Gauge anomalies from an on-shell perspective

Edoardo Alviani, Adam Falkowski

alviani@ijclab.in2p3.fr, falkowsk@ijclab.in2p3.fr

Based on 2507.XXXXX, A. Falkowski, EA

Symmetries are blueprinted in lagrangians

But it can happen that they are lost upon computing correlators

Gauge symmetry cannot be lost: we gear our theories accordingly

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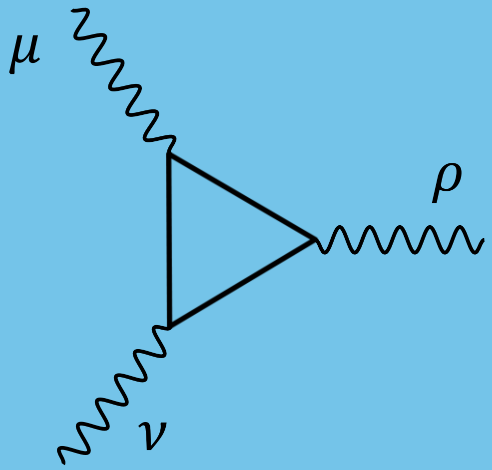

$\neq 0$ → $\sum_n Q_n^3 = 0$

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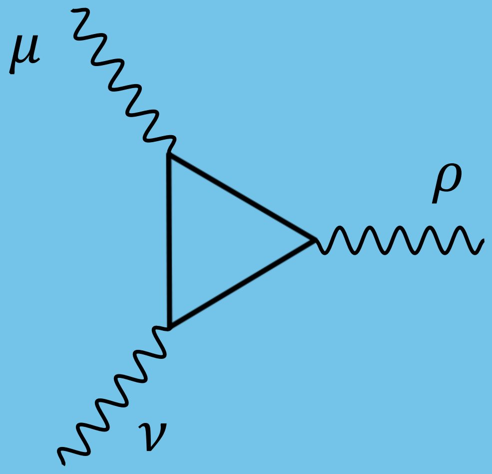


$\neq 0$

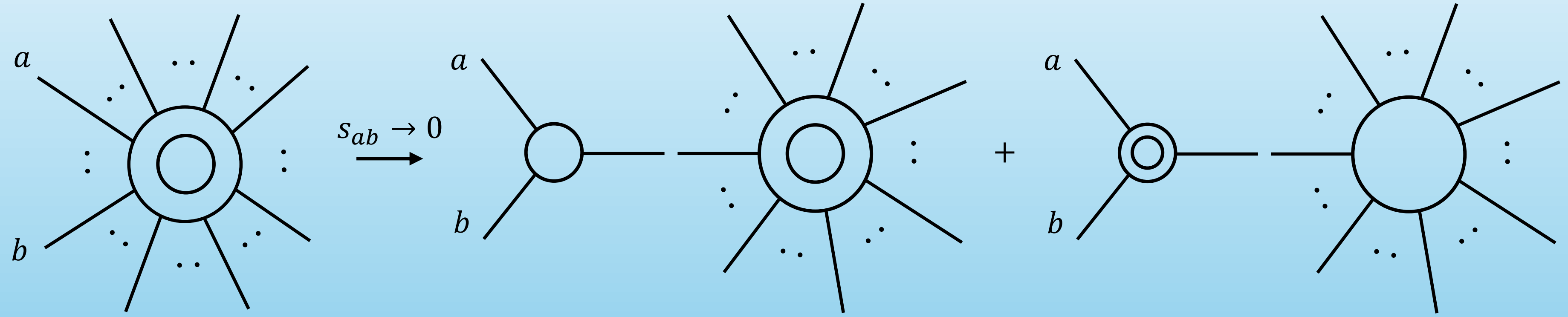
$$\sum_n Q_n^3 = 0$$

On-shell methods bypass gauge symmetry from the get go. What are anomaly cancellation conditions in this perspective?

arXiv:1402.7062
[Y. Huang, D. Mcgady]

Certain amplitudes expose a tension between locality and unitarity

$n \geq 5$



$$\sim \frac{1}{\sqrt{s_{ab}}} \qquad (1)$$

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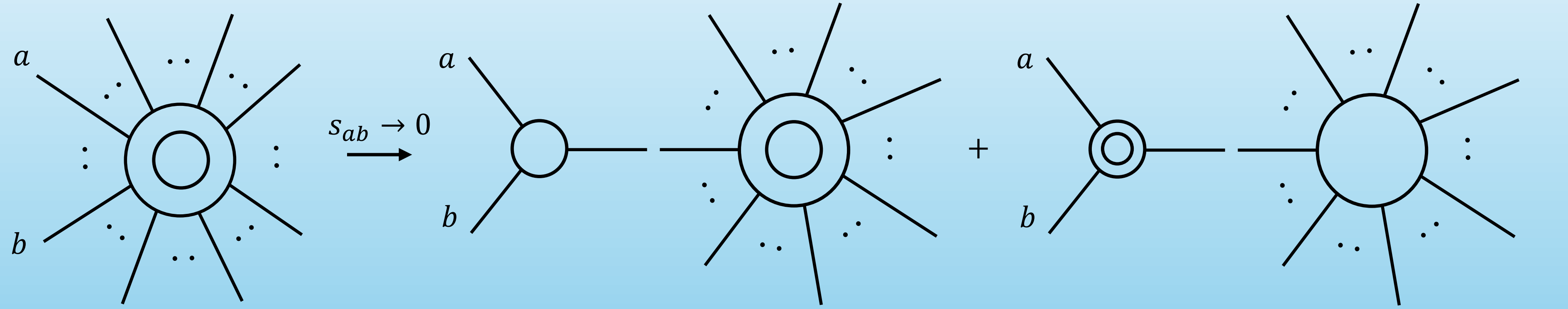

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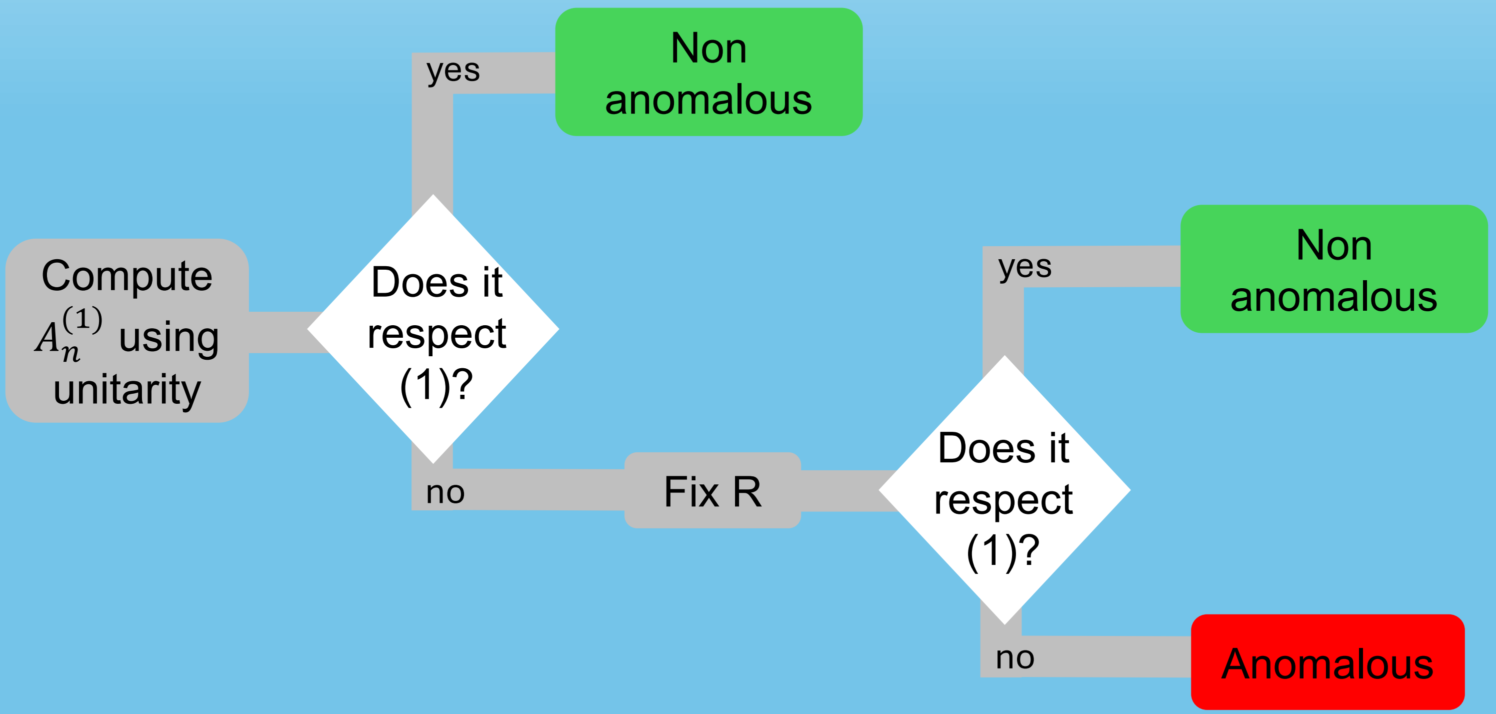

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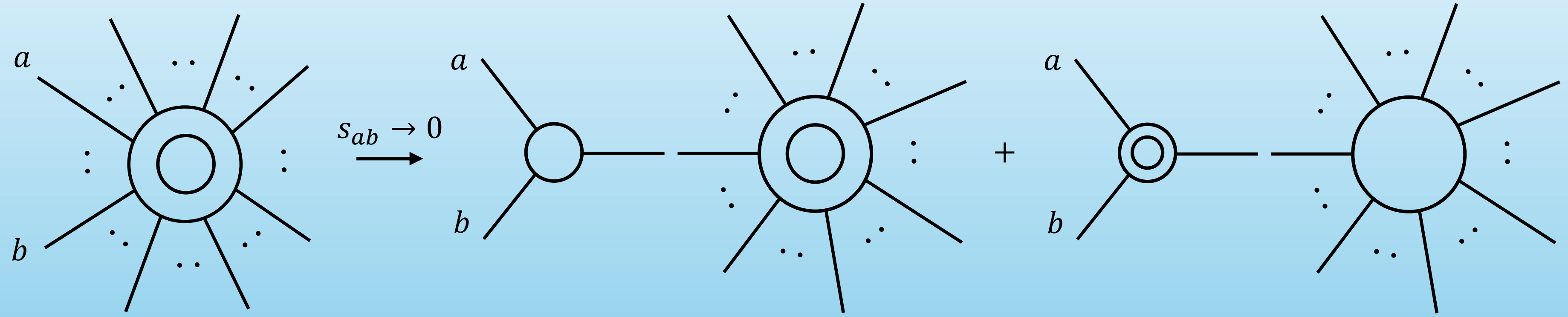

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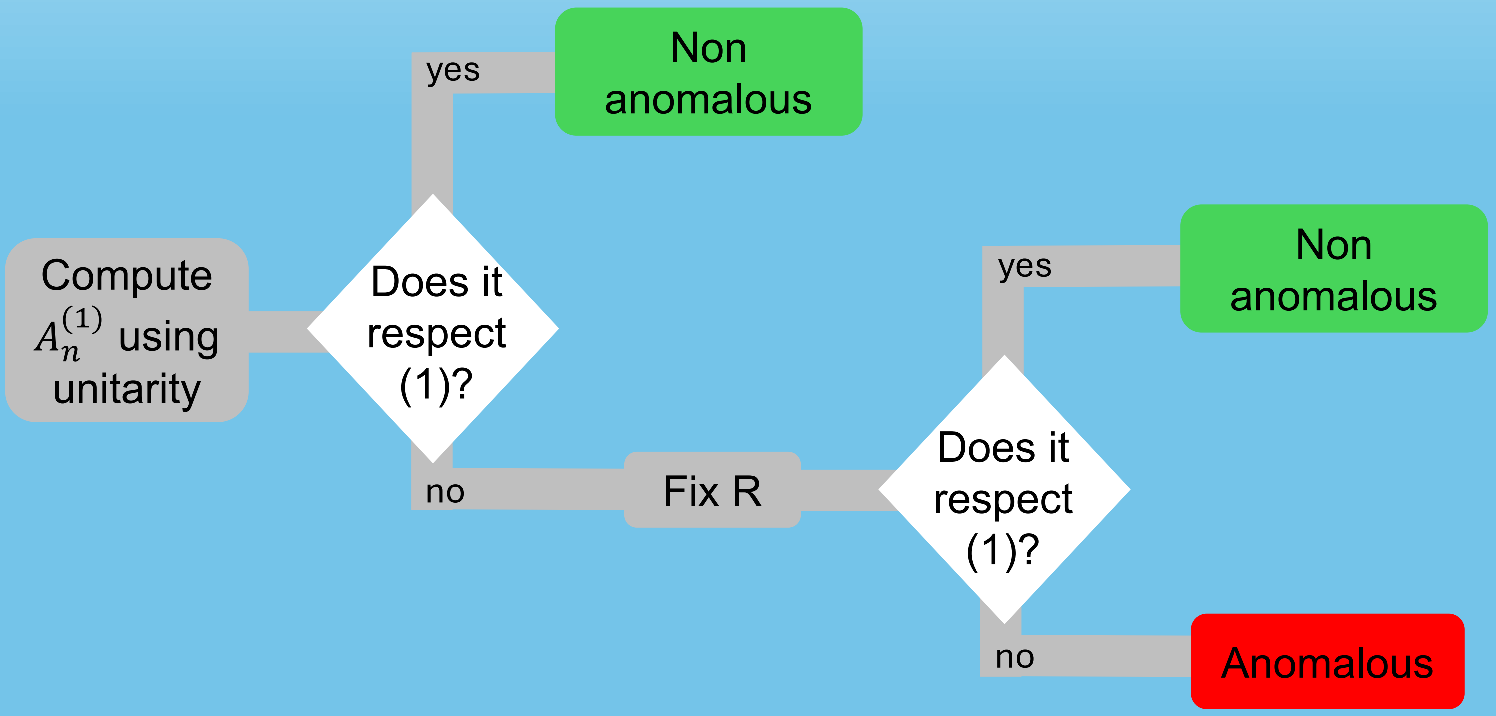
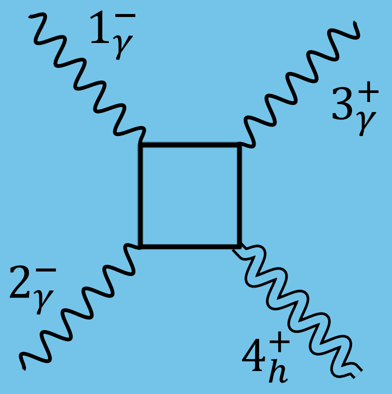
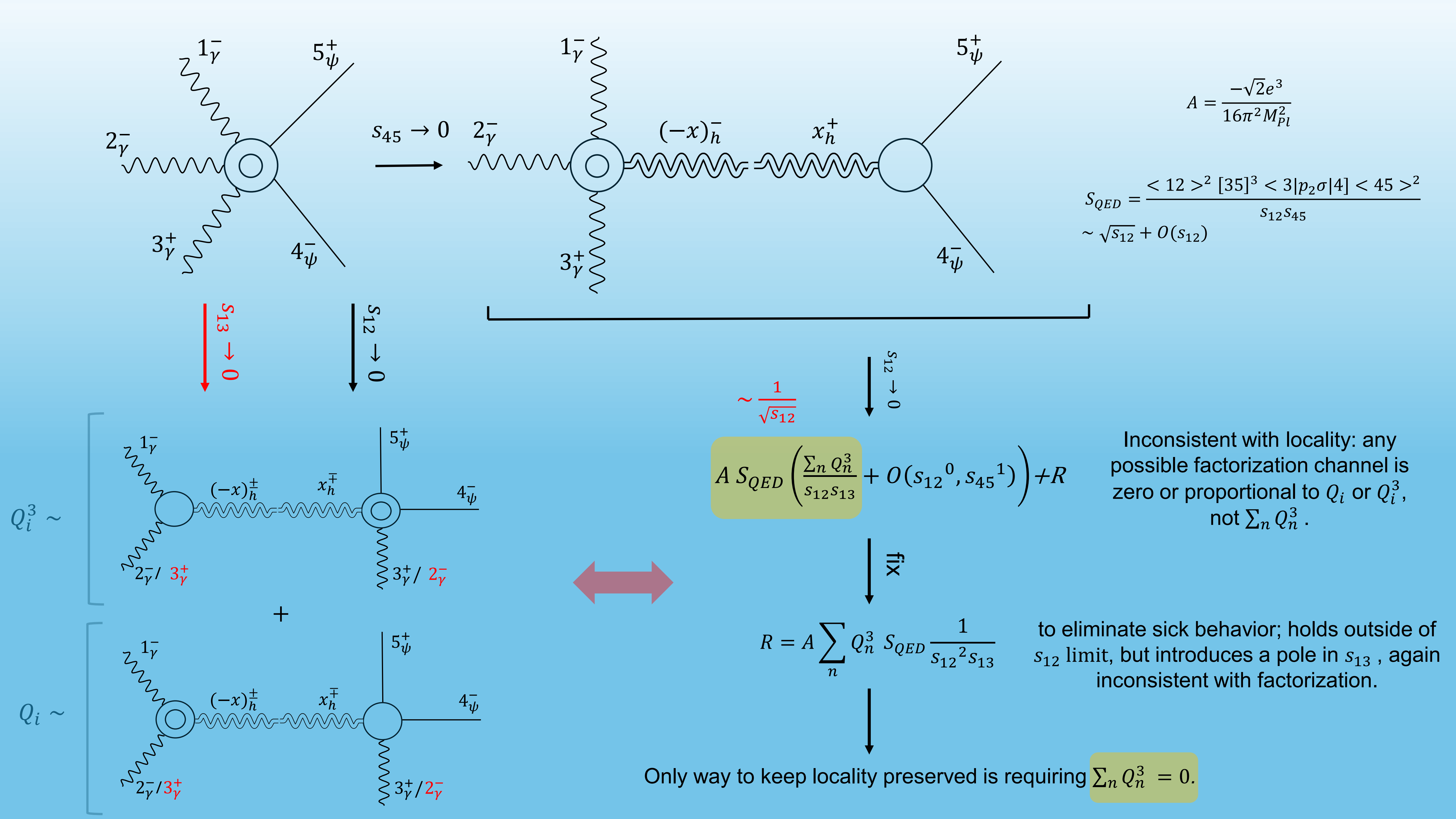




$$\sim \sum_n Q_n^3$$


1_γ^-
2_γ^-
3_γ^+
4_ψ^-
5_ψ^+
$s_{45} \to 0$
$(-x)_h^-$
x_h^+
$A = \frac{-\sqrt{2}e^3}{16\pi^2 M_{Pl}^2}$
$S_{QED} = \frac{<12>^2\,[35]^3 <3|p_2\sigma|4]<45>^2}{s_{12}s_{45}}$
$\sim \sqrt{s_{12}} + O(s_{12})$
$s_{13} \to 0$
$s_{12} \to 0$
$Q_i^3 \sim$
$(-x)_h^\pm$
$x_h^\mp$
$2_\gamma^- / 3_\gamma^+$
$3_\gamma^+ / 2_\gamma^-$
+
$Q_i \sim$
$\sim \frac{1}{\sqrt{s_{12}}}$
$A\,S_{QED}\left(\frac{\sum_n Q_n^3}{s_{12}s_{13}} + O({s_{12}}^0, {s_{45}}^1)\right) + R$
Inconsistent with locality: any possible factorization channel is zero or proportional to Q_i or Q_i^3, not $\sum_n Q_n^3$.
fix
$R = A \sum_n Q_n^3\; S_{QED} \frac{1}{{s_{12}}^2 s_{13}}$
to eliminate sick behavior; holds outside of s_{12} limit, but introduces a pole in s_{13} , again inconsistent with factorization.
Only way to keep locality preserved is requiring $\sum_n Q_n^3 = 0$.

Thank you!

$A = \frac{-\sqrt{2}e^3}{16\pi^2 M_{Pl}^2}$
$S_{QED} = \frac{< 12 >^2\ [35]^3 < 3|p_2\sigma|4] < 45 >^2}{s_{12}s_{45}}$
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$Q_i^3 \sim$
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