VOLUME 1

Foreword .... *i*

Introduction, *B.H. Wiik* .... *ii*

List of contents .... *iii*

- **Structure Functions** 1

Structure functions in deep inelastic scattering at HERA 3
J. Blümlein, T. Doyle, F. Hautmann, M. Klein, A. Vogt

Recent developments in radiative corrections at HERA 13
D. Bardin, J. Blümlein, P. Christova, L. Kalinovskaya

A detailed comparison of NLO QCD evolution codes 23
J. Blümlein, M. Botje, C. Pascaud, S. Riemersma, W.L. van Neerven, A. Vogt, F. Zomer

Future precision measurements of $F_2(x,Q^2)$, $\alpha_s(Q^2)$ and $xg(x,Q^2)$ at HERA 33
M. Botje, M. Klein, C. Pascaud

Theoretical uncertainties in the determination of $\alpha_s(M_Z^2)$ from F_2^p at HERA 52
J. Blümlein, S. Riemersma, W.L. van Neerven, A. Vogt

Review of higher order QCD corrections to structure functions 56
W.L. van Neerven

The next-to-next-to-leading QCD calculation of the moments of deep inelastic structure functions 67
S.A. Larin, P. Nogueira, T. van Ritbergen, J.A.M. Vermaseren

Future measurement of the longitudinal proton structure function at HERA 77
L. Bauerdick, A. Glazov, M. Klein

QCD corrections to $F_L(x,Q^2)$ 82
J. Blümlein, S. Riemersma

IR-renormalon contribution to the longitudinal structure function F_L 86
M. Meyer-Hermann, A. Schäfer, E. Stein

The heavy-flavour contribution to proton structure 89
K. Daum, S. Riemersma, B.W. Harris, E. Laenen, J. Smith

The charm-strange contribution to charged-current DIS structure functions 102
V. Barone, U. D'Alesio, M. Genovese

$F_2(x,Q^2)$ and $F_L(x,Q^2)$ at leading order in $\ln(1/x)$ as well as $\alpha_s(Q^2)$ 107
R.S. Thorne

The QCD dipole picture of small-x physics 110
R. Peschanski, G.P. Salam

Gluon distributions from the CCFM equation 116
P. Sutton

Experimental constraints on coefficients of α_s-expansion of Gottfried sum rule 119
A.V. Sidorov, M.V. Tokarev

• **Electroweak Physics** 127

Electroweak physics at HERA: Introduction and summary 129
R. Cashmore, E. Elsen, B.A. Kniehl, H. Spiesberger

Electroweak precision tests with deep inelastic scattering at HERA 140
R. Beyer, E. Elsen, S. Riess, H. Spiesberger, F. Zetsche

Theoretical uncertainties in precision electroweak physics at HERA 160
B.A. Kniehl

Measurement of weak neutral current couplings of quarks at HERA 163
R.J. Cashmore, S. Dagan, O. Deppe, J. Edmonds, J.C. Hart, H. Hessling, K.R. Long, J.K. Sedgbeer, H. Spiesberger, R. Walczak, A.F. Whitfield, F. Zetsche

Limits on $WW\gamma$ couplings from single W boson production in ep collisions 190
V.A. Noyes

Bounds on the $Z\gamma\gamma$ couplings from HERA 208
F. Cornet, R. Graciani, J.L. Illana

Standard-Model Higgs-boson production at HERA 219
B.A. Kniehl

Lepton beam polarisation at HERA 222
F. Zetsche

EPRC: A program package for electroweak physics at HERA 227
H. Spiesberger

• **Beyond the Standard Model** 237

Beyond the Standard Model Group Summary 239
H. Dreiner, H.-U. Martyn, S. Ritz, D. Wyler

Higgs search at HERA 244
M. Krawczyk

Sensitivity of the ZEUS experiment to contact interactions at high integrated luminosities 256
J. Gilmore

Lepton flavor violation searches 260
F. Sciulli, S. Yang

Heavy neutral lepton searches 270
F. Sciulli, L. Wai

Searches for minimal supersymmetry at HERA 275
P. Schleper

Associated production of selectron neutralino pairs 289
M. Corradi

R-parity violating supersymmetry at HERA 295
E. Perez, Y. Sirois, H. Dreiner

Direct searches for light gluinos at HERA 312
M. David

Light, long-lived gluinos in DIS at HERA 321
D. Graudenz, K. Meier, O. Nachtmann, D. Stevens, K. Zuber

Perspectives on new phenomena 327
H.-U. Martyn

Leptoquark pair production at HERA 338
J. Blümlein, E. Boos, A. Kryukov

• **Heavy Quark Production and Decay** 343

Introductory remarks 345
A. Ali, R. Eichler, S. Frixione, U. Karshon, H. Schröder

Heavy flavour production 347
R. Eichler, S. Frixione

Heavy flavour decays - Introduction and summary 358
A. Ali, H. Schröder

Rare D meson decays at HERA 376
C. Grab

$D^0 - \overline{D}^0$ mixing at the ep-collider HERA 387
G. Tsipolitis

Deep-inelastic production of heavy quarks 393
E. Laenen et. al.

High p_T charm photoproduction 402
G. Abbiendi, J.M. Butterworth, R. Graciani

Prospects for heavy flavour photoproduction at HERA 408
S. Frixione

Future perspectives of quarkonium physics at HERA 416
M. Cacciari, M.Krämer

CP violation and flavour mixing in the Standard Model – 1996 update 432
A. Ali, D. London

Rare B decays in the Standard Model 446
A. Ali

The partial reconstruction of $B^0 \to \chi_{c1} K_S^0, B^0 \to \psi' K_S^0$ and $B^0 \to J/\psi K^{*0}$ 465
R. Mizuk

Pion tag of B meson flavour at HERA-B 470
C.H. Shepherd-Themistocleous

Low p_t lepton tag at the HERA-B experiment 475
R. Mizuk

Trigger for radiative B decays at the HERA-B experiment 479
F. Saadi-Lüdemann

Accuracy of $B^0 - \overline{B}^0$ mixing and B^0 lifetime measurements at HERA-B 484
P. Kreuzer

On the study of $B\overline{B}$ correlations at HERA-B 490
R. Rylko

• **Jets and High-$E_\perp$ Phenomena** 497

Jets and high-$E_\perp$ phenomena 500
M. Erdmann, D. Graudenz, L. Lönnblad, K. Tokushuku

Search strategies for Instanton-induced processes at HERA 509
M. Gibbs, T. Greenshaw, D. Milstead, A. Ringwald, F. Schrempp

Jet production in deep inelastic scattering at next-to-leading order 515
E. Mirkes, D. Zeppenfeld

NLO QCD calculations in DIS at HERA based on the dipole formalism 519
S. Catani, M. Seymour

Prospects of a determination of α_s from jet rates 524
Th. Hadig, Ch. Niedzballa, K. Rabbertz, K. Rosenbauer

On a consistent determination of α_s from jet rates in DIS 529
J. Chýla, J. Rameš

Prospects for a measurement of α_s via scaling violations of fragmentation functions in deeply inelastic scattering 533
D. Graudenz

Extraction of the gluon density from F_2 and jet rates 537
G. Lobo

The extraction of the gluon density from jet production in deeply inelastic scattering 541
D. Graudenz, M. Hampel, A. Vogt

Virtual photon structure from jet production at HERA 545
J. Chýla, J. Cvach

Access to the NLO gluon distribution of the photon 549
J. Binnewies, M. Erdmann, B.A. Kniehl, G. Kramer

Matching experimental and theoretical jet definitions for photoproduction at HERA 554
J. Butterworth, L. Feld, M. Klasen, G. Kramer

Colour coherence in photon induced reactions 560
A. Lebedev, L. Sinclair, E. Strickland, J. Vazdik

Rapidity gaps between jets 566
M. Hayes, J. Butterworth, M. Seymour, L. Sinclair

Dijet cross section in photoproduction at HERA 570
P. Aurenche, L. Bourhis, M. Fontannaz, J.P. Guillet

Prompt photon, Drell-Yan and Bethe-Heitler processes in hard photoproduction ... 574
P. Bussey, B. Levtchenko, A. Shumilin

QCD in the forward region 580
A. Edin, G. Ingelman, J. Rathsman

On forward jets and the hot spot limit at HERA 584
H. Hessling

Fixed-order QCD backgrounds to BFKL dynamics in forward jet production 588
E. Mirkes, D. Zeppenfeld

Forward jet cross sections 594
T. Haas, M. Riveline

Production of forward jets at HERA 598
J. Bartels, A. De Roeck, M. Wüsthoff

Target proton properties in deep inelastic scattering at HERA 602
I. Gialas, J. Hartmann

High-$p_\perp$ particles in the forward region at HERA 606
M. Kuhlen

HZTool: A package for Monte Carlo – data comparison at HERA (Version 1.0) 611
J. Bromley et al.

Tuning Monte Carlo event generators to HERA data 613
N. Brook, T. Carli, R. Mohr, M. Sutton, R. Waugh

The LDC event generator 620
G. Gustafson, H. Kharraziha, L. Lönnblad

The physics case for a forward detector upgrade 625
H. Abramowicz, et al.

VOLUME 2

- **Diffractive Hard Scattering** 633

Diffractive hard scattering – Summary report of the working group 635
H. Abramowicz, J. Bartels, L. Frankfurt, H. Jung

Quark - antiquark jets in DIS diffractive dissociation 668
J. Bartels, C. Ewerz, H. Lotter, M. Wüsthoff, M. Diehl

Vector meson production in $ep \to epV$ 674
W.Koepf, P. Landshoff, E. Levin, N. Nikolaev

Future aspects of vector meson production at HERA 679
H. Abramowicz, T. Doeker, L. Iannotti, S. Kananov, A. Levy, L. West

Diffractive structure functions in DIS 691
M.F. McDermott, G. Briskin

Future diffractive structure function measurements at HERA 704
A. Mehta, J. Phillips, B. Waugh

The LPS in diffractive physics with HERA upgrade 719
T. Massam

Measurements with the ZEUS leading proton spectrometer 721
E. Gallo, M. Grothe, C. Peroni, J. Rahn, R. Sacchi, A. Solano

Diffraction in charged current DIS 728
J. Pliszka, A.F. Zarnecki

Proton diffractive dissociation. Studying proton dissociation using
forward taggers or calorimeters 734
H. Abramowicz, G. Barbagli, M. Kasprzak, A. Levy

Diffractive and jet physics with a forward PLUG calorimeter at ZEUS 743
A. Bamberger, S. Eisenhardt, H. Heßling, H. Raach, S. Wölfle

- **Polarized Protons and Electrons** 757

Physics with a polarized proton beam – a summary 760
J. Feltesse, A. Schäfer

Measurement of the spin dependent structure function $g_1^p(x, Q^2)$ at HERA 777
R. Ball, A. Deshpande, S. Forte, V.W. Hughes, J. Lichtenstadt, G. Ridolfi

Errors in the extraction of α_s from the Bjorken sum rule 794
E. Gardi, J. Ellis, M. Karliner

The effect of small-x resummations on the evolution of polarized structure functions 799
J. Blümlein, A. Vogt

Prospects for measuring ΔG from jets at HERA with polarized protons and electrons 803
A. De Roeck, J. Feltesse, F. Kunne, M. Maul, E. Mirkes, G. Rädel, A. Schäfer, C.Y. Wu

Photoproduction of jets and heavy flavors in polarized ep-collisions at HERA 815
M. Stratmann, W. Vogelsang

Spin asymmetries from charged current events 827
M. Anselmino, J. Blümlein, P. Gambino, J. Kalinowski, N. Kochelev, M. Maul, A. Schäfer, T. Yamanishi

On the physics potential of polarized nucleon-nucleon collisions at HERA 837
M. Anselmino, E. Andreeva, V. Korotkov, F. Murgia, W.-D. Nowak, S. Nurushev, O. Teryaev, A.Tkabladze

Drell-Yan asymmetries at HERA-N 847
T. Gehrmann, W.J. Stirling

Study of the pomeron coupling in diffractive reactions at HERA 851
S.V. Goloskokov

Spectator tagging in electron deuteron scattering and the measurement of the Bjorken sum rule 854
M. Düren

Nuclear effects in extraction of $g_{1n}(x, Q^2)$ at small x 859
M. Strikman

An absolute polarimeter for the measurement of the proton beam polarization at HERA 863
N. Akchurin, W.-D. Nowak, S.B. Nurushev, A. Penzo, A.G. Ufimtsev

Absolute polarimetry for the proton beams of the RHIC spin collider and HERA ...866
G. Igo

Tracing the origin of the left-right asymmetries observed in inclusive single-spin hadron-hadron collisions 867
C. Boros, Z. Liang, T. Meng, R. Rittel

Time-reversal-odd asymmetries at HERA 870
T. Gehrmann

Cosmological spin-offs 872
J. Ellis, M. Karliner

Probing dissociation of space-like photons at HERA 879
C. Boros, Z. Liang, T. Meng

• **Light and Heavy Nuclei in HERA** 883

Collider mode:

Nuclear beams in HERA 887
M. Arneodo, A. Bialas, M.W. Krasny, T. Sloan, M. Strikman

Nuclear gluon distribution in QCD 927
A.L. Ayala, M.B. Gay Ducati, E.M. Levin

Shadowing in the deuteron 934
B. Badelek, J. Kwiecinski

Longitudinal and transverse nuclear shadowing 938
V. Barone, M. Genovese

Nuclear effects at HERA 942
S.J. Brodsky

Color transparency and color opacity in coherent production of vector mesons off light nuclei at small x 946
L. Frankfurt, V. Guzey, W. Koepf, M. Sargsian, M. Strikman

Possible evidence for color transparency from dijet production with large rapidity gaps in γ-p scattering at HERA and how to test it in γ-p, γ-A scattering .. 949
L. Frankfurt, M. Strikman

The ratio of gluon distributions in Sn and C 953
T. Gousset, H.J. Pirner

Binding effects and nuclear shadowing 956
D. Indumathi, W. Zhu

Interplay of soft and hard interactions in nuclear shadowing at high Q^2 and low x .. 959
B. Kopeliovich, B. Povh

Comments on electron-deuteron scattering at HERA 964
M.W. Krasny

Q^2 evolution studies of nuclear structure function F_2 at HERA 968
S. Kumano, M. Miyama

Diffraction and shadowing in deep inelastic scattering from nuclei 971
G. Niesler, G. Piller, W. Weise

Diffraction in DIS on nuclear targets 974
N.N. Nikolaev, W. Schäfer, B.G. Zakharov, V.R. Zoller

Two-photon mechanism production of the Higgs boson, SUSY particles, hadrons and lepton pairs in eA collisions at HERA 978
M. Krawczy, B. Levtchenko

Leading baryon production in ed interactions at HERA 983
G. Levman

Use of the LPS in eA events at HERA. A new stripping channel. 986
T. Massam

What can we gain by detecting nuclear fragments in electron-nucleus
collisions at HERA? 991
J. Chwastowski, M.W. Krasny

Hadron distributions in deep inelastic electron-nucleus scattering at collider energies 998
N. Pavel

Energy loss of high energy partons in a finite QCD medium 1003
R. Baier, Yu. Dokshitzer, A.H. Mueller, S. Peigné, D. Schiff

Radiative corrections to deep inelastic scattering on heavy nuclei at HERA 1007
I. Akushevich, H. Spiesberger

QED radiative processes in electron-heavy ion collisions at HERA 1012
K. Kurek

VNI - An event generator for deep inelastic final states in a space-time
description of shower development and hadronization 1019
K. Geiger

Fixed target mode:

Experiments with light and heavy nuclei at HERMES 1022
G. van der Steenhoven

Color transparency and quark propagation 1033
T.G. O'Neill, G. van der Steenhoven

Hadronization in nuclear environment 1038
B. Kopeliovich, J. Nemchik, E. Predazzi

Study of hadronization in deep inelastic lepton-nucleus scattering at HERMES 1043
N. Pavel

Towards a study of color transparency with medium energy electron beams 1048
J. Hüfner, B. Kopeliovich

Coherent ρ-production from polarized deuterium 1053
L. Frankfurt et al.

Investigation of the neutron structure function via semi-inclusive deep inelastic
scattering off the deuteron 1058
S. Simula

Tagged structure functions of the deuteron and the origin of the EMC effect 1064
W. Melnitchouk, M. Sargsian, M. Strikman

Tagged nuclear structure functions with HERMES 1069
S. Simula

Probing the nucleon meson cloud in semi-inclusive deep inelastic scattering:
Tagging of ^{3}He 1075
A.E.L. Dieperink

Meson cloud signatures in semi-inclusive deep inelastic scattering from
polarized nucleons 1079
W. Melnitchouk, A.W. Thomas

Soft neutron production – a window to final state interactions in deep-inelastic
scattering 1085
M. Strikman, M.G. Tverskoy, M. Zhalov

Near threshold large Q^2 electroproduction off polarized deuterium 1089
L. Frankfurt, M. Sargsian, M. Strikman

- **HERA Upgrades and Impacts on Experiments** 1093

HERA luminosity upgrade 1095
W. Bartel, E. Gianfelice, N. Holtkamp, E. Lohrmann, J. Maidment, B. Parker, D. Pitzlc, F. Willeke, HERA-ZEUS Upgrade Group

Polarized protons in HERA 1205
D.P. Barber, K. Heinemann, G.H. Hoffstätter, M. Vogt