LAPP-EXP 2004-4
August 3, 2004

KLOE measurements and the QED vacuum polarization

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Abstract

Recent KLOE measurements in the low energy e^+e^- annihilation data and their influence on the determination of the hadronic contribution to the determination of the QED fine structure constant at m_Z are discussed.

Contribution to the 2004 summer conferences

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In the year 2001, we published an updated evaluation of the hadronic contribution to the running of the QED fine structure constant [1], based on a dispersion integral using a parametrization of the measured cross section of $e^+e^- \to$ hadrons. We obtained a hadronic contribution of $\Delta\alpha^{(5)}_{\text{had}}(s) = 0.02761 \pm 0.00036$ at s = m_Z^2.

Our parametrization in the c.m.s. energy region between 0.61 and 0.96 GeV was based on form factor results obtained with the CMD-2 detector at the VEPP-2M collider [2]. The overall uncertainty of the ρ region integral, including the statistical uncertainty, is 2.3% (that of Γ_{ee} in [2]) in our analysis.

Since then, the CMD-2 collaboration improved the treatment of radiative corrections twice. An intermediate improvement has appeared in the published document [3] and an additional improvement has become available in 2003 [4]. We have concluded that the most recent CMD-2 results imply only a small change in the estimate of the hadronic contribution [5].

Recently, the KLOE collaboration [6] has measured the cross section of $e^+e^- \to$ hadrons with high statistical accuracy in small energy bins using the "radiative return" from the ϕ resonance to the ρ. The c.m.s. energy region covered by KLOE is very similar to that of the published CMD2 data.

In our 2001 analysis, we used the parametrization of the pion form factor as published by the CMD2 collaboration. There is no consistent set of $\rho-\omega$ parameters yet from KLOE. To estimate the effect of the new results on $\Delta\alpha^{(5)}_{\text{had}}(m_Z^2)$, we compared the dispersion integral results using directly the CMD2 and KLOE data points. Outside the measured regions, we used the parametrization scaled by the change of normalization between the results given in Ref. [2] and in Ref. [4]. We treated the systematic uncertainties as fully correlated between measurements at different c.m.s. energies.

Similarly, we have directly integrated the KLOE measurements. Outside the measured region, the same parametrization from CMD2 is applied. Finally the results of the integration of KLOE and CMD2 results have been combined and introduced in the analysis of the hadronic contribution to the determination of the QED fine structure constant at m_Z^2. The small increase in $\alpha(m_Z 2)$ due to the recent updates from CMD2, that we reported in the 2003 summer conference [4] is about cancelled when we include the KLOE data, confirming our published result from the year 2001 [1]. We therefore recommend to use our published 2001 results as a basis of up-to-date electroweak analyses.

We would like to strongly encourage efforts to further clarify and improve the knowledge of the low energy hadronic cross section, with a consistent fit of the π-form factor based on all data in an extended energy range, possibly by including also BABAR and BELLE measurements.

References

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