CROSS SECTION OF HADRON PRODUCTION IN $\gamma\gamma$ COLLISIONS AT LEP

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Abstract

The reaction $e^+e^- \rightarrow e^+e^-\gamma^*\gamma^* \rightarrow e^+e^-$ *hadrons* is analysed using data collected by the L3 detector during the LEP runs at $\sqrt{s}$ = 130-140 GeV and $\sqrt{s}$ = 161 GeV. The cross sections $\sigma(e^+e^- \rightarrow e^+e^-$ *hadrons*) and $\sigma(\gamma\gamma \rightarrow$ *hadrons*) are measured in the interval $10 \leq W_{\gamma\gamma} \leq 75$ GeV for the first time. The energy dependence of the real photons total cross section, $\sigma(\gamma\gamma \rightarrow$ *hadrons*), is consistent with the universal Regge behaviour of total hadronic cross sections.

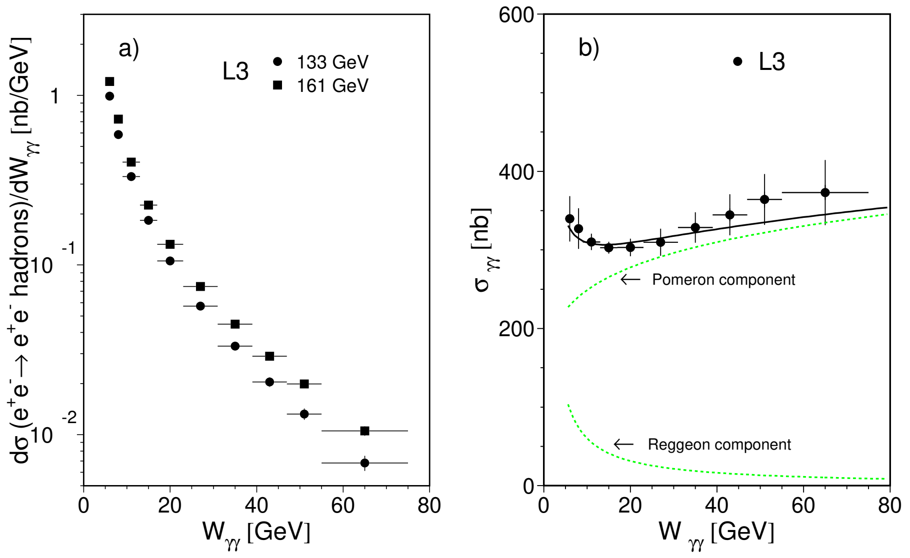

Figure 1: a)The cross section $d\sigma($ e$^+$e$^-\rightarrow$ e$^+$e$^-$$hadrons)/dW_{\gamma\gamma}$ as measured at $\sqrt{s}$=133 GeV and at $\sqrt{s}$= 161 GeV . b) Total cross section $\gamma\gamma \rightarrow hadrons$. The continous line is the Regge fit described in the text. The two components : the rapidly decreasing Reggeon part and the slow rising component due to Pomeron exchange are indicated with a dashed line.

Two-photon interactions are the dominant source of hadron production at LEP2. In the two high energy runs at $\sqrt{s}$=133 (L=4.98 pb^{-1}) and $\sqrt{s}$=161 GeV (L=10.37 pb^{-1}), a total of 32000 events of anti-tagged two-photon interaction e$^+$e$^-\rightarrow$ e$^+$e$^-$ *hadrons* were observed in the L3 detector, with $W_{\mathrm{vis}}\geq$ 5 GeV. The effective mass of the hadron system (W_{vis}) is calculated by using well reconstructed tracks (≥ 3) and clusters measured in all the calorimeters.

The detailed features of the events: angular and momentum distributions, energy deposited in the calorimeters and visible mass are rather well reproduced by the recent generators PYTHIA [1] and PHOJET [2]. From the visible mass the two-photon center of mass energy $W_{\gamma\gamma}$ is derived by using an efficiency and acceptance matrix calculated with the two generators.

The cross section $\sigma($ e$^+$e$^-\rightarrow$ e$^+$e$^-$$hadrons)$ for $< Q^2 > \simeq 0.025$ GeV^2 is measured in the interval $5 \leq W_{\gamma\gamma} \leq 75$ GeV (Fig.1a). The real photon total cross section $\sigma(\gamma\gamma \rightarrow hadrons)$ is also derived from the data (Fig.1b). The $\sigma(\gamma\gamma \rightarrow hadrons)$ cross section is dominated by soft $\gamma\gamma$ interactions, where the photon behaves like a hadron. The increase with energy of this cross section is characteristic of Pomeron exchange. The universal Regge parametrisation of A. Donnachie and P.V. Landshoff [3] $\sigma_{\mathrm{tot}} = A\, s^{\epsilon} + B\, s^{-\eta}$ and the energy dependence fixed by the world average hadronic total cross sections [4] $\epsilon = 0.0790 \pm 0.0011$, $\eta = 0.4678 \pm 0.0059$ reproduce well the data (χ^2/d.o.f. $= 3/8$) with parameters $A = 173 \pm 7$, $B = 519 \pm 125$, obtained with a fit which takes into account the bin-to-bin systematic errors.

References

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