

Contents

Part I Opening Review on Hadron–Collider Physics

Hadron Colliders, the Standard Model, and Beyond

| | |
|---|----|
| Scott Willenbrock | 3 |
| 1 What is the Standard Model? | 3 |
| 2 Hadron Colliders and the Standard Model | 6 |
| 2.1 Precision electroweak | 7 |
| 2.2 CKM | 9 |
| 2.3 Top quark | 12 |
| 2.4 Higgs boson | 13 |
| 2.5 QCD | 14 |
| 3 Beyond the Standard Model | 18 |
| 3.1 Direct evidence | 18 |
| 3.2 Indirect evidence | 19 |
| References | 21 |

Part II Status of the Accelerators and Detectors

Tevatron Collider Run II Status

| | |
|---|----|
| Elvin R. Harms, Jr. | 25 |
| 1 Introduction | 25 |
| 2 Overview | 25 |
| 3 Run II Milestones | 26 |
| 4 Parameters | 26 |
| 5 Performance to Date | 27 |
| 6 Accomplishments | 27 |
| 6.1 Accomplishments: Helix Adjustments | 28 |
| 6.2 Accomplishments: Antiproton Emittance | 29 |
| 6.3 Accomplishments: Tevatron Injection Closure | 29 |
| 7 Outstanding Issues | 30 |
| 8 Future Prospects | 30 |
| 9 Reliability | 31 |
| 10 Summary | 31 |
| 11 Acknowledgements | 31 |

Status of CDF II and Prospects for Run II

| | |
|--|----|
| Frank Chlebana | 32 |
| 1 Introduction | 32 |
| 2 The CDF II Detector and Trigger Upgrades | 32 |
| 3 Physics Results and Prospects | 35 |
| 4 Conclusions | 38 |
| References | 38 |

Status of the DØ Detector

| | |
|--------------------------------------|----|
| Volker Büscher | 39 |
| 1 Introduction | 39 |
| 2 Overview | 39 |
| 3 Silicon Vertex Detector | 39 |
| 4 Central Fiber Tracker | 40 |
| 5 Calorimeters | 42 |
| 6 Muon Detectors | 43 |
| 7 Forward Proton Detectors | 44 |
| 8 Trigger and Data Acquisition | 45 |
| 9 Conclusions | 45 |
| References | 45 |

**Part III Standard Model Processes:
Parton Luminosities, QCD Evolution**

The Proton Structure as Measured at HERA

| | |
|---|----|
| Henning Schnurbusch | 49 |
| 1 Introduction | 49 |
| 2 NC Cross Sections in the Complete Kinematic Plane | 50 |
| 3 High- Q^2 Measurements | 52 |
| 4 Charged Current Measurements | 53 |
| 5 Summary and Outlook | 55 |
| References | 55 |

Global Fits of Parton Distributions

| | |
|---|----|
| Robert S. Thorne | 56 |
| 1 Introduction | 56 |
| 2 Parton Uncertainties | 58 |
| 2.1 Hessian (Error Matrix) approach | 58 |
| 2.2 Offset method | 60 |
| 2.3 Statistical approach | 61 |
| 2.4 Lagrange multiplier method | 61 |
| 2.5 Results | 62 |

| | | |
|-----|--|----|
| 3 | Theoretical Errors | 63 |
| 3.1 | Problems in the fit | 63 |
| 3.2 | Types of Theoretical Error, NNLO | 64 |
| 3.3 | Empirical approach | 65 |
| 4 | Conclusions | 67 |
| | References | 68 |

Low x Physics at HERA

| | | |
|-----|----------------------------------|----|
| | Olaf Behnke | 69 |
| 1 | Introduction | 69 |
| 2 | Formalism and Theory | 70 |
| 3 | Results | 71 |
| 3.1 | Inclusive measurements | 71 |
| 3.2 | Exclusive results | 72 |
| 4 | Summary | 74 |
| | References | 74 |

Saturation Effects in Hadronic Cross Sections

| | | |
|---|--|----|
| | Arif I. Shoshi and <u>Frank D. Steffen</u> | 75 |
| 1 | Introduction | 75 |
| 2 | The Loop-Loop Correlation Model | 75 |
| 3 | Saturation in Proton-Proton Scattering | 77 |
| 4 | Gluon Saturation | 80 |
| 5 | Conclusion | 82 |
| | References | 83 |

Part IV Standard Model Processes: QCD at High p_t

Progress in NNLO Calculations for Scattering Processes

| | | |
|-----|---|----|
| | E. W. N. Glover | 87 |
| 1 | Why NNLO Calculations are Important | 87 |
| 1.1 | Renormalisation scale uncertainty | 87 |
| 1.2 | Factorisation scale dependence | 89 |
| 1.3 | Jet algorithms | 89 |
| 1.4 | Transverse momentum of the incoming partons | 89 |
| 1.5 | Power corrections | 89 |
| 1.6 | The shape of the prediction | 90 |
| 1.7 | Parton densities at NNLO | 91 |
| 2 | Recent Progress in the Field | 91 |
| 3 | What Remains to be Done | 93 |
| | References | 93 |

Heavy Flavour Production at DØ

| | |
|---------------------------------------|----|
| Daniela Bauer | 95 |
| 1 Introduction | 95 |
| 2 b -production Cross-section | 95 |
| 2.1 Muon and Jet Cross-section | 95 |
| 2.2 b -tagging | 96 |
| 3 J/ψ Cross-section | 97 |
| 4 Other Measurements | 98 |
| References | 99 |

Heavy Quark Production at CDF

| | |
|--|-----|
| Mary Bishai | 100 |
| 1 Introduction | 100 |
| 2 Beauty Production at CDF | 100 |
| 2.1 CDF Run I results | 100 |
| 2.2 Preliminary results from CDF Run II | 102 |
| 3 Quarkonia Production at CDF | 103 |
| 4 Charm Production at CDF | 104 |
| 4.1 Run I results | 104 |
| 4.2 Run II charm production cross-sections | 105 |
| 5 Conclusion | 106 |
| References | 106 |

Heavy Quark Production at HERA

| | |
|-------------------------------|-----|
| Andreas B. Meyer | 108 |
| 1 Introduction | 108 |
| 2 Open Charm Production | 109 |
| 3 Charmonium | 110 |
| 4 Beauty Production | 111 |
| 5 Summary | 113 |
| References | 114 |

**Theoretical Developments on Hard QCD Processes
at Colliders**

| | |
|---|-----|
| Thomas Gehrmann | 115 |
| 1 Introduction | 115 |
| 2 Heavy Quarks | 116 |
| 2.1 Total Cross Sections | 116 |
| 2.2 Transverse Momentum Distributions | 116 |
| 2.3 Top Quark Spin Correlations | 118 |
| 3 Jets | 118 |
| 3.1 Jet Definitions | 120 |
| 3.2 Precision Jet Physics | 120 |

| | | |
|-----|---|-----|
| 3.3 | Multiparton Processes | 122 |
| 4 | Photons and Massive Gauge Bosons | 123 |
| 4.1 | Isolated Photons | 124 |
| 4.2 | Photon Pairs | 124 |
| 4.3 | Vector Boson and Higgs Production | 126 |
| 4.4 | Transverse Momentum Distributions | 127 |
| 5 | Conclusions and Outlook | 128 |
| | References | 128 |

Jet Production at CDF

| | | |
|---|--|-----|
| | Mario Martínez | 133 |
| 1 | Introduction | 133 |
| 2 | Inclusive Jet Production | 133 |
| 3 | Three-jet Production | 135 |
| 4 | Study of Jet Shapes in Run 2 | 136 |
| 5 | Study of the Underlying Event | 137 |
| 6 | Study of $W+N_{\text{jet}}$ Production | 138 |
| | References | 139 |

Jet Algorithms at DØ

| | | |
|---|---|-----|
| | Elizabeth Gallas | 140 |
| 1 | Introduction | 140 |
| 2 | The Measurement of Jets | 140 |
| 3 | Run I Cone Algorithm | 141 |
| 4 | Run I k_T Algorithm and Comparisons | 142 |
| 5 | Run II | 144 |
| 6 | Acknowledgments | 145 |
| | References | 146 |

Jet Physics at HERA

| | | |
|-----|---|-----|
| | Oscar González | 147 |
| 1 | Introduction | 147 |
| 2 | Photoproduction of Jets | 147 |
| 2.1 | The Internal Structure of the Photon | 148 |
| 2.2 | Multijet Photoproduction | 148 |
| 2.3 | Inclusive Jet Photoproduction | 149 |
| 3 | Jet Physics in DIS | 150 |
| 3.1 | Jet Cross Sections at Low Q^2 and at Forward Angles | 150 |
| 3.2 | Multijet Production in DIS | 151 |
| 3.3 | Precise Tests of QCD from Jet Production in DIS | 151 |
| 4 | Conclusions | 152 |
| | References | 153 |

Global Photon Summary

| | |
|---|-----|
| Sung-Won Lee | 154 |
| 1 Introduction | 154 |
| 2 Prompt photon production at the Tevatron | 155 |
| 2.1 Run I results | 156 |
| 2.2 Run II prospects | 156 |
| 3 Prompt photon production at HERA | 157 |
| 3.1 Inclusive photoproduction of prompt photons | 157 |
| 3.2 Photoproduction of prompt photon and jets | 157 |
| 3.3 Prompt photons in deep inelastic scattering | 158 |
| 4 Current issues in photon production | 159 |
| 5 Summary | 160 |
| References | 160 |

Hadron Production in Hadron-Hadron and Lepton-Hadron Collisions

| | |
|--|-----|
| Bernd A. Kniehl | 161 |
| 1 Introduction | 161 |
| 2 Determination of the FFs | 162 |
| 3 Global Analysis of Collider Data | 164 |
| 4 Inclusive B -Meson Production | 164 |
| 5 Conclusions | 168 |
| References | 169 |

Part V Standard Model Processes: QCD: Diffractive Processes

Measurements of Diffractive Processes at HERA

| | |
|--|-----|
| Aharon Levy | 173 |
| 1 Introduction | 173 |
| 2 Kinematics of Diffractive Scattering | 174 |
| 3 Diffraction as Soft or Hard Process | 174 |
| 4 Inclusive Diffraction | 175 |
| 5 Exclusive Vector Mesons | 178 |
| 6 Deeply Virtual Compton Scattering (DVCS) | 181 |
| References | 183 |

Diffractive Physics at DØ

| | |
|--|-----|
| Silvia Tentindo-Repond | 184 |
| 1 Diffractive Processes | 184 |
| 2 The DØ Detector | 185 |
| 3 Hard Single Diffraction: Diffractive W and Z | 186 |
| 4 Comparison of W,Z Diffractive Data to Models | 187 |

| | | |
|---|--|-----|
| 5 | Hard Single Diffraction: Dijets | 188 |
| 6 | HSD and Models | 189 |
| 7 | Present and Future Prospects for Diffractive Physics at D0 Run II .. | 189 |
| | References | 191 |

Measurements of Diffractive Processes at CDF

| | | |
|---|--------------------------------------|-----|
| | Konstantin Goulianos | 192 |
| 1 | Introduction | 192 |
| 2 | Hard diffraction | 193 |
| | 2.1 Rapidity gap results | 193 |
| | 2.2 Leading antiproton results | 193 |
| 3 | Double-gap soft diffraction | 195 |
| 4 | Data and results | 195 |
| | References | 198 |

Selected topics in Rapidity Gap Physics

| | | |
|---|------------------------------------|-----|
| | Jeffrey R. Forshaw | 199 |
| 1 | Introduction | 199 |
| 2 | Hard diffraction | 199 |
| | 2.1 Central higgs production | 203 |
| 3 | Dipole models | 204 |
| 4 | Rapidity gaps at high- t | 207 |
| | 4.1 Vector mesons | 207 |
| | 4.2 Gaps between jets | 208 |
| 5 | Summary | 210 |
| | References | 210 |

Part VI Standard Model Processes: Heavy-Ion Collisions

Recent Results from STAR

| | | |
|---|---|-----|
| | Markus D. Oldenburg | 215 |
| 1 | The Relativistic Heavy-Ion Collider | 215 |
| 2 | The STAR Experiment | 215 |
| 3 | Measurements of Anisotropic Flow | 216 |
| 4 | Jets in Nucleus-Nucleus Collisions | 218 |
| 5 | Ultra-Peripheral Heavy-Ion Collisions | 219 |
| 6 | Conclusions and Outlook | 221 |
| | References | 221 |

**Part VII Standard Model Processes:
Heavy Flavour, CKM and CP-Violation**

**Beauty and Charm Physics at CDF,
First Results and Perspectives**

| | |
|---------------------------------------|-----|
| Sandro De Cecco | 225 |
| 1 Introduction | 225 |
| 2 Leptonic sample | 225 |
| 3 Hadronic sample | 227 |
| 4 Beauty and Charm perspectives | 229 |
| References | 231 |

**Prospects for B Lifetimes, Oscillations
and CP Violation at DØ**

| | |
|---------------------------------------|-----|
| Wendy Taylor | 232 |
| 1 Introduction | 232 |
| 2 The Run II DØ Detector | 233 |
| 3 The DØ Beauty Physics Program | 234 |
| 3.1 Average B Lifetime | 234 |
| 3.2 B_s^0 Mixing | 236 |
| 3.3 CP Violation | 236 |
| 3.4 A_b^0 Lifetime | 237 |
| 4 Conclusions | 237 |
| References | 238 |

**Impact of Bottom-Quark Measurements on our Knowledge
of the Standard Model**

| | |
|--|-----|
| Robert Fleischer | 239 |
| 1 Introduction | 239 |
| 2 CP Violation in B Decays | 240 |
| 2.1 Weak Decays | 240 |
| 2.2 Unitarity Triangles | 241 |
| 2.3 Main Strategies | 242 |
| 3 Benchmark Decay Modes of B^\pm and B_d Mesons | 243 |
| 3.1 $B \rightarrow \pi K$ | 243 |
| 3.2 $B \rightarrow J/\psi K$ | 245 |
| 3.3 $B \rightarrow \phi K$ | 246 |
| 3.4 $B \rightarrow \pi\pi$ | 247 |
| 4 “El Dorado” for Hadron Colliders: B_s -Meson System | 248 |
| 4.1 General Features | 248 |
| 4.2 Benchmark Decay Modes of B_s Mesons | 249 |
| 4.3 The $B_s \rightarrow K^+ K^-$, $B_d \rightarrow \pi^+ \pi^-$ System | 250 |

| | | |
|---|-----------------------------------|-----|
| 5 | Comments on Rare B Decays | 252 |
| 6 | Conclusions and Outlook | 253 |
| | References | 253 |

Part VIII Standard Model Processes: W, Z-Bosons, Electroweak Parameters

Electroweak Physics Prospects for CDF in Run II

| | |
|---|-----|
| Eric James | 259 |
| 1 Introduction | 259 |
| 2 W/Z Production Cross Sections | 260 |
| References | 265 |

Measurement of the Z and W Boson Production Cross

| | |
|--|-----|
| Andrew Alton | 266 |
| 1 Introduction | 266 |
| 2 Detector | 266 |
| 3 Data Selection | 267 |
| 4 Detector Simulation and Acceptance | 269 |
| 5 Results | 270 |
| 6 Future Plans | 272 |
| References | 272 |

Associated Hadroproduction of Charmonia and Electroweak Bosons

| | |
|--|-----|
| Caesar P. Palisoc, Bernd A. Kniehl, Lennart Zwierner | 273 |
| 1 Analytic Results | 273 |
| 2 Numerical Results | 275 |
| 3 Conclusions | 278 |
| References | 279 |

Review of Potential for Precision Electroweak Studies at the LHC

| | |
|--|-----|
| Dominique Pallin | 280 |
| 1 Introduction | 280 |
| 1.1 EW Precision measurements: past and future | 281 |
| 2 Precision EW measurements at LHC | 281 |
| 2.1 Production cross sections and detectors parameters | 281 |
| 2.2 Top Mass measurement at the LHC | 282 |
| 2.3 W Mass measurement at the LHC | 284 |
| 2.4 $\sin^2\theta_{eff}^l$ measurement at the LHC | 285 |
| 3 Conclusion | 285 |
| References | 286 |

Part IX Standard Model Processes:
Top Quark

Top Quark Physics at DØ

| | |
|--------------------------------------|-----|
| Kenneth Johns | 289 |
| 1 Introduction | 289 |
| 2 Run I Results | 289 |
| 3 Run IIa Results | 290 |
| 4 Run IIa and IIb Expectations | 294 |
| 5 Conclusions | 294 |
| References | 295 |

Top Quark Physics with CDF

| | |
|---|-----|
| Wolfgang Wagner | 296 |
| 1 The CDF II Upgrade | 296 |
| 2 The Top Physics Program of CDF | 297 |
| 2.1 $t\bar{t}$ Cross Section | 297 |
| 2.2 Top Mass Measurement | 299 |
| 2.3 Physics with $t\bar{t}$ Events | 299 |
| 3 Single Top Quark Production | 299 |
| 4 Search for FCNC in the Top Sector | 302 |
| 5 Conclusions | 303 |
| References | 303 |

The Top Quark: Experimental Roots and Branches of Theory

| | |
|---------------------------------------|-----|
| Elizabeth H. Simmons | 304 |
| 1 Introduction | 304 |
| 2 Experimental Roots | 304 |
| 2.1 Mass | 304 |
| 2.2 Top Width and Decays | 306 |
| 2.3 Pair Production | 307 |
| 2.4 Spin Correlations | 308 |
| 3 Branches of Theory | 310 |
| 3.1 Light Neutral Higgs in MSSM | 310 |
| 3.2 Charged Higgs | 310 |
| 3.3 Sfermion Masses | 310 |
| 3.4 Extra EW Gauge Bosons | 312 |
| 3.5 New Top Strong Interactions | 313 |
| 4 Summary | 315 |
| References | 316 |

**Part X Searches for New Phenomena:
Higgs**

Higgs Production at Hadron Colliders

| | |
|--------------------------------|-----|
| Robert V. Harlander | 321 |
| 1 Higgs mass limits and bounds | 321 |
| 2 Higgs production modes | 321 |
| 2.1 Higgs Strahlung | 323 |
| 2.2 Weak Boson Fusion (WBF) | 324 |
| 2.3 $t\bar{t}H$ | 324 |
| 3 Gluon fusion | 325 |
| 3.1 Total rate at NNLO | 328 |
| 3.2 Distributions | 329 |
| 3.3 Higgs pair production | 330 |
| 4 MSSM | 330 |
| 5 Conclusions | 331 |
| References | 332 |

Higgs Searches and Prospects at CDF

| | |
|--|-----|
| Pavel Murat | 334 |
| 1 Introduction | 334 |
| 2 SM Higgs Production at Hadron Colliders | 334 |
| 2.1 CDF Run I searches for the light SM Higgs | 335 |
| 2.2 $l\nu b\bar{b}$ channel | 335 |
| 2.3 $ll b\bar{b}$ channel | 336 |
| 2.4 $qq b\bar{b}$ channel | 336 |
| 2.5 $\nu\nu b\bar{b}$ channel | 337 |
| 2.6 Summary of the Run I SM Higgs Searches and Projections for Run II | 337 |
| 3 CDF Searches for MSSM Higgs Bosons | 338 |
| 3.1 Search for the Neutral MSSM Higgs | 338 |
| 3.2 Search for the Charged Higgs | 338 |
| 3.3 MSSM and Detection of the τ -leptons | 339 |
| 4 Summary | 339 |
| References | 340 |

Prospects for Higgs Bosons at DØ

| | |
|---|-----|
| Suyong Choi | 341 |
| 1 Introduction | 341 |
| 2 The Run 2 DØ Detector | 341 |
| 3 Run 2 Expectations | 342 |
| 3.1 SM Higgs Production at the Tevatron | 342 |
| 3.2 MSSM Higgs Production at the Tevatron | 342 |

| | | |
|-----|--|-----|
| 3.3 | Review of Results from the SUSY-Higgs Workshop | 343 |
| 4 | Current Status of $D\bar{D}$ | 345 |
| 4.1 | Lepton Identification | 345 |
| 4.2 | b-jet Tagging | 346 |
| 4.3 | Summary of MC Simulation Studies at $D\bar{D}$ | 346 |
| | References | 347 |

Prospects of Higgs Physics at the LHC

| | | |
|-----|---|-----|
| | Bruce Mellado | 348 |
| 1 | Introduction | 348 |
| 2 | Running Conditions and Physics Analysis | 348 |
| 3 | The Search for the SM Higgs Boson | 349 |
| 3.1 | Recent Progress in SM Higgs Searches | 350 |
| 4 | Recent Progress in MSSM Higgs Searches | 352 |
| 5 | Conclusions | 354 |
| | References | 355 |

Part XI Searches for New Phenomena: Alternative Symmetry Breaking Mechanisms, SUSY, Extra Dimensions, Anomalous Couplings, Leptoquarks and Compositeness

Isolated Lepton Signatures at HERA

| | | |
|-----|--|-----|
| | Elisabetta Gallo | 359 |
| 1 | Introduction | 359 |
| 2 | Multi-lepton Events | 359 |
| 2.1 | Multi-electron Events in H1 | 359 |
| 2.2 | Multi-electron Events in ZEUS | 361 |
| 2.3 | Discussion | 361 |
| 3 | Events with an Isolated Lepton and Missing p_T | 362 |
| 4 | Isolated τ Events in ZEUS | 363 |
| 5 | Conclusion | 365 |
| | References | 365 |

Searches for New Particles/Phenomena at CDF

| | | |
|---|---|-----|
| | Hyunsoo Kim | 366 |
| 1 | Overview | 366 |
| 2 | Searches for New Gauge Bosons | 366 |
| 3 | Large Extra Dimensions | 367 |
| 4 | Search for Long-Lived Heavy Charged Particles | 368 |
| 5 | Leptoquark Searches | 368 |
| 6 | New Physics with Inclusive Lepton and Photon Final States | 369 |
| 7 | Search for Gluinos and Scalar Quarks | 369 |
| 8 | Scalar Top Quark Searches | 370 |

| | | |
|-----|--|-----|
| 8.1 | <i>R</i> -Parity Conserving Stop Decay | 370 |
| 8.2 | <i>R</i> -Parity Violating Stop Decay | 371 |
| | References | 372 |

Searches and Expected Signatures at DØ

| | | |
|-----|--|-----|
| | Andrei Nomerotski | 373 |
| 1 | Introduction | 373 |
| 2 | Search for Large Extra Dimensions | 373 |
| 2.1 | Dielectron and Diphoton Channels | 373 |
| 2.2 | Dimuon Channel | 375 |
| 3 | Search for RPV SUSY in Trilepton Channels | 376 |
| 4 | GMSB SUSY in Di-Photon Events | 377 |
| 5 | Search for Leptoquarks in the Dielectron Channel | 378 |
| 6 | Search for Squarks and Gluinos in Jets + \cancel{E}_T Events | 378 |
| 7 | Conclusions | 379 |

Searches and Discovery Prospects at HERA

| | | |
|---|--|-----|
| | Yves Sirois | 380 |
| 1 | Introduction | 380 |
| 2 | Leptoquarks in Minimal Models | 382 |
| 3 | Contact Interactions | 384 |
| 4 | Leptoquarks in Generic Models | 386 |
| 5 | Lepton Flavour Violation | 387 |
| 6 | <i>R</i> -Parity Violating Supersymmetry | 388 |
| 7 | Extra Dimensions | 388 |
| 8 | Doubly Charged Higgs | 390 |
| 9 | Anomalous Top Couplings | 391 |
| | References | 392 |

Supersymmetry at the LHC: Searches, Discovery Windows, and Expected Signatures

| | | |
|-----|------------------------------------|-----|
| | Darin Acosta | 394 |
| 1 | Introduction | 394 |
| 2 | Trigger Strategies | 395 |
| 3 | mSUGRA | 396 |
| 3.1 | Inclusive Searches | 396 |
| 3.2 | Exclusive Sparticle Reconstruction | 398 |
| 4 | GMSB | 399 |
| | References | 400 |

Searches, Discovery Windows, and Expected Signatures of New Phenomena at ATLAS and CMS

| | | |
|---|----------------|-----|
| | Pamela Chumney | 402 |
| 1 | Introduction | 402 |
| 2 | Compositeness | 402 |

XXII Contents

| | | |
|----|-------------------------------|-----|
| 3 | Excited Quarks | 403 |
| 4 | Technicolor | 404 |
| 5 | Leptoquarks | 404 |
| 6 | New Gauge Bosons | 405 |
| 7 | Majorana Neutrinos | 406 |
| 8 | Monopoles | 406 |
| 9 | Extra Dimensions | 407 |
| 10 | Black Holes | 407 |
| 11 | Lepton Flavor Violation | 408 |
| 12 | Conclusions | 408 |
| | References | 408 |

**Part XII Tools and Techniques for Physics Analysis:
Luminosity Determination in Hadron-Hadron Collisions,
Event Generators, New Developments in Analysis Techniques**

Luminosity Determination at the Tevatron

| | |
|---|-----|
| S. Klimenko | 413 |
| 1 Introduction | 413 |
| 2 Reference processes | 414 |
| 2.1 Inelastic $p\bar{p}$ scattering | 414 |
| 2.2 W-production | 415 |
| 3 Luminosity monitoring in Run II | 415 |
| 3.1 CDF luminosity monitor | 415 |
| 3.2 DØ luminosity monitor | 416 |
| 4 Methods of luminosity measurement | 416 |
| 4.1 Counting of empty bunch crossings | 417 |
| 4.2 Counting of hits | 418 |
| 4.3 Counting of particles by the CDF luminosity monitor | 419 |
| 5 Uncertainties of luminosity measurement | 420 |
| 6 Luminosity cross-check with the W-production | 421 |
| 7 Conclusion | 422 |
| 8 Acknowledgments | 422 |
| References | 422 |

Luminosity Measurement at the LHC

| | |
|---|-----|
| Michael Rijssenbeek | 424 |
| 1 Introduction | 424 |
| 2 Luminosity from Machine Parameters | 425 |
| 2.1 Machine Instrumentation | 426 |
| 3 Luminosity Measurement in the Experiments | 426 |
| 3.1 CMS–TOTEM | 426 |
| 3.2 ATLAS | 427 |
| 3.3 LHCb | 429 |

| | | |
|--|---|-----|
| 3.4 | ALICE | 429 |
| 4 | Conclusion | 430 |
| | References | 430 |
| Precision Parton Luminosities at the LHC | | |
| | Michael Dittmar | 431 |
| 1 | Measuring Cross Sections at the LHC | 431 |
| 2 | W and Z Production, a Well Known Reference Reaction | 432 |
| 3 | Constraining Gluons and Heavy Quarks at the LHC | 435 |
| 4 | What Remains to be Demonstrated? | 437 |
| | References | 438 |
| Event Generators — New Developments | | |
| | Stefan Gieseke | 439 |
| 1 | Introduction: event generators | 439 |
| 1.1 | An event generator for e^+e^- -collisions | 439 |
| 1.2 | Additional complications in $p\bar{p}$ collisions | 440 |
| 2 | Matrix elements and parton showers | 442 |
| 2.1 | Matrix element corrections | 442 |
| 2.2 | Matching LO matrix elements with parton showers | 444 |
| 2.3 | Matching parton showers with NLO matrix elements | 445 |
| 3 | Development of Herwig++ | 445 |
| 3.1 | New parton shower variables | 448 |
| 3.2 | Multiscale shower | 449 |
| 3.3 | Status of the program | 450 |
| | References | 451 |
| HERA Event Generators for the Low Mass Region | | |
| | Victor Lendermann | 453 |
| 1 | Introduction | 453 |
| 2 | Processes Involving Low Mass Hadronisation | 453 |
| 3 | Hadronisation Models | 456 |
| 3.1 | DIFFVM | 456 |
| 3.2 | EPSOFT | 458 |
| 3.3 | SOPHIA | 460 |
| 4 | Summary | 462 |
| | References | 462 |
| Optimal Use of Information for Measuring M_t in Lepton+jets $t\bar{t}$ Events | | |
| | Juan Estrada | 464 |
| 1 | Introduction | 464 |
| 2 | Measurement of M_t | 464 |
| 3 | Conclusion | 470 |
| | References | 470 |

Multivariate Analysis Techniques for Final State Reconstruction

| | |
|---|-----|
| B. Koblitz | 471 |
| 1 Introduction | 471 |
| 2 Probability Density Estimation Techniques | 471 |
| 3 The PDE-RS Method | 472 |
| 3.1 The Range-Search Algorithm | 473 |
| 3.2 Properties of PDE-RS and Comparison with NNs | 474 |
| 3.3 Time Consumption and Dependence on Box-Size | 475 |
| 3.4 An Application: Instanton-Induced Processes at HERA | 476 |
| 4 Conclusions | 477 |
| 5 Acknowledgement | 477 |
| References | 477 |

Jet Algorithms: a Mini-Review

| | |
|--|-----|
| Sergei Chekanov | 478 |
| 1 Introduction | 478 |
| 2 Requirements on jet algorithms | 478 |
| 3 Clustering algorithms for e^+e^- | 479 |
| 4 Jet algorithms for ep and $p\bar{p}$ collisions | 480 |
| 4.1 Differences between e^+e^- and hadron collisions | 480 |
| 4.2 The cone algorithm | 481 |
| 4.3 The modified JADE algorithm | 482 |
| 4.4 The k_\perp algorithm | 482 |
| 4.5 The longitudinally invariant k_\perp algorithm | 482 |
| 5 Differences between algorithms | 483 |
| 5.1 Exclusive algorithms | 483 |
| 5.2 Inclusive jet algorithms | 483 |
| 6 Experimental situation | 484 |
| References | 486 |

CDF τ Triggers, Analysis and Other Developments

| | |
|--|-----|
| John R. Smith | 487 |
| 1 Introduction | 487 |
| 2 Run II Trigger System and Tau Triggers | 487 |
| 3 Finding Taus: $W \rightarrow \tau\nu$ First Result | 489 |
| 4 Fast Derivatives: Backwards Differentiation | 490 |
| References | 493 |

User Oriented Design in High Energy Physics Applications: Physics Analysis Expert

| | |
|---|-----|
| Martin Erdmann, Dominic Hirschbühl, Yves Kemp, Patrick Schemitz, and Thorsten Walter | 494 |
| 1 Introduction | 494 |

| | | |
|---|--|-----|
| 2 | Tradition | 495 |
| 3 | Multiple Interpretations of an Event | 495 |
| 4 | Command Syntax | 496 |
| 5 | Excluding/Re-Including Physics Objects | 496 |
| 6 | Detector Reconstruction | 497 |
| 7 | Relation to Other Packages | 497 |
| 8 | Progress | 497 |
| | References | 497 |

Part XIII Future Colliders

Why We Need Both the LHC and an e^+e^- Linear Collider

| | |
|------------------------------|-----|
| S. Dawson | 501 |
| 1 Introduction | 501 |
| 2 Higgs Physics | 502 |
| 3 Supersymmetry (SUSY) | 505 |
| 3.1 SUSY Higgs Sector | 505 |
| 3.2 SUSY Partners | 506 |
| 4 The Top Quark | 507 |
| 5 Conclusion | 508 |
| References | 509 |

Part XIV Summary Talk

Summary and Highlights of the Conference

| | |
|--|-----|
| John Womersley | 513 |
| 1 Introduction | 513 |
| 2 Our Tools | 513 |
| 2.1 Accelerators and Detectors | 513 |
| 2.2 Luminosity Measurement | 514 |
| 2.3 Computing and Analysis | 515 |
| 2.4 Simulation | 515 |
| 2.5 Proton Structure | 516 |
| 2.6 Theoretical Progress | 516 |
| 3 Our Physics | 517 |
| 3.1 QCD | 517 |
| 3.2 CKM Physics | 520 |
| 3.3 Electroweak Physics | 521 |
| 3.4 The Top Quark | 522 |
| 3.5 The Higgs Boson | 523 |
| 3.6 Searches for Physics Beyond the Standard Model | 523 |
| 4 Our Future | 524 |
| References | 526 |

Hadron Collider Physics 2002

Proceedings of the 14th Topical Conference on Hadron
Collider Physics, Karlsruhe, Germany, September
29–October 4, 2002

Erdmann, M.; Müller, Th. (Eds.)

2003, XXXIV, 529 p., Hardcover

ISBN: 978-3-540-00995-5