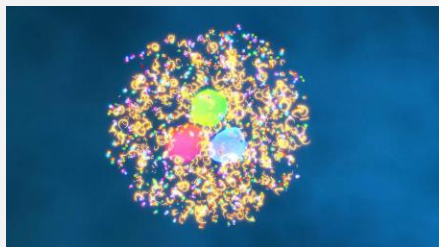


Elementary reactions and Nucleon structure (2020-2025)

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In collaboration with
N.P. Merenkov, M.I. Konchatnij, G.I. Gakh, A.G. Gakh

In memory of M.F. Shulga

French-Ukrainian Workshop 2025
IJCLab, June 12, 2025



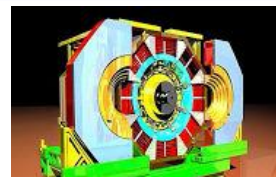
Elementary reactions

- Elastic scattering

Polarization effects in elastic deuteron-electron scattering

G.I. Gakh (Kharkov Natl. U.), M.I. Konchatnij (Kharkov Natl. U.), N.P. Merenkov (Kharkov Natl. U.), E. Tomasi-Gustafsson (IRFU, Saclay), A.G. Gakh (Kharkov Natl. U.) (Nov 2, 2023)

Published in: *Phys.Rev.C* 109 (2024) 6, 065203 • e-Print: [2311.01102](#) [nucl-th]



- Annihilation: charged and neutral pions

Charged pion production in the annihilation reactions $e^+ + e^- \rightarrow p + \bar{n} + \pi^-$ and $e^+ + e^- \rightarrow n + \bar{p} + \pi^+$

G.I. Gakh (Kharkov, KIPT), M.I. Konchatnij (Kharkov, KIPT), N.P. Merenkov (Kharkov, KIPT), E. Tomasi-Gustafsson (IRFU, Saclay) (Dec 6, 2023)

e-Print: [2312.03578](#) [hep-ph]

Polarization phenomena in the reaction $e^+ + e^- \rightarrow N + \bar{N} + \pi^0$ in the framework of the nonresonant mechanism #3

G.I. Gakh (Kharkov, KIPT and Kharkov Natl. U.), M.I. Konchatnij (Kharkov, KIPT and Kharkov Natl. U.), N.P. Merenkov (Kharkov, KIPT and Kharkov Natl. U.), E. Tomasi-Gustafsson (IRFU, Saclay) (Nov 12, 2022)

Published in: *Phys.Rev.D* 106 (2022) 11, 114018 • e-Print: [2211.06656](#) [hep-ph]



Elementary reactions

...a number of papers

THANKS...

REMEMBERING...



Kharkiv, 2010

Alexey P. Rekalo (1946-2011)



Gennadyi I. Gakh (1945-2023)



....M.P. Rekalov and E.A. Kuraev



M.P. Rekalov
(1938-2004)



E.A. Kuraev
(1940-2014)

Projection

- *The film will focus on the present understanding of the internal structure of the proton, and show that all these images contain a part of truth.*

<https://www.youtube.com/watch?v=8iuBwdBxp3M>



Conclusion

The present understanding points to a dynamical structure depending on the internal distance one looks at.

- *Elastic processes: a ‘snapshot’ at distance Q^2 .*
- *Inelastic processes: access position and momentum distribution of quarks.*
- *Annihilation processes: ‘see ‘ the creation of matter from quantum vacuum.*

