



Preliminary analysis of multi-photon events with missing energy at $\sqrt{s} = 189$ GeV

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Abstract

Multi-photon events with missing energy have been preliminary analysed in the data collected with the DELPHI detector at $\sqrt{s} = 189$ GeV. Single-photon events with the photon not originating from the beam interaction region have also been considered. No evidence for new physics has been found.

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1 Introduction

This note describes a study of final states with at least two photons and missing energy in the data taken with the DELPHI detector at the centre-of-mass energy of 189 GeV. The sample of data used consists of about 158 pb^{-1} collected during 1998.

The physics motivations and the selection criteria have been discussed in detail in a published paper [1] dedicated to the analysis of the data taken at centre-of-mass energies up to 183 GeV. Here only a brief update of the results is given on the basis of the 1998 data. All results reported in this note are very preliminary.

2 Data analysis

The analysis of 1998 data is identical to that applied to lower centre-of-mass energies and described in [1]. As in [1], four data samples have been selected and studied:

1. Preselected events with at least two photons and missing energy: in this case the selection is based on very loose cuts and is used in order to monitor the modeling of the $e^+e^- \rightarrow \nu\nu\gamma\gamma(\gamma)$ background by the Koralz generator [2].
2. Events passing the selection dedicated to the search of the process $e^+e^- \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0 \rightarrow \tilde{G}\gamma\tilde{G}\gamma$.
3. Events passing the selection dedicated to the search of the process $e^+e^- \rightarrow \tilde{\chi}_2^0\tilde{\chi}_2^0 \rightarrow \tilde{\chi}_1^0\gamma\tilde{\chi}_1^0\gamma$.
4. Events with a single photon which does not point to the beam interaction region: this sample is used in order to look for processes of the type $e^+e^- \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0 \rightarrow \tilde{G}\gamma\tilde{G}\gamma$ for the case when the gravitino is heavy enough to make the lifetime of the decay $\tilde{\chi}_1^0 \rightarrow \tilde{G}\gamma$ long relative to the detector scale.

3 Results

The number of events found and expected within the standard model for each of the four data samples described in the previous section can be found in Table 1. No evidence for an excess of events is found. More details on the comparison between the data and the simulation of the standard model background and on the derived cross-section limits for new physics can be extracted from Figures 1 to 4.

References

- [1] DELPHI Collaboration, CERN-EP/98-142, E.Phys.J. C6 (1999) 37.
- [2] S. Jadach *et al.*, Comp. Phys. Comm. **66** (1991) 276;
S. Jadach *et al.*, Comp. Phys. Comm. **79** (1994) 503.

Data sample	\sqrt{s}	Found events	Expected events
Sample 1	189 GeV	15	14.0
Sample 2	189 GeV	4	5.3
Sample 3	189 GeV	7	5.5
Sample 4	189 GeV	4	5.2
Sample 1	130-189 GeV	25	24.2
Sample 2	130-189 GeV	6	8.0
Sample 3	130-189 GeV	11	8.9
Sample 4	130-189 GeV	6	7.9

Table 1: Events found and expected from standard model sources in the four selected data samples.

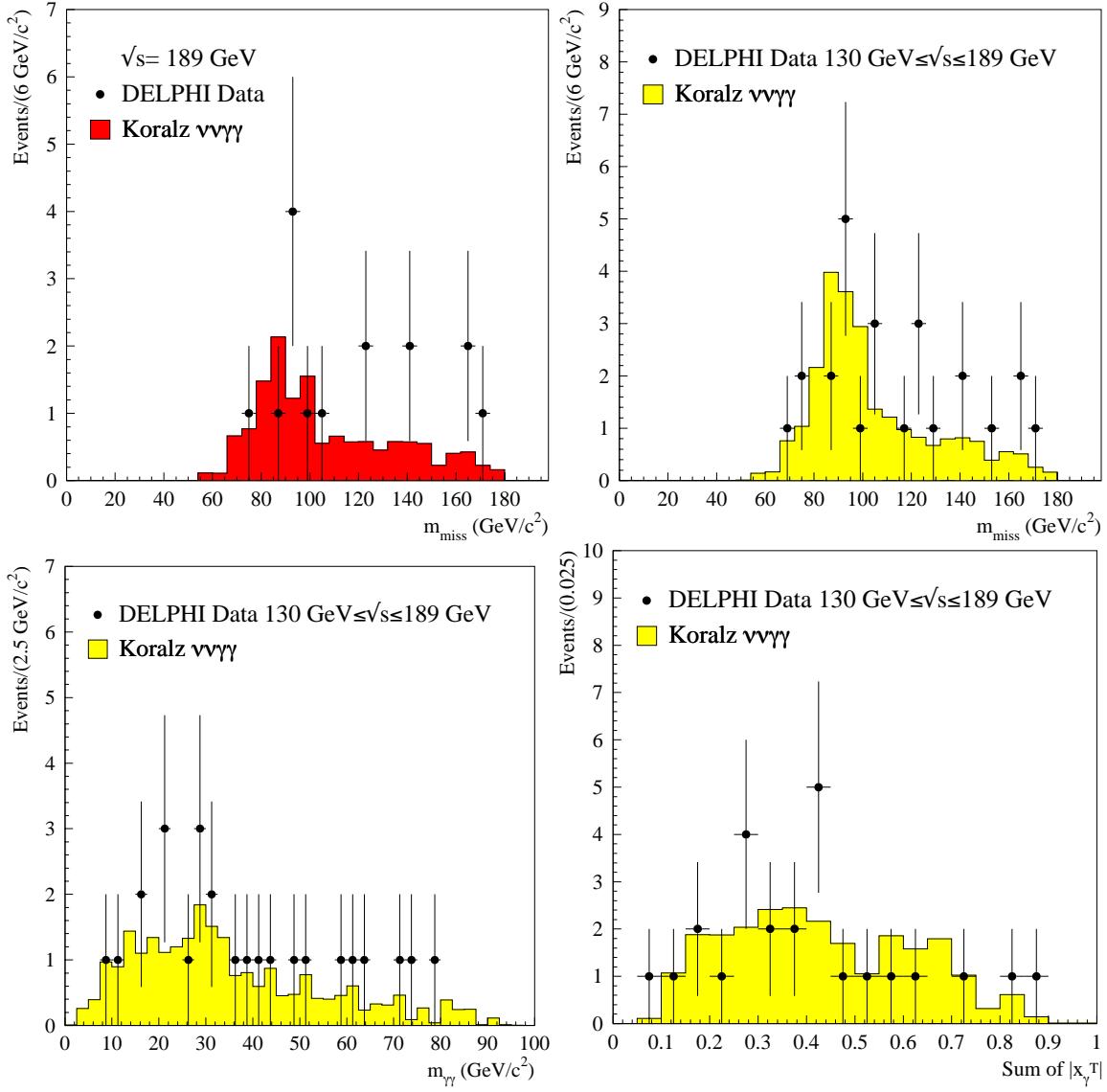


Figure 1: Event preselection: missing mass distribution observed in 189 GeV data (top left), missing mass (top right), $\gamma\gamma$ invariant mass (bottom left) and sum of the photons (scaled) transverse momenta (bottom right) after combining all DELPHI LEP2 data. The $\gamma\gamma$ invariant mass is calculated from the two most energetic photons.

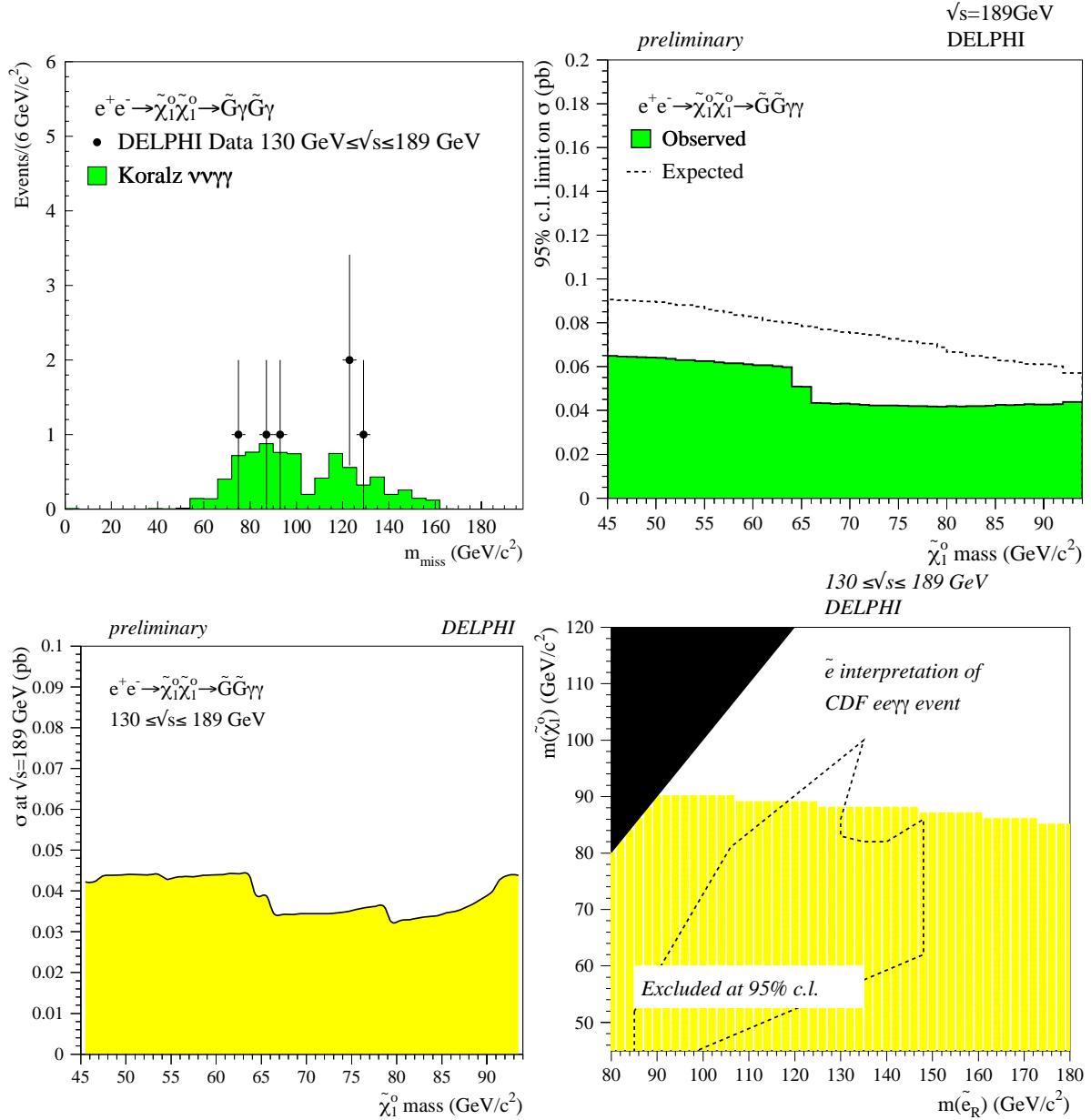


Figure 2: Search for $e^+e^- \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0 \rightarrow \tilde{G}\gamma\tilde{G}\gamma$: missing mass distribution for all LEP2 samples (top left), cross-section limit at 189 GeV obtained from 189 GeV data only (top right), cross-section limit and exclusion region in the $m(\tilde{\chi}_1^0)$ vs $m(\tilde{e}_R)$ plane obtained from all LEP2 data samples (bottom left and right). The branching ratio for $\tilde{\chi}_1^0 \rightarrow \tilde{G}\gamma$ is assumed to be 100%.

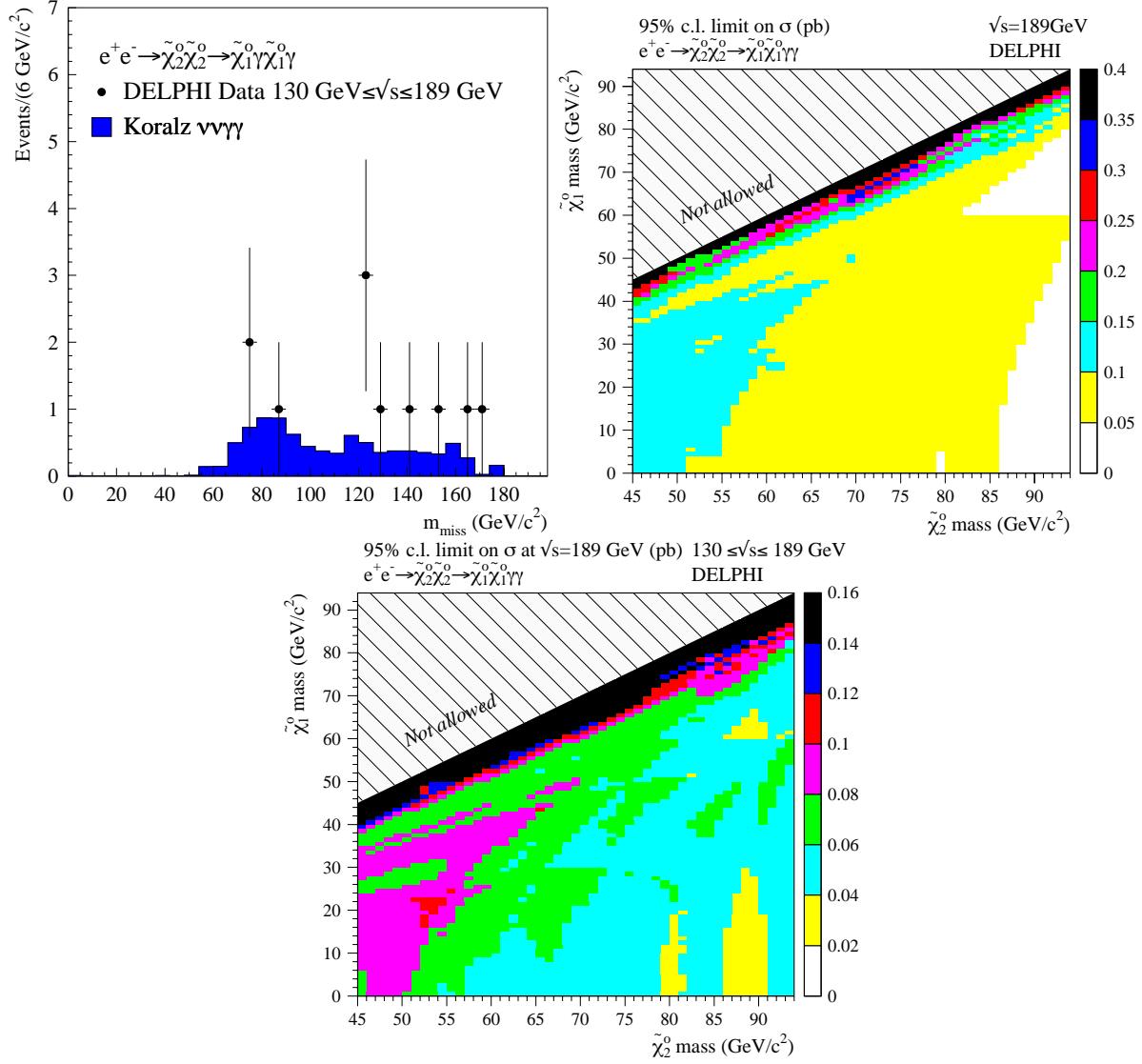


Figure 3: Search for $e^+e^- \rightarrow \tilde{\chi}_2^0\tilde{\chi}_2^0 \rightarrow \tilde{\chi}_1^0\gamma\tilde{\chi}_1^0\gamma$: missing mass distribution for all LEP2 samples (top left), cross-section limit at 189 GeV obtained from 189 GeV data only (top right) and from all LEP2 data samples (bottom). The branching ratio for $\tilde{\chi}_2^0 \rightarrow \tilde{\chi}_1^0\gamma$ is assumed to be 100%.

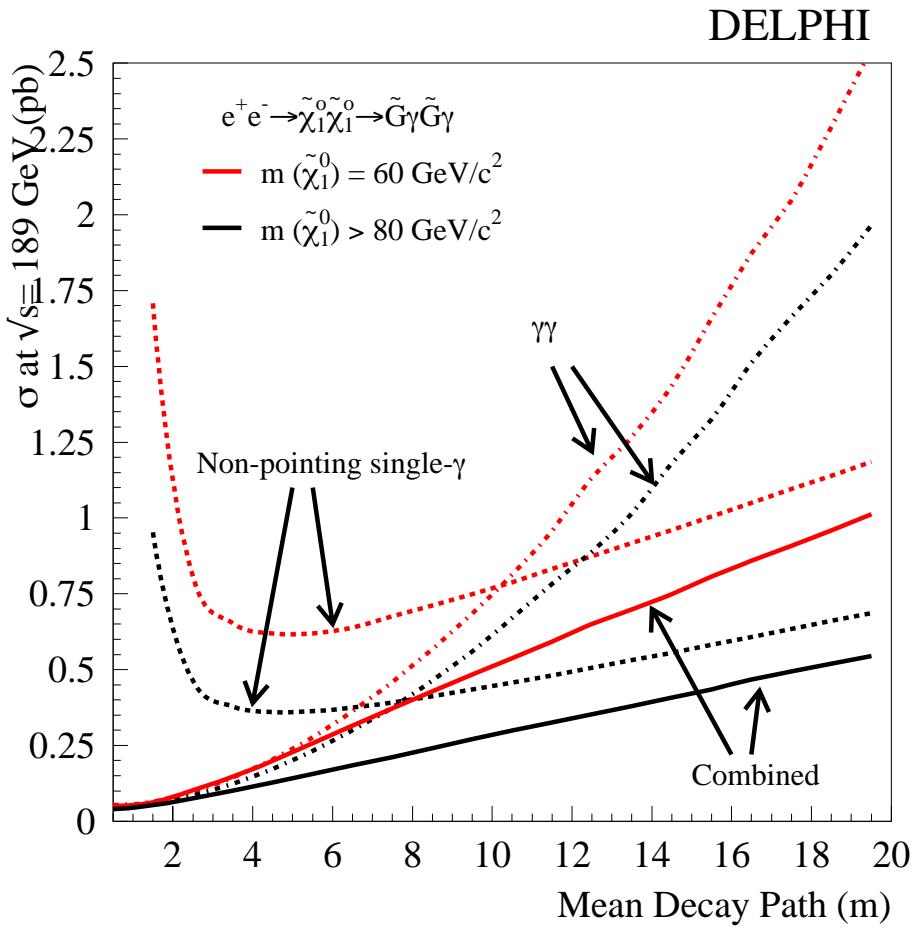


Figure 4: Search for non-pointing single-photons: cross-section limit at 189 GeV as a function of the $\tilde{\chi}_1^0$ mean decay path obtained from all LEP2 data samples. The branching ratio for $\tilde{\chi}_1^0 \rightarrow \tilde{G}\gamma$ is assumed to be 100%.