HAL
open science

RECENT RESULTS FROM THE CELLO COLLABORATION AT PETRA

H.-J. Behrend

To cite this version:

H.-J. Behrend. RECENT RESULTS FROM THE CELLO COLLABORATION AT PETRA. Journal de Physique Colloques, 1982, 43 (C3), pp.C3-72-C3-74. 10.1051/jphyscol:1982314 . jpa-00221867

HAL Id: jpa-00221867

https://hal.science/jpa-00221867

Submitted on 4 Feb 2008

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

JOURNAL DE PHYSIQUE
Colloque C3, supplément au n° 12, Tome 43, décembre 1982 *page* C3-72

RECENT RESULTS FROM THE CELLO COLLABORATION[+] AT PETRA

H.-J. Behrend

DESY, Notkestrasse 85, 2000 Hamburg 52, F.R.G.

1. $e^+e^- \to \tau^+\tau^-$

The reaction was measured using all possible decay channels except $e^+e^-\nu\bar{\nu}$ and $\mu^+\mu^-\nu\bar{\nu}$ final states by triggering the detector on ≥2 charged particles with transverse momentum of ≥ 200 MeV/c. With $\int Ldt = 11.3\ pb^{-1}$ 434 events were collected. The branching fractions are given in Table 1.

Table 1: Branching Fractions for τ-lepton

charge multipl.	observed number	branching fraction
1	672	0.84 ± 0.02
3	186	0.15 ± 0.02
5	10	0.01 ± 0.004

The total cross section is consistent with the point cross section $R_\tau = \sigma_\tau/\sigma_{pt} = 1.03 \pm 0.05 \pm 0.07$ (stat., syst.) (standard model = 1.003). The cutoff parameters $\Lambda_\pm$ are determined from $\sigma_\tau = \sigma_{pt}(1 \pm s/(s-\Lambda_\mp^2))^2$ to $\Lambda_- > 111$ GeV, $\Lambda_+ > 149$ GeV with 95% c.l.

The asymmetry of the forward-backward production is $\langle A_{\tau\tau}\rangle = -(10.3\pm5.2)\cdot10^{-2}$ compared to the standard GWS-theory of $-9.2\cdot10^{-2}$. The lifetime of the τ-leptons was determined my measuring the decay vertex to $(4.7 + 3.9/-2.9)\cdot10^{-13}$ sec.

2. Coupling Strengths of Weak Neutral Currents

Using all three leptonic reactions $e^+e^- \to e^+e^-$, $\mu^+\mu^-$, $\tau^+\tau^-$, the weak neutral coupling constants a, v were determined from a common fit of the theoretical differential cross section expressions to the experimental distributions yielding $a^2 = 1.22 \pm 0.47$, $v^2 = -0.12 \pm 0.33$ (standard model: $a^2 = 1$, $v^2 = 0.008$) (see Fig.1).

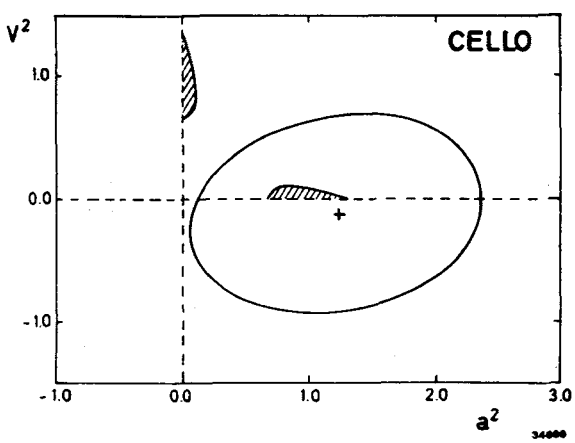


Fig.1: The 95% c.l.-contours as determined from νe-scattering (shaded areas) and this experiment in a v^2 - a^2 plane.

Article published online by EDP Sciences and available at http://dx.doi.org/10.1051/jphyscol:1982314

Assuming the validity of the standard GWS-model the simultaneous fit gives $\sin^2\theta_W = 0.21 + 0.14/-0.09$.

3. Systematic Errors in α_s Determination from e^+e^- Reactions

The properties of hadronic annihilation events were compared to two models for the fragmentation into hadrons:

a) Hoyer model, which uses independent fragmentation of quarks and gluons a la Feynman-Field.

b) Lund model, utilizing a colour string model where $q\bar{q}$ pairs and $q\bar{q}g$ events are produced along the string between the original $q\bar{q}$ pair.

The study was done with charged hadrons only and is based on a statistics of 3021 events (11.6 pb^{-1}). Three different methods were used for the determination of α_s:

- from the fraction f_3 of 3 jet events determined by 3 different methods
- from the thrust distribution of 3 jet events determined by a cluster method
- from the asymmetry of energy weighted angular correlations.

Experimental results were compared to Monte-Carlo predictions adjusting α_s to get agreement in both distributions. For other parameters in the models the standard values were used. The results are given in Table 2.

Table 2: Values of α_s deduced from Lund and Hoyer model with different methods

Method Nr. of 3 jet events f_3 by:	Lund α_s	Hoyer α_s
$S \geq 0.25$, $A \leq 0.1$	0.28 ± .045	0.19 ± .03
$O \geq 0.3$	0.255 ± .050	0.20 ± .035
$O \geq 0.2$	0.260 ± .040	0.19 ± .02
cluster-algorithm	0.235 ± .025	0.145 ± .02
cluster thrust	0.235 ± .025	0.155 ± .015
Energy weighted ang.corr.	0.25 ± .04	0.150 ± .020

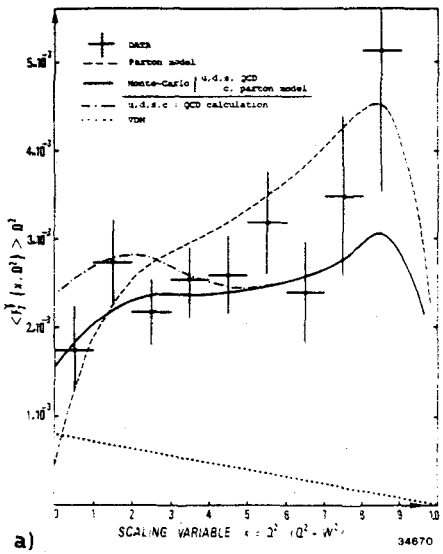
The conclusion from this study is that the Lund model yields systematically higher α_s-values by 20-50%, whereas within one model the variations are within 20%. The reason can be largely explained by the difference in the fragmentation process.

4. Photon Structure Functions

a.) Final state is a lepton pair ($\mu^+\mu^-$ and e^+e^-).
The photon structure function formalism was used to analyse events of the type $e + \gamma^* \to e + \ell^+ + \ell^-$, where γ^* is a virtual photon with a Q^2 of ≈ 10 GeV^2. The process can be calculated on the basis of the pointlike couplings and good agreement is found for F_2 versus x, the Feynman scale variable.

b.) Hadronic final state.
Events of the type $e + \gamma^* \to e + X$ (= hadronic system) were detected by recording the large angle scattered electron in endcap calorimeters. The results were compared to three type of model calculations:

- the hadronic contribution described by VDM
- the quark parton contribution, calculated on the basis of pointlike q-γ-couplings
- QCD corrections to the quark parton contribution by the exchange of gluons in the box diagram .



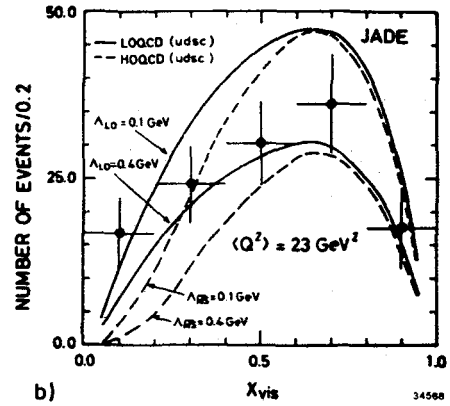


Fig.2:
F2(γ) versus x(vis) and comparisons with different model calculations for CELLO (Fig.2a) and JADE (Fig.2b) experiment.

Conclusions for the CELLO experiment:

- The form factor is far bigger than the VDM predictions giving evidence for pointlike coupling of the target photon to q and $\bar{q}$.
- The experimental points can best be described by an u,d,s-contribution from the QCD-calculation together with a c-quark contribution according to the quark-parton model
- the QCD scale parameter is in the range of $\Lambda \approx 0.1 - 0.2$ GeV.

Conclusions for the JADE-experiment:

- Data are consistent with Leading Order QCD
- Contribution of c-quark not necessary to explain data
- Higher order calculations are consistent with the data except at small x-values
- $\Lambda_{LO} = 0.28 + 0.13/-0.09$; $\Lambda_{\overline{MS}} = 0.22 + 0.10/-0.09$

+The CELLO-Collaboration consists of members of the following institutions:

DESY, Hamburg, Germany
Kernforschungszentrum Karlsruhe and Universität Karlsruhe, Germany
Max-Planck-Institut für Physik und Astrophysik, München, Germany
Laboratoire de l'Accélérateur Linéaire, Orsay, France
Laboratoire de Physique Nucléaire et Hautes Energies, Université de Paris, France
Centre d'Etudes Nucléaires, Saclay, France.