Top Pair Threshold Production at a Linear Collider with WHIZARD

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in collaboration with Maximilian Stahlhofen

DESY Hamburg
LC top workshop, LPNHE Paris, 2014/03/05

Outline

1. Motivation
2. Heavy quark threshold resummation
3. Whizard teaser
4. Whizard *ttbar* threshold implementation
5. Whizard *ttbar* threshold model & parameters

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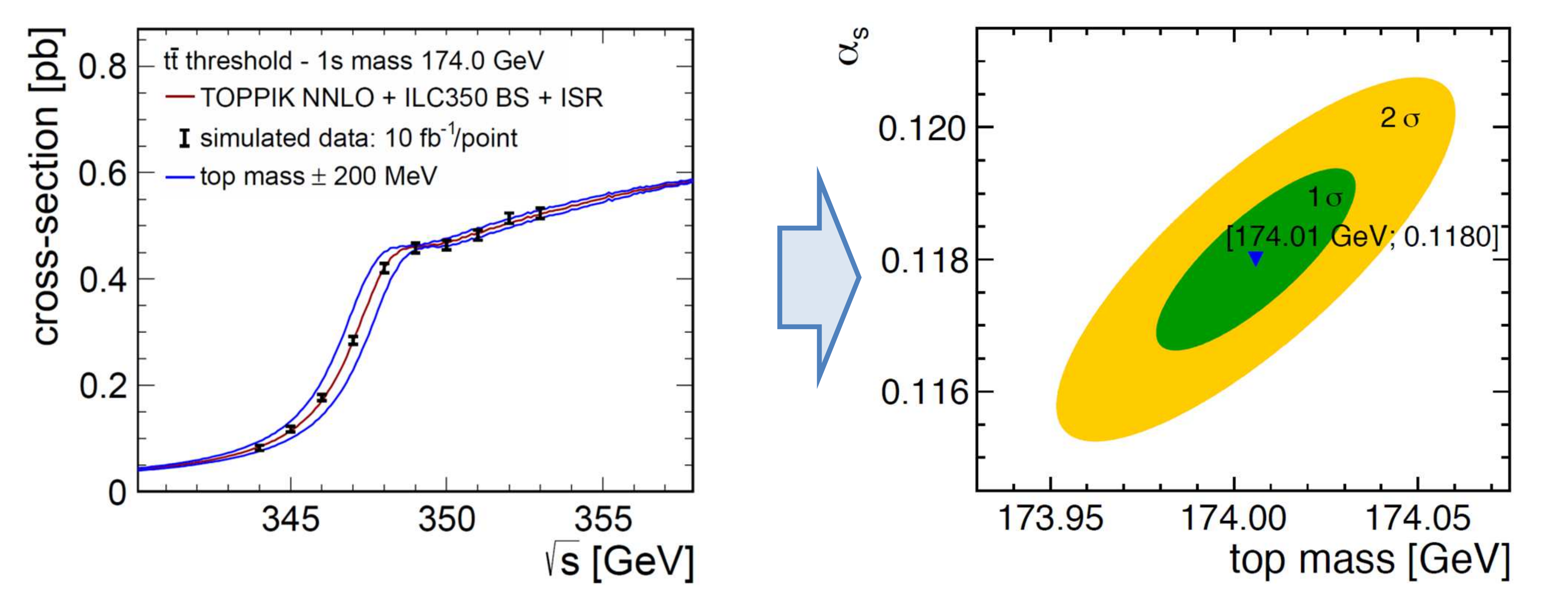

[ILC TDR, '13]

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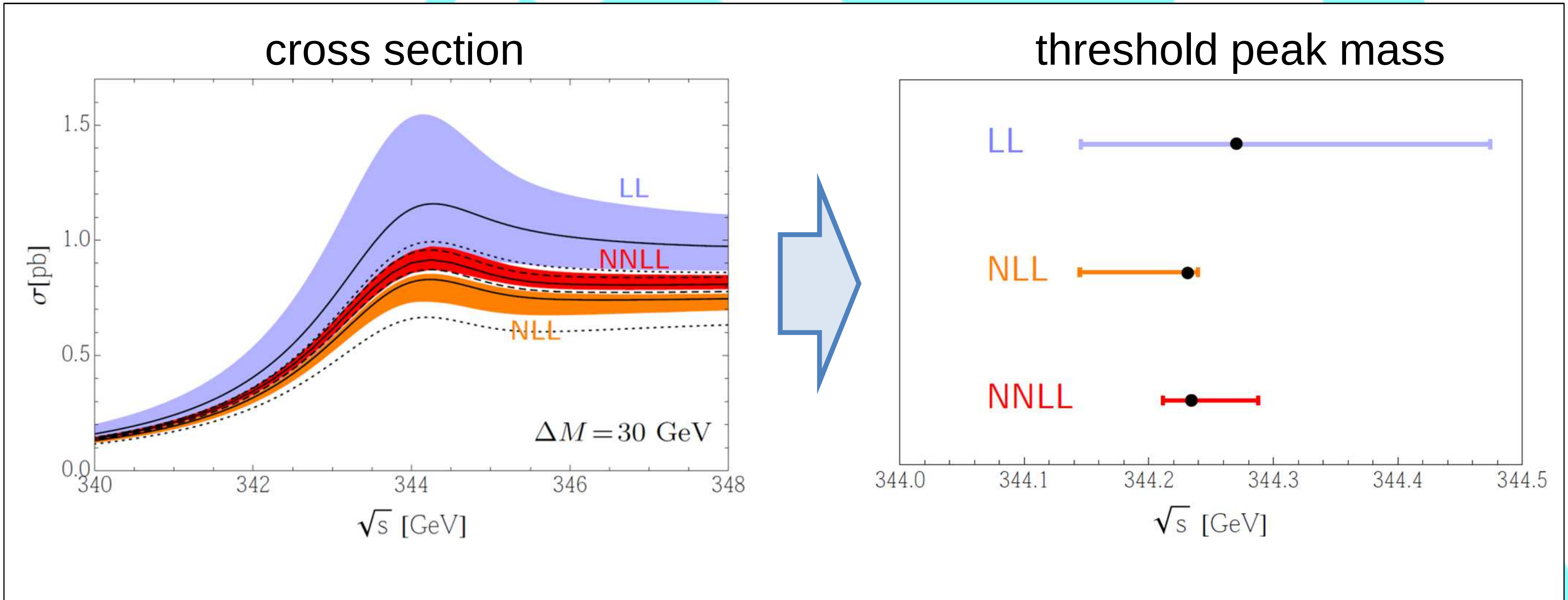

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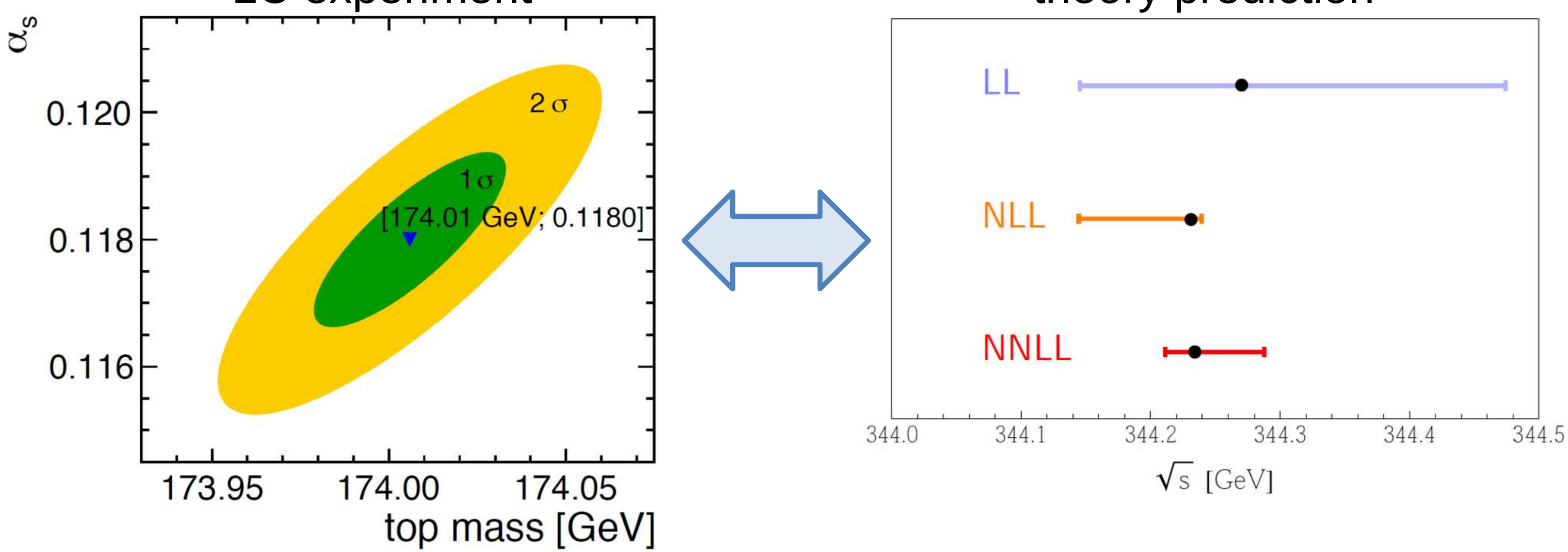
LC experiment

theory prediction



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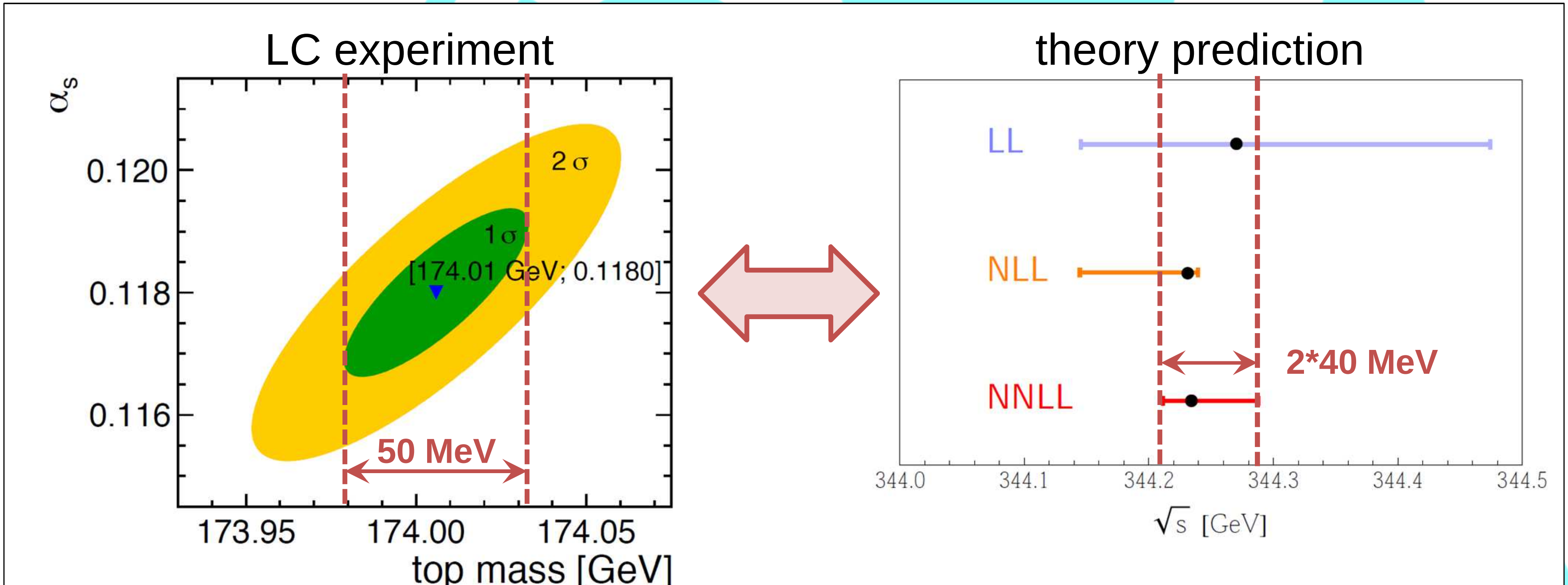

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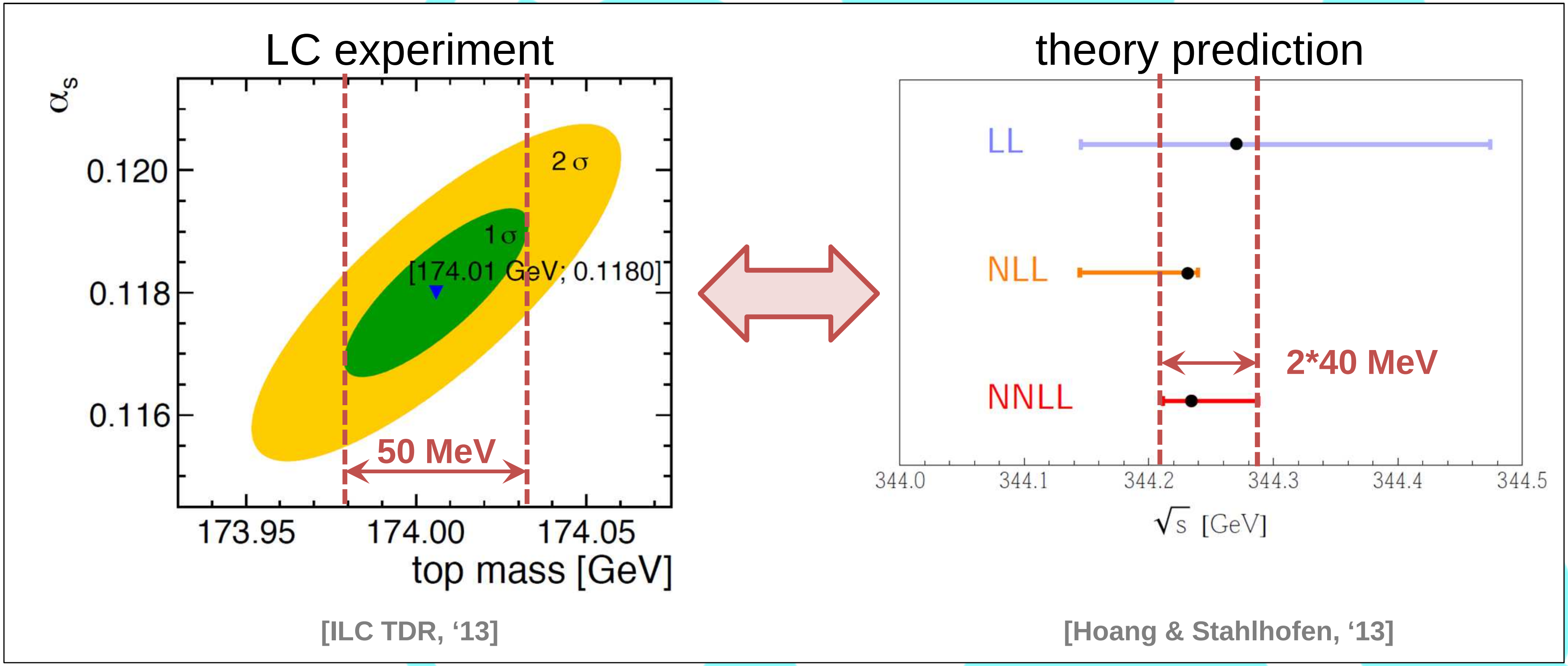

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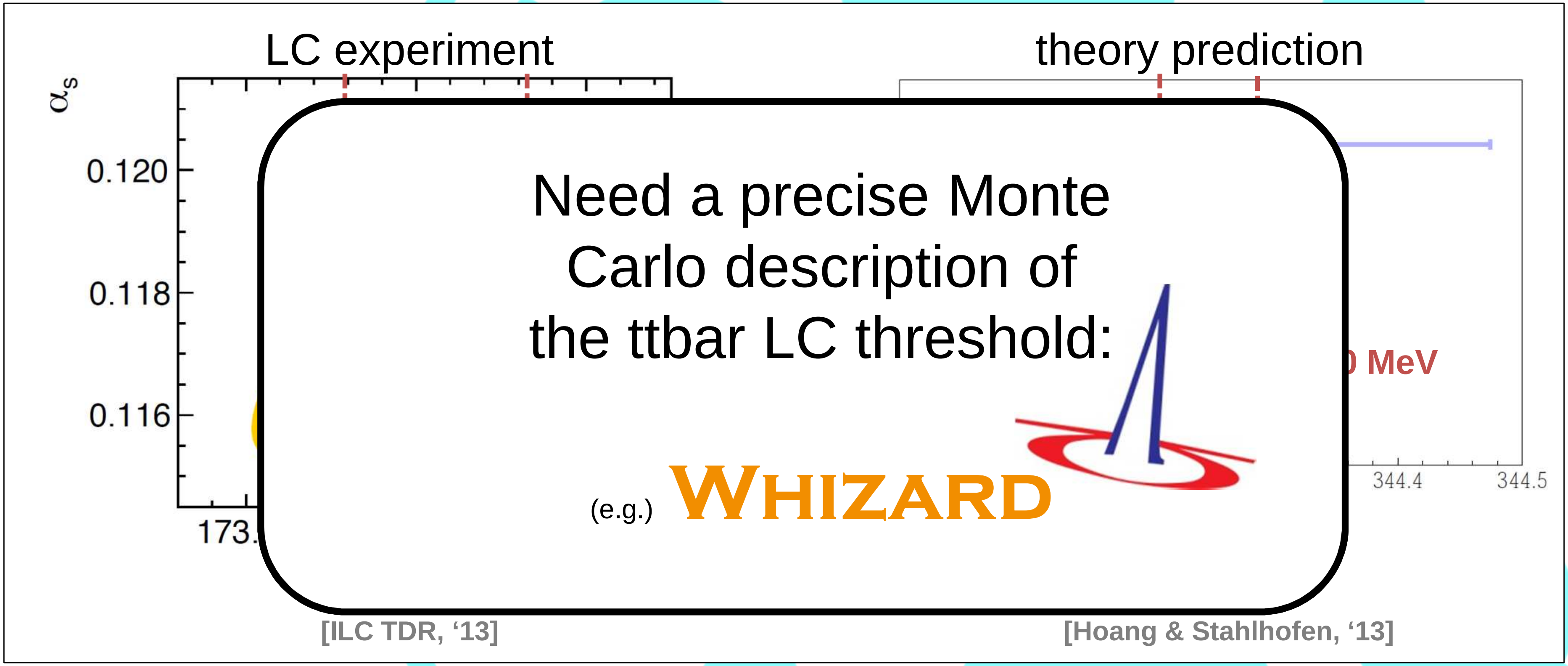

Need a precise Monte Carlo description of the ttbar LC threshold:

(e.g.) WHIZARD

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phase space of two massive particles

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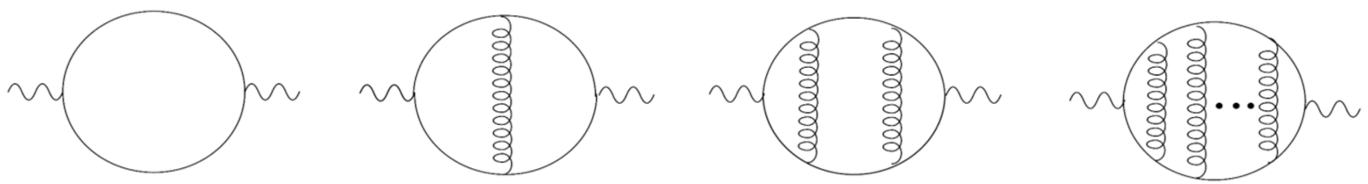

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low energy effective theory w/ matching conditions: renormalization group improved framework vNRQCD

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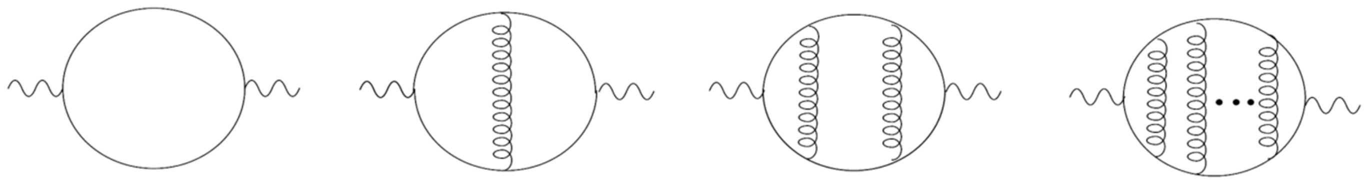

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tree level γ/Z exchange:
"what WHIZARD does"

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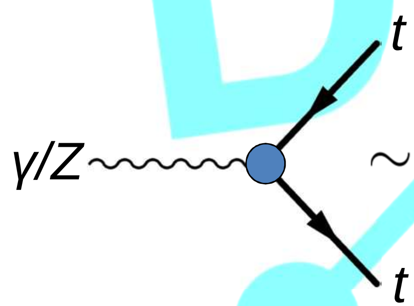

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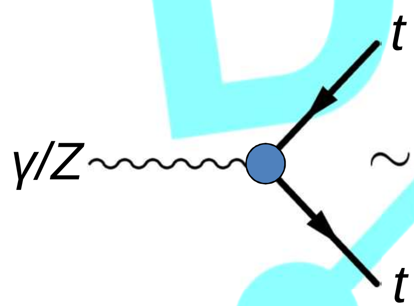

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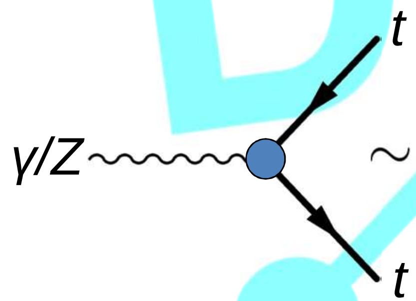

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differential in off-shell ttbar phase space

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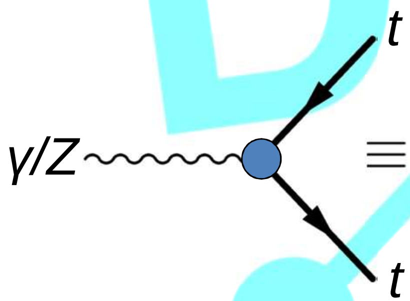

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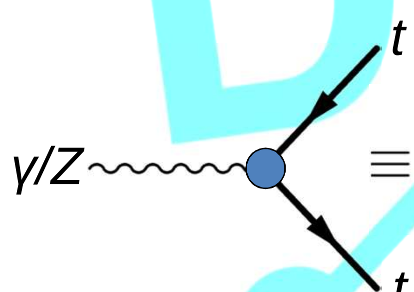

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far away from threshold

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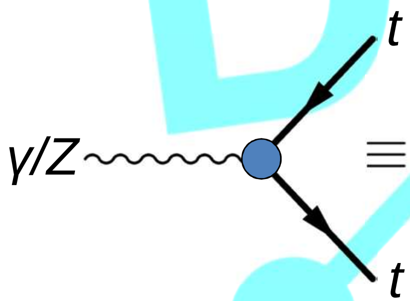

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interference with LO electroweak background

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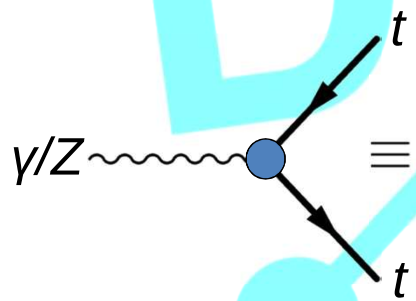

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WHIZARD approach

WHIZARD teaser

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> WHIZARD release **v2.2.0 imminent**

➔ find out more during Jürgen Reuter's talk in **tomorrow's tools session**!

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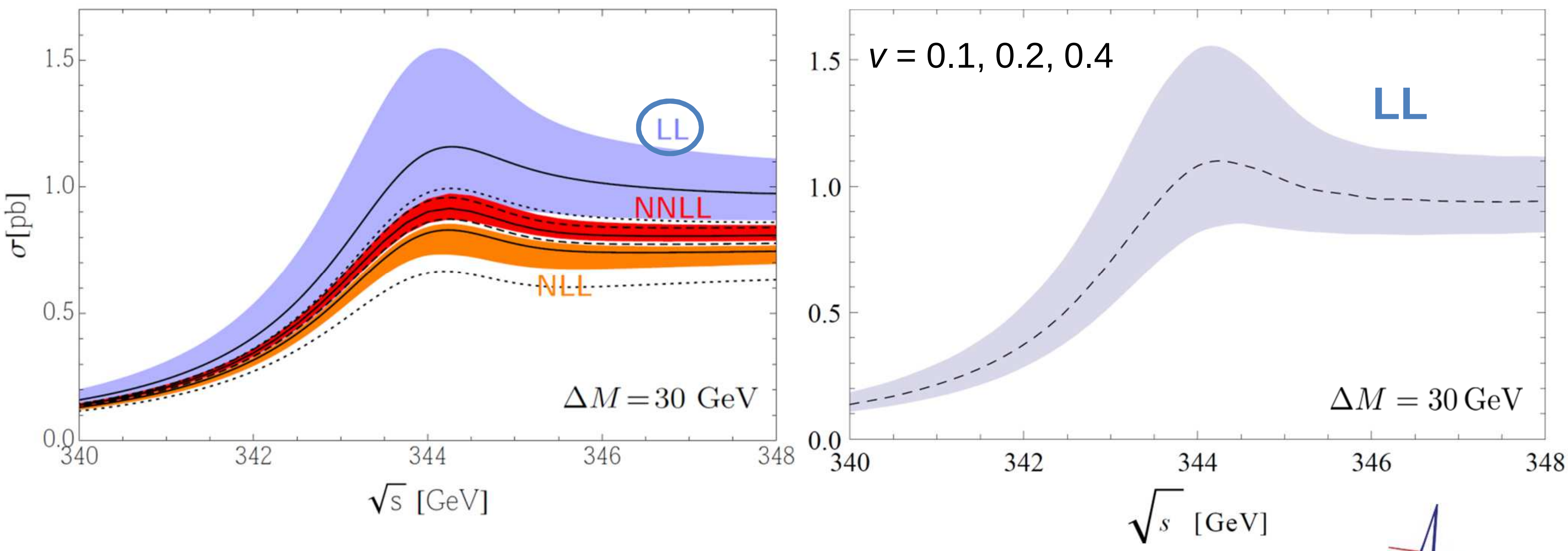

[Hoang & Stahlhofen, '13]

WHIZARD v2.2.0 unofficial

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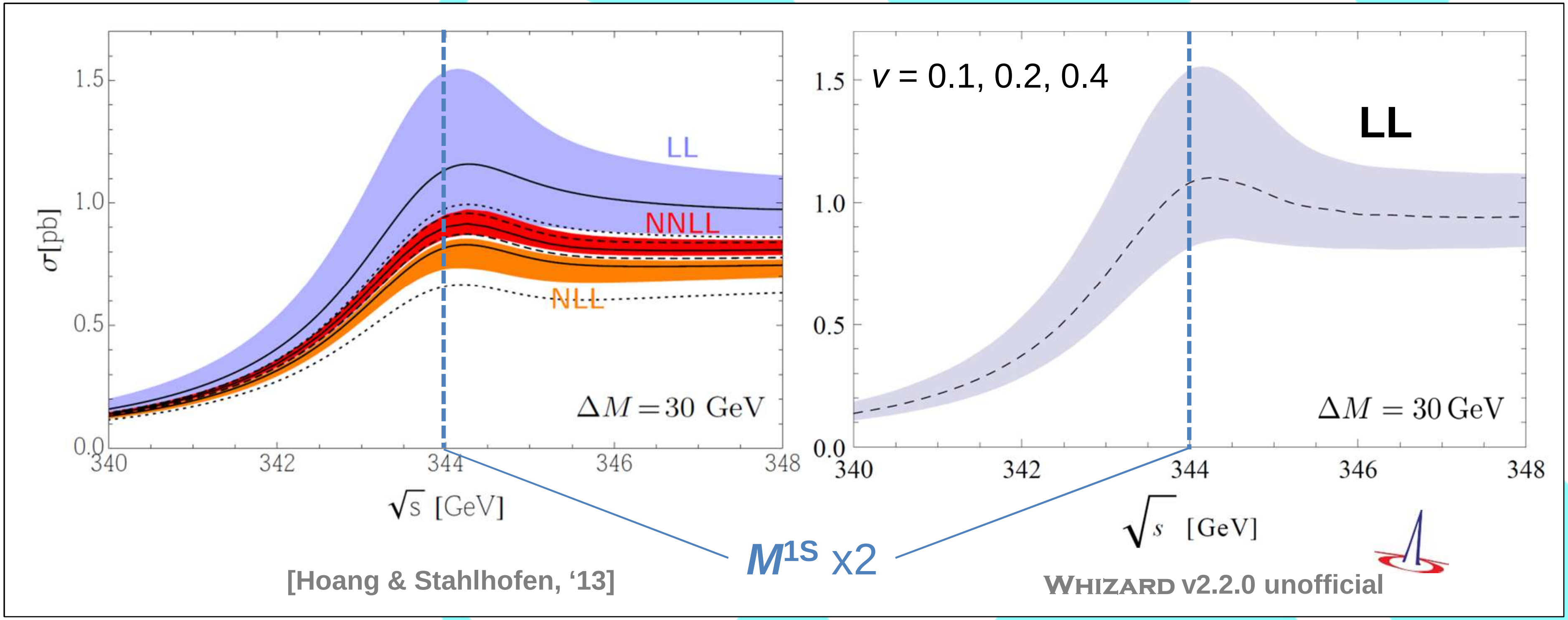

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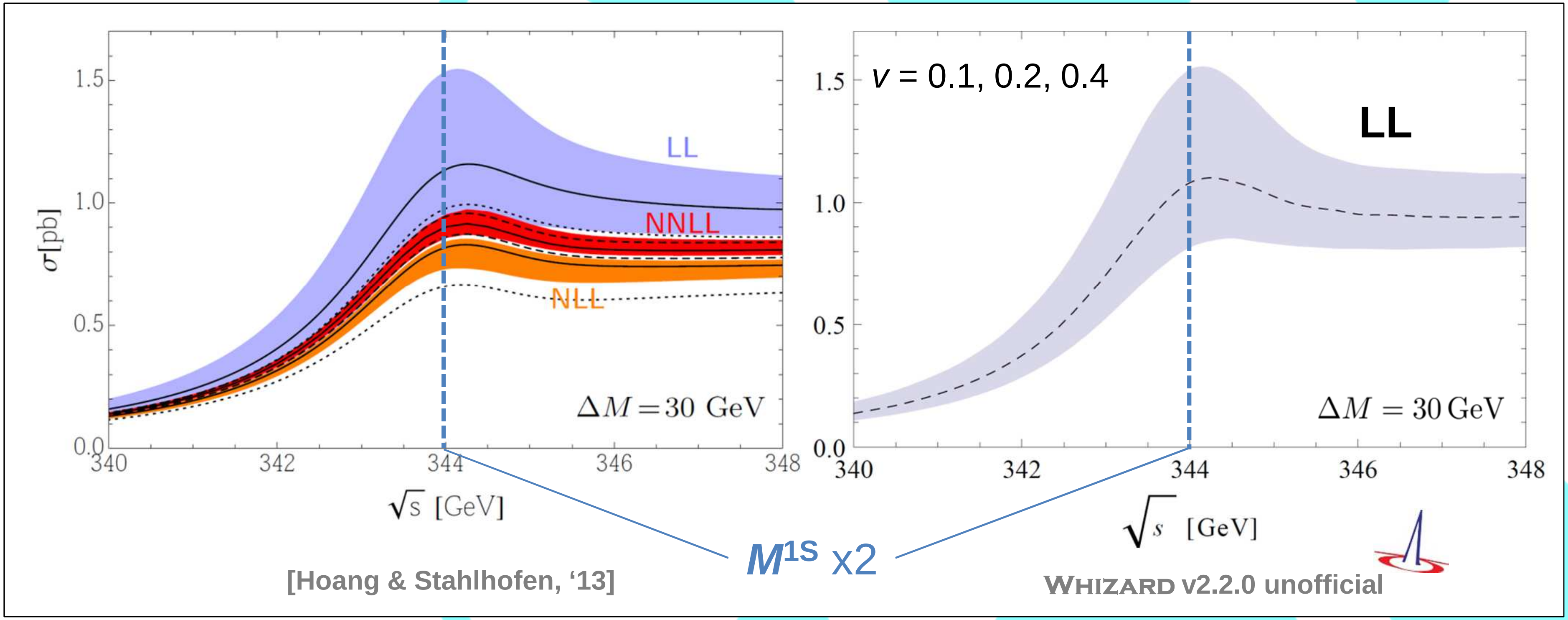
Coulomb potential



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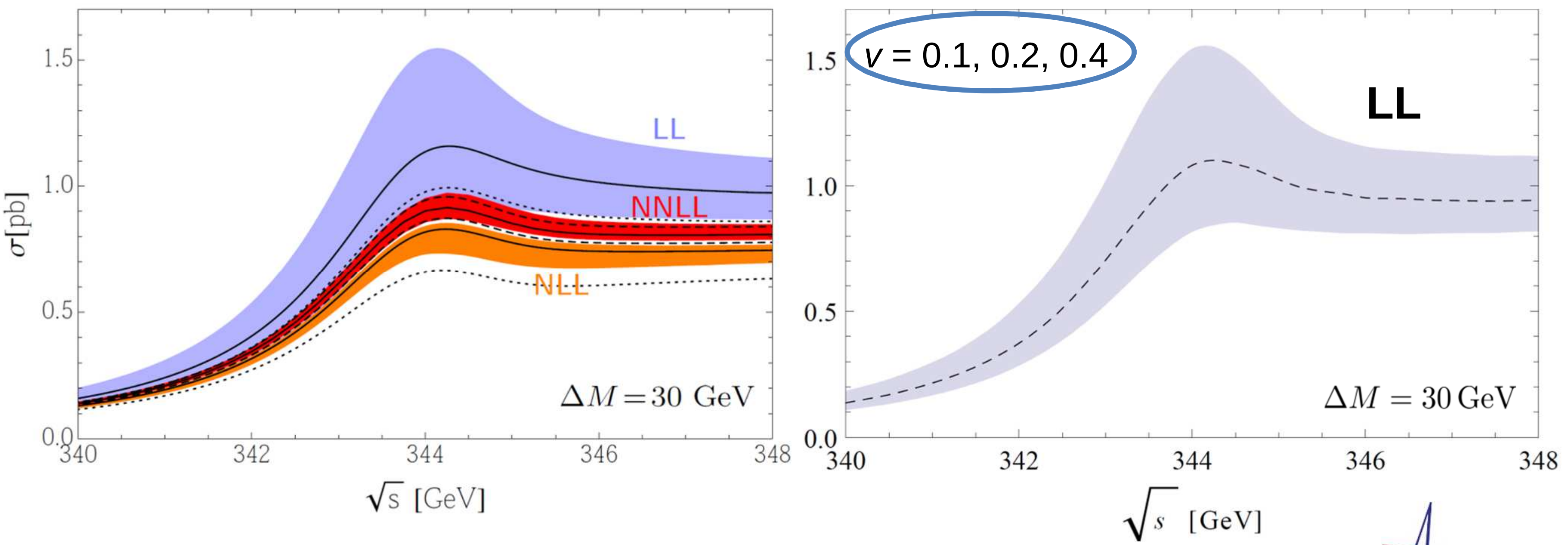

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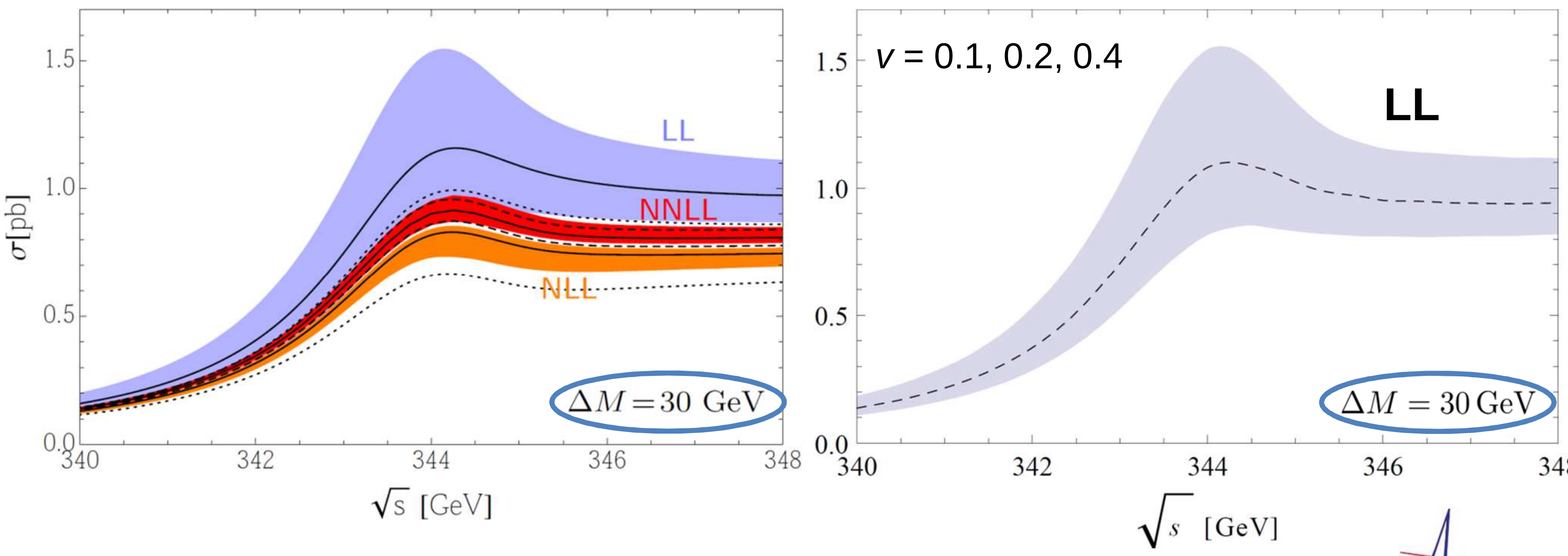
- ➔ analytic LL unstable far off-shell: impose **top mass cut** $\Delta M \leq 30$ GeV



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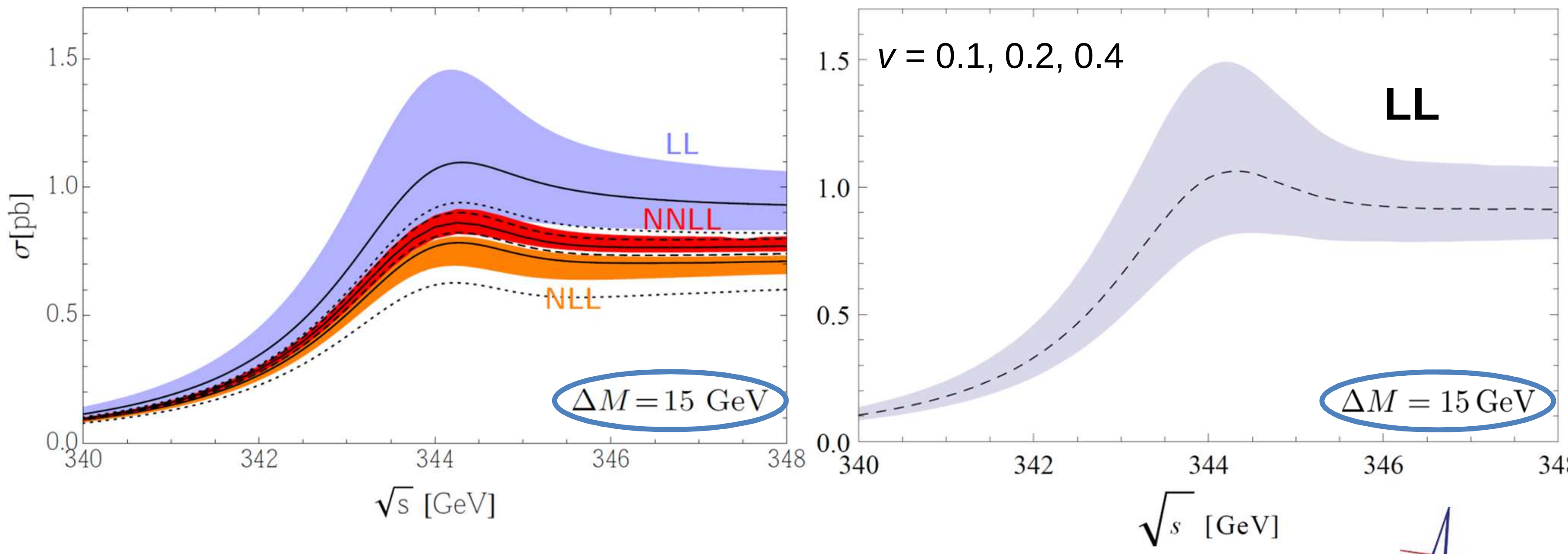
➔ theor. uncertainty: variation of the **soft scale** $\mu_s = m_t v$ (in **WHIZARD**)

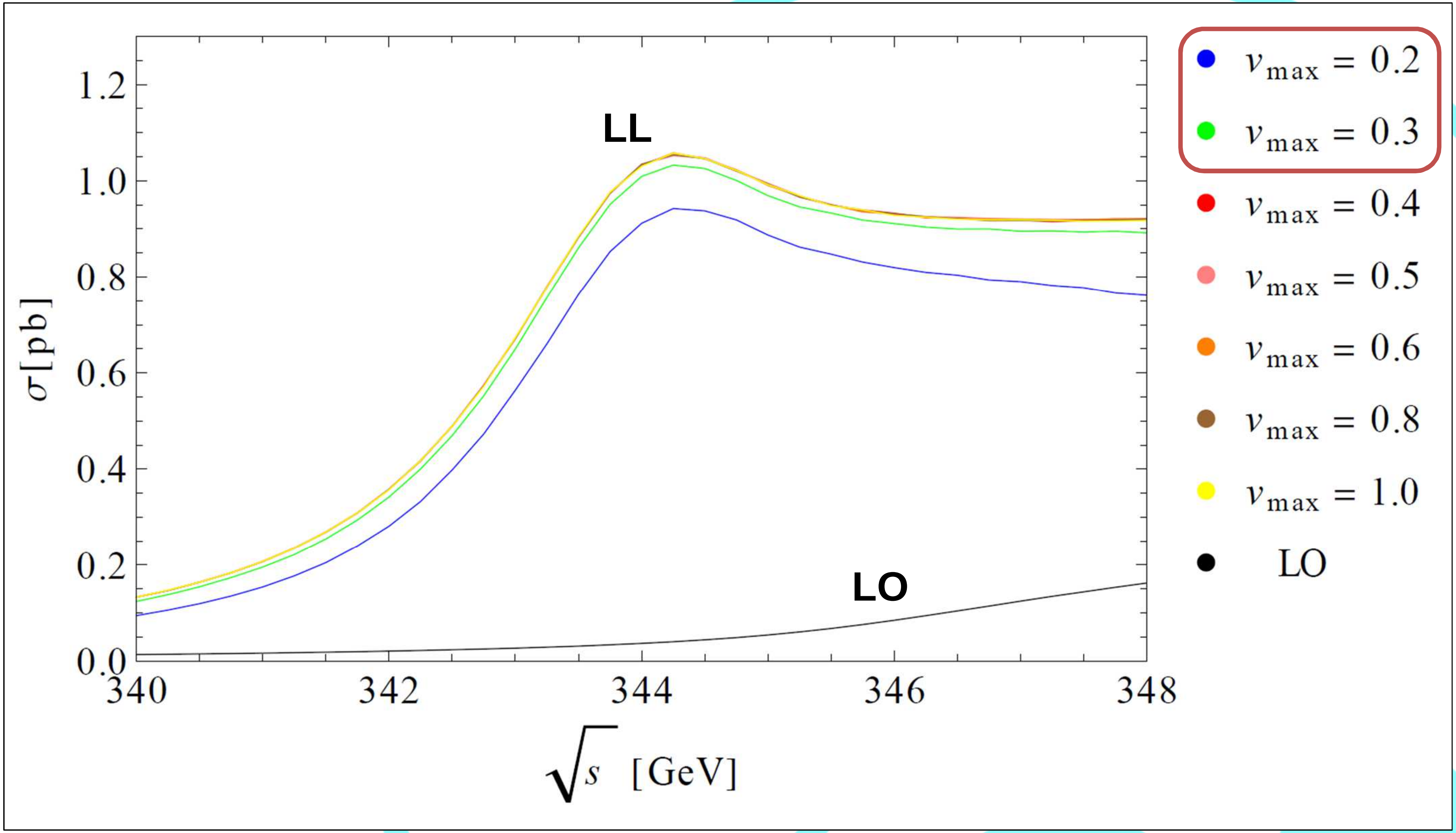
➔ analytic LL unstable far off-shell: impose **top mass cut** $\Delta M \leq 30$ GeV



[Hoang & Stahlhofen, '13]

WHIZARD v2.2.0 unofficial

Whizard ttbar threshold implementation (v2.2.1 release)



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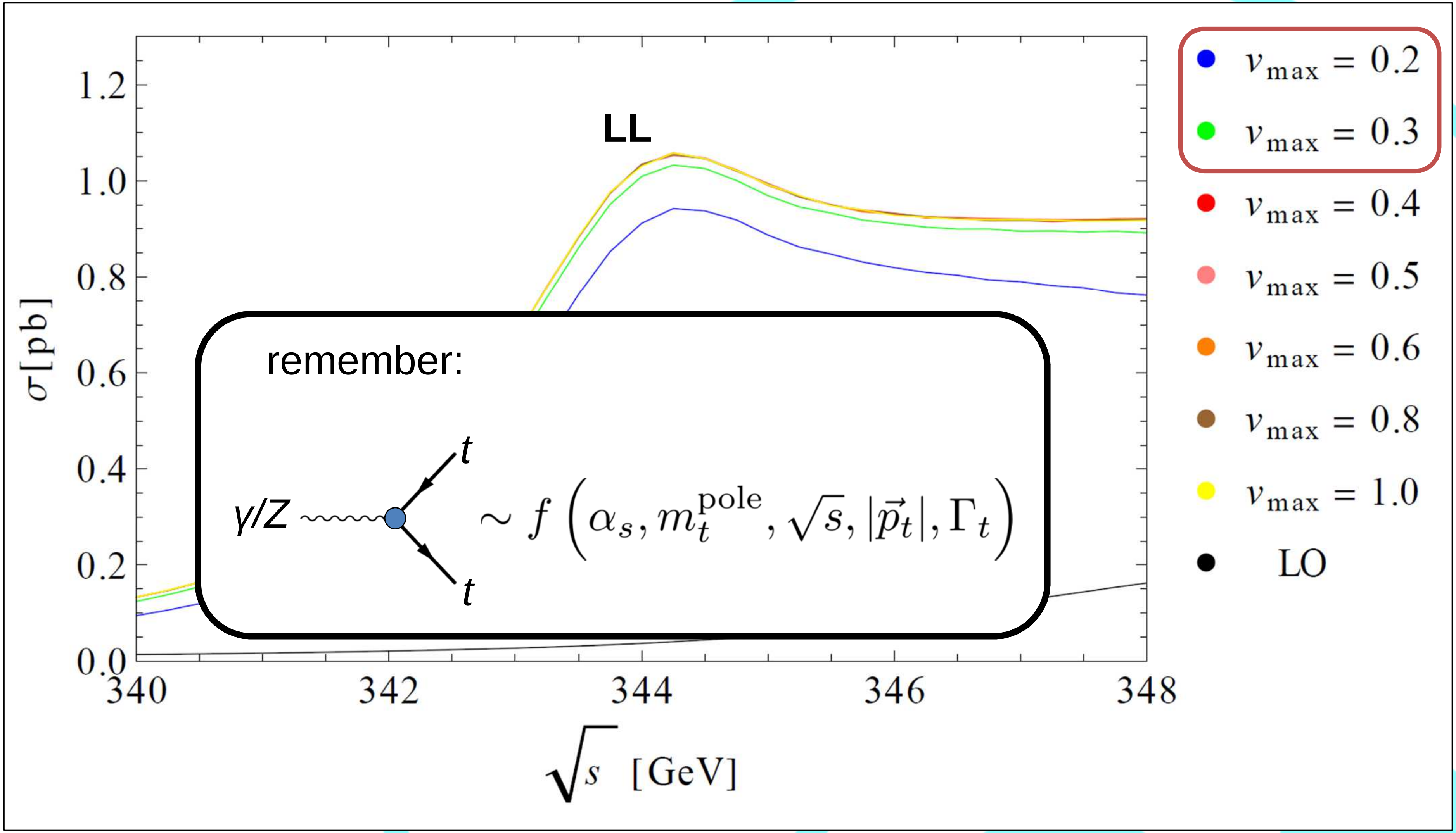

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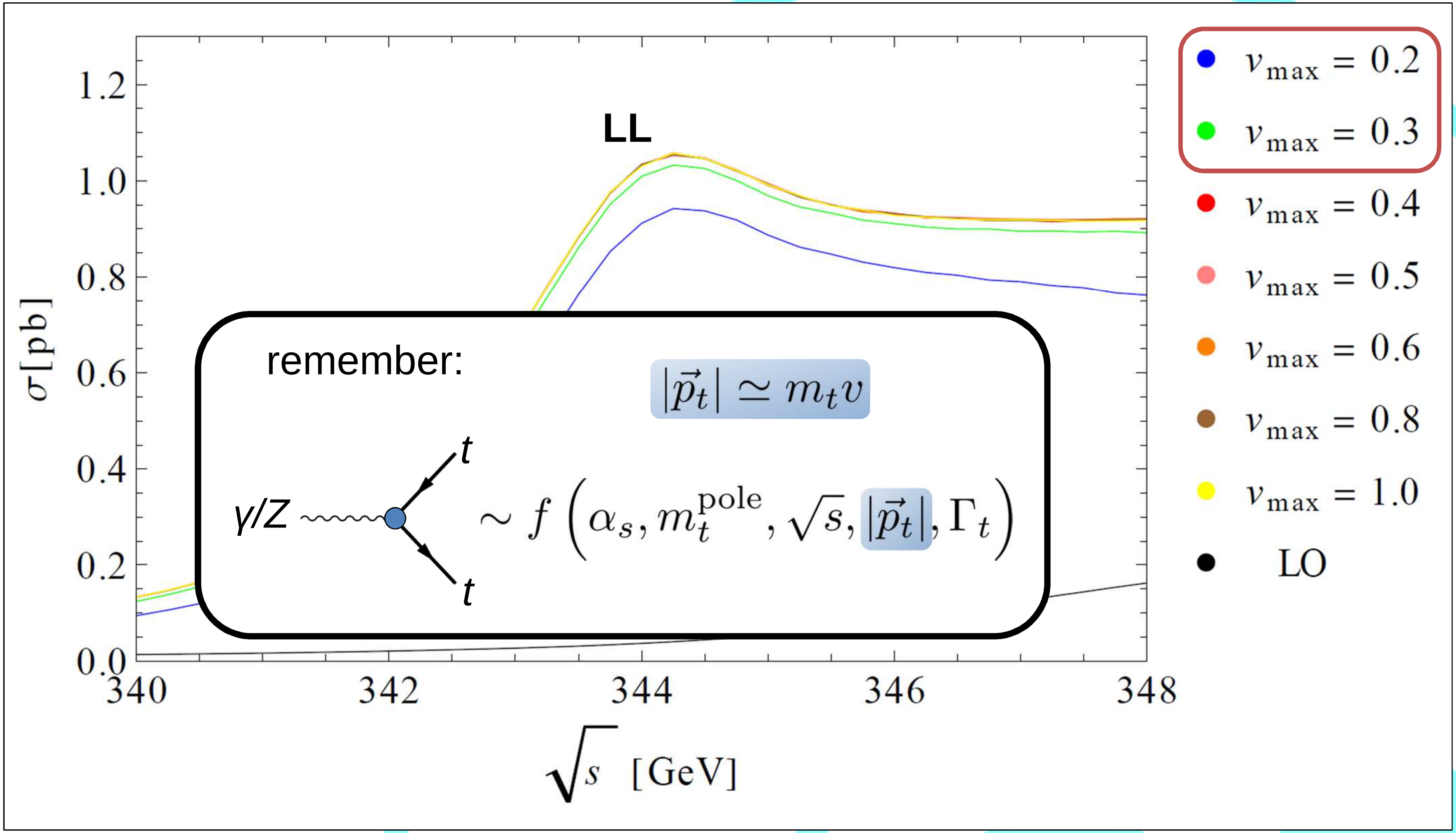

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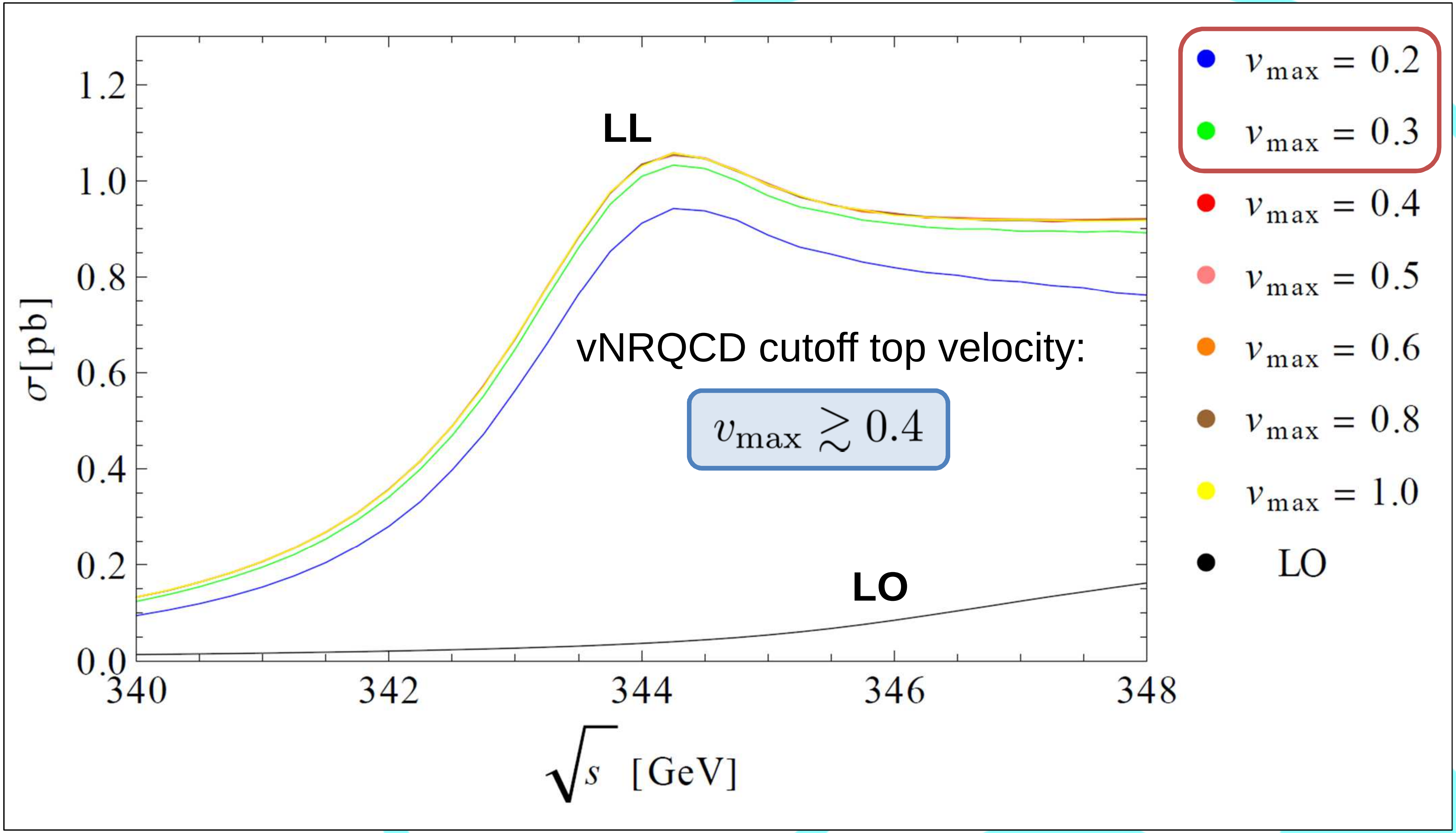

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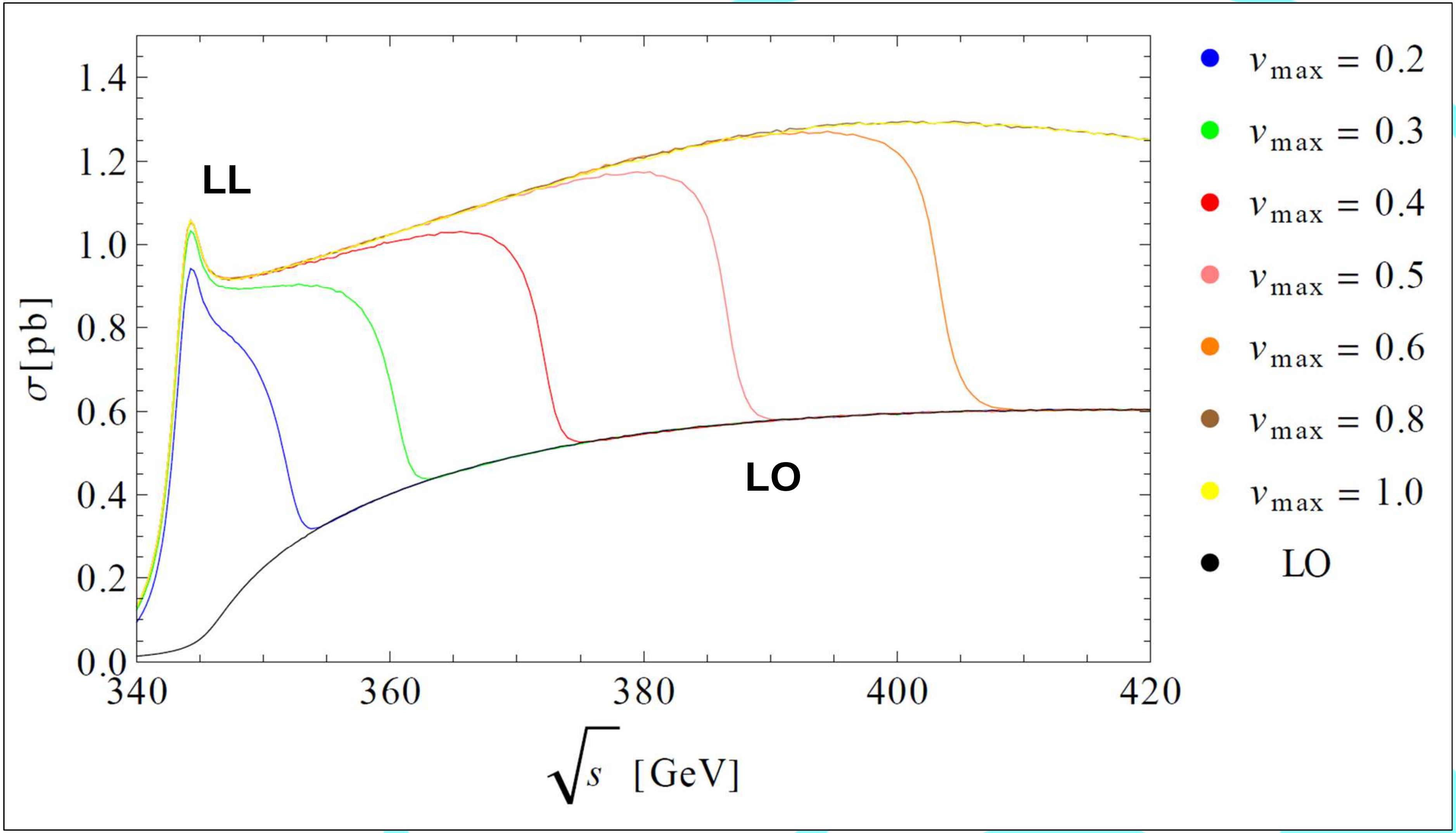

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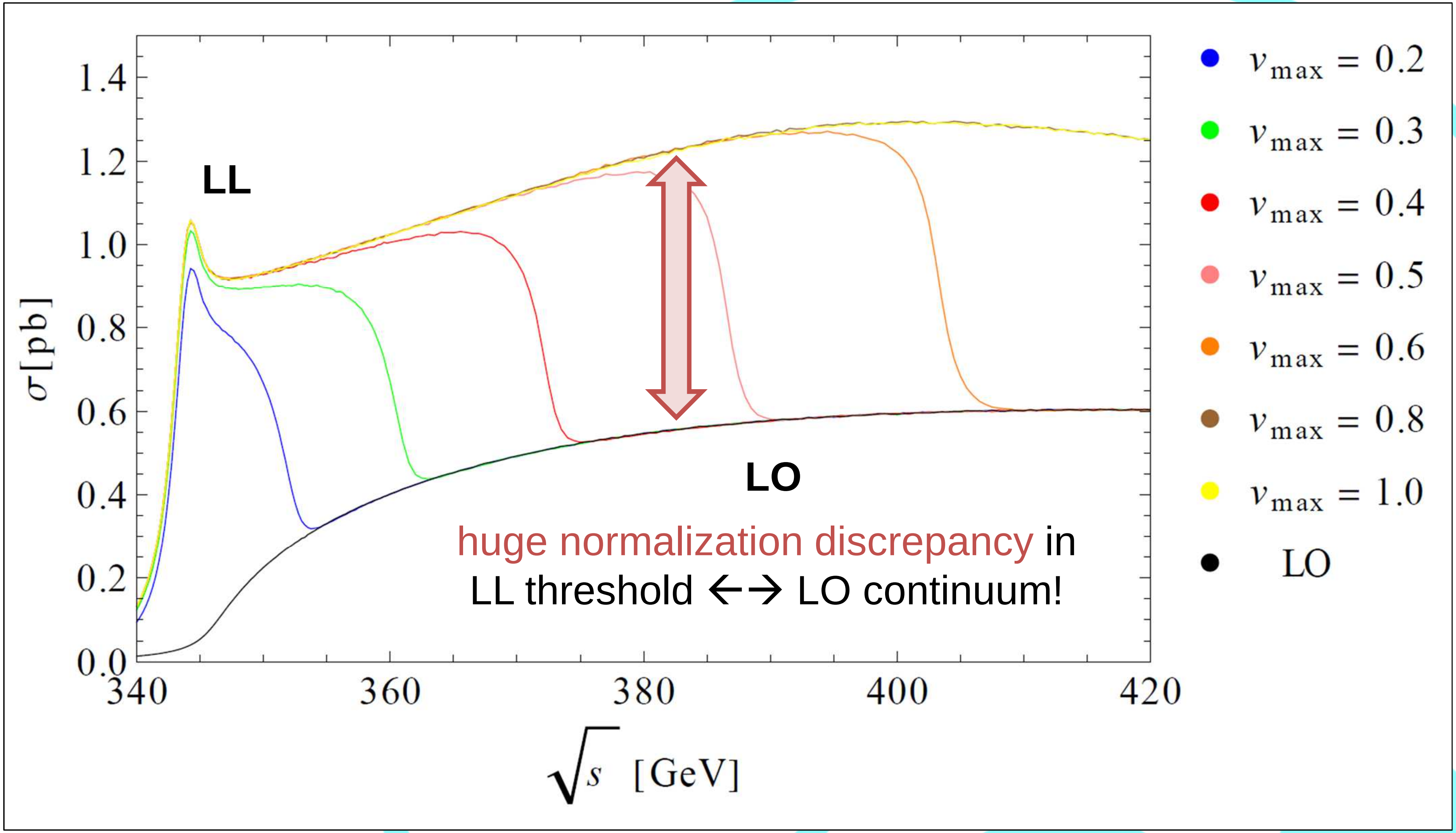

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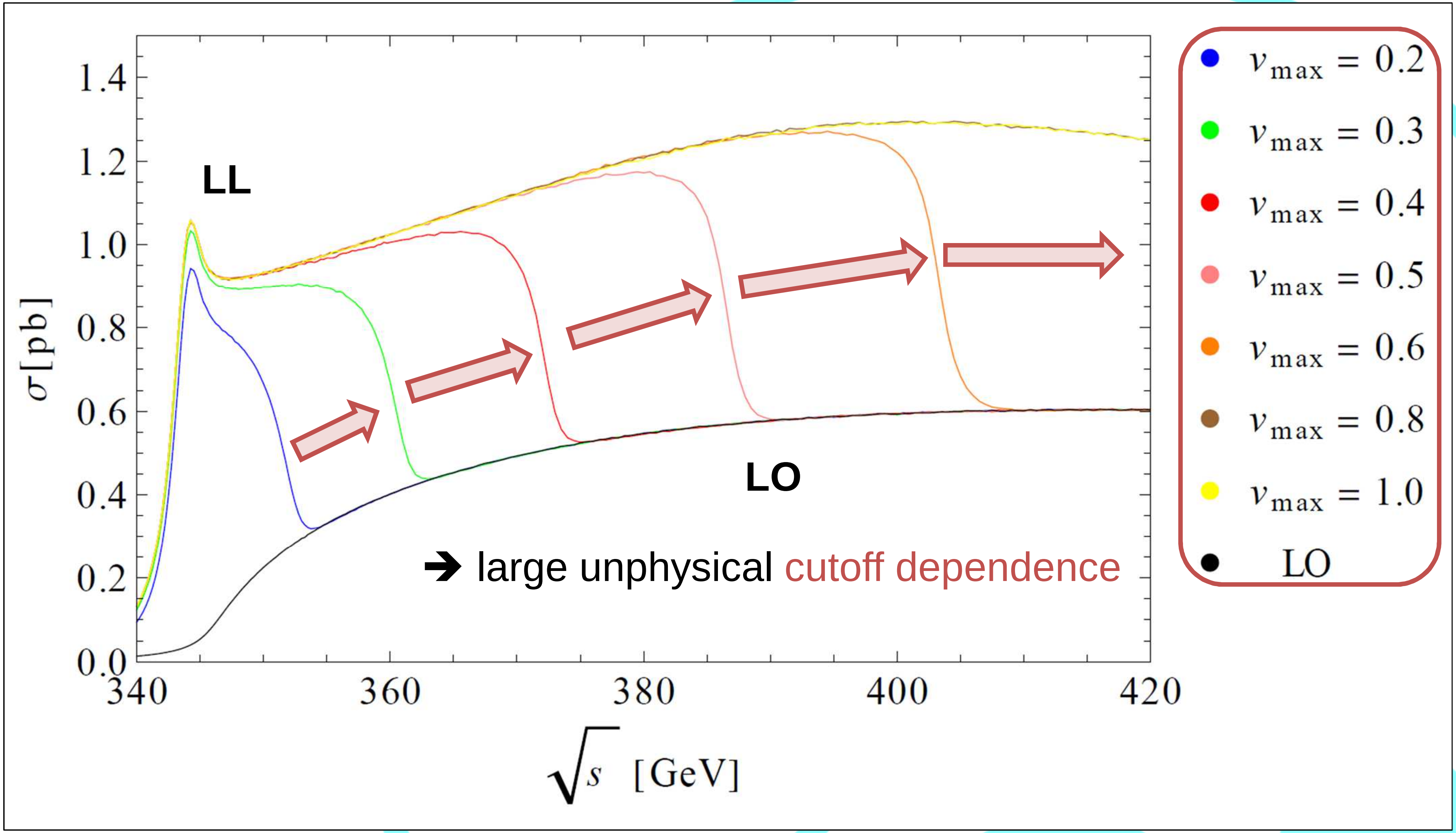

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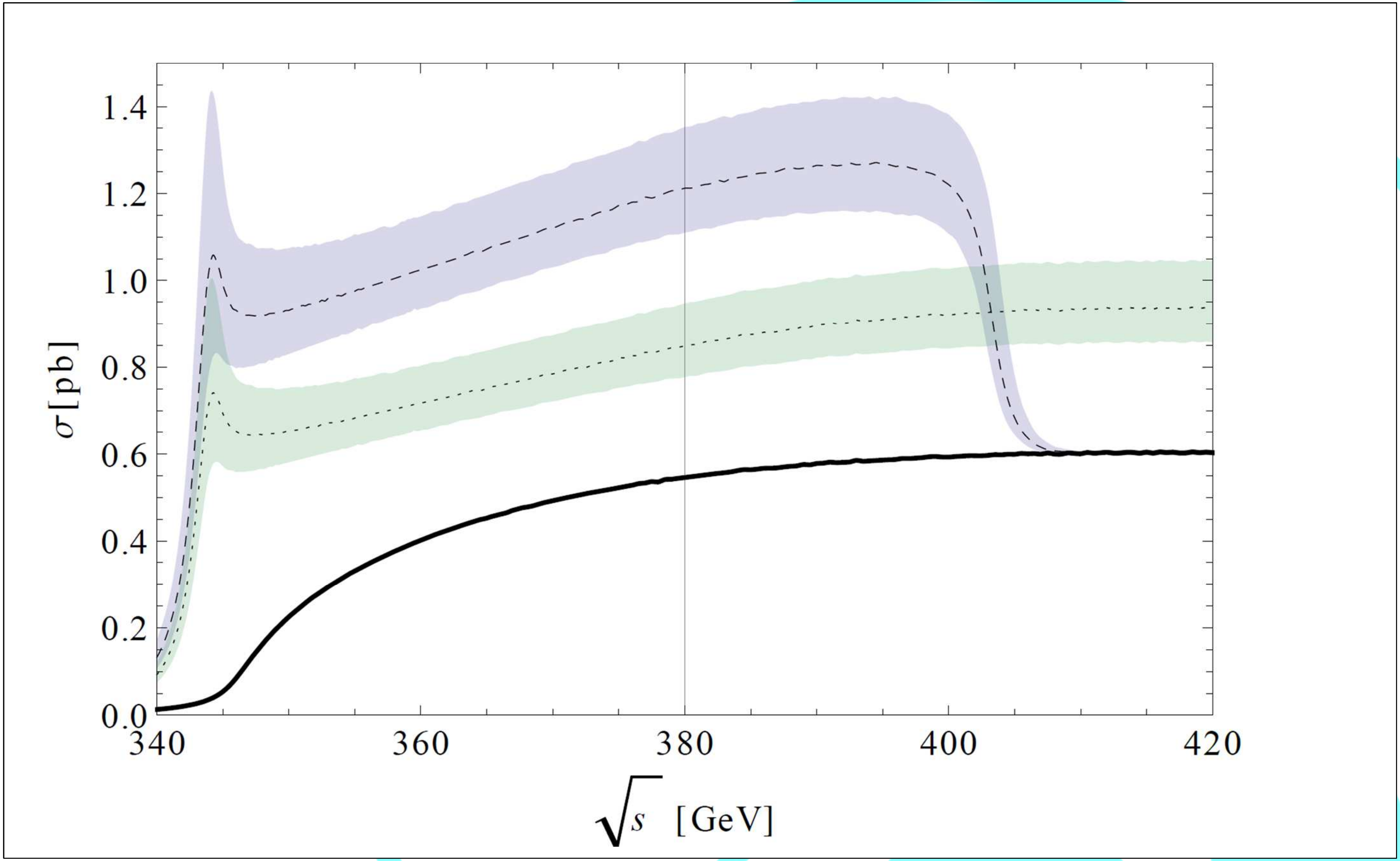

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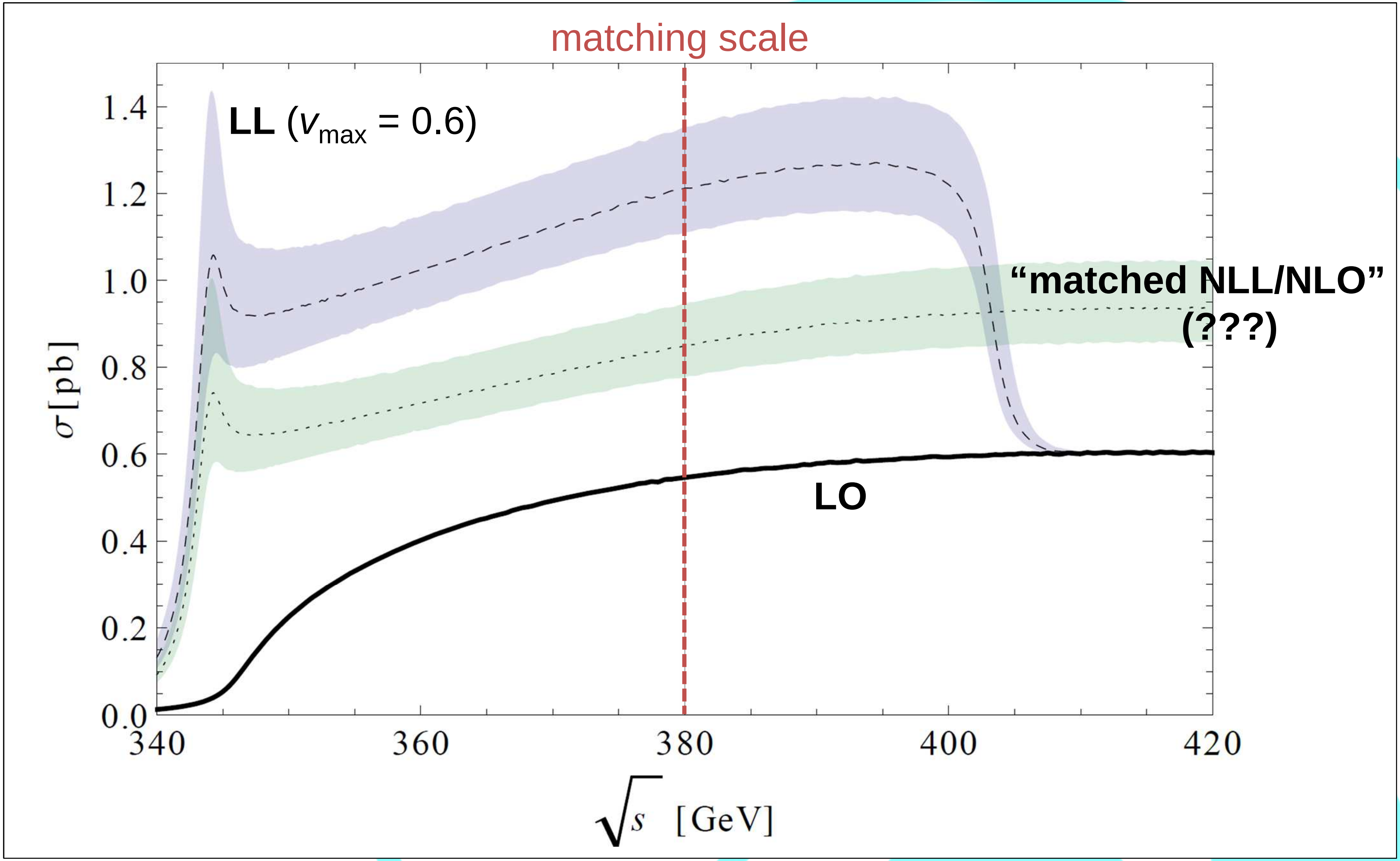

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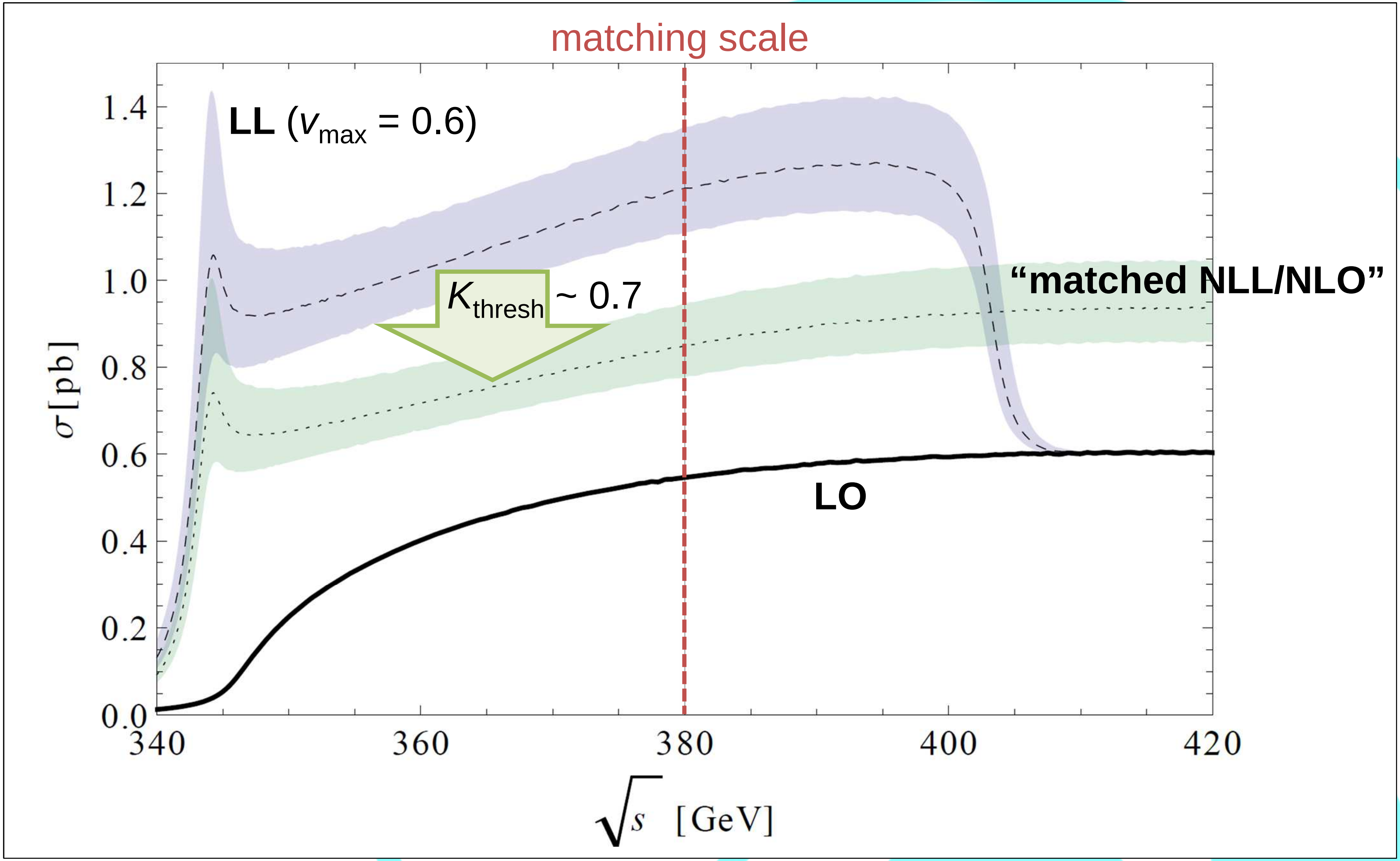

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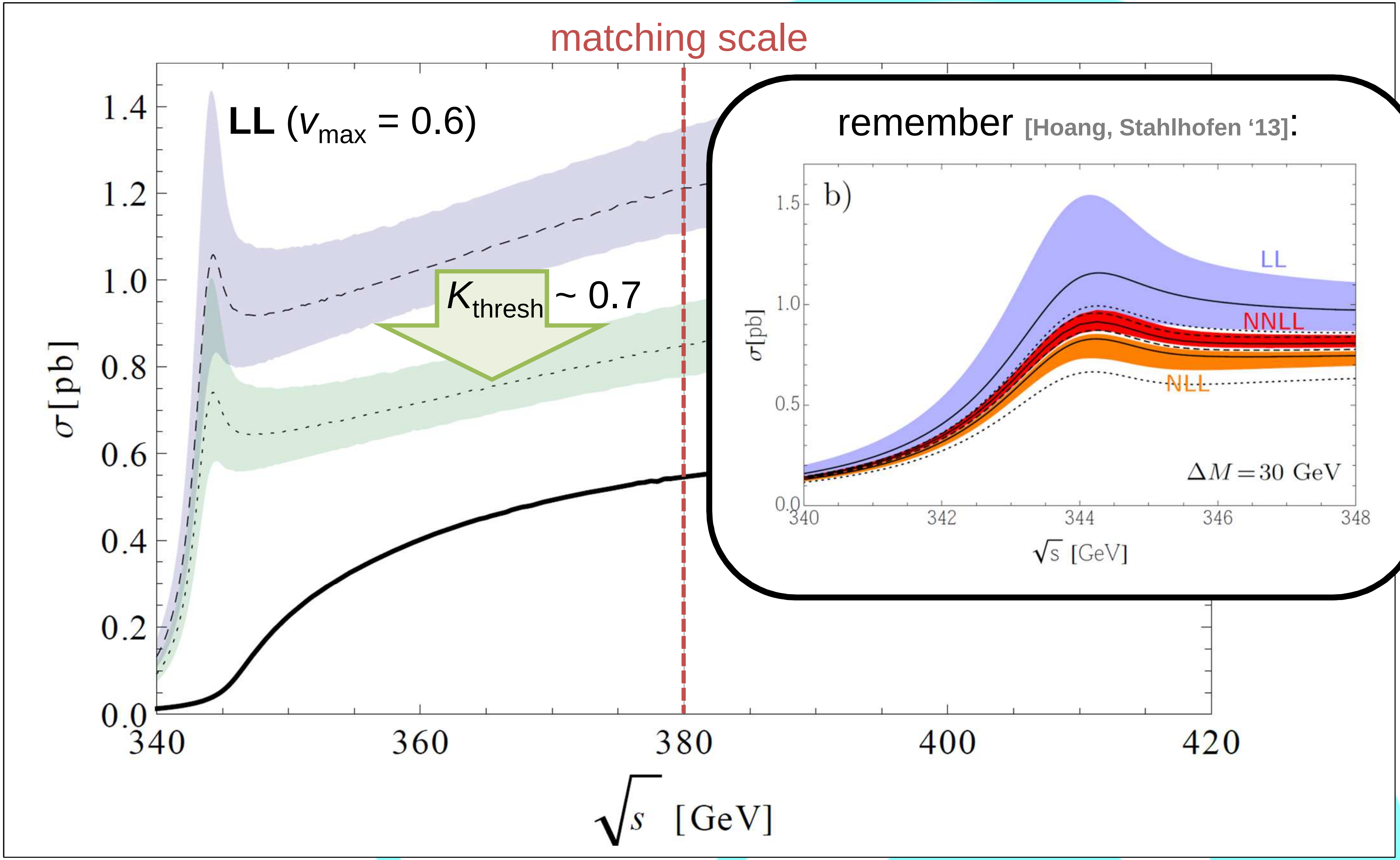

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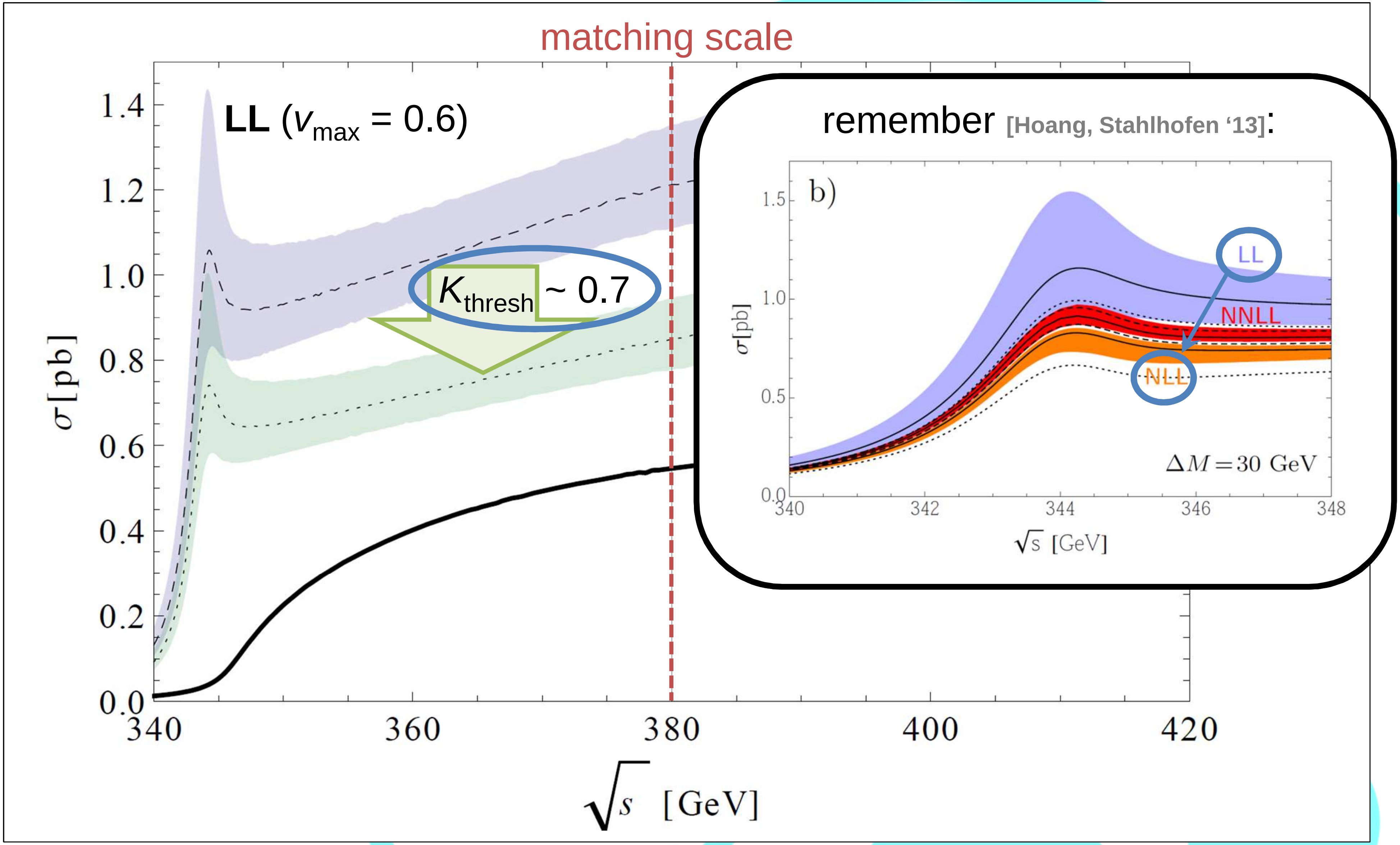

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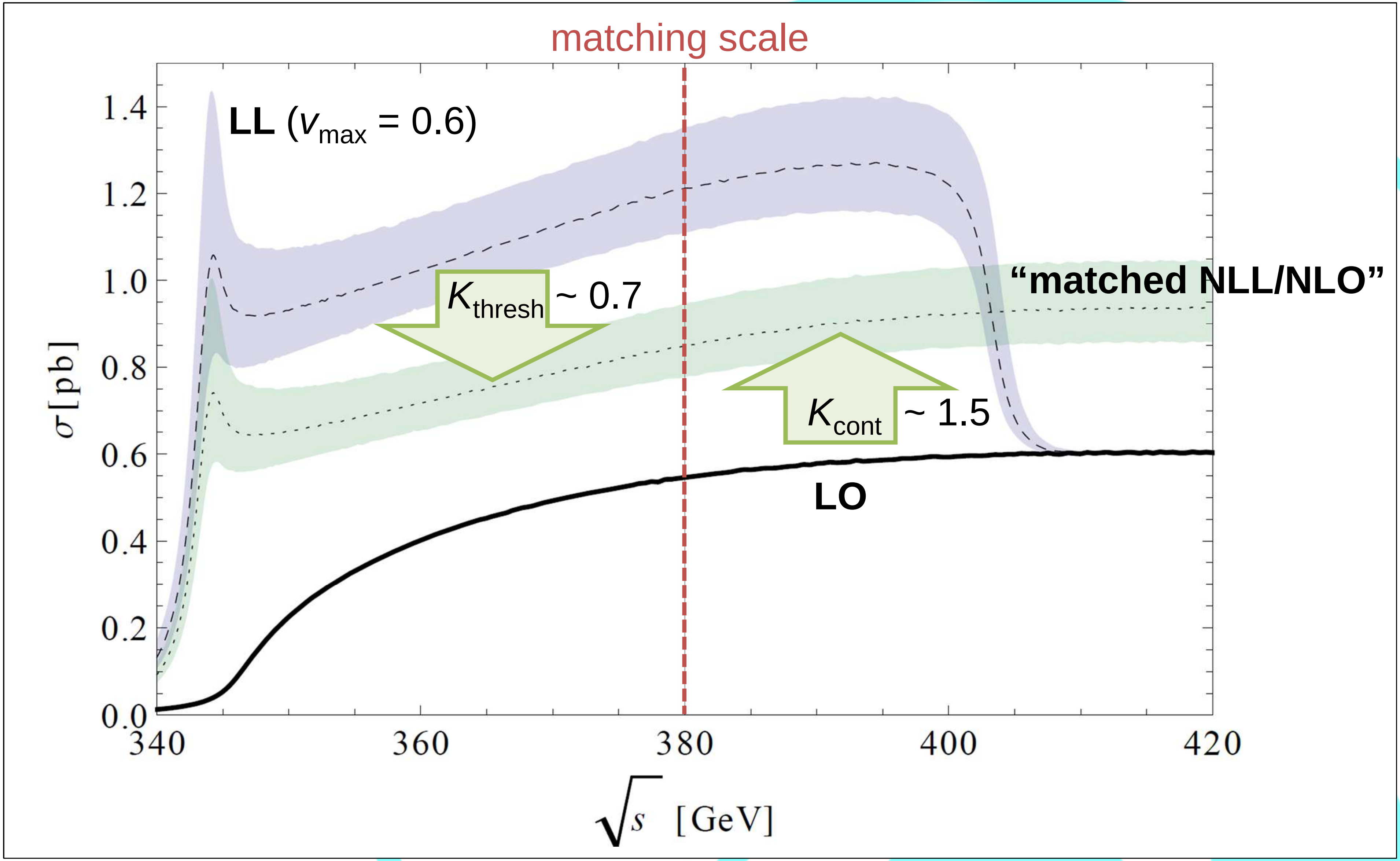

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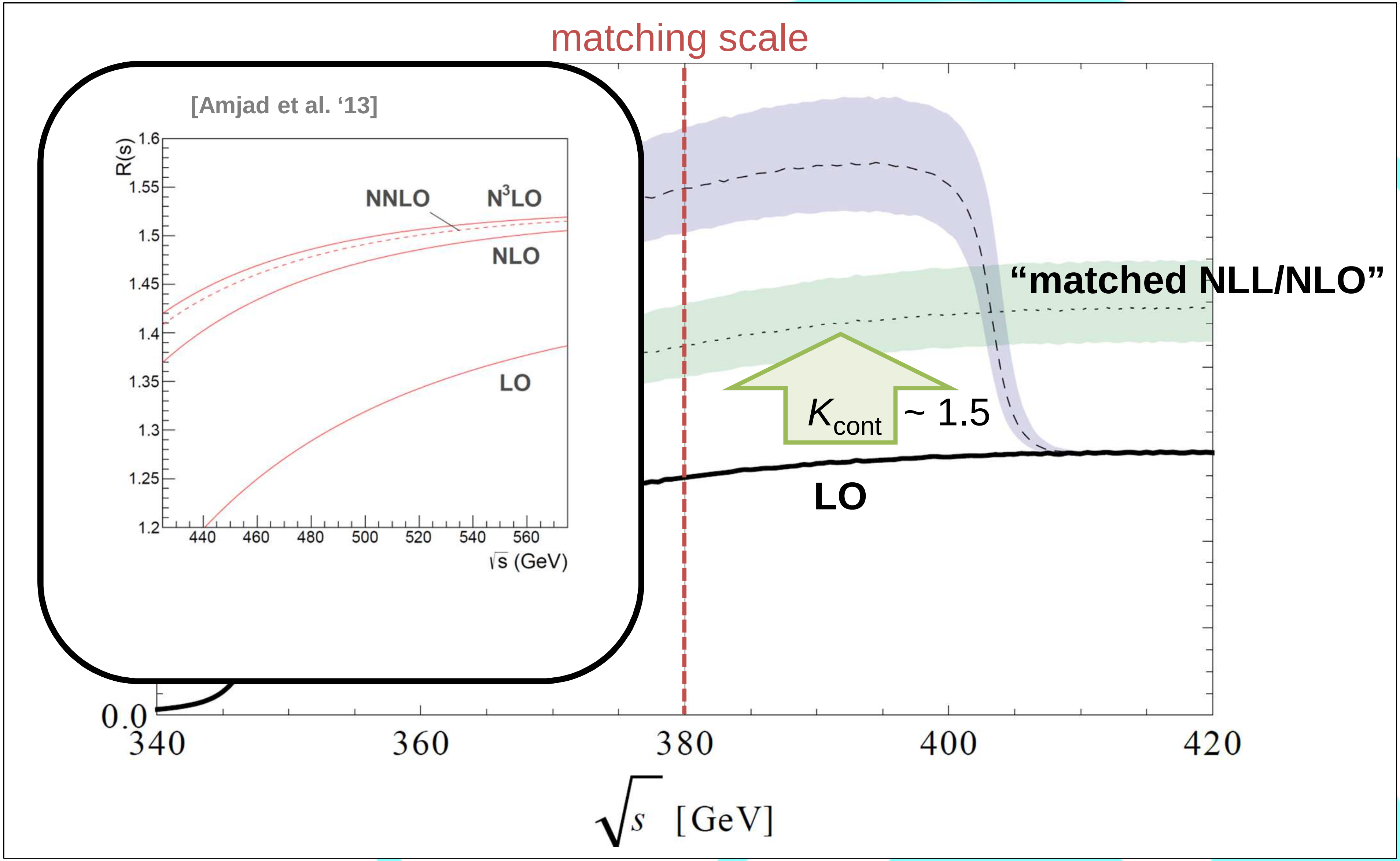

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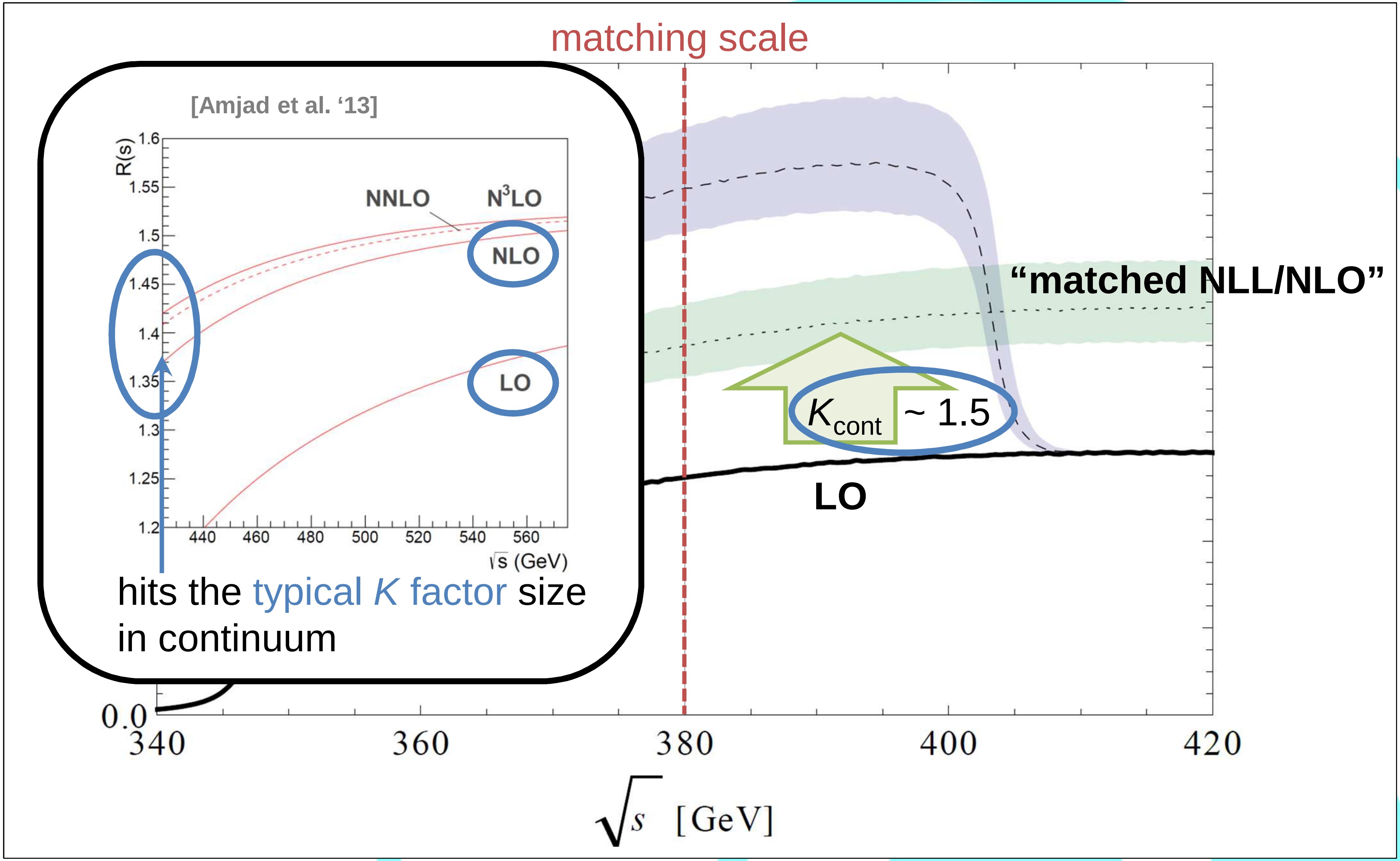

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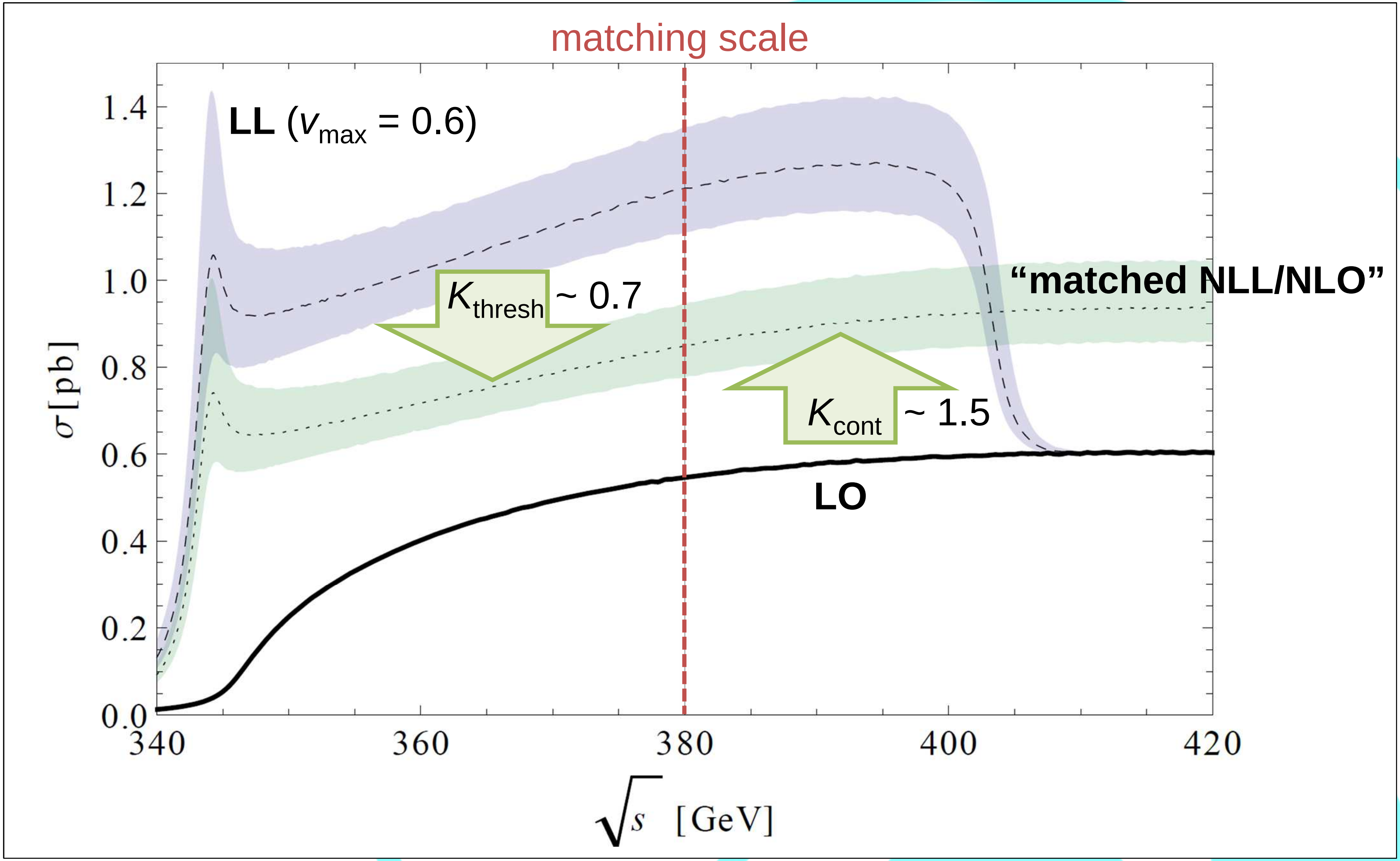
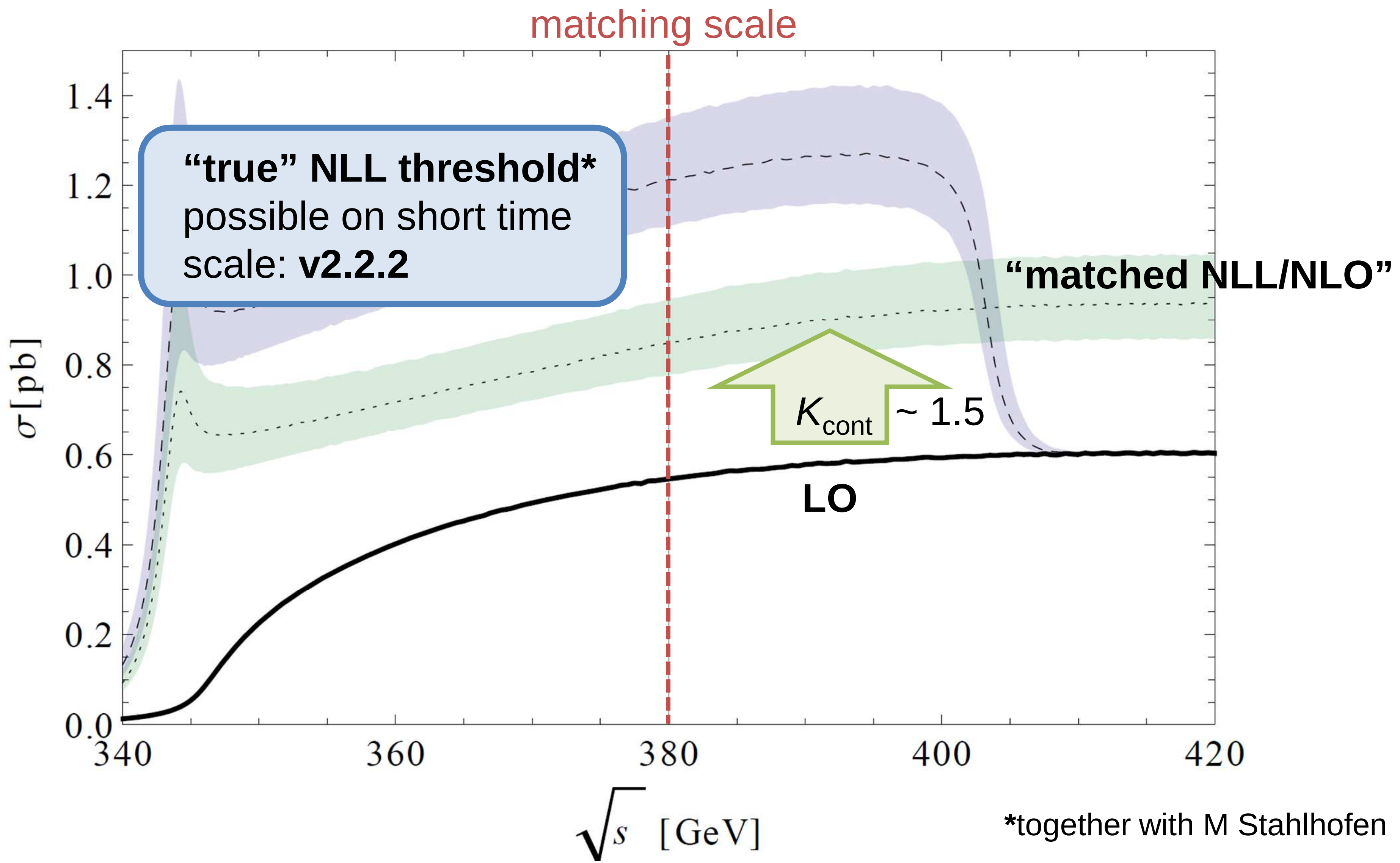
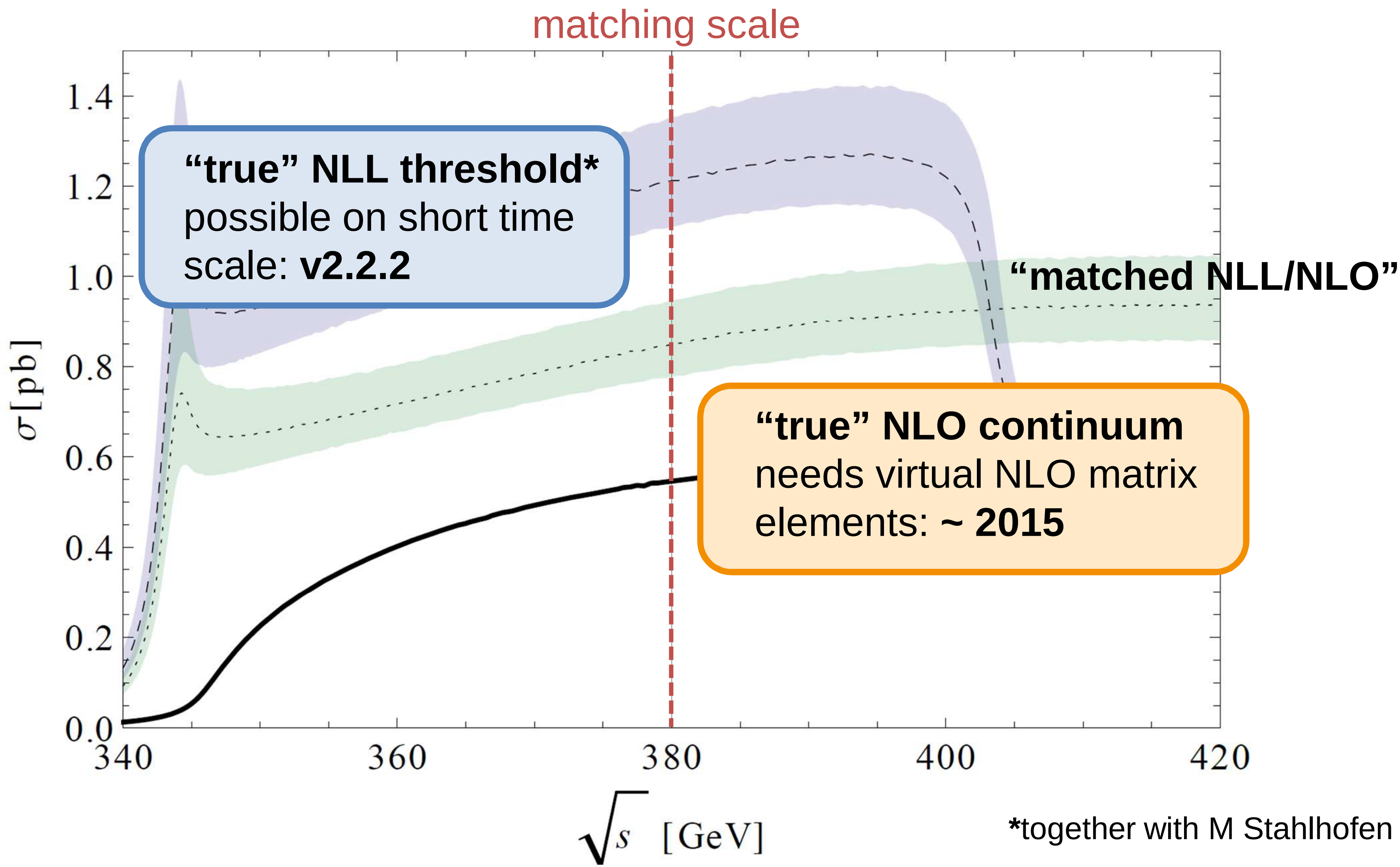


Whizard ttbar threshold implementation (v2.2.2 release)



*together with M Stahlhofen

WHIZARD ttbar threshold implementation (~ 2015)



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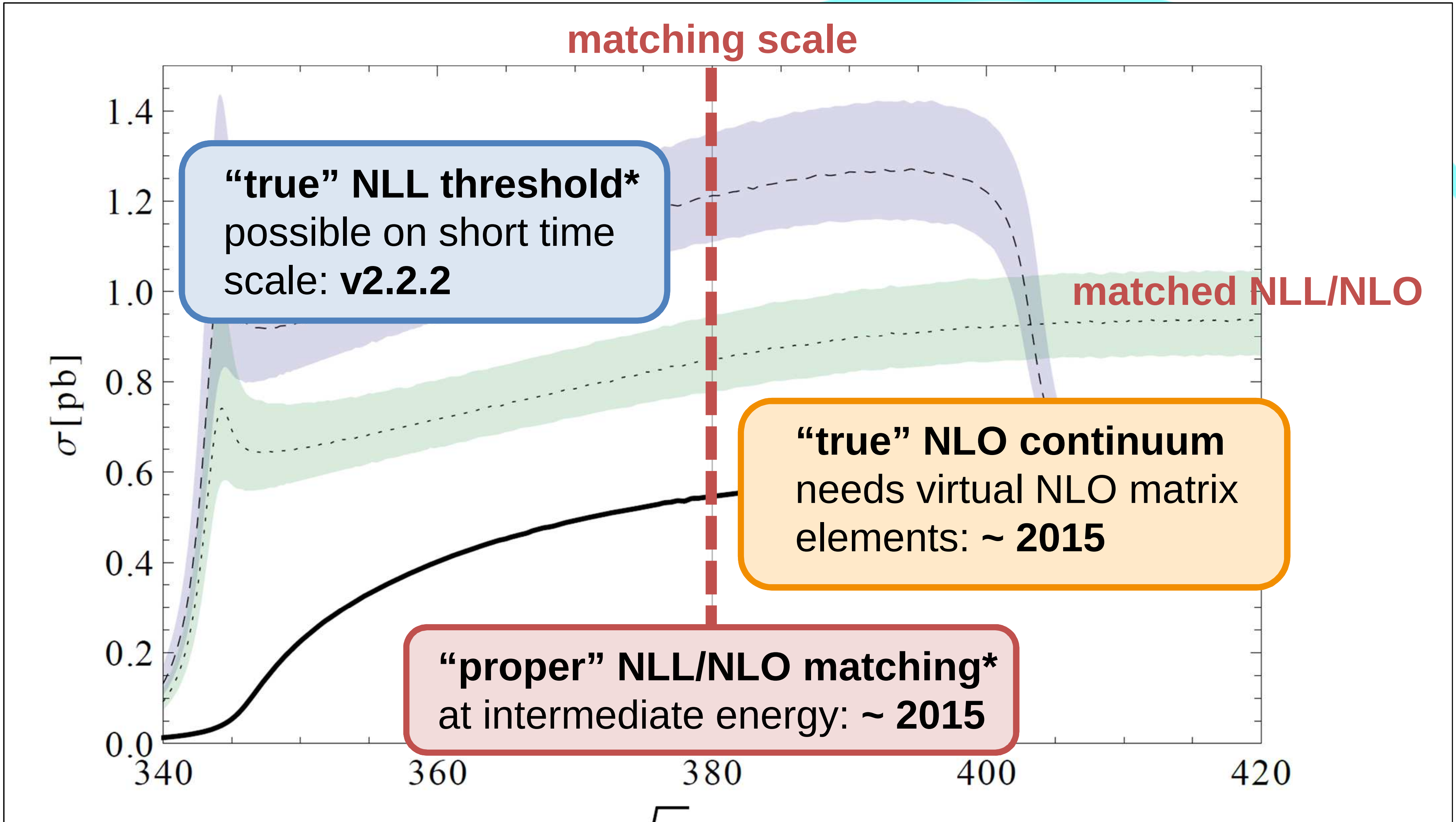

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WHIZARD ttbar threshold model & parameters

> ttbar LC threshold model **not officially released yet** (v2.2.0 unofficial)
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redundant!
→ eliminate one?
→ which one?

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> **more/less flexibility desirable?**
  ➔ eliminate one mass parameter to avoid confusion? → Which one?
  ➔ access/vary vNRQCD cutoff by hand?
  ➔ set threshold order (LL/NLL) manually? (as soon as NLL is there…)
  ➔ …?