

Contents

1. Introduction	1
1.1 History of Deep Inelastic Scattering	3
1.2 The HERA Collider: Parameters and Performance	5
1.3 Deep Inelastic Scattering at HERA	6
1.3.1 Kinematic Variables	7
1.3.2 Characteristics of High- Q^2 NC and CC Reactions	9
2. Deep Inelastic ep Cross Sections	13
2.1 Deep Inelastic Scattering in the Standard Model	13
2.1.1 The Leading-Order Differential Cross Sections	14
2.1.2 Including QCD Effects	18
2.1.3 Electroweak Radiative Corrections	28
2.1.4 Experimental Input Data from Previous Experiments	30
2.1.5 Parton Distribution Fits	36
2.1.6 Selected Parton Distribution and Cross Section Results	37
2.1.7 Modeling the Hadronic Final State	47
2.2 Modifications of the Standard-Model Scenario	49
2.2.1 Nonstandard Parton Distribution Functions	49
2.2.2 Theoretical Scenarios Involving New Physics	52
3. Experimental Issues	73
3.1 The ZEUS and H1 Detectors	73
3.1.1 Overview	74
3.1.2 Calorimetric Energy and Position Measurements	77
3.1.3 Track Measurements	81
3.1.4 Luminosity Measurements	82
3.1.5 Triggering	84
3.2 Event and Detector Simulation	87
3.3 Event Reconstruction	89
3.3.1 Global Event Variables	90
3.3.2 Electron Identification	91
3.3.3 Reconstruction of Kinematic Variables	92
3.3.4 Electron Energy Calibration	99
3.4 Event Selection and Correction Procedures	99

VIII Contents

3.4.1	Selection Criteria and Acceptances	101
3.4.2	Background Studies	104
3.4.3	Acceptance and Migration Corrections	106
3.5	Summary of Analyses and Data Samples	107
4.	Results from the ZEUS and H1 Experiments	115
4.1	Neutral-Current Results	116
4.1.1	Investigation of Neutral-Current Event Distributions ..	117
4.1.2	Differential Neutral-Current Cross Sections	126
4.2	Charged-Current Results	136
4.2.1	Investigation of Charged-Current Event Distributions .	136
4.2.2	Differential Charged-Current Cross Sections	140
4.3	QCD Analyses and Tests of the Electroweak Theory	147
4.3.1	The ZEUS and H1 QCD Fits	148
4.3.2	Sensitivity to Electroweak Aspects	152
4.4	Searches for New Physics	157
4.4.1	Electron-Quark Resonances	158
4.4.2	Contact Interactions	178
5.	Outlook	187
6.	Summary	191
	List of Abbreviations, Acronyms and Symbols	199
	Frequently Used Abbreviations	199
	Acronyms of Laboratories, Accelerators and Experiments	200
	Frequently Used Symbols	201
	References	203
	Index	221