# Global Fits in the Top sector

## Based on: 1910.03606

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BSM 2021
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SFitter

Sebastian
Bruggisser

# Why Global Fits in the Top sector?

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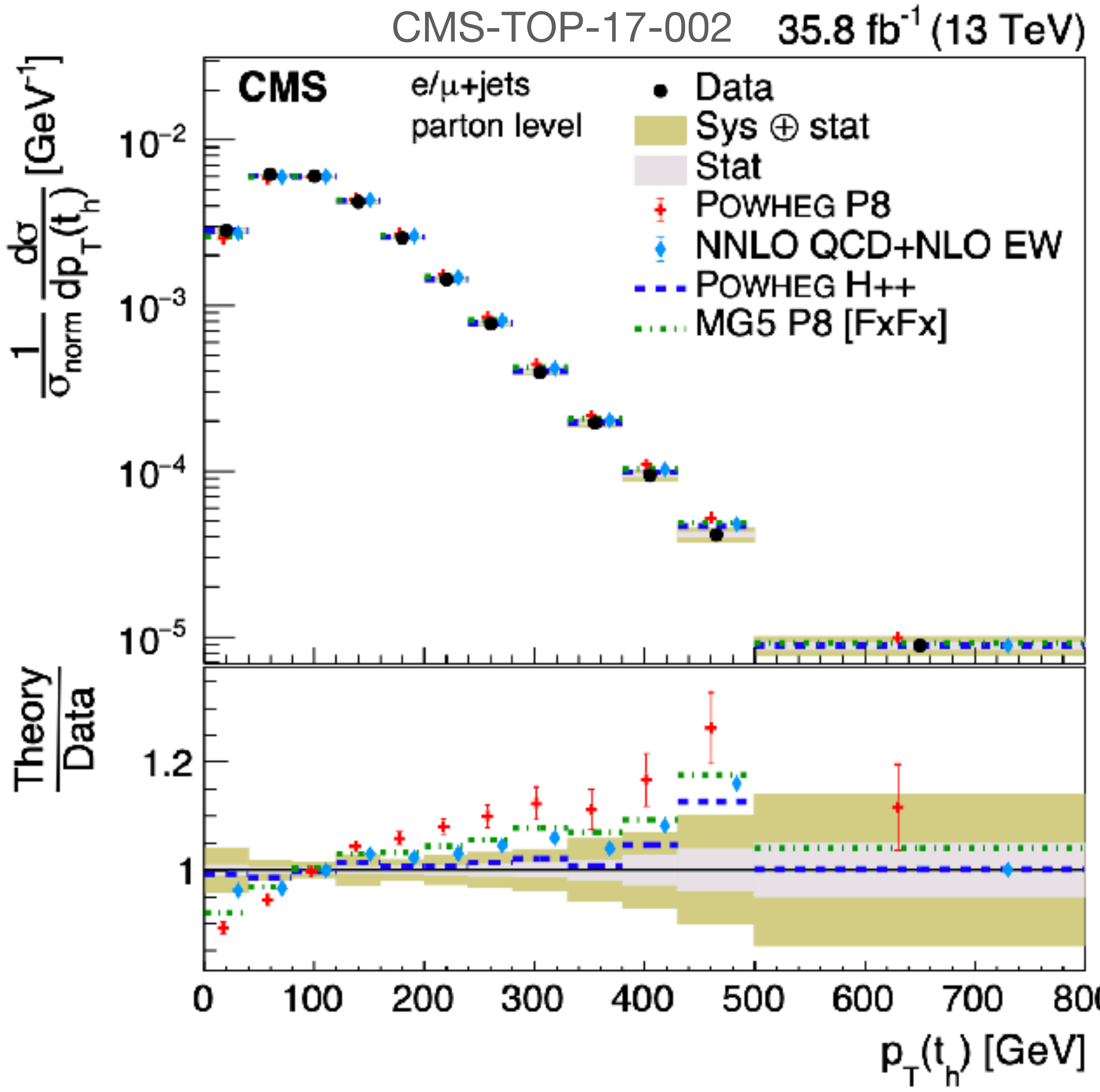

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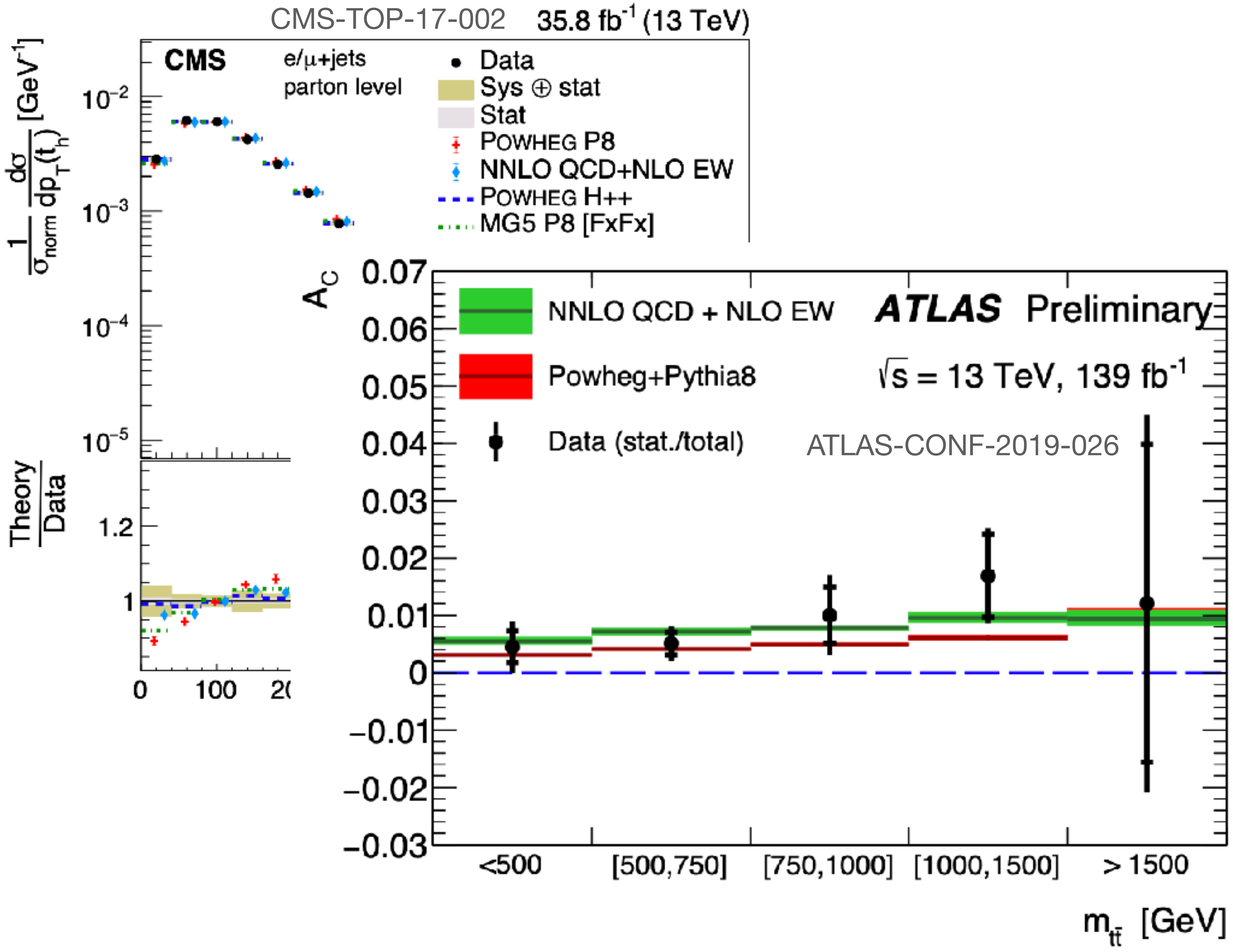

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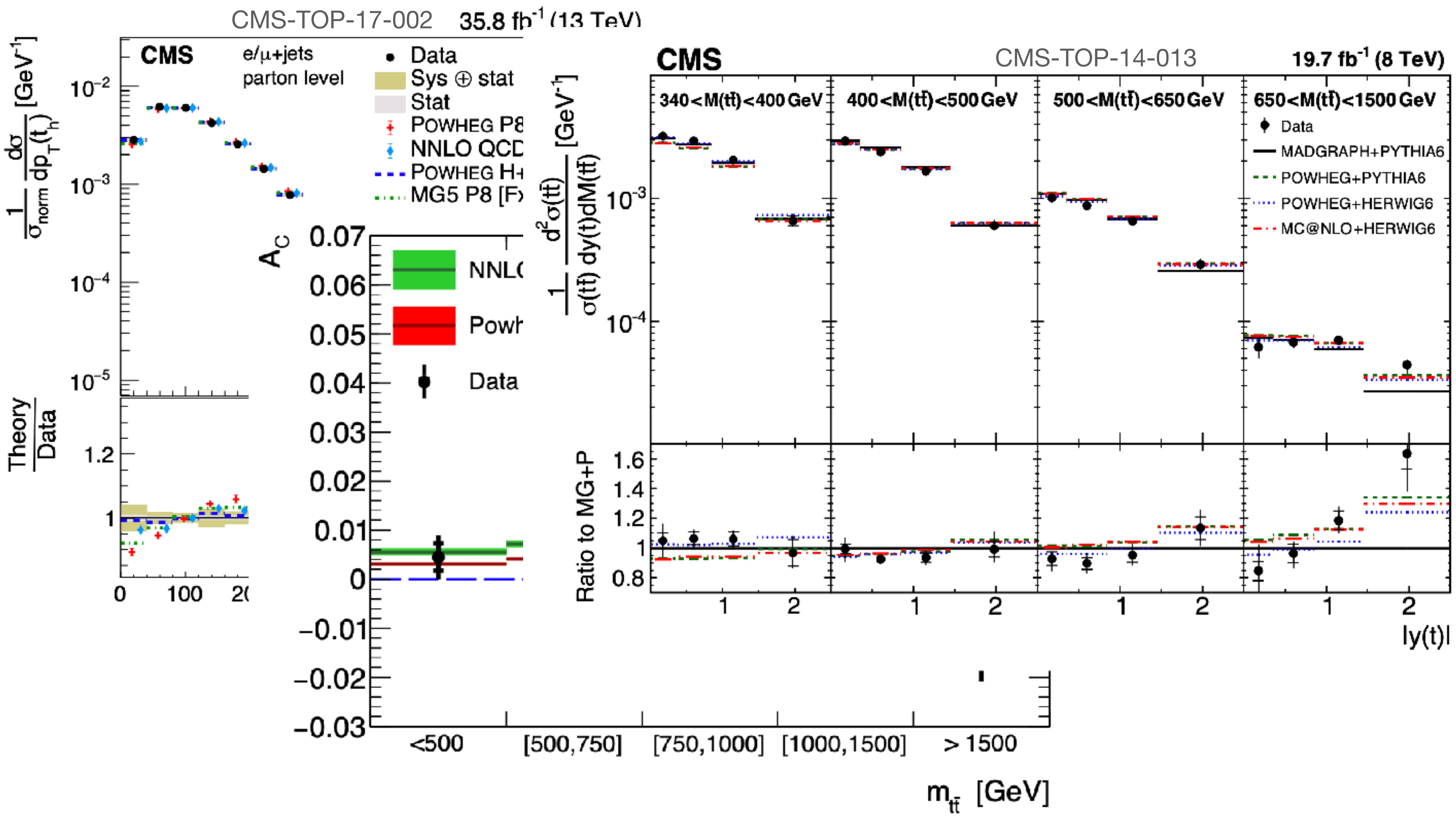

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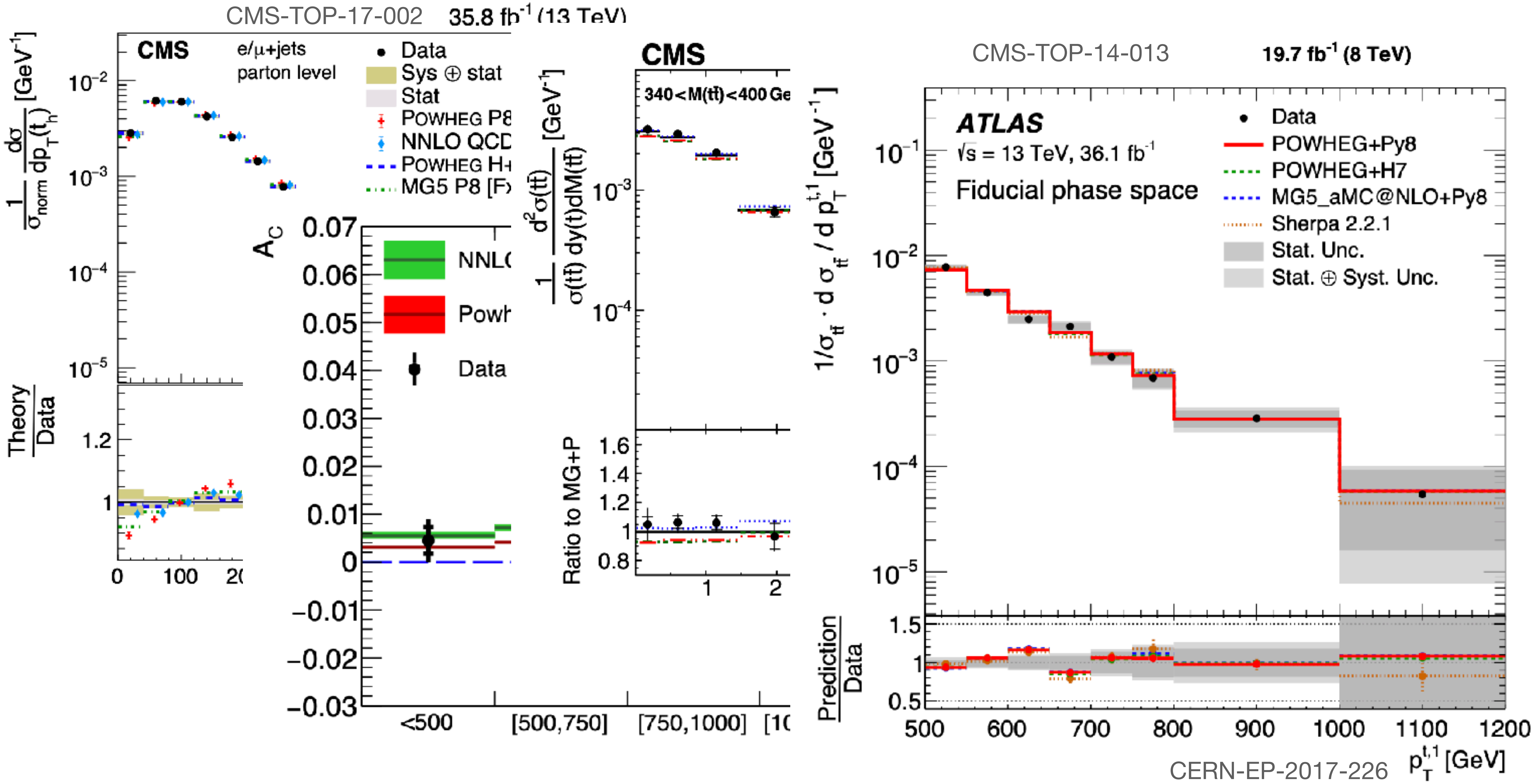

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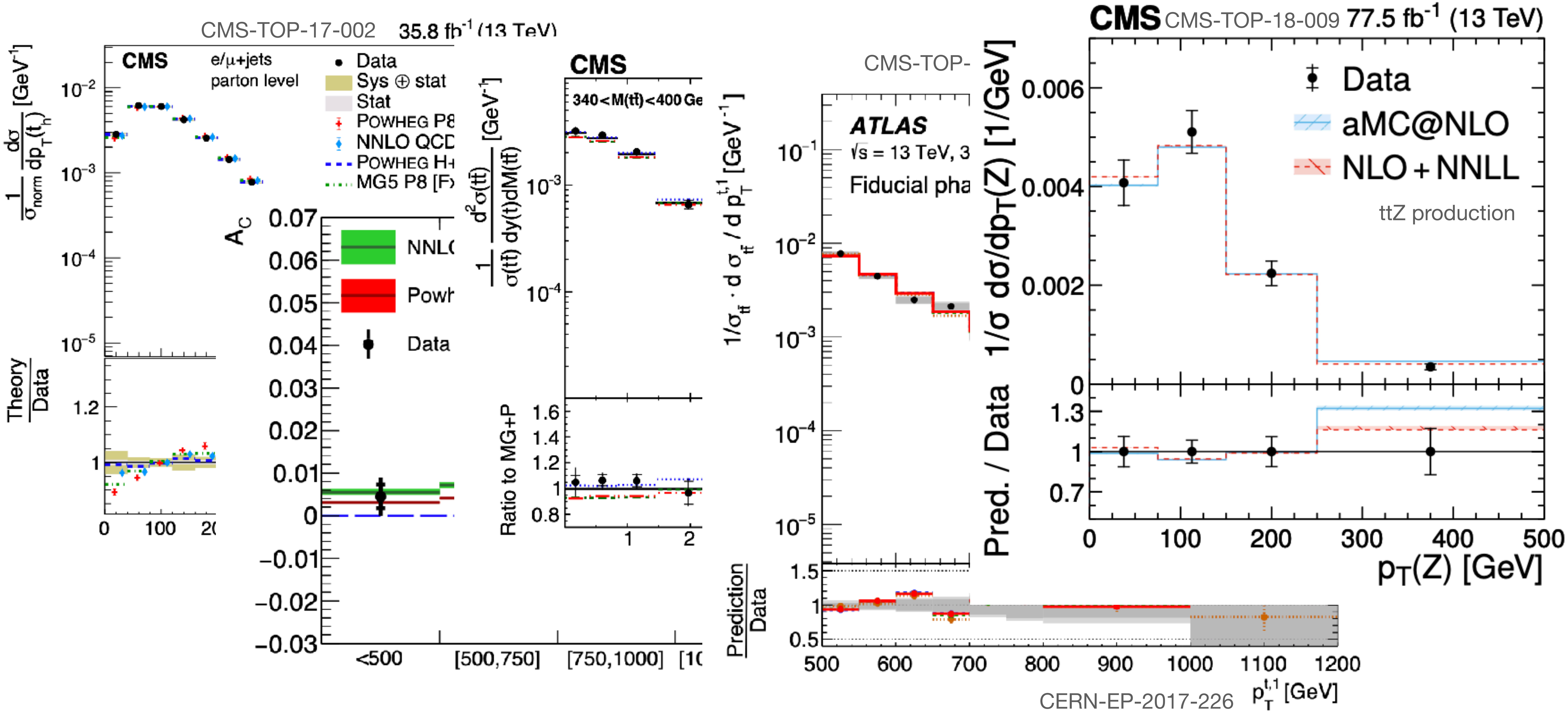

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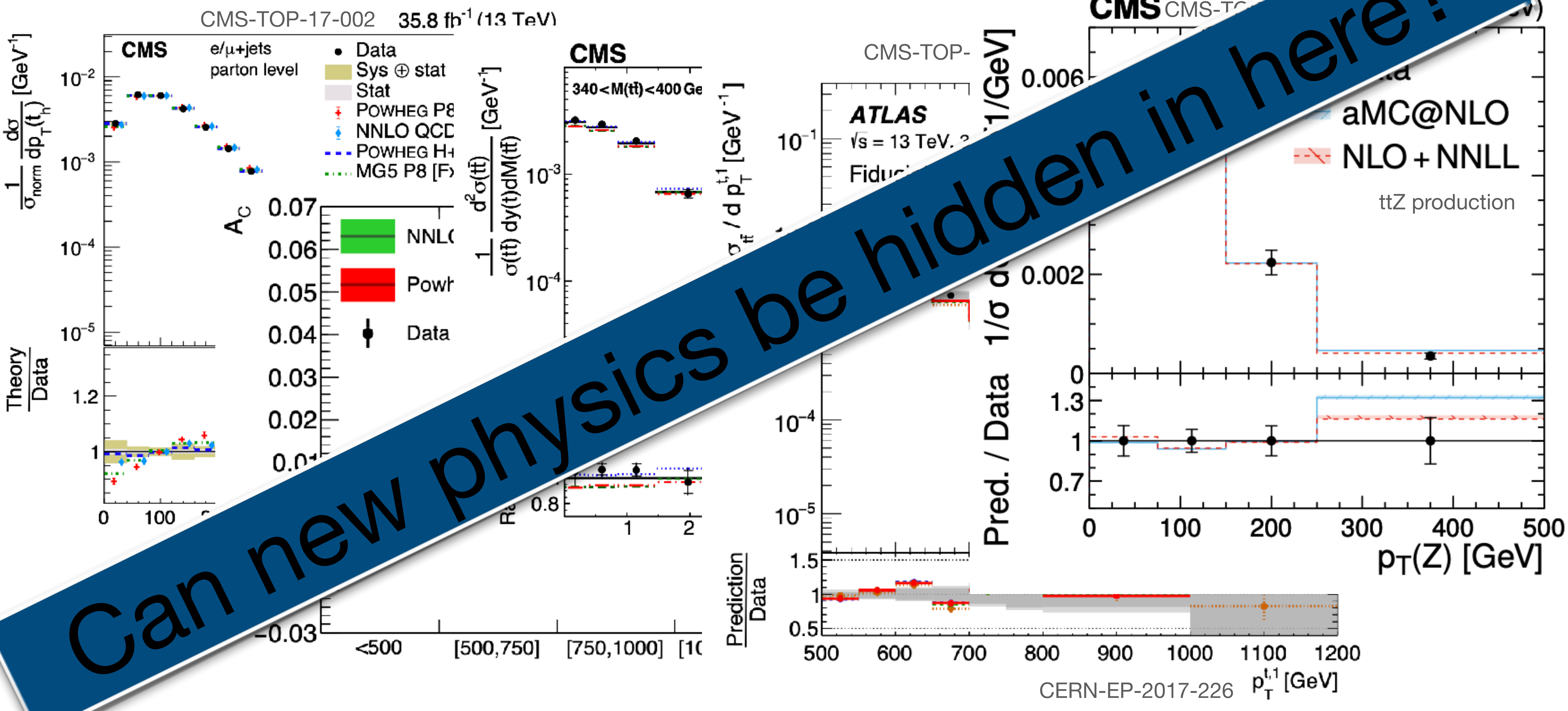


Can new physics be hidden in here?

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- Choose a model
  - SMEFT
    - Basis
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# The Data

## Where the sensitivity comes from

# The Data

$$O_{tG} = C_{tG}(\bar{q}_3\sigma^{\mu\nu}T^A u_3)\tilde{\phi}G^A_{\mu\nu}$$

$$O^8_{tu} = C^8_{tu}(\bar{u}_3\gamma^\mu T^A u_3)(\bar{u}_i\gamma_\mu T^A u_i)$$

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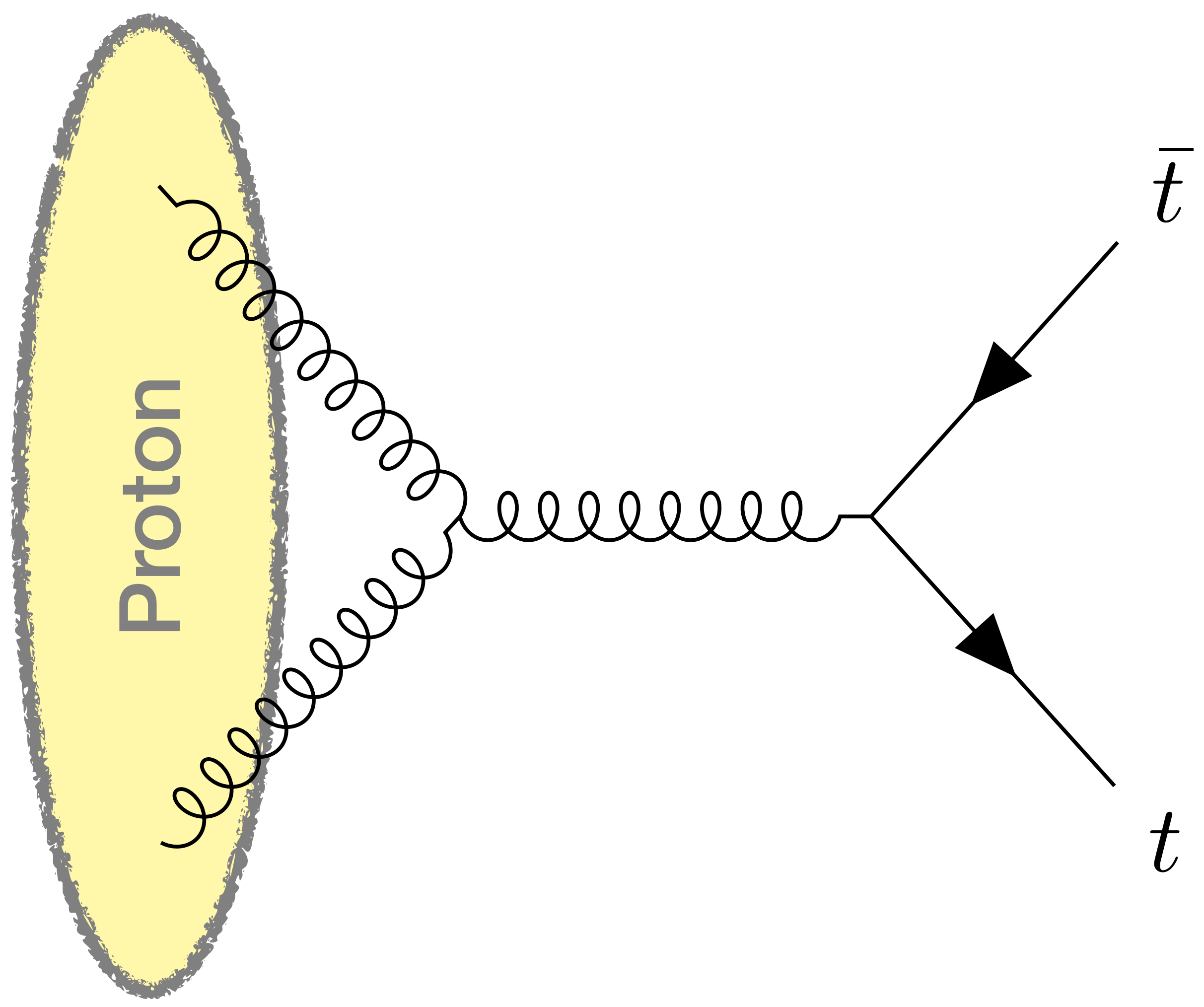


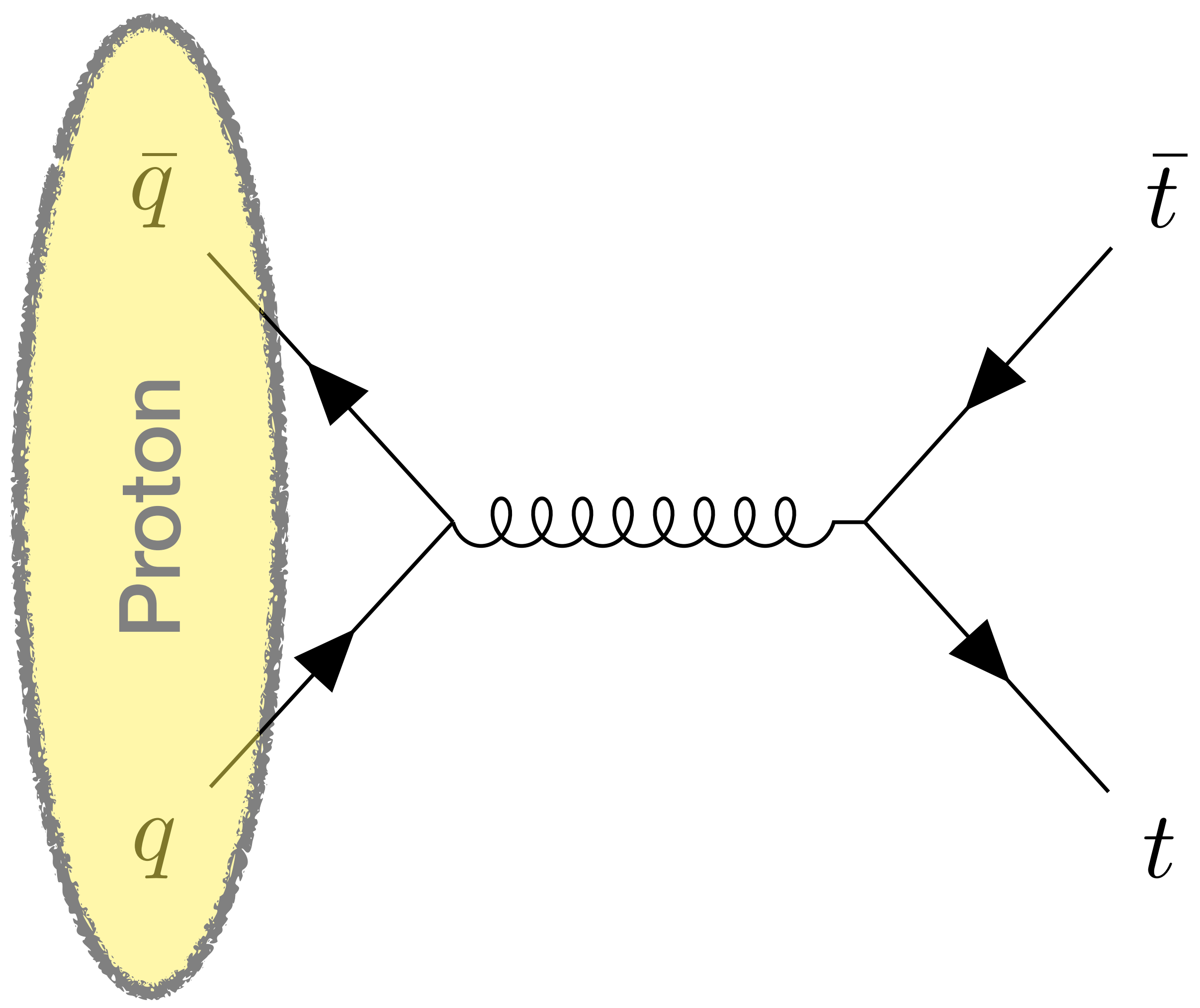

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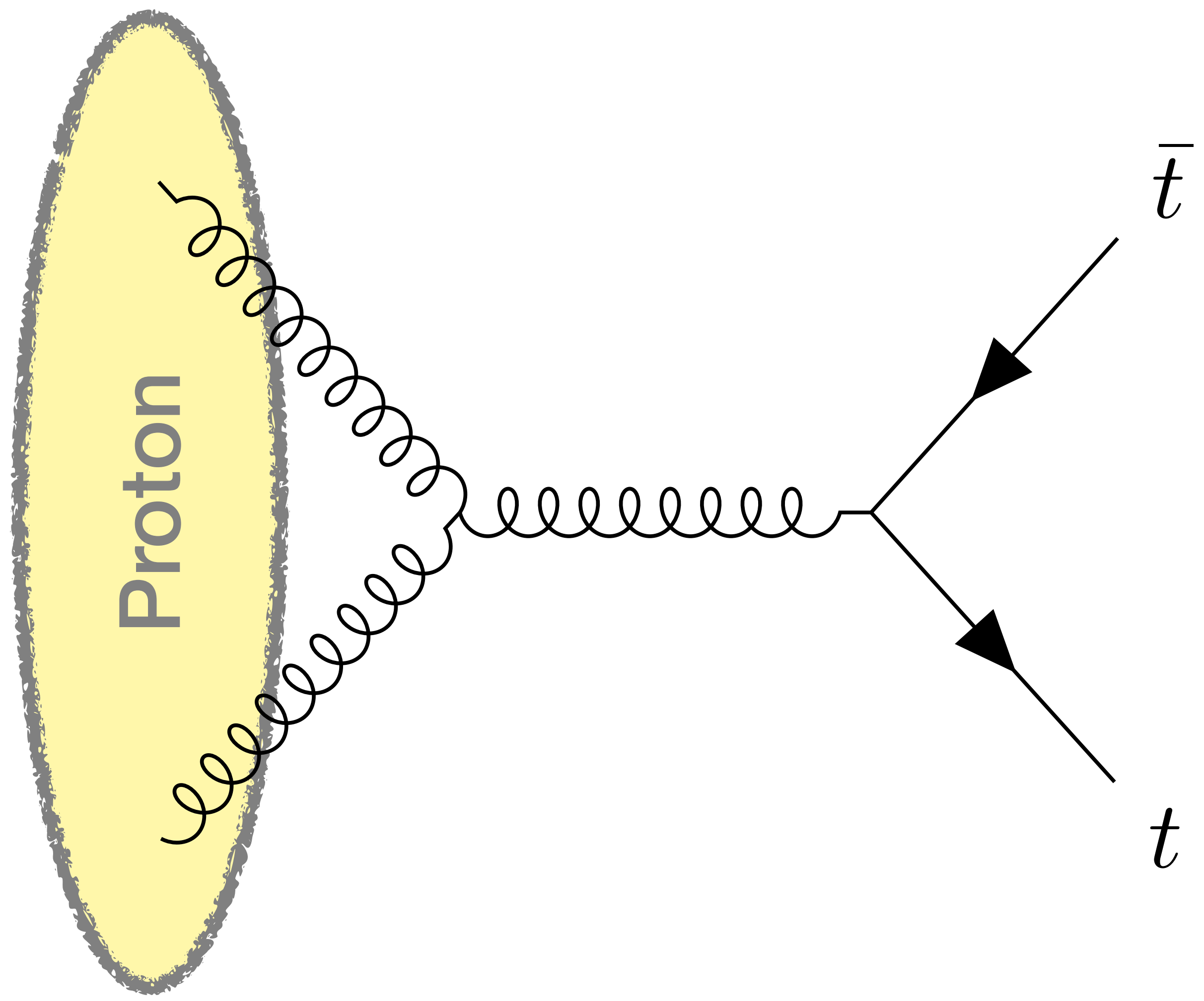


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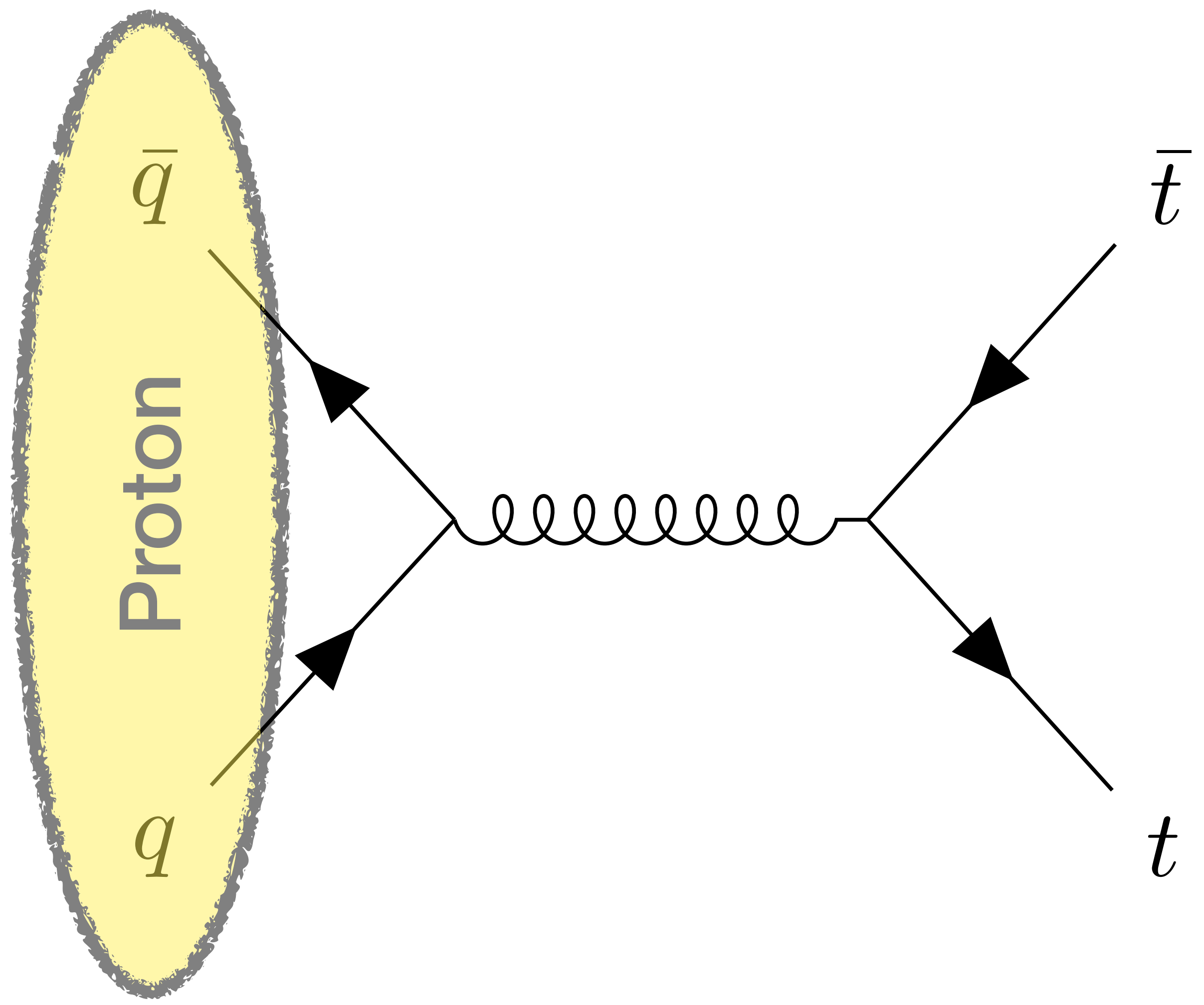

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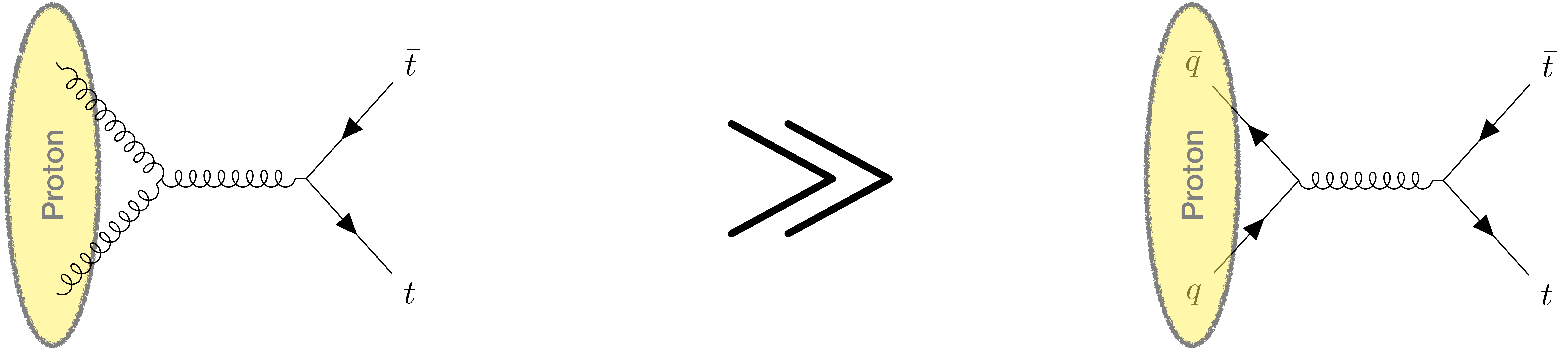

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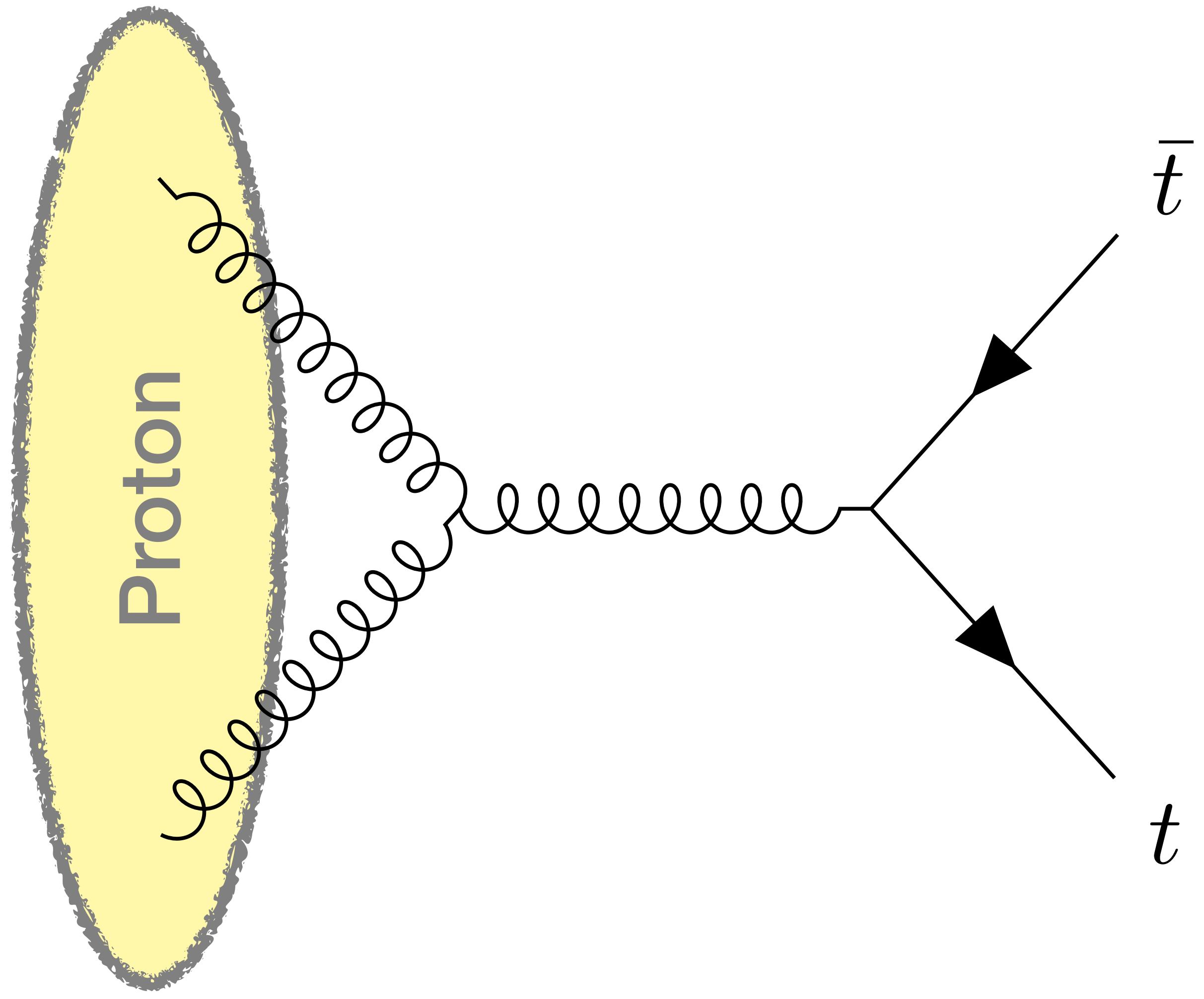


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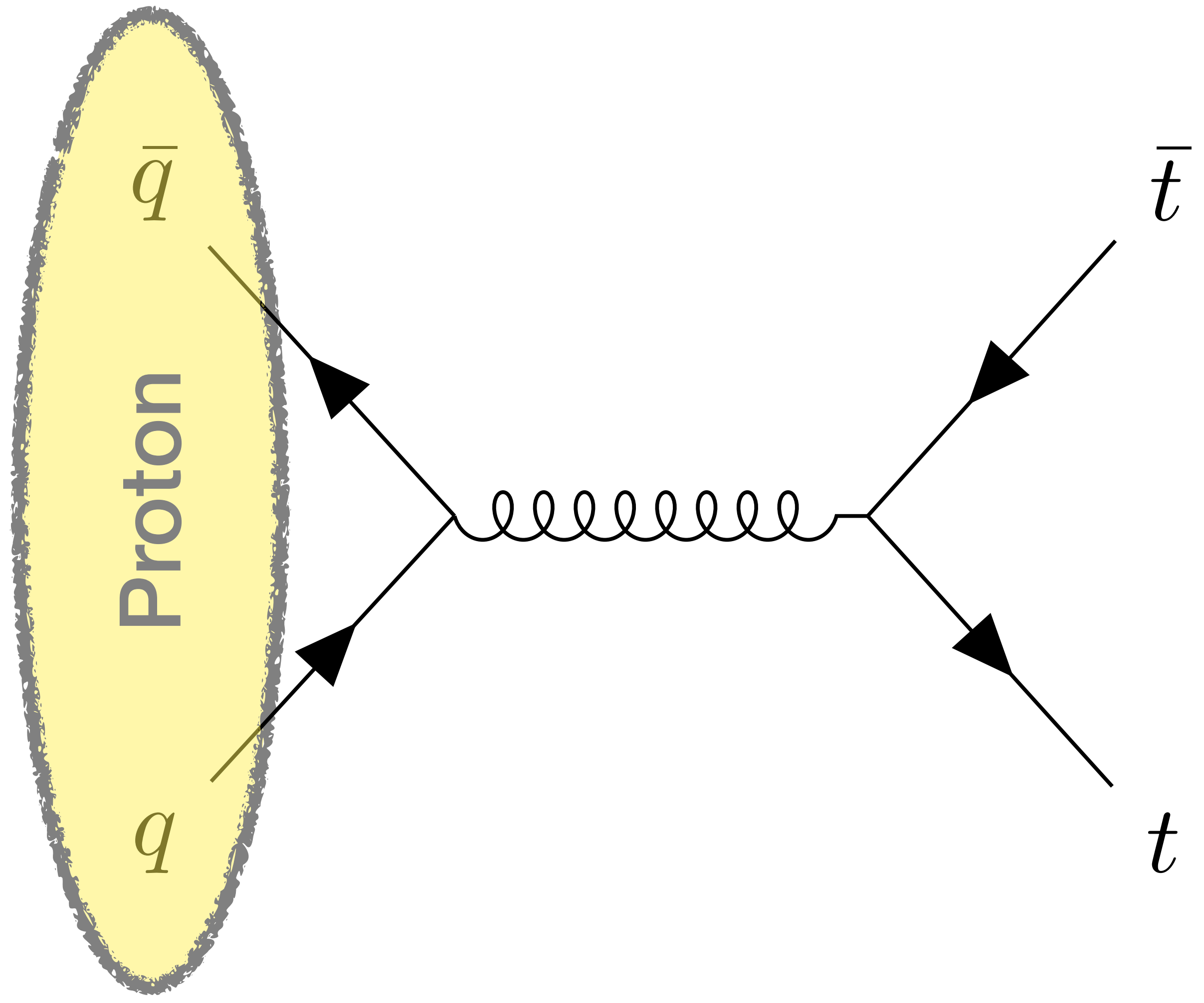

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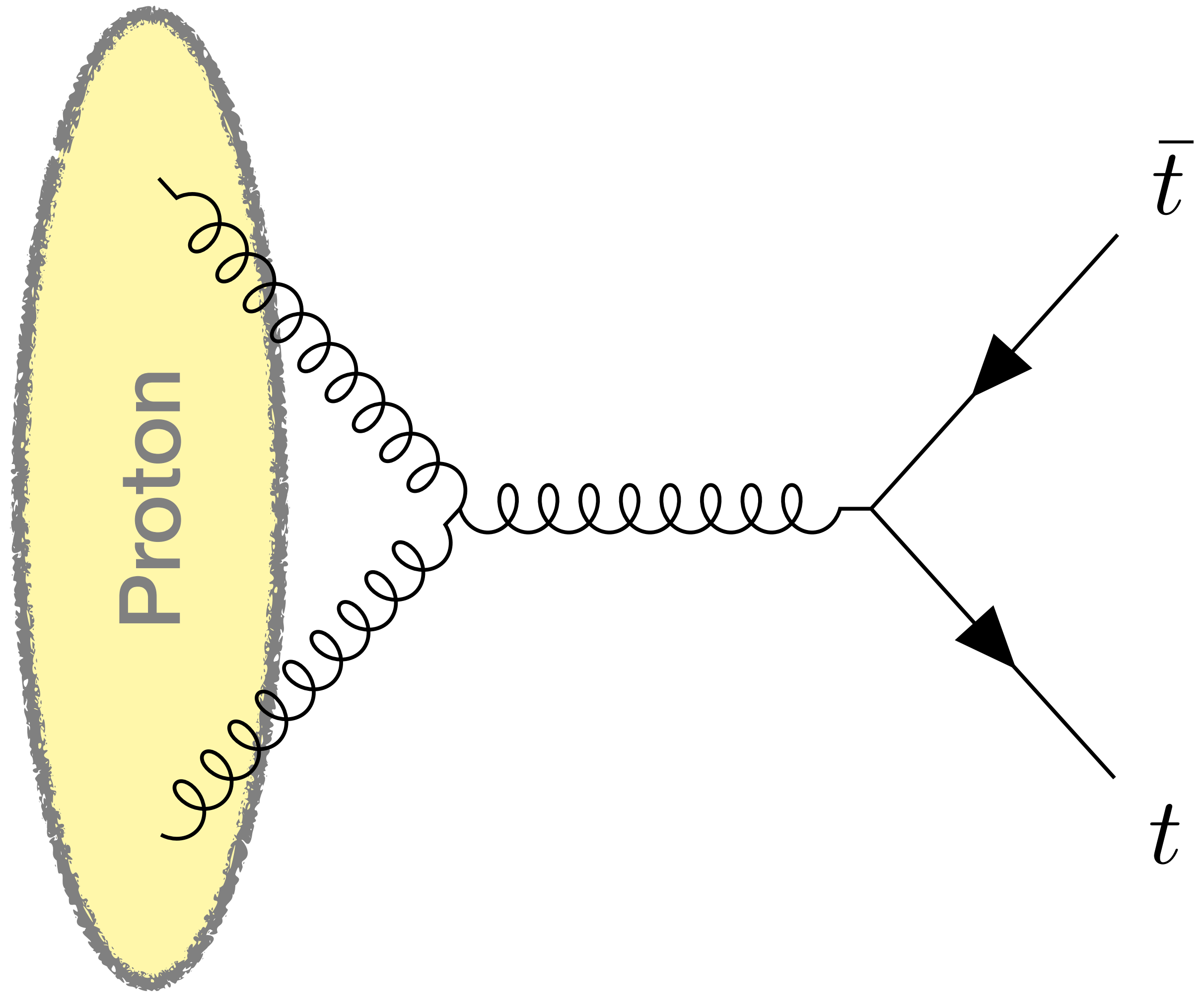
**Grows very large for high bins**

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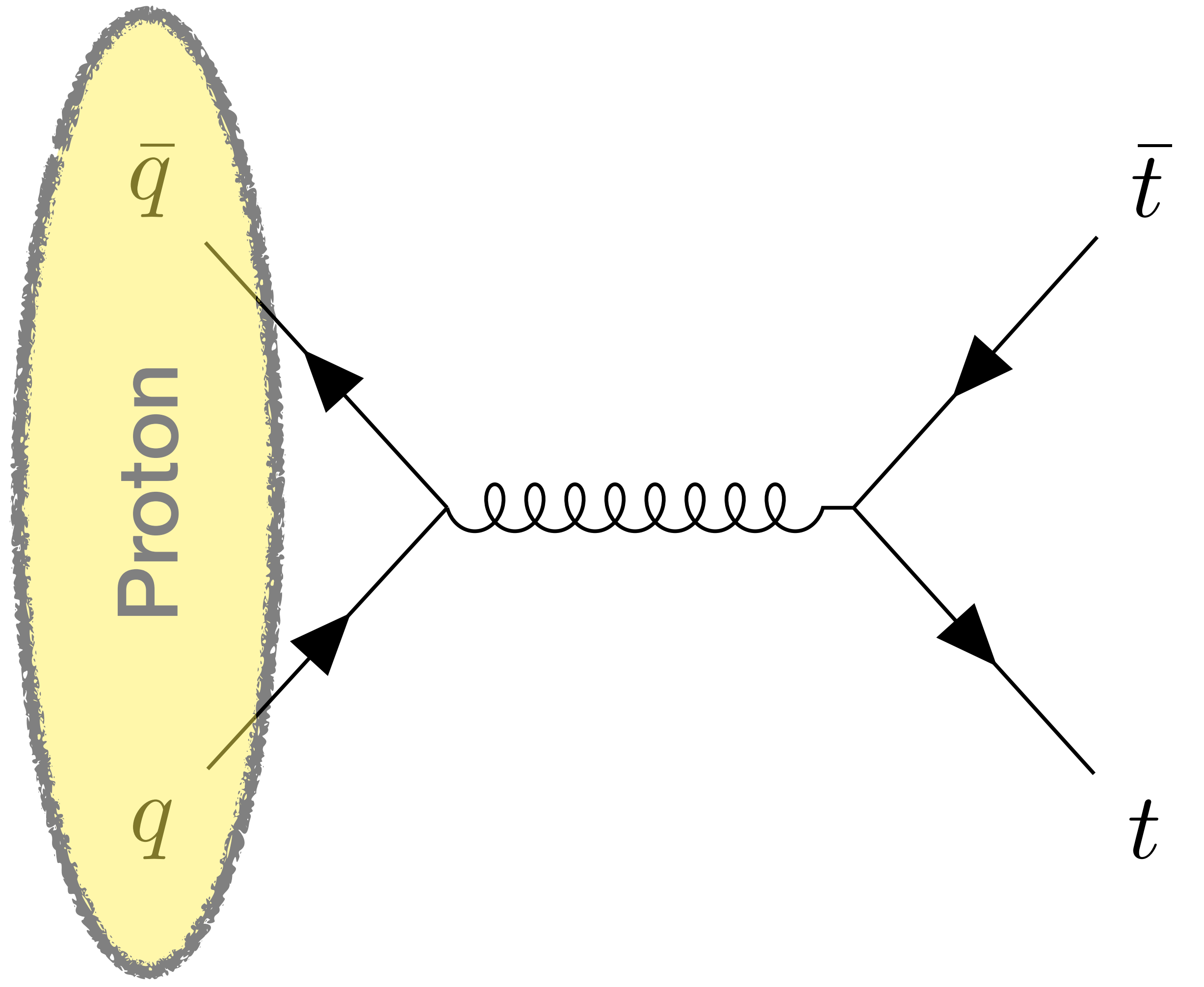

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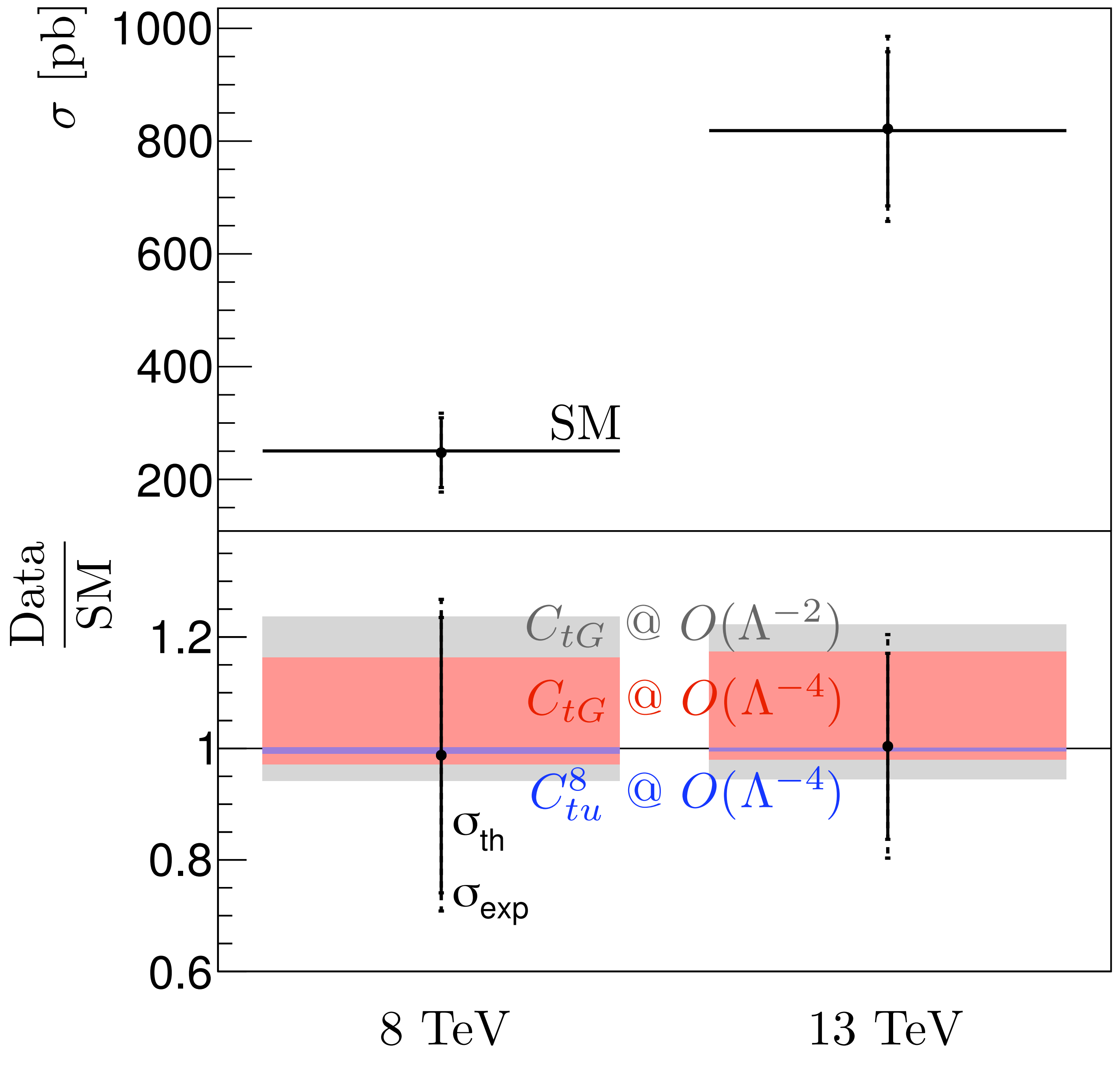


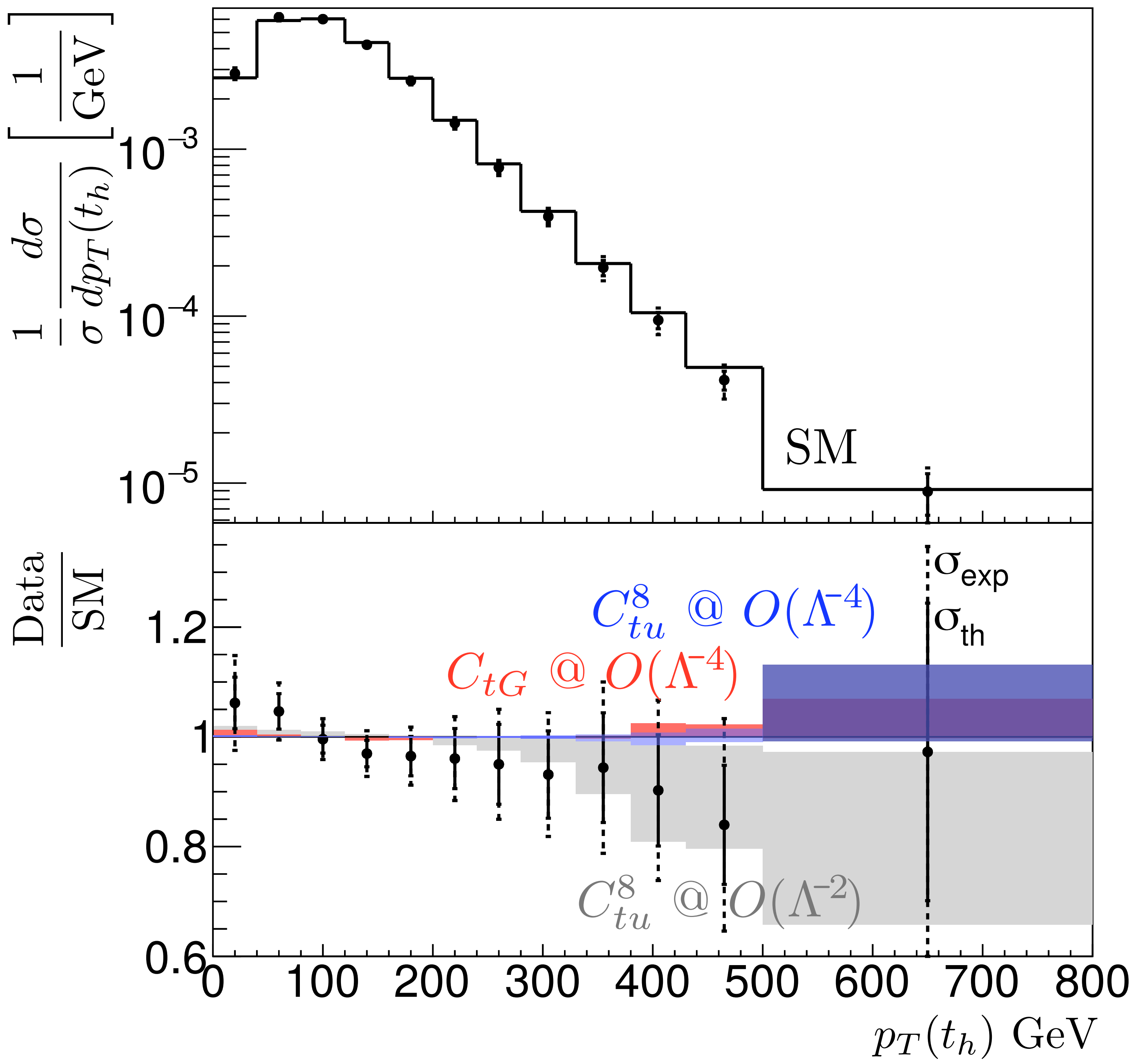

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## Resolving blind directions

$$O_{Qq}^{1,8} = C_{Qq}^{1,8}(\bar{q}_3\gamma^\mu T^A q_3)(\bar{q}_i\gamma_\mu T^A q_i) \qquad O_{Qq}^{3,8} = C_{Qq}^{3,8}(\bar{q}_3\gamma^\mu T^A \tau^I q_3)(\bar{q}_i\gamma_\mu T^A \tau^I q_i)$$

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SU(2) Singlet
Sensitive to u+d initial state

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SU(2) Tripplet
Sensitive to u-d initial state

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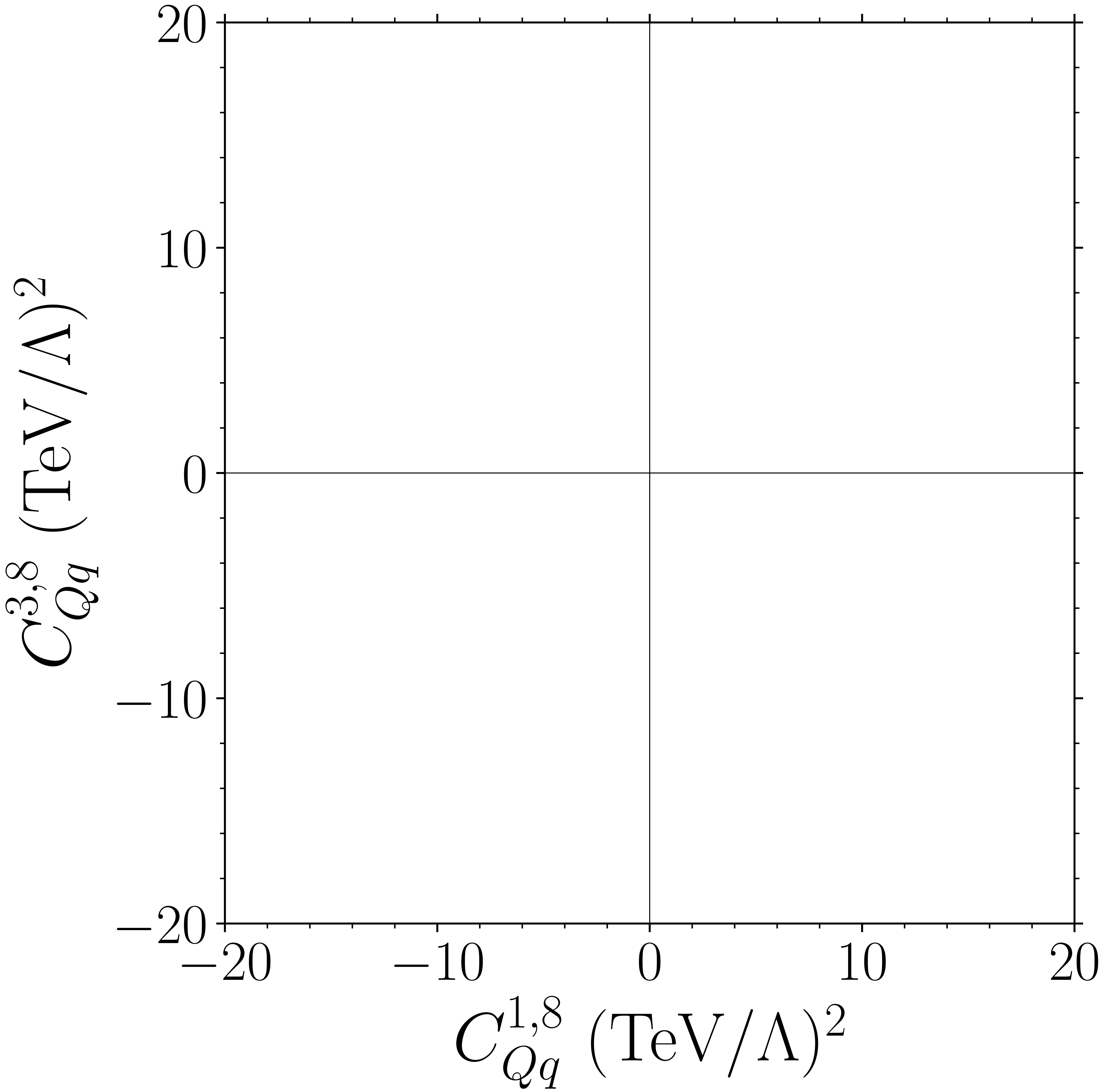

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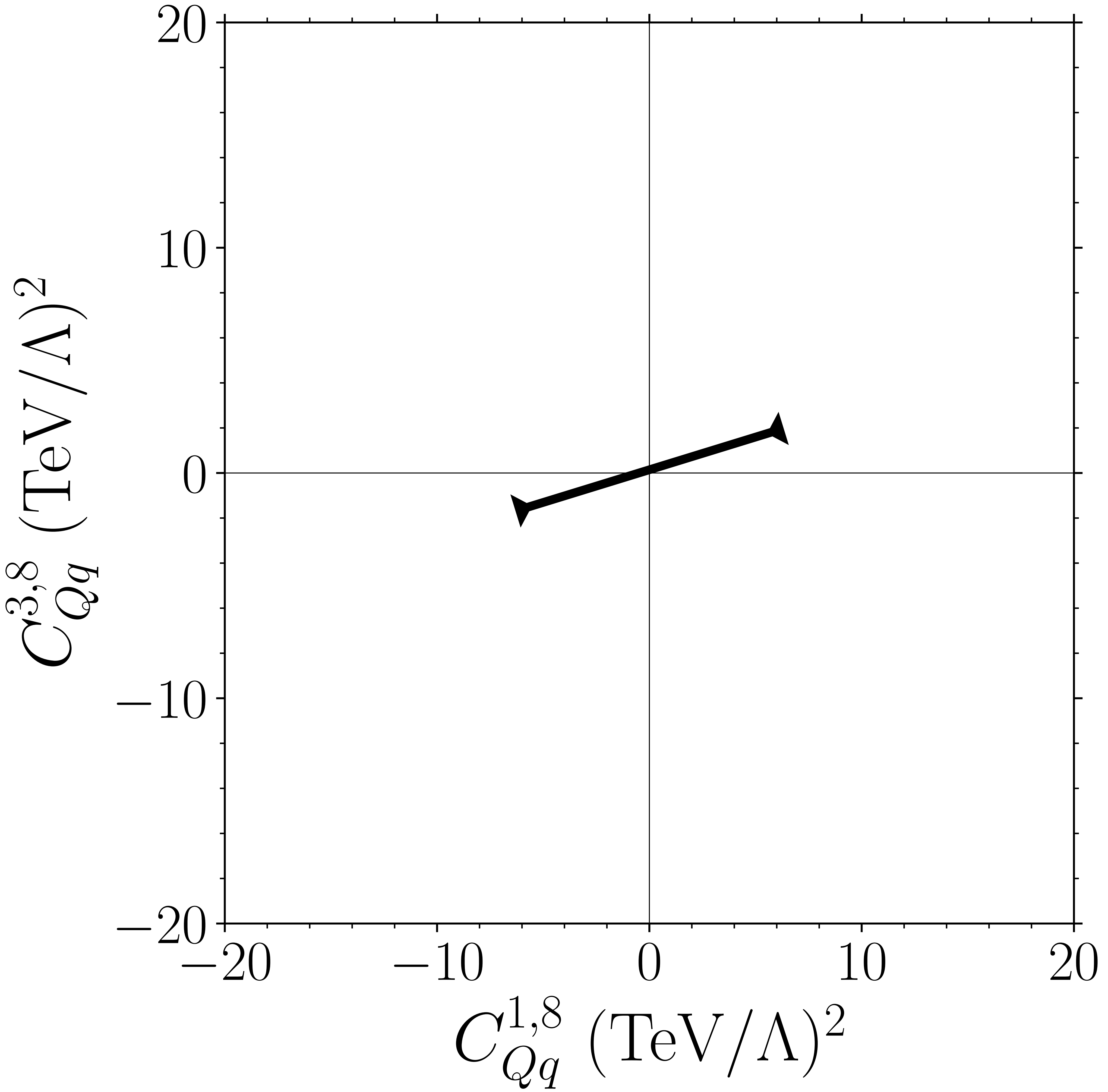

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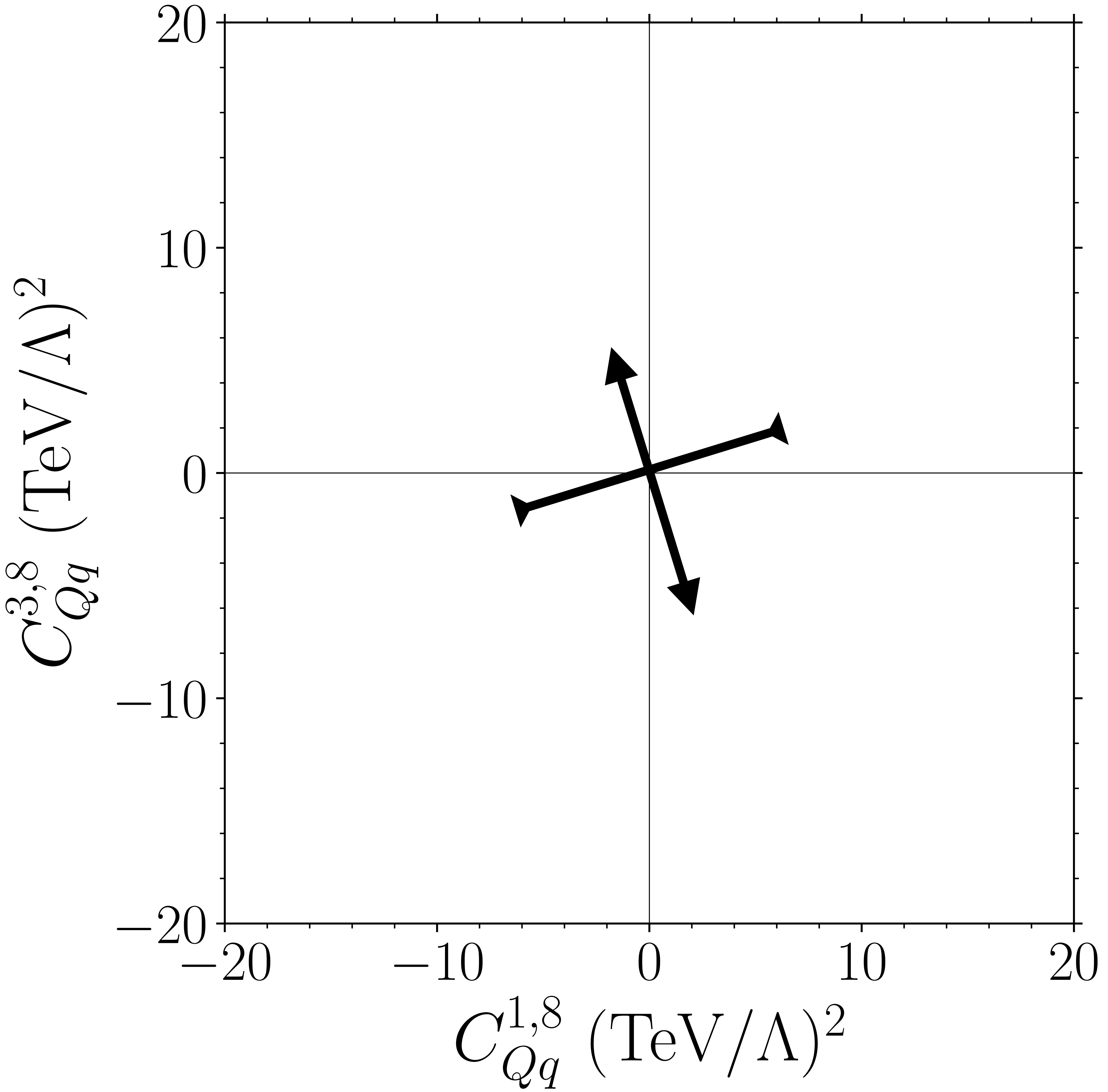

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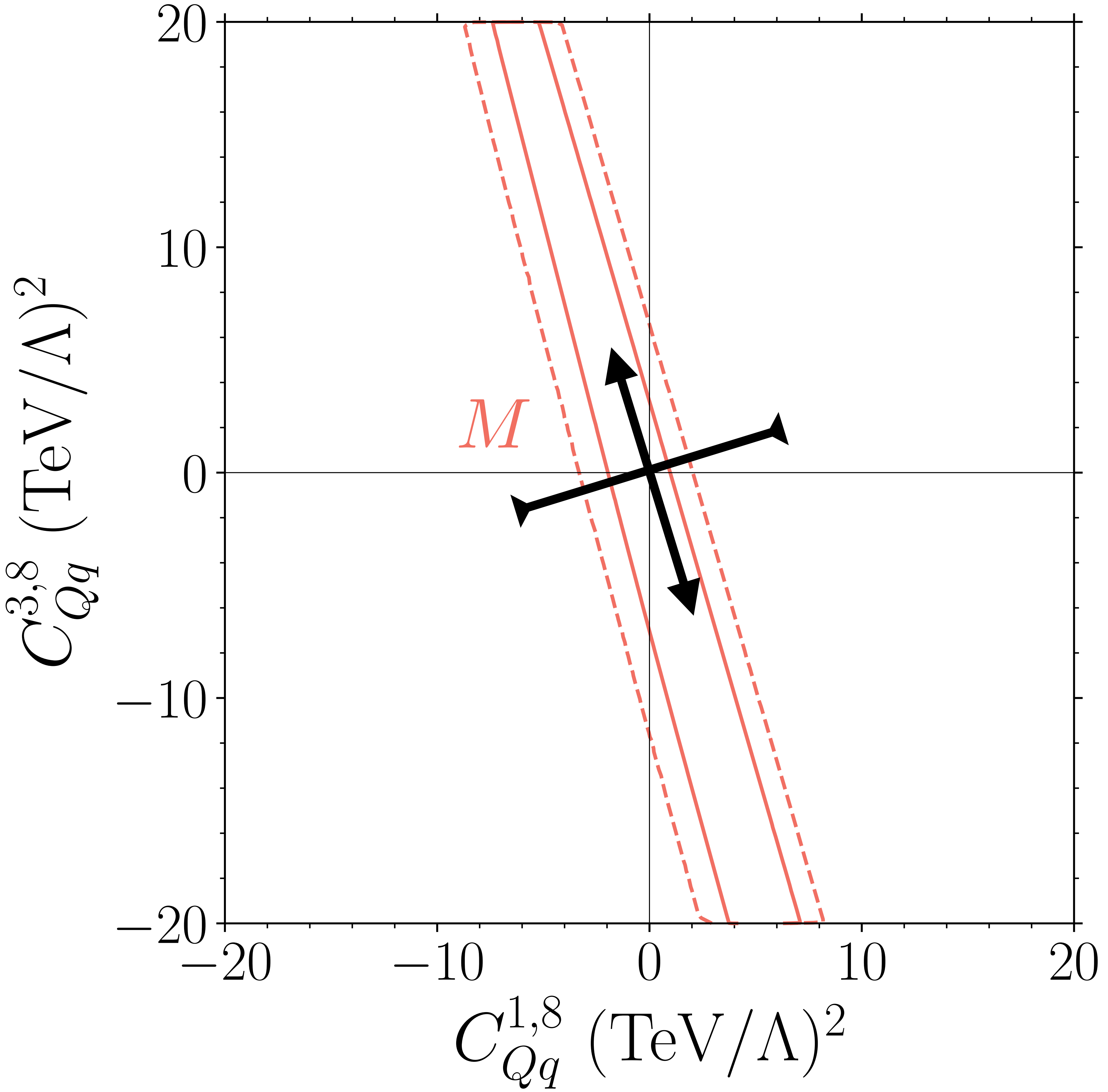

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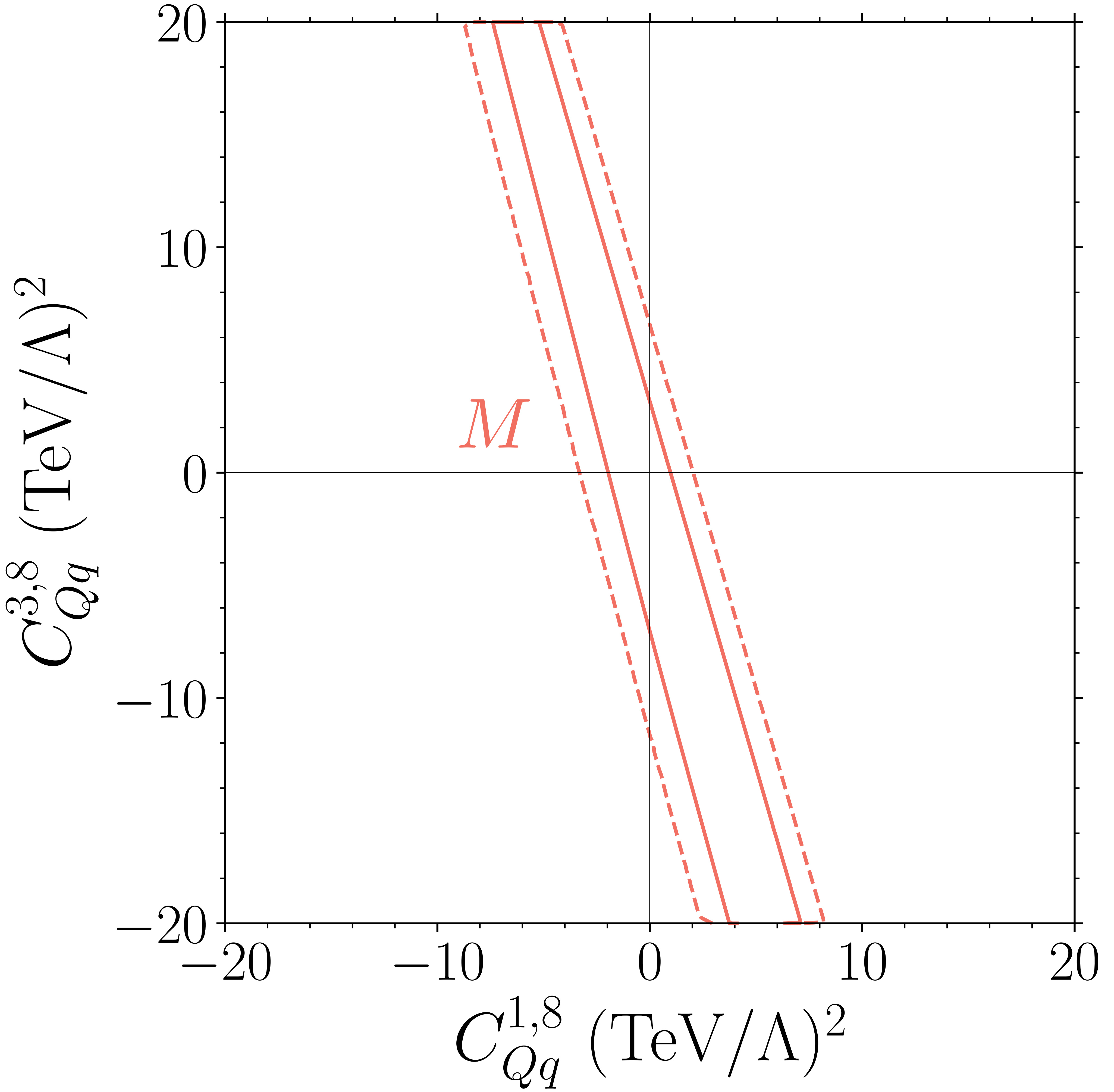
Probe different r(x) in boosted regime



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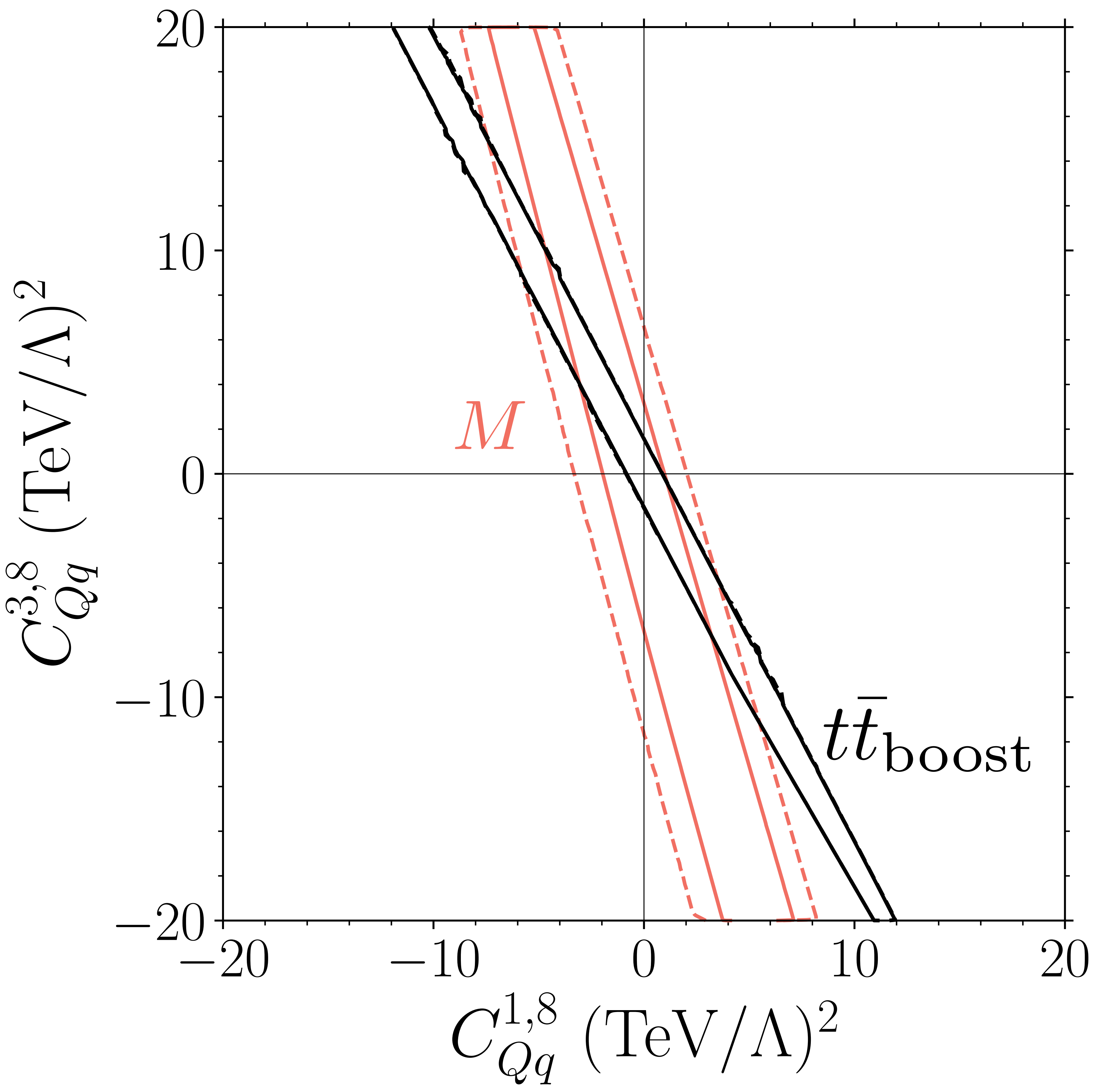

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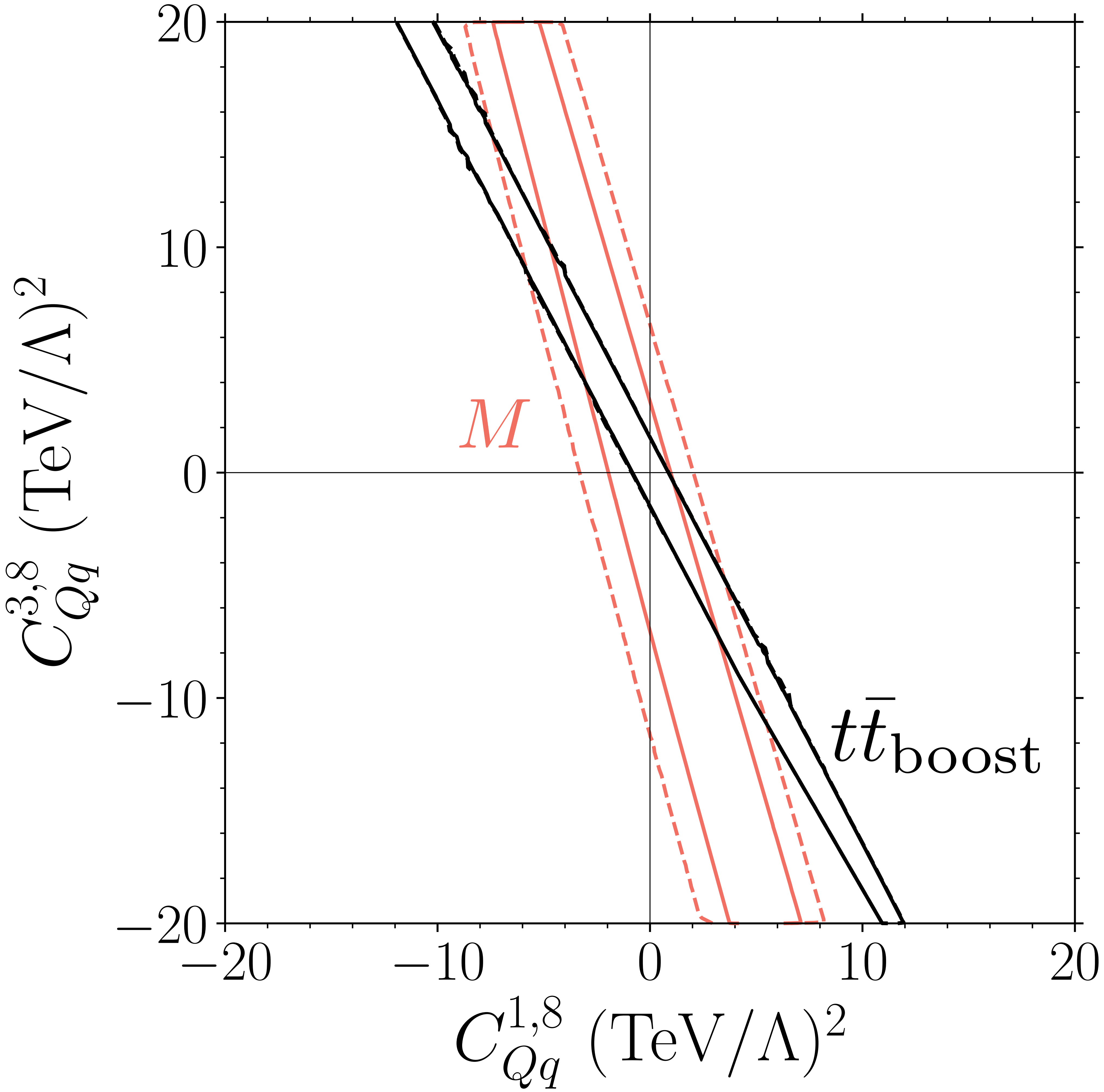

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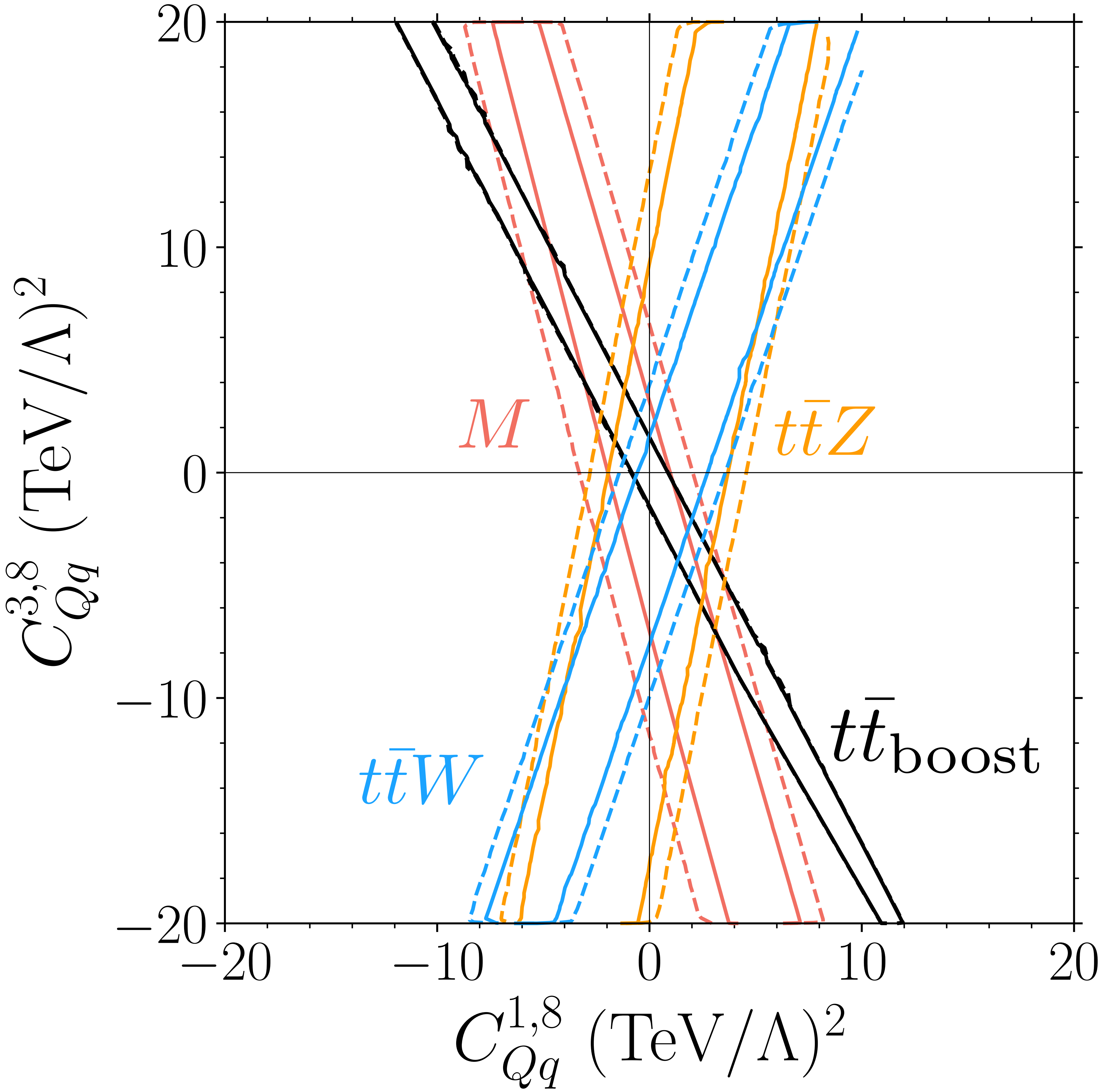


# The Data

## Resolving blind directions

$$O_{Qq}^{1,8} = C_{Qq}^{1,8}(\bar{q}_3\gamma^\mu T^A q_3)(\bar{q}_i\gamma_\mu T^A q_i) \qquad O_{Qq}^{3,8} = C_{Qq}^{3,8}(\bar{q}_3\gamma^\mu T^A \tau^I q_3)(\bar{q}_i\gamma_\mu T^A \tau^I q_i)$$

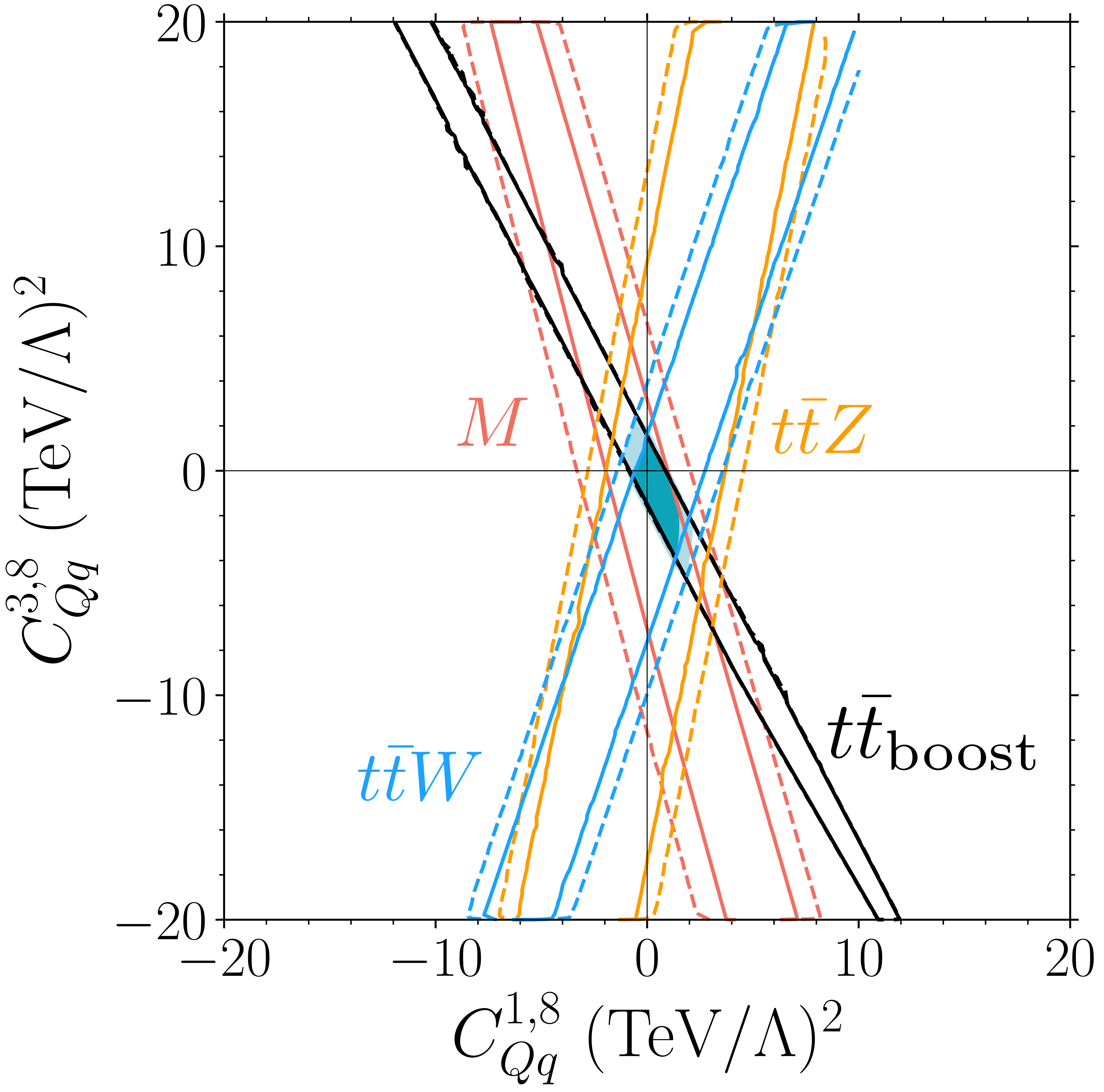
$$r(x) = \frac{f_u(x) f_{\bar{u}}(s/xS)}{f_d(x) f_{\bar{d}}(s/xS)} \sim 2$$

Valence quark maximum

$$\sigma_{t\bar{t}} = \sigma_{t\bar{t}}^{SM} + \sigma_{t\bar{t}}^{NP}\left[\quad 3\,C_{Qq}^{1,8} + \quad 1\,C_{Qq}^{3,8}\right]$$

Probe different r(x) in boosted regime

Include ttZ and ttW measurements



# The Model

## Linear vs. Quadratic

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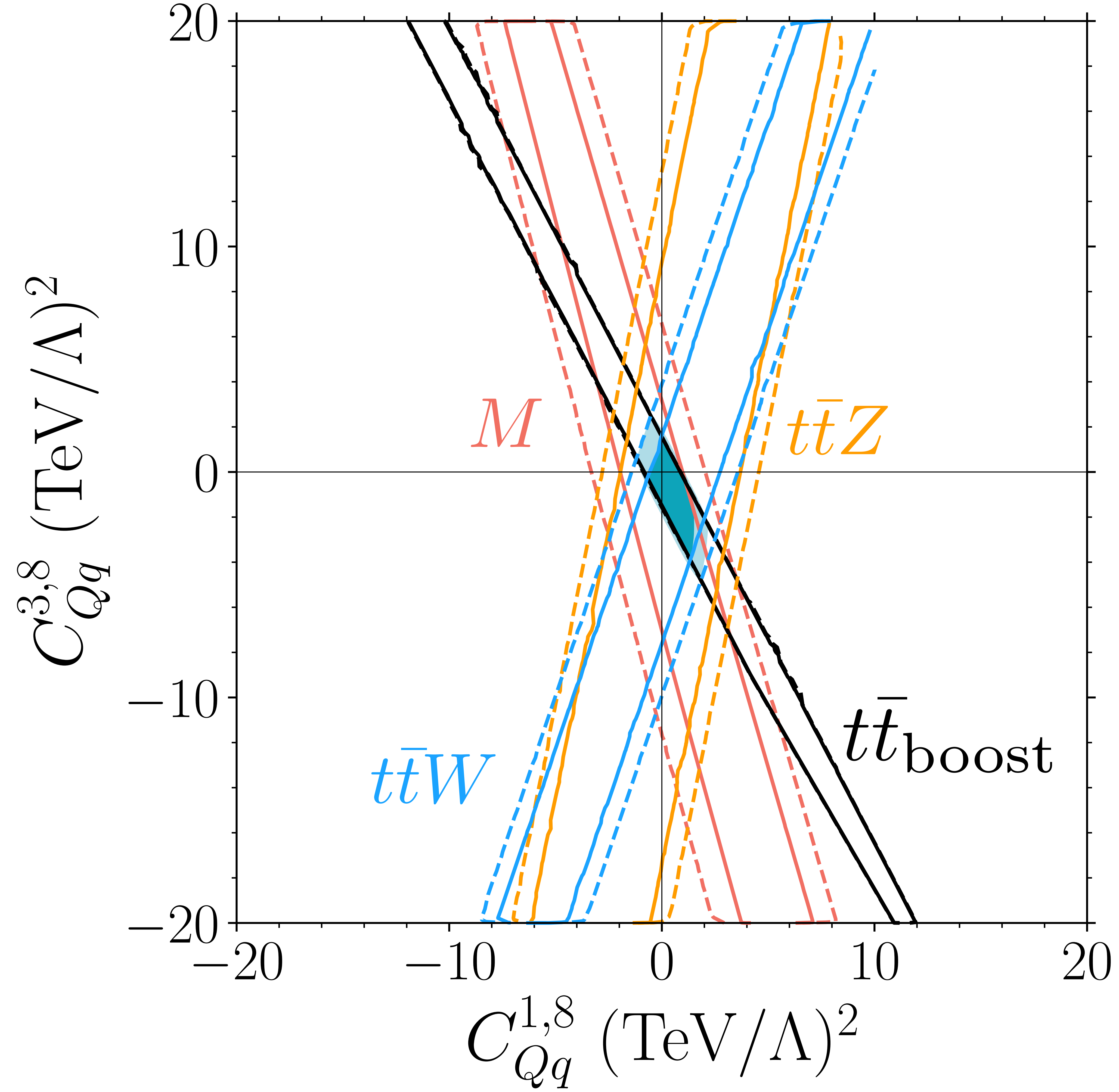

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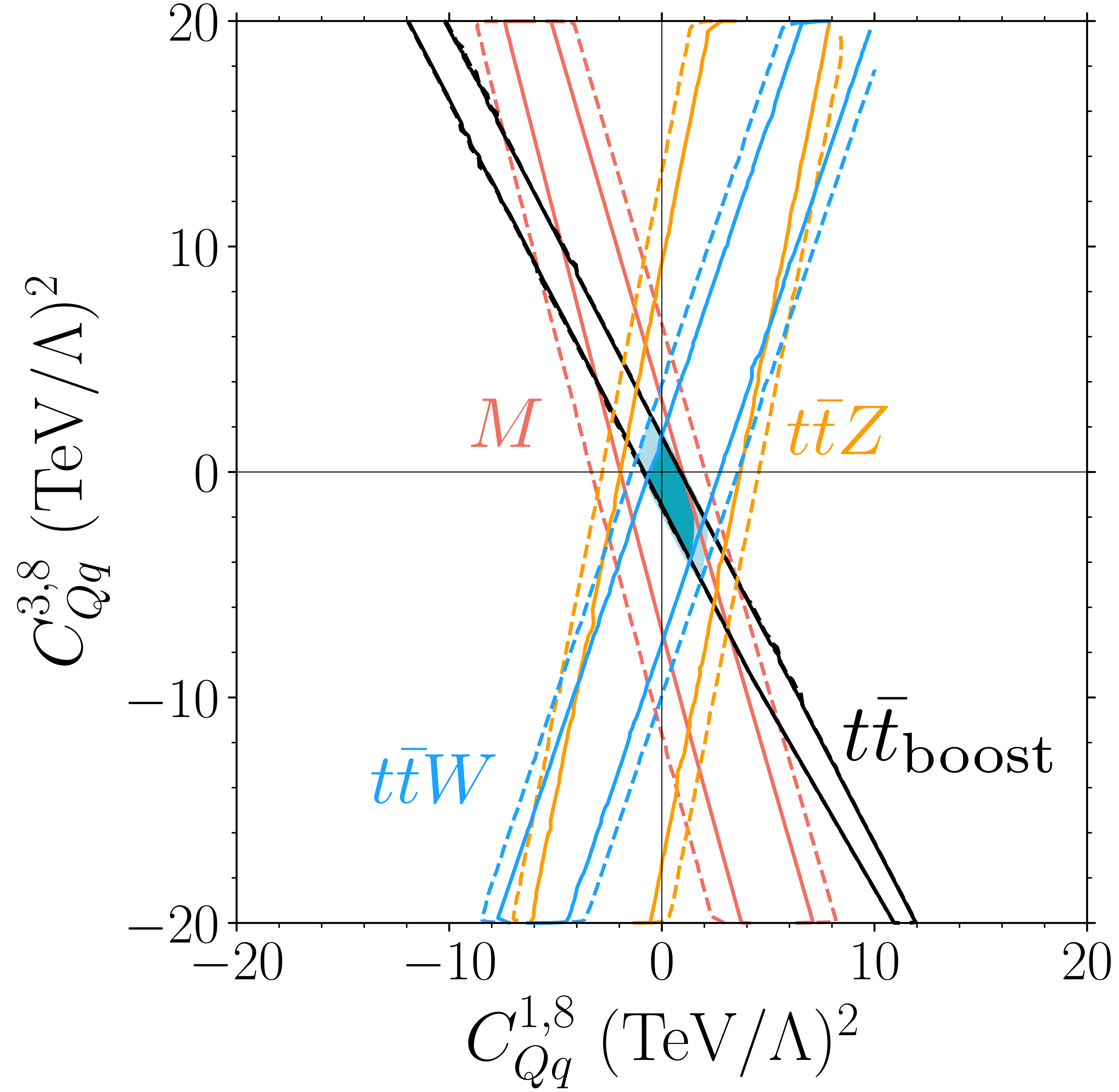

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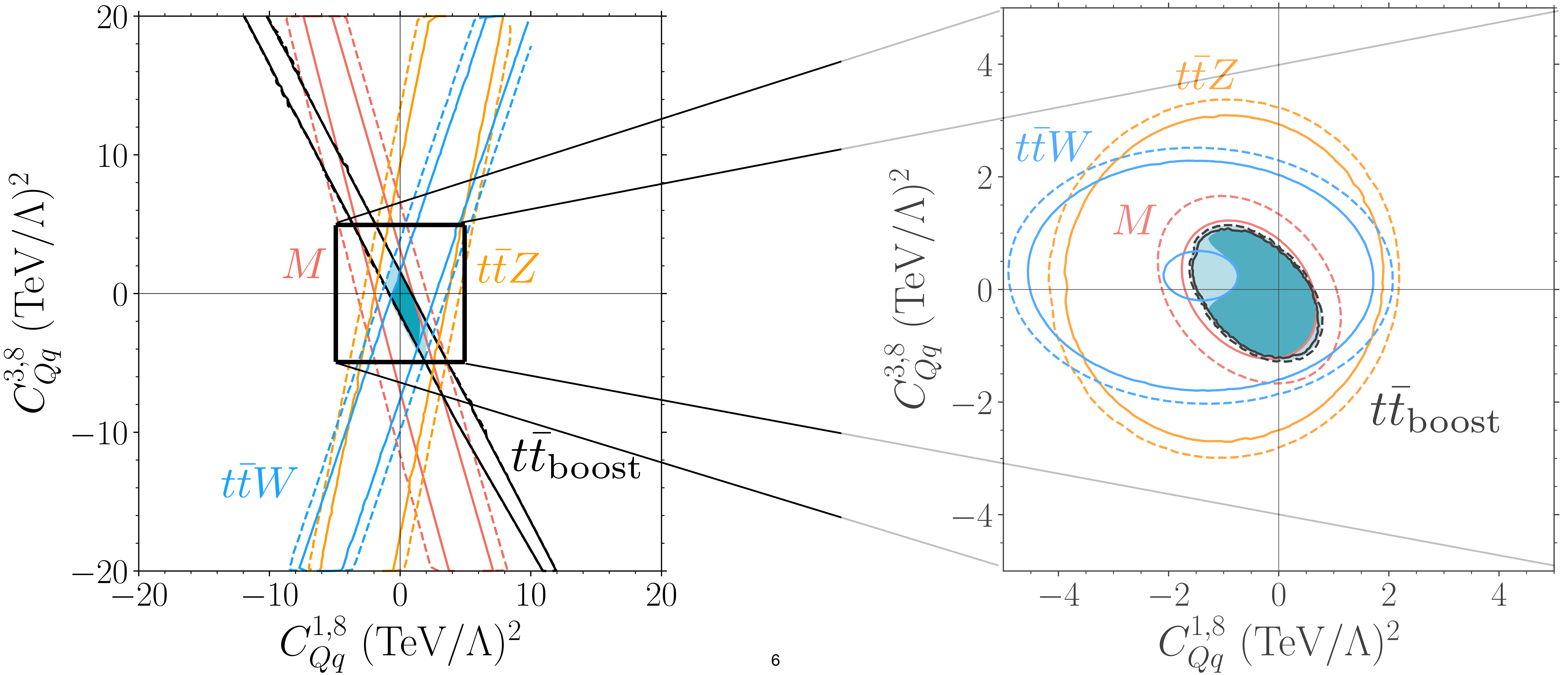

# Summary

## What really matters!

- We need Data!
  - at very high momentum
  - unfolded
  - precise
  - varied
- The model matters for the interpretation
- Uncertainties matter → the more information we have the better

# Uncertainties

## What matters?

$$\mu_j = \bar{\mu}_j \pm \sigma_{\mathrm{pois},j} \pm \sigma_{\mathrm{gauss},j} \pm \sum_i \sigma_{\mathrm{syst},ij} \pm \sigma_{\mathrm{theo},j}$$

Central Value

Statistical Uncertainty

Uncorrelated systematic Uncertainty

Correlated systematics Uncertainty

Flat Uncertainties

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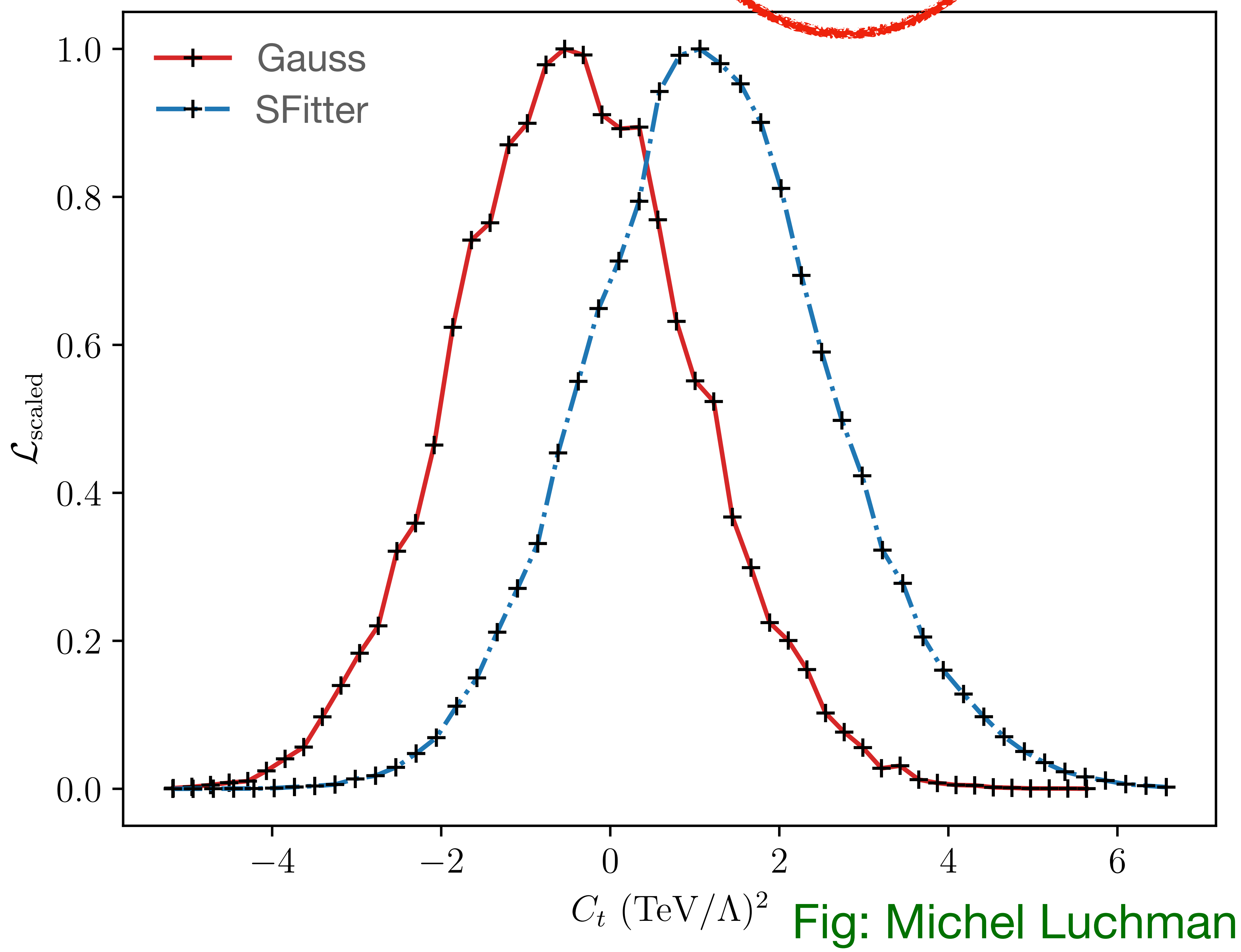


Fig: Michel Luchmann, 8D-Fit

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Yes → Full correlation matrix

No → Assume full (1) or no (0) correlation

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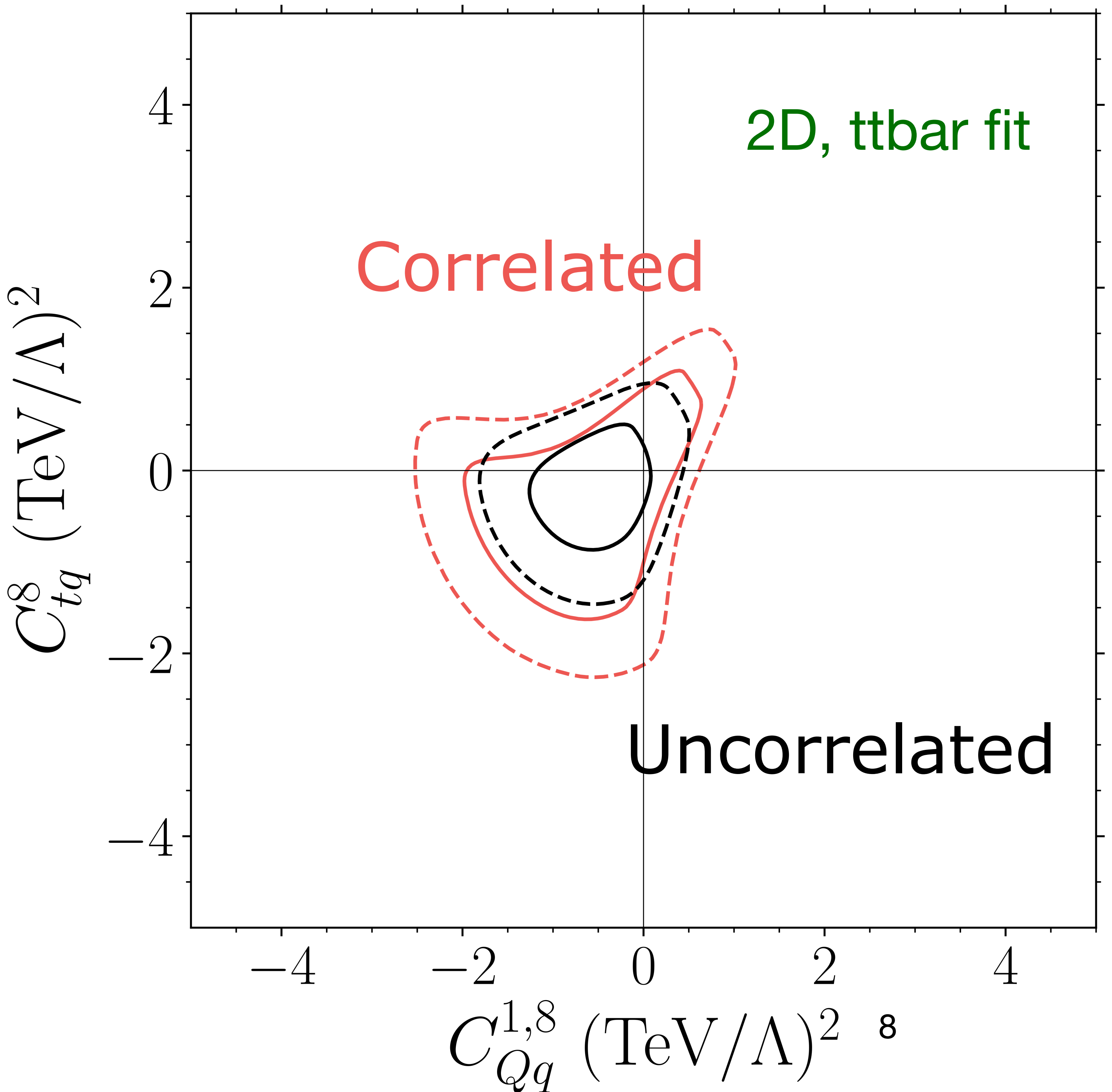


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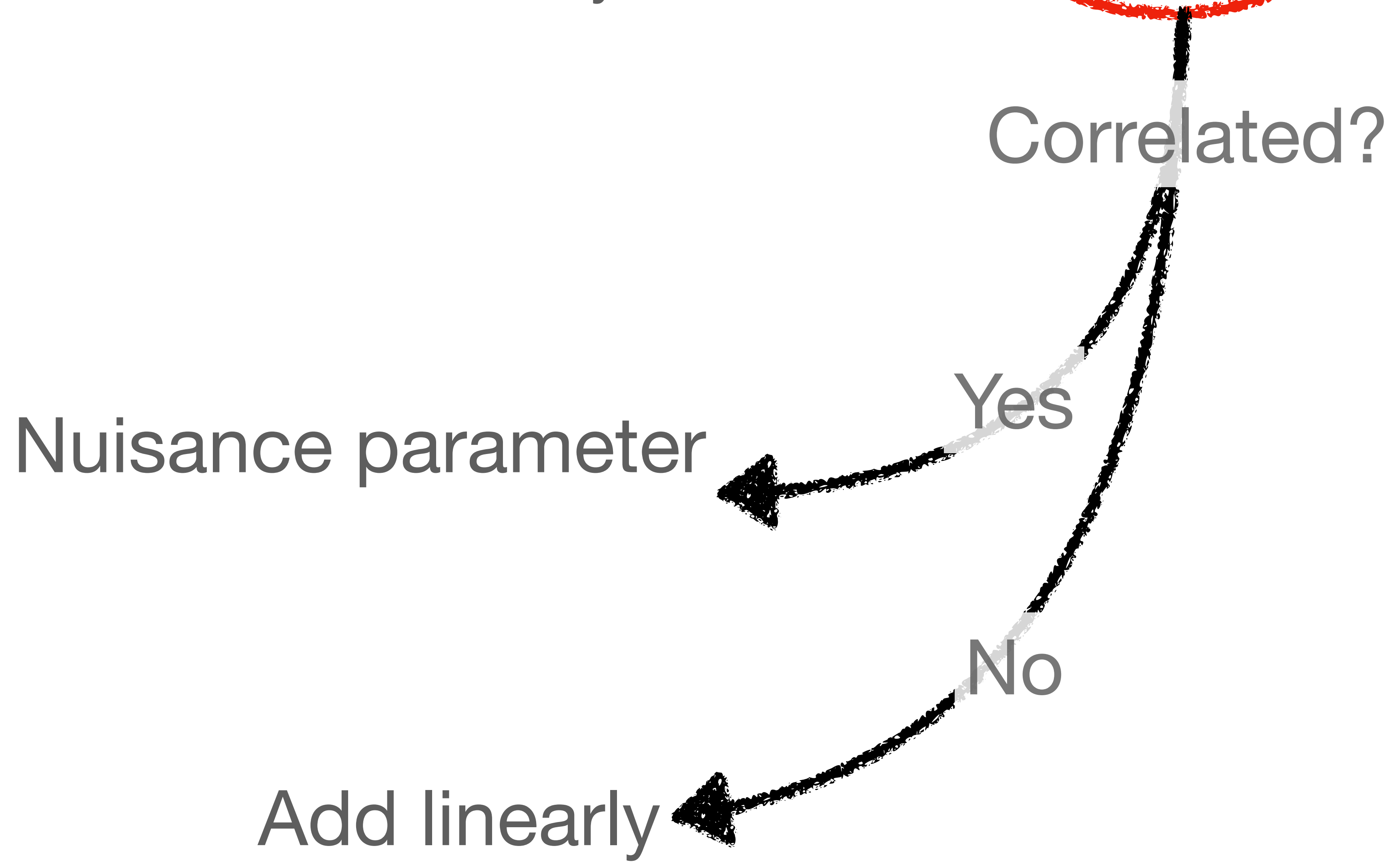

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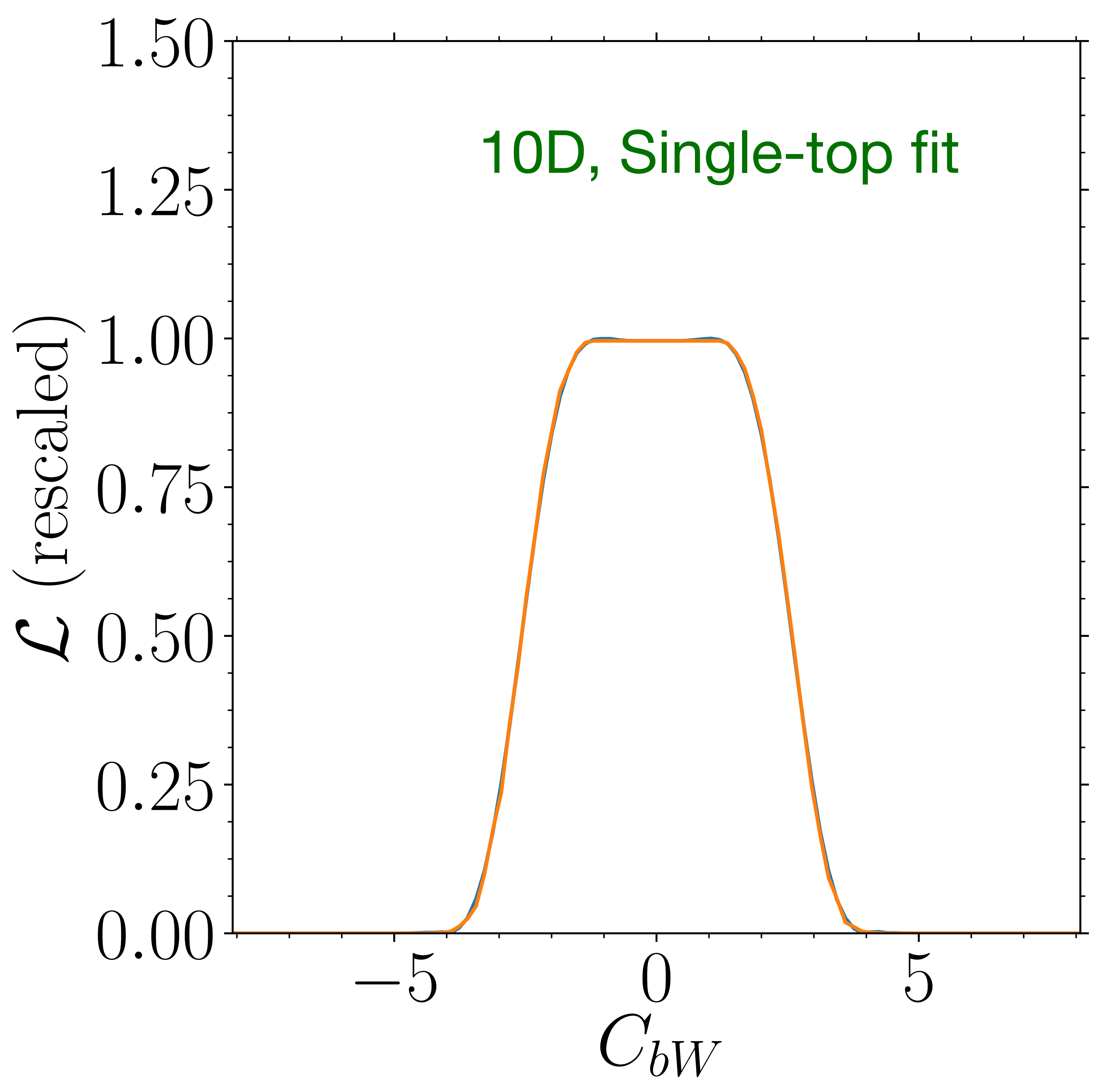


Correlated?

Yes → Nuisance parameter

No → Add linearly

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- Conservative and ignorant
- Better: e.g. include as nuissance parameters