Preliminary analysis of multi-photon events with missing energy at $\sqrt{s} = 192 - 202$ GeV

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Abstract

Multi-photon events with missing energy collected with the DELPHI detector in 1999 have been preliminary analysed to search for supersymmetric particles. The data corresponds to a total luminosity of 228 pb$^{-1}$ collected at centre-of-mass energies between 192 and 202 GeV. No deviations from standard model expectations have been observed in the data.
1 Introduction

This note describes an update of the analysis of multi-photon final states with missing energy in the data taken with the DELPHI detector in 1999. The sample of data used in this analysis has been collected at approximate centre-of-mass energies of 192, 196, 200 and 202 GeV, with integrated luminosities of 25.88, 76.90, 84.28 and 41.1 pb\(^{-1}\), respectively. The results obtained for the same final states at lower centre-of-mass energies have been already published elsewhere [1, 2].

All results reported in this note are preliminary.

2 Data analysis

The analysis of 1999 data is identical to that applied to lower centre-of-mass energies and described in [1]. In particular, three data samples have been selected and studied:

- Sample 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 in the simulation.
- Sample 2: events passing the selection dedicated to the search of the process \(e^+e^- \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0 \rightarrow \tilde{G}\tilde{G}\gamma\), where \(\tilde{\chi}_1^0\) is the lightest neutralino and \(\tilde{G}\) is the gravitino.
- Sample 3: events passing the selection dedicated to the search of the process \(e^+e^- \rightarrow \tilde{\chi}_2^0\tilde{\chi}_2^0 \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0\gamma\), where \(\tilde{\chi}_2^0\) is the next-to-lightest neutralino.

Samples 2 and 3 are a subsample of Sample 1. The main standard model background consists of events \(e^+e^- \rightarrow \nu\nu\gamma\gamma(\gamma)\), which are simulated according to the Koralz generator [3]. Additional background contributions from the processes \(e^+e^- \rightarrow \gamma\gamma(\gamma)\) (QED), \(e\gamma \rightarrow e\gamma\) (Compton) and \(e^+e^- \rightarrow (e^+e^-) - \gamma\gamma\) (Bhabha) have been estimated to be below 0.3 events at preselection level and have been neglected.

3 Results

The number of events found and expected within the standard model for each of the three data samples described in the previous section can be found in Table 1. No evidence for an excess of events is found.

The missing mass distributions observed in the data after preselection are compared to those of the standard model background in Figure 1. Cross-section limits at 95% C.L. for the processes \(e^+e^- \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0 \rightarrow \tilde{G}\tilde{G}\gamma\) and \(e^+e^- \rightarrow \tilde{\chi}_2^0\tilde{\chi}_2^0 \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0\gamma\) are displayed in Figures 2 and 3.

References


Table 1: Events found and expected from standard model sources in the three samples described in the text. The last line of each sample corresponds to the sum of all LEP2 data.
Figure 1: Event preselection: missing mass distribution observed in 1999 data alone (top) and in the full sample collected at LEP2 (bottom).
Figure 2: Search for $e^+e^- \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0 \rightarrow \tilde{\chi}_2^0\tilde{\chi}_2^0 \gamma\gamma$: cross-section limit at $\sqrt{s} = 202$ GeV and corresponding exclusion region in the $m(\tilde{\chi}_1^0)$ vs $m(\tilde{e}_R)$ plane obtained by combining all samples collected at LEP2. The neutralino is assumed to be pure Bino, with 100% branching ratio for the decay $\tilde{\chi}_1^0 \rightarrow \tilde{\gamma} \gamma$. The dotted region in the right plot corresponds to the selectron interpretation of the CDF $e^-\gamma E_{\text{miss}}$ event [4].

Figure 3: Search for $e^+e^- \rightarrow \tilde{\chi}_2^0\tilde{\chi}_2^0 \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0 \gamma\gamma$: cross-section limit at $\sqrt{s} = 202$ GeV obtained by combining all samples collected at LEP2. The branching ratio for $\tilde{\chi}_2^0 \rightarrow \tilde{\chi}_1^0 \gamma$ is assumed to be 100%.