The Discovery of the Z boson

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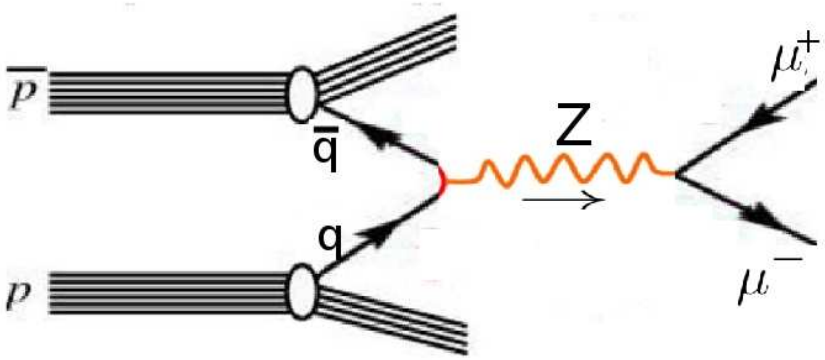
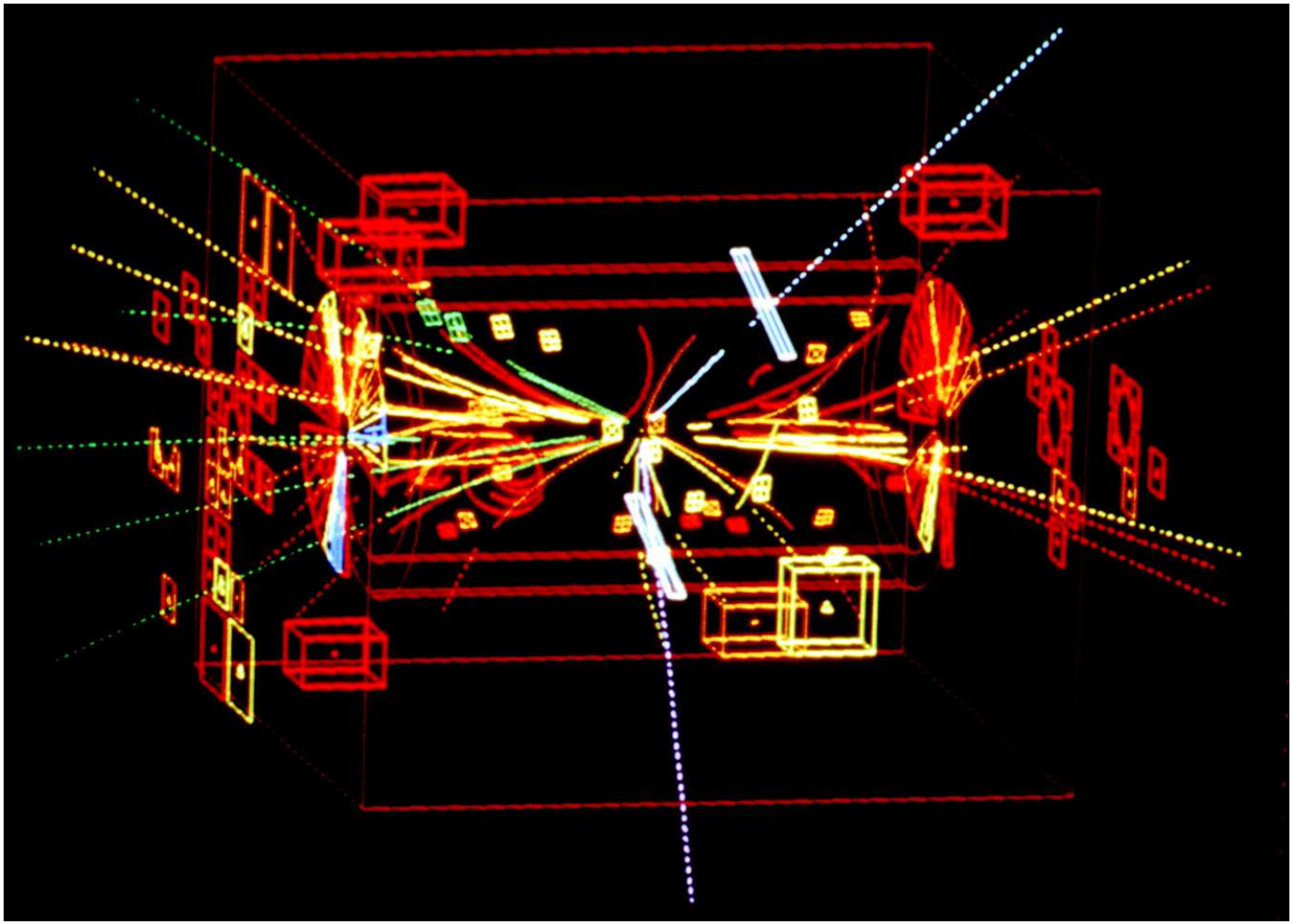
The basic diagram for this process is



$\leftarrow$ Two energetic $\mu^\pm$ tracks with $(p_{\mu^+} + p_{\mu^-})^2 = M_Z^2$

The real event display



It was more cleanly observed in $e^+e^- \to \mu^+\mu^-$ collision

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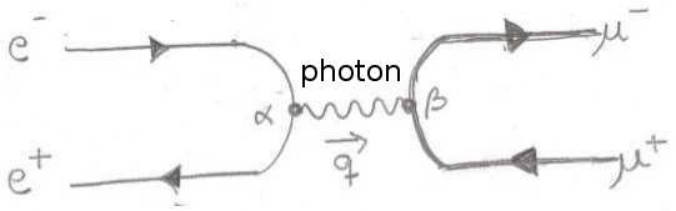

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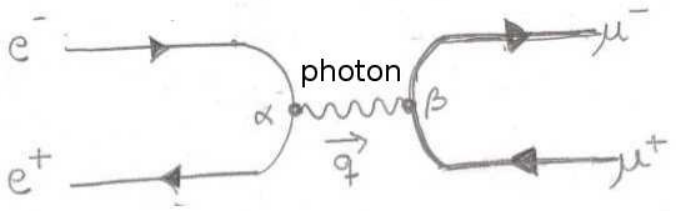

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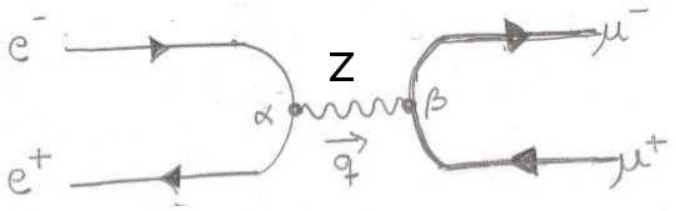

Adding both amplitudes we can compute the prediction for the cross section

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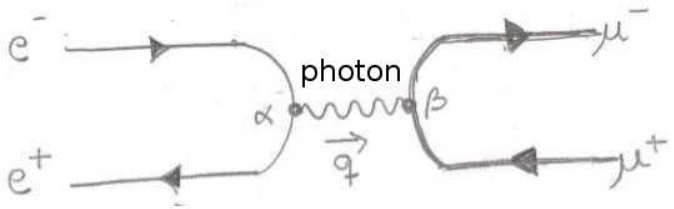

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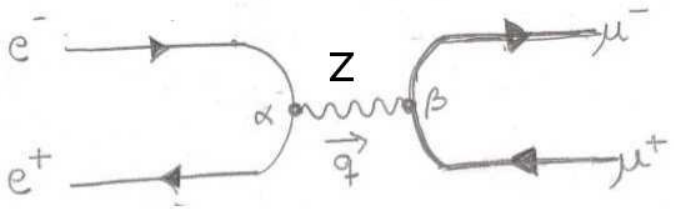

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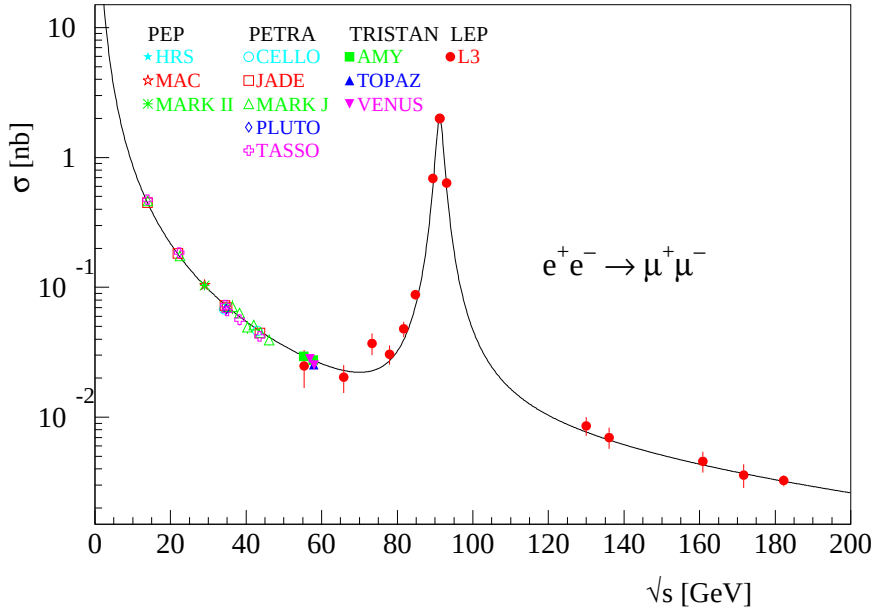

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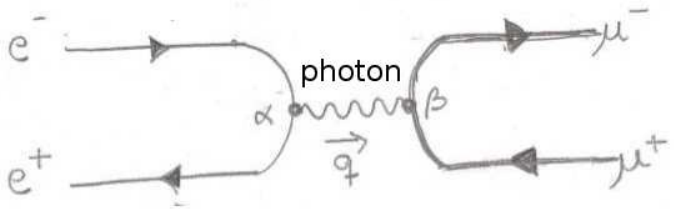

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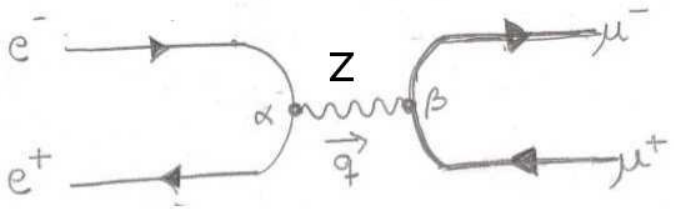

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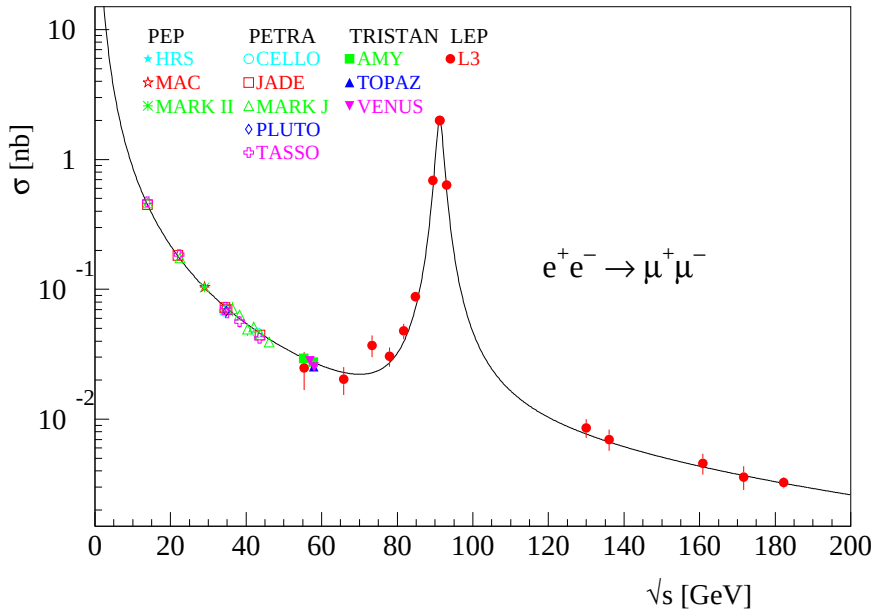

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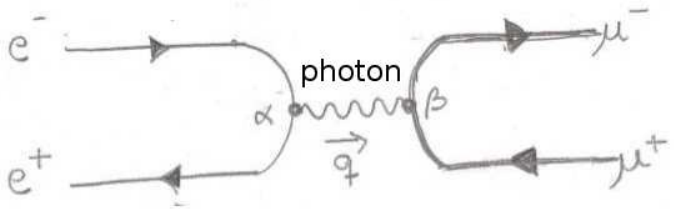

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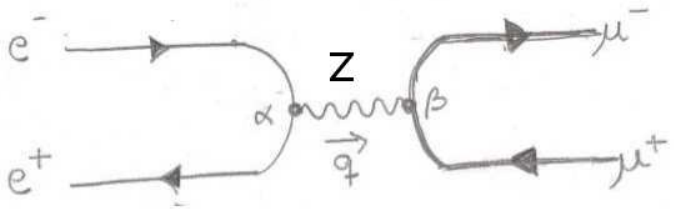

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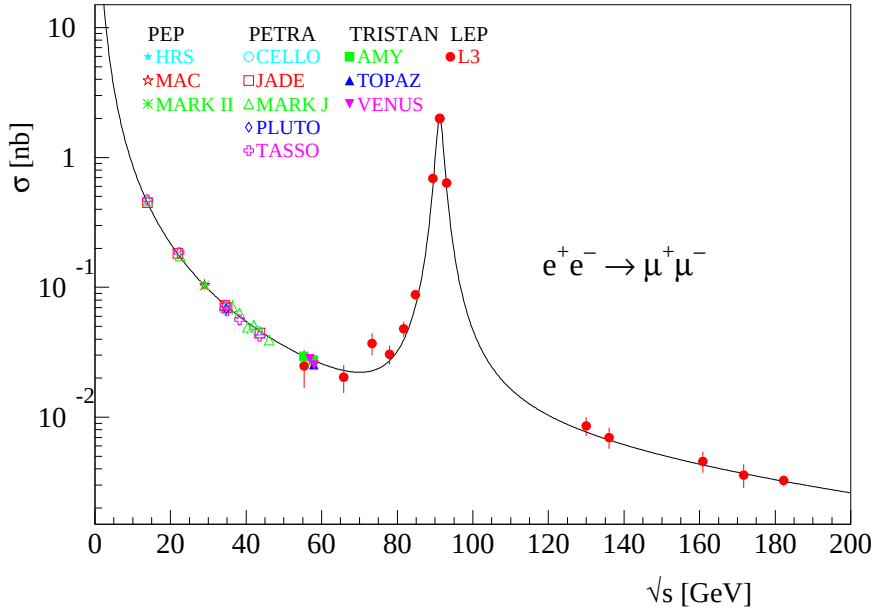

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$\Rightarrow$ allows to measure M_Z very precisely

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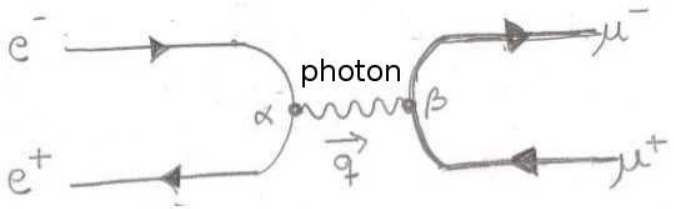

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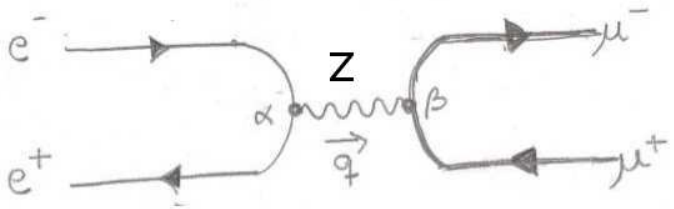

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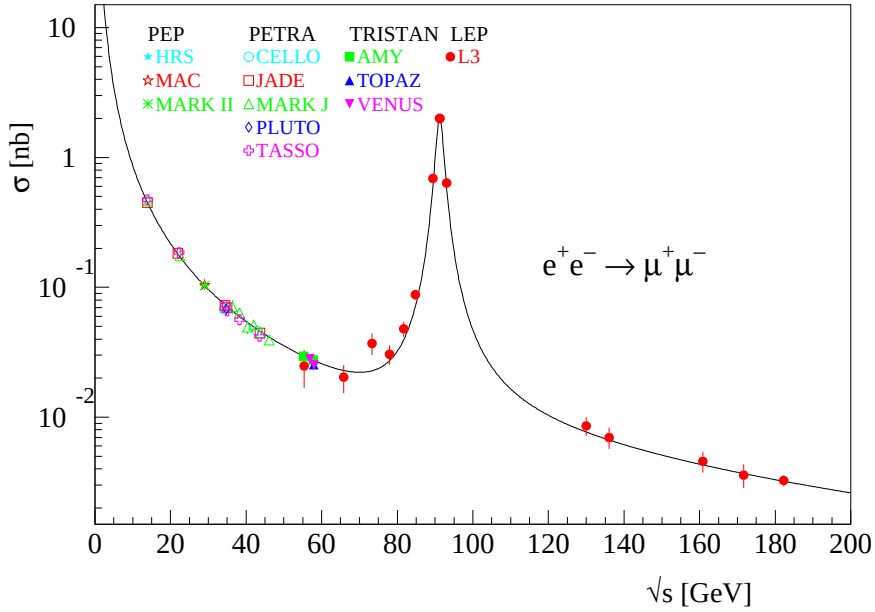

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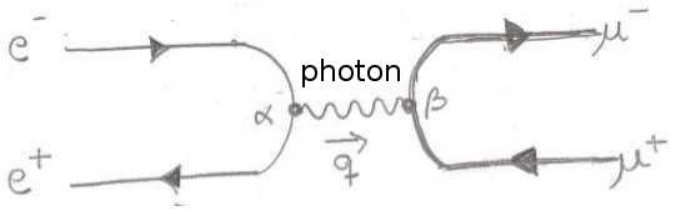

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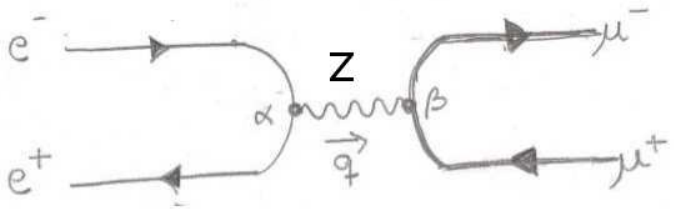

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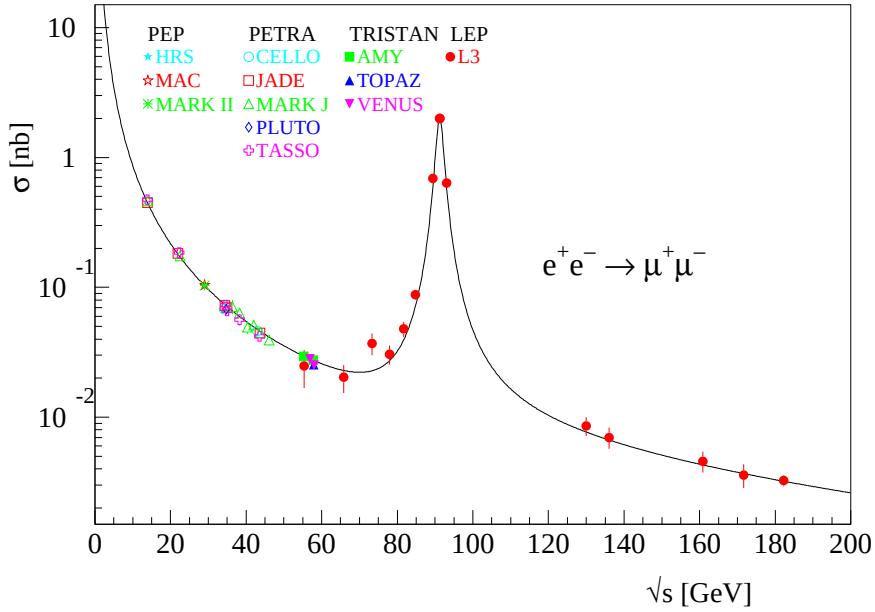

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But more interesting

$$\frac{M_W^2}{M_Z^2} = \frac{(80.4)^2}{(91.2)^2} = 0.78 = 1 - 0.22!!$$