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Combination of the LEP II e^+e^- Results

LEPEWWG $f\bar{f}$ Subgroup

Members :

C. Geweniger, C. Goy, M-N Minard
M. Elsing, J. Holt, W. Liebig, P. Renton
S. Blyth, D. Bourilkov, S. Riemann, S. Wynhoff
M. Kobel, S. Marcellini, K. Sachs, P. Ward

Abstract

Preliminary combinations of differential cross-section measurements of the 4 LEP collaborations of the process $e^+e^- \rightarrow e^+e^-$ at LEP-II are presented.

Results Prepared for Winter Conferences 2002

1 Introduction

Averages of cross-sections and forward-backward asymmetries for $e^+e^- \to q\bar{q}$, $e^+e^- \to \mu^+\mu^-$ and $e^+e^- \to \tau^+\tau^-$ at LEP II, as well as differential cross-sections, $\frac{d\sigma}{d\cos\theta}$, for $e^+e^- \to \mu^+\mu^-$ and $e^+e^- \to \tau^+\tau^-$ can be found in [1], along with averages for heavy quark production at LEP II. There have been no updates to those measurements since then. This short note provides details of a new combination of differential cross-sections for $e^+e^- \to e^+e^-$.

2 Averages of differential cross-sections for $e^+e^- \to e^+e^-$

The LEP experiments have measured the differential cross-section, $\frac{d\sigma}{d\cos\theta}$, for the $e^+e^- \to e^+e^-$ channel for samples of events with different acolinearity cuts. A preliminary combination of these results has been made for the first time, by performing a χ^2 fit to the measured differential cross sections, using the experimental errors as given by the experiments. In contrast to the muon and tau channels [1] the higher statistics makes the use of expected errors unnecessary.

The combination included data from 192 to 207 GeV, but not all experiments provided data at these energies. Since [1], new, preliminary, results for centre-of-mass energies between 192–207 GeV have been made available by some experiments. The data used in the combination are summarised in Table 1.

Each experiment's data were binned according to an agreed common definition, which takes into account the large forward peak of Bhabha scattering:

- 10 bins for $\cos\theta$ between 0.0 and 0.90 and
- 5 bins for $\cos\theta$ between -0.90 and 0.0 at each

energy. Except for the binning, each experiment is using their own signal definiton. The scattering angle, θ, is the angle of the negative lepton with respect to the incoming electron direction in the lab coordinate system. The outer acceptances of the most forward and most backward bins for which the experiments have presented their data were different. The ranges in $\cos\theta$ of the individual experiments and the average are given in Table 2. The signal definition used for the LEP average corresponded to acolinearity cut of 10°.

Correlated systematic errors between different experiments, energies and bins at the same energy, arising from uncertainties on the overall normalisation, and from migration of events between forward and backward bins with the same absolute value of $\cos\theta$ due to uncertainties in the corrections for charge confusion, were considered in the averaging procedure.

An average for all energies between 192–207 GeV was performed. The results of the averages are shown in Figure 1. The χ^2 per degree of freedom for the average is 64/72.

The correlations between bins in the average are well below 10% of the total error on the averages in each bin for most of the cases, and around 20% for bins close to the edges of the acceptance. The agreement between the averaged data and the predictions from the Monte Carlo generator BHWIDE [2] is good, with a χ^2 of 85 for 90 degrees of freedom.

$\sqrt{s}$(GeV)	$e^+e^- \rightarrow e^+e^-$			
	A	D	L	O
192–202	-	-	P	P
205–207	-	-	P	P

Table 1: Differential cross-section data provided by the LEP collaborations (ALEPH, DELPHI, L3 and OPAL) for $e^+e^- \rightarrow e^+e^-$ Data marked with P are preliminary. Data marked with a - were not available for combination.

Experiment	$\cos\theta_{min}$	$\cos\theta_{max}$
L3 (acol. $< 25°$)	-0.72	0.72
OPAL (acol. $< 10°$)	-0.90	0.90
Average (acol. $< 10°$)	-0.90	0.90

Table 2: The acceptances for which experimental data are presented for the $e^+e^- \rightarrow e^+e^-$ channel and the acceptance for the LEP average.

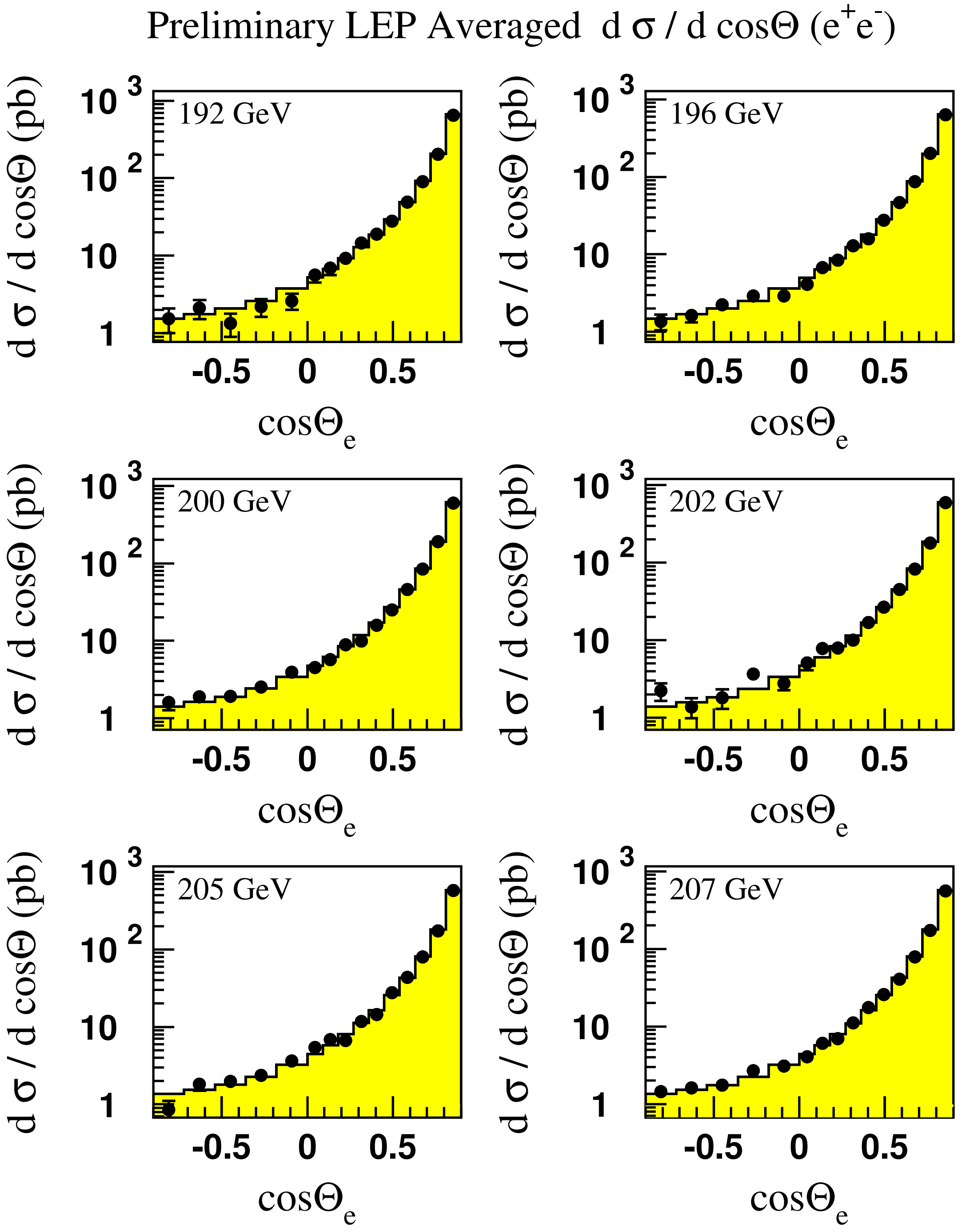

Figure 1: LEP averaged differential cross-sections for $e^+e^- \to e^+e^-$ at energies of 192–207 GeV. The SM predictions, shown as solid histograms, are computed with BHWIDE [2].

References

[1] The LEP Collaborations ALEPH, DELPHI, L3, OPAL and the LEP Electroweak Working Group, and the SLD Heavy Flavour and Electroweak Groups, *A Combination of Preliminary Electroweak Measurments and Constriants on the Standard Model* CERN-EP-2002-098,hep-ex/0112021.

[2] S. Jadach, W. Placzek and B.Ward, Phys. Lett. **B390** (1997) 298.