

SLAC-398  
CONF-910836  
UC-414  
(T/E)

**PROCEEDINGS  
OF  
SUMMER INSTITUTE ON PARTICLE PHYSICS**

*August 5-16, 1991*

**LEPTON—HADRON SCATTERING**

**Program Directors:**

**David Burke**

**Lance Dixon**

**David W.G.S. Leith**

**Edited by Jane F. Hawthorne**

Sponsored by Stanford University and Stanford Linear Accelerator Center under contract with the U.S. Department of Energy. Contract DE-AC03-76SF00515.

September 1992

Printed in the United States of America. Available from National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

## PREFACE

The nineteenth annual SLAC Summer Institute on Particle Physics took place from August 5 to 16, 1991, attracting 236 participants from 10 different countries. The theme was lepton-hadron scattering, the subjects ranging from the pioneering SLAC-MIT experiments, through the new era of  $e$ - $p$  collisions to be ushered in by HERA. Richard Taylor led off the Institute with a historical review of lepton-proton scattering experiments, from Rutherford to the 1960s, while Sid Drell laid out the theoretical framework, in terms of parton distributions and sum rules. Frank Sciulli picked up where Richard Taylor left off, at the discovery of scaling violation, and brought us up to the present. Joel Feltesse and Roberto Peccei described the physics opportunities at HERA, most notably the investigation of the low  $x$  behavior of structure functions. Traudl Hansl-Kozanecka reviewed the current experimental status of QCD, at  $e^+e^-$  and hadron colliders as well as in deep-inelastic lepton-hadron scattering. Bob Hollebeek lectured on techniques for electromagnetic and hadronic calorimetry. Finally, Bob Siemann gave a series of lectures on the many uses of superconductivity in particle accelerators, from bending magnets at FNAL HERA and the SSC to RF cavities at CEBAF and LEP.

Following the school, the topical conference provided us with a spectrum of current experimental and theoretical developments. Lepton-hadron scattering experiments at CERN and Fermilab were well represented. The existence of the  $17^0$  keV neutrino was debated in two separate talks. We heard the latest results from the CDF and UA2 hadron collider experiments; from the four LEP experiments; and from ARGUS and CLEO. Also presented were overviews of the rare  $K$  decay program at BNL, the CP violation experiments at CERN and Fermilab,  $B$  physics, neutrino masses and mixings, and precision electroweak theory.

Many people besides the lecturers contributed to making the Institute a rewarding experience. We had a number of excellent provocateurs to keep the afternoon discussions moving: Charlie Prescott, Dave Coward, Brian Warr, Al Odian, Frank Taylor, Gary Godfrey, Jon Labs, Tom Markiewicz, David Muller, Philip Burrows, Mike Hildreth, Brad Hubbard, Tom Junk, Carl Schmidt, Roberto Vega, Tim Barklow, Roger Erickson, Tor Raubenheimer, Steve St. Lorant and Chris Adolphsen. Thia Keppel did an outstanding job of arranging tours of the SLAC experimental facilities for the students. Thanks to everyone involved!

This year the Institute welcomed two new program directors, David Burke and Lance Dixon, as well as a new conference coordinator, Jane Hawthorne. Many thanks to Jane for putting together such a smooth-running school - and for putting out these proceedings!

David Burke  
Lance Dixon  
David W.G.S. Leith  
Program Directors

## TABLE OF CONTENTS

| <b>Part I. LECTURES FROM SUMMER SCHOOL</b>                           | <b>page</b> | <b>Part II. TOPICAL CONFERENCE</b>  | <b>page</b> |
|--|-------------|---|-------------|
| R. TAYLOR  |             | S. OLSEN  |             |
| "Historical Review of Lepton-Photon Scattering" .....                | 1           | "Recent Results from TRISTAN" .....   | 289         |
| R. SIEMANN   |             | H. BREUKER  |             |
| "Uses of Superconductivity in Particle Accelerators" .....           | 21          | "Tests of the Standard Model at LEP" .....  | 297         |
| S. DRELL   |             | W. MARCIANO   |             |
| "Theoretical Aspects of Lepton-Hadron Scattering" .....              | 47          | "Precision Tests of Electroweak Theory" .....   | 299         |
| F. SCIULLI   |             | F. RICHARD  |             |
| "Lepton-Hadron Scattering from Scaling Violation through HERA" ..... | 69          | "Search for New Phenomena at LEP" .....   | 305         |
| T. HANSL-KOZANECKA   |             | S. WAGNER   |             |
| "Experimental Studies on QCD" .....                                  | 105         | "Recent Results from the Mark II Experiment" .....  | 327         |
| J. FELTESSE  |             | D. BRITTON  |             |
| "HERA The New Frontier" .....  | 155         | "Recent Beauty Physics Results from ARGUS" .....  | 337         |
| R. HOLLEBEEK   |             | J. ALEXANDER  |             |
| "Topics in Calorimetry for High Energy Physics" .....                | 207         | "Recent Results from CLEO II" .....   | 353         |
| R. PECCEI  |             | R. LIPTON   |             |
| "High Energy Lepton Hadron Scattering as a Probe of QCD" .....       | 259         | "Charm and Beauty Physics at Fermilab" .....  | 373         |
|  |             | M. WITHERELL  |             |
|  |             | "Heavy Quark Physics and the CKM Matrix" .....  | 391         |
|  |             | S. MISHRA   |             |
|  |             | "Nucleon Structure Functions from the $\nu$ -Fe Scattering<br>at the Fermilab Tevatron" ..... | 407         |
|  |             | R. VOSS   |             |
|  |             | "Highlights from Muon Scattering at CERN" .....   | 427         |
|  |             | H. MONTGOMERY   |             |
|  |             | "Recent Results from the E665 Muon Scattering Experiment<br>at Fermilab" .....                | 439         |
|  |             | J. HAGGERTY   |             |
|  |             | "Current Status of Rare Kaon Decay Experiments at Brookhaven" .....                           | 453         |
|  |             | Y. HSIUNG   |             |
|  |             | "Latest Results on Direct CP Violation Measurements - $\epsilon'/\epsilon$ " .....            | 467         |

| <b>Part II. TOPICAL CONFERENCE</b>   | <b>page</b> |
|--|-------------|
| <b>B. CABRERA</b>  |             |
| "Monopoles and Dark Matter Searches" .....   | 493         |
| <b>J. PATRICK</b>  |             |
| "Recent Results from CDF" .....  | 495         |
| <b>M. PEPE</b>   |             |
| "W, Z, Photon Physics and a Search for New Particles<br>with the UA2 Detector" ..... | 517         |
| <b>E. NORMAN</b>   |             |
| "Solid State Detectors and 17 keV Neutrino" .....                                    | 533         |
| <b>F. CALAPRICE</b>  |             |
| "Magnetic Spectrometers and 17 keV Neutrino" .....                                   | 535         |
| <b>L. WOLFENSTEIN</b>  |             |
| "Neutrino Masses and Mixings" .....  | 537         |
| <b>APPENDIX</b>  |             |
| List of Participants .....   | 549         |
| Previous SLAC Summer Institute   |             |
| Titles and Speakers .....  | 559         |