Backward proton production in nuclei-nuclei collisions

A.Litvinenko VBLHE, JINR

litvin@moonhe.jinr.ru

Plan

1. Backward proton production in nucleon-nuclei collisions.

2. Backward proton production in nuclei-nuclei collisions.

3. Counting rate for CBM conditions.

4. Possible set-up for backward proton detection on CBM.

5. Conclusions.

Some experimental features of backward proton production in nucleon-nuclei collisions :

1.The spectra show a weak beam energy dependence starting from momentum 4 CeV/c.

2.The spectrum shape is independent from target mass number

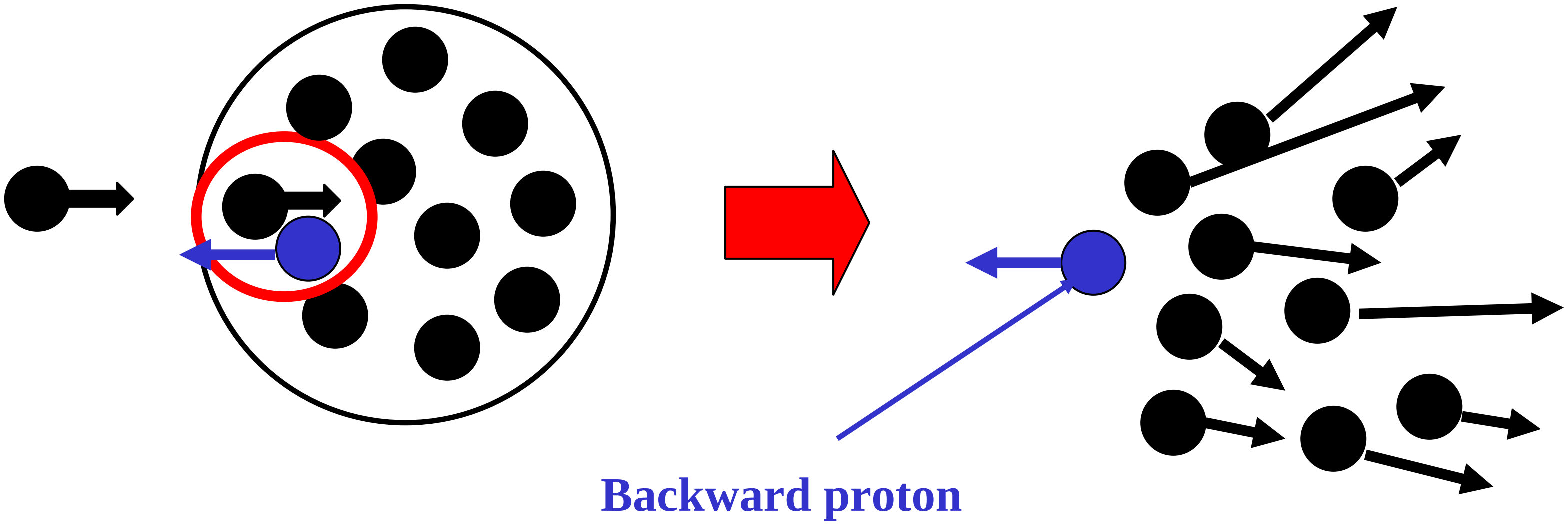
3.There is also a weak spectrum shape dependence from the type of beam particle (for the lepton, proton and lights nuclei ($A < 12$)).

4.The cross section has a strong atomic mass dependence $\sim \mathbf{A^n}$, **n>1.**

- **A.Baldin, *Part. And Nucl., V.8(3), p.429 (1977)***
- **V.Lukyanov, A.Titov, *Part. And Nucl., V.10(4), p.815* (1979)**
- **V.Stavinsky, Part. And Nucl., V.10(5), p.979 (1979)**
- **L.Frankfurt and M.Strikman, *Phys.Rep.,V.76,p.215,(1981)***
- **A.Efremov, *Part. And Nucl., V.13(5), p.613 (1982)***

The most sophisticated explanation:

High momentum component in target nucleus (different nature for different models)



$$P_{int} \geq 0.3 \;\; GeV/c \;\; \text{i.e.} \;\; L_{NN} \leq 1 \;\; Fm.$$

Why it can be interesting in nuclei-nuclei collisions?

Analogy with high P_T hadrons production at RHIC.
Jet Quenching at RHIC.

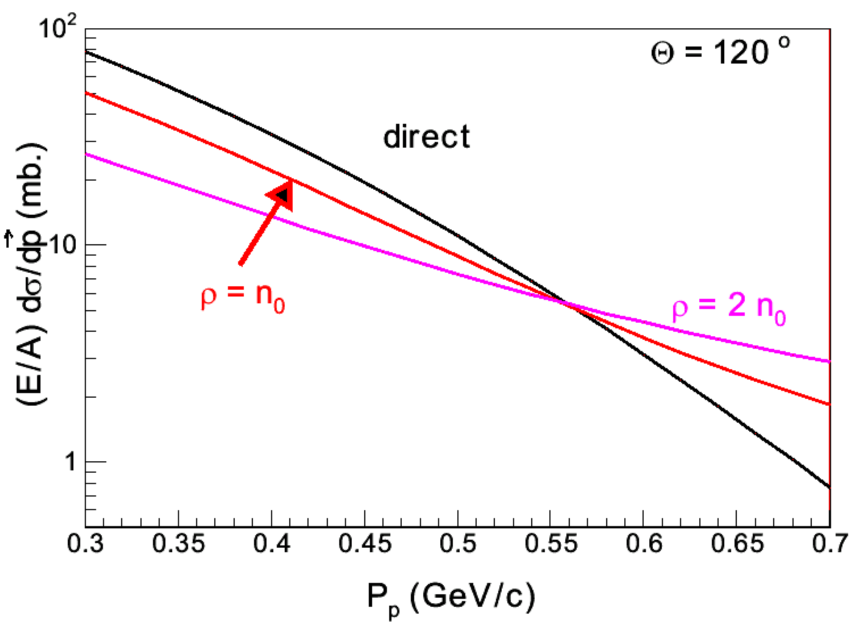
1. Backward protons are produced during the first stage of collision (See spectrum on the next slides) .
2. Spectrum have to be sensitive to the density of the compressed fireball.

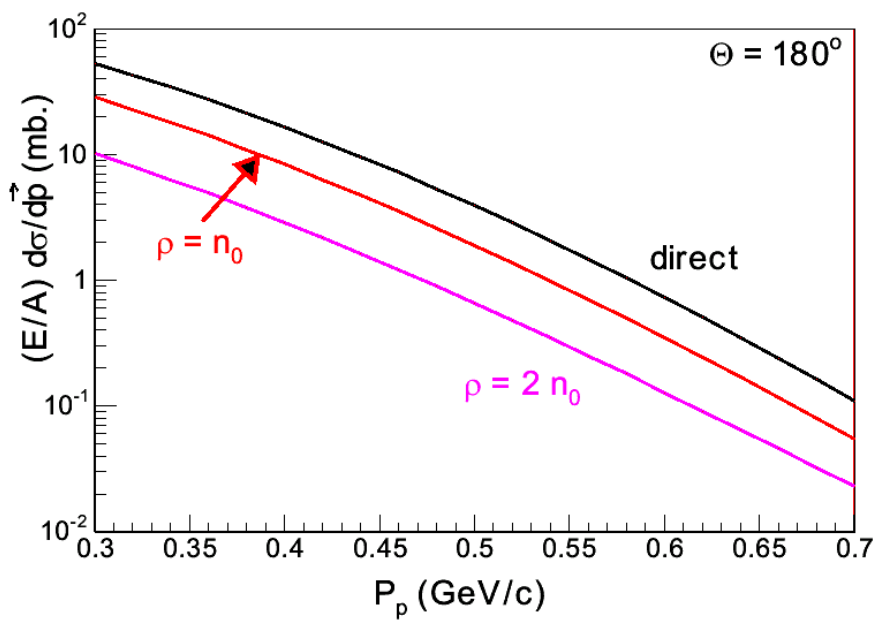
The possible mark for initial state.

Spectra can not be explain as a thermal from the fireball with reasonable velocity and temperature (See next slide).

Medium density effects .

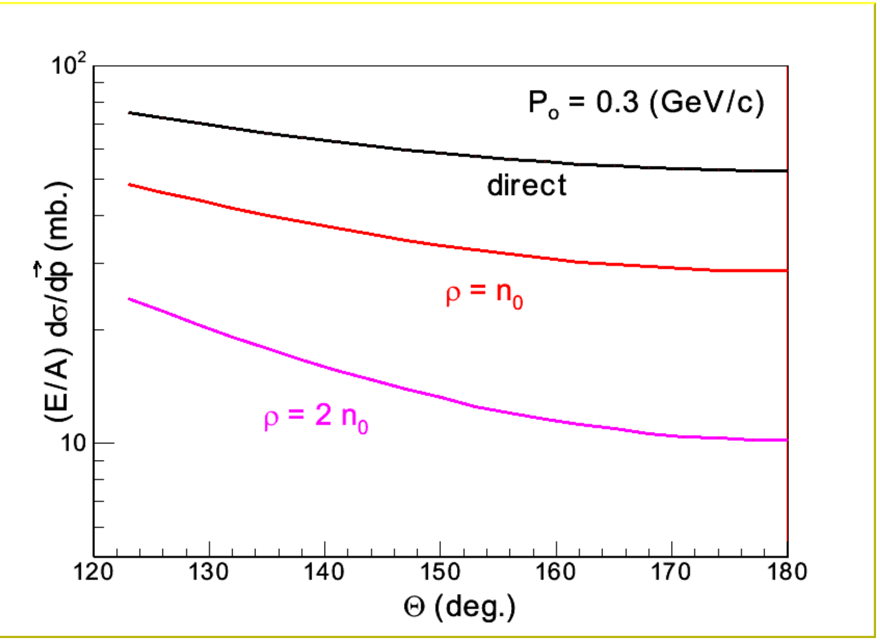
“direct spectrum” and spectrum after proton penetrating through 4 fm hadronic matter with two different densities.

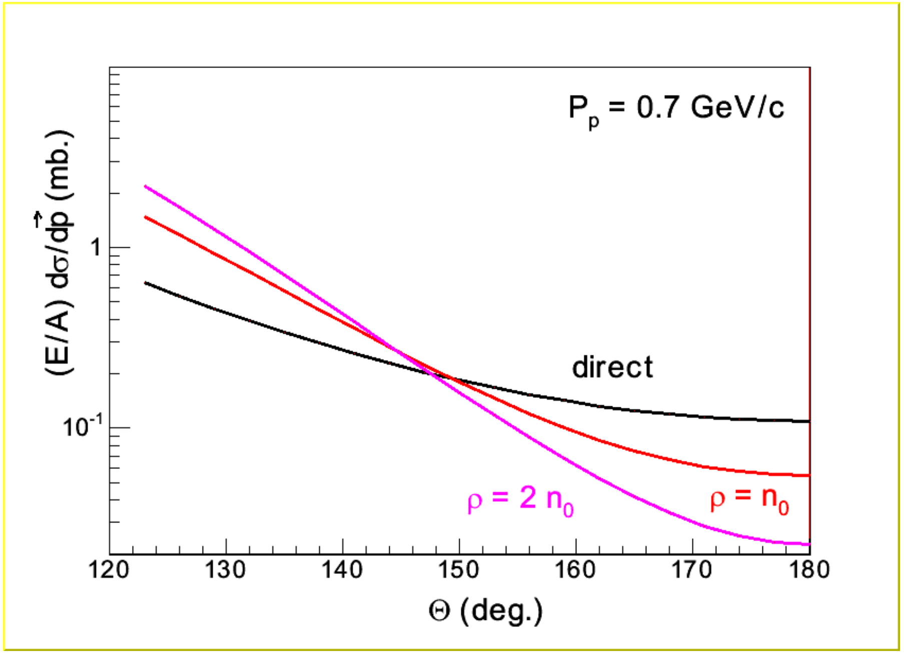




Medium density effects .

"direct spectrum" and spectrum after proton penetrating through 4 fm hadronic matter with two different densities.



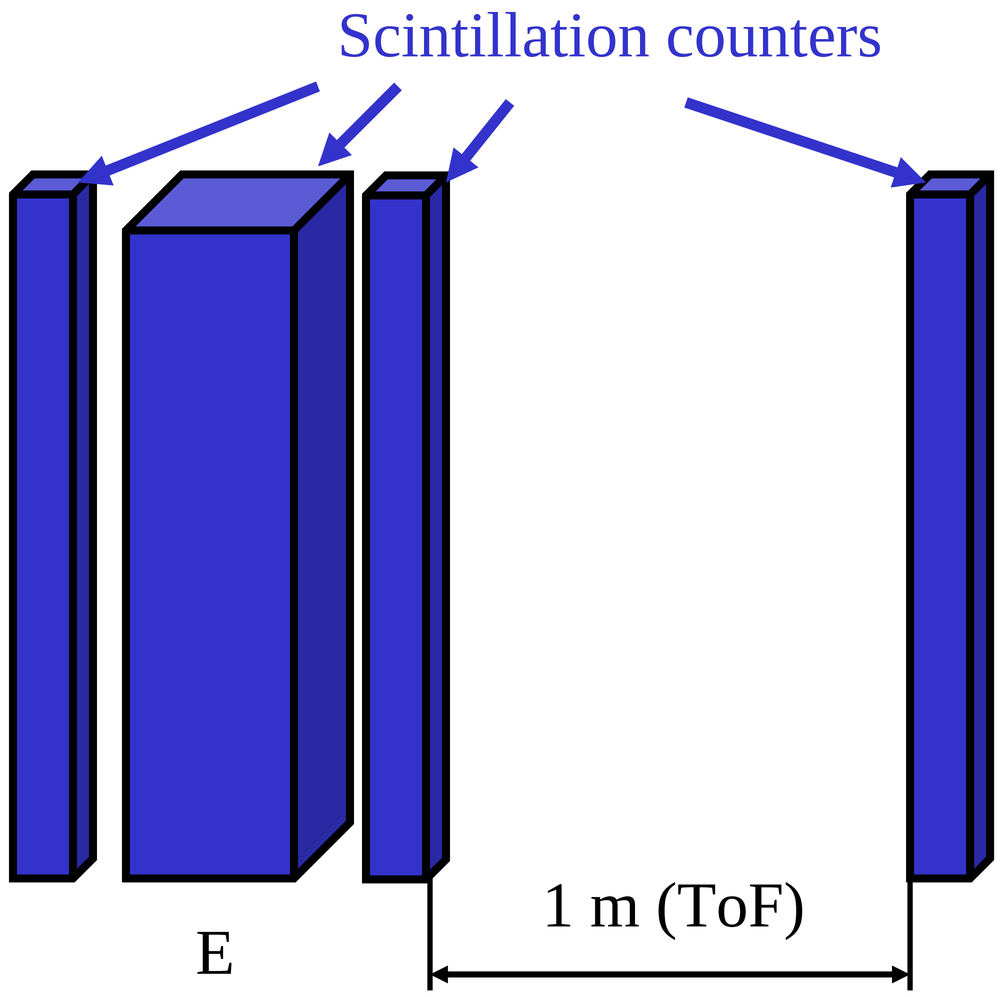


Counting rates for CBM condition.

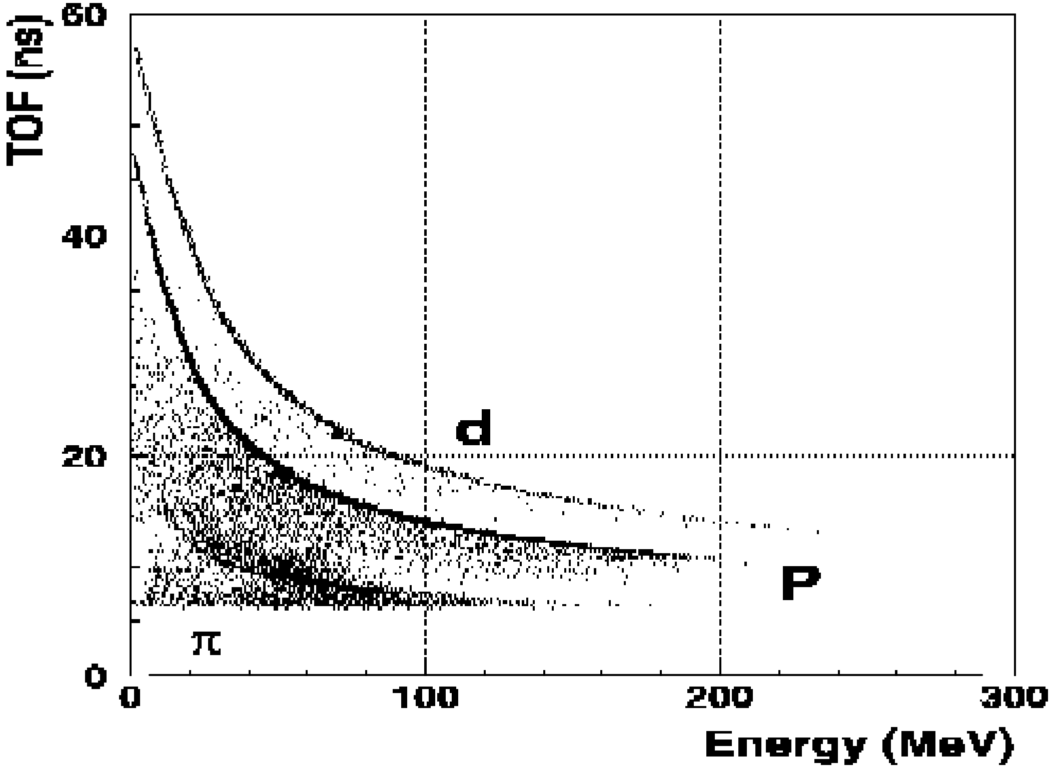
The counting rates were estimated for the wall of detectors 1x1 mxm situated on the distance 2 m at the backward direction. The estimations have been done for two different A dependencies ($A^{(1/3)}$ and $A^{(1)}$) and l_t=0.1(g/cm^2).

counting rate (10^7 1/s.)	$A^{(1/3)}$	$A^{(1)}$
One proton	$6\ 10^2$	10^6
Two protons	10^1	10^3

The possible set up .



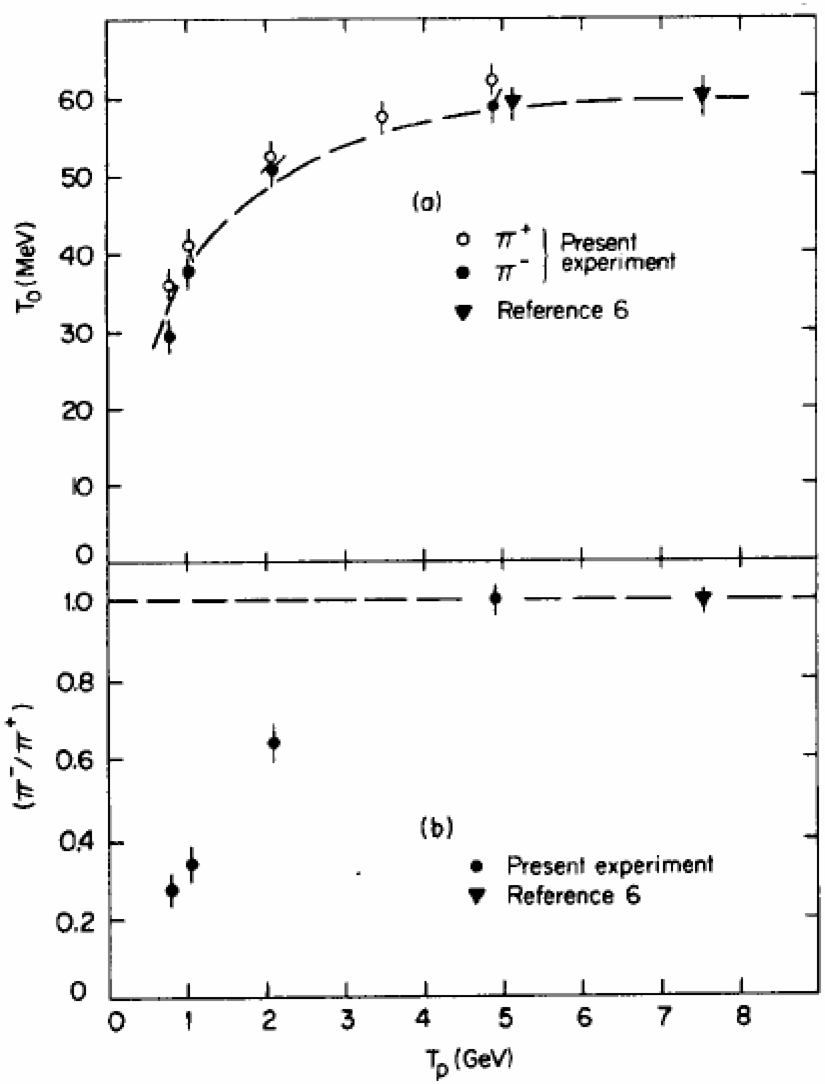
Hadron spectrometer without a magnet


TOF (ns)
60
40
20
0
d
P
π
0
100
200
300
Energy (MeV)

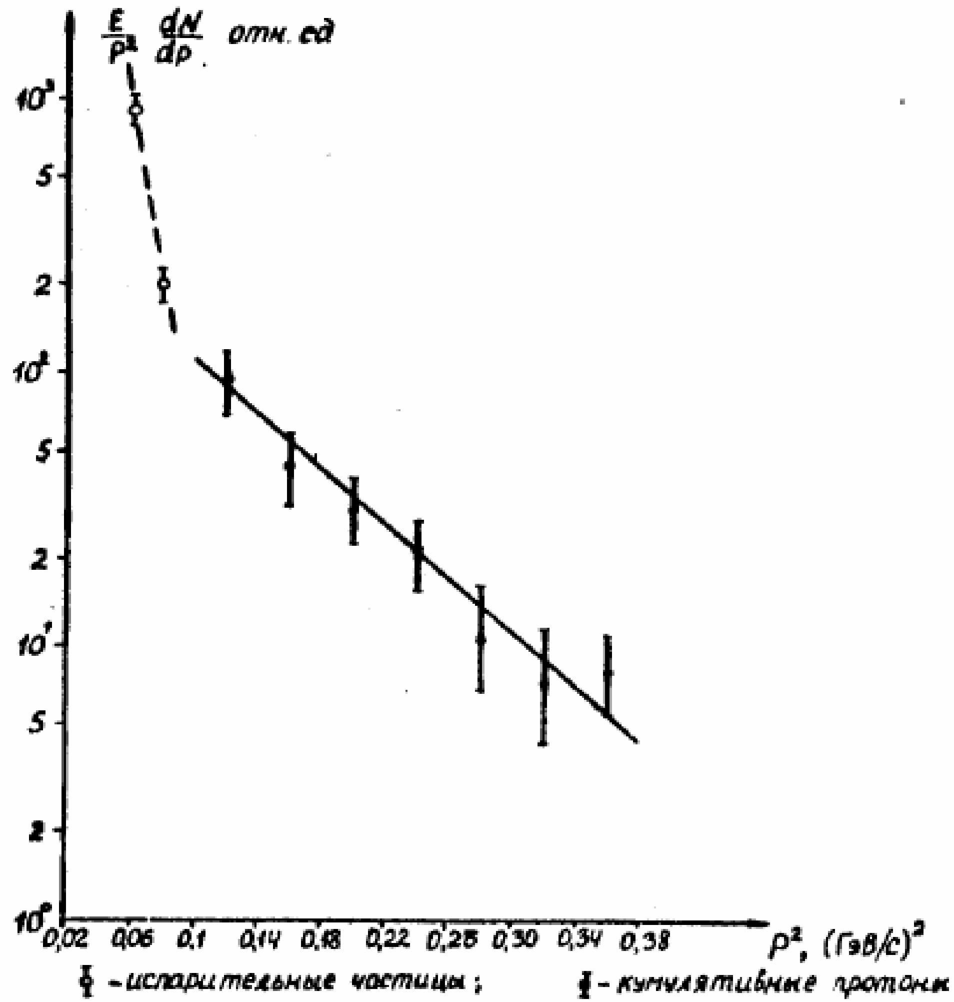
Conclusions.

1. With this type of spectrometers it is possible to detect not only protons, but also pions, deuterons and neutrons with 20 % efficiency.
2. The numbers of detected deuterons are expected to be three times smaller the the numbers of protons.
3. The numbers of detected pions is expected to be at about 5% with respect to the protons.
4. The counting rate for two protons detection is high enough for HBT.

Backup slides

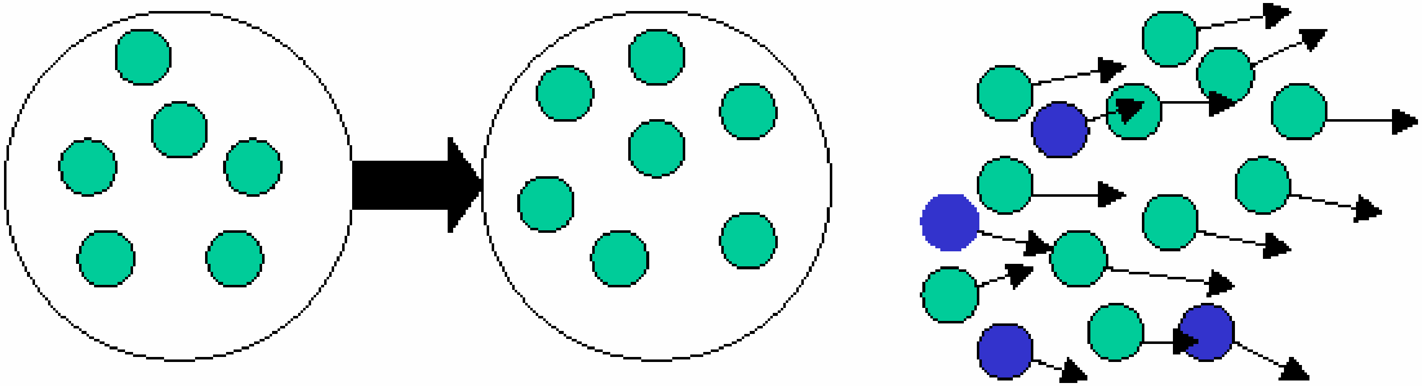


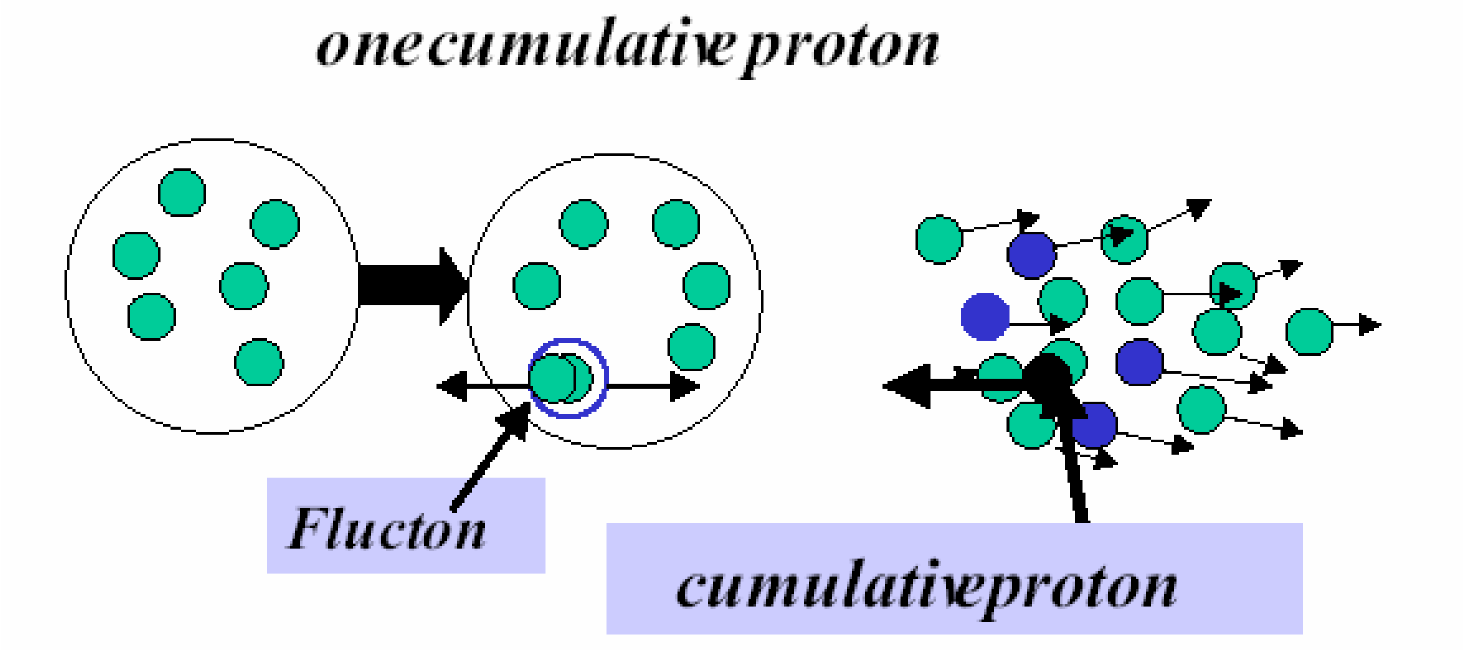
- ***A.M.Baldin Sov.J.Part and Nucl.,V8(3),p.429 (1977)***
- ***L.S.Shreder et al.,Phys.Rev.Lett.,V43, No.24,p.1787 (1979)***

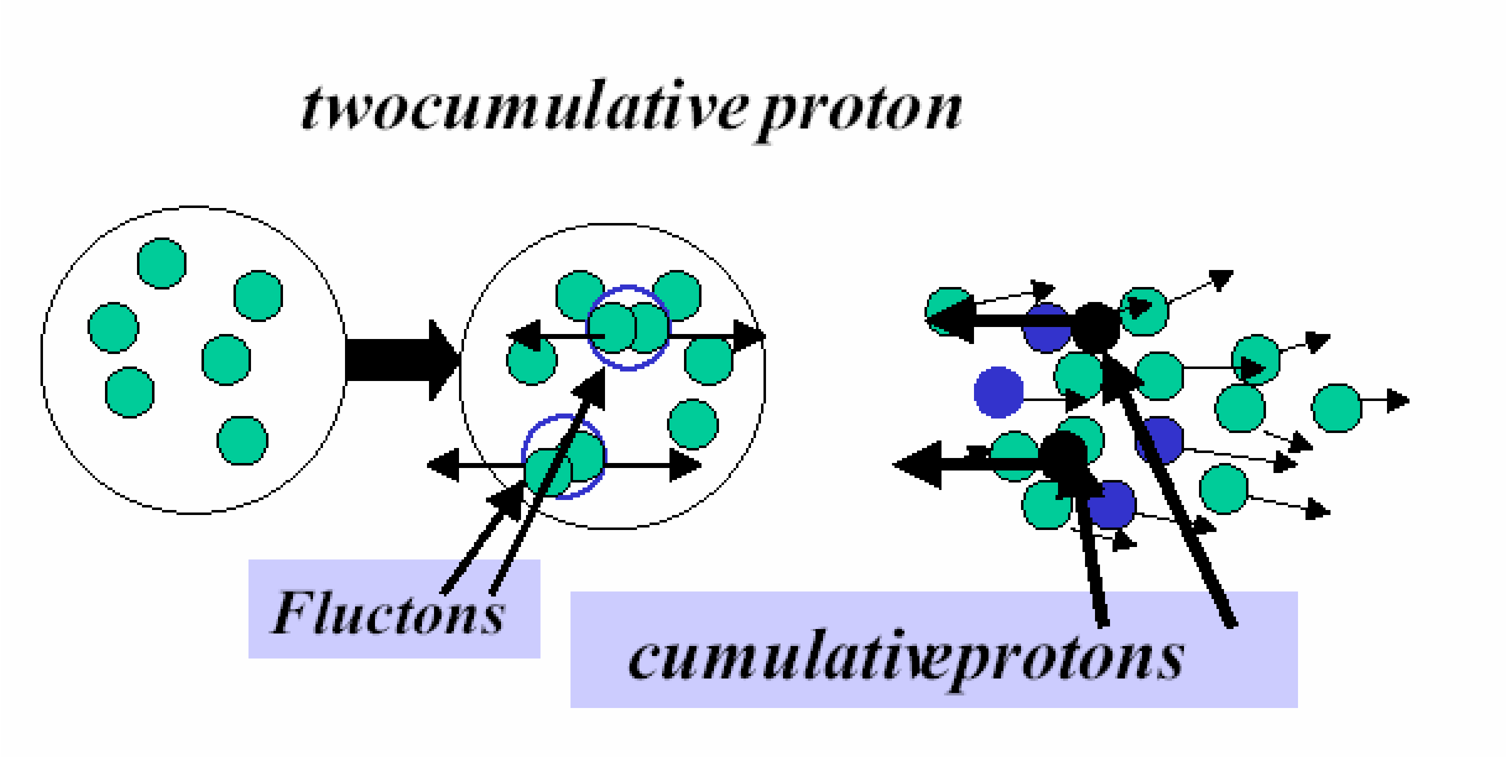


P.Ammar et al., Pisma v JETF,V.49,No.4,p.189 (1989)

without cumulativeproton

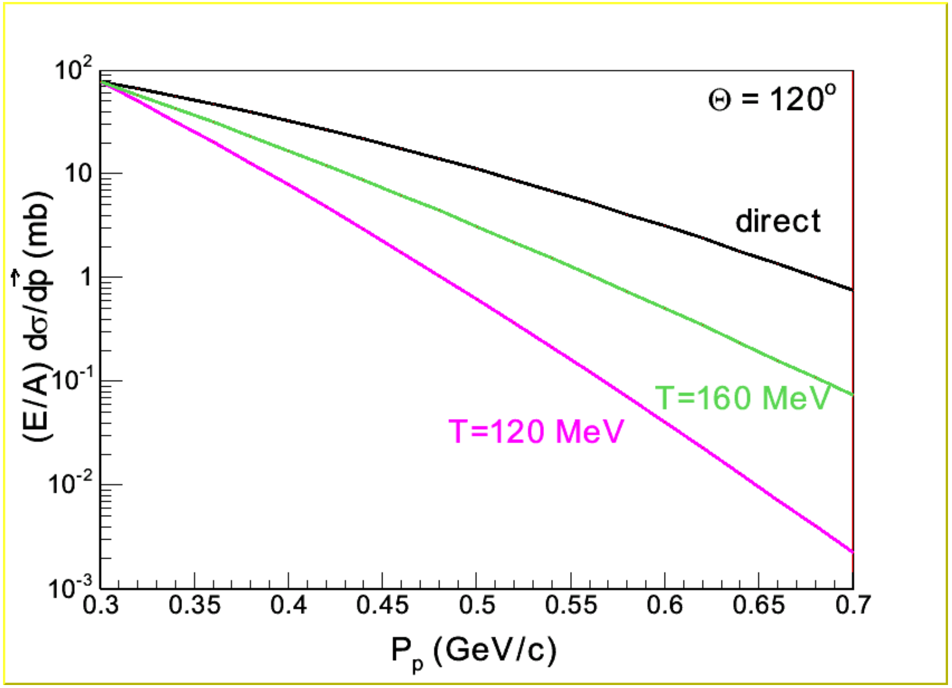


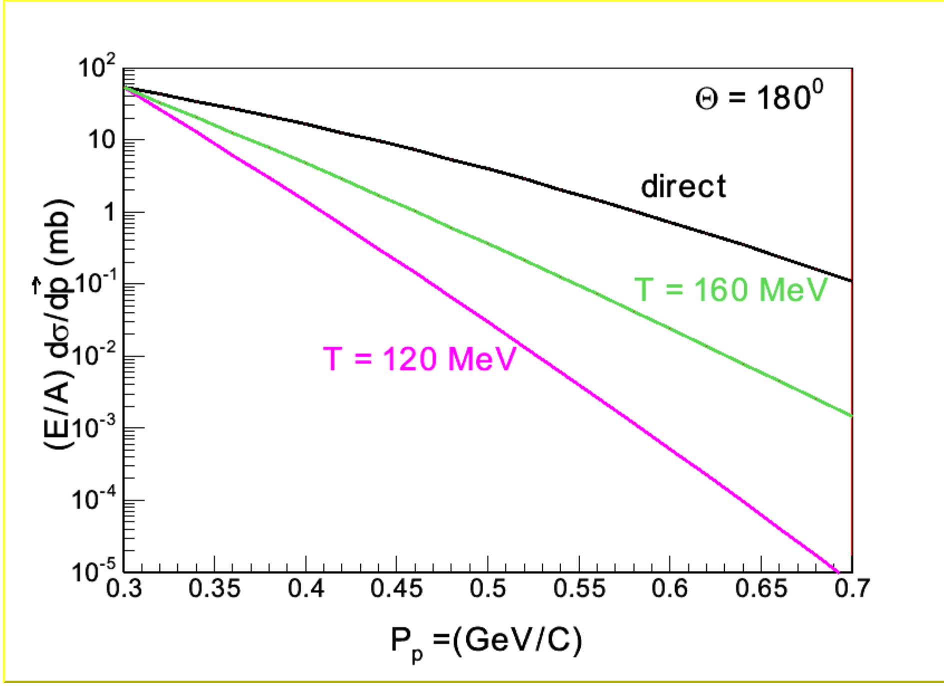

onecumulative proton
Flucton
cumulativeproton



twocumulative proton
Fluctons
cumulativeprotons

Cross section as a proton momentum from (pA) collisions and from a thermal fireballs with two temperatures in (AA) collisions (P(beam) = 20 GeV/c).





Cross section as a proton emission angle from (pA) collisions and from a thermal fireballs with two temperatures in (AA) collisions (P(beam) = 20 GeV/c).