$e^+e^-(\gamma)$ at 183 and 189 GeV: Data vs BHWIDE

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- **Motivation**
- **Comparison data - BHWIDE**
  Contributions from ALEPH, L3, OPAL
- **Outlook**

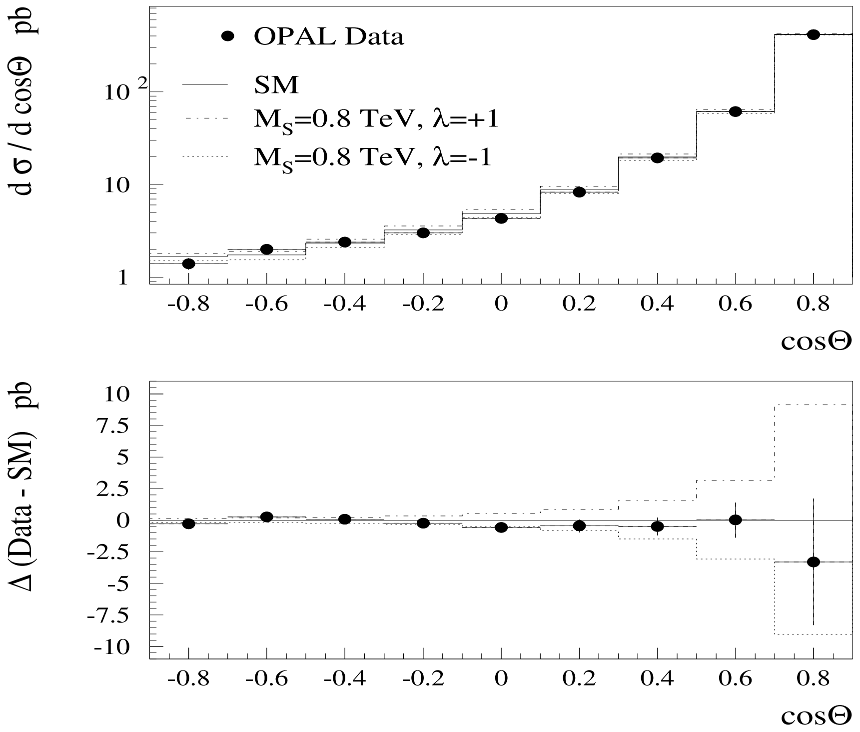
http://l3www.cern.ch/~bourilko/lep2-ee.ps

Search for low scale gravity effects
Best limits at LEP2 come from combined analysis of Bhabha scattering

$\Lambda_T = 1.412$ TeV for $\lambda = +1$ and
$\Lambda_T = 1.077$ TeV for $\lambda = -1$ at 95 % CL

(D.Bourilkov, JHEP 08 (1999) 006; hep-ph/9907380)

theory uncertainty $\sim$ 3 % (conservative) is greater than the statistical error in the forward region



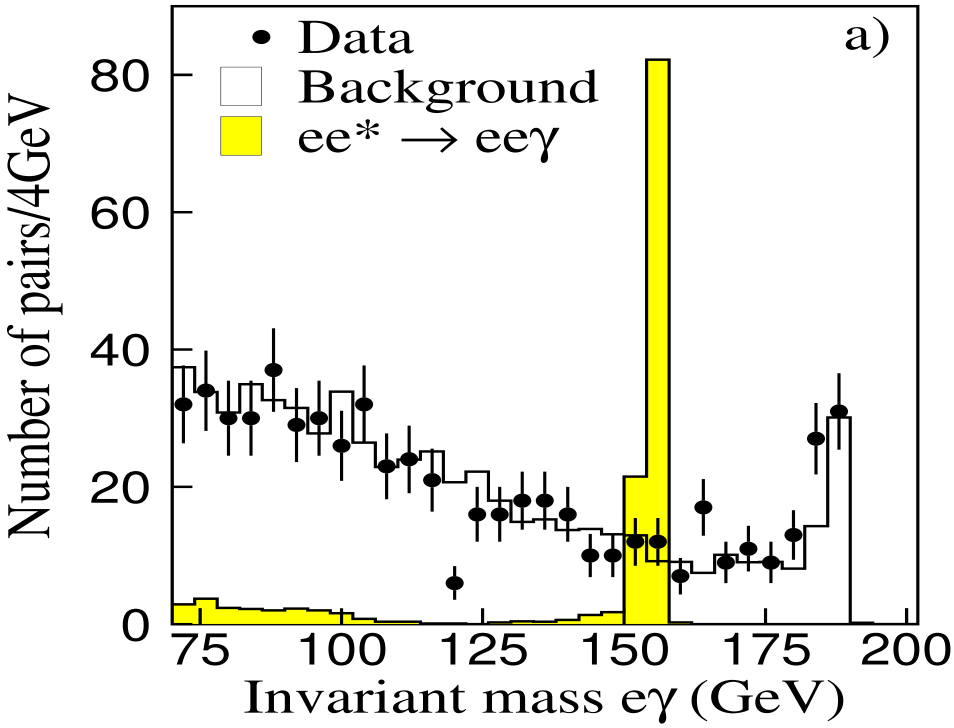
Search for excited leptons:

$$e^+e^- \longrightarrow ee^* \longrightarrow e^+e^-\gamma$$

Typical selection:

- $E_\gamma > 10 - 20$ GeV, $|\cos\theta\,| < 0.70 - 0.75$
- one lepton with $|\cos\theta\,| < 0.70 - 0.75$
- (second lepton with $|\cos\theta\,| < 0.95$)

Precision tag 1.3 %

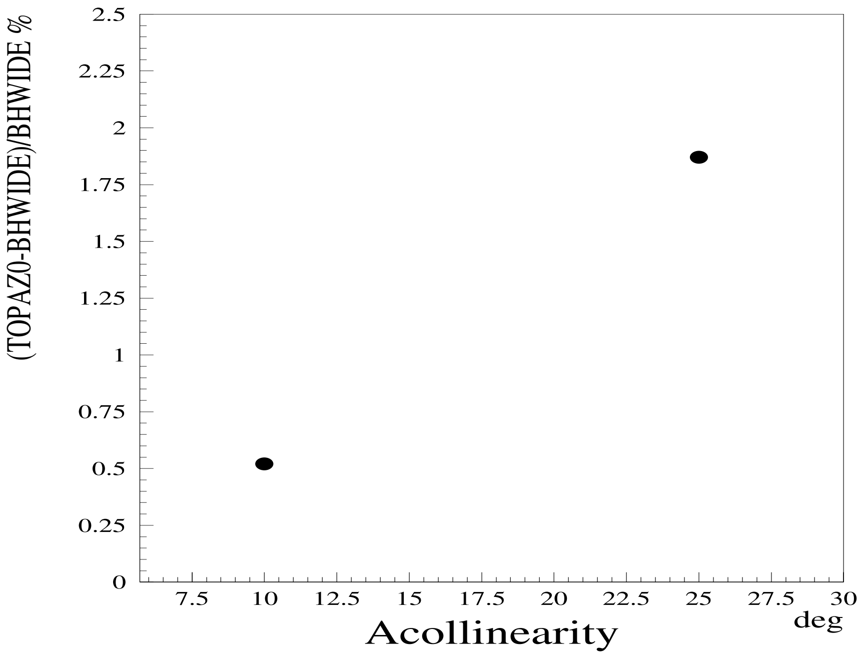


S.Jadach, W.Placzek, B.F.L.Ward

exact $O(\alpha)$ YFS exponentiated calculation; PL B390(1997)298

CALO selection for LEP2: 175, 190, 205 GeV

- $40^\circ < \theta_{e^-} < 180^\circ$
- $0^\circ < \theta_{e^+} < 180^\circ$
- acollinearity $\zeta < 10^\circ$ or $\zeta < 25^\circ$
- $E_{min} > 20$ GeV for $e^-(e^+) + \gamma$ in cone of half-angle 1°

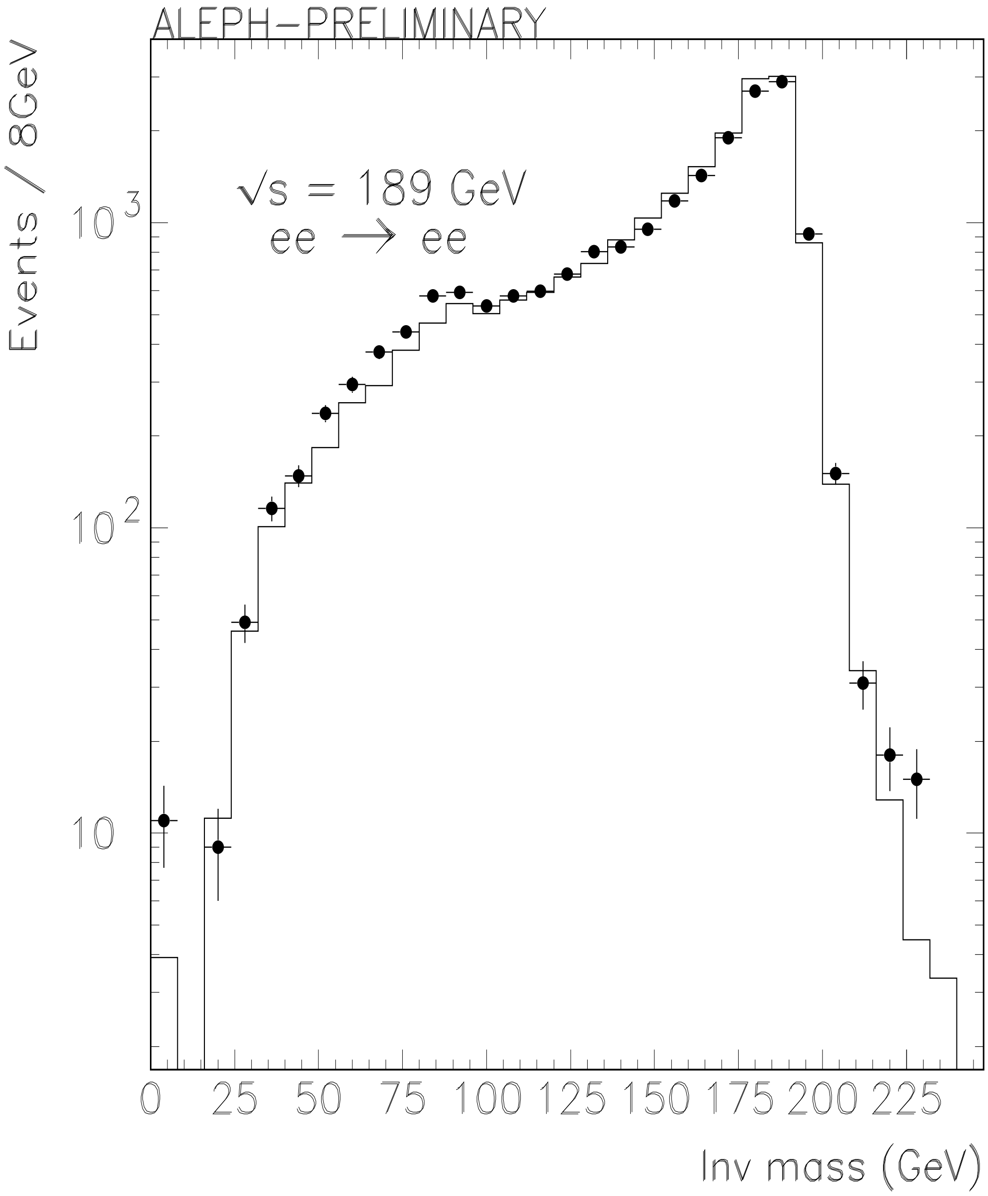


Precision tag set as 1.5 % for LEP2

Compare with data now !

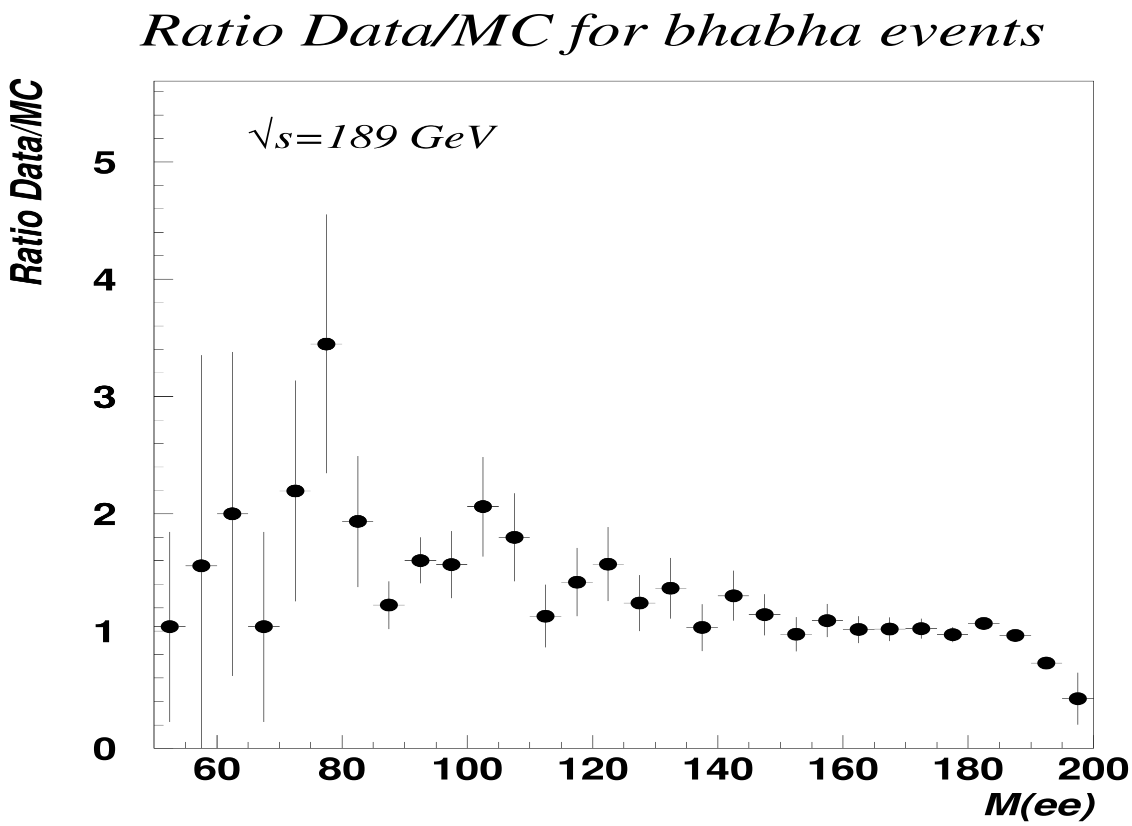
Selection:

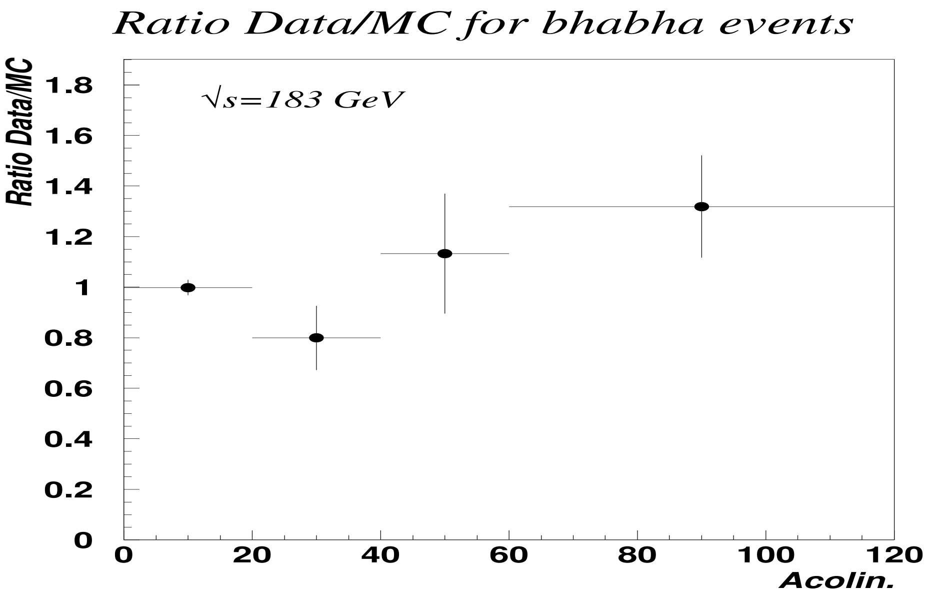
- mass from angles
- $|\cos\theta| < 0.9$

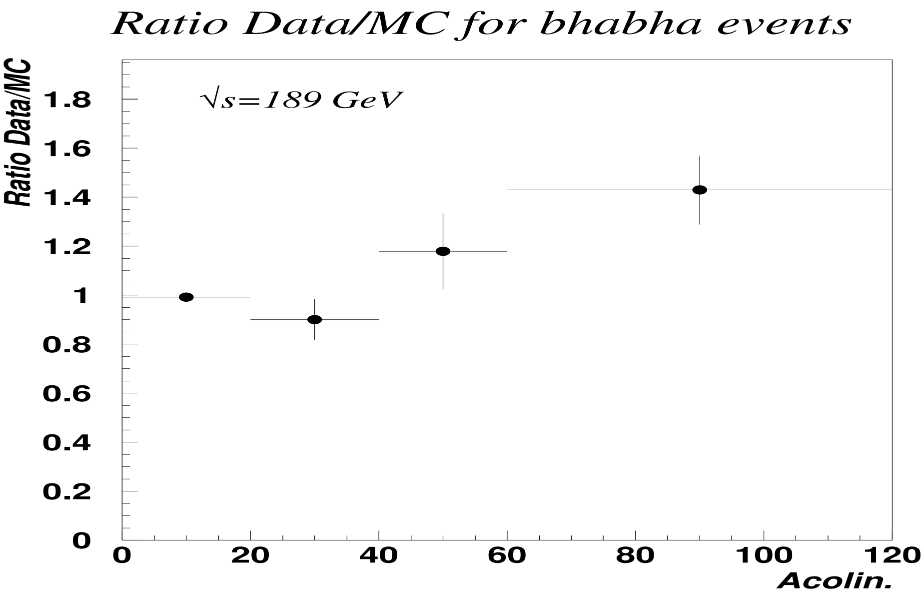


Selection:

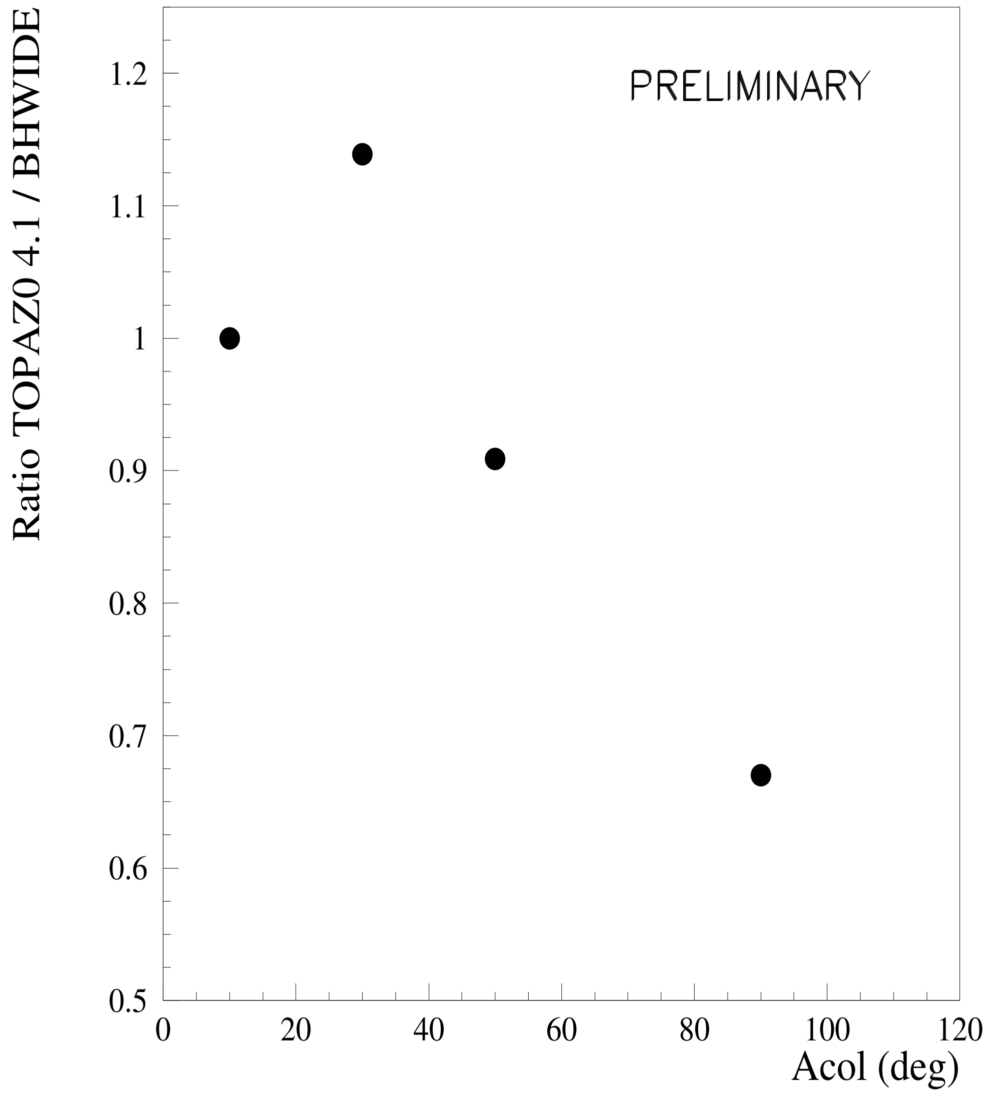
- mass from calorimetric energies & angles
- $44^\circ < \theta_{e^-}, \theta_{e^+} < 136^\circ$
- $E_{min} > 20$ GeV for $e^-(e^+) + \gamma$ in cone of half-angle 2.5°




Ratio Data/MC for bhabha events
Ratio Data/MC
√s=183 GeV
Acolin.

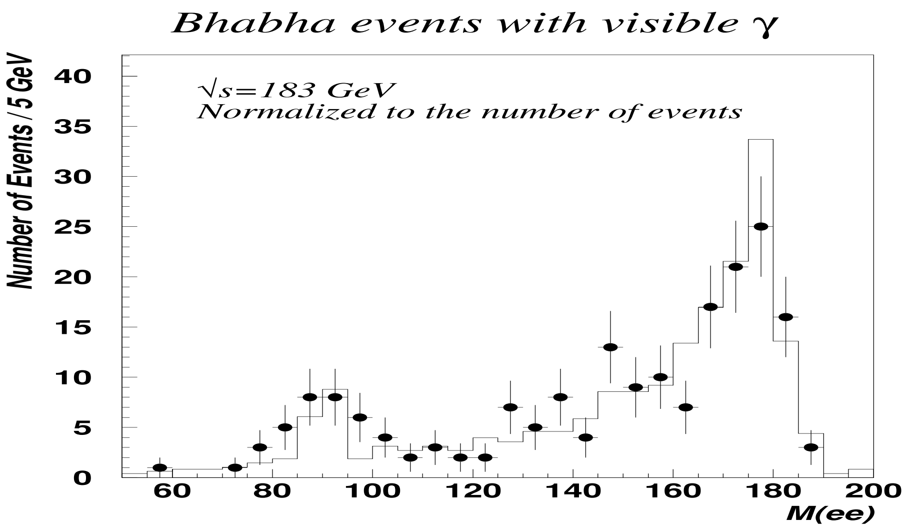

Ratio Data/MC for bhabha events
Ratio Data/MC
√s=189 GeV
Acolin.

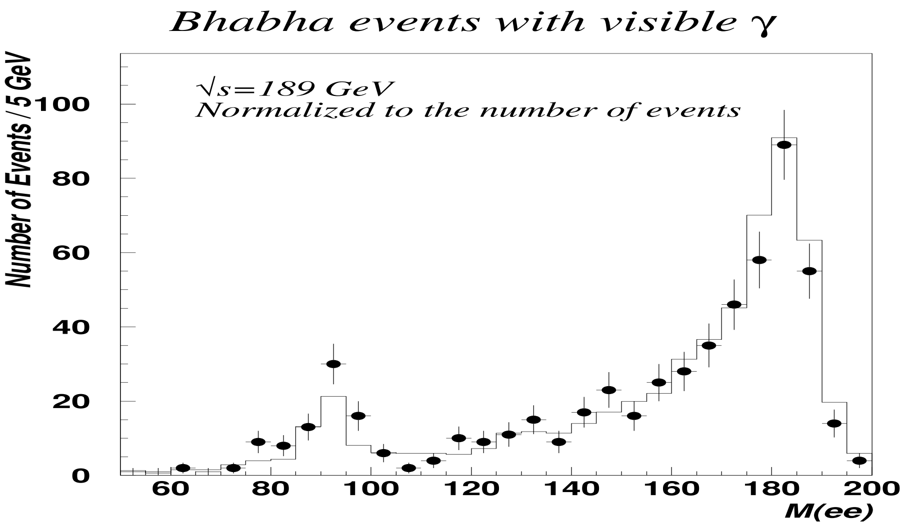
Compare TOPAZ0 4.1 - BHWIDE



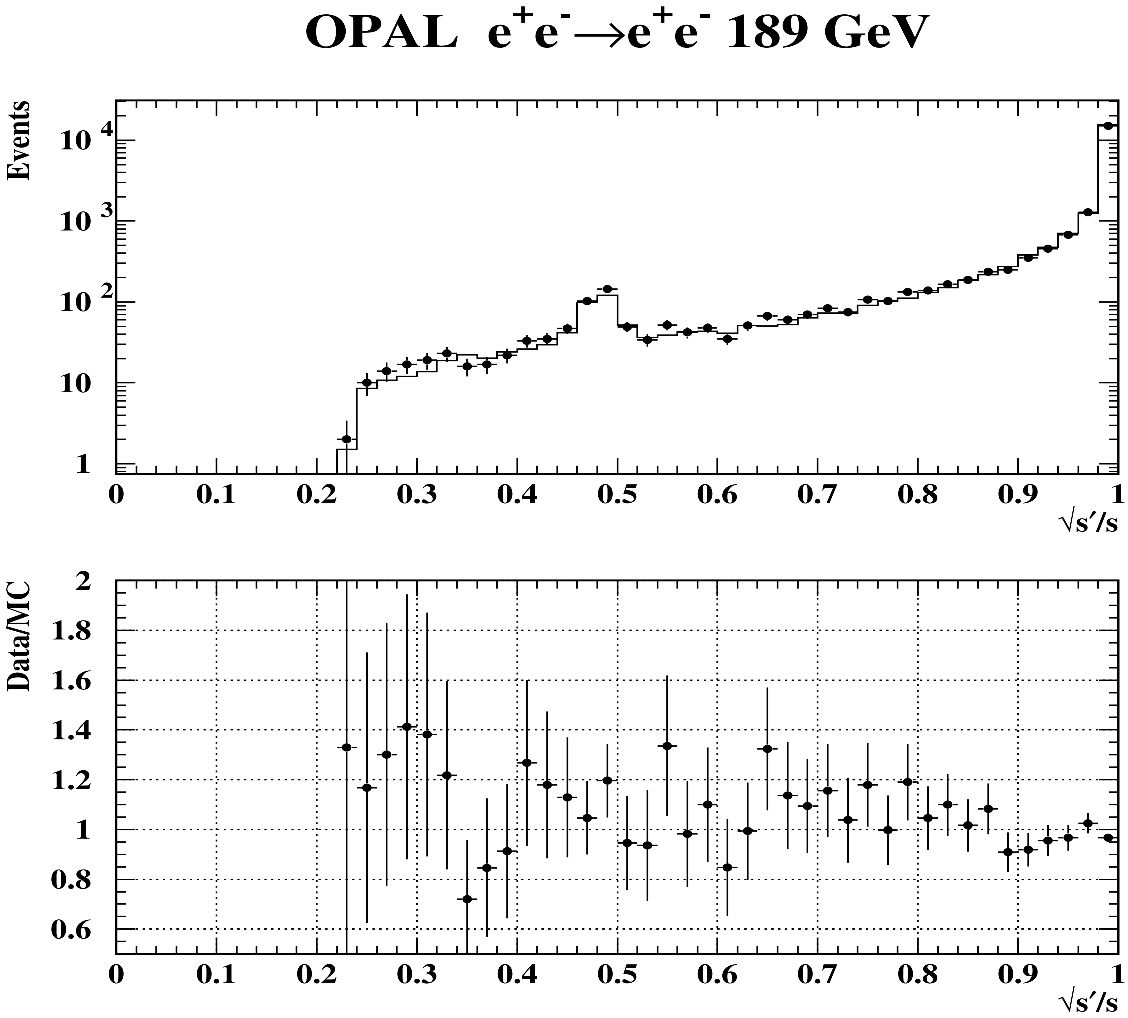
Selection:

- $|\cos\theta_{\gamma}| < 0.97$
- $E^{\gamma}_{min} > 2$ GeV

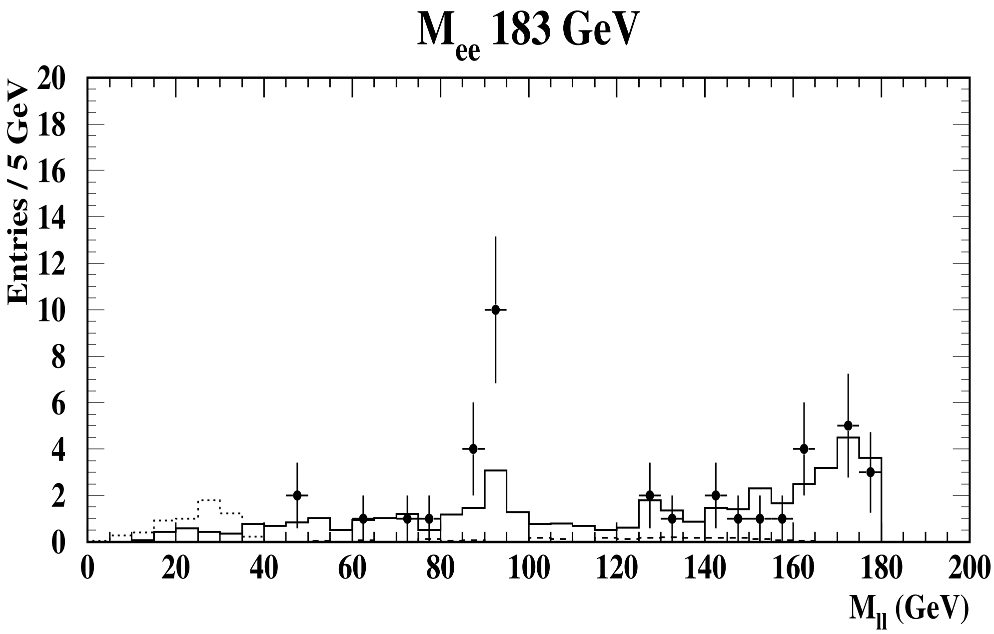


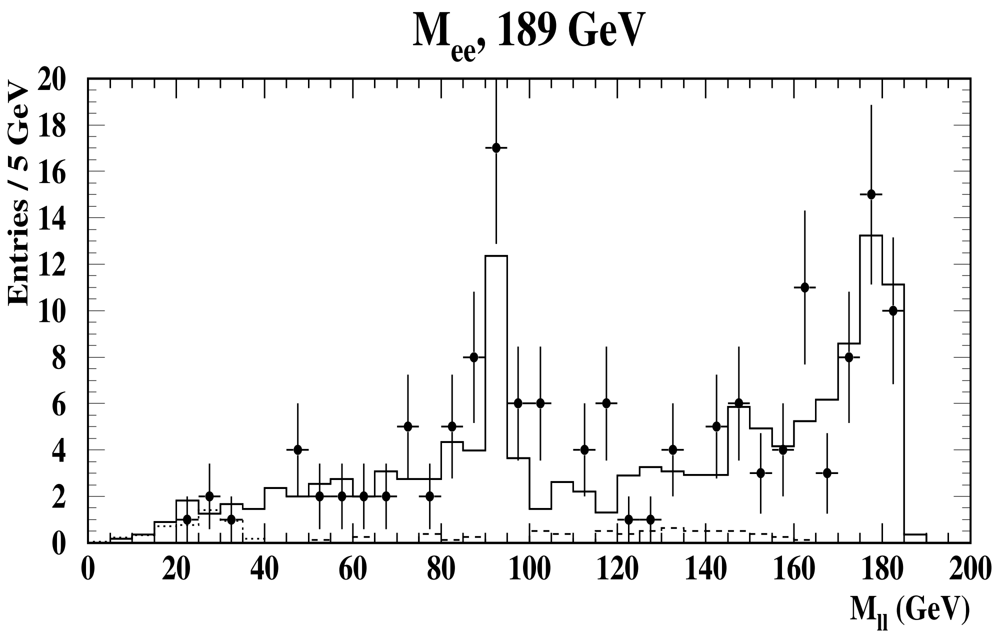


- $\sqrt{s'}$ from angles
- $|\cos\theta\,| < 0.9$
- acollinearity $\zeta < 170°$



- mass from angles
- one electron $|\cos\theta| < 0.7$, second - $|\cos\theta| < 0.9$
- visible photon: $|\cos\theta_\gamma| < 0.7$
- $E_{vis} > 0.8 \cdot \sqrt{s}$





Outlook

- the agreement Data/BHWIDE is best for

$$\sqrt{s'/s} \sim 1$$

  for lower energies (or higher acollinearities) the data is generally higher than the MC

- at least the $O(\alpha^2)$ LL correction is needed before one can expect precision results for the Z-return region (comment from B.F.L.Ward)

- precision tags from the 2f group *now* are challenging for $\sigma_{e^+e^-}$:
  - 0.13 % for $|\cos\theta| < 0.9$
  - 0.21 % for $|\cos\theta| < 0.7$

- searches (low scale gravity, excited leptons, sneutrinos, contact interactions ...) need increased precision of theory programs / generators to fully exploit the rich potential of Bhabha scattering at LEP2