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Quark results from the DØ experiment

Mark Adams
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DØ Collaboration

Abstract

Heavy quark results from D0 are reviewed. We present the b–quark production cross section at forward rapidity, in $p\overline{p}$ collisions at a center–of–mass energy of 1.8 TeV. The ratio of b–quark production cross sections in $p\overline{p}$ collisions at center–of–mass energies of 630 GeV and 1.8 TeV is also presented and compared to next–to–leading order QCD predictions. In addition, we present a measurement of the inclusive J/ψ production cross section in the forward rapidity region, and compare it to current models of charmonium production. The $t\bar{t}$ production cross section at a center–of–mass energy of 1.8 TeV and the top quark mass, both determined from several decay channels, are presented. The M_W is also presented and its implications for the Standard Model Higgs are discussed.

The new observation of S=-2 heavy H^+ stable dibaryon

P.Z. Aslanyan , B.A. Shahbazian, T.A. Volokhovskaya, V.N.Yemelyanenko, A.S. Martynov and V.S.Rikhvitzkiy
JINR–Dubna
(Presented by P. Z. Aslanyan)

Abstract

We have observed else two positively charged events which were interpreted as S=-2 positively charged H^+ heavy stable dibaryons.

New particles or states of matter containing 2 or more strange quarks have inspired many experiments and much theoretical speculation. Simple considerations of symmetry and the properties of the color-magnetic interaction argue for increased binding in three flavor matter - system containing u,d and s quarks(true Hundy). These objects known a H particles (uuddss), strangulates, and strange matter and are predicted to be stable in many calculations. Heavy isotriplet stable dibaryon H (I=1, J=0+, Y=0, B=2, S=-2) a mass 2370 MeV/c^2 predicted by the Callan-Klebanov-Kunz-Mulders.

The reliable identification of the above events needs for multivertex kinematical analysis which in turn is feasible only using 4π–detectors and high measurement precisions of the sought for objects. The best suited for these purpose is the 2 m propane bubble chamber.

The identification of events was performed using the methods, well known in bubble chamber work. The dibaryons were identified via a multivertex kinematical analysis using the CERN program Grind as well as all methods of particle identification afforded by the PBC technique.

1.Several events detected on photographs of the JINR 2m propane bubble chamber exposed to 10GeV/c proton beam, were interpreted a heavy neutral and positive charge H stable dibaryons.

2.The candidates for H^+ dibaryons were searched for in sample of the so called one-positive-prong secondary events. In this events the Λ^0 -hyperons point to vertices of one-positive-prong stars, created by positive particles, emitted from the parent interactions of the primary 10 GeV/c protons in propane. The first event detected in this sample is formed by a beam proton, producing a five prong star. The appearance of its first part, 21.85 cm long and relative ionization I/$I_0 \approx 1.8$, situated between the star and kink -vertices, suggests that it is due to a relativistic, heavily ionizing positively charged massive particle than proton. The second part is certainly due to a slow proton, $P_p = 252.9 MeV/c^2$, which stops in propane. A slow V^0-particle is clearly seen near star.

Note, that on this photograph there are no interactions seen, which could serve as potential V^0 emission vertices. The decay particles track are a proton $P_p = 768.7 \pm 11.6 MeV/c^2$ and a slow negative pion with $P_\pi^- = 196.1 \pm 25.0 MeV/c^2$. Thus the V^0 can be due to the weak decay of a Λ^0 hyperon only. Indeed, the invariant mass of the (p, π^-) pair is $1115.5 \pm 1.4 MeV/c^2$. The hypothesis on emission of this hyperon from primary interaction fails to the fit event with $\chi^2 = 967$. This negative result is due to a large non angle $\eta = 0.4718 rad.$. Contrary to this, the hypothesis on emission of the Λ-hyperon from the kink vertex fits well the event with χ^2(1V-3C) = 1.2, CL=$75^o/_o, P_{\Lambda^0}$ =$964 \pm 87 MeV/c \Delta p^\perp = 37 \pm 34 MeV/c, \eta = 0.136 rad.$) .

The hypothesis on the inclusive three body weak decay $H^+ \rightarrow p + \pi^0 + \Lambda^0, \Lambda \rightarrow p + \pi^-$ fits the event with $\chi^2(2V - 3C) = 2.3, CL = 89^o/_o, M_{H^+} = 2534 \pm 75 MeV/c^2$.

3.The search other candidates, excepting the event, have been tried for the weak decay hypothesis $H^+ \rightarrow p + \Lambda^0$, $\Lambda \rightarrow p + \pi^-$ and $H^+ \rightarrow p + \pi^0 + \Lambda^0, \Lambda \rightarrow p + \pi^-$. If either of them or both hypotheses fitted an event, the hypotheses on the possible imitating reactions have been tried.

Only one event with $I/I_0 \approx 6$ relative ionization from all candidates events was successfully fitted by only weak decay hypothesis, $H^+ \rightarrow p + \pi^0 + \Lambda^0, \Lambda \rightarrow p + \pi^-$ and there are not imitating reactions. Note that the (1V-1C) weak decay hypothesis $Y^0 \rightarrow M^0 + \Lambda^0 or \gamma + \Lambda^0$ failed to fit the event. The inclusive weak decay hypothesis $H^+ \rightarrow p + \pi^0 + \Lambda^0, \Lambda \rightarrow p + \pi^-$ fits the event with $\chi^2(2V - 4C)$=3.29, CL=$51.1^o/_o, P_{\Lambda^0} = 476.9 \pm 9.2 MeV/c, M_{H^+} = 2400.5 \pm 4.92 MeV/c^2$. The Λ^0 - hyperon points only to H^+ decay vertex. Unfortunately the vertex of parent primary interaction is not seen on this photograph.

An experiment to study CP violation in the B–system using an internal target at the HERA proton ring

Ivan Belyaev
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Abstract

The **HERA – B** experiment is designed for studying CP violation phenomena in B system. The physical program of **HERA – B** detector includes the measurements of CP asymmetries in $B_d \rightarrow J/\psi K_S^0$ and $B_d \rightarrow \pi^+\pi^-$ decay channels, the measurement of $B_s^0 - \bar{B}_s^0$ oscillation strength, search for direct CP violation phenomena and many other items.

B hadrons are produced in interactions of 820 GeV/c protons with an internal target. The performed measurements have shown that the required target efficiency of about 60% is obtained with two sets of thin (50 μm) target wires introduced into the beam halo.

The **HERA – B** detector is a large acceptance forward spectrometer which combines a good momentum and vertex resolution, electron identification in electromagnetic calorimeter and transition radiation detector, muon identification and hadron identification in RICH detector.

The small $b\bar{b}$ production cross section, the high rate of background processes and the necessity to operate with several superimposed interactions per HERA bunch crossing result in events with large charge and neutral multiplicities, hard radiation conditions for detector operation and challenge for triggering. A sophisticated multilevel trigger scheme includes the fast selection and estimation of kinematical properties of pairs of leptons and hadrons with high transverse momenta already at first level.

The full commissioning of the **HERA – B** detector is expected in 1999. An overview of physical perspectives of **HERA – B** experiment, detector and trigger technologies, the current status of the detector and the experience gained during the test runs will be reported.

New measurements of the J/ψ decay in nucleon–antinucleon

Cesare Bini
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FENICE Collaboration

Abstract

The Branching ratios of the J/ψ decay in both neutron–antineutron and proton–antiproton have been measured by the FENICE experiment at the e^+e^- collider Adone in Frascati. The result concerning the decay in neutron–antineutron improves by a factor 2 the uncertainty on this decay. An analysis of these decays in terms of the interference between the strong and the electromagnetic contributions show unexpectedly no interference between them. The

implications and the connections with other results on the J/ψ decays are discussed. Finally a direct measurement of the interference pattern between the strong and the electromagnetic contributions is proposed.

Light–quark meson spectroscopy with Crystal Barrel

Peter Blüm
Universität Karlsruhe

Abstract

The main physics objective of the Crystal Barrel Experiment is to clarify the spectrum of light–quark mesons with particular emphasis to search for new form of exotic hadronic matter like glueballs and hybrids predicted in QCD. This talk will be confined to discuss the present understanding of the $^3P_0$ scalar nonet and the observed evidence for the ground state scalar glueball. Moreover, the status of perception of the hybrid state at 1400 MeV/c^2 with the exotic quantum numbers 1^{-+} will be illuminated.

The latest experimental results of the experiment E687

Gianluigi Boca
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Abstract

E687 has been a highly successful experiment on charm physics at Fermilab that collected approximately 100,000 fully reconstructed charm events. Still until recently, after seven years since last data taking, E687 has produced world class physics results, the latest of which will be summarized in this talk.

Gluon splitting to $b\bar{b}$ and $c\bar{c}$ at the Z resonance

Tommaso Boccali
INFN–Pisa
ALEPH Collaboration

Abstract

The measurements of the gluon splitting rates into $b\bar{b}$ and $c\bar{c}$ pairs ($g_{b\bar{b}}$ and $g_{c\bar{c}}$) at the Z resonance are presented and compared with theory. Combined estimations for each measurement are performed, taking into account correlations. For the first time, the measured value for $g_{b\bar{b}}$ has an error smaller than the predicted value; it is now possible to use the combined value presented here as input to heavy flavour measurements.

Oscillations of neutral B systems

Jacques Boucrot
CERN/LAL–Orsay
ALEPH Collaboration

Abstract

The oscillation phenomenon in the neutral B systems is now well established and measured for the B$_d$ meson; the last average value of its frequency oscillation will be given. In the framework of the Standard Model, the neutral strange meson B$_s$ is expected to oscillate with a frequency about 20 times that of the B$_d$ meson. This oscillation has not yet been observed, in spite of elaborate analyzes at LEP and SLC; the status of the lower limit on the B$_s$ oscillation frequency will be given and prospects for the near future will be described.

Charm production at HERMES

Stephan Brons
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HERMES Collaboration

Abstract

Charm production in polarised deep–inelastic lepton nucleon scattering is believed to be one of the cleanest probes of the fraction of the nucleon spin ΔG carried by gluons. An extensive search for charm signals in the HERMES data from the years 1995–97 has been carried out. Clean signals for hidden and open charm could be extracted. The statistics are still limited, though, since the experimental conditions at HERMES are not in favour of charm detection. This talk will report on the ongoing analysis and present preliminary results. In the shutdown of 1997/98 major upgrades of the HERMES detector have been implemented, which will improve the charm reconstruction capabilities of the experiment significantly.

Status of the BTeV experiment at Fermilab

Joel Butler
Fermilab

Abstract

BTeV is a program whose long term goal is to carry out precision studies of CP violation, mixing, and rare decays of bottom and charmed quarks in the forward direction at the Fermilab Tevatron Collider. It is planned for the new interaction region, C0, currently being constructed. We describe the techniques, physics reach, and status of BTeV.

The measurement of R_b and R_c at LEP

Massimo Caccia
University and INFN–Milano
DELPHI Collaboration

Abstract

The measurement of R_b and R_c, the fraction of hadronic Z boson decays into $b\bar{b}$ and $c\bar{c}$ final states, provides a tight test on the Standard Model.

The LEP experiments achieved a precision on the R_b measurement at the 0.5% level and an accuracy on R_c at the 3% level. The analysis techniques are reviewed; the evolution of the measurement is traced back and the current results are presented.

W physics at LEP

Mario Campanelli
ETH Zürich
L3 Collaboration

Abstract

After the first observations of W bosons in leptonic interactions, about 1000 WW candidate events per experiment have been collected at LEP2. This allows the measurement of the WW production cross section at different centre–of–mass energies, as well as W decay branching fractions. The W hadronic branching fraction can be converted into a test of the unitarity of the CKM matrix, or into an indirect determination of the matrix element $|V_{cs}|$. A more direct measurement comes from a charm tag performed on jets from W decays, exploiting their heavy–quark characteristics in an environment with small b–quark contamination. The W mass has been measured via the cross section (in the threshold region) and the direct reconstruction of the W decay products, using different techniques to account for the distortions due to experimental effects. The cross sections, together with distributions of W production and decay angles, are used to measure trilinear gauge boson couplings, and to put constraints on possible anomalies with respect to the standard model values.

Spin–dependent forward scattering amplitude of Ω^-–hyperon on an unpolarized proton in Glauber eikonal approximation and possibility of the constituent quark rescattering observation

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(Presented by S. Cherkas)

Abstract

Forward scattering amplitude of the particles with spin can be measured by the spin dichroism, rotation and oscillation observation. This effects can be described by particle spin-dependent refractive index in a medium which is proportional to the forward scattering amplitude on target particle. For particles with spin $S \geq 1$ (Ω^--hyperon, deuteron) the effects above exist even in unpolarized target. Forward scattering amplitude of particle with $S \geq 1$ on, for instance, an unpolarized proton has the form:

$$\hat{F}(0) = f_1 + f_2(Sn)^2 \ ,$$

where S is particle spin operator and n is direction of the momentum. It is significant that in the frame of Glauber multiscattering theory f_2 is determined only by the rescattering of the colliding particle constituents i.e. first term of Glauber series does not contribute to the f_2. So one have unique possibility to checks hypotheses of the constituent quarks by observation of their rescattering. Picture of hadrons as being made of spatially separated constituent quarks is not new. It was considered on phenomenological grounds many times since the pioneer works of Gell-Mann. After some period of misunderstanding it was clearly stated by Gell-Mann that "constituent" and "current" quarks are completely different objects. The constituent quarks or appear as quasiparticles,

that is as current quarks and surrounding them clouds of gluons and quark-antiquark pairs. The elastic hadron scattering can be understood in terms of constituent quark collisions. The main idea of our work is the possibility of the testing constituent quark model. We calculated Ω^- dichroism $A \approx 2.0 \times 10^{-4} - 2.6 \times 10^{-4}$ and rotation angle $\phi \approx 7.1 \times 10^{-5} - 1.1 \times 10^{-4}$ for 300 Gev hyperon in 1 metre hydrogen target of $\rho = 0.0675 g/cm^3$ density. Here

$$\phi(z) = 2\pi\rho Re(F_{3/2}(0) - F_{1/2}(0))z,$$

and

$$A(z) = \frac{I_{1/2}(z) - I_{3/2}(z)}{I_{3/2}(z) + I_{1/2}(z)} = 2\pi\rho Im(F_{3/2}(0) - F_{1/2}(0))z$$

describes dichroism. $I_m(z)$ is the intensity of hyperons on the depth z with the spin projection m on the direction of the Ω^- momentum, if the incident beam is unpolarized. We can also present quantity

$$\frac{\sigma_{3/2} - \sigma_{1/2}}{\sigma_{3/2} + \sigma_{1/2}} \approx 1.5 \times 10^{-3}.$$

B decays to excited charm mesons

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(Presented by P. Colangelo)

Abstract

The excited $\bar{q}Q$ mesons corresponding to $P-$wave states in the constituent quark model (D^{**}, B^{**}) play an important role from a theoretical point of view, since they represent relevant channels for testing the predictions of the heavy quark effective theory. Such states are also interesting from the experimental side, since, for example, the semileptonic $B \to D^{**}$ transitions could represent a sizeable fraction of the inclusive $B \to X_c \ell \bar{\nu}$, and significantly contribute to the shape of the inclusive lepton energy spectrum.

In the talk, the main aspects of the excited charm and beauty P-wave states are discussed (spectrum and hadronic widths [1, 2]). Moreover, a calculation of the universal Isgur-Wise form factors governing the semileptonic $B \to D^{**} \ell \bar{\nu}$ transitions by QCD sum rules in HQET is described, and the role of $\mathcal{O}(\alpha_s)$ radiative corrections and of $1/m_Q$ corrections is discussed [3].

References

[1] P. Colangelo, F. De Fazio, G. Nardulli, N. Di Bartolomeo, R. Gatto, Phys. Rev. D52 (1995) 6422.

[2] P. Colangelo and F. De Fazio, hep-ph9706271, to appear on European Physical Journal C - Particles and Fields .

[3] P. Colangelo, F. De Fazio and N. Paver, hep-ph/9804377.

Measurement of $|V_{ub}|$ and $|V_{cb}|$

Paula Collins
CERN
DELPHI Collaboration

Abstract

New measurements of the CKM matrix elements $|V_{ub}|$ and $|V_{cb}|$ have been made, using the ~ 3 million hadronic Z^0 decays collected by the DELPHI detector at LEP1. The analyses exploit the latest theoretical parametrisations to reduce the systematic errors, and the overall error in each case is comparable to or better than the present world average.

The $|V_{ub}|$ measurement uses the observation that for the majority of $b \to ul\nu$ decays the invariant mass of the hadronic system recoiling against the lepton lies below the D mass. Moreover, the model dependence in predicting the shape of the mass spectrum is expected to be small. $|V_{ub}|$ is extracted by a fit to the full spectrum of the lepton energy in the B hadron rest frame, for semileptonic B decays with a sufficiently small hadronic mass. The experimental systematics are controlled by using alternative techniques to enrich or deplete the sample in $b \to u$ decays.

The $|V_{cb}|$ measurement is based on an analysis of the semileptonic decays $b \to D^{*+} l \overline{\nu} X$, using the identified soft pion from $D^{*+} \to D^0 \pi^+$. Precise measurements of the branching ratios $BR(\overline{B}^0 \to D^{*+} l \overline{\nu})$ and $BR(b \to D^{*+} l \overline{\nu} X)$ are presented. The extraction of $|V_{cb}|$ is made

with low theoretical uncertainty from a fit to the kinematics of the decay. The result is compatible with the previous DELPHI result but with a much reduced error, and robust against all cross checks.

BaBar detector and CP violation in neutral B system

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INFN–Genova
BaBar Collaboration

Abstract

The direct measurements of CP violation in the Beauty system is one of the most important test of the Standard Model. If the Model predictions will not be confirmed, this study can open new perspective in our understanding of the elementary particle forces. The BaBar experiment will measure the unitary angles with enough precision to verify the model prediction. The detector, under construction at the B factory PEP–II at SLAC, will be described and the performances of each component will be reviewed.

Charmonium resonance formation in $\gamma\gamma$ collisions at LEP with the L3 detector

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L3 Collaboration

Abstract

The formation of charmonium mesons in two-photon collisions has been studied with the L3 detector at LEP e^+e^- collider. We present results on the two photon partial widths for the charmonium resonances η_c and χ_{c2}, measured at $\sqrt{s} \simeq 91$ GeV with an integrated luminosity of 140 pb^{-1} and at $\sqrt{s} \simeq 183$ GeV with an integrated luminosity of 50 pb^{-1}. The studied decay channels are $\eta_c \to 4\pi$, 4K, $K^+K^-\pi^+\pi^-$, $K^0K^\pm\pi^\mp$, $\pi^0K^+K^-$, $\eta\pi^+\pi^-$ and $\chi_{c2} \to J/\psi\gamma$ ($J/\psi \to l^+l^-$).

Recent heavy meson results from CLEO

Mark Dickson
Cornell University
CLEO Collaboration

Abstract

Analysis of the 5 fb^{-1} CLEO II data-set is still yielding many interesting results, and by the end of 1998 an additional 8 fb^{-1} will have been collected by the CLEO II.5 detector; it doesn't end there either. The CLEO III detector, currently under construction, will be installed early next year in conjunction with an upgrade to the accelerator, assuring an exciting future for heavy quark physics at CLEO. Recent results from the study of rare, semileptonic and hadronic B decays will be presented, as well as measurements of charm meson properties. The future plans for the CLEO detector will also be briefly described.

QCD sum rules calculation of heavy Λ semileptonic decay and heavy quark effective theory

H. G. Dosch, E. Ferreira, M. Nielsen and R. Rosenfeld
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(Presented by H. G. Dosch)

Abstract

A sum rule analysis of heavy Λ decays in full QCD is reported. For the semileptonic Λ_c decay a reasonable agreement with experiment is obtained : $\Gamma(\Lambda_c \to \Lambda + e^+ + \nu_e) = (1.0 \pm 0.3) \times 10^{-13}\, GeV$.

Although the formalism incorporates in the heavy quark mass limit the symmetries of heavy quark effective theory, one finds for the semileptonic decay of the $\Lambda_b \to \Lambda_c$ at the zero recoil point a violation of the heavy quark symmetry of about - 20%.

Results from HyperCP on the search for CP violation in hyperon decays

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HyperCP Collaboration

Abstract

The HyperCP collaboration is searching for direct CP violation by comparing the proton angular distribution in charged Ξ hyperon decays to that of the CP conjugate decays. Over one and a half billion Ξ and $\overline{\Xi}$ decays were collected in the 1997 fixed–target run at Fermilab, which should enable a measurement of the CP asymmetry to a precision of about 2 10^{-4}. Results from a preliminary analysis of approximately 10% of the data will be presented.

Development of HERA-B high–p_T trigger

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DESY
HERA–B Collaboration

Abstract

The main goal of the HERA–B fixed target experiment at the HERA proton ring is to measure the CP asymmetry in the decay $B^0 \to J/\psi K^0_S$, which is sensitive to the $\sin 2\beta$ parameter of the unitarity triangle. The high–p_T hadron trigger of HERA–B provides a capability to obtain results complementary to the main goal of the experiment.

The implementation of the high–p_T trigger allows to make an effective selection of two–prong B–meson decays i.e. events with pairs of oppositely charged tracks having large invariant mass and high transverse momenta. Measurement of asymmetry in the decay $B^0 \to \pi^+\pi^-$ could be used to extract $\sin 2(\beta + \gamma)$ parameter. The total yield of reconstructed $B^0 \to \pi^+\pi^-$ events on HERA–B amounts to about 500/year. It was recently pointed out that a constraint or even a measurement of the angle γ of the unitarity triangle is also possible via the measurement of asymmetry between decay rates of $B^0 \to K^+\pi^-$ and $\bar{B}^0 \to K^-\pi^+$. There will be approximately 750 of such decays reconstructed per one year of HERA–B running. A high suppression of minimum bias background (up to 6 orders of magnitude) could be achieved by use of detached vertex requirement, topological cuts, additional secondary vertex requirement and others.

The high–p_T trigger uses three layers of pad chambers located within the HERA–B magnet. Each layer has chambers with different pad sizes to assure a projective geometry of pads. This allows a fast selection of tracks with high transverse momenta.

The inner region of each layer is covered by the gas pixel chambers developed at ITEP (Moscow). The outer region is covered by straw tubes with cathode pad readout developed at Princeton University.

Full scale prototypes of gas pixel chambers were extensively tested. An efficiency of 99.87% has been obtained with a test chamber. The high efficiency is extremely important since the chamber efficiency enters the total one to the 6th power (for two–prong B–meson decays). A chamber prototype with $10.4 \times 10.4\ mm^2$ pad size filled with the fast CF_4 based gas mixture allows detection of more than 99% of all particles within 80 nsec. Stable operation was achieved with fluxes of up to 10^6 particles/cm^2/sec without any visible degradation of the performance. The full scale prototypes worked well for about one and half years in HERA–B experimental hall under real conditions.

Signal for CP violation in $B^\pm \to P\bar{P}\pi^\pm$ decays

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(Presented by S. Fajfer)

Abstract

We analyze CP violating signal in the partial rate asymmetry of $B^\pm \to P\bar{P}\pi^\pm$ decays $(P = \pi^+, K^+, \pi^0, \eta)$ which results from the interference of the nonresonant decay amplitude and $B^\pm \to \chi_{c0}\pi^\pm$ followed by decay $\chi_{c0} \to P\bar{P}$. The branching ratios of nonresonant decays $B^\pm \to P\bar{P}\pi^\pm$ $(P = \pi^+, K^+, \pi^0, \eta$) are calculated using the model which combines heavy quark effective theory and the chiral perturbation theory. In the analysis of the decay amplitudes we follow the factorization approach. For the calculations of the matrix element $< \bar{P}P|\bar{d}b|B >$ we use the results obtained in the analysis of the $D \to K\pi l\nu_l$ nonresonant decay. The partial rate asymmetries and the branching ratios of nonresonant $B^\mp \to P\bar{P}\pi^\mp$ decays are rather dependent on the choice of parameters required by model. We chose parameters which give the branching ratios for $B^+ \to \pi^+\pi^-\pi^+$, $B^+ \to K^+K^-\pi^+$ in agreement with CLEO upper limits. We find that the asymmetry for $B^\pm \to \pi^+\pi^-\pi^\pm$ is typically $0.3 sin\gamma$, while for $B^\pm \to K^+K^-\pi^\pm$ it is $0.2 sin\gamma$.

D production in b and c decays**

Catherine Ferdi
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ALEPH Collaboration

Abstract

A study of the production of L=1 charmed mesons (D^{**} states) has been performed using 4 million of Z^0 decays collected by the ALEPH detector at LEP. D_1, D_{s1}, ($J^P = 1^+$) states are observed in the decay channel $D^*\pi$ and D^*K respectively, and the D_2^*, D_{s2}^* ($J^P = 2^+$) states both in the channels $D^*\pi$, $D\pi$ and D^*K, DK respectively. Since D^{**} states could originate from beauty hadron decay produced in $Z^0 \to b\bar{b}$ or from charm fragmentation in $Z^0 \to c\bar{c}$ events, rates are measured separately for $b \to D_1, D_2^*, D_{s1}, D_{s2}^*$ and $c \to D_1, D_2^*, D_{s1}, D_{s2}^*$.

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b and c semileptonic decays in OPAL

Pauline Gagnon
CERN and CRPP
OPAL Collaboration

Abstract

For several years, experimental results for BR(b $\to \ell$) obtained near the Υ(4S) and Z^0 resonance have disagreed at a few sigma level. A new OPAL result for BR(b $\to \ell$) based on the full data sample collected near the Z^0 resonance will be presented. The result is extracted using muon momentum and jet shape information in b-tagged events. The inclusive charm hadron semileptonic branching ratio is measured in a charm enriched sample of hadronic Z^0 decays. These new analysis methods used by OPAL to extract (b $\to \ell$) and (c $\to \ell$) will be discussed in more details. The OPAL results will be compared to those from other experiments at LEP and at lower centre-of-mass energy, and to theoretical predictions.

Beauty hadro–production in the WA92 fixed–target experiment

Claudia Gemme
Department of Physics and INFN–Genova
BEATRICE Collaboration

Abstract

Using a sample of 10^8 triggered events, produced in π^-–Cu interactions at 350 GeV/c, we have identified 26 events in which there is evidence of beauty production. The estimated background in this sample is 0.6 ± 0.6 events. From these data, assuming a linear A–dependence, we measure a beauty production cross–section of $5.7\,^{+1.3}_{-1.1}(stat.)\,^{+0.6}_{-0.5}(syst.)$ nb/N. Differential distributions with respect to x_F and p_T^2 and the azimuthal correlation between B and $\overline{B}$ decays have been determined. Results have been compared with perturbative QCD predictions.

Prospects of heavy quark physics in run II with the DØ detector

Krishnaswamy Gounder
University of California
DØ Collaboration

Abstract

After a successful Run I, DØ is poised for an encore performance in Run II. This talk summarizes the essential features of the DØ upgrade that involve a central magnetic field, a new tracking system, upgraded muon detection, and enhancements to muon and calorimeter electronics and the data acquisition system. The top quark physics goals for the Run II are outlined along with issues affecting the precision measurement of top quark mass and single top quark production. The prospects and issues determining the B physics capabilities of the DØ in Run II are addressed briefly. A preliminary study of observing $B_d^0 - \overline{B}_d^0$ and $B_s^0 - \overline{B}_s^0$ mixing with the upgraded DØ detector is also presented.

CP violation in $B \to J/\psi K_S^0$ decay

Richard Hawkings
CERN/DESY
OPAL Collaboration

Abstract

Experimental tests of CP violation in the B–system will be reviewed. Particular emphasis will be placed on the study of sin(2 β) via the decay $B \to J/\psi K_S^0$.

Heavy vector meson production at HERA

Christopher Hilton
DESY/Manchester University

Abstract

The production of J/ψ, ψ(2S) and Υ mesons in positron–proton collisions at a centre-of-mass energy of 300 GeV has been studied by the H1 and ZEUS experiments at the HERA collider. Results are obtained over large ranges in the exchange photon virtuality, the virtual photon-proton centre-of-mass energy, and the inelasticity of the production. Models incorporating perturbative QCD calculations are confronted with the experimental data.

The dynamics of quarkonium production

Paul Hoyer and Stéphane Peigné
NORDITA
(Presented by Paul Hoyer)

Abstract

Quarkonium production is a sensitive probe of the dynamics of hard scattering, which can 'measure' the environment of the heavy quark pair after it is created in a hard process. Quarkonium hadroproduction data indicates that the produced pair experiences a secondary, hard interaction and then ceases to interact at a stage when the pair is still compact (compared to the size of the quarkonium wave function). These features differ from the scenarios postulated by current models. An approach which relies on an early, perturbative rescattering of the pair with a comoving color field can explain the observed features, including the polarization, the χ_1/χ_2 ratio and the nuclear target A–dependence, which are difficult to understand otherwise.

First physics results from SELEX (E781)

Maurizio Iori
Department of Physics and INFN–Roma
E781 Collaboration

Abstract

The SELEX experiment (E781) is a 3–stage magnetic spectrometer for high statistics study of hadroproduction of charm baryon up to large x_f using 650 GeV Σ^-, π^- and proton beams. The main features of the spectrometer are: high precision silicon vertex system with 30 μrad angular resolution, powerful particle identification provided by TRD and RICH, forward L(s) decay spectrometer and 3–stage lead glass photon detector. Experiment overview and description of the spectrometer features are shown. Preliminary reconstructed charm states and results on Λ_c and D^+ particles and antiparticles produced by Σ^-, π^- and proton beams at $x_f > 0.3$ are presented. Asymmetry for Λ_c production is also discussed.

New results in B physics at SLD

David Jackson
Rutherford Appleton Laboratory
SLD Collaboration

Abstract

Results in B physics from a sample of 400,000 hadronic Z^0 decays collected by the SLD experiment at the SLC between 1993 and 1998 will be presented. The precise 3D pixel vertex detector at SLD and the highly polarised SLC electron beam are exploited by the analyses. The results include a new limit on the B_s oscillation frequency Δm_s, the worlds statistically most precise measurement of the lifetimes of the B^+ and B^0 mesons and a search for the process $B \to sg$.

Baryon spectroscopy in the charm and beauty sectors using a renormalization group improved quark phenomenological model

Calvin S. Kalman and Ian D'Souza
Concordia University–Montreal
(Presented by Calvin S. Kalman)

Abstract

The model used in this calculation is based on the model of Kalman and Tran. That model which uses fewer parameters than any other model successfully reproduces the spectroscopy and decay rates of baryons in the uds sector. It is not as good in the b and c sectors, because it uses a fixed value of alpha(s). In this model the value of alpha(s) is taken as the experimental value at the Z mass and the values at all other scales are obtained using the renormalization group applied to quasi particles within the baryon. These quasi particles are excitations of the three-body baryon system which behave as two-body systems. Excellent agreement with experiment is achieved. Since an iterative procedure exists

that aligns the model with that of Kalman and Tran in the uds sectors, this model is consistent over the entire baryon spectra.

Mixing and CP violation

Ken Kelley
MIT
CDF Collaboration

Abstract

We present results on “flavor tagging” methods in pbar–p collisions at sqrt(s) = 1.8 TeV. These methods are useful for measuring mixing and CP studies in neutral B mesons.

We give special emphasis to “same–side tagging”, which exploits a correlation between the flavor of a B meson and some of the nearby particles (e.g. from B** decays).

We discuss how such tagging algorithms have been used to measure Δm and how they can be used to measure CP–violation parameters in B decays at a hadron collider.

CMS detector and its B–physics potential

Ritva Kinnunen
Helsinki Institute of Physics
CMS Collaboration

Abstract

The main features of the CMS detector are described. The B–physics potential of the detector is discussed and expectations for rare decay modes and B_s^0 oscillations are shown.

Results on $D^{*\pm}$ production from CERN experiment WA92

Cristina Lazzeroni
Department of Physics and INFN–Pisa
BEATRICE Collaboration

Abstract

We report on $D^{*\pm}$ production in interactions between 350 GeV/c π^- particles and nuclei. Reconstruction of the decay $D^{*+} \rightarrow D^0\pi^+$ and charge conjugate, with D^0 identified via its decays to $K^-\pi^+$ and $K^-\pi^+\pi^+\pi^-$, has allowed isolation of a sample of 614 ± 30 $D^{*\pm}$ mesons, produced at positive x_F. Assuming a linear A–dependence, the measured forward cross sections per nucleon are 1.36 ± 0.11 μb for D^{*+} and 1.84 ± 0.12 μb for D^{*-}. We present measurements of differential cross sections with respect to x_F and ${P_t}^2$, and compare data for $D^{*\pm}$ (vector–meson) production with data for production of charmed pseudoscalar mesons.

Recent results obtained by BES in charmonium physics

Xinhua Li
Institute of High Energy Physics, Beijing
100039, China
BES Collaboration

Abstract

Running at the BEPC e^+e^- storage ring, the BES detector has collected 8.0 ± 1.2 million J/ψ data prior to the participation of US members of the BES Collaboration, and 3.8 ± 0.3 million $\psi(2S)$ data which is the largest statistics $\psi(2S)$ sample at present.

A precise measurement has been performed in the process of $\psi(2S) \rightarrow \pi^+\pi^- J/\psi$: $B(J/\psi \rightarrow e^+e^-) = (5.90 \pm 0.05 \pm 0.10)\%$ and $B(J/\psi \rightarrow \mu^+\mu^-) = (5.84 \pm 0.06 \pm 0.10)\%$, where the first error is statistical and the second is systematic.

On the basis of perturbative QCD, branching fractions of J/ψ and $\psi(2S)$ decays into light hadrons via $3g$, or γ^*, or γgg follow the $''15\%\ rule''$

$$Q_h \equiv \frac{B(\psi(2S) \to h)}{B(J/\psi \to h)} \cong \frac{B(\psi(2S) \to e^+e^-)}{B(J/\psi \to e^+e^-)} = (14.6 \pm 2.2)\%$$

The BES measurements of $\psi(2S)$ decays and the corresponding J/ψ decays of PDG 96’ are compared with the above expectation.

- Decays into vector pseudoscalar mesons

  The MARK II observations of the suppression of $\psi(2S)$ to $\rho\pi$ and $K^{*+}K^- + c.c.$ have been confirmed at much higher levels of sensitivity. The $\omega\eta$ is also suppressed by a factor of > 7 in the $\psi(2S)$ decay.

  The decay rate of isospin-violating decay $\psi(2S) \rightarrow \omega\pi^0$ is as large as, or even larger than, the isospin-conserving $\psi(2S) \rightarrow \rho\pi$ decay. Large isospin violations are also seen in $\psi(2S) \rightarrow K^+\bar{K}^*(892)^- + c.c.$ and $K^0\bar{K}^*(892)^0 + c.c.$

- New suppression beyond vector pseudoscalar decays

The $\psi(2S)$ decays into vector tensor final states, ωf_2, ρa_2, $K^{*0}\overline{K_2}^{*0}$ and $\phi f_2'$, are suppressed with respect to $''15\%\ rule''$ which poses an additional challenge to current understanding of charmonium physics.

- Radiative decays

  The $\psi(2S)$ radiative decays into γf_2, $\gamma\eta$ and $\gamma\eta'$ have been measured. While the γf_2 observes the $''15\%\ rule''$ which is contrary to ωf_2, a suppression relative to $''15\%\ rule''$ occurs for the $\gamma\eta$ and $\gamma\eta'$ but not as strongly as $\rho\pi$. The $\psi(2S) \to \gamma\eta'$ result is consistent with expectation of a model that considers the possibility of η' - η_c mixing.

The helicity amplitudes analysis has been applied to $J/\psi \to \gamma\pi^+\pi^-$ and $\gamma\pi^0\pi^0$. The measured helicity ratios $x = \lambda_1/\lambda_0$ and $y = \lambda_2/\lambda_0$ of $f_2(1270)$ are not consistent with expectation of a model that considers the $f_2(1270)$ as a pure $q\bar{q}$ state.

The partial–wave analysis has been applied to $J/\psi \to \gamma\eta\pi^+\pi^-$ by including the $\eta\sigma$ amplitudes as well as the $a_0(980)\pi$, where the σ stands for the entire $\pi\pi$ S-wave amplitude. A structure of $\eta(1440)$ is observed in the $\eta\pi^+\pi^-$ mass spectrum with statistic significance 4.7σ, $M = 1415 \pm 10$ MeV and $\Gamma = 44 \pm 6$ MeV. $J^P = 0^-$ is preferred over 1^+. It decays into both $\eta\sigma$ and $a_0(980)\pi$ with

$$\frac{B(a_0(980)\pi, a_0 \to \eta\pi)}{B(\eta\sigma, \sigma \to \pi\pi)} = 0.7 \pm 0.12(stat) \pm 0.20(syst)$$

B Physics in Run II with upgraded CDF II

Donatella Lucchesi
INFN–Pisa
CDF Collaboration

Abstract

The new data taking for CDF will begin around the year 2000 with an upgraded detector. The major upgrades (tracking system and trigger) are motivated by the new accelerator beam crossing period. With the new detector the Run II physics program at CDF II will span a broad range of physics topics. One of these is the B physics. At $p\bar{p}$ collider several different measurements are possible as demonstrated in these last few years. CDF II will have the opportunity to repeat on new data analysis already done. For example high precision tests of the theory through the lifetime measurements will be possible only at the Tevatron for B_s, B_u and Λ_b. Besides, CDF II will have the possibility of new measurements. The CP violation parameter $\sin 2\beta$ will be measurable in the decay asymmetry of $B_d \to J/\psi K_s$ with an accuracy comparable with the B factories. Other CP parameters will be studied exploiting new trigger systems. Moreover, there will be a chance to study CP violation and mixing also in the B_s system unique to Tevatron collider.

Neutrino induced charm production in the CHORUS experiment at CERN

Oliver Melzer
NIKHEF
CHORUS Collaboration

Abstract

The CHORUS (WA95) experiment is designed for $\nu_\mu \to \nu_\tau$ oscillation search in the CERN wide–band neutrino beam. It is a hybrid experiment with an emulsion target and an electronic tracking system, opening the possibility to study the production and decay of short–lived particles with a three dimensional spatial resolution of $\sim 1\mu$m. From 1994 to 1997 $\sim 8.4 \times 10^5$ ν_μ charged current neutrino interactions were recorded in the emulsion target. Events are being scanned and analysed. First observations of charmed mesons produced in neutrino induced deep inelastic and diffractive interactions will be presented.

A_{FB} for $b\bar{b}$ and $c\bar{c}$

Ernesto Migliore
INFN–Torino
DELPHI Collaboration

Abstract

At LEP the forward–backward asymmetry in the distribution of the polar angle of charm (A^c_{FB}) and bottom (A^b_{FB}) quarks produced in the Z boson decay have been measured in about 14 millions events.

The measurement of (A^c_{FB}) is performed reconstructing a D* meson in the final state while (A^b_{FB}) analysis is based either on a high p, $p_\perp$ lepton tag or on the lifetime based b–tagging techniques combined with a jet charge method

to determine the decay hemisphere of the quark. From the measurement of heavy flavour quark asymmetry a value of $\sin^2\theta_W^{eff}$ could be determined with a relative accuracy of 1.6×10^{-3}.

Ξ^0 beta decays at KTeV

Emmanuel Monnier
University of Chicago
KTeV Collaboration

Abstract

KTeV is a Fermilab fixed target experiment designed to study mainly CP violation and rare decays in the neutral Kaon system. However, with a large fraction of neutral Hyperons (Λ^0 and Ξ^0) in the beam, this experiment allows the study of their decays. We report here on the status of these studies in Hyperon beta decay modes. The discovery of the $\Xi^0 \to \Sigma^+ e^- \overline{\nu}$ decay mode will be presented with a preliminary measurement of its branching ratio. An order of a thousand of these events have been accumulated. Asymmetry measurements of this decay mode will be presented and a status of the analysis of the Ξ^0 form factor discussed. Studies of $\overline{\Xi}^0$ beta decay and Ξ^0 muonic decay will also be presented. Finally, the future of Hyperon beta decay physics at KTeV will be given in the framework of the next data taking period scheduled in 1999.

A general connection between inclusive decay rates of bound and free heavy quarks

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(Presented by I.M. Narodetskii)

Abstract

The relativistic constituent quark model, formulated on the light–front, is used to derive a new parton approximation for the inclusive semileptonic and nonleptonic decay widths of the B-meson. A simple connection between the decay rate of a free heavy-quark and the one of a heavy-quark bound in a meson or in a baryon is established. The main features of our approach are the treatment of the b-quark as an on-mass-shell particle and the inclusion of the effects arising from the b-quark transverse motion in the B-meson. In a way conceptually similar to the deep-inelastic scattering case, the B-meson inclusive width is expressed as the integral of the free b-quark partial width multiplied by a bound-state factor related to the b-quark distribution function in the B-meson. The non-perturbative meson structure is described through various quark-model wave functions, constructed via the Hamiltonian light-front formalism using as input both relativistic and non-relativistic potential models. A link between spectroscopic quark models and the B-meson physics is obtained in this way. It is shown that the bound-state effects and the Fermi motion of the b-quark remarkably reduce the free-quark decay rate. Our predictions for the $B \to X_c \ell \nu_\ell$ and $B \to X_u \ell \nu_\ell$ decays are used for extracting the CKM parameters $|V_{cb}|$ and $|V_{ub}|$ from available inclusive data. After averaging over the various quark models adopted, we obtain $|V_{cb}| = (41.2 \pm 0.7_{exp} \pm 1.7_{th}) \cdot 10^{-3}$ and $|V_{ub}| = (3.53 \pm 0.44_{exp} \pm 0.14_{th}) \cdot 10^{-3}$, implying $|V_{ub}/V_{cb}| = 0.086 \pm 0.011_{exp} \pm 0.005_{th}$, in nice agreement with existing predictions. Finally, we discuss the applications of our parton formulae for calculation of B_d lifetime and the inclusive width $\Gamma(B \to X_s \gamma)$.

Recent CLEO results on charmed baryon spectroscopy

John J. O'Neill
Minneapolis
CLEO Collaboration

Abstract

We discuss recent charmed baryon spectroscopy results made by the CLEO–II collaboration. Highlights include the observation of the Ξ_{c1} and $\Xi_c^{'}$ charmed baryons which are excitations of the Ξ_c. We observe the decays $\Xi_{c1} \to \Xi_c^* \pi$, with $\Xi_c^* \to \Xi_c \pi$ and $\Xi_c^{'} \to \Xi_c \gamma$. Also, the study of the Λ_c^*, Σ_c^*, and Ξ_c^* charmed baryons is presented. There has been much activity in charmed baryon spectroscopy of late and the p–wave states, with the Λ_c^* and Ξ_{c1}, are starting to be studied. Our future prospects will be discussed.

Charmed baryon and semileptonic physics at FOCUS

Brian O'Reilly
University of Colorado
FOCUS Collaboration

Abstract

Analysis of a subset of our data indicates that we will exceed our initial goal of a factor of 10 increase over Fermilab photoproduction experiment E687. From on–line reconstruction we can demonstrate a factor of 20 increase in our samples of $D^+ \rightarrow K^- l^+ \nu$ + C.C., and $\Lambda_c^+ \rightarrow pK^-\pi^+$ + C.C. decays. Preliminary signals from various charmed baryon and semileptonic charmed meson decays will be presented.

A fundamental approach to hybrid states

Martin Olsson
University of Wisconsin

Abstract

Recent lattice results for the energy of gluonic excitation as a function of quark separation are shown to correspond to transverse relativistic flux tube vibration modes. For large quark separations all states appear to degenerate into a few categories which are predicted uniquely given the ground state. Encouraged by the success of the fixed end result we have considered the case of a rotating and vibrating flux tube starting from a Nambu–Goto action. We believe that this approach will evolve into a basic understanding of the properties of hybrid mesons.

Present status of charmonium spectroscopy in proton antiproton annihilations

Marco Pallavicini
Department of Physics and INFN–Genova
E760/E835 Collaboration

Abstract

The E760/E835 collaboration is committed to complete the study of charmonium resonances with proton–antiproton annihilations.

All charmonium states are formed in proton–antiproton collisions between the Fermilab Antiproton Accumulator beam and molecular hydrogen coming from an internal jet target. In this contribution we report recent results from 1996/1997 run that has increased the total integrated luminosity by a factor 5 with respect to previous experiments.

Present status of charmonium spectroscopy and experimental program for the near future are also discussed.

Contribution of CPLEAR to the physics of the neutral kaon system

Noulis Pavlopoulos
CERN

Abstract

CPLEAR has experimentally determined, for the first time, the violation of T invariance and disentangled all the CP– and CPT–violating quantities in the neutral kaon system from each other. This allows each of the CPT violation parameters to be determined with a precision of a few 10^{-4} and, in particular, the mass and width equality between the K^0 and $\overline{K}^0$ to be tested down to the level of 10^{-18} GeV. Moreover, the precision of the CPLEAR measurements allows us to probe for the first time physics on a scale approaching the Planck mass and to provide the most precise test of the equivalent principle.

Overview of FOCUS and a report on charmed mesons in FOCUS

Daniele Pedrini
INFN–Milano
FOCUS (E831) Collaboration

Abstract

An overview of Fermilab experiment FOCUS and of its physics goals will be presented. During the 96–97 fixed target run at Fermilab we collected more than 6.3 billion events with the expectation of excess of 1 million fully reconstructed charmed particles. Preliminary results on charmed meson decays obtained in FOCUS will be reported.

Polarization in strange and heavy–flavor baryon production

Aldo Penzo
Department of Physics and INFN–Trieste

Abstract

A sizable polarization of hyperons produced at high energy has been known for a long time and has been interpreted with various theoretical models in terms of the constituents' spin. New results on hyperon production measured recently at Fermilab with polarized beams indicate that the mechanisms of spin dependence are more complex than those considered in current models and revive interest in the measurements of polarization effects in strange and heavy–flavor baryons. The contribution will give a survey of the present experimental status of the subject, in comparison with current model predictions and will highlight new theoretical and experimental ways to further test the underlying mechanisms of polarization dependence in strange and heavy–flavor baryon production.

Long and short distance contributions to the weak $D \to Vl^+l^-$ decays

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b) Department of Physics, Technion - Israel Institute of Technology, Haifa 32000, Israel
(Presented by S. Prelovšek)

Abstract

We analyse the long and short distance contributions to $D \to Vl^+l^-$ decays using the model, which combines heavy quark symmetry and chiral perturbation theory. We divide the long distance contribution in the resonant part, which arises from the intermediate light vector meson V_0 exchange ($D \to VV_0 \to V\gamma \to Vl^+l^-$, V_0 is ρ^0, ω or ϕ)), and the nonresonant part, which arises from the direct photon emission ($D \to V\gamma \to Vl^+l^-$). In addition, there is a short distance contribution in the Cabibbo suppressed decays, due to the $c \to ul^+l^-$ transition. The most frequent decays into a muon–antimuon pair are the Cabibbo allowed decays $D^0 \to \bar{K}^{*0}\mu^+\mu^-$ and $D_s^+ \to \rho^+\mu^+\mu^-$, which are expected to occur with the sizable branching ratios $\sim 2 \cdot 10^{-6}$ and $\sim 3 \cdot 10^{-5}$, respectively, and are driven by the long distance dynamics. The short distance dynamics with the possible signal of new physics can be in principle observed in the Cabibbo suppressed decays. We find that in all the Cabibbo suppressed decays the short distance contribution is well masked in the standard model by the resonant long distance contribution. In the case of $D^0 \to \rho^0(\omega)l^+l^-$ decays, however, the short distance contribution is of comparable size as the nonresonant long distance part. The Cabibbo suppressed decays are typically expected at $[3-7]\cdot 10^{-7}$ range for $D^0 \to \rho^0(\omega)\mu^+\mu^-$ and $D_s^+ \to K^{*+}\mu^+\mu^-$ decays and in the 10^{-6} range for the decay $D^+ \to \rho^+\mu^+\mu^-$. Accordingly, branching ratios well above 10^{-7} for Cabibbo suppressed decays could signal new physics.

Results from Fermilab charm experiment E791

Milind Purohit
South Carolina University
E791 Collaboration

Abstract

Recent results from Fermilab experiment E791 are summarized. Topics to be covered include form factors in the semileptonic decay $D^+ \to \overline{K}^{*0} l\nu$, charm particle production distributions, the production of pairs of charm particles, asymmetries in charm particle production, mixing and CP violation in charm decays, resonant analysis of charm meson and charm baryon decays and the lifetime of the D_s^+.

The HERA–B Ring Imaging Čerenkov Detector — design, expected performance, and status

Jörg Pyrlik
University of Houston
HERA–B Collaboration

Abstract

The RICH system of the fixed target experiment HERA–B, which recently was completed at the DESY 820 GeV proton storage ring HERA, is one of the most advanced Čerenkov ring imaging detectors. It consists of a 100 m^3 gaseous C_4F_{10} radiator, two tilted spherical mirrors with an area of 24 m^2 and planar mirrors to move the two focal plane halves out of the particle flux. A total of 2.9 m^2 of photon detection area is mapped by

2240 two–lens telescopes onto an array of 2240 Hamamatsu R5900 multi–anode photomultipliers. The system contains about 27,000 pixels, 9×9 mm^2 (89%) and 18×18 mm^2 (11%) in size. We expect for a 2.75 m long radiator and $\beta = 1$ particles 34 ±2 detected photons per ring. This will allow pion/kaon separation in the momentum range $5 < p < 80$ GeV/c and will be vital for B tagging via the charge of high momentum kaons.

The design challenges and their innovative solutions, the expected performance derived from prototype measurements and the current status of the assembly will be presented.

Weak radiative Ξ° decays at KTEV

Erik J. Ramberg
Fermilab
KTeV Collaboration

Abstract

Besides investigating CP violation in the neutral kaon sector, the KTeV experiment at Fermilab also has a strong program of neutral hyperon physics. We report here on the status of our work on studying the two weak radiative decays of the Ξ° hyperon: $\Xi^\circ \to \Lambda\gamma$ and $\Xi^\circ \to \Sigma^\circ\gamma$. We have increased the worlds sample by factors of 6 and 50 respectively in these two decays. We also discuss photon asymmetry measurements and polarization issues in this sector.

SU(3) breaking in hyperon beta decays: a prediction for $\Xi^0 \to \Sigma^+ e\bar{\nu}$

Philip Ratcliffe
University of Milano at Como

Abstract

On the basis of a previous analysis of hyperon semi–leptonic decay data, we present a prediction for the value of g_A in the $\Xi^0 \to \Sigma^+ e\bar{\nu}$ β–decay. The analysis takes into account SU(3) breaking in this sector via the inclusion of purely mass–driven corrections. A rather precise measurement of the above channel will soon be made available by the KTeV experiment at Fermilab. Since the dependence on the SU(3) parameters, F and D, is identical to that of the neutron β–decay, this measurement will provide a rather stringent test of SU(3) and the models used to describe its violation in these decays. The prediction presented here is $g_A = 1.17$ for the above decay, which leads to a partial rate of $0.80 \times 10^6\,\mathrm{s}^{-1}$ and thus a branching fraction of 2.3×10^{-4}.

Spin alignment in heavy and light flavour systems in Z^0 decays

Simon Robins
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OPAL Collaboration

Abstract

Spin alignment of inclusive vector mesons and longitudinal polarization of Λ hyperons have been measured in a sample of 4.3 million hadronic Z^0 decays from the OPAL detector at LEP. Leading, light vector mesons have been found to populate preferentially the helicity–zero state, a result which has no firm theoretical explanation. The values of off–diagonal elements of the helicity density matrix are in agreement with a theory based on the standard model with coherent fragmentation. The longitudinal polarization of the Λ is well described by a model in which the constituent strange quark carries all of the hyperon spin.

CP violation with the ATLAS detector

David Rousseau
CERN
ATLAS Collaboration

Abstract

Measurements of CP violation parameters in the B system with the ATLAS detector at LHC will be reviewed. $\sin(2\beta)$ measurement in the $B^0 \to J/\psi K^0$ channel and $\sin(2\alpha)$ measurement in the $B^0 \to \pi^+\pi^-$ channel will be described in details. Other channels sensitive to the angles γ and $\delta\gamma$ will also be covered.

Charmonia production at Tevatron, HERA and LHC

Miguel Angel Sanchis–Lozano
Valencia

Abstract

Charmonia hadro– and photoproduction is analyzed in the framework of the colour–octet model. We include initial–state radiation of

gluons as a higher–order effect which could reconcile experimental data from Tevatron and HERA experiments. We review and compare non–relativistic QCD matrix elements showing agreement within experimental uncertainties. We extrapolate to LHC energies estimating the cross section of high–p_T muons from prompt charmonia as a background for the first level trigger of LHC experiments regarding the B physics programme.

Electroweak measurements with heavy quarks at SLD

Victor Serbo
Stanford Linear Accelerator Center
SLD Collaboration

Abstract

The SLD detector collects data at the Z^0 resonance using the SLC e^+e^- colliding beams. Polarized electron beams and small SLC interaction region together with the unique CCD vertex detector provide an outstanding opportunity for testing the electroweak part of the standard model, especially at the heavy quark sector. Experiment overview and physics outline are shown. Improved measurements of heavy quarks electroweak parameters, like A_b, A_c, R_b, and R_c are presented. Measurements are based on approximately 400k hadronic Z^0 events, including data from the SLC most recent 1997–98 run.

Flavor–symmetry based analysis of two–body vector decays of B–mesons

Avinash Sharma and R.C.Verma
Department of Physics, Kurukshetra University, Kurkshetra–136 119, India
(Presented by Avinash Sharma)

Abstract

Two–body Vector–Vector weak decay modes of B–mesons are studied within the SU(4) Flavor Symmetry framework. Various decay amplitudes are calculated and several relations among the branching ratios are obtained. Branching ratios of many decay modes are predicted wherein the experimental data is not available so far.

Overview talk on B–physics in ATLAS

Peter Sherwood
UC London
ATLAS Collaboration

Abstract

The performance of the various ATLAS detector and trigger components relevant to B physics will be discussed. Asymmetry measurements sensitive to CP violation will be described in the talk by D. Rousseau at this conference. The measurements of $B_s^0 - \overline{B}_s^0$ mixing and search for rare B decays with the ATLAS detector will be reviewed.

Mass spectrum of quarkonia: role of closed mesonic channels

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Abstract

We address the long standing problem of the mass spectrum of quarkonia states. Various potential models describing successfully gross features of the mass spectra of quarkonia fail to reproduce their fine details, particularly those related to spin degrees of freedom. The combined action of forces involving spins of the quarks (spin–orbit and tensor forces) results in the mass splitting of the ^3P_J quarkonia states. The latter translates in the non–zero value of the ratio R defined as follows:

$$R(\chi) = \frac{m(^3P_2) - m(^3P_1)}{m(^3P_1) - m(^3P_0)} \qquad (1)$$

All the approaches to the problem based on a potential description of the heavy quark interaction resulted in the following relations between values of R for various types of quarkonium:

$$R(\chi_b') \gtrsim R(\chi_b) > R(\chi_c) \qquad (2)$$

Predictions of potential models are in qualitative disagreement with the experimental results reading

$$R(\chi_b) > R(\chi_b') > R(\chi_c) \qquad (3)$$

This long–standing problem casts doubts on the validity of a potential–based description of the interaction between heave quark and antiquark, or, at least, on the generally accepted Lorentz structure of the $\tilde{Q}Q$ potential.

We consider a mechanism which allows explaining experimentally observed regularities (3) in the framework of the conventional picture of the $\tilde{Q}Q$ interaction. Due to the quantum–mechanical production of light–quark pairs the quarkonia states dissociate into a pair of heavy mesons

$$(\tilde{Q}Q) \leftrightarrow (\tilde{Q}q) + (Q\tilde{q})$$

A coupling between the states of quarkonia and the heavy–meson states affects the mass spectrum of the former. *Qualitative* analysis shows that such a coupling alters the R values (1) bringing them in correspondence with the experimentally observed hierarchy (3). These findings are supported by numerical calculations of the effect in a simple model of the quarkonium dissociation. Thus the considered mechanism provides a clue to the solution of a long–standing problem of the quarkonia physics.

Probing the Standard Model in rare $b \to s\ell^+\ell^-$ decays

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(Presented by S. Simula)

Abstract

We study long–distance (LD) effects in rare $FCNC$ transitions $b \to s\ell^+\ell^-$ and their interference with short–distance (SD) effects both in inclusive and exclusive decay modes. The main novel features of our analysis are [1]:

- we take into account the constraints imposed by gauge invariance on the possible form of the long–range $c\bar{c}$ penguin contribution to the SD Wilson coefficient C_{9V}, ruling out in particular the presence of a pole at $q^2 = 0$;
- we consider the effects of nonfactorizable soft gluon exchanges on the Wilson coefficient $C_{7\gamma}$. Measurements of the ψ polarization in $b \to s\psi$ transitions combined with QCD sum rule calculations of nonfactorizable effects in $B \to K^*\gamma$ allow a realistic estimate of the nonfactorizable contributions in the whole kinematically accessible q^2–region in $b \to s\ell^+\ell^-$ decays.

Based on our analysis of the LD effects, we re–examine the interference between the LD and SD contributions to inclusive $B \to X_s\ell^+\ell^-$ decays and find that there is a broad range of values of q^2 where such an interference is negligible.
A similar analysis is performed also for the exclusive modes, where another type of LD effects, connected with the presence of the light meson in the final state and encoded in the meson transition form factors, comes into the game. We find that present–day theoretical uncertainties in the transition form factors strongly influence the dilepton distributions, which cannot therefore be predicted with sufficient accuracy [2]. At the same time, however, the forward–backward asymmetry A_{FB} and the longitudinal lepton polarization asymmetry P_L remain largely unaffected by the uncertainties in the LD effects arising from the $c\bar{c}$ penguins and the meson transition form factors, and exhibit a remarkable sensitivity to the SD Wilson coefficients.
Thus, the determination of the observables A_{FB} and P_L both in inclusive and exclusive rare decays as well as that of the dilepton distribution in inclusive rare decays could allow to *measure* the SD Wilson coefficients, providing in this way a stringent test of the Standard Model.

[1] D. Melikhov, N. Nikitin and S. Simula: preprint INFN–ISS 98/3 (e–print archive hep–ph/9803343).
[2] D. Melikhov, N. Nikitin and S. Simula: Phys. Lett. **B410** (1997) 290; preprint INFN–ISS 97/15 (e–print archive hep–ph/9711362) to appear in Phys. Rev. **D57** (1998).

Radiative decays of D–mesons

Paul Singer
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Abstract

The short–distance (SD) contribution due to the $c \longrightarrow u + \gamma$ magnetic penguin as well as the long–distance (LD) contributions are considered in an analysis of the $D \longrightarrow V + \gamma$ decays. Except for special circumstances which are pointed out, the LD effects are dominant. Using the factorization scheme for the nonleptonic $D \longrightarrow VV_0$ weak amplitudes and vector meson dominance for the $V_0 \longrightarrow \gamma$ transition we classify all diagrams which arise in $D \longrightarrow V+\gamma$ decays. The matrix elements are calculated with

the help of the hybrid model which combines heavy quark effective theory and the chiral Lagrangian. We present the expected range of the branching ratios for nine Cabibbo–allowed and Cabibbo–suppressed $D \longrightarrow V + \gamma$ transitions, the most frequent ones being a few times 10^{-4}.

CP violation in CMS: expected performance

Jacqueline Stefanescu
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CMS Collaboration

Abstract

The huge amount of $b\overline{b}$ events that will be obtained at LHC during the first years of operation will offer the possibility to study CP violation in the $B^0 - \overline{B^0}$ system. The CMS experiment can contribute significantly to the measurement of the CP violation asymmetry in the channel $B_d^0 \rightarrow J/\psi K_S^0$. Recent evaluation of the expected precision on the CP violation parameter $sin2\beta$ has been performed using a full simulation of the CMS tracker including track and vertex reconstruction. CMS has also studied the possibility to test CP violation in the decay channel $B_s^0 \rightarrow J/\psi\Phi$. The results of these studies will be reviewed.

Total charm production cross section and production asymmetries in Σ^--Nucleus interactions at 340 GeV/c

Oliver Thilmann
University of Heidelberg

Abstract

CERN experiment WA89 uses a Σ^- beam at 340 GeV/c to study the production of charmed particles. Based on the reconstruction of all final charm states from the full data sample of our 93 and 94 beamtimes the total $c\bar{c}$ cross–section has been determined.

Production of particles which have a light quark in common with the beam is compared to production of those which do not. Considerable production asymmetries between D^- and D^+, D_s^- and D_s^+, and Λ_c and $\bar{\Lambda}_c$ are observed.

Kaon physics from KTeV

Gordon Thomson
Rutgers University
KTeV Collaboration

Abstract

The KTeV experiment at Fermilab consists of two experiments: E832 which is a study of CP violation in the neutral kaon system, with emphasis on the search for direct CP violation, and E799 II which is a study of rare decays of the K_L meson. We completed a long data collection period in September, 1997, and we are now engaged in analysis of those data. This talk will concentrate on the status of our CP–violation measurements, and the first results of our rare decay searches.

Λ polarization in the NA48 experiment at CERN

Alexander Tkatchev
JINR Moscow
NA48 Collaboration

Abstract

A study of the polarisation of Λ hyperons produced in inelastic pN reactions by the 450 GeV proton beam from the CERN SPS has been performed with the NA48 detector. The Λ hyperons were detected at a fixed angle of 4.2 mrad in the momentum range from 50 GeV to 200 GeV. The polarisation increases from -0.053±0.034 to -0.298±0.074 for a transverse momentum range of the Λ between 0.28 GeV and 0.86 GeV. The $\overline{\Lambda}$ polarisation is consistent with zero.

Rare B decays from the CDF experiment

William Trischuk
University of Toronto
CDF Collaboration

Abstract

The enormous b–quark production cross–section in $p\bar{p}$ collisions at the Tevatron make it an ideal place to search for very rare decays of B–hadrons. This talk will describe CDF's recently published discovery of the B_c meson – the combination of a bottom and a charm quark. This particle has been discovered in partially reconstructed J/ψ + lepton decay channels. The production cross–section, mass and lifetime determination of the observed signal will be discussed. The talk will also include a brief review

of other rare B decays recently seen (or not seen) by CDF. These will include decays that include ψ(2S) mesons in the final state as well as limits from searches for $B \to \mu^+ e^-$ and $B \to \mu^+ \mu^-$.

Σ^+ and Σ^0 production measured at LEP with the L3 Detector

Chris Tully
CERN/Princeton
L3 Collaboration

Abstract

Production rate measurements have been performed for Σ^+ and Σ^0 baryons produced in hadronic decays of the Z^0. The rates are compared against those of mesons and other baryons with a hadronization temperature model. These measurements take advantage of the unique photon detection capability of the L3 Experiment. The rates are in agreement with those measured by other LEP Experiments.

CP violation in B–decays: prospects for the LHCb experiment

David Websdale
Imperial College–London

Abstract

The LHCb experiment proposes to exploit the high B production rate at the CERN LHC. CP violating asymmetries will be measured in several decay modes, probing the consistency of the CKM unitarity constraints with sensitivities at the percent level.

The detector is optimized for B–physics and is configured as a single arm forward spectrometer. It features an efficient trigger, based on events with secondary vertices and particles with high transverse momenta. A high-precision vertex detector permits the study of oscillation phenomena in the neutral B-system and Ring Imaging Cherenkov detectors provide clean identification of rare decay modes.

Hyperons as collective excitations of chiral solitons

Herbert Weigel
Tübingen University

Abstract

The description of baryons as soliton configurations in effective meson theories is studied for the case of three flavors[1]. In the collective approach the soliton configuration is equipped with baryon quantum numbers by canonical quantization of the coordinates describing the flavor orientation. The baryon spectrum is obtained by exactly diagonalizing the Hamiltonian for the collective coordinates. The resulting eigenstates are identified as the the low–lying $\frac{1}{2}^+$ and $\frac{3}{2}^+$ baryons. Such model computations constitute a comprehensive picture of hyperons, in particular the complete incorporation of flavor symmetry breaking effects in the baryon wave–functions makes possible the analysis of symmetry breaking effects on baryon properties. In particular their variation with the strength of flavor symmetry breaking is investigated. For example, it is observed that current matrix elements like $\langle N|\bar{s}(\gamma_5)\gamma_3 s|N\rangle$ diminish quickly as the symmetry breaking increases; contrary matrix elements like $\langle N|\bar{s}s|N\rangle$ exhibit only moderate variations. These nucleon matrix elements are compared with those entering the phenomenologically successful Cabibbo scheme for the semi–leptonic hyperon decays, like $\langle p|\bar{s}(\gamma_5)\gamma_3 u|\Lambda\rangle$. It is found that these strangeness changing matrix elements are significantly less sensitive to symmetry breaking than the strangeness current matrix elements of the nucleon. In the context of the semi–leptonic hyperon decays the effect of symmetry breaking is small. However, it is sizable for the strangeness conserving nucleon matrix elements. This casts some doubts on the application of flavor–$SU(3)$–relations when analyzing the axial current matrix elements in the context of the *proton spin puzzle*. Turning to other hyperon properties it is especially shown that the observed deviation from the U–spin symmetry of the hyperon magnetic moments requires the shape of the soliton to account for symmetry breaking.

Having completed these conceptional discussions on the collective quantization, realistic models are employed to make quantitative predictions on baryon properties. These models constitute various extensions of the Skyrme model by *e.g.* including vector mesons or explicit quark degrees of freedom. For example, the vector meson model predicts the axial singlet current matrix element of the nucleon to be 0.3.

[1] These studies have recently been reviewed in: H. Weigel, Intl. J. Mod. Phys. **A11** (1996) 2419. An exhaustive list of references is also supplied in that article.

This result appears to be robust against permissible variations of the model parameters. The explicit inclusion of quark fields provides a tool to compute various nucleon structure functions at a low momentum scale. In the $SU(3)$ model even the contributions of strange quarks to the structure functions can be separated.

Short distance and long distance QCD contributions to radiative decays, $B \to X_s + 2\gamma' s$ and $B_s \to 2\gamma' s$

Y.-P. Ed Yao
University of Michigan, Ann Arbor

Abstract

The short distance QCD corrections to $b \to s\gamma\gamma$ will be discussed. This leads in particular to a branching ratio of 5×10^{-7} for $B_s \to \gamma\gamma$ and modifies considerably the relative strengths between the CP-even and the CP-odd photon amplitudes. For the non-perturbative effects on the energy spectrum on either one of the photons in $B \to X_s\gamma\gamma$, we consider the subprocesses in which a charm quark loop interacts with a self-consistently produced background static QCD field. This magnitude is estimated to be a few percents in $B \to X_s\gamma\gamma$, but can be quite substantial in $B_s \to \gamma\gamma$.

DIRC, the Particle Identification Detector of BaBar

Christophe Yeche
C.E.A. Saclay DAPNIA
BaBar Collaboration

Abstract

A novel Particle Identification Detector has been developed for the BaBar experiment which is foreseen to operate at the PEPII B factory at SLAC. This new and promising PID, called the DIRC (Detection of Internally Reflected Cherenkov light), is a ring–imaging device which utilizes the total internal reflection of light in long thin quartz radiator bars to form a velocity–dependent image. The light is observed by an array of photomultiplier tubes displaced from the end of the bar. After a brief description of the detector, we will present the results of a large scale prototype which was built and tested at CERN using pion, kaon and proton beams. Finally, the status of the project will be presented and its prospects.

Hyperon production in Σ^-, neutron and pion interactions at 345 GeV/c in the Hyperon experiment WA–89 at CERN

Mikhail Zavertyaev
Lebedev Physical Institute
Moscow

Abstract

We report a hyperon differential and total production cross section measurement in three type of interactions : Σ^-, neutron and pion. We studied production of vees (Λ_0, K_0, $\bar{\Lambda}$) and Ξ-hyperons ($\Xi(1320)$, $\Xi(1530)$, $\Xi(1820)$, $\Xi(1960)$). Very strong leading effect was observed in case of Σ^- interaction. A new decay mode was observed for $\Xi(1690) \longrightarrow \Xi(1320)\pi$.

Weak radiative hyperon decays and vector meson dominance

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Abstract

We study the question whether the phenomenologically successful pole–model VMD approach to weak radiative hyperon decays can be made consistent with Hara's theorem and still yield the pattern of asymmetries exhibited by experimental data. It appears that an essential ingredient which governs the pattern of asymmetries is the off–shell behaviour of the input electromagnetic 1/2$^-$ - 1/2$^+$ - γ couplings, which was not discussed in the literature so far. Although this behaviour can be chosen in such a way that the experimentally observed pattern is obtained and yet Hara's theorem satisfied, the approach yields then a definite prediction for the size of weak meson-nucleon coupling constants. Comparison with experiment reveals then another conflict.

Testing technicolor models in top quark pair production at high energy photon colliders

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(Presented by Hong–Yi Zhou)

Abstract

We study pseudo-Goldstone boson corrections to $\gamma\gamma \to t\bar{t}$ production rates in technicolor models with and without topcolor at the $\sqrt{s} = 0.5\ and\ 1.5$ TeV photon colliders. We find that, for reasonable ranges of the parameters, the corrections are large enough to be observable, and the corrections in models with topcolor are considerably larger than those in models without topcolor, and they are all significantly larger than the corresponding corrections in the minimal supersymmetric standard model (MSSM) with $\tan\beta \geq 1$. So that the two kinds of technicolor models and the MSSM with $\tan\beta \geq 1$ can be experimentally distinguished.

[2] Mailing address