

$$Z' \rightarrow \textit{inv.}$$

In 3TeV  $e^+e^- \rightarrow t\bar{t} Z'$  events

Final state with ISR, Beamstrahlung  
and Detector resolution

# Generating events with ISR

- Event generation : calcHEP

pdf1 : ISR & Beamstrahlung

pdf2 : ISR & Beamstrahlung

- Pythia8 vs calcHEP

- calcHEP: Small ISR neglected

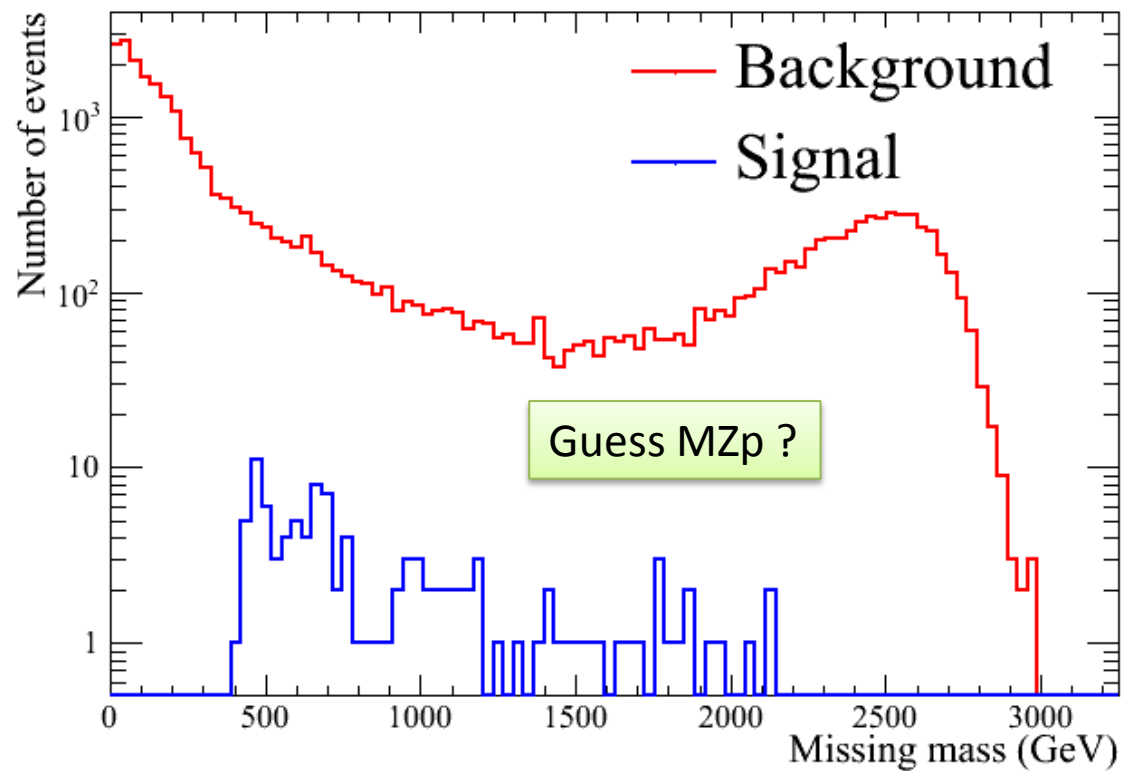
- Pythia: crashes if no ISR is found

Solution found thanks to Torbjörn Sjöstrand

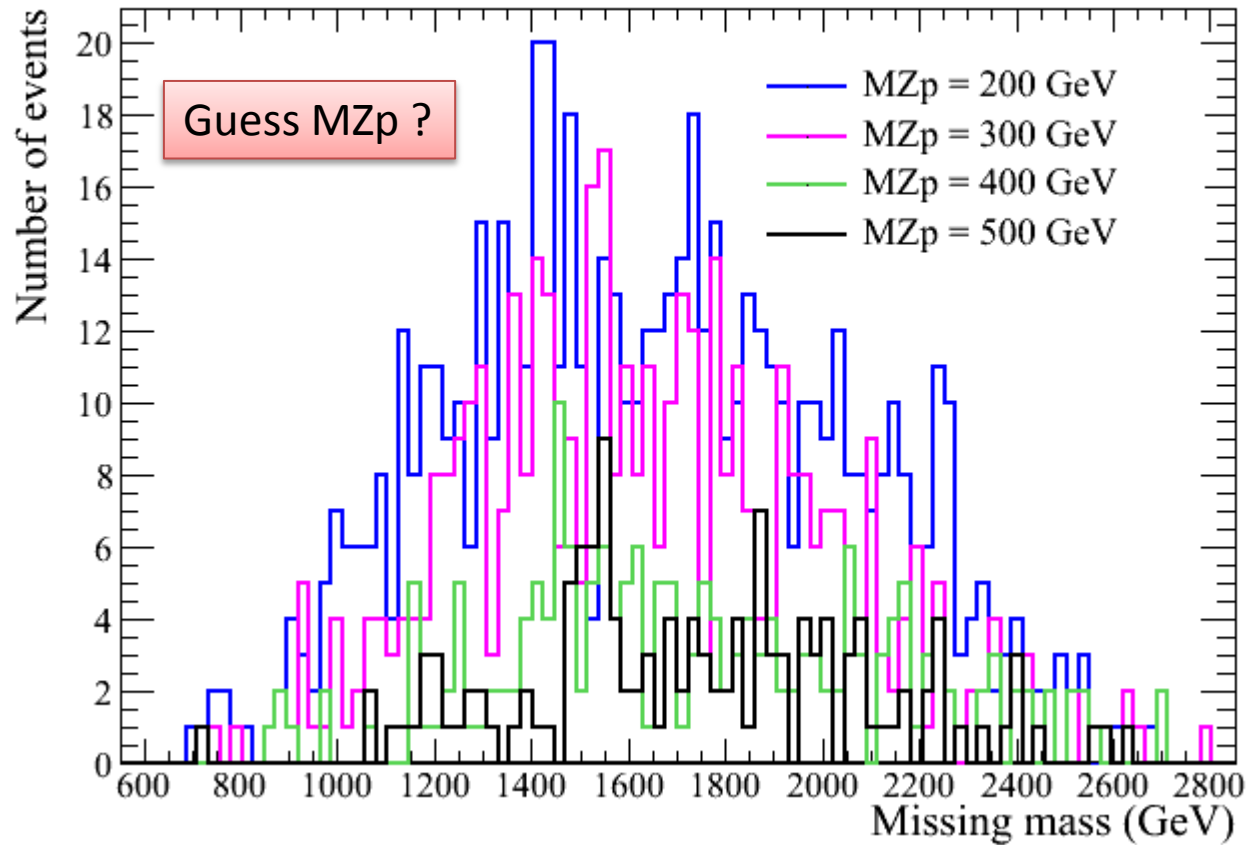
# Detector resolution

- Smearing applied when filling finalstate TTree
- Charged particle Energy and momentum from tracker
  - $\Delta p/p^2 = 2e-5$  on  $p_{x,y,z}$  propagated to E
- Neutrals from E/H-CAL
  - Photons:  $10\%/E^{-1/2}$  propagated to  $p_{x,y,z}$
  - Neutral hadrons:  $40\%/E^{-1/2}$  propagated to  $p_{x,y,z}$

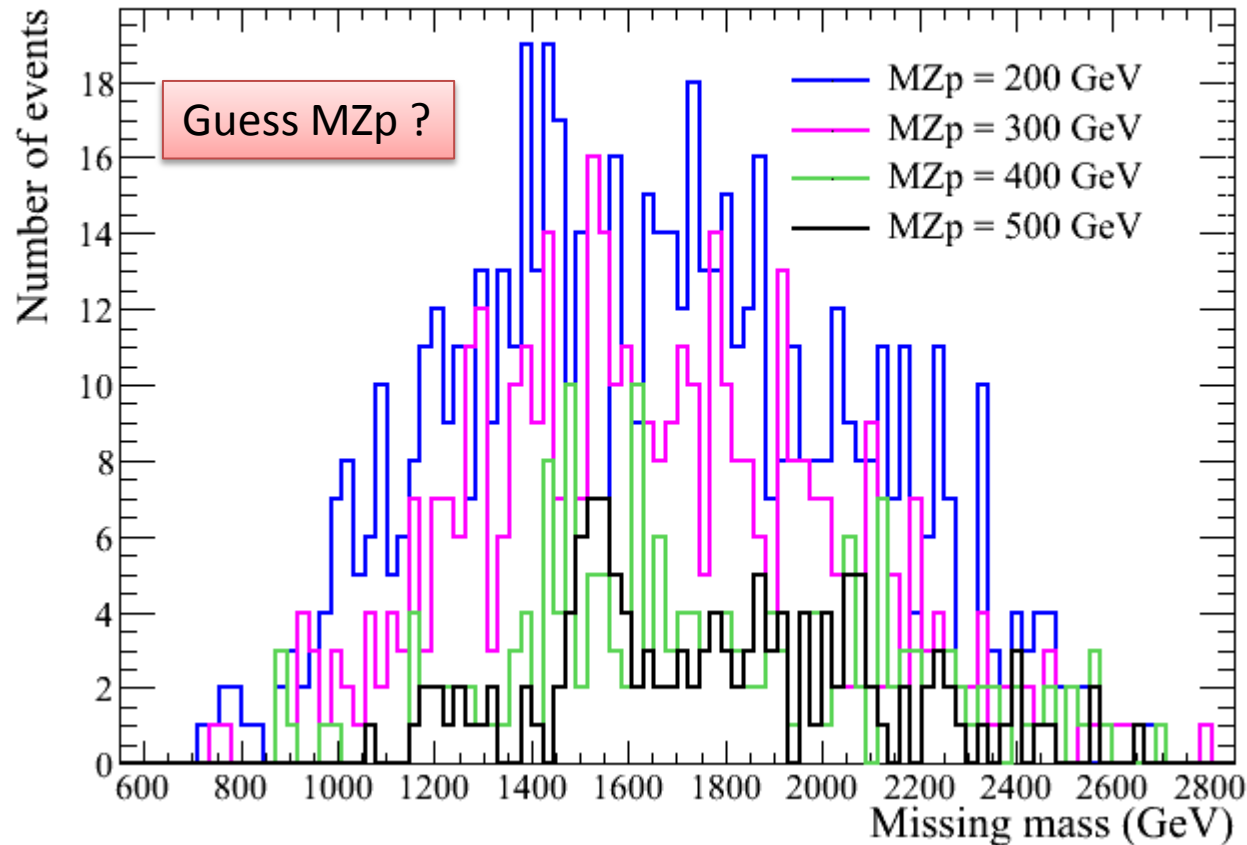
# Missing mass spectra (no ISR)



# Missing mass spectra (with ISR)



# Missing mass spectra (with ISR, no Resolution)



# Signal Significance

| MZp                                 | 200  | 300  | 400  | 500  | 600  | 700 | 800 | 900 | 1000 |
|-------------------------------------|------|------|------|------|------|-----|-----|-----|------|
| Br( $Z_p \rightarrow inv.$ )        | 19%  | 20%  | 13%  | 12%  | 12%  | 12% | 12% | 12% | 12%  |
| Z' events                           | 3600 | 2200 | 1500 | 1100 | 7000 | 500 | 400 | 300 | 200  |
| $Z_p \rightarrow inv. \text{ evts}$ | 684  | 440  | 195  | 132  | 84   | 60  | 48  | 36  | 24   |
| BDT signif.                         | 6.2  | 4.9  | 2.2  | 1.8  | 1.1  | 0.8 | 0.5 | 0.7 | 0.7  |
| BDTG signif.                        | 6.3  | 5.3  | 2.2  | 1.7  | 1.1  | 0.7 | 0.5 | 0.7 | 0.7  |
| MLP signif.                         | 5.8  | 4.6  | 1.8  | 1.4  | 0.9  | 0.6 | 0.4 | 0.6 | 0.3  |

# Where to measure $Z'$ mass ?

- missM seems unusable
- Marco:  $t\bar{t}b\bar{b}$  invariant mass ?
  - No ISR in his study  $\rightarrow$  same problem may await
- What else ?