

David C. Williams

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GOALS

The application of scientific skills and knowledge for the benefit of society.

EXPERIENCE

Postdoctoral Researcher, University of California, Santa Cruz, CA **1994-Present**

Contributed to the search for SUSY using signatures associated with missing energy as a member of the ATLAS Collaboration. Explored various topics in Charm physics, such as D^0 mixing and charm spectroscopy, as a member of the BaBar Collaboration. Served as co-convenor of the BaBar Charm Analysis Working Group. Developed the BaBar Geant4 detector simulation. Explored topics in proton computed tomography as a member of the pCT Collaboration. Explored various topics in diffraction, deep-inelastic scattering, and exotic physics as a member of the ZEUS Collaboration. Helped commission and operate the LPS and BPT detector subsystems of ZEUS.

Lecturer in Physics, University of California, Santa Cruz, CA **2000**

Organized and taught the graduate course *Introduction to Particle Physics*.

Research Associate, Massachusetts Institute of Technology, Cambridge, MA **1987-1994**

Spearheaded the study of the left-right forward-backward asymmetry of b and c quarks as a member of the SLD Collaboration. Designed and implemented the tracking pattern recognition algorithm. Organized, revamped, and commissioned both the online and offline software for the WIC subsystem of SLD. Developed particle identification algorithms and a fast-shower simulation.

Research Associate, Northeastern University, Boston, MA **1983-1985**

Helped construct the hadron calorimeter of the E-706 Experiment on site at the Fermi National Accelerator Laboratory.

EDUCATION

Ph.D., Massachusetts Institute of Technology, Cambridge, MA, 1994

B.S., Physics, Northeastern University, Boston, MA, 1987

RESEARCH

Supersymmetry

As a member of the ATLAS Collaboration, the Santa Cruz Institute of Particle Physics has been developing techniques for studying missing event energy for evidence of SUSY. Issues that we are addressing are transverse energy calibration and resolution (with emphasis on the tracking systems) and the characterization and simulation of irreducible sources of physics background. My role in the collaboration is focused on tracking alignment and Monte Carlo detector simulation.

D^0 Mixing and CP Violation

Mixing and CP violation in the charm sector, both potential hunting grounds for new physics, have yet to be observed. My analysis of the effective lifetime of samples of D^0 mesons that decay into $K^-\pi^+$, K^-K^+ , and $\pi^-\pi^+$, published by the BaBar Collaboration in *Physical Review Letters*, represent the

current best limits on D^0 mixing. We are continuing our search for mixing in the BaBar Collaboration by analyzing the lifetime distribution of wrong-sign hadronic D^0 decays.

Charm Spectroscopy

The discovery of the $D_{s_j}^*(2317)^+$ meson by the BaBar Collaboration has sparked a modern revival of hadron meson spectroscopy. More than 40 theoretical papers have appeared since the publication of our results in *Physical Review Letters*, in a paper in which I was the principle editor. I later prepared the collaboration's paper on the $D_{s_j}(2460)^+$ meson published in *Physical Review D*. I am currently the primary analyst on a detailed update of these two mesons based on higher statistics data, targeted for *Physical Review D*. I am also currently exploring the potential signal of a new charm baryon.

Proton Computed Tomography

In collaboration with other Santa Cruz physicists, Brookhaven National Laboratory, SUNY Stony Brook, Loma Linda University Medical Center, and INFN Catania, I have been developing the basic principles of medical imaging with a proton beam, using computer simulations and reconstructed data from a prototype detector. The results of this work are published in *Physics in Medicine and Biology* and the *IEEE Transactions on Medical Imaging*.

Diffraction

One of the initial discoveries of the HERA program was an unexpected class of events with large rapidity gaps. These events were associated with diffractive scattering, but at cross sections larger than expected based on proton collision data. Several models have since been developed to explain the diffractive cross section, but it has become difficult to distinguish these models based on the cross section alone. To address these issues I studied the characteristics of the hadronic final state of diffractive events unambiguously tagged by the leading proton and compared the data to various models. The results of this analysis were published in *Physics Review D* in a paper of which I was the principle author.

High Q^2 Cross Section

The measurement of the DIS cross section at high Q^2 became important to the ZEUS Collaboration when, in 1996, it became clear that both HERA experiments had evidence of a statistically significant excess of events at high Q^2 . The announcement of this discovery produced considerable excitement in the field. The challenges of this analysis was to calculate the uncertainties in the Standard Model cross section (due to radiative corrections and the parton distribution of the proton), to identify all possible sources of background, and to provide objective estimates of the likelihood of observing the excess events. The results of this analysis were published in the *European Physics Journal* in a paper of which I was the principle author.

Contact Interactions

A general approach in the search for new physics is to place limits on the size of four-fermion contact interactions. My contact interaction analysis at HERA required a thorough understanding of cross sections, including radiative corrections, the uncertainties in the parton distribution of the proton, and the application of sophisticated statistical methods for low statistics data samples. The results were published in the *European Physics Journal* in a paper of which I was one of the principle authors.

Left-Right Forward-Backward Asymmetry

My thesis topic was one of the first direct measurements of the electroweak parameter A_b , a quantity that remains controversial to this date. The result of this analysis was published in *Physical Review Letters*.

TECHNICAL EXPERIENCE

Hardware

A basic knowledge of machine tools such as mills, drill presses, and saws. Experience with NIM electronics and the construction of cosmic triggers. Experimented with different methods of shielding for large detector planes. Experience constructing custom scintillator planes and calibrating photomultiplier tubes.

Software Languages

Proficient in c, c++, and FORTRAN. University courses in software development, software design, data structures, Pascal, LISP, and VMS MACRO. Experience with Sinclair, Atari, Apple II, PL/11, MS-DOS, MacOS 9, MacOS X, VAX/VMS, IBM VM, Aix, Ultrix, Irix, Solaris, OS/9, Linux, and Windows NT and XP platforms.

Online Software

Worked with camac, VME, and Fastbus readout systems. Experience designing and writing run-time monitoring, diagnostic, and control software.

Offline Software

Involved in implementing the reconstruction for drift chambers, CCD vertex detectors, Silicon strip detectors, limited streamer tubes, and calorimeters. Designed the pattern recognition code for three different detector subsystems. Implemented alignments for four different detector subsystems. Implemented track fitters for two different detector subsystems.

Simulation

Experience implementing the simulation of a variety of detector systems, including the WIC subsystem of the SLD, the LPS and BPT subsystems of ZEUS, various portions of the tracking system of BaBar, and conceptual designs of pCT detectors. Implemented the fast shower parameterization for the SLD. Member of the Geant4 Collaboration and author of several key portions of the Geant4 toolkit.

TEACHING EXPERIENCE

Invited to teach the graduate-level course *Introduction to Particle Physics I* (Physics 221A, Fall 2000) at the University of California, Santa Cruz. Responsible for developing all course content. Topics in the course included an introduction to the Standard Model, symmetries, the quark model of hadrons, the passage of particles through matter, experimental techniques and detector design, accelerator theory, and the application of quantum field theory and Feynman rules in quantum electrodynamics.

Supported, encouraged, and defended the work of seven graduate students at DESY and SLAC for the University of California, Santa Cruz. Supervised the work of an eighth.

Developed computer-aided experiments for the Northeastern University Introductory Physics Laboratory to be taken by most science, engineering, and medical undergraduate students. Contributed to the laboratory text book.

SELECTED TALKS

The Most Likely Path of an Energetic Charged Particle Through a Uniform Medium, presented at the Hadron Therapy Satellite Workshop, IEEE Medical Imaging Conference (MIC/NSS 2003), Portland, October 21, 2003.

BaBar's Discovery of the $D_{s1}^(2317)^+$ and Confirmation of the $D_{s1}(2458)^+$* , Joint Experimental-Theoretical Seminar, Fermi National Accelerator Laboratory, July 11, 2003.

Recent results on Charm Physics at BaBar, Research Progress Meeting, Lawrence Berkeley National Laboratory, May 15, 2003.

D^0 Mixing, Lifetime Differences, and Hadronic Decays of Charmed Hadrons, presented on behalf of the BaBar Collaboration at the 31st International Conference on High-Energy Physics (ICHEP 2002), Amsterdam, July 26, 2002.

Transportation Process for BaBar, presented at the Geant4 User's Workshop, Stanford, February 20, 2002.

Charm Physics at BaBar, presented on behalf of the BaBar Collaboration at the Aspen Winter Conference on Particle Physics, Aspen, February 8, 2002.

Measuring the Proton Structure Function with Electron-Proton Scattering, invited talk at the 1999 meeting of the Division of Nuclear Physics of the American Physics Society, Asilomar, October 20, 1999.

Beyond the Standard Model Physics at HERA, presented on behalf of the H1 and ZEUS Collaborations at Les Rencontres de Physique de la Vallée d'Aoste (La Thuile 99), La Thuile, March 3, 1999.

The High Q^2 NC DIS Cross Section and Contact Interactions, presented on behalf of the ZEUS Collaboration at the 6th International Workshop on Deep Inelastic Scattering and QCD (DIS98), Brussels, April 7, 1998.

High Q^2 Results from ZEUS, presented on behalf of the ZEUS Collaboration at Collider Physics XII, State University of New York at Stony Brook, June 10, 1997.

Anomalous High Q^2 Events at ZEUS, SLAC Special Experimental Seminar, March 6, 1997.

High Q^2 Neutral Current DIS and Limits on New Physics, presented on behalf of the H1 and ZEUS Collaborations at the 4th International Workshop on Deep-inelastic Scattering (DIS96), Rome, 1996.

Recent Results from ZEUS on Searches for New Particles, presented on behalf of the ZEUS Collaboration at the Europhysics Conference on High Energy Physics (EPS95), Brussels, 1995.

The Left-Right Forward-Backward Asymmetry of Heavy Quarks Measured with Jet Charge and with Leptons at the SLD, presented on behalf of the SLD Collaboration at the 1994 meeting of the Division of Particle and Fields of the American Physical Society (DPF94), Albuquerque, 1994.

A Direct Measurement of the Left-Right Asymmetry for Heavy Quarks at SLD Using Z_s Produced with Polarized Electrons, CERN PPE Seminar, April 18, 1994.

A Measurement of the Left-Right Forward-Backward Asymmetry of B Quarks at the SLD, SLAC Experimental Seminar, March 15, 1994.

SELECTED PUBLICATIONS

The Most Likely Path of an Energetic Charged Particle Through a Uniform Medium, D.C. Williams, Phys.Med.Biol. 49 No 13: 2899, 2004.

Observation of a Narrow Meson Decaying to $D_s^+ \pi^0 \gamma$ at a Mass of 2.458 GeV/c², the BaBar Collaboration (B. Aubert et al.), Phys.Rev. D69: 031101, 2004.

Limits on D^0 Mixing and CP Violation from the Ratio of Lifetimes from $K^- \pi^+$, $K^- K^+$, and $\pi^- \pi^+$ Decays, the BaBar Collaboration (B. Aubert et al.), Phys.Rev.Lett., 91: 121801, 2003.

Observation of a Narrow Meson Decaying to $D_s^+ \pi^0$ at a Mass of 2.32 GeV/c², the BaBar Collaboration (B. Aubert et al.), Phys.Rev.Lett. 90: 242001, 2003.

Search for D^0 D^0 -bar Mixing and a Measurement of the Doubly Cabibbo-suppressed Decay Rate in $D \rightarrow K^+ \pi^-$ Decays, the BaBar Collaboration (B. Aubert et al.), Phys.Rev.Lett., 91: 171801, 2003.

Conceptual Design of a Proton Computed Tomography System for Applications in Proton Radiation Therapy, R. Schulte, et al., IEEE Tran.Nucl.Science 31: 867, 2004.

Geant4: A Simulation Toolkit, the Geant4 Collaboration (S. Agostinelli et al.), Nucl.Inst.Meth. A506: 250, 2003.

Properties of Hadronic Final States in Diffractive Deep Inelastic ep Scattering at HERA, the ZEUS Collaboration, (J. Breitweg et al.), Phys.Rev. D65: 052001, 2002.

Measurement of the Proton Structure Function F_2 at Very Low Q^2 at HERA, the ZEUS Collaboration (J. Breitweg et al.), Phys. Lett. B487: 53, 2000.

Search for Contact Interactions in Deep Inelastic $e^+p \rightarrow e^+X$ Scattering at HERA, the ZEUS Collaboration (J. Breitweg et al.), Eur. Phys.J. C14: 239, 2000.

Measurement of High Q^2 Neutral Current e^+p Deep Inelastic Scattering Cross Sections at HERA, the ZEUS Collaboration (J. Breitweg et al.), Eur. Phys.J. C11: 427, 1999.

Measurement of the Diffractive Structure Function at HERA, the ZEUS Collaboration (J. Breitweg et al.), Eur. Phys.J. C1: 81, 1998.

Performance of the Binary Silicon System for ATLAS, J. DeWitt et al., Nucl.Phys.Proc.Suppl. 61B: 218, 1998.

Comparison of ZEUS Data with Standard Model Predictions for $e^+p \rightarrow e^+X$ Scattering at High x and Q^2 , the ZEUS Collaboration (J. Breitweg et al.), Z.Phys C74: 207, 1997.

Study of Charged Current ep Interactions at $Q^2 > 100$ GeV² with the ZEUS Detector at HERA, the ZEUS Collaboration (M. Derrick, et al.), Z.Phys C72: 47, 1996.

Measurement of the Average B Hadron Lifetime in Z Decays Using Reconstructed Vertices, the SLD Collaboration (K. Abe, et al.), Phys. Rev. Lett. 75: 364, 1995.

Performance of the SLD Central Drift Chamber, M.J. Fero, et al., Nucl. Instrum. Meth. A367: 111, 1995.

Measurement of A_b and A_c from the Left-Right Forward-Backward Asymmetry of Leptons in Hadronic Events at the Z^0 Resonance, the SLD Collaboration (K. Abe, et al.), Phys. Rev. Lett. 74: 2895, 1995.

Precise Measurement of the Left-Right Cross-Section Asymmetry in Z Boson Production by $e^+ e^-$ Collisions, the SLD Collaboration (K. Abe, et al.), Phys. Rev. Lett. 73:25, 1994.

First Measurement of the Left-Right Cross-Section Asymmetry in Z Boson Production by e^+e^- Collisions, the SLD Collaboration, Phys. Rev. Lett. 70: 2515, 1993.

The Limited Streamer Tubes of the SLD, A. C. Benvenuti, et al., Nucl. Instrum. Meth. A290: 353, 1990.

The Iron Calorimeter and Muon Identifier for SLD, A.C. Benvenuti, et al., Nucl. Instrum. Meth. A276: 94, 1989.

Topological Solutions in Gauge Theory and their Computer Graphic Representation, A. Hey, J. Merlin, M. Ricketts, M. Vaugn, D. Williams, Science, vol 240: 1163, 1988.