Implications of Strict Gauge Invariance for Particle Spectra and Precision Observables

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with
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06th of July 2017
Venice
Italy

Strict Gauge Invariance

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't Hooft'80,
Bank et al.'79]

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  - Peaks in (experimental) cross-sections

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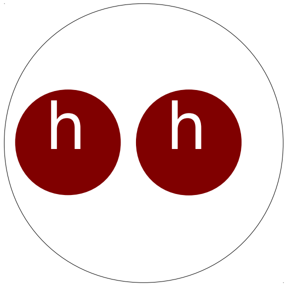

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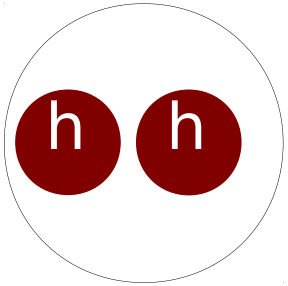

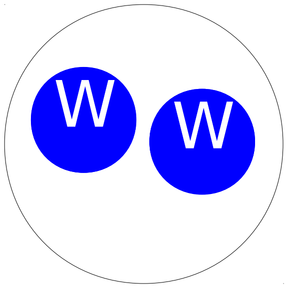

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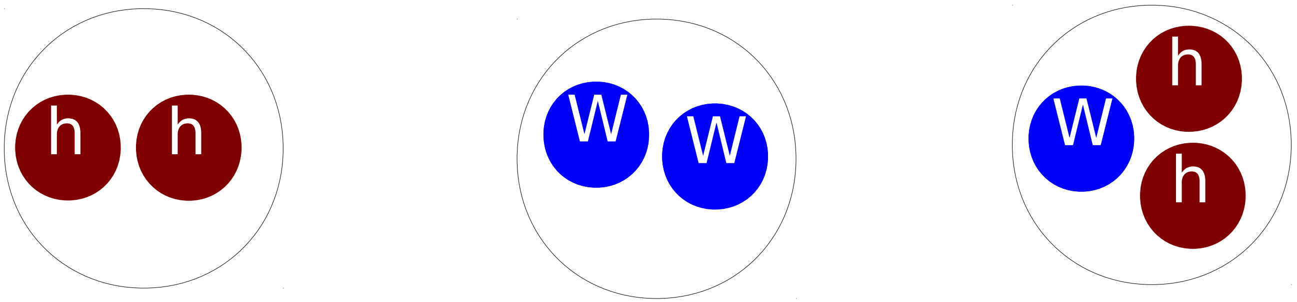

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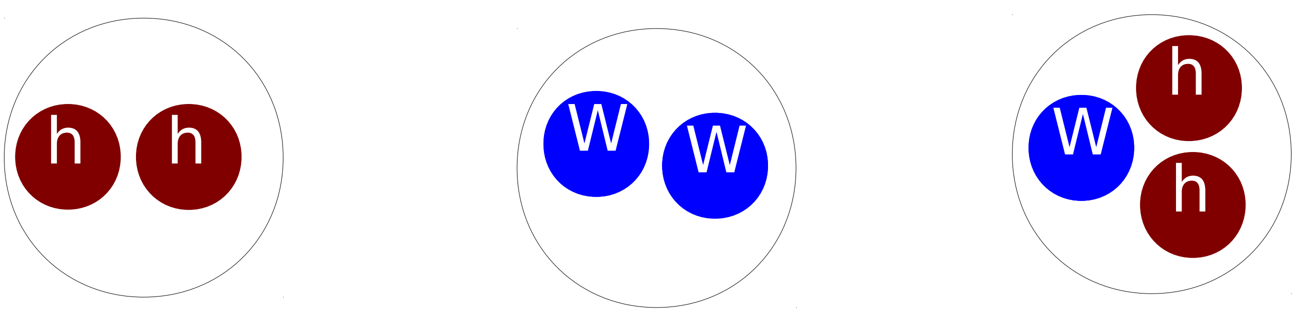

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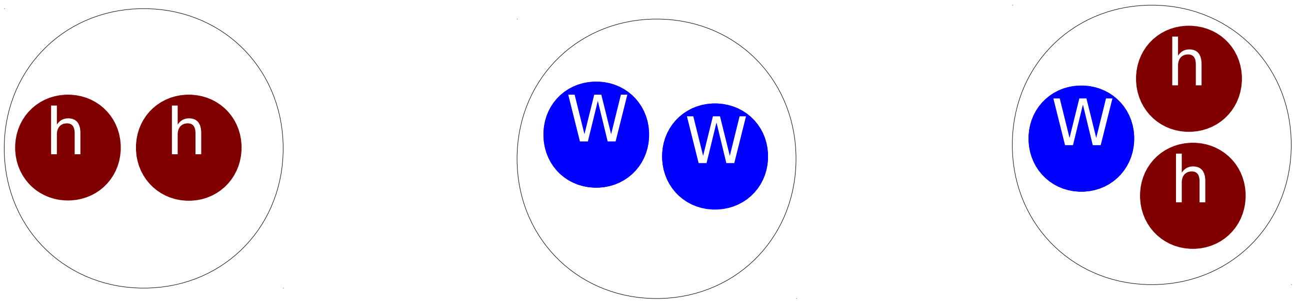

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  - Test: Mass spectrum

Mass relation - Higgs

[Fröhlich et al.'80
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  - But: Physical state is a custodial triplet!

Flavor

[Fröhlich et al.'80,
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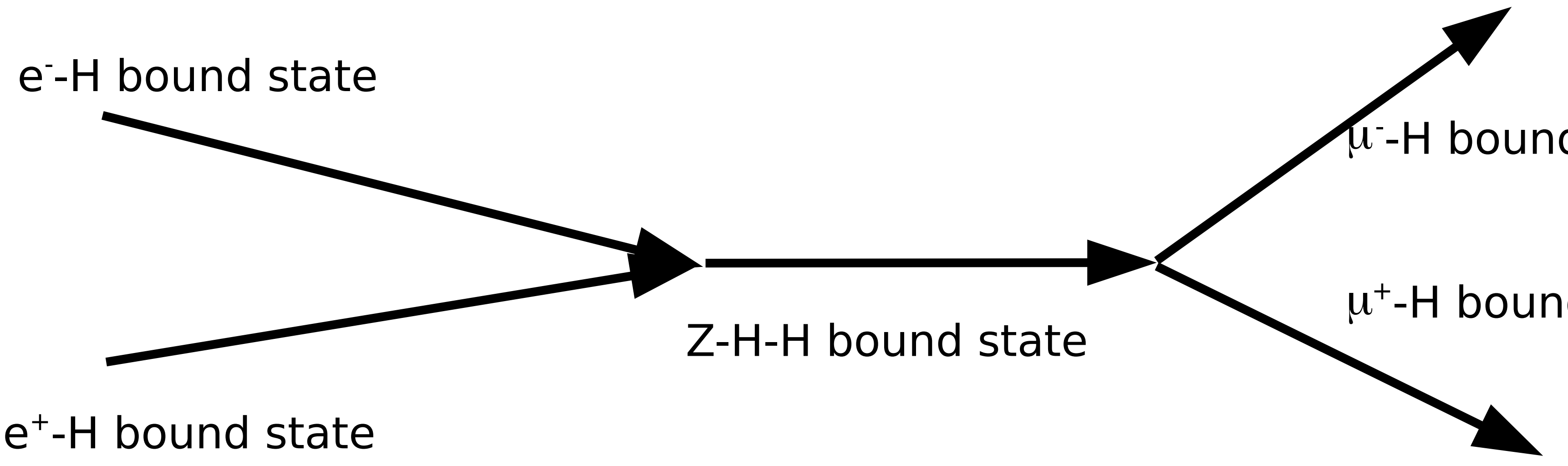
How events looks like (LEP/ILC)

[Maas'12]



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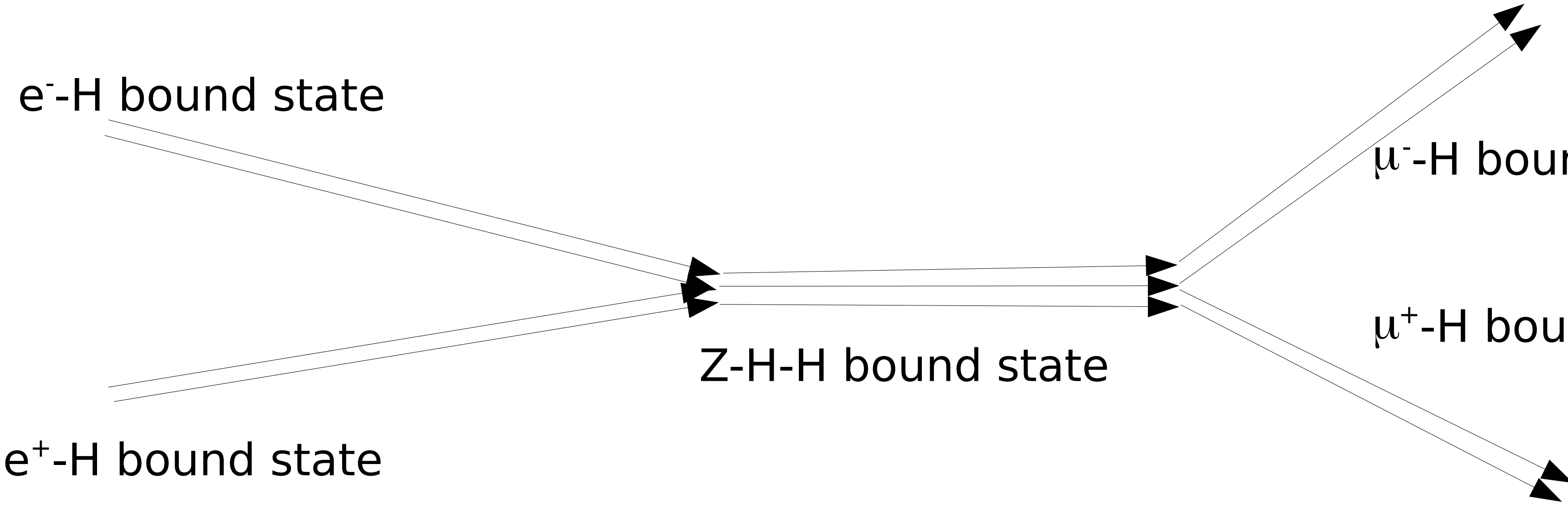

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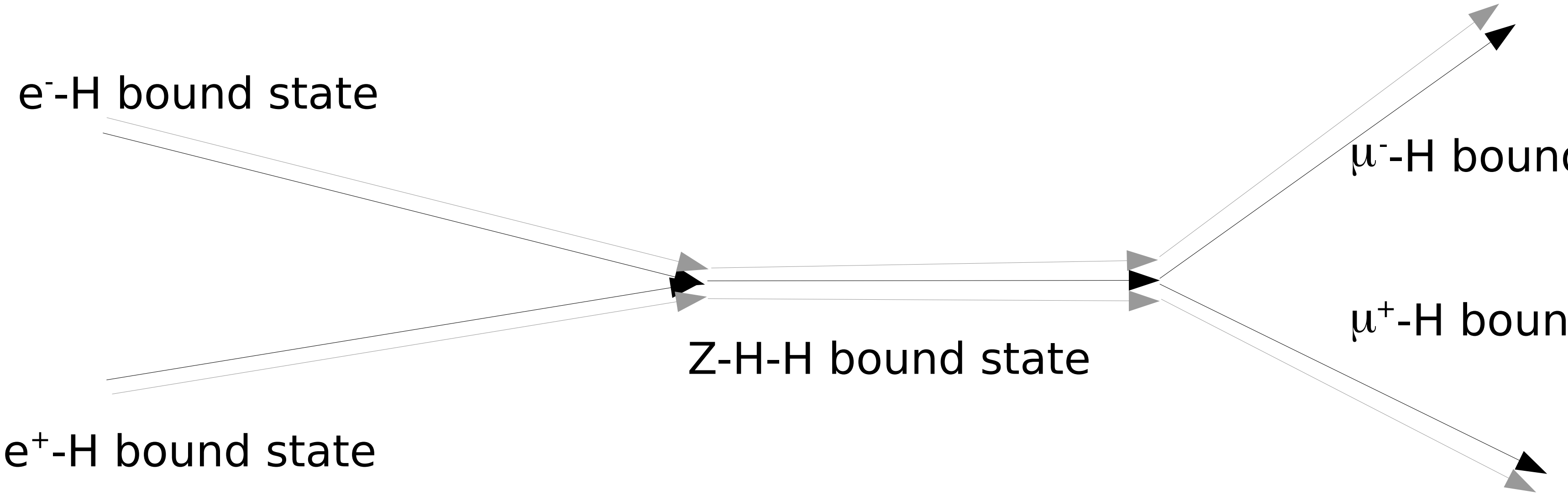

- Collision of bound states - 'constituent' particles
- Higgs partners just spectators
  - Similar to pp collisions

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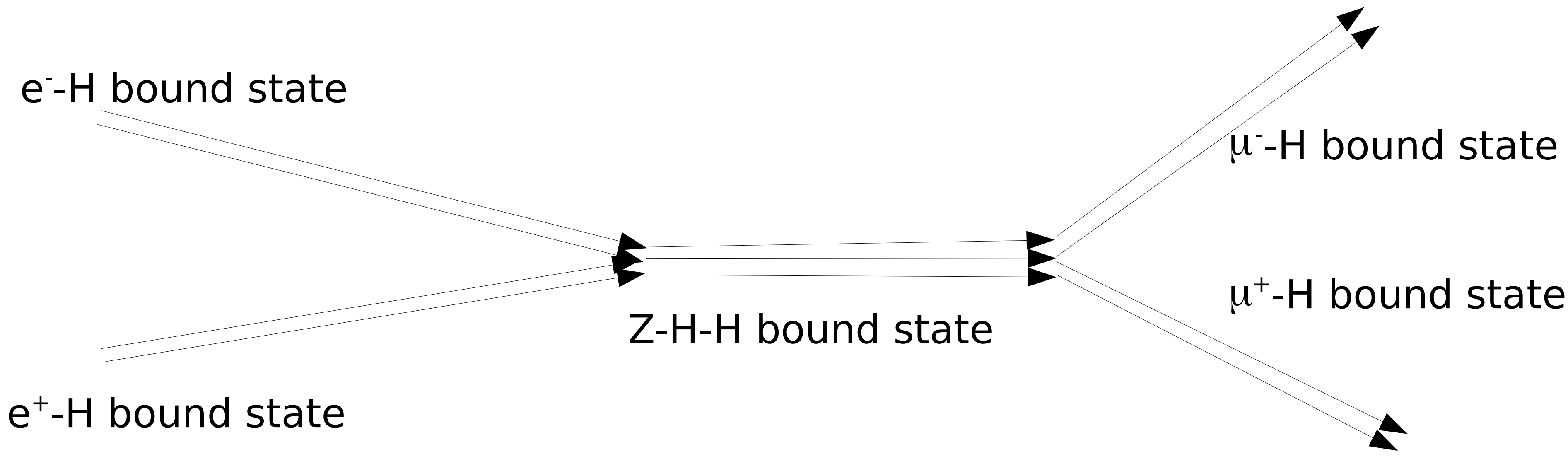

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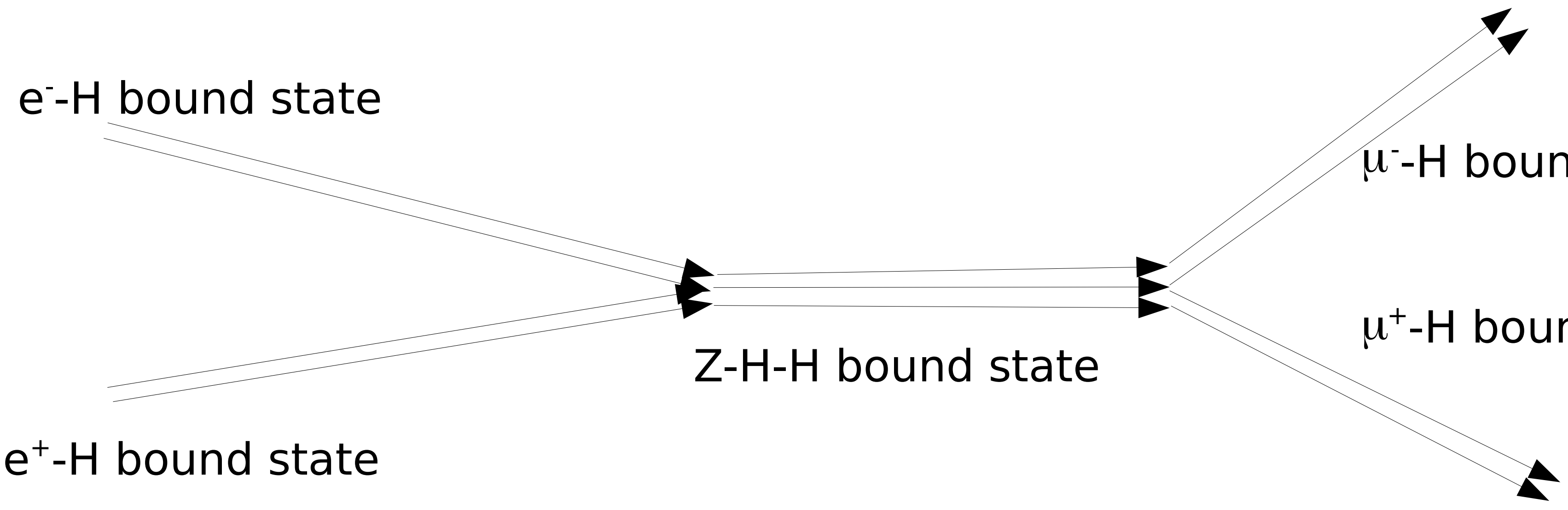

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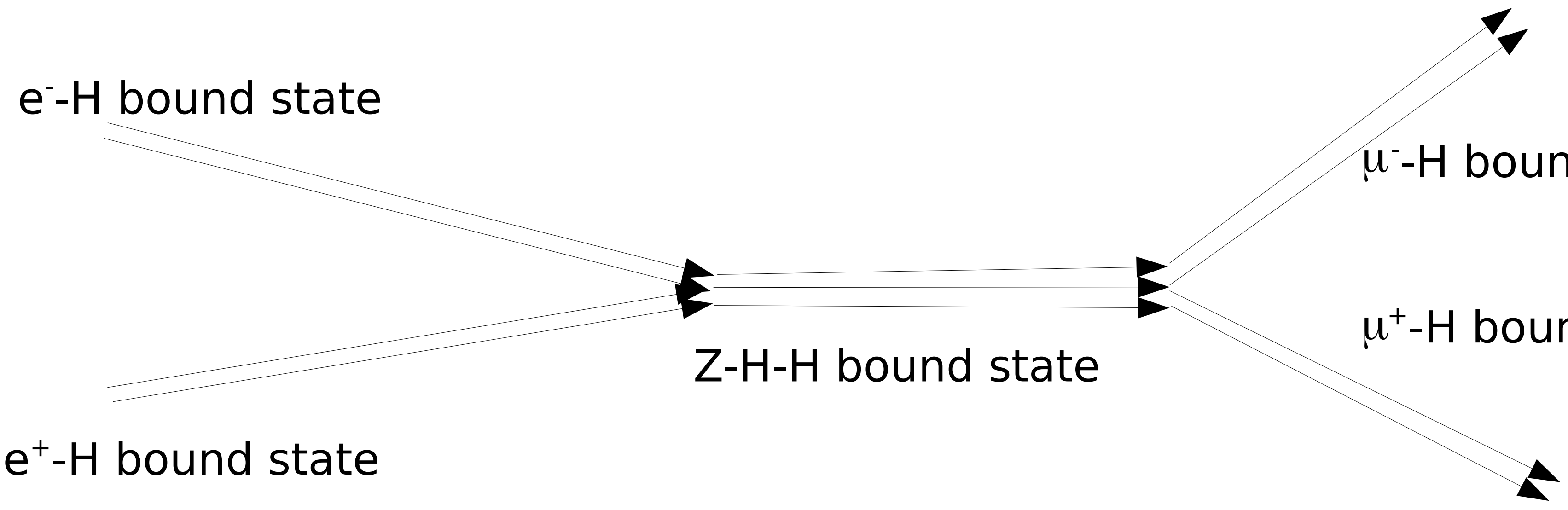

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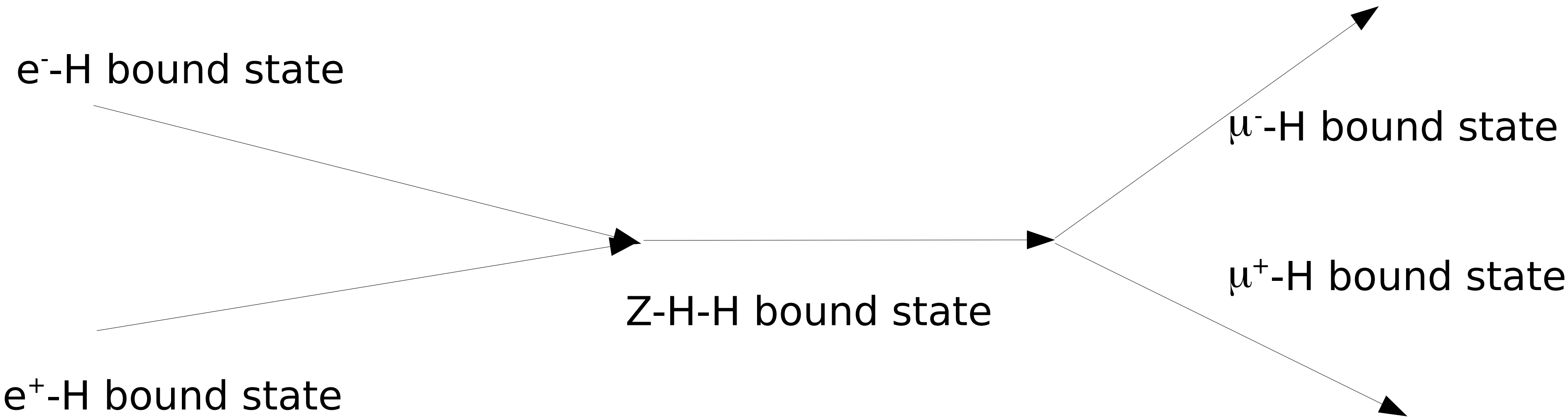

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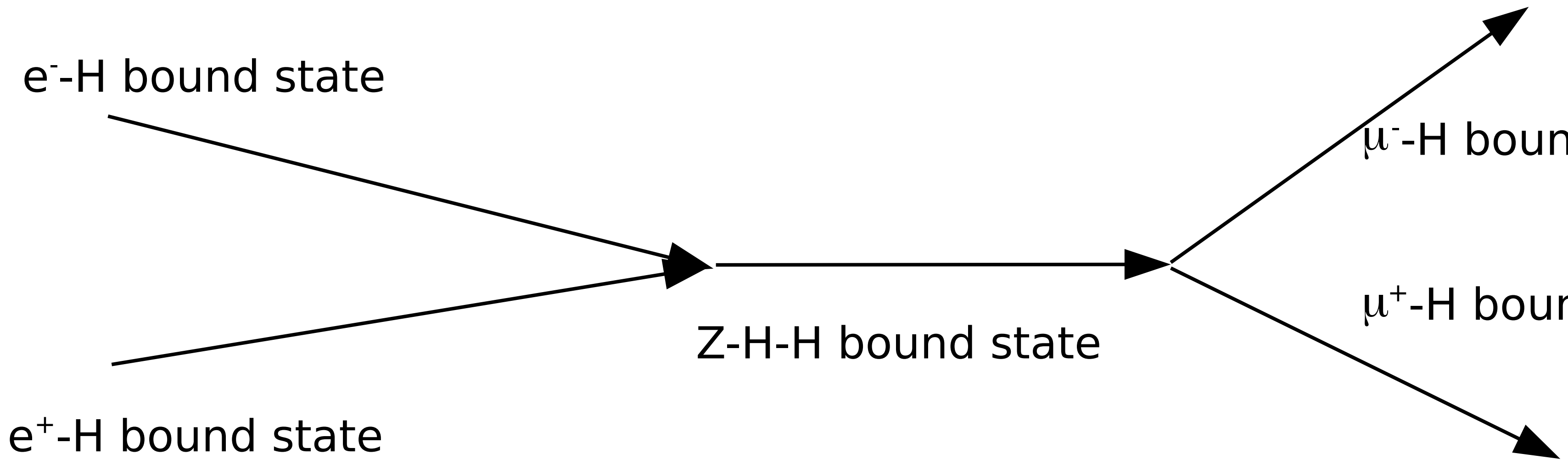

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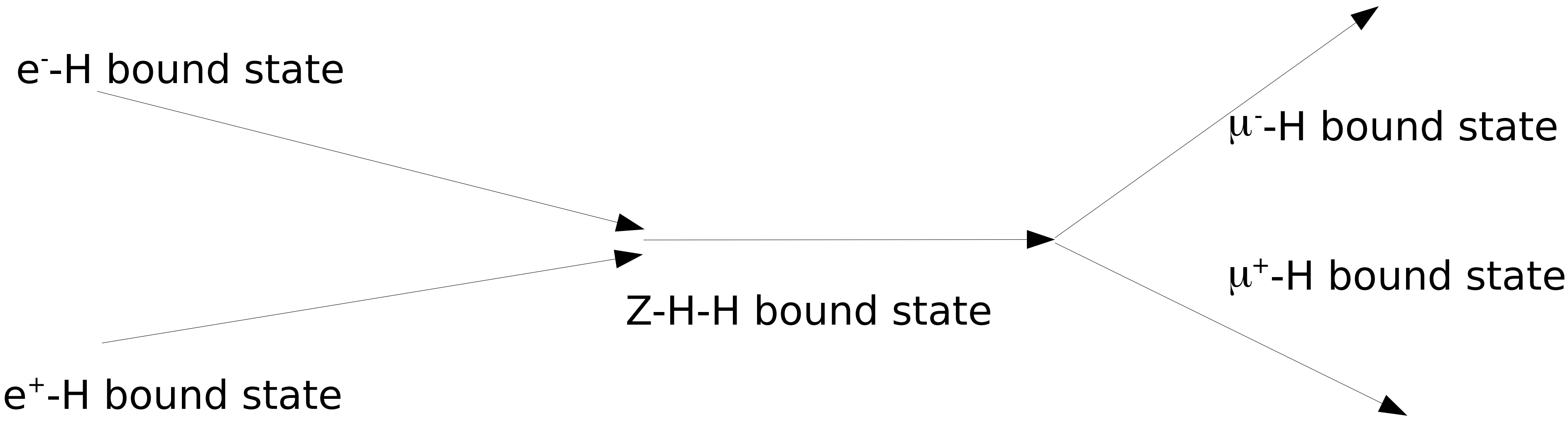

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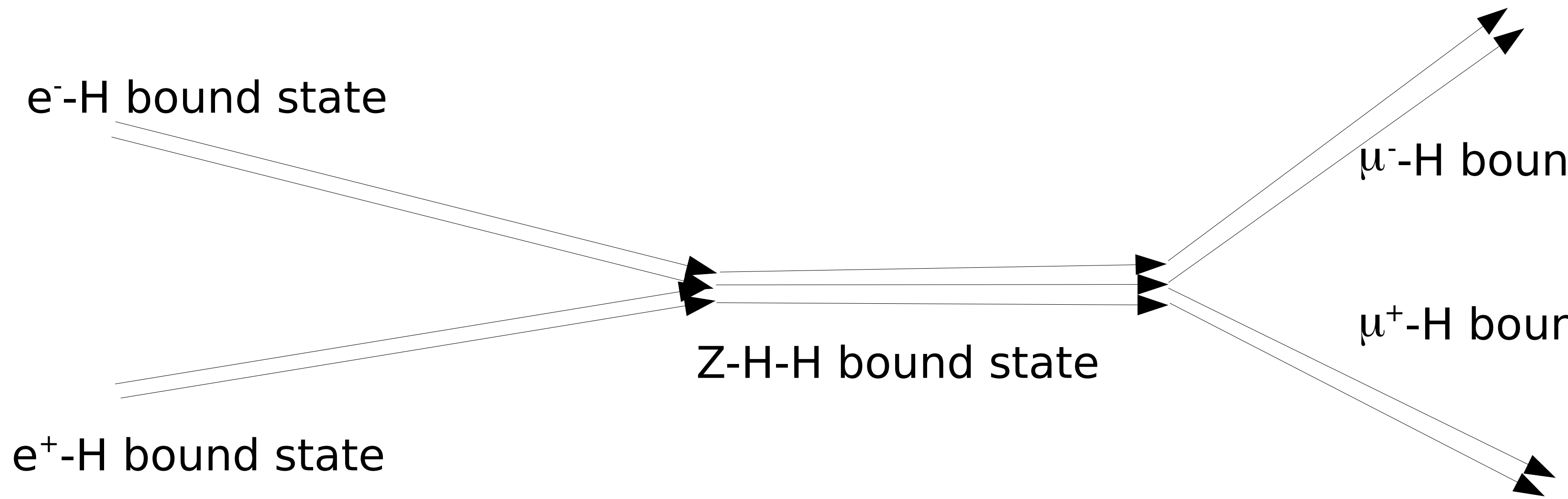

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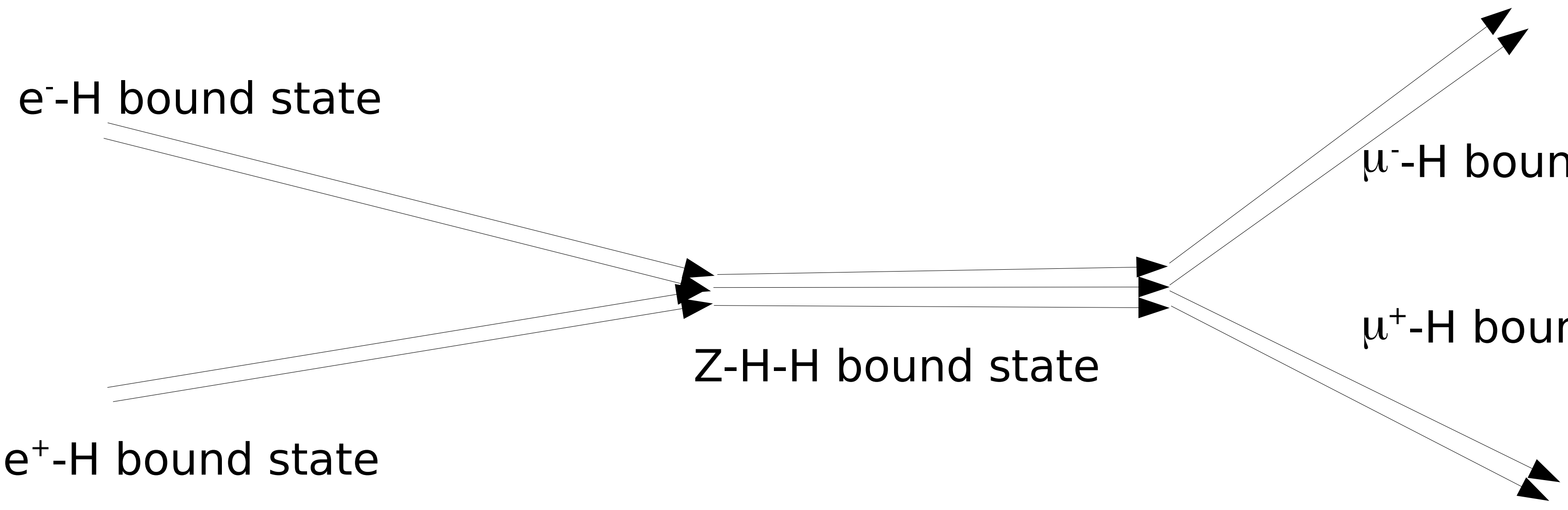

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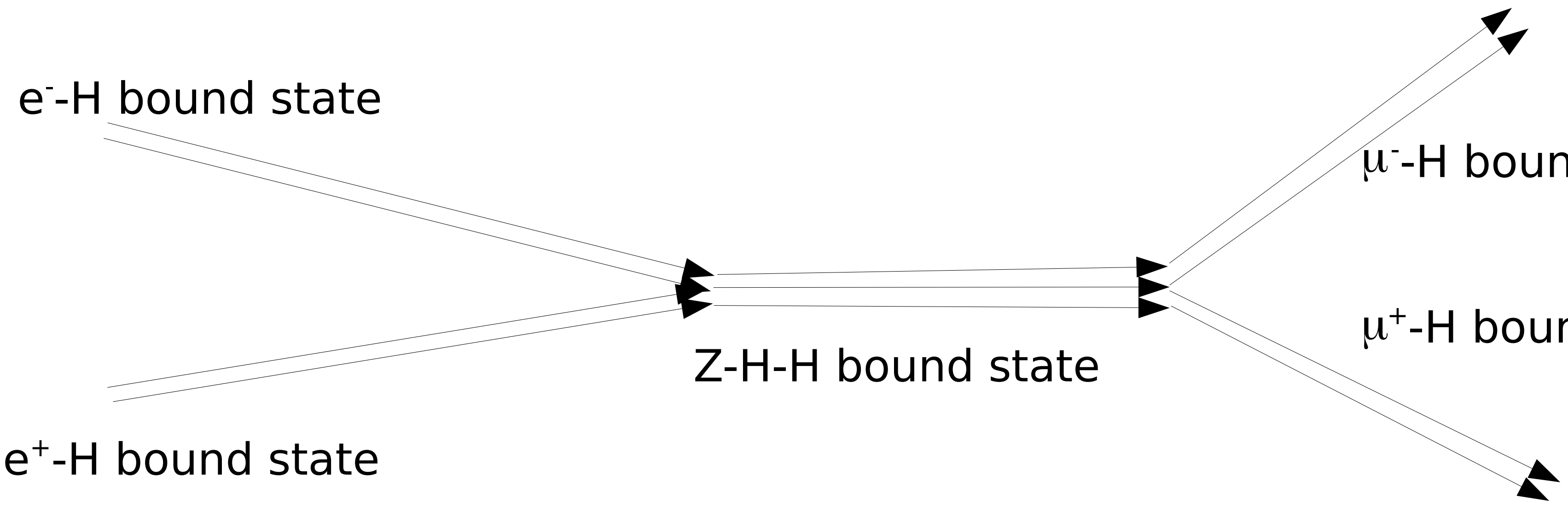

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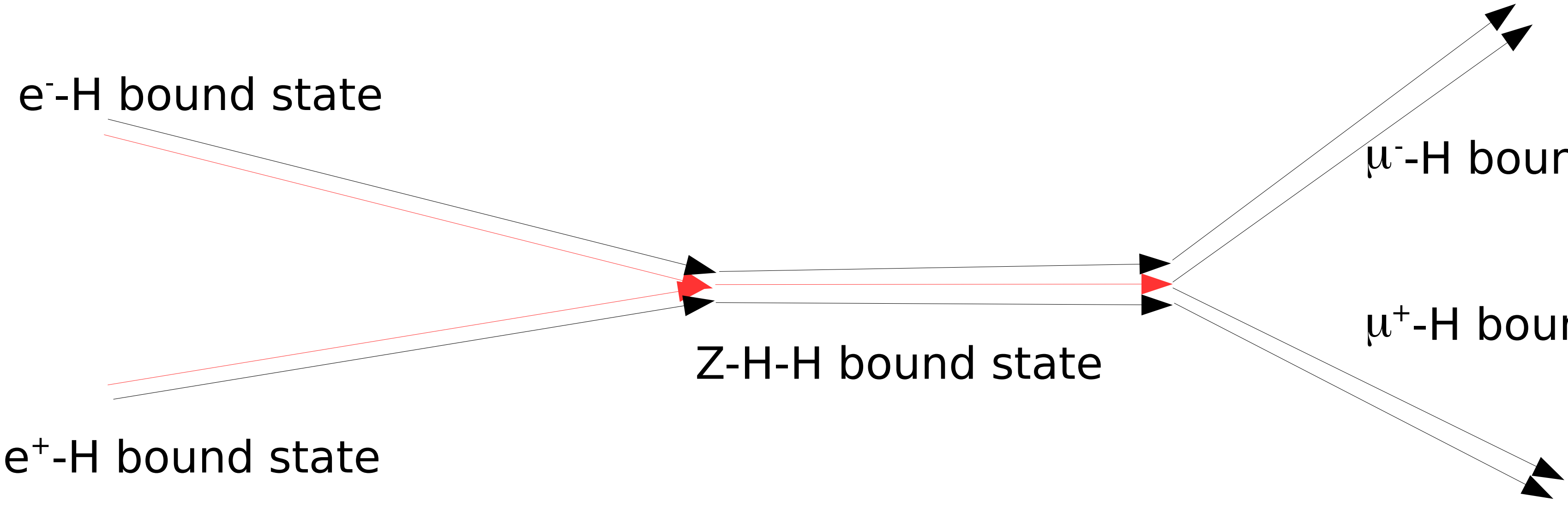

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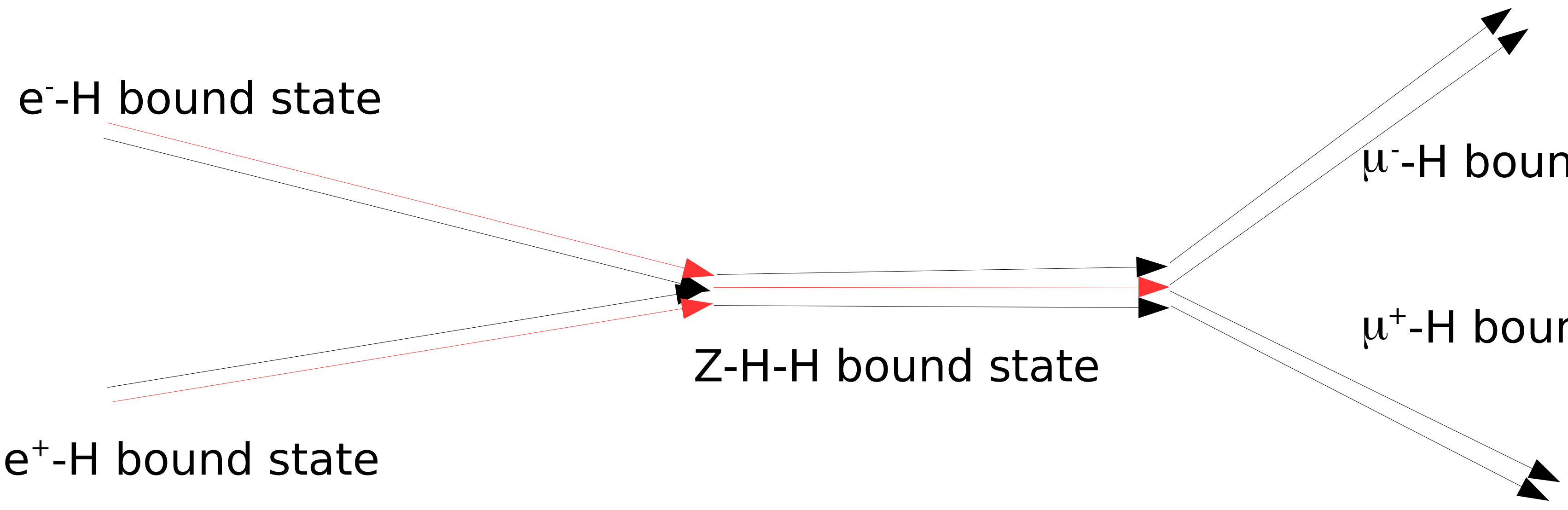

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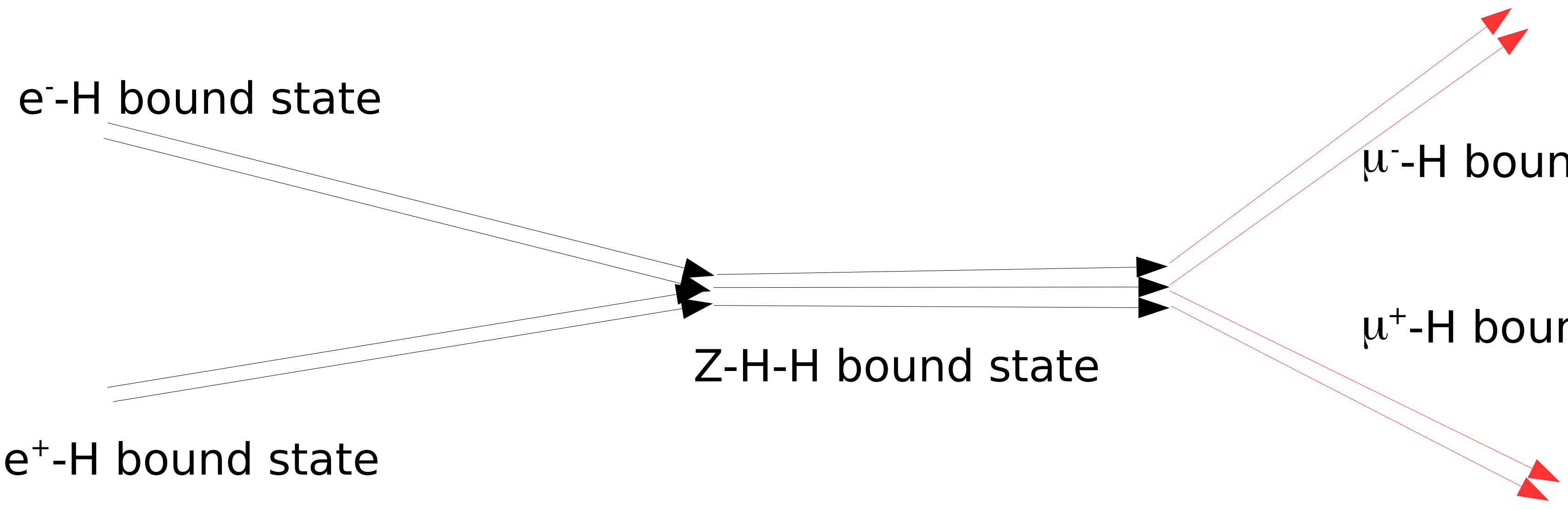

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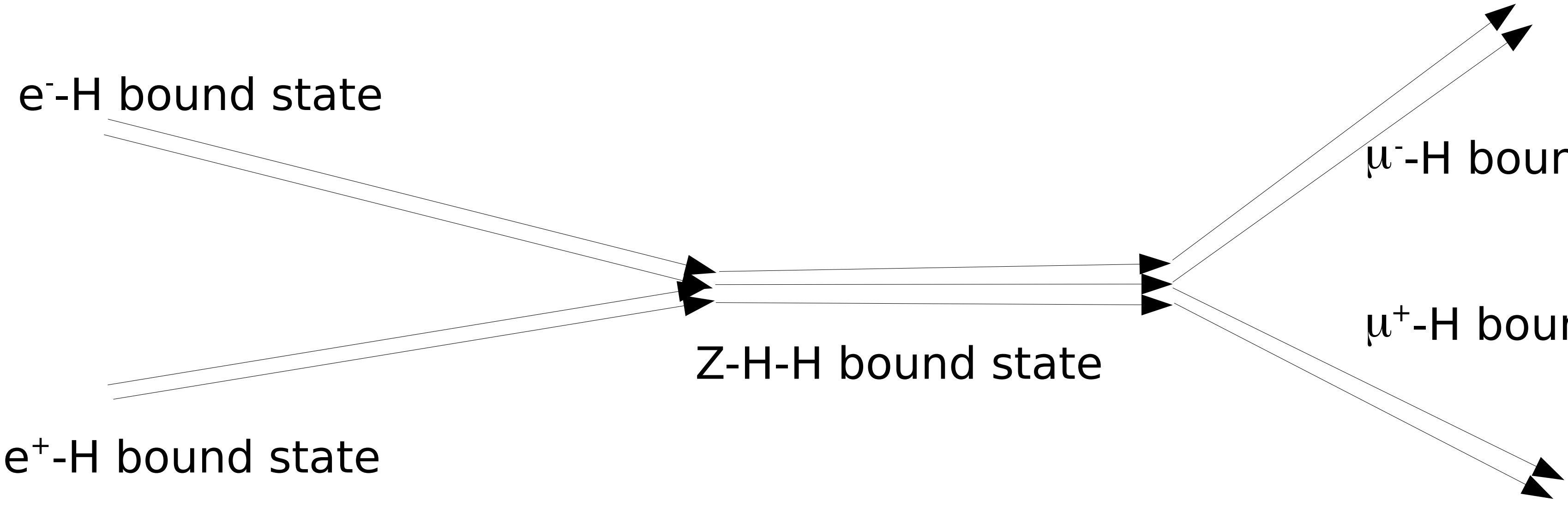

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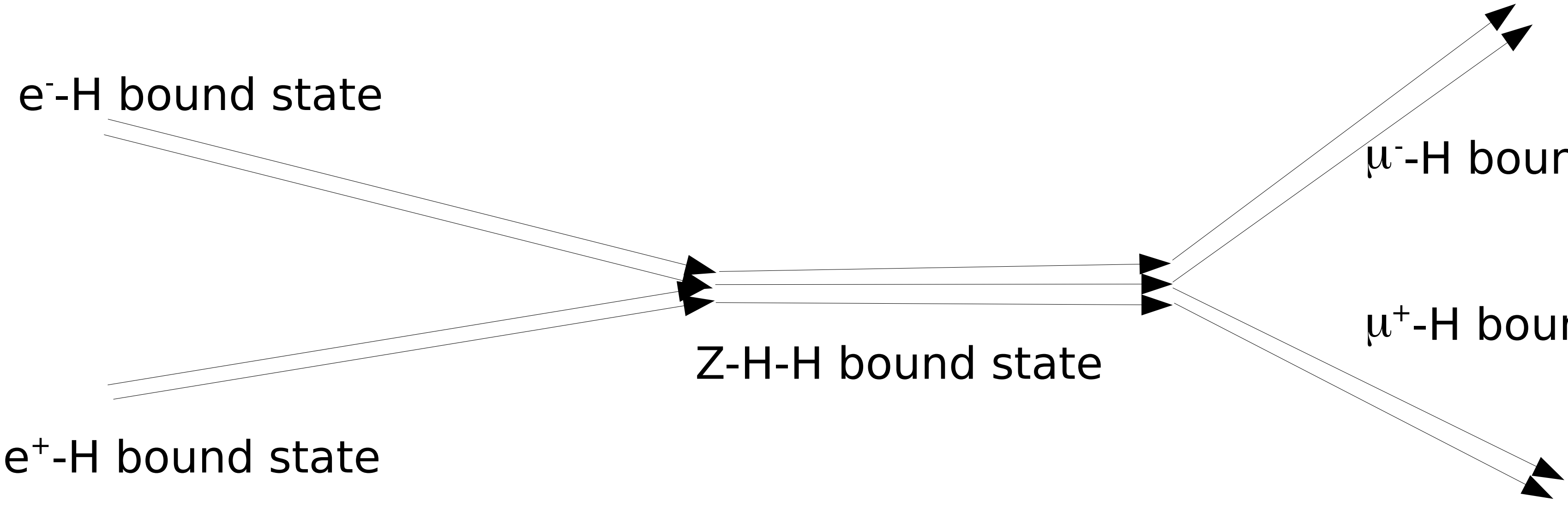

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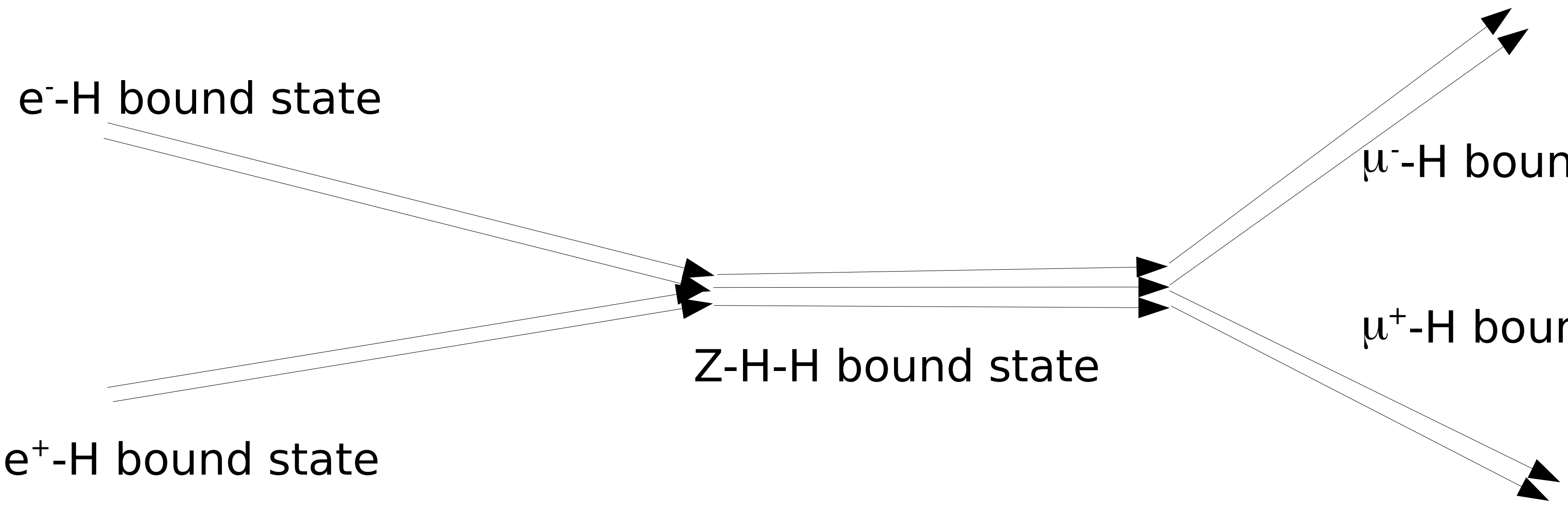

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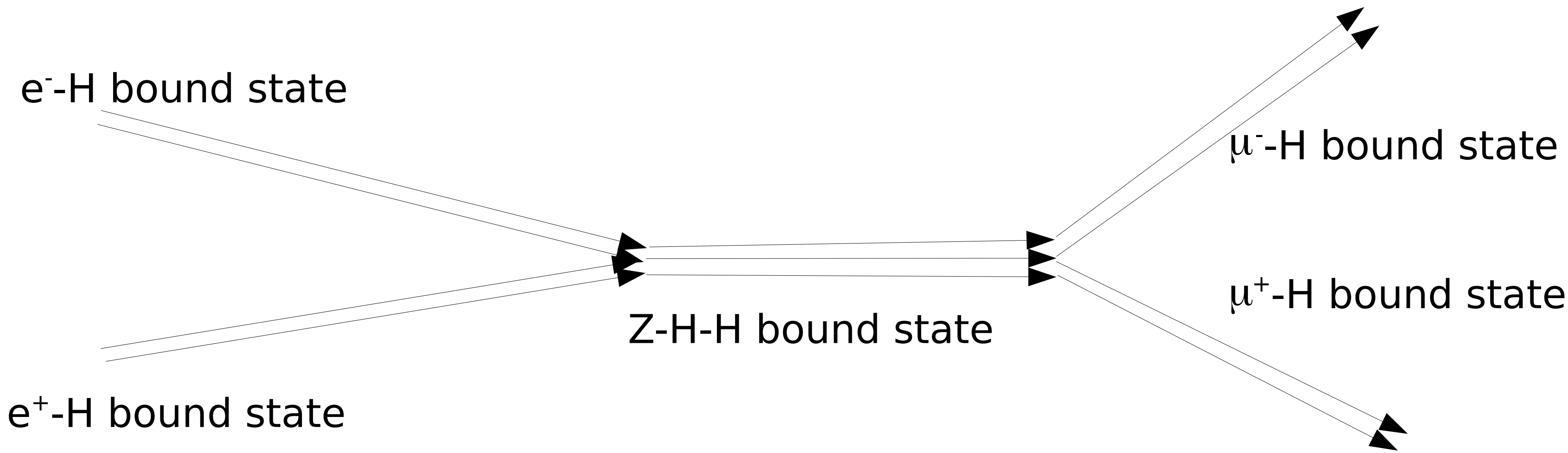
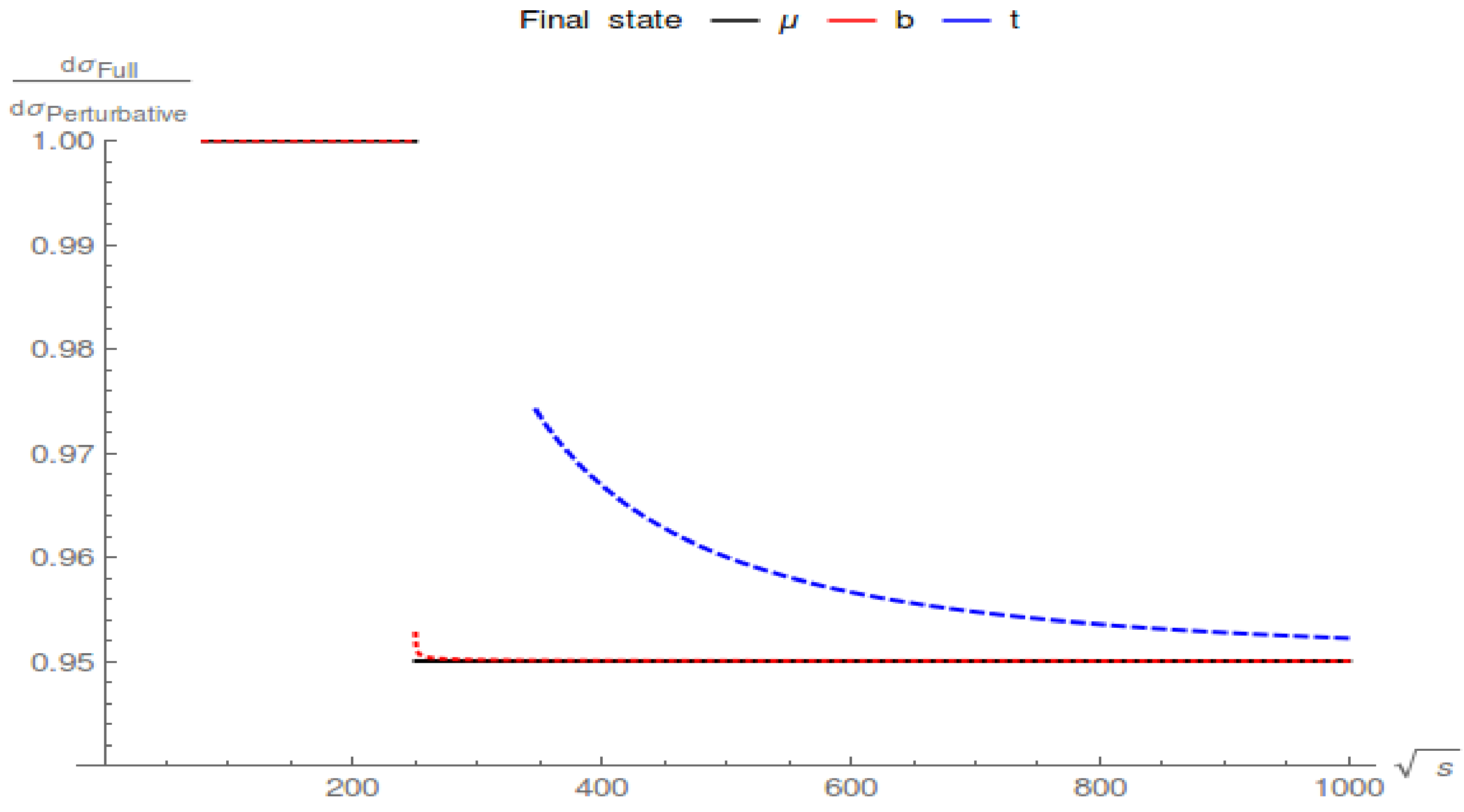
  - No data for PDFs available → model: 2.5% Higgs

How events looks like (ILC)

[Egger, Maas, Sondenheimer'17]





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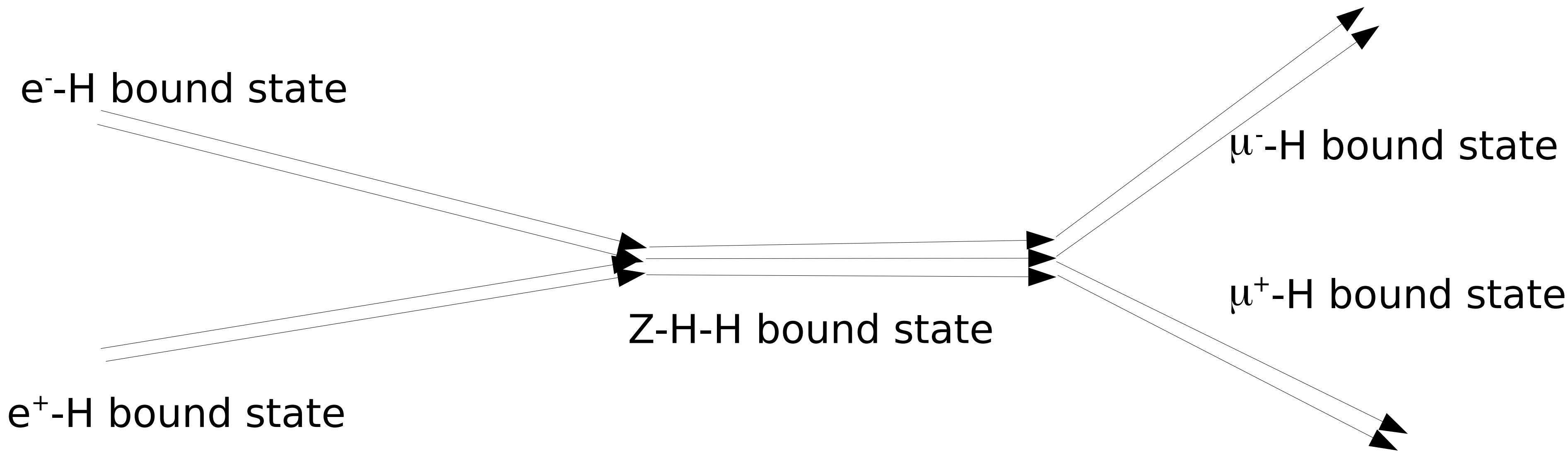

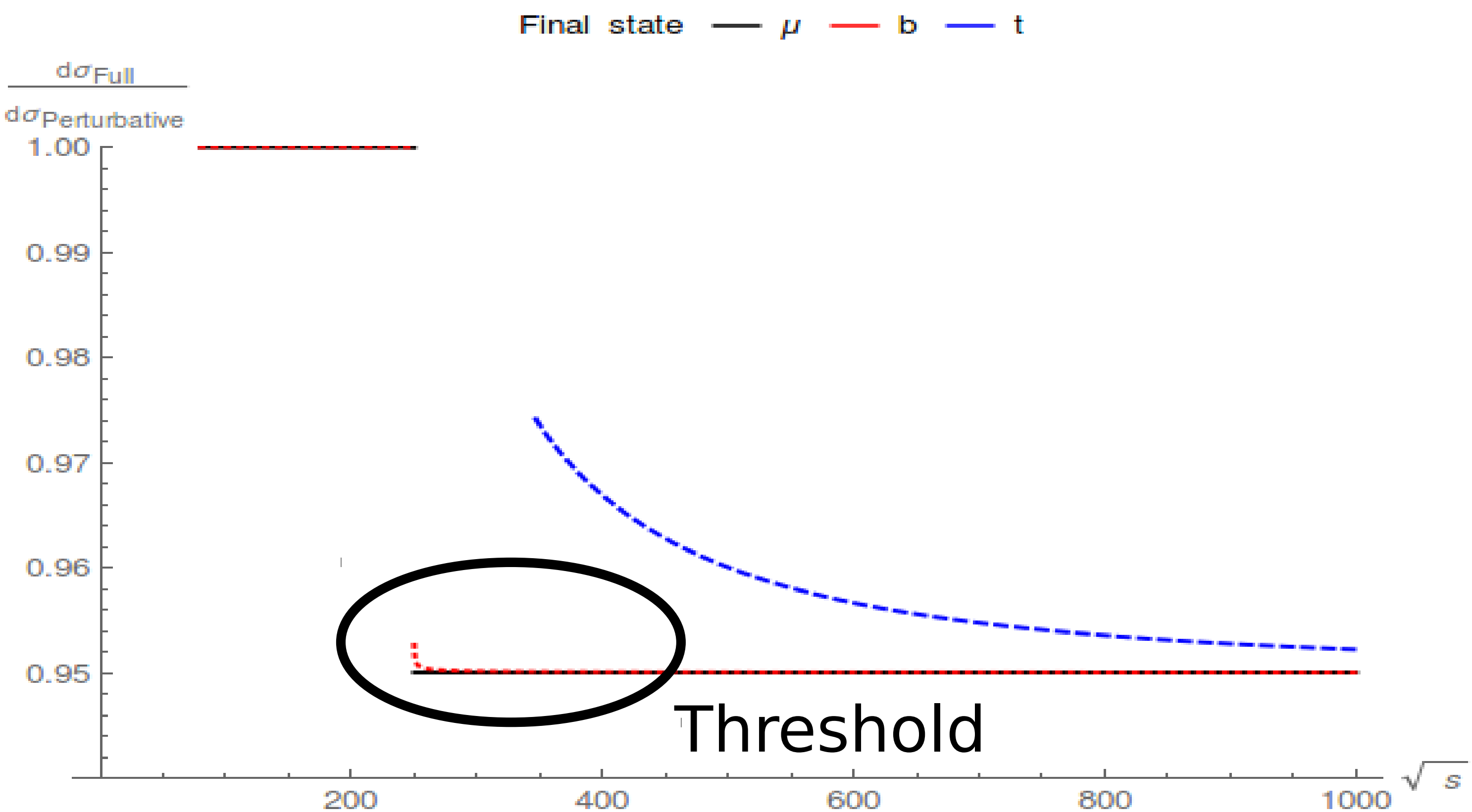

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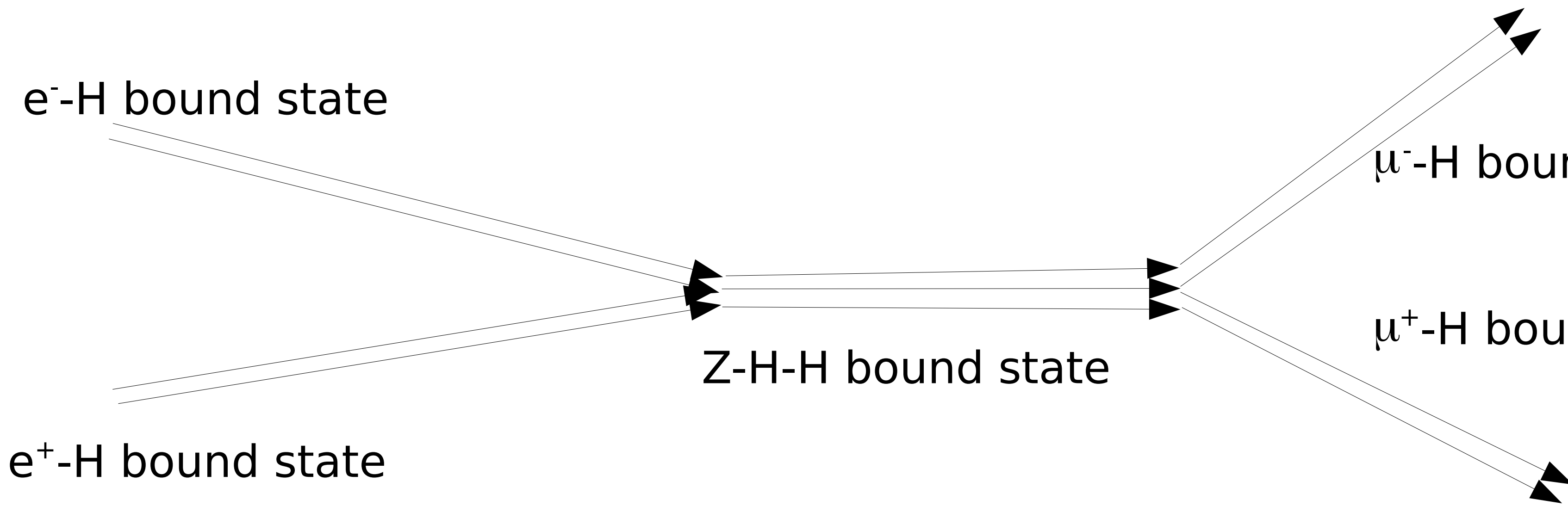

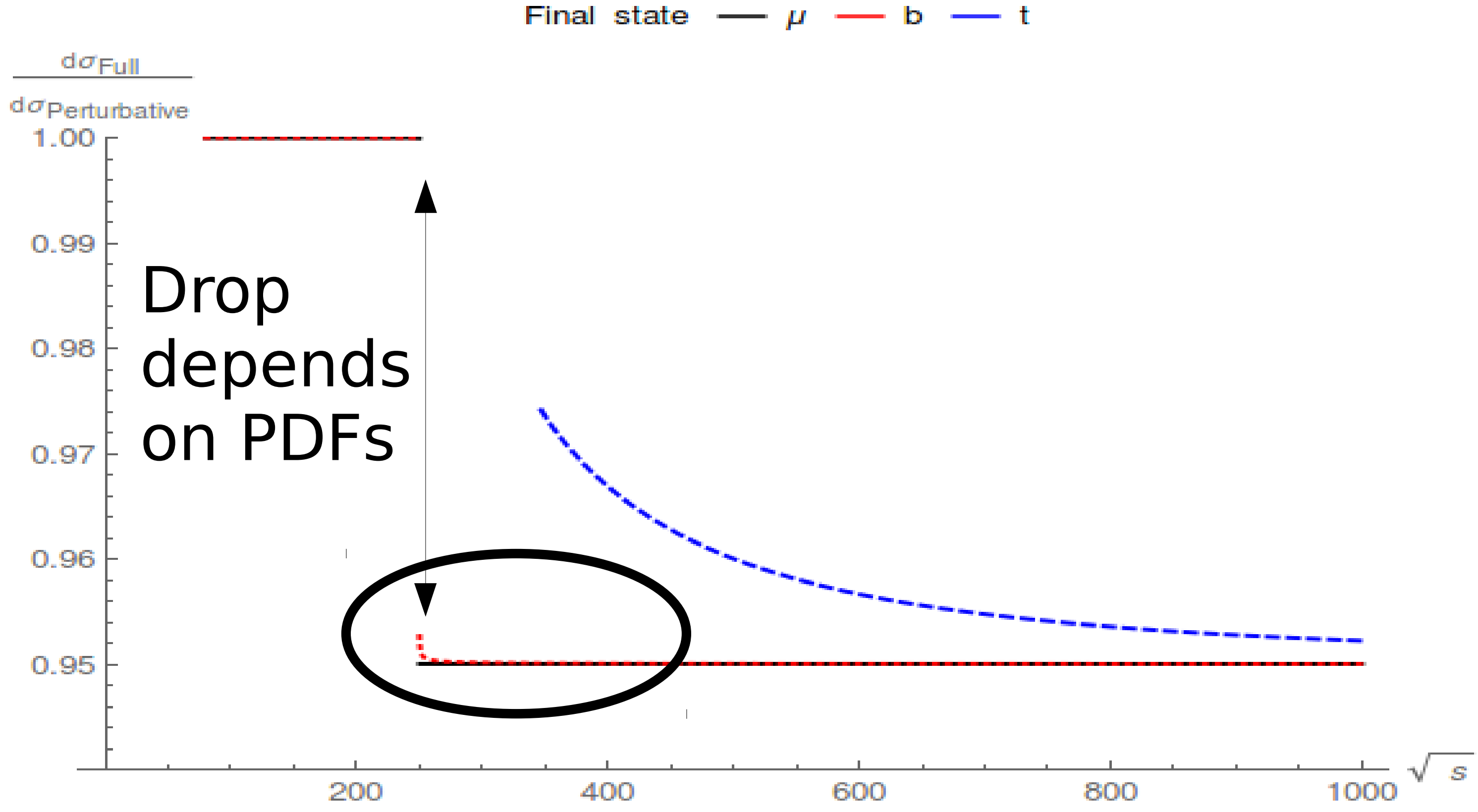

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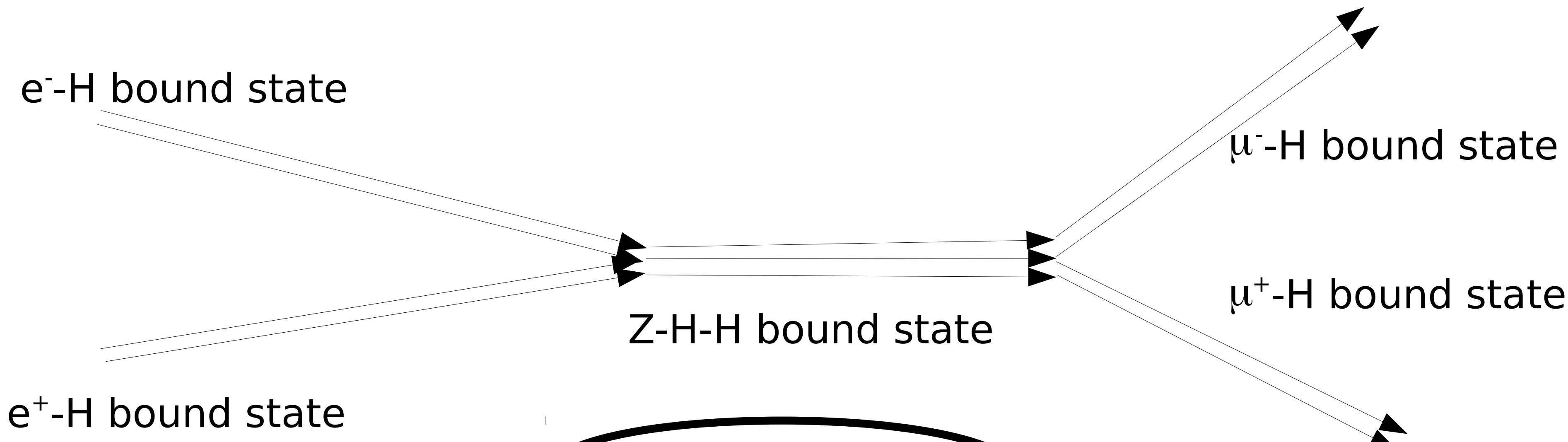

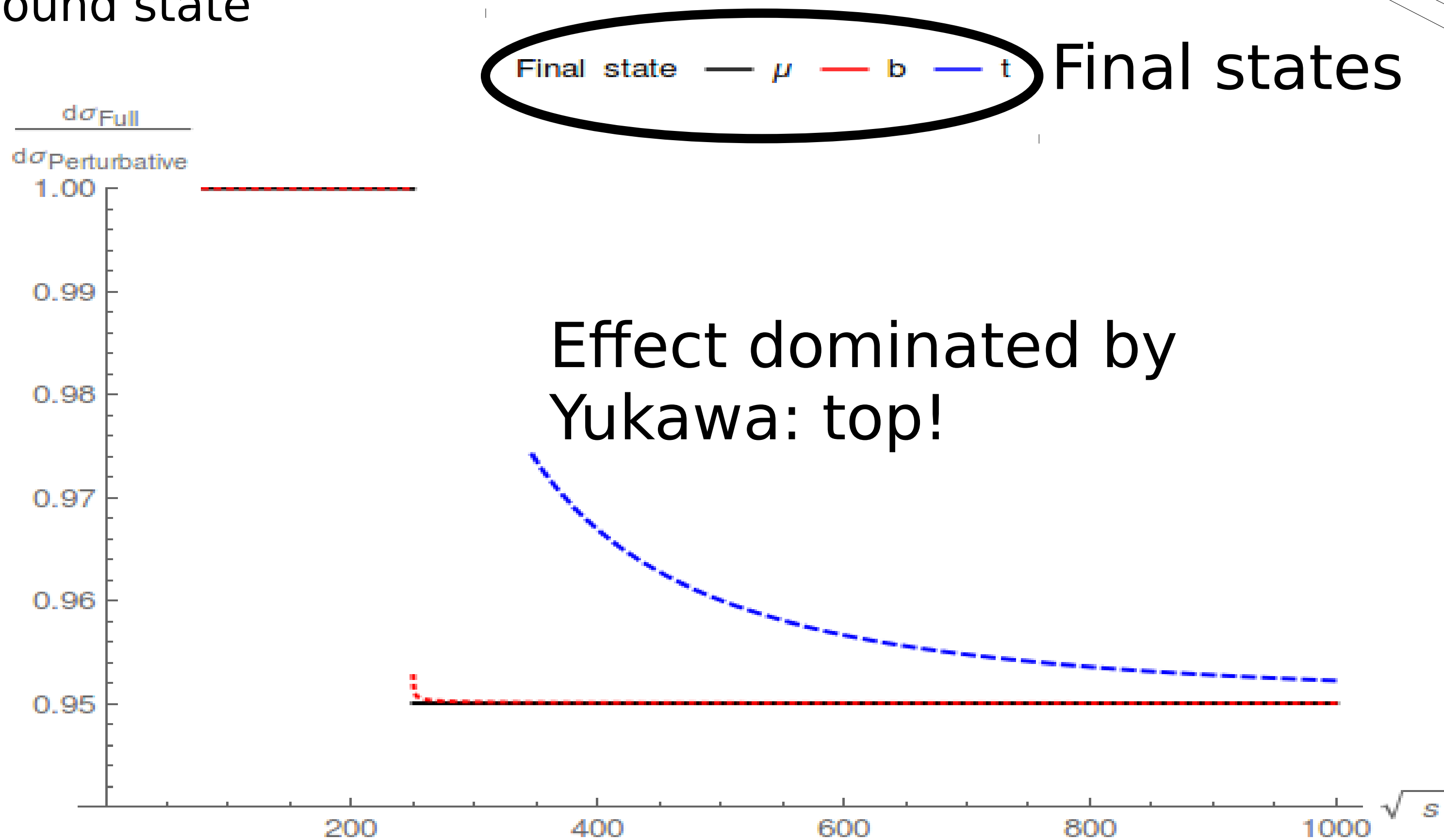

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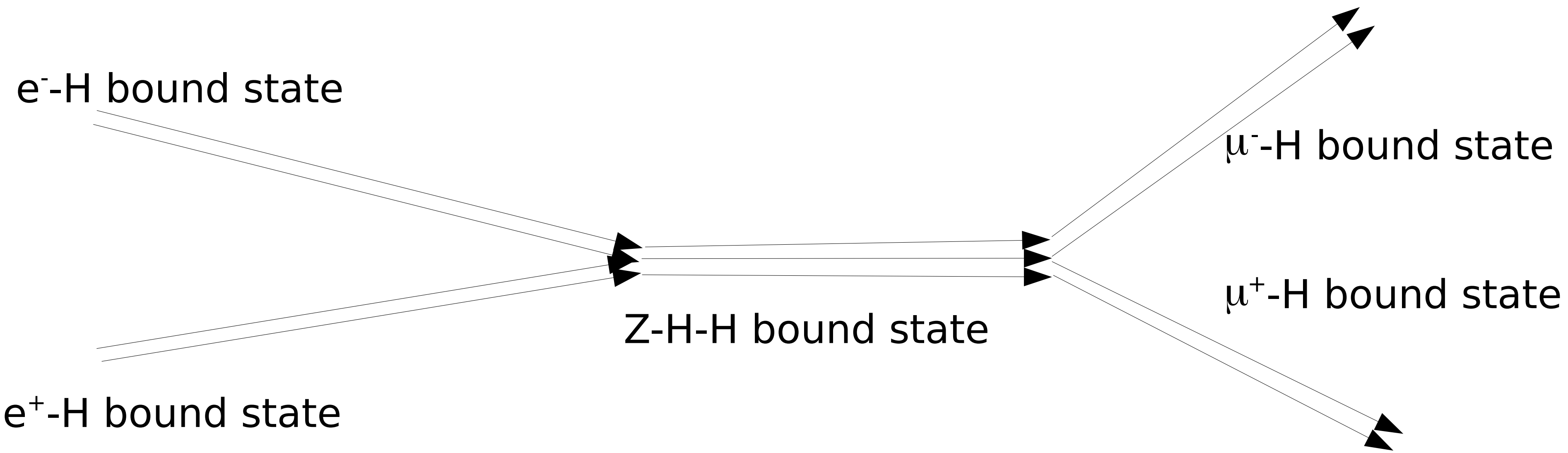

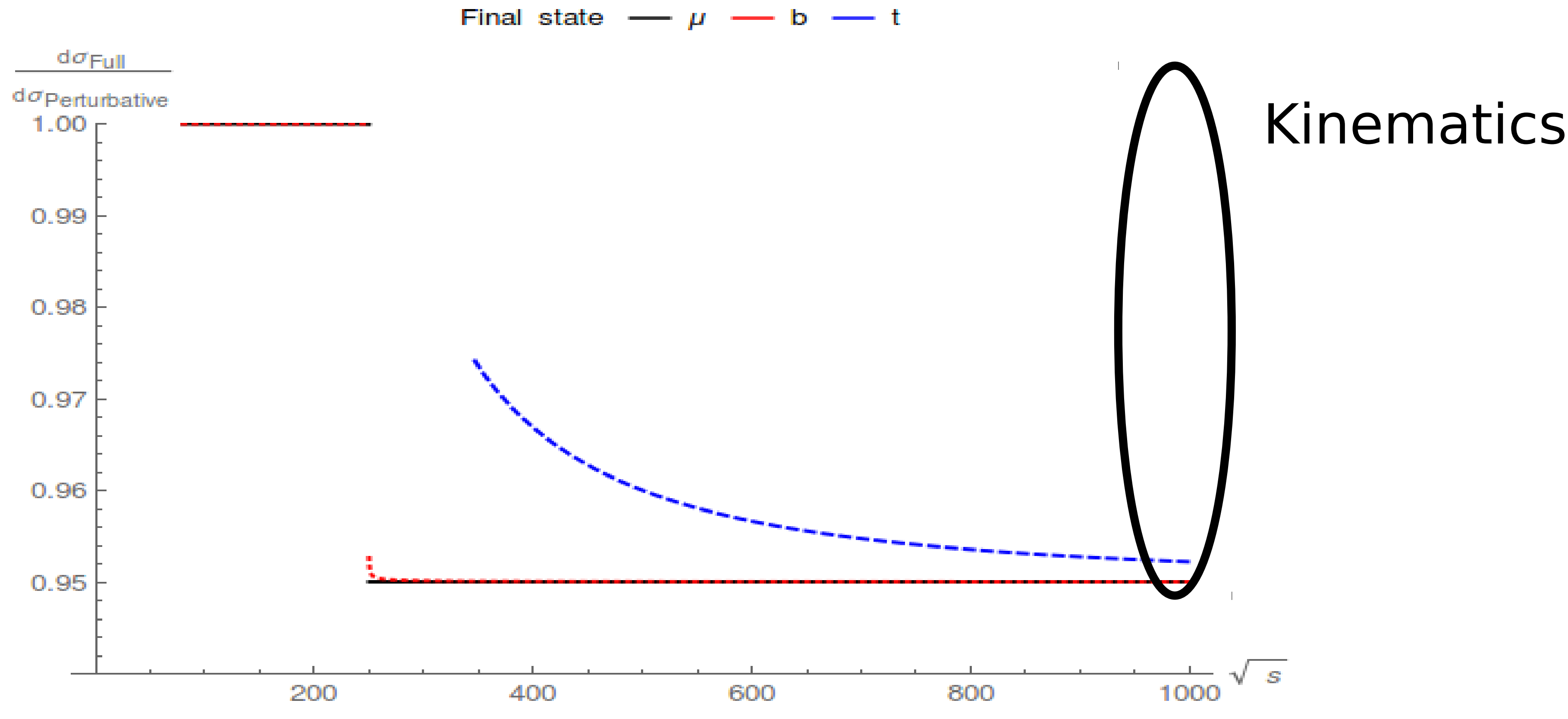

Summary

[Maas'12,'15
Törek & Maas'16
Egger, Maas, Sondenheimer'17]

- Observable spectrum must be gauge-invariant
  - In non-Abelian gauge theories: Bound states
  - FMS mechanism: Success of perturbation theory

Introduction: 1610.04188 These results: 1701.02881

Review upcoming

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- Higgs admixture to many states
  - Small effect...but may be testable!
  - Must be accounted for in new physics searches
  - Similar considerations for pp: Watch pp $\rightarrow \bar{t}t$

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- Observable spectrum must be gauge-invariant
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- Qualitative impact beyond the standard model

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Review upcoming