

# Weakly-coupled low-mass bound states in 3 vector boson final states

**Axel Maas**

1<sup>st</sup> of October 2013  
Anomalous Quartic Gauge Couplings  
Dresden  
Germany



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- Resolves several theoretical inconsistencies

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# The trick with the Higgs

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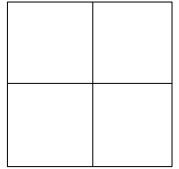
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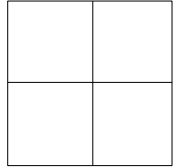
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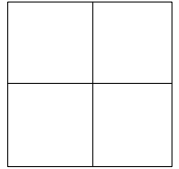


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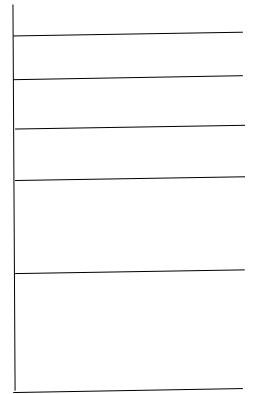
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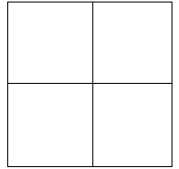




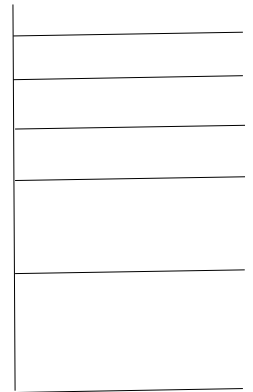
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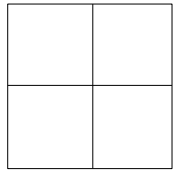
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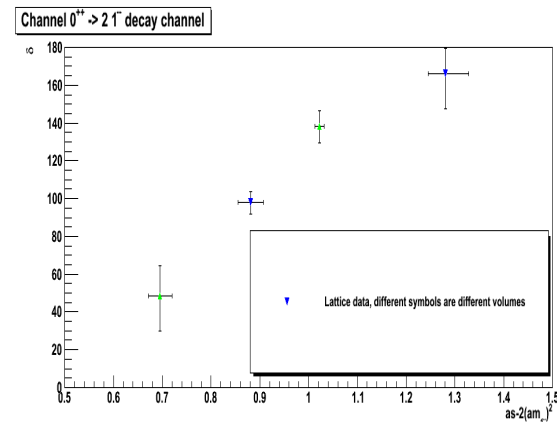
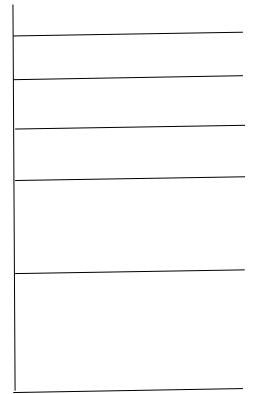
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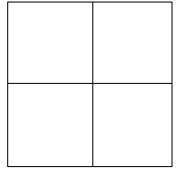
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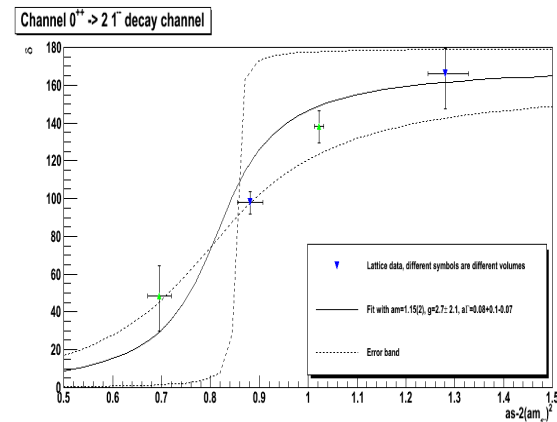
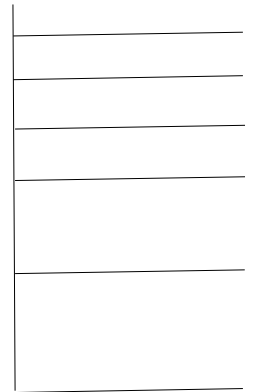
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- Phase shift fits to determine resonance properties, e.g. width



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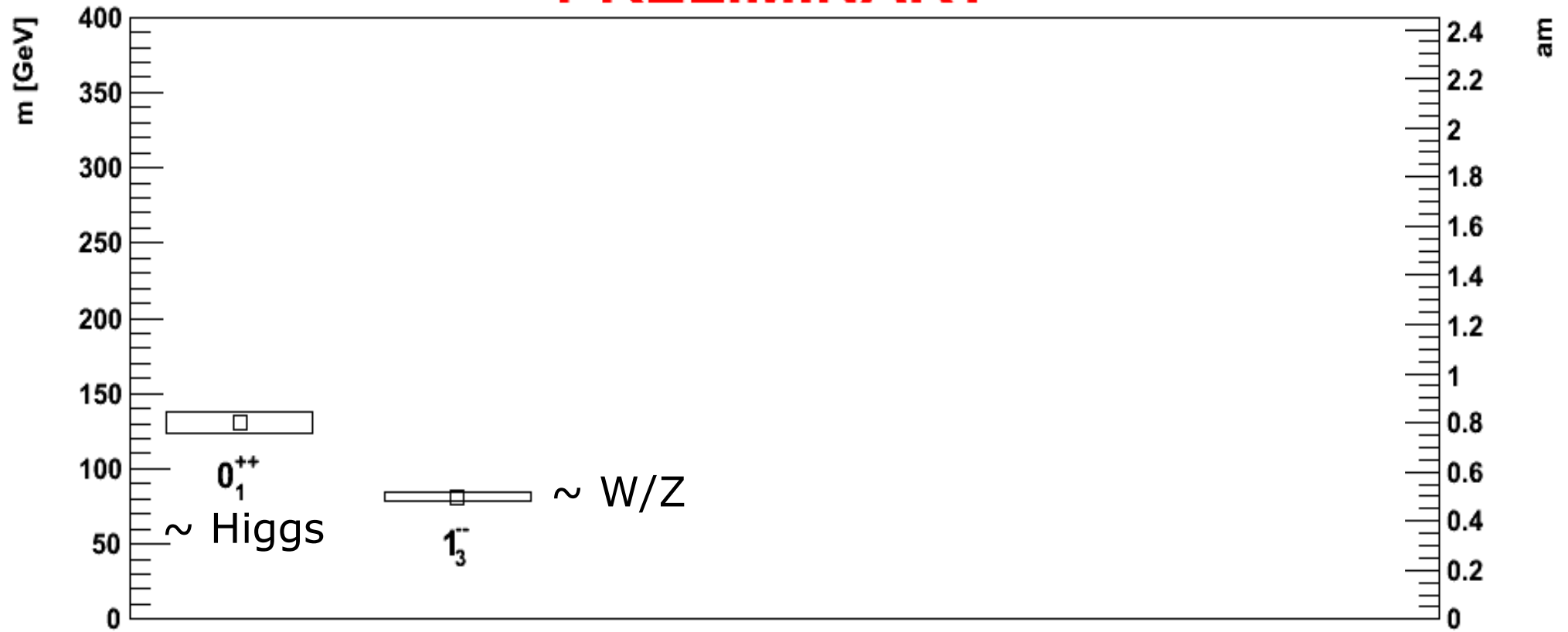
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    - Important contribution to gauge-beta function
  - Fixing parameters by Higgs and  $W/Z$  mass and running coupling
    - A third mass would be better

# Spectrum

Spectrum

**PRELIMINARY**

[Maas et al. Unpublished, '12]

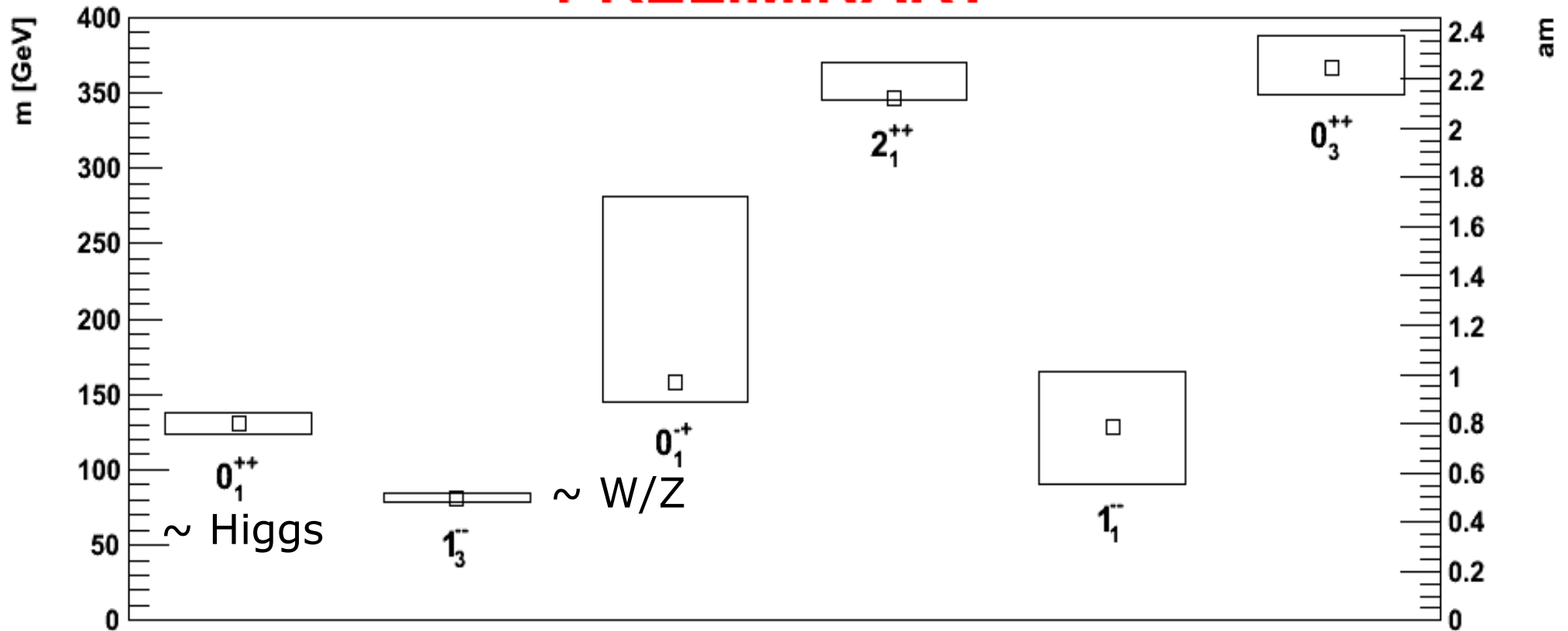


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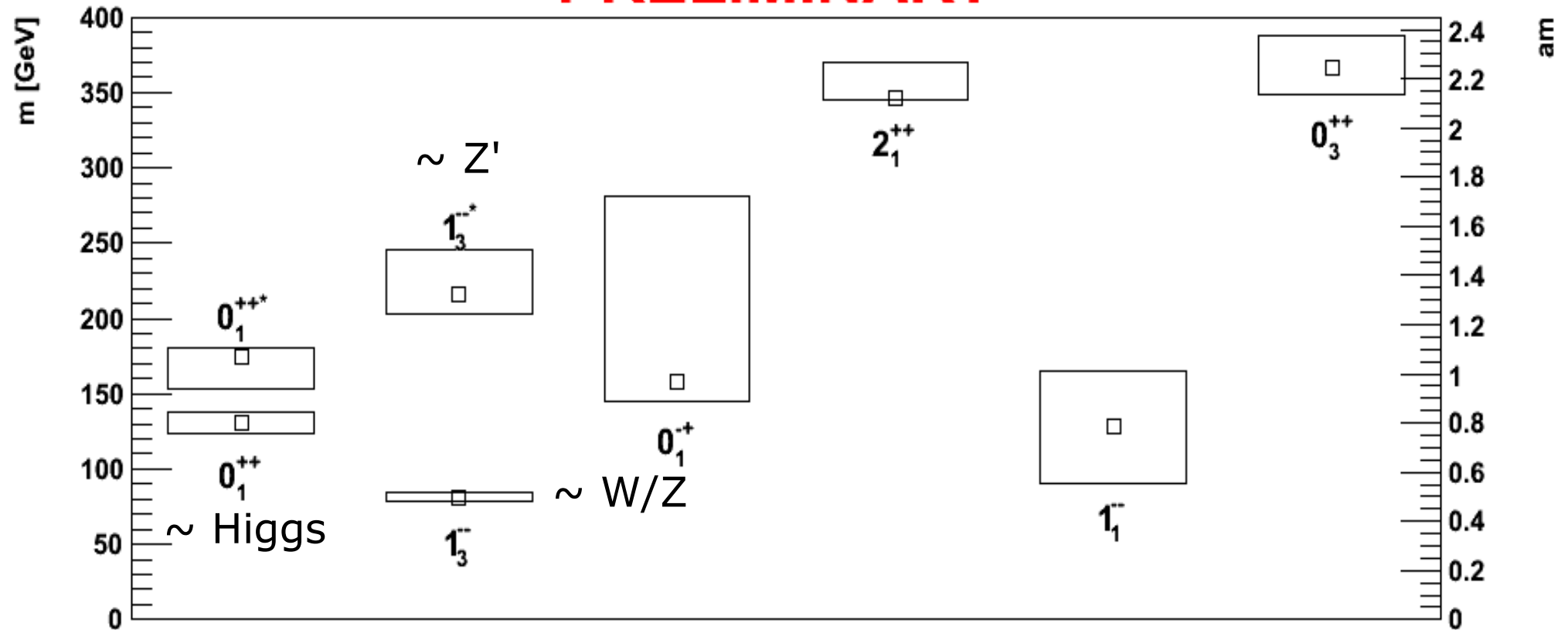


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- Excited states decay widths  $> \sim 10\%$  of mass

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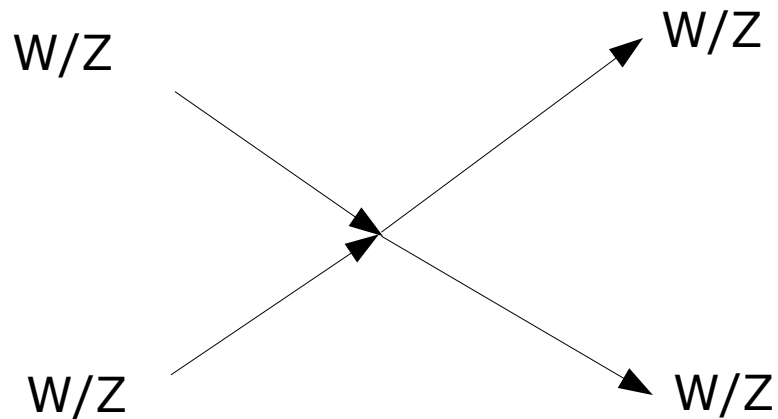
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  - Excited states or different quantum numbers possible best signal channel

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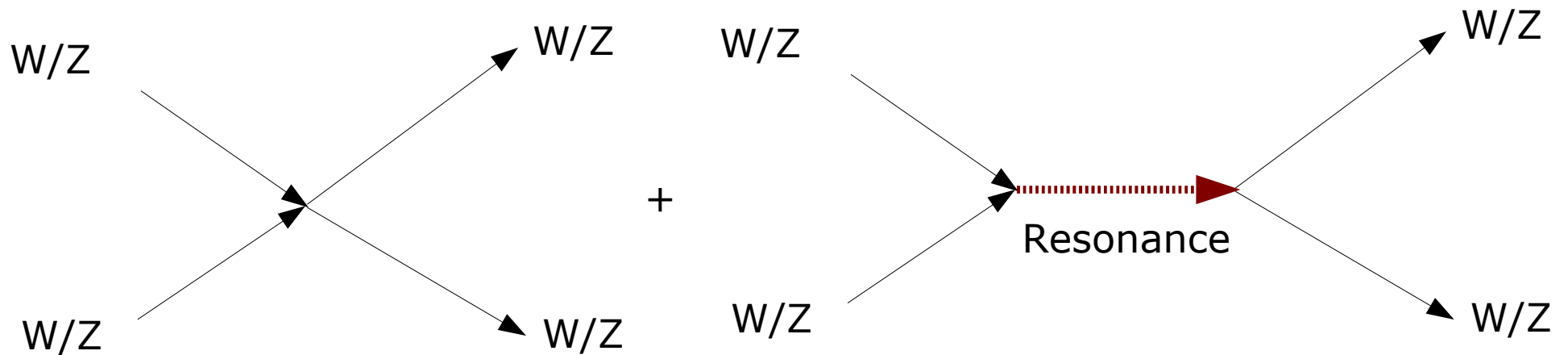
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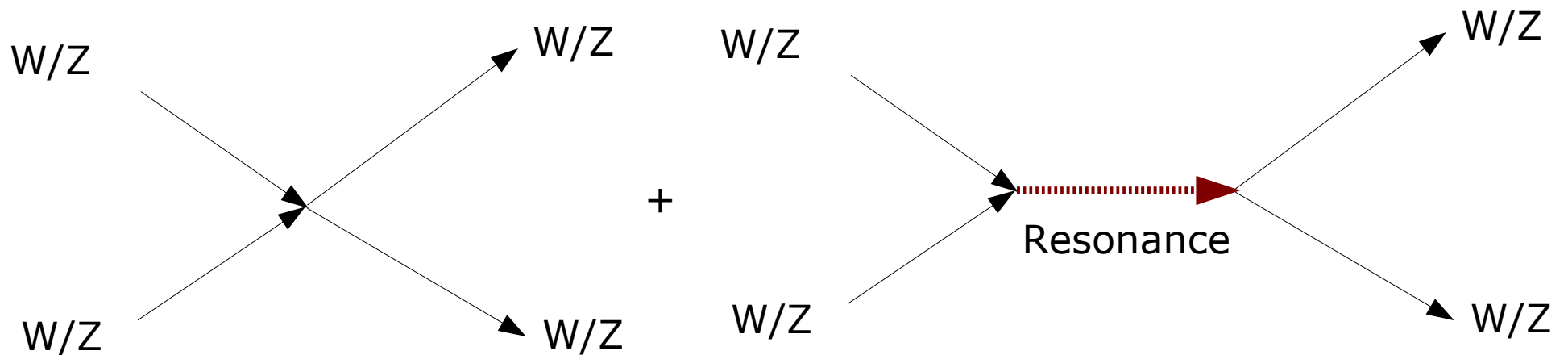
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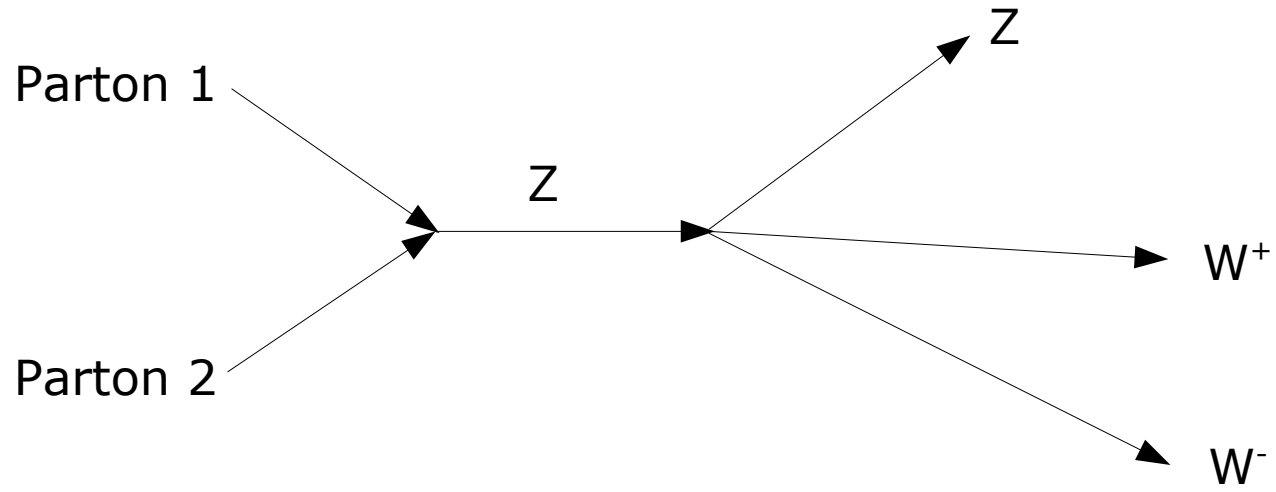
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- Resonance peak in final state invariant mass?
  - Estimate using effective theory+Sherpa: Too small to be seen (less than 1% at peak)

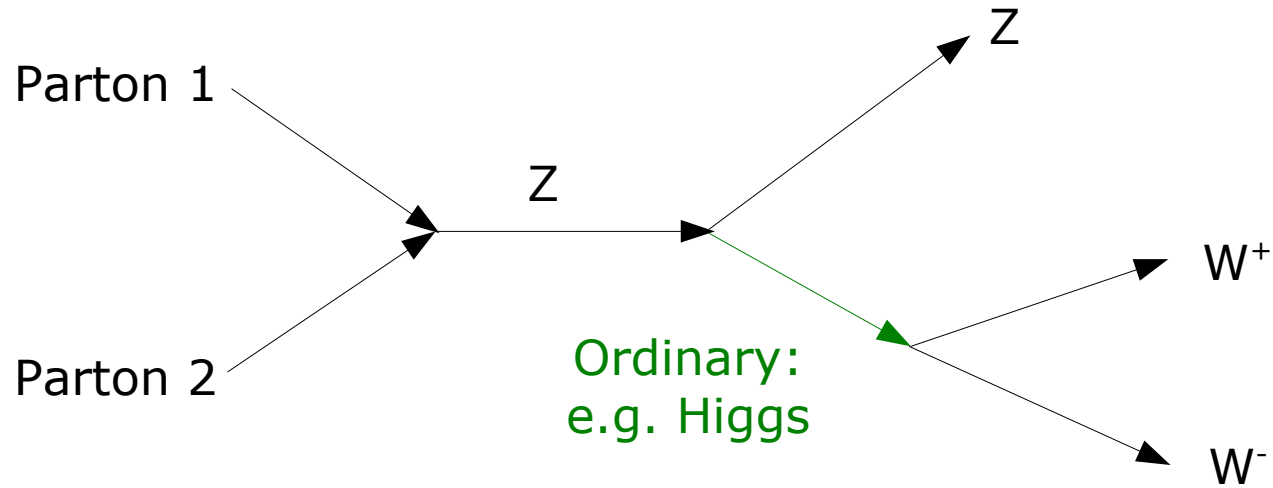
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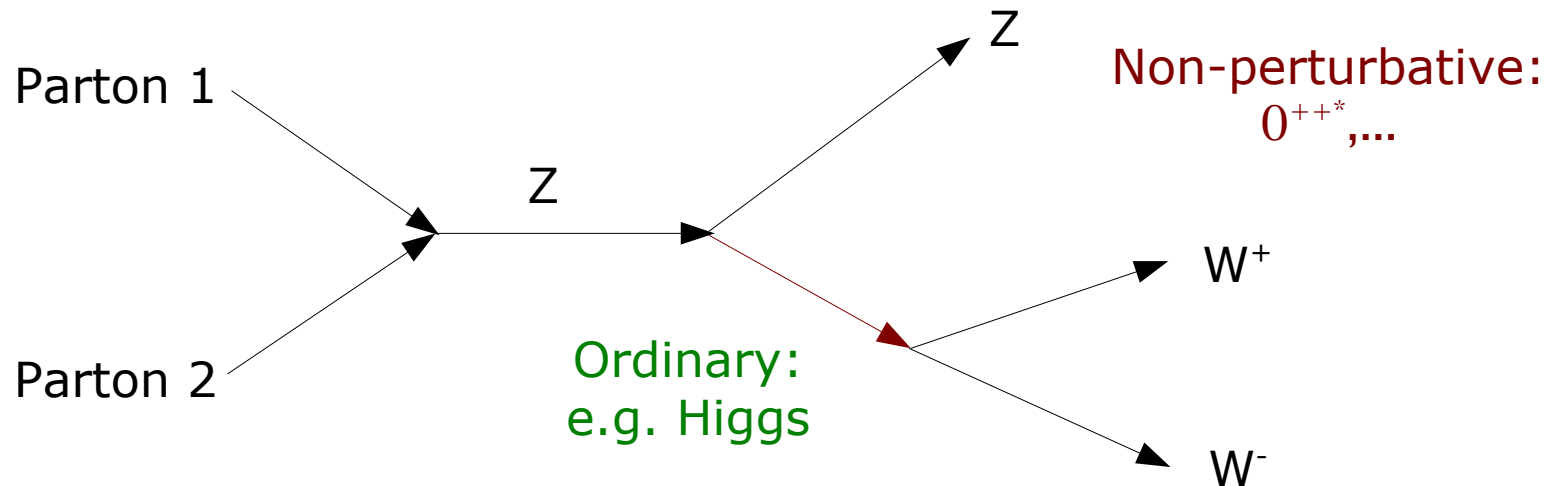
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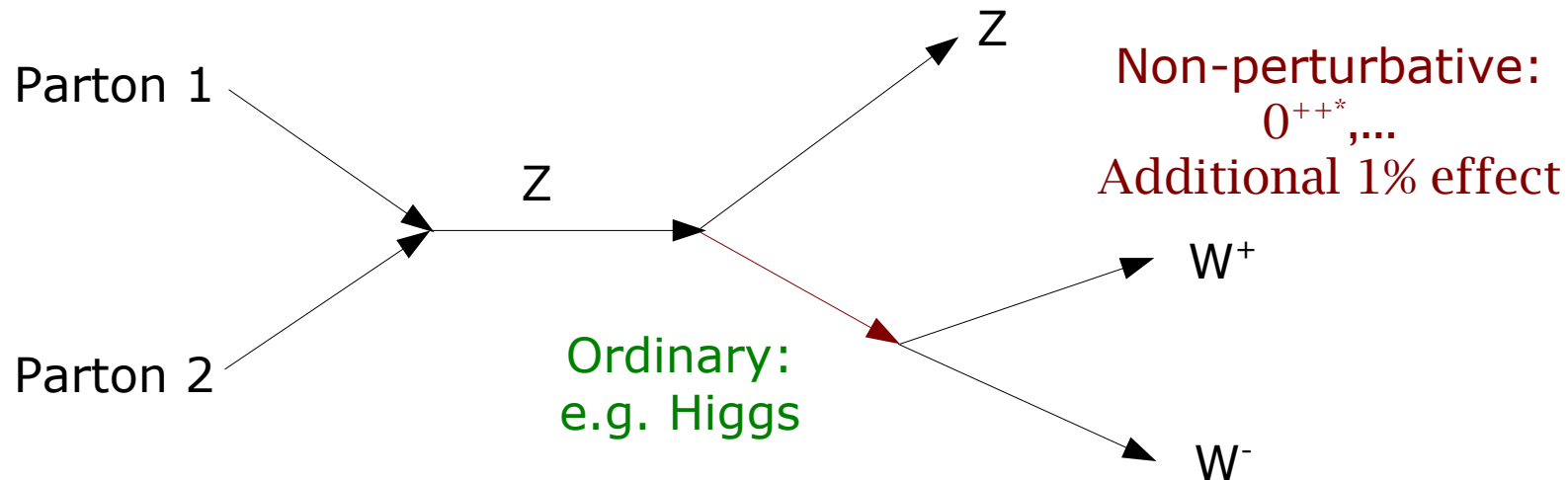
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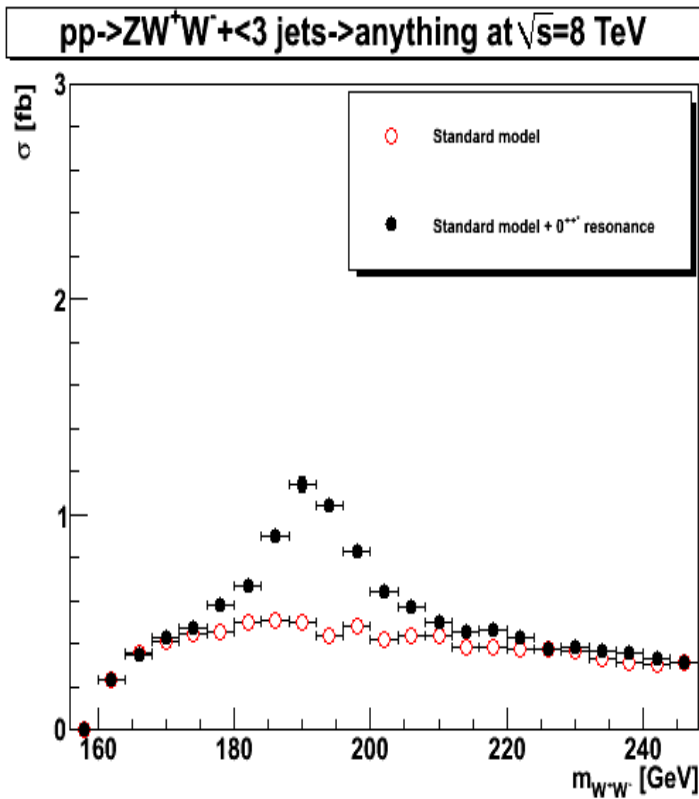


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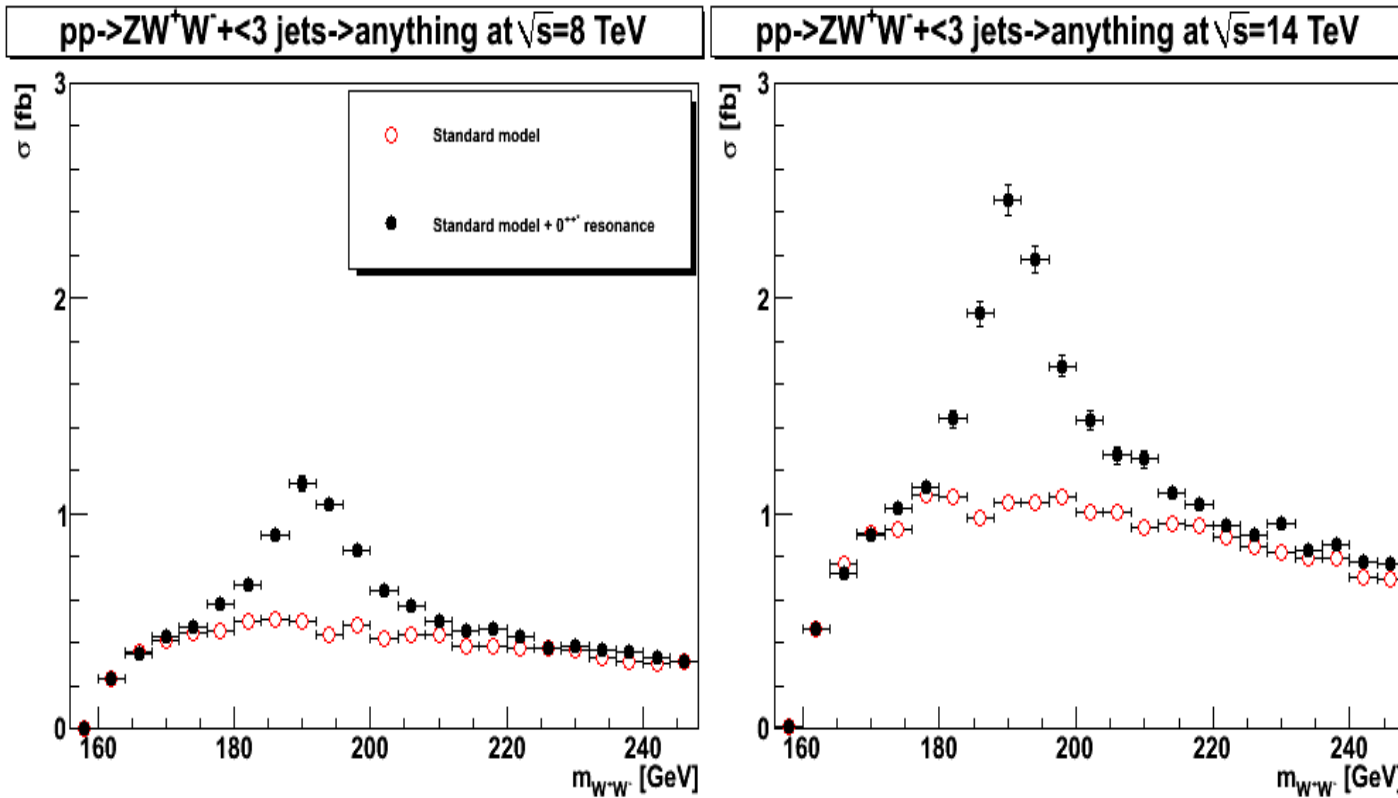
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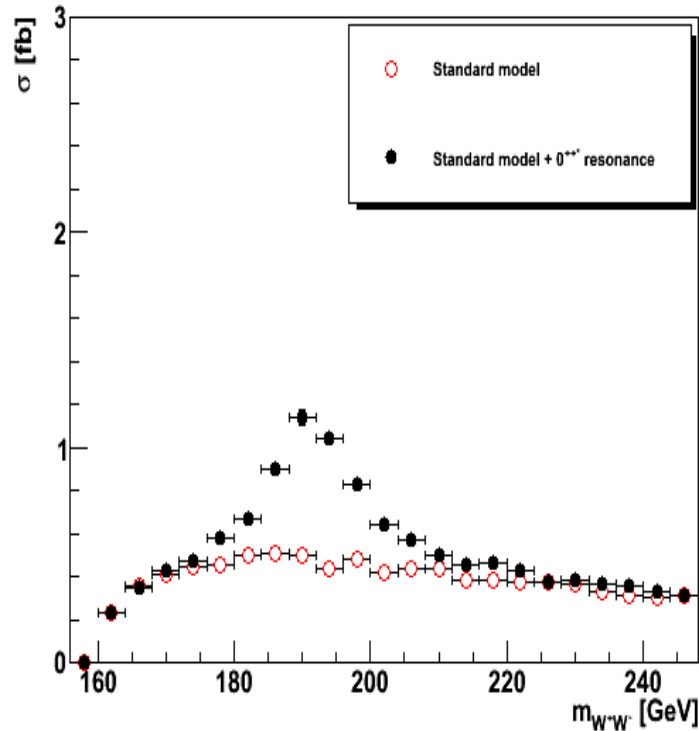
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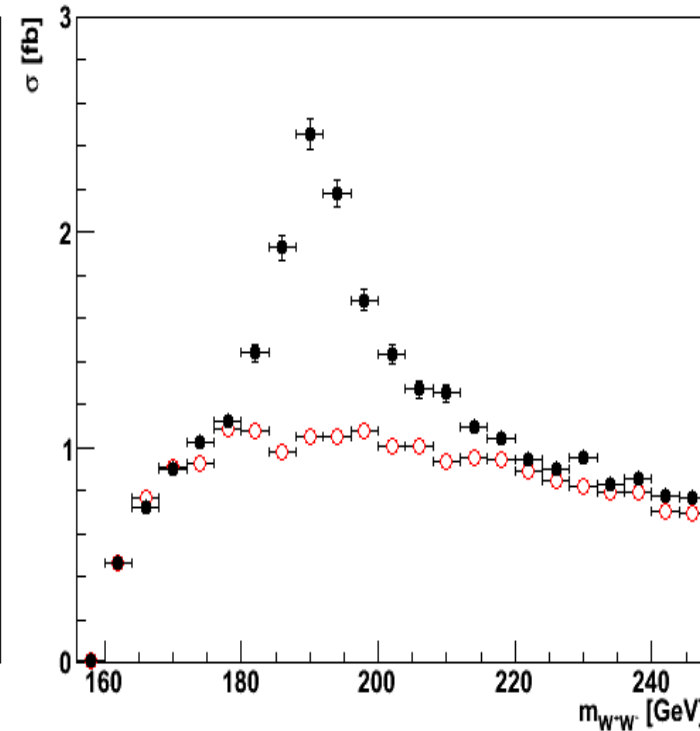
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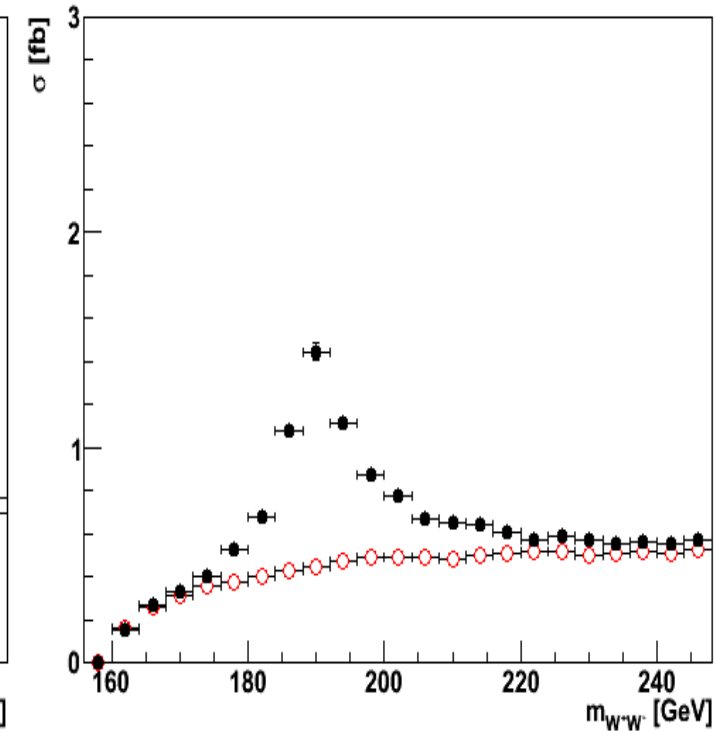
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e<sup>+</sup>e<sup>-</sup>→ZW<sup>+</sup>W<sup>-</sup>→anything at √s=500 GeV



[Low-energy effective Lagrangian, MC by Sherpa 1.4.2]

- E.g. excited Higgs: Decay channel: 2W
- Decides whether present in the standard model
- If not standard-model physics, but present, this would be a gateway to new physics



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- Requires substantially more theoretical work