Baryon number dynamics from RHIC to the EIC

David Frenklakh

- *Phys.Lett.B* 853 (2024) with D. Kharzeev and W. Li (2312.15039)
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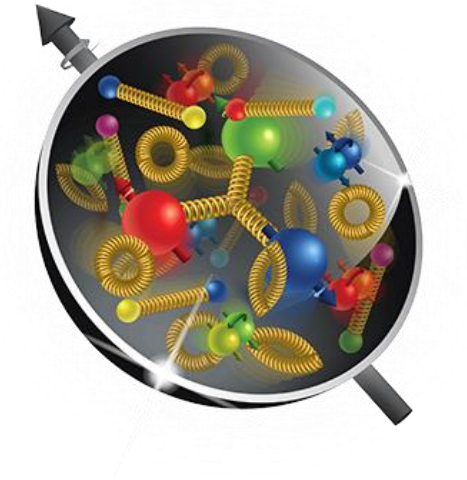
Proton quantum numbers:

- ❖ Mass
- ❖ Spin
- ❖ Electric charge
- ❖ Baryon number



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Proton quantum numbers:

EIC Trivial

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Proton quantum numbers:

EIC

Trivial

Not so trivial!

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Proton quantum numbers:

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What carries the baryon number?

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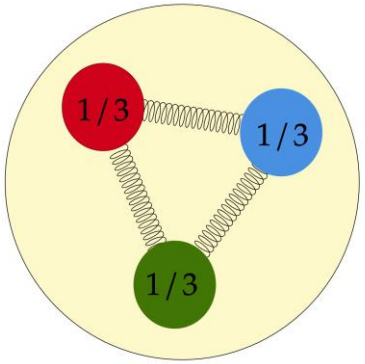
Motivation: what carries the baryon number?

$$B(x_1, x_2, x_3) = \epsilon^{ijk} q(x_1)_i \; q(x_2)_j q(x_3)_k$$



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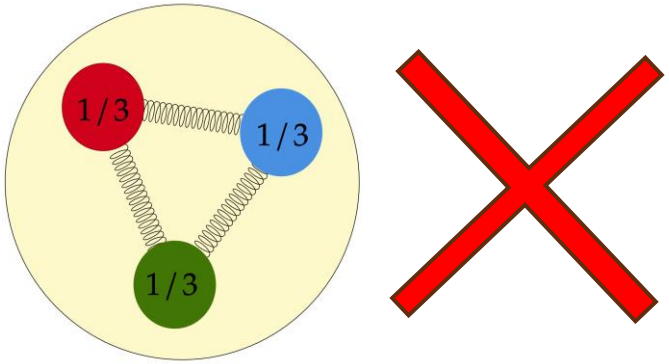
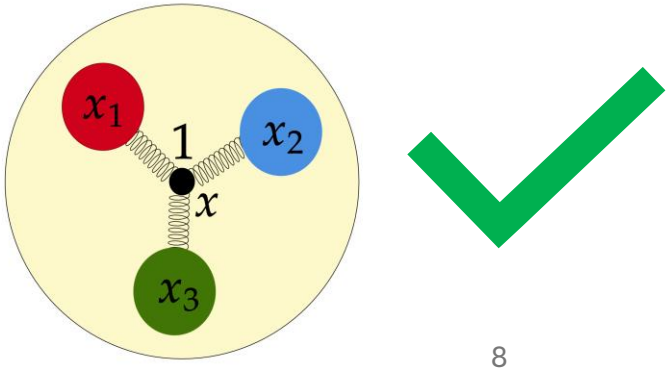
Gauge invariance



$$B(x_1, x_2, x_3, x) = \epsilon^{ijk} \; [P(x_1, x) \; q(x_1)]_i \; [P(x_2, x) \; q(x_2)]_j \, [P(x_3, x) \; q(x_3)]$$

$$P(x_n, x) \equiv \mathcal{P} \exp\left(ig \int_{x_n}^{x} A_\mu dx^\mu \right)$$ G.C. Rossi and G. Veneziano, Nucl. Phys. B 123 (1977)



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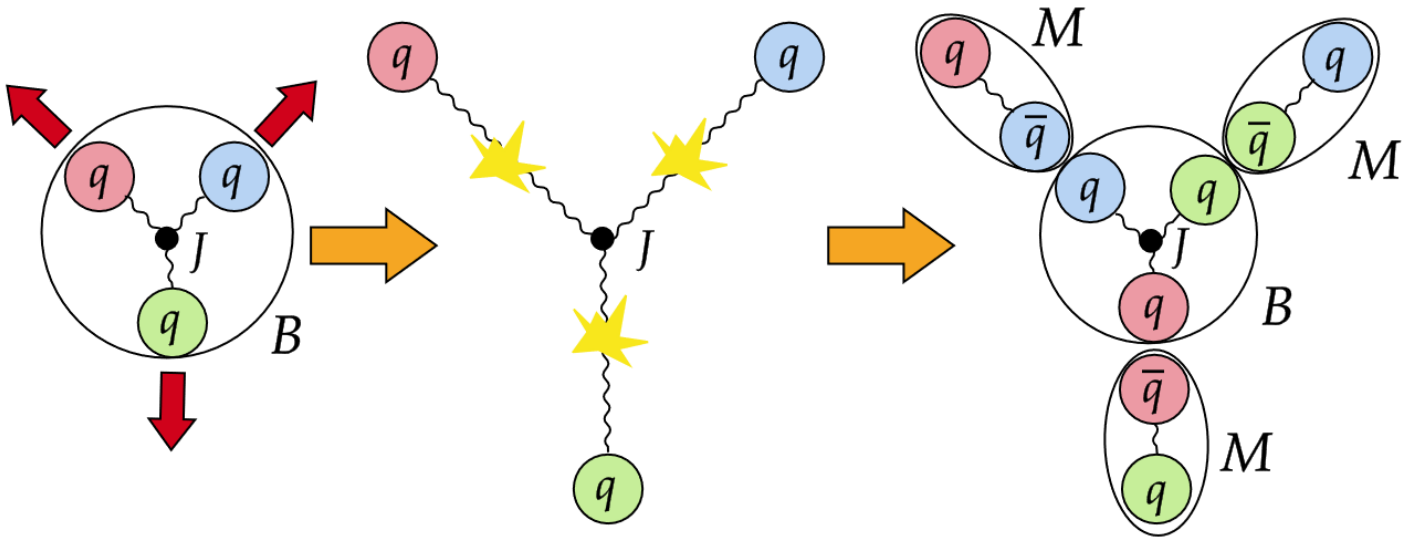
Can string junction carry the baryon number?



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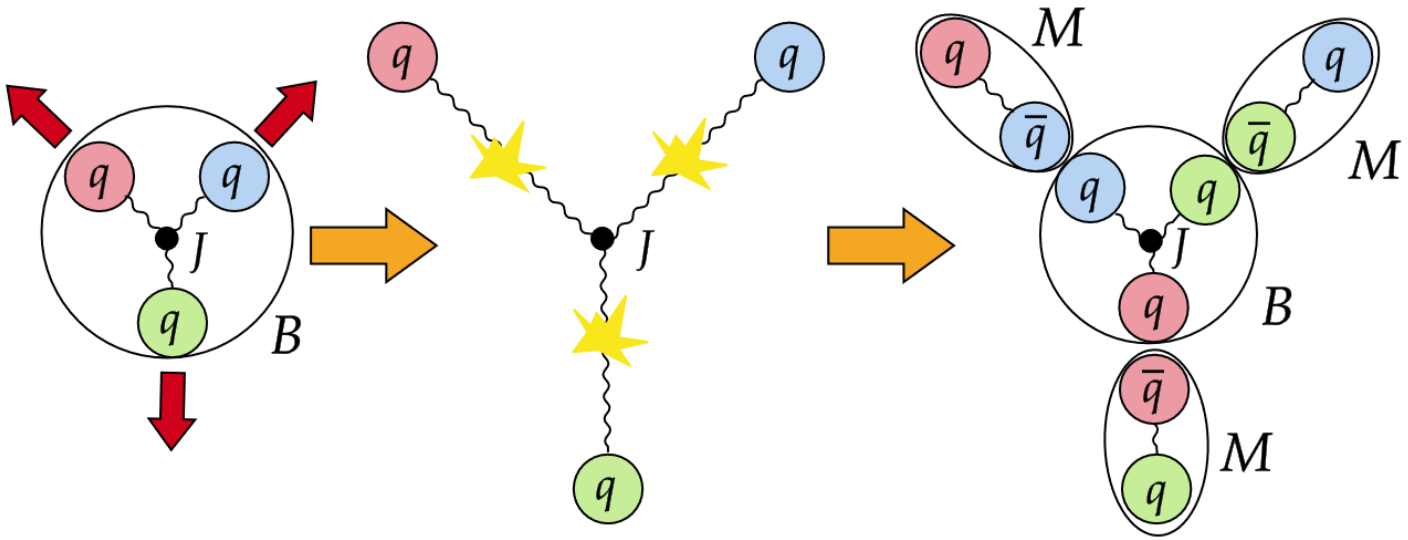

Test in high-energy hadronic collisions by looking at baryon number transport in rapidity.

p + p
A + A
γ + A
} STAR

e + p
e + A
} EIC

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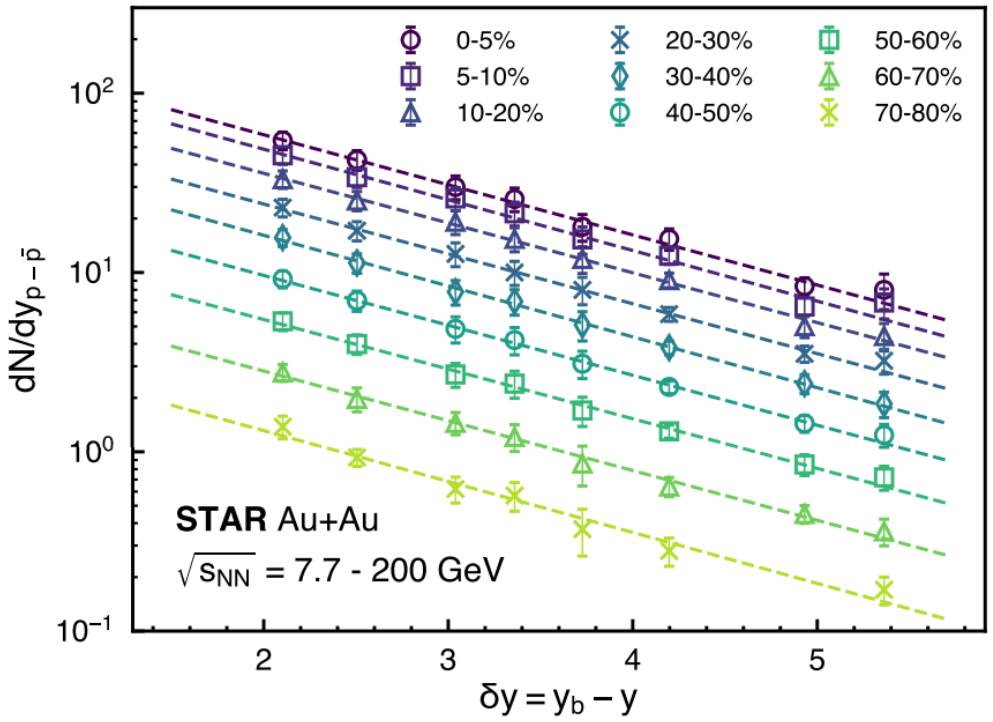

N. Lewis et al
arXiv:2205.05685(2022)

Experimental rapidity slope:

$$\sim 0.65 \pm 0.1$$

New theory input on $\alpha_{\mathbb{J}_0}$!

Topological expansion + Feynman-Wilson gas accounting for correlations in three strings breaking: $\alpha_{\mathbb{J}_0} \simeq 0.26$

leading to beam rapidity slope

$$|\alpha_{\mathbb{J}_0} + \alpha_{\mathbb{P}} - 2| \simeq 0.66$$