QCD Analyses and Determinations of α_s in e^+e^- Annihilation at Energies between 35 and 189 GeV

The JADE and the OPAL Collaboration

Abstract

We employ data taken by the JADE and OPAL experiments for an integrated QCD study in hadronic e^+e^- annihilations at c.m.s. energies ranging from 35 GeV through 189 GeV. The study is based on jet-multiplicity related observables. The observables are obtained to high jet resolution scales with the JADE, Durham, Cambridge and cone jet finders, and compared with the predictions of various QCD and Monte Carlo models. The strong coupling strength, α_s, is determined at each energy by fits of $\mathcal{O}(\alpha_s^2)$ calculations, as well as matched $\mathcal{O}(\alpha_s^2)$ and NLLA predictions, to the data. Matching schemes are compared, and the dependence of the results on the choice of the renormalization scale is investigated. The combination of the results using matched predictions gives

$$\alpha_s(M_{Z^0}) = 0.1187^{+0.0034}_{-0.0019}.$$

The strong coupling is also obtained, at lower precision, from $\mathcal{O}(\alpha_s^2)$ fits of the c.m.s. energy evolution of some of the observables. A qualitative comparison is made between the data and a recent MLLA prediction for mean jet multiplicities.

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