QCD PREDICTIONS FOR HEAVY FLAVOUR PRODUCTION

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ABSTRACT

Predictions of Quantum Chromodynamics for the hadronic production of heavy flavours are reviewed, with special attention to the progress made in the last year. The contribution of flavour excitation diagrams is discussed in detail and a procedure is given which allows to cure their divergences and to stabilize their calculation. A comparison of the results with charm cross-section data is made, showing that the level and the energy behaviour of the charm cross-section are thus correctly reproduced. The observed production of diffractive $\Delta_c$ is shown to be naturally understood by means of a simple recombination model. Expectations for the general features of charm production at collider energies are worked out and in particular it is shown that i) $\sigma^{(\overline{c}c)} \approx 10$ mb at the CERN $\overline{p}p$ collider, which entails $e/\gamma \approx 5 \times 10^{-3}$ near 90°, ii) charm events should have relatively high multiplicities. Problems arising in the theoretical prediction of bottom and top particle production are outlined.
INTRODUCTION

Recent experimental surveys of hadronic production of charm can be found in the talks by Treille\(^1\) at the Bonn Symposium (1981) and by Fisher\(^2\) at the Paris Conference (1982). The theoretical understanding of the data has been reviewed by Phillips\(^3\) at the Madison Workshop (1981) and more recently by Halzen\(^4\) at the Paris Conference (1982). About one year ago the main conclusions about the conventional treatment of charm hadroproduction in terms of QCD fusion diagrams (Fig. 1) alone were\(^3\):

i) production of hidden charm is adequately reproduced;
ii) cross sections for open charm are too low when compared to data;
iii) calculated longitudinal spectra of charmed hadrons are too soft and insufficient to explain diffractive production of \(\Lambda_c\).

Because of this unsatisfactory situation a number of alternatives to perturbative QCD models were proposed. Among them diffraction excitation\(^5\), intrinsic charm\(^6\) and diquark recombination\(^7\).

In the last year there has been considerable progress in the ability to make a more complete calculation of what should actually be expected from perturbative QCD in this process\(^4\). Specifically, ways have been found to determine the contribution of the hard to calculate flavour excitation diagrams\(^8\). As a result of that, the seeming difficulties met by perturbative QCD in describing hadronic production of open charm have disappeared.

Flavour excitation diagrams were often neglected before because of poor knowledge of the charm distribution, \(c(x,Q^2)\), which is