

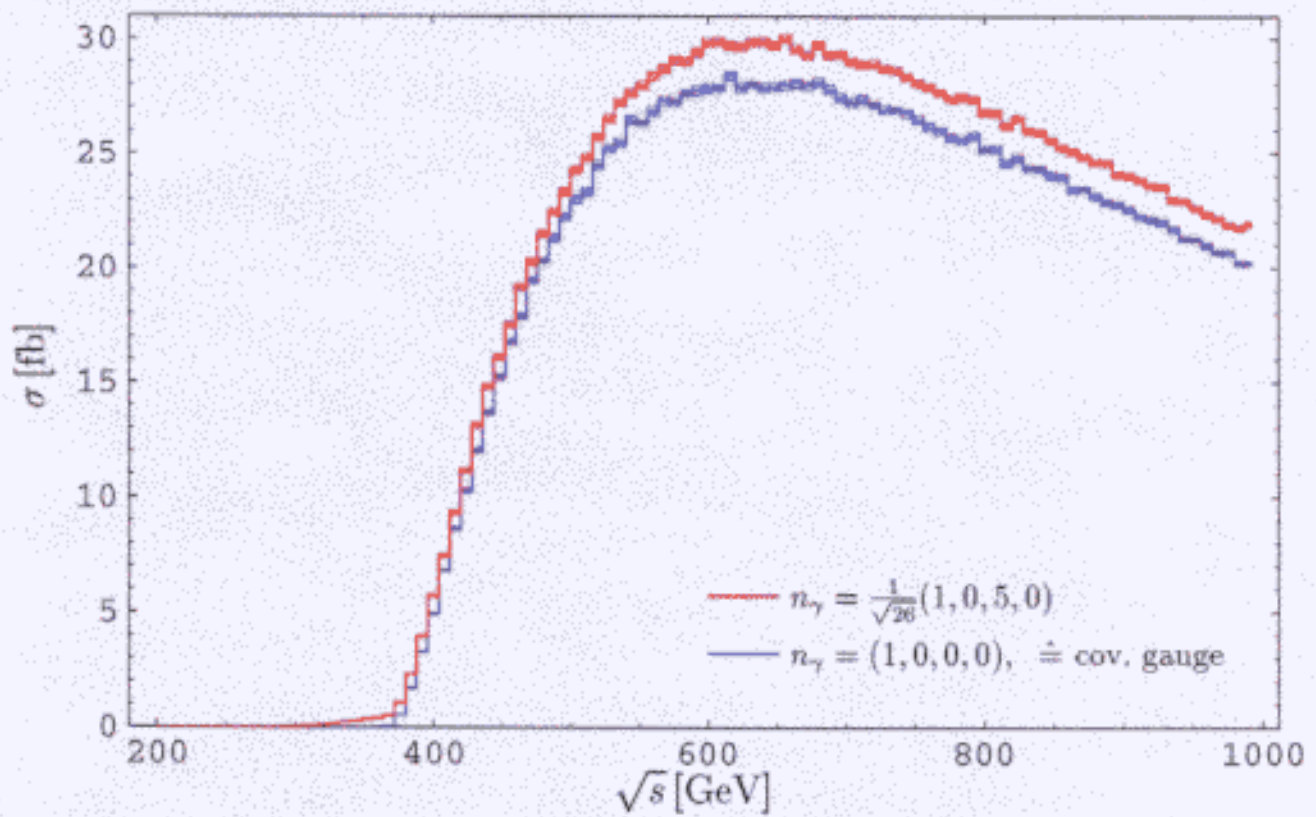
## ANALYSIS OF $\tilde{\mu}$ PAIR PRODUCTION

- Measurements of smuon mass
  - Threshold scan of  $e^+ e^- \rightarrow \tilde{\mu}_R^+ \tilde{\mu}_R^-$  with high accuracy
- Needed for precision analysis:
  - Width effects
  - Gauge invariance
  - Irreducible backgrounds(as done for WW production)
- Gauge invariance
  - Calculation of full gauge-invariant process
  - $e^+ e^- \rightarrow (\tilde{\mu}_R^+ \tilde{\mu}_R^-) \rightarrow \mu^+ \mu^- \tilde{\chi}_1^0 \tilde{\chi}_1^0$
- Gauge dependence of  $e^+ e^- \rightarrow \tilde{\mu}_R^+ \tilde{\mu}_R^- \rightarrow \mu^+ \mu^- \tilde{\chi}_1^0 \tilde{\chi}_1^0$  ?

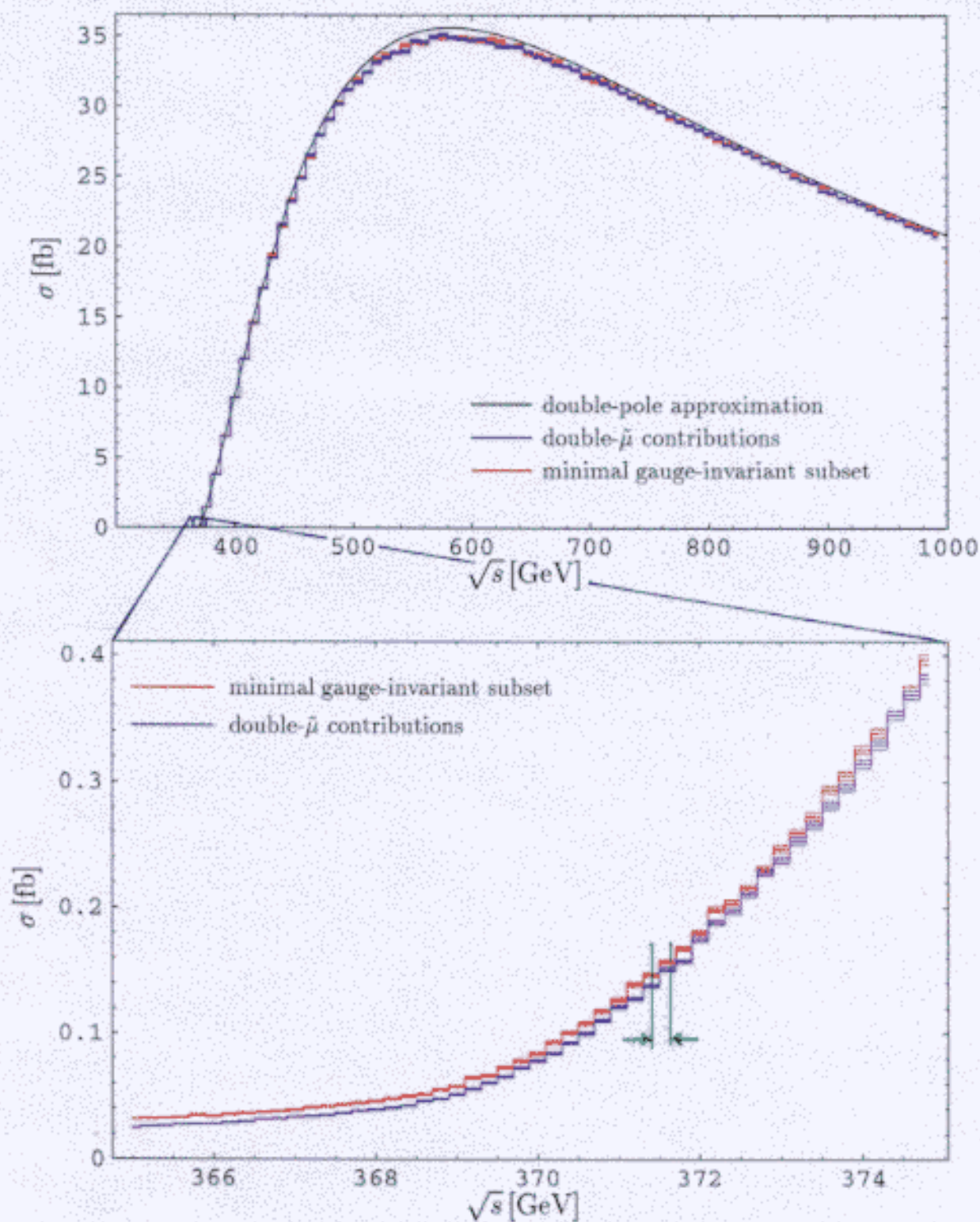
## 4 Discussion of gauge-invariance issue

### Influence of axial gauge

$n_\gamma$  = photon gauge vector



## Gauge-invariant treatment $\leftrightarrow$ double-smuon contribution (no cuts)



$\Rightarrow$  Reasonable agreement if covariant gauge is used (deviations  $\sim 1\%$ )

Shift in centre-of-mass energy of  $\sim 0.14$  GeV

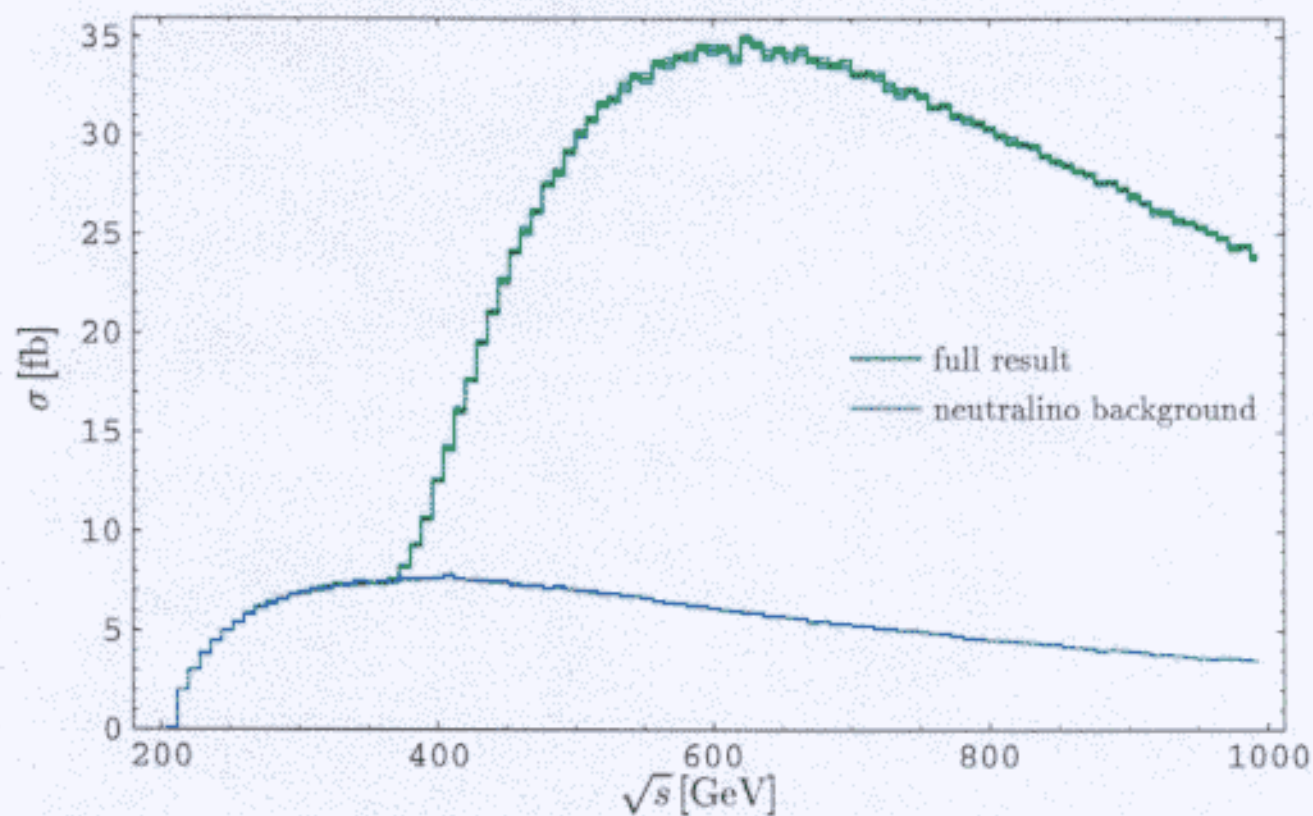
i.e. shift in threshold mass of  $\sim 70$  MeV

- Coherent treatment of irreducible backgrounds including interference terms  
 $\Rightarrow$  full process  $e^+ e^- \rightarrow \mu^+ \mu^- \tilde{\chi}_1^0 \tilde{\chi}_1^0$
- Reduction of MSSM background by cut on miss. energy  
 $\Rightarrow$  small background effect remaining

## 7 Total cross section and dominant background

**Note:** narrow-width approximation used for intermediate  $\tilde{\chi}_j^0, Z$   
 $\Rightarrow$  gauge-invariant subset of background diagrams

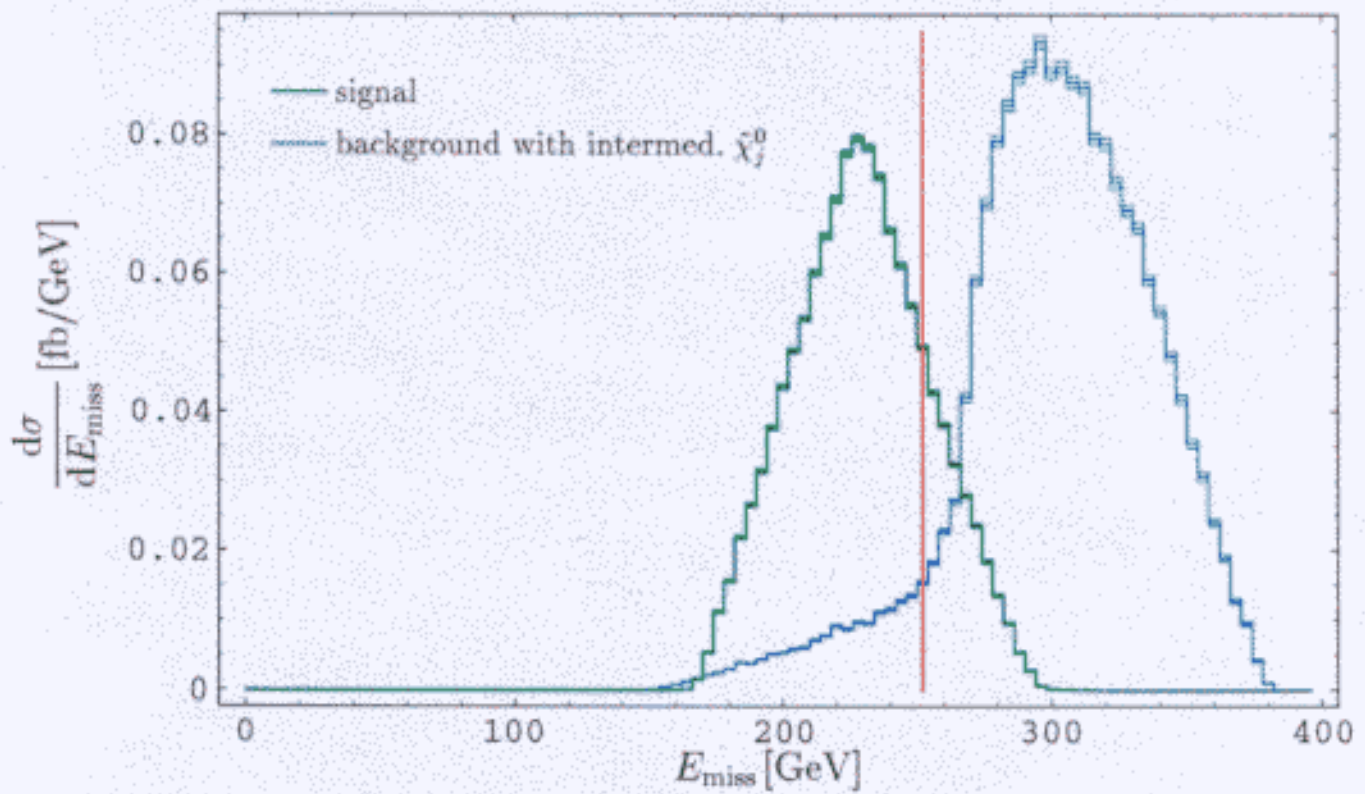
without background cuts :



## $E_{\text{miss}}$ distribution and cut

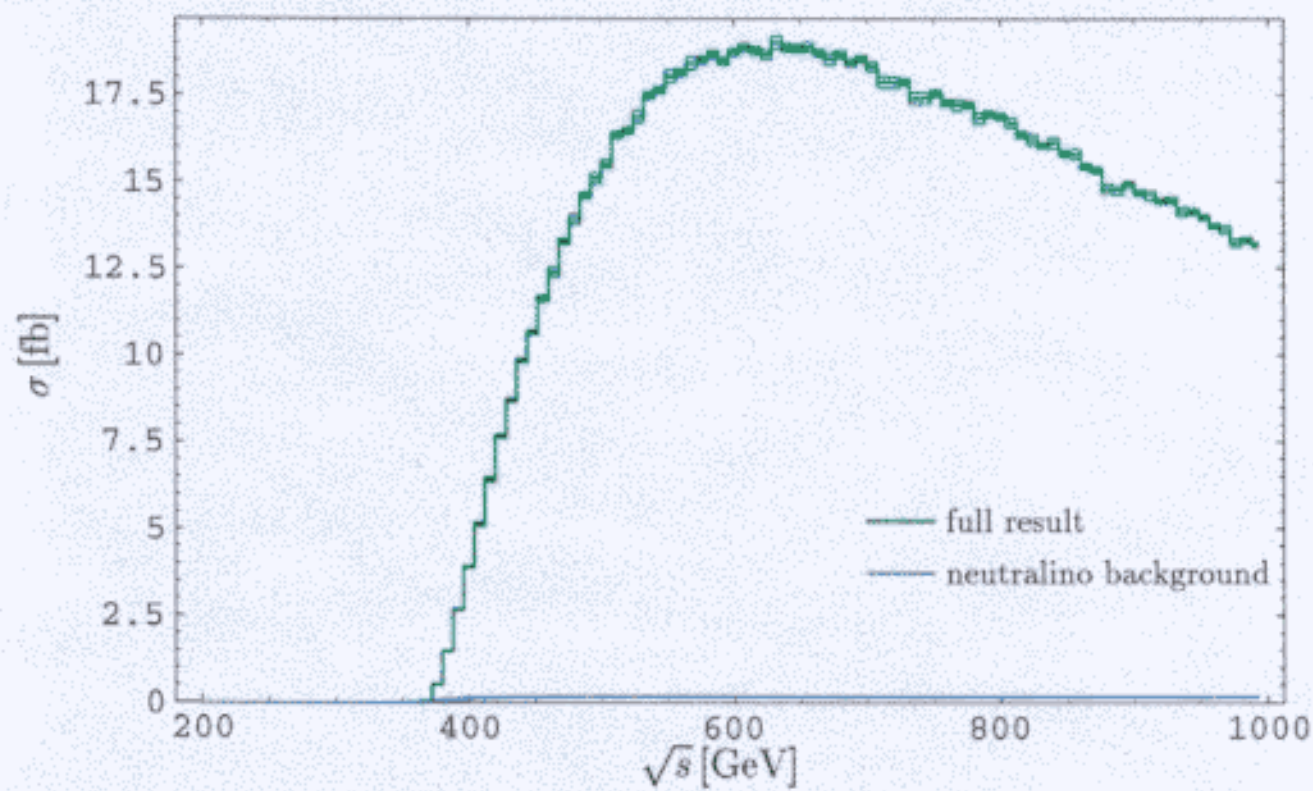
Cut on missing energy  $E_{\text{miss}} < c\sqrt{s}$ ,  $c = 0.63$

$$\sqrt{s} = 400 \text{ GeV}$$



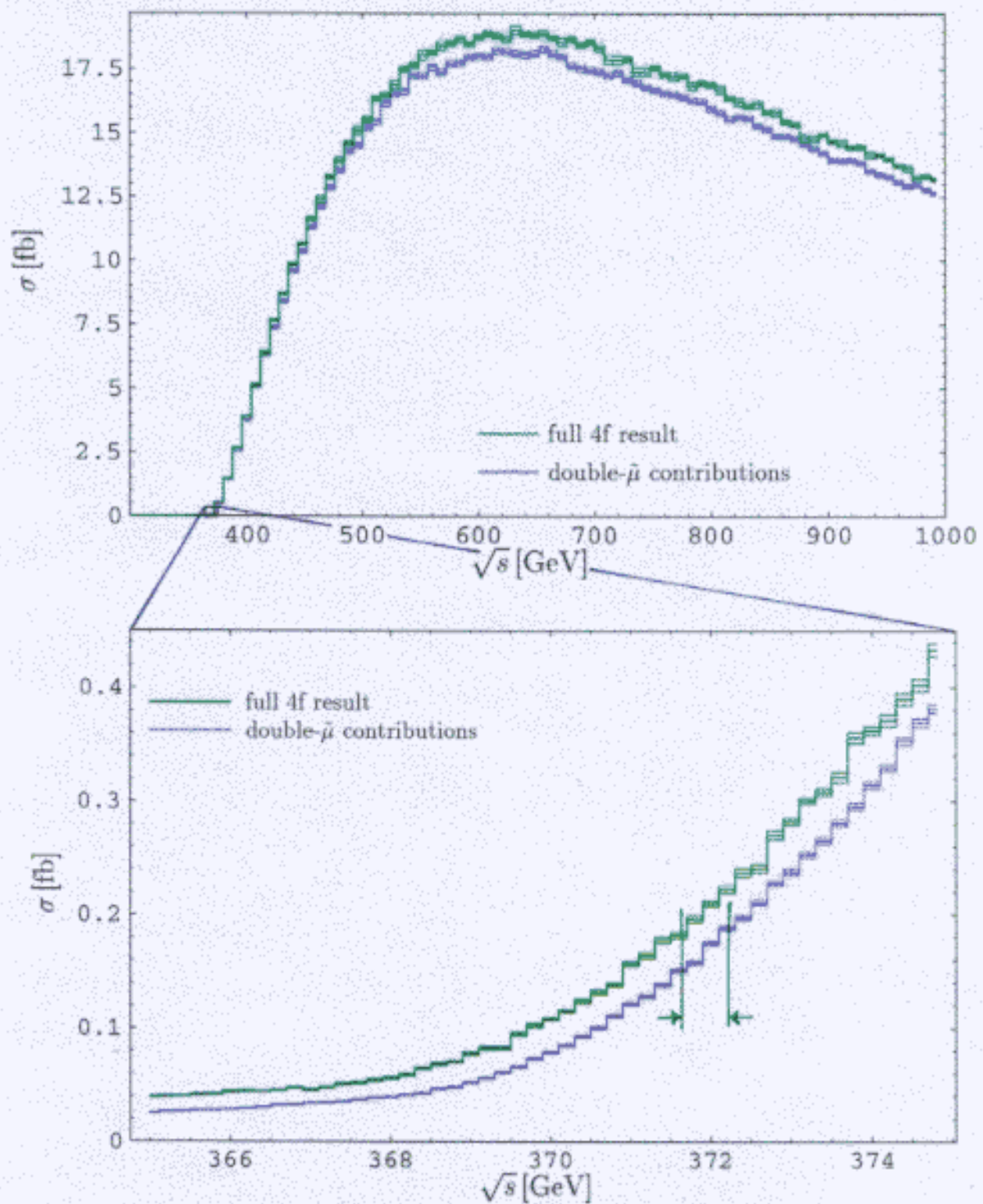
## 9 Cross section and background

with cut on missing energy,  $E_{\text{miss}} < c\sqrt{s}$ ,  $c = 0.63$  :



## 11 Full result $\leftrightarrow$ double-smuon diagrams

(with cut on missing energy,  $E_{\text{miss}} < c\sqrt{s}$ ,  $c = 0.63$ )



$\Rightarrow$  Shift in centre-of-mass energy of  $0.7 \sim 0.8$  GeV  
i.e. shift in threshold mass of  $0.3 \sim 0.4$  GeV



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- **Summary:**

- Dominant contributions in covariant gauge good for analysis of detector performance
- Full treatment including sub-dominant effects necessary for high precision measurements