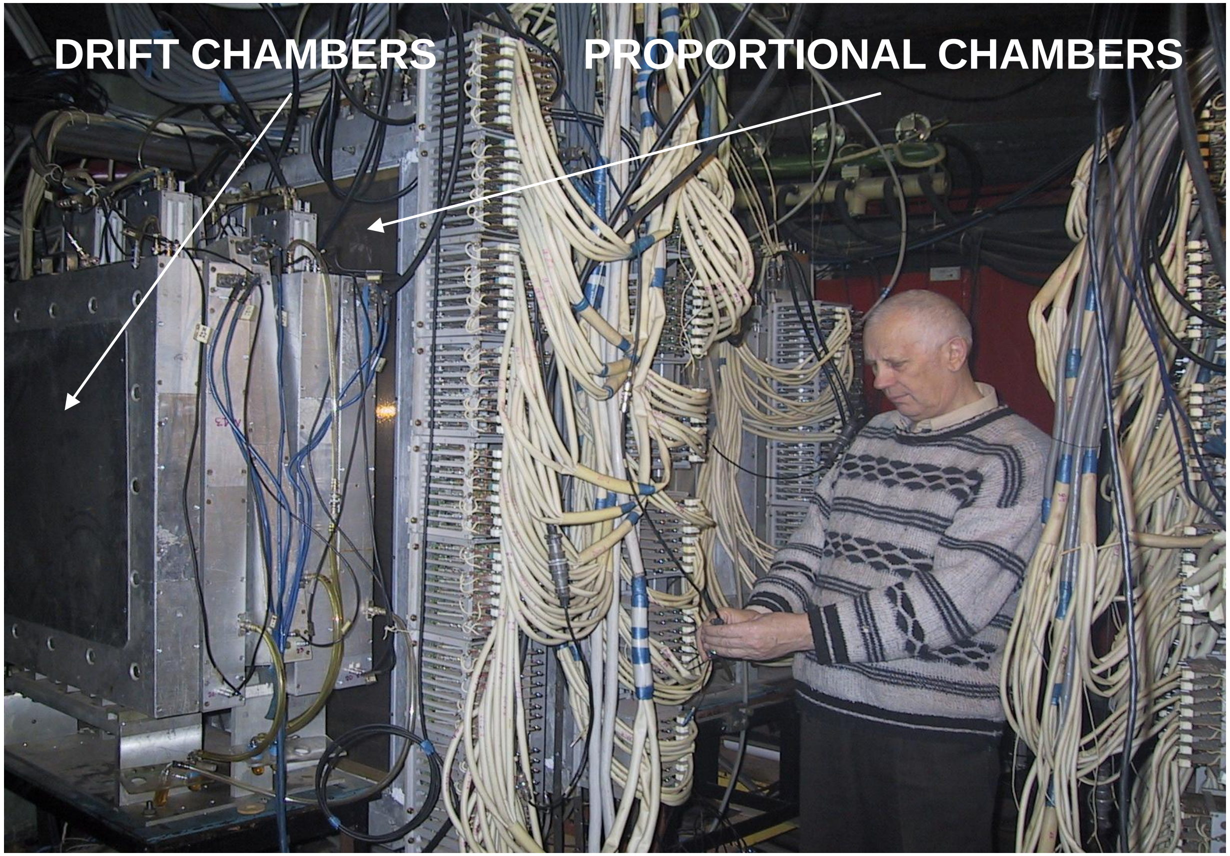
1. Beam parameters are measure by ionization chambers, hodoscopes and scintillation monitors.
2. Particle trajectories are measured after the magnet are measured by drift and proportional chambers.
3. At the magnet entrance there are installed scintillation hodoscopes and scintillation trigger counters to suppress background particle originated in magnet structure.
4. Particles are identified by threshold Cherenkov counters inserted in magnet and Spectrometer of Cherenkov Light Circles.

5. The trigger is using information from scintillation counters, calorimeters, hodoscopes and muon identifiers.

There are provided the following types of triggers:

- one hadron/muon in an arm;
- two hadrons/muons in different arm;
- two hadrons/ muons in each arm.

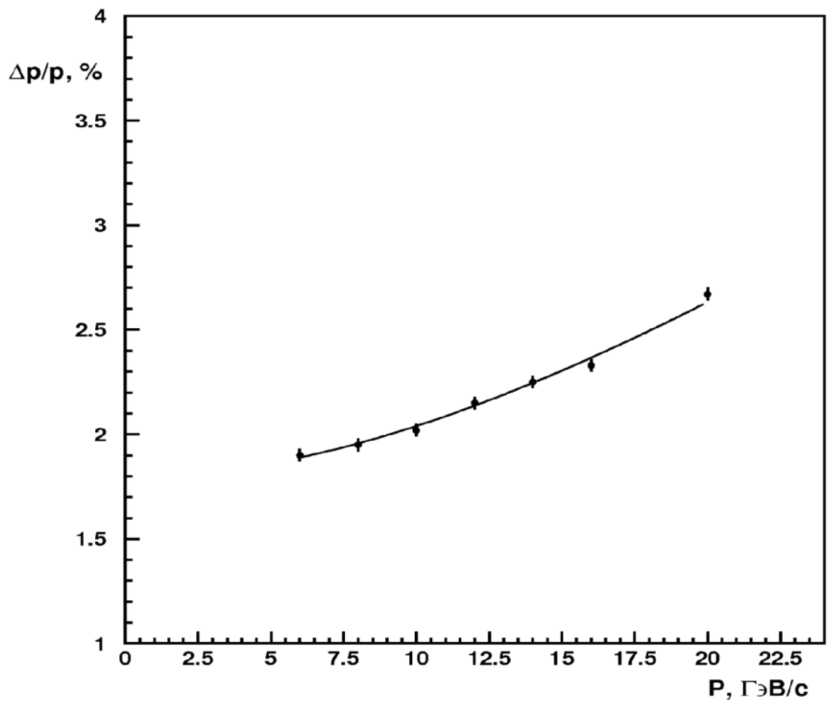
TRECKERS and CALORIMETERS



Proportional chamber for wide angles (4480 channels) and drift chambers for small angles (768 channels).

Hadron calorimeters with 1×2 m^2 active surface, all light from scintillators is collected by wave length shifting fibers to a single phototubes. Fast trigger, easy to calibrate in 1 point (<10% uniformity). "Single" tower calorimeter.

PRECITION of MOMENTUM MEASUREMENT



$$\Delta p / p = 0{,}018 \oplus 0{,}00048 \times p \times \sigma_y$$

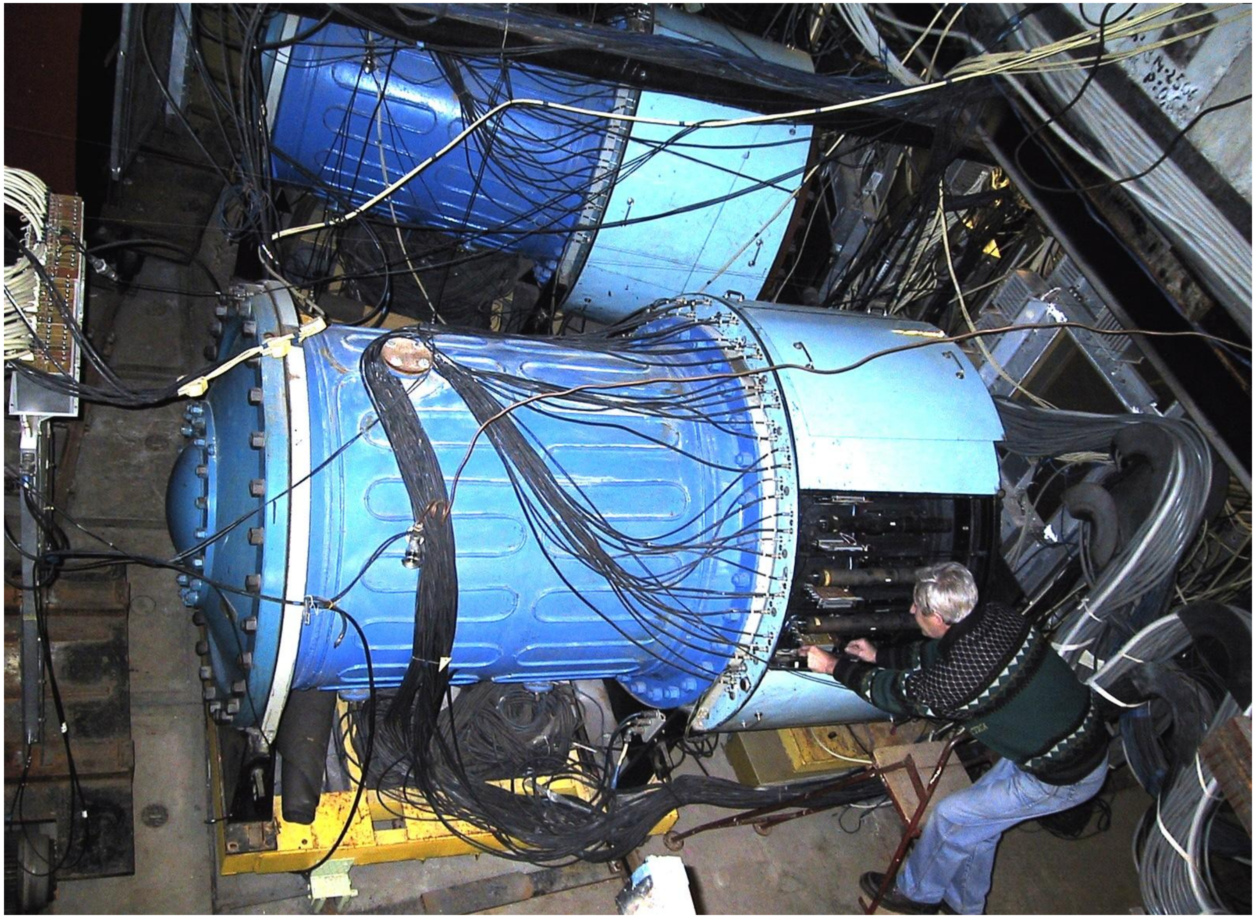
SPECTROMETR SCOCH

Hadron identification ($\pi^{\pm}$, $K^{\pm}$, p и $\bar{p}$) by SCOCH in limited solid angle and pions ($\pi^{\pm}$) by threshold Cherenkov counters in wide solid angle.

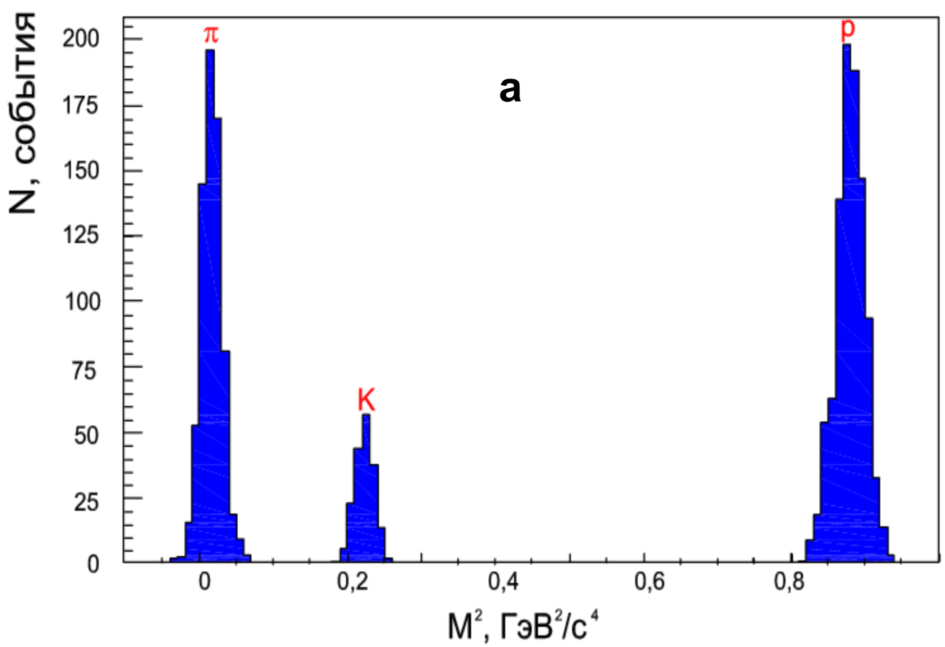
Filling gas C_4F_{10} at 1 – 1,5 at.

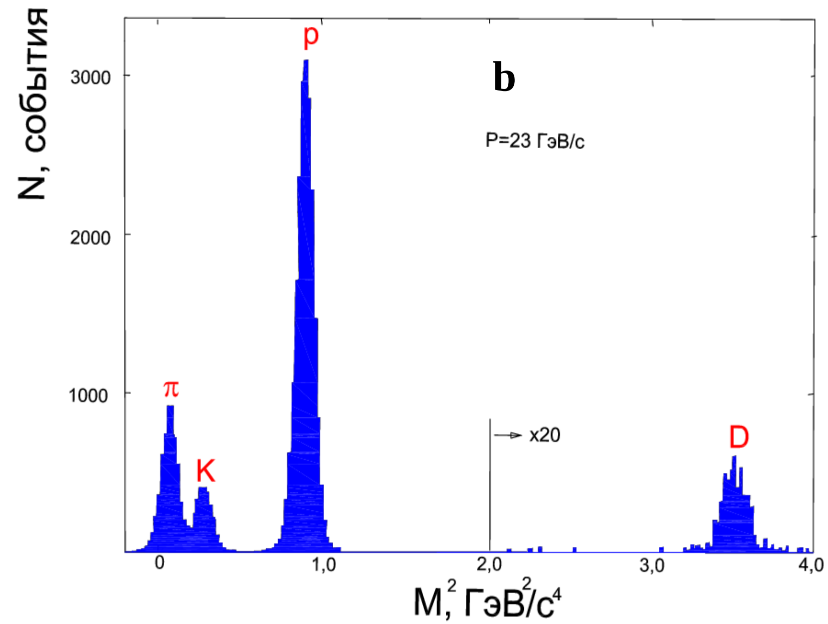
Photon coordinates are measured by position sensitive hodoscopes phototubes..

There are simultaneously measured up to 4 particles.



HADRON IDENTIFICATION





Particle mass squared distribution for momentum a) 13 GeV/c and b) 23 GeV/c.

Momentum range of particle identification: $\pi^{\pm}$ (2 - 40 GeV/c); $K^{\pm}$ (5 - 40 GeV/c); p и $\bar{p}$ (10 - 40 GeV/c).

SHORT RANGE CORRELATION

Experiments show that protons with high p_T are prodeuced more often than pions.

It can be explained if protons are produced not in fragmentation of partons but by scattering of valence quark system at high momentum transfer.

Such process select compact quark state in nucleons with dimensions ~$1/p_T$ (squeezed state).

Nuclear absorption cross section of such states is small that results to *A* dependence with exponent $\alpha \approx 1$.

Striking example of proton interaction in such state is elastic scattering at high p_T: $pA \to p+p+(A-1)$.

ELASTIC *pp*- SCTTERING at 90° c.m.s.

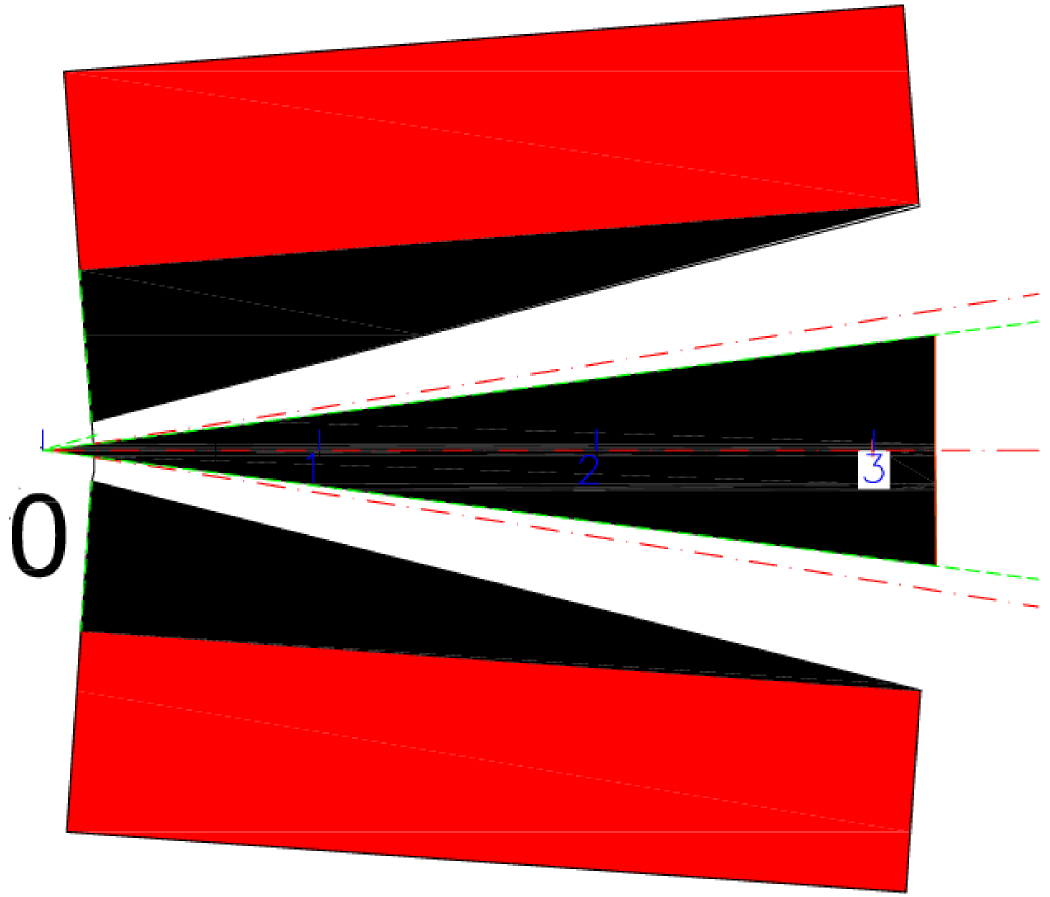
At the moment FODS is capable to detect *pp* elastic scattering with high p_T only at 70 GeV/c.

Cross section at this energy is too small to be measured with acceptable statistics.

The measurements are feasible ones only at energy below 40 GeV.

For this purpose the FODS analyzing magnet must be modified.

FODS MAGNET UPGRADE



The goal of the upgrade is to enlarge azimuth angles of particles flying from the target. Besides the horizontal dimensions of proportional chambers will match the new aperture (almost 2 times increase of solid angle). The upgrade is under way.

ELASTIC *pp*- SCTTERING at 90° c.m.s.

We propose to measure the process with hydrogen and nuclei targets to study the effects of nuclei transparency.

Cross section of the elastic scattering *dσ/dt* at 90° in c.m.s. for 30 GeV protons is about ~ 10^{-10} mb/(GeV/c)^2.

Total number of collected events for 30 day exposure for hydrogen target, 0.05 λ_{int} length and beam intensity 10^9 ppp will be ~ 1500.

For nuclear targets the number of events will be ≈ *A* times larger.

It is well established that deuterons can interact with protons as a single whole at small p_T with probability about 10% (cumulative process).

This is due to configuration of nucleons at distance smaller than the interaction length.

Such process can be realized at larger p_T with much smaller probability. Nucleons must be squeezed to much smaller volume to form six quark bound state.

The probability of such configuration is about 1%.

To study such effect the secondary protons with p_T above kinematically allowed value for *pp* scattering must be detected.

dA- и CA- INTERACTIONS at HIGH p_T

We propose to use 50 GeV deuteron beam. For *pp* interaction maximum p_T of the secondary particles is less than 3.5 GeV/c.

For cumulative process the maximum p_T is 5 GeV/c.

If the probability of the process turns out to be about 1% then during 30 days with C^{12} target, 0.1 λ_{int} length and beam intensity 10^8 ppp about 4000 secondary protons can be collected with p_T>3,5 GeV/c.

Such processes can be observed with heavier beam particles. Therefore it must be studied with carbon beams also.

There are interesting processes of low mass hadron and muon pair production at high p_T in *pA* и *AA* interactions.

In this case correlation function in dependence on particle moment must be measured.

The correlation function of identical and not identical particles interference can reveal the space structure of the interaction.

With rise of p_T the space resolution is decreasing and can be below 1 fm.

Such direction called femtoscopy can be proved to be promising field but will require development of analyzing technique.

SUMMARY

The presented program to study high x_T processes in *pp*-, *pA*- и *AA*-interactions must be considered as the reconnaissance - to polish methodic and define most promising directions.

At the moment spectrometer FODS (except the upgrade of analyzing magnet) is ready to start to fulfill the proposed program.