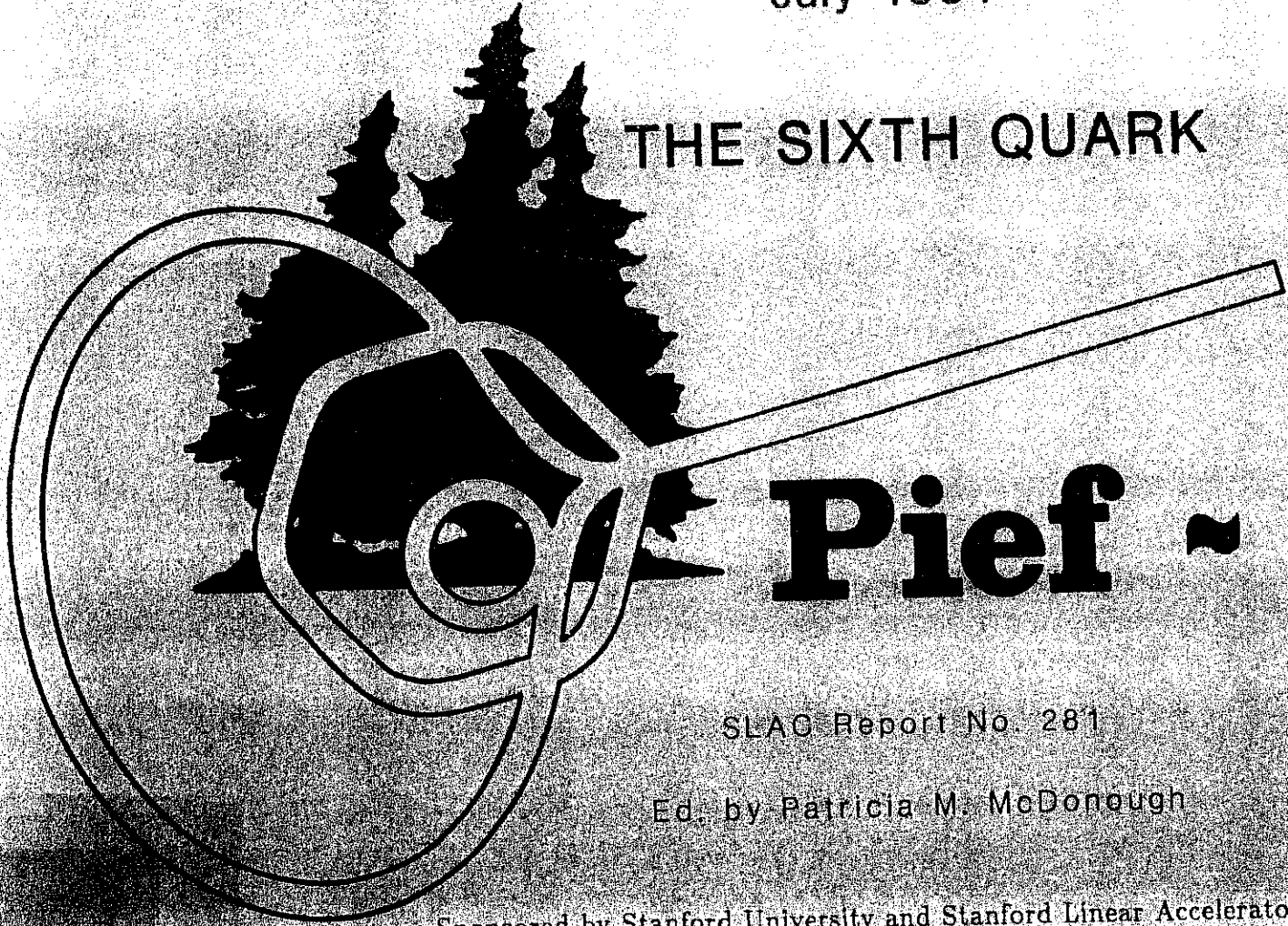


PROCEEDINGS OF THE TWELFTH SLAC SUMMER INSTITUTE  
ON PARTICLE PHYSICS

July 1984

THE SIXTH QUARK



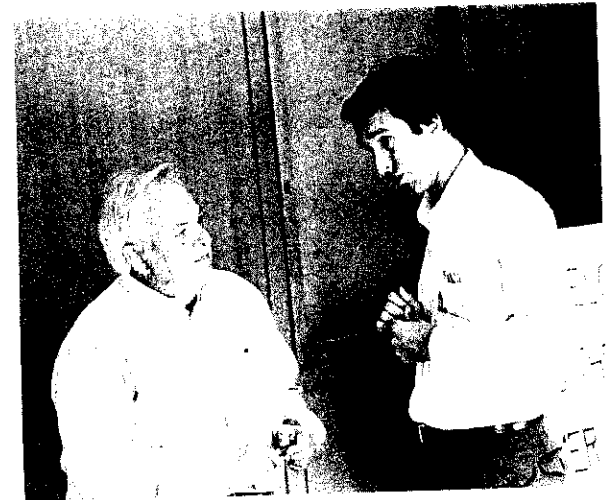
**Pief ~ Fest**

SLAC Report No. 281

Ed. by Patricia M. McDonough

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

STANFORD LINEAR ACCELERATOR CENTER  
Stanford University • Stanford, California



*These Proceedings are dedicated to Pief Panofsky,  
who retired as Director of SLAC after more than two  
decades of leadership and service.*

SLAC - 281  
CONF - 8407112  
UC-34d  
(T/E)

PROCEEDINGS  
OF  
SUMMER INSTITUTE ON PARTICLE PHYSICS

*July 29 - August 3, 1984*

THE SIXTH QUARK

Program Directors

Gary J. Feldman

Frederick J. Gilman

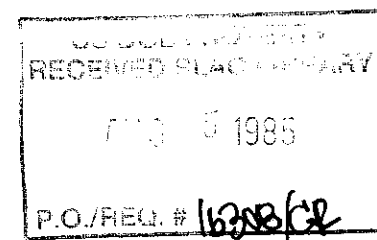
David W. G. S. Leith

Ed. by Patricia M. McDonough

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

January 1985

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 twelfth SLAC Summer Institute on Particle Physics was held from July 23 to August 3, 1984. The main topic was "The Sixth Quark," and the traditional format was followed of having the first seven days as a "Summer School" and the last three as a "Topical Conference." The school portion involved both theoretical and experimental courses on the weak interactions of quarks and leptons in general, followed by specific courses on the production of top quarks, the physics of toponium, and the role of the top quark in weak interactions and CP violation. These were interlaced with lectures on the technology and physics of heavy quark flavor tagging by ring imaging Cherenkov counters and by solid state precision vertex detectors. The Topical Conference confirmed reports on the most recent results on heavy quark production and decay and associated theoretical developments and was highlighted by the presentation of the first experimental evidence for the existence of the top quark from the UA1 experiment at the CERN SPS collider. The last day of the Topical Conference was devoted to a Pief-Fest, a tribute to Pief Panofsky on his retirement as director of SLAC, with policy and physics topics of particular interest to him. The attendance of 454 physicists from 11 countries, the excellent lectures, and the exciting physics made for a most interesting and lively meeting.

We thank Patricia McDonough, the Coordinator of the Institute and Editor of these Proceedings, and her staff for their help and hard work in both the planning and running of the meeting.

Gary Feldman  
Frederick J. Gilman  
David W. G. S. Leith  
Program Directors

TABLE OF CONTENTS

	page		page
<b>Part I. LECTURES</b>			
E. EICHTEN		S. COOPER	
"The Last Hurrah for Quarkonium Physics: The Top System" . . . . .	1	"Testing the Potential Model in the $\Upsilon$ System" . . . . .	388
C. J. S. DAMERELL		D. L. KREINICK	
"Developments in Solid State Vertex Detectors" . . . . .	43	"B Decays and the Upsilon Family Above B Threshold" . . . . .	409
T. HIMEL		J. JAROS	
"Experimental Methods of Heavy Quark Detection" . . . . .	118	"Measurements of Heavy Quark and Lepton Lifetime" . . . . .	427
G. L. KANE		P. ODDONE	
"Production and Uses of Heavy Quarks" . . . . .	155	"Quark Fragmentation in $e^+e^-$ Collisions" . . . . .	442
S. WOJCICKI		W. RUCKSTUHL	
"Weak Interactions of Quarks and Leptons: Experimental Status" . . . . .	175	"New $\tau$ Physics from PEP" . . . . .	466
T. EKELÖF		R. PREPOST	
"The Experimental Method of Ring-Imaging Cherenkov (RICH) Counters" . . . . .	244	"Search for New Particles at PEP" . . . . .	488
H. HARARI		W. S. SMITH	
"Weak Interactions of Quarks and Leptons (Theory)" . . . . .	264	"Neutrino Production of Dimuons" . . . . .	503
<b>Part II. SEMINARS</b>		B. NICZYPORUK	
F. C. ERNE		"Evidence for a Narrow Massive State in the Radiative Decays of the Upsilon" . . . . .	513
"Results on the Total Hadronic Cross Section and Four-Prong Production in Photon-Photon Interactions" . . . . .	305	D. HITLIN	
C. KLOPFENSTEIN		"D Meson Decay Studies at the $\Psi''$ " . . . . .	524
"Spectroscopy Above the $b$ -Flavor Threshold from CUSB" . . . . .	322	J. W. CRONIN	
D. RITSON		"Current Status of CP Violation in K Decays" . . . . .	556
"Prototype Tests for a Vertex Chamber" . . . . .	332	M. B. WISE	
<b>Part III. TOPICAL CONFERENCE</b>		"CP Violation in the Standard Model" . . . . .	574
M. DAVIER		M. BOURQUIN	
"Recent Results from PETRA" . . . . .	349	"Recent Results on Baryons with Strangeness and Charm" . . . . .	583
J. CHAPMAN		S. BRODSKY	
"Charm Production and Fragmentation" . . . . .	373	"Heavy Quark Production Processes in QCD" . . . . .	603
		A. ROTHENBERG	
		"Latest Results from the UA2 Experiment at the CERN $p\bar{p}$ Collider at 540 GeV" . . . . .	613
		C. RUBBIA	
		"Physics Results of the UA1 Collaboration at the CERN Proton-Antiproton Collider" . . . . .	634

<b>Part IV. PIEF-FEST</b>	<b>page</b>
S. DRELL	
"Pief" . . . . .	653
R. R. WILSON	
"Accelerator Physics" . . . . .	659
T. D. LEE	
"High Energy Theory" . . . . .	664
F. PRESS	
"Science and Technology Policies for the 1980s" . . . . .	679
J. STEINBERGER	
"Inclusive Lepton-Hadron Experiments" . . . . .	687
B. RICHTER	
"Forty-Five Years of $e^+e^-$ Annihilation Physics: 1956 to 2001" . . .	709
J. WIESNER	
"We Need More Piefs" . . . . .	729
<b>APPENDIX</b>	
List of Participants . . . . .	743
Previous SLAC Summer Institute Titles and Speakers . . . . .	755