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CHARM AND BEAUTY PRODUCTION IN TWO PHOTON COLLISIONS AT LEP

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ABSTRACT

Heavy quark production is widely studied in two-photon collisions at LEP and is a very fruitful laboratory for testing perturbative QCD. Clear evidence for the gluon content of the photon is obtained. The data favour low values of the charm mass. The $b\bar{b}$ production is found to be three times higher than the NLO QCD predictions.

Two photon collisions are the main source of hadrons at LEP. The study of charm and beauty production in two-photon collisions, introducing a large physical scale, provides a means of testing pertubative QCD and of probing the partonic structure of the photon. At LEP energies, the direct and single resolved processes, sketched in Figure 1, are predicted to give comparable contributions to the cross section $\sigma(\gamma\gamma \to c\bar{c}, b\bar{b})$. The resolved photon cross

* On behalf of the L3 Collaboration

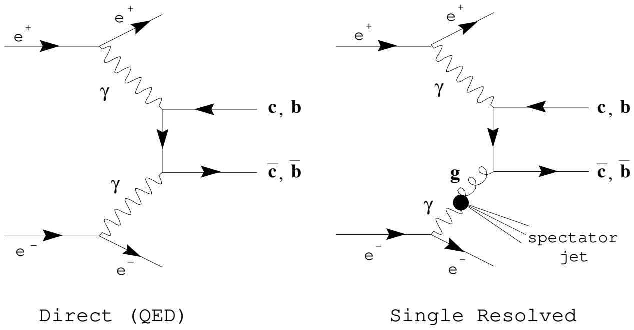

Figure 1: *Feynman diagrams of the two main* $\gamma\gamma \rightarrow c\bar{c}, b\bar{b}$ *processes*

section is dominated by the photon-gluon fusion process $\gamma g \rightarrow q\bar{q}$. This talk is a short survey of recent LEP results [1].

The event selection follows two steps: first hadronic final states from two-photon collisions are selected, then an heavy quark is tagged. A cut on the calorimetric energy deposited in the detector provides a clean separation between two-photon collisions and e^+e^- annihilation processes. The charm is

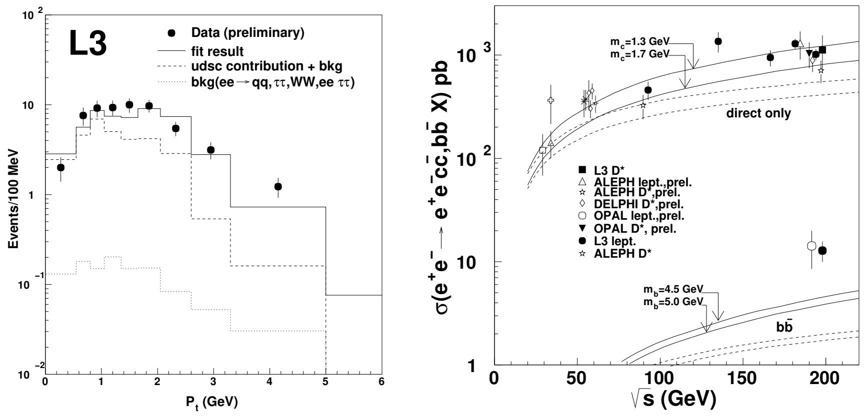

Figure 2: *Left: transverse momentum of the electron with respect to the nearest jet. Right: total cross section of* $c\bar{c}$ *and* $b\bar{b}$ *productions with respect to* $\sqrt{s}$.

tagged either by the presence of a D* resonance or by the presence of a lepton (electron or muon). The D$^{*\pm}$ meson is studied via its decay into a D^0 meson and a low energy $\pi^\pm$. $D^0 \to K^-\pi^+$, $D^0 \to K^-\pi^+\pi^0$ and $D^0 \to K^-\pi^+\pi^-\pi^+$ decay channels are analysed. The beauty is tagged with high momentum leptons. The transverse momentum distribution of the lepton with respect to the nearest jet is fitted with uds, c and b content as free parameters as shown in Figure 2(left).

The total cross section of charm production, $e^+e^- \to e^+e^- c\bar{c}X$, shown in Figure 2(right) is in good agreement with NLO QCD predictions [2]. The direct process alone is insufficient to describe the data. This is an evidence of the importance of the gluon-photon fusion process and of the gluon content of the photon.

The L3 and OPAL measurements of the total cross section of beauty production are in good agreement with each other, but data are more than three times higher than NLO QCD predictions [2].

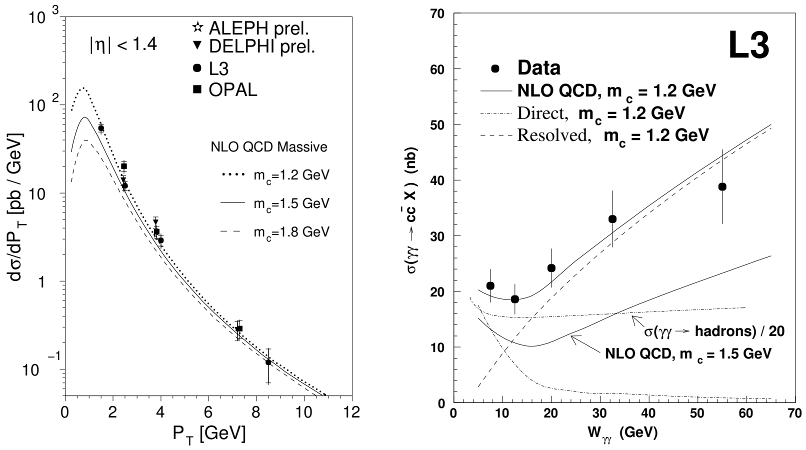

Figure 3: *Left: differential cross section of the charm production with respect to the transverse momentum of the D^*. Right: total cross section with respect to the mass of the $\gamma\gamma$ system.*

The differential cross section of the charm production as a function of the transverse momentum and the total cross section $\gamma\gamma \to c\bar{c}X$ as a function of the mass of the $\gamma\gamma$ system $W_{\gamma\gamma}$ are also measured. In Figure 3, one can see that

these measurements favour a low value of the charm mass. The rise of the $\gamma\gamma$ cross section at high $W_{\gamma\gamma}$ values is characteristic of the resolved processes [3]. The separation between the direct and the resolved processes has also been studied with kinematic variables of the jets.
As shown in Figure 4, the charm structure function of the photon exhibits at low x higher values than predicted [4]. The gluon component of the photon is therefore probably underestimated.

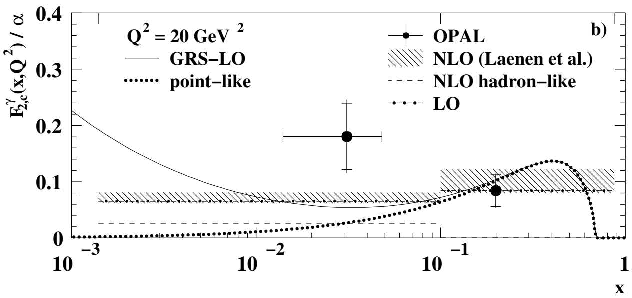

Figure 4: *Charm structure function of the photon.*

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