QUMULATIVE PROTONS IN HADRON-NUCLEUS AND NUCLEUS-NUCLEUS INTERACTIONS AT HIGH ENERGIES

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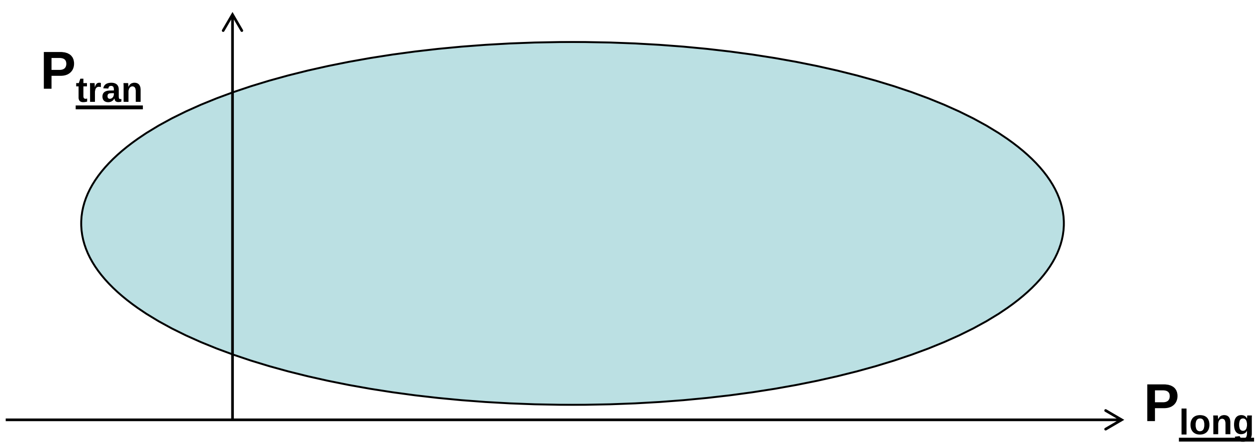
In interactions with nuclei there are at least three sources of secondary nucleons:

a) nucleons knocked out from target nucleus due re-scattering of either primary or secondary particles in a nucleus – so-called **recoil nucleons**;

b**) "evaporation" nucleons** coming through production and subsequent decay of heavy excited nuclear fragments;

c) nucleons coming from **"black box",** i.e. those nucleons which origin is not obvious and so-called "cumulative' nucleons are among them.

By definition (introduced by academician Alexander Baldin in early 70’s of last century) the cumulative particles are those which produced outside of the kinematical boundary allowed in the scattering on a single nucleon (with taking into account the Fermi motion of internal nucleons)



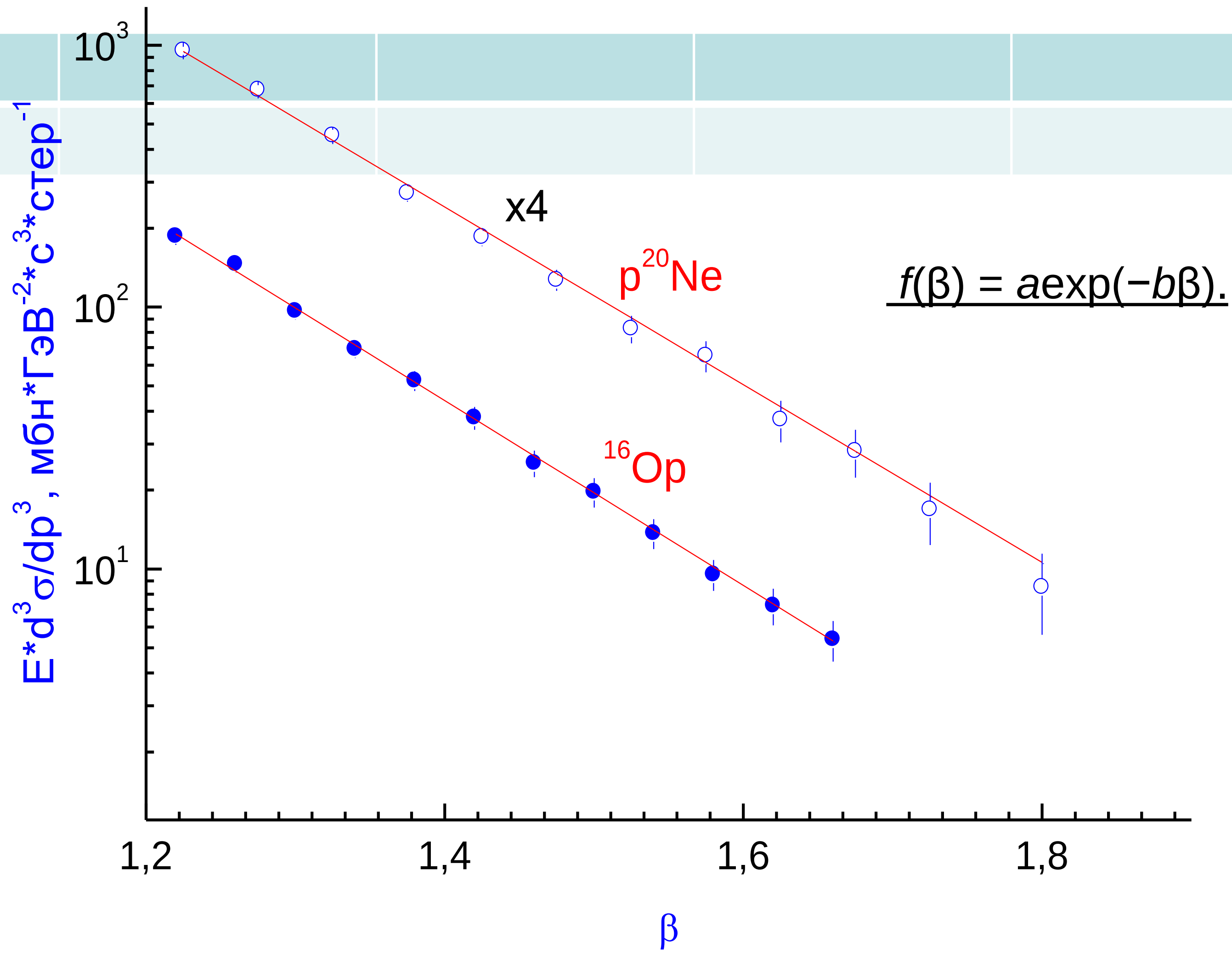
The presented results are based on the analysis of experimental data obtained from different heavy liquid (propane and NeH mixture) bubble chambers irradiated to beams of **protons, negative pions, He-, Carbon- and Oxygen-nuclei in the momentum range from 3 to 300 GeV/c per nucleon.**

In total more than 90000 events were analysed - 4π-geometry, identification of secondaries, including neutral particles

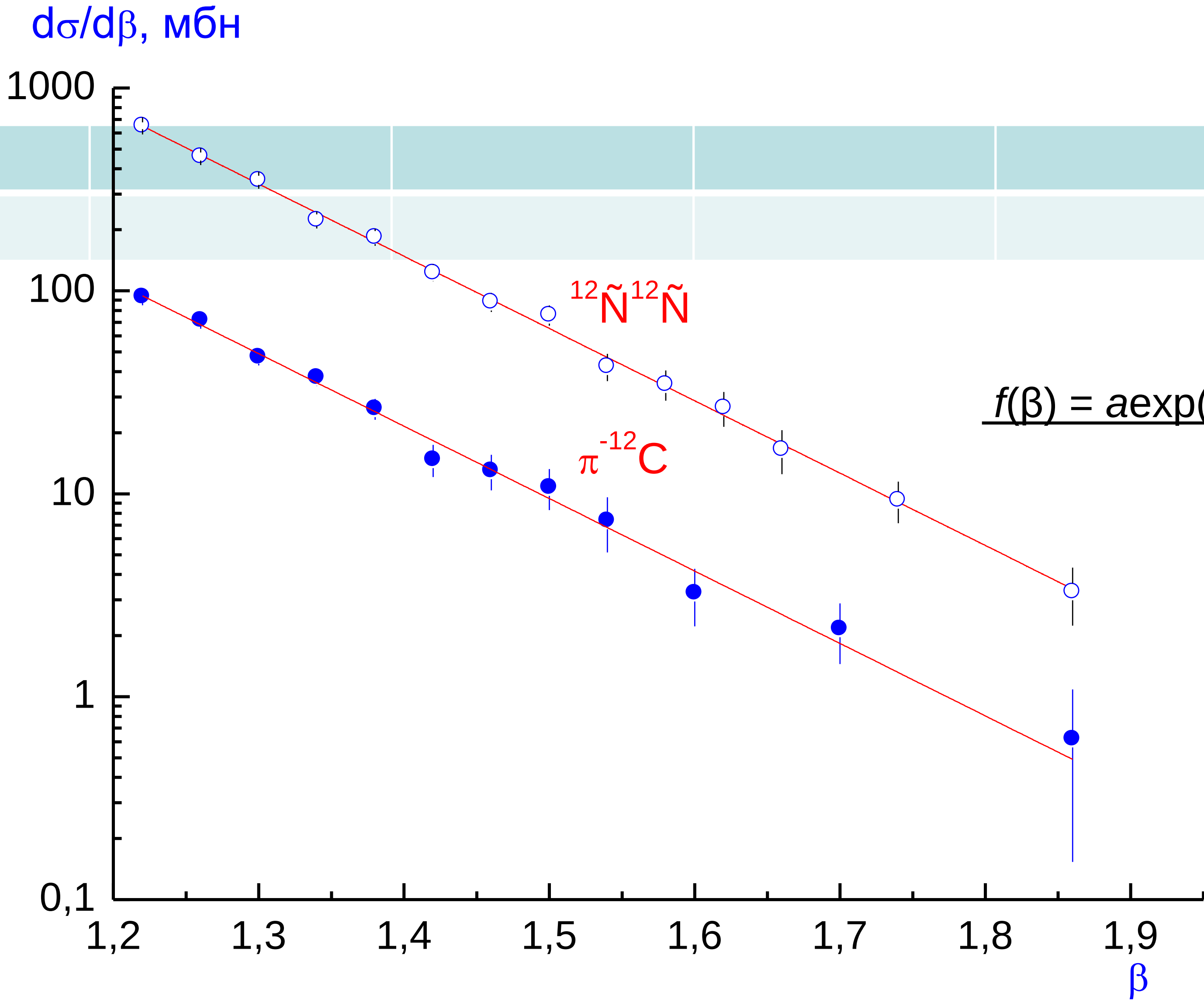
There is "light cone" variable which is widely used in analysis of cumulative particles:

$$\beta = (E - P\cos\vartheta)/m_n$$

The cut $\beta \geq 1.2$ significantly reduces a contribution from "evaporation" nucleons



10^3
10^2
10^1
x4
$p^{20}Ne$
^{16}Op
$f(\beta) = a\exp(-b\beta)$.
$E*d^3\sigma/dp^3$, мбн*ГэВ$^{-2}$*с^3*стер$^{-1}$
1,2
1,4
1,6
1,8
β



$f(\beta) = a\exp(-b\beta)$.

Таблица 1

Параметры наклона в параметризации (1), тип соударений, число событий и средние множественности кумулятивных протонов

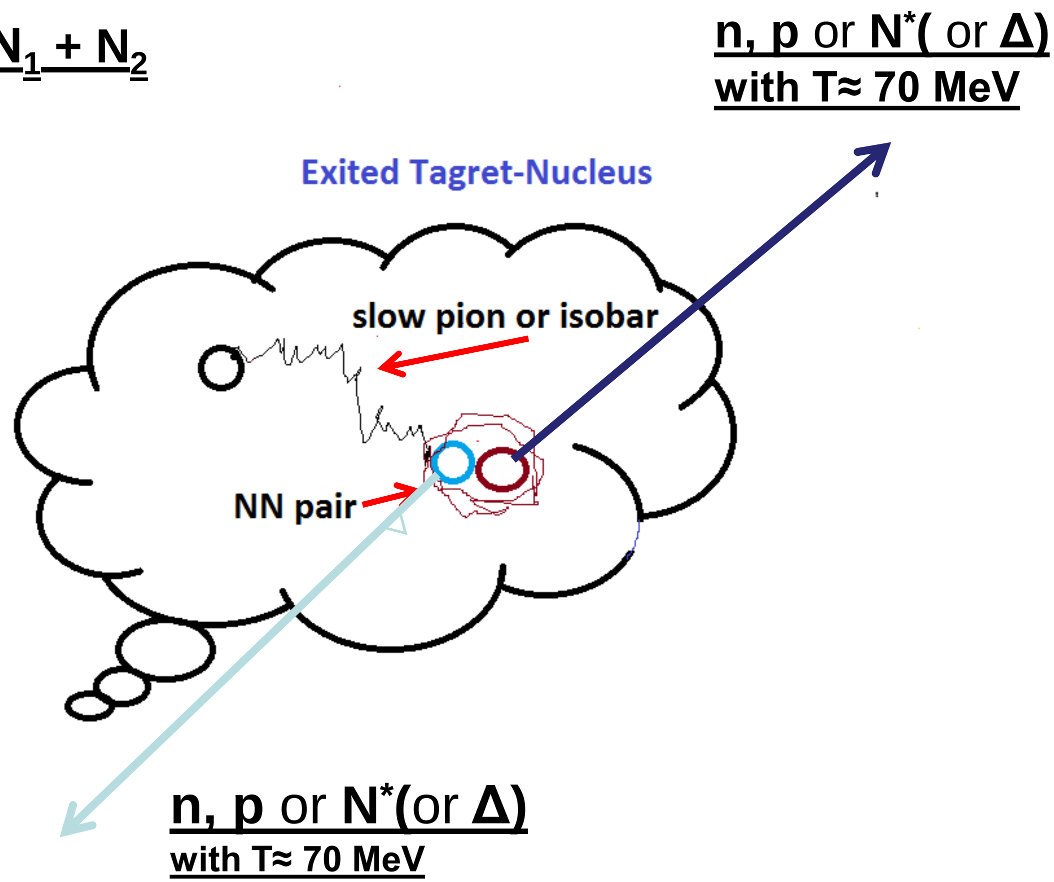
Тип взаимодействия, P_o(ГэВ/с)	Число событий	Параметр наклона, b	χ^2/ч.ст.св.	Среднее число кумулятивных протонов
π^{-12}C, 40.0	16657	8.18 ± 0.26	1.1	1.06 ± 0.03
p^{12}C, 4.2	6901	8.09 ± 0.49	1.0	1.04 ± 0.03
p^{12}C, 9.9	18325	8.10 ± 0.25	0.9	1.06 ± 0.03
^{4}He^{12}C, 4.2 A	12326	8.00 ± 0.28	1.2	1.06 ± 0.05
^{12}C^{12}C, 4.2 A	20530	8.14 ± 0.20	0.4	1.05 ± 0.04
^{16}Op, 3.25 A	12367	8.13 ± 0.21	0.4	1.11 ± 0.02
p^{20}Ne, 300	4990	7.99 ± 0.18	0.8	1.16 ± 0.03

NN systems in a nucleus and reactions on them

π + “b” → $N_1 + N_2$, $T_{kin} \approx m_\pi / 2 \approx$ 70 MeV

π + “b” → N + Δ (or N*),

Δ(N*) + N → $N_1 + N_2$



KINEMATICS

$$\mu^2 = q^2_\pi = (q_1 + q_2 - q_N)^2 \approx$$

$$\approx (T_1 + T_2)^2 - (\mathbf{p}_1 + \mathbf{p}_2)^2 \approx m^2_\pi$$

$$\mu^2_1 \approx (T_1 + T_\Delta)^2 - (\mathbf{p}_1 + \mathbf{p}_\Delta)^2 \approx m^2_\pi$$

$$\mu^2_1 - \mu^2 \leq 0$$

p^{20}Ne interactions at 300 GeV,

B.S.Yuldashev et al, Phys.Rev. **46**(1992)45