

Study of flucton-flucton interaction in dd collisions

The advantages:

- It can be studied **only in new cumulative region of large transverse momenta in mid-rapidity region at NICA** (not in the traditional cumulative region of fragmentation of one of the nuclei).
- There are **no additional interactions in dd collision**, compared with collisions of heavier nuclei, if both deuterons are in flucton configuration at the moment of collision. =>
- The possibility to register, in addition to the cumulative particle, the **particles formed from fragmentation of the flucton residue**.
- **Higher frequency of dd collisions** that can be recorded by the SPD, compared to the slower MPD (important for a registration of rare cumulative events).
- The studies in new cumulative region becomes **possible due to the moderate energy of the NICA** collider and is completely impossible at ultrahigh energies of the RHIC and LHC.

It is expected that this new phenomenon will be studied in MPD and SPD experiments at the NICA collider using existing and new ultrathin pixel detector systems. In this regard, information from the internal tracking system is especially important, making it possible to reliably confirm the exit of the track of a cumulative particle from the primary interaction vertex, and thus isolate this rare event from the inevitable noise background.

**Estimation of pion and proton yields in the new cumulative region
of large transverse momenta and the rapidities $0.5 < |y| < 1$
in dd collisions at SPD for $t = 1$ hour**

$$Y_{dd} = 0.1 \cdot L_{dd} \cdot \sigma_{dd}^{tot} \cdot \langle n \rangle_{dd} \cdot t$$

$$L_{dd} = 10^{30} \text{ cm}^{-2} \text{ c}^{-1} \quad \text{at 8 GeV and 100 times lower at 4 GeV}$$

V.M. Abazov, et al. [The SPD collaboration], "Conceptual design of the Spin Physics Detector ArXiv:2102.00442v3 [hep-ex], 2022.

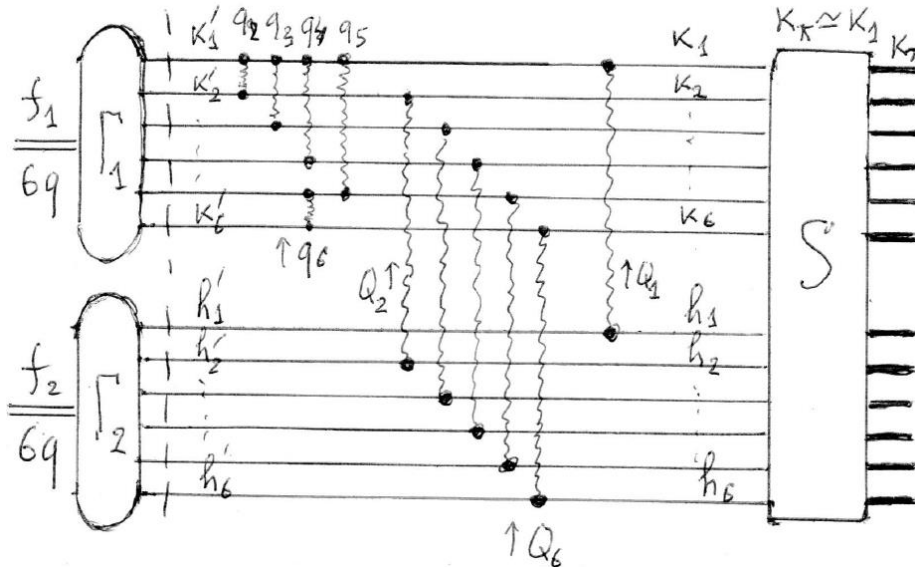
	$\sqrt{s_{NN}}$	4 GeV	8 GeV
$Y_{dd} \rightarrow \pi^-$	$x > 1$	400	8 000
	$x > 1.2$	30	500
	$x > 1.5$	0.16	2.5
$Y_{dd} \rightarrow p$	$x > 1$	10 000	400
	$x > 1.2$	500	20
	$x > 1.5$	4.5	0.18

***V.V. Vechernin, S.N. Belokurova,
S.V. Yurchenko,
Cumulative Production in the
Region of Central Rapidities and
Large Transverse Momenta at
the NICA Collider
Physics of Particles and Nuclei,
2024, Vol. 55, No. 4, pp. 889-894.***

Quark counting rules for *inclusive cross sections* in a new cumulative region of large transverse momenta

Generalization of the theoretical approach for the microscopic description of cumulative phenomena in the region of fragmentation of one of the nuclei due to flucton-nucleon interactions

[M.A.Braun, V.V.Vechernin, 1994-2016] to the case of interaction of two fluctons.



$x = x_1 = x_2$ - cumulative number
 $\eta = -\ln \operatorname{tg} \frac{\theta^*}{2}$ - pseudorapidity

p – number of recoil quarks ($p=11$)

$$f(\mathbf{k}) \equiv \frac{k_0 d^3 \sigma}{d^3 \mathbf{k}} = f(x, \eta) = C s^{-m} (2-x)^{\frac{3}{2}(p-1)-1} F(\eta)$$

For details see the slides of my report at the conference “Nucleus-2024”:
[Vechernin V.V., Yurchenko S.V.](https://indico.jinr.ru/event/4304/contributions/26840/)

“Cumulative production at central rapidities due to interactions involving fluctons”,

<https://indico.jinr.ru/event/4304/contributions/26840/>