

EDMOND CRAIG DUKES

3 January 2011

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EDUCATION

1977–1984 University of Michigan PhD Physics
Ann Arbor, Michigan
1972–1975 College of William and Mary BS with High Honors in Physics
Williamsburg, Virginia

PROFESSIONAL EXPERIENCE

Dates	Position	Institution
Jan. 2002 — present	Professor	University of Virginia
Jan. 2008 — Aug. 2008	Visiting Scientist	Fermilab
Aug. 2002 — Dec. 2007	Professor	University of Virginia
Sept. 1995 — Sept. 2002	Associate Professor	University of Virginia
Sept. 1998 — Aug. 1999	Research Fellow	Lawrence Berkeley National Laboratory
Sept. 1989 — Aug. 1995	Assistant Professor	University of Virginia
Nov. 1992 — Aug. 1993	Guest Scientist	Superconducting Super Collider
Jan. 1987 — June 1989	Research Fellow (CERN)	University of Michigan
Jan. 1985 — Jan. 1987	CERN Fellow	CERN
May 1980 — Dec. 1984	Research Assistant	University of Michigan
May 1980 — May 1982	Guest Jr. Research Associate	Brookhaven National Laboratory

PROFESSIONAL AND HONOR SOCIETIES

American Association for the Advancement of Science
American Physical Society — Division of Particles and Fields
Brookhaven National Laboratory Users Group
Fermi National Accelerator Laboratory Users Group
IEEE Computer Society
Phi Beta Kappa
Sigma Xi
Who's Who

ADMINISTRATIVE, COMMITTEE, AND PUBLIC SERVICES**LOCAL**

Principal Investigator, Task C of the Department of Energy Contract for Experimental High Energy Physics at the University of Virginia, 1997–present.

Faculty Associate for Undergraduate Advising, 1989–present.

Secretary–Treasurer for the Virginia chapter of Sigma Xi, 1994–present.

Chair, Graduate Student Admissions Committee, 2000–2001.

Co-organizer of National Physics Day, April, 1995.

Chair, Physics Department Colloquium Committee, 1995–1996.

Fellow of Hereford College of the University of Virginia, 1993–1995.

Society of Physics Students faculty adviser, 1993–1996.

Undergraduate Program Committee, 1991–1992.

Member of the Commonwealth Center for Nuclear and Particle Physics, 1989–present.

NATIONAL

Editorial Board, *Advances in High Energy Physics*, 2007–present.

Scientific co-spokesperson for the *HyperCP* (E871) experiment at Fermilab, 1993–present.

Head (Level-2 manager) of the *Mu2e* Cosmic Ray Veto system, 2009–present.

Chair, *Mu2e* Institutional Board, 2008–present.

Member $\text{NO}\nu\text{A}$ Executive Committee, 2008–present.

Member $\text{NO}\nu\text{A}$ Speakers Board, 2008–present.

Member *Mu2e* Speakers Board, 2008–present.

Member of the Local Organizing Committee of the XIIIth International Workshop on Neutrino Factories, Super beams and Beta beams (NuFact'12).

Convener of the afternoon session of the 2011 BCVSPIN Advanced Study Institute in Particle Physics and cosmology, Hue, Vietnam, July 28, 2011.

Member of the HEP Early Career Research Program Review Panel, 2011.

Convener of Muon Working Group Session, 10th International Workshop on Neutrino Factories, Super beams and Beta Beams, Valencia, Spain, July 3, 2008.

Convener of Lake Louise Winter Institute 2008 session, Lake Louise, February 22, 2008.

Member of NSF Elementary Particle Physics EPP2007 Panel which convened December 10–12, 2007 to evaluate all FY08 elementary particle physics proposals

Convener of the Morning Session for the *Mu2e* meeting, Fermilab, September 15–16, 2006.

Member of the Steering Group for the *Mu2e* collaboration, 2006–present.

$\text{NO}\nu\text{A}$ institutional board, 2005–present.

MIPP institutional board, 2002–present.

Co-convener of Session IV (Light Quarks: Hadrons, Nuclei, Hypernuclei) of the *Particles and Nuclei International Conference (PANIC05)*, 2005.

Member of the Local Organizing Committee of the *2002 Meeting of the Division of Particles and Fields (DPF) of the American Physics Society*, 2000–2002.

Convener of Session VII (Flavor (B,K) Physics) of the *2002 Meeting of the Division of Particles and Fields (DPF) of the American Physics Society*, May 27, 2002.

Member of the Organizing Committee of the *Hyperon99 Hyperon Physics Symposium*, Fermilab, 27–29 September, 1999.

Member of the expert review panel for assessment of the U.S. Department of Energy Large Computational Projects, Washington, D.C., July 13–15, 1994.

Member of the Organizing Committee of the *Workshop on B Physics at Hadron Accelerators, Snowmass, Colorado, June 21–July 2, 1993*.

Co-convener of the Electron and Gamma Detection Group of the *Workshop on B Physics at Hadron Accelerators, Snowmass, Colorado, June 21–July 2, 1993*.

Member of the Editorial Board of the *Workshop on B Physics at Hadron Accelerators, Snowmass, Colorado, June 21–July 2, 1993*.

Member of the *SSC Working Group on Neutrino Physics*, SSC, Dallas, Texas, 1992.

Reviewer for Department of Energy proposals, 1995–present.

Referee for Physical Review Letters, 1995–present.

TEACHING ACTIVITIES

Year	Spring	Fall
2011	Workshop Physics I (Physics 1429)	
2010	Workshop Physics I (Physics 1429)	Workshop Physics II (Physics 2419)
2009	Workshop Physics I (Physics 142W)	Workshop Physics II (Physics 2419)
2008	Research Leave: Fermilab	General Physics II (Physics 241E)
2007	General Physics I (Physics 142)	Research Leave: Fermilab
2006	Premed Physics Lab (Physics 202L)	General Physics II (Physics 241E)
2005	Premed Physics Lab (Physics 202L)	Premed Physics Lab (Physics 201L)
2004	Premed Physics Lab (Physics 202L)	Premed Physics Lab (Physics 201L)
2003	Double taught in fall.	Premed Physics Lab (Physics 201L)
2002	Double taught in fall.	Premed Physics (Physics 201)
2001	Double taught in fall.	Premed Physics (Physics 201)
2000	Widely Applied Physics (Physics 312)	Premed Physics (Physics 201)
1999	Research leave: Berkeley/Fermilab	Widely Applied Physics (Physics 311)
1998	Premed Physics (Physics 202)	Research leave: Berkeley
1997	Premed Physics (Physics 202)	Premed Physics (Physics 201)
1996	Premed Physics (Physics 202)	Premed Physics (Physics 201)
1995	Premed Physics (Physics 202)	Premed Physics (Physics 201)
1994	Premed Physics (Physics 202)	Premed Physics (Physics 201)
1993	Research leave: SSC	Premed Physics (Physics 201)
1992	Intermediate Lab I (Physics 317)	Research leave: SSC
1991	Research leave: Fermilab	Intermediate Lab II (Physics 318)
1990	Intermediate Lab I (Physics 317)	Intermediate Lab II (Physics 318)
1989		Research leave: Fermilab

SUPERVISED STUDENT RESEARCH

Graduate Students

- Tyler Smith, *NO ν A experiment*, work in progress.
- Zukai Wang, *NO ν A experiment*, work in progress.
- Chad Materniak, *CP Violation in Ξ and Λ Hyperon Decays*, May 2009.
- Tim Holmstrom, *CP Violation in Ξ and Λ Hyperon Decays*, May 2003.
- Durgaprasad Rajaram, *Construction of the Hadronic Calorimeter for the HyperCP Experiment*, May 1995.
- Steven S. DeSanto, *Design and Construction of a High-Resolution Electromagnetic Calorimeter using Scintillating Fibers Embedded in a Lead Powder-Epoxy Absorber*, January 1993.
- Terence A. Wynne, *A Monte Carlo Simulation of a High-Resolution Scintillating Fiber Calorimeter using a Lead-Epoxy Absorber*, August 1992.

Independent Study Projects (Physics 393)

- Jason Gran, *Neutrino Oscillation Phenomenology*, spring, 2011.
- Hunter Tammaro, *NO ν A Power Distribution Box Test Design*, spring, 2010.
- Machi Fields, *Resistive Plate Counters for the Mu2e Cosmic Ray Shield*, summer, 2009.
- Nicole Fields, *Neutrinos and NO ν A*, spring, 2008.
- Nicole Fields, *Light Mixing of Lightguides*, fall 2006.
- Elizabeth Xu, *The HyperCP Spectrometer*, spring 2006.
- John Tener, *The Uniformity of Light Guides*, spring 2006.
- Benjamin Streufert, *Tests of a Prototype Spark Chamber for a Large-Area Detector*, spring 2005.
- Fred Ross, *Tests of a Prototype Spark Chamber for a Large-Area Detector*, fall 2004.
- Jennifer Gannon, *HyperCP Experiment*, summer 1998, summer 1999.
- Matt Deming, *Construction and Test of the Muon Lifetime and Magnetic Moment Experiment*, August, 1995.
- Alison Cohen, *Fabrication of an Undergraduate Muon Lifetime and Magnetic Moment Experiment*, December, 1994.
- Matt Lane, *A Data Acquisition System for an Undergraduate Muon Experiment*, December, 1994.
- Matt Weber, *Design and Construction of a Large Magnet for an Undergraduate Muon Experiment*, December, 1994.

- Walter R. Swindell, *Cosmic Ray Muon Detector*, December 1992.
- Joshua S. Wells, *Design of a Rectangular Bore Magnet for an Elementary Muon Lifetime and Magnetic Moment Experiment*, April 1992.
- Tong-Uk Lee, *Phototube Performance in High-Rate Environment*, December 1991.
- Kan D. Fang, *Monte Carlo Results on Reflection Losses of Scintillating Fibers*, December 1991.
- David DeLalio, *Ray-Tracing Simulation of Cerenkov Radiation and RICH Vessels*, April 1990.

Research Experiences for Undergraduates (REU) Projects

- Marc Cousoulis, *Computer Simulation of a Ring Imaging Cerenkov Detector*, Summer 1991.
- Trey White, *Computer Aided Design of the E771 Electromagnetic Calorimeter*, Summer 1990.

RESEARCH ACTIVITIES

***Mu2e* Experiment** (2006–present)

The goal of the *Mu2e* experiment is to search for the forbidden lepton-violating process $\mu^-(Z, A) \rightarrow e^-(Z, A)$ at a level of 2×10^{-17} , *four orders of magnitude beyond the present level of sensitivity*. This would make it sensitive to many theories for new physics beyond the standard model, including supersymmetry and models explaining the neutrino mass hierarchy. The experiment is expected to be a key part of the new Intensity Frontier program upon which Fermilab is embarking. I was a member of a small steering committee that met in January 2006 to explore the possibilities of mounting such an experiment at Fermilab. We submitted a proposal, edited by me, in the fall of 2008. The detailed design of the detector and beamline is underway. It is anticipated that construction will start in 2013. My group has been joined on this effort by M.A. Bychkov, E. Frlez, R.J. Hirosky, K.D. Paschke, and D. Počanić of the University of Virginia physics department. I currently head the *Mu2e* Cosmic Ray Veto group as Level-2 manager, the only Level-2 manager on *Mu2e* from a university. I also serve as chair of the Institution Board and I am a member of the Speakers Board.

NO ν A Experiment (E871) (2003–present)

NO ν A is a long-baseline neutrino oscillation experiment designed to make a variety of important measurements of neutrino properties. In the ten year since the discovery of neutrino mass through neutrino oscillations — the first evidence of physics beyond the standard model — much has been learned about neutrinos. Yet much remains to be learned. NO ν A is poised to make seminal measurements of neutrino properties and in the coming decade will be one of the flagship experiments of the Fermilab experimental program, indeed the US domestic particle physics program. It will cost \$280 million. NO ν A consists of two detectors, a far detector sited in northern Minnesota, and a near detector on site at Fermilab. The far detector, at 15,000 tons, will be one of the largest ever built. Construction started in 2009 and will continue for about four years. My research group is responsible for the design, fabrication, and installation of two critical components of the NO ν A detectors: the Power Distribution System (PDS) that provides power to all of the electronics, and the Detector Controls and Monitoring System that essentially runs the detector and insures it is working properly.

DØ Experiment (2005–present)

My research group is working on the DØ experiment, collaborating with Bob Hirosky, who has been a long-standing member of DØ. DØ is one of the flagship experiments in the US HEP program. It is searching for new phenomena resulting from proton-antiproton collisions at the world's highest energy accelerator, the Fermilab Tevatron. The physics program includes searches for new phenomena, such as supersymmetry, the Higgs, and leptoquarks, the study of the top quark and its decays, precision measurements of electroweak sector and QCD, and studies of particles composed of the bottom quark. The DØ detector had a major upgrade during 1996–1999 which resulted in a much-improved apparatus. Run II is proceeding well and about 5 fb^{-1} of data has been logged to tape, an increase of about fifty over Run I. An upgrade of the detector was installed in the spring of 2006. Our group is involved in the Level 1 Central Track Trigger and Level 2 Trigger operations and upgrades. My group has spearheaded the Rare B Physics working group; in particular we are searching for lepton-flavor violating B decays.

MIPP Experiment (E907) (2002–2006)

The Fermilab MIPP experiment (E907) employs an open-geometry spectrometer to measure hadronic particle production with good particle identification at incident beam energies from 5 GeV/ c to 120 GeV/ c using proton, anti-proton, kaon, pion, muon and electron beams. The goal of MIPP is to explore a variety of phenomena in hadronic particle production with a full-acceptance detector, including hadronic fragmentation scaling laws, searches for exotic particle states and resonances, strangeness propagation through nuclear matter, measurements relevant to proton radiography imaging techniques, and important measurements needed for the MINOS experiment as well as atmospheric neutrino experiments. Our group was responsible for the installation, maintenance, and operation of the hadronic calorimeter, the design and installation of the trigger, the operation of the drift and beam chambers, the design and installation of the scintillating fiber crosshair detector, and the design and implementation of the high-voltage control system and monitoring interfaces. Data taking commenced in the spring of 2005, after a commissioning run in 2004, and continued into the spring of 2006. Unfortunately, funding constraints and responsibilities elsewhere have led my group to curtail its MIPP effort in 2006.

HyperCP Experiment (E871) (1993–present)

I serve as the scientific spokesperson of this Fermilab experiment (with Kam-Biu Luk), which was the first major *new* experimental effort initiated by the newly formed Experimental High Energy Physics group at the University of Virginia. The *HyperCP* experiment, a collaboration of Academia Sinica, Berkeley, Lawrence Berkeley National Laboratory, Fermilab, University of Guanajuato, Illinois Institute of Technology, University of Lausanne, University of Michigan, University of South Alabama, and the University of Virginia, was designed to search for rare phenomena in the decays of charged-strange particles, in particular CP violation in Ξ and Λ hyperon decays with a sensitivity far beyond previous limits. *HyperCP* was only one of two new experiments approved at Fermilab for the 1996–1997 fixed-target run and one of only two experiments that took data in the 1999–2000 fixed target run. The experiment recorded the largest number of events ever by a particle physics experiment: 231 billion events on 29,401 magnetic tapes (119.5 TB). The UVa group had a leading role in the construction of the spectrometer, including the design and construction of the hadronic calorimeter, the trigger, the front wire chambers, and 20,000 channels of preamplifiers. I was directly responsible for the design and fabrication of the calorimeter and the trigger. All of the precision measurements have been made by the UVa group, and we have been written or co-written roughly half of the 14 *HyperCP* papers published to date. Highlights of the *HyperCP* physics results include:

- The most sensitive search for CP violation in hyperon decays, with a twenty times smaller error than that of the previous best result, and the first such result that constrains some SUSY predictions of an effect.
- First observation of the FCNC $K^- \rightarrow \pi^- \mu^+ \mu^-$ and resolution of a discrepancy in two BNL measurements of the $K^+ \rightarrow \pi^+ \mu^+ \mu^-$ branching ratio.
- First reported high-statistics high-resolution search for pentaquark, and one of the first null results.
- First evidence of parity violation in Ω^- decays, with the measurement of a nonzero α decay parameter, currently the most precisely measured hyperon α parameter.
- First precision test of CP violation in Ω^- decays.
- Observation of the rarest baryon decay ever, $\Sigma^+ \rightarrow p \mu^+ \mu^-$. Evidence suggests that the decay proceeds via an hitherto unknown intermediate state, consistent with the sgoldstino.
- First precision measurement of the β parameter in $\Xi^- \rightarrow \Lambda \pi^-$ decays, suggesting that it is

larger than recent chiral-perturbation theory predictions. It is the most precisely known β parameter.

- Searches for forbidden hyperon decays that go orders of magnitude in sensitivity beyond previous results.

CKM Experiment (E921) (1999–2003)

The primary goal of the CKM experiment was to test the hypothesis that the sole source of CP violation lies with the imaginary phase of the CKM matrix. This was to have been done by a precision measurement of the CKM matrix element V_{td} through the super-rare decay: $K^+ \rightarrow \pi^+ \nu \nu$. The experiment was approved in June, 2001. It was a major new initiative and was expected to “form the core of a 120 GeV fixed target program” at Fermilab. Unfortunately, due to budget constraints, Fermilab decided in the fall of 2003 not to go forward with the experiment. Our group was responsible for the simulation, design and fabrication of several major elements of the CKM spectrometer: the Upstream Magnetic Spectrometer (UMS), the Kaon Entrance Angle Tagger (KEAT), the Beam Time Stamp Module (BTSM), and front-end electronics for the entire spectrometer. The wire chambers for the UMS and KEAT were to be state-of-the-art, with extremely high rate capability and very low mass. I designed a prototype wire chamber, based on our *HyperCP* design, which my group fabricated at Virginia in the summer of 2003. I also designed a prototype of the Beam Time Stamp Module which was fabricated by a student of mine at Virginia.

SFT Experiment (1990–1994)

My interest in fundamental symmetries included the exploration of CP violation in the decays of hadrons composed of the b quark. I was a major player in a large collaboration — led by Brad Cox of the University of Virginia — which intended to explore CP violation in beauty mesons by extracting a fraction of the 20 TeV proton beam of the Superconducting Super Collider (SSC) and transporting it to a fixed-target spectrometer. The project was called the Super Fixed Target facility (SFT) and I was the head of the calorimetry group. From Nov. 1992 to Aug. 1993 I was on research leave at the SSC laboratory, exploring the experimental possibilities of the SSC to see CP violation in the B system. While there I designed, with Brett Parker of the SSC and Thornton Murphy of Fermilab, the crystal extraction beam line needed to extract the protons from the collider to the SFT experimental hall. I also helped organize the *Workshop on B Physics at Hadron Accelerators*, which was sponsored by the SSC and Fermilab and held at Snowmass, Colorado in the summer of 1993. In addition, I was the head of the *Electron and Gamma Identification Group* of the workshop. The demise of the SSC changed the focus of this future experimental activity from the SSC to the LHC, at the European Center for Particle Physics Research (CERN) in Geneva, Switzerland. Again the High Energy Group at the University of Virginia took a leading role in the design of a new experiment (LHC-B) with identical physics goals as the SFT. The experiment was approved in 1998. In 1998 we were informed that because of political considerations at the highest levels the Department of Energy could not support any U.S. collaborators on LHC-B and hence I withdrew from the experiment.

E771 Experiment (1989–2000)

The main thrust of my research effort from 1989 through 1992 was focused on the Fermilab experiment E771, for which I was the head of the calorimetry group. The goal of the experiment was the study of heavy quark production and decay, mainly through high p_T muons and high-mass muon pairs. In January of 1992 we concluded the data taking part of the experiment, having

accumulated approximately 200 million triggers. Analysis of the data finished in 2000 with our last publication being on the hadroproduction of the χ_1 and χ_2 , the ratio of the two being of considerable interest because it is a sensitive test of the mechanism for charm production. Other publications include including a measurement of the B cross section in 800 GeV/c pN interactions, a measurement of the J/ψ , ψ' , and Υ cross sections, and a search for the flavor changing neutral current decay $D^0 \rightarrow \mu^+ \mu^-$.

PEPSCI Calorimeter Project (1990–1996)

Because of the large interaction rates (over 10^7 per second) anticipated for *any* experiment studying CP violation in the B system at hadron accelerators, fast radiation hard calorimetry is needed. To respond to this need I developed a novel calorimeter fabricated out of a matrix of 1 mm diameter scintillating fibers (SCIFI) embedded in a lead powder-epoxy slurry. It is called a powder-epoxy (PEPSCI) calorimeter. Besides providing a simple method of constructing SCIFI calorimeters of arbitrary shapes, the method allows considerable flexibility in tuning the calorimeter sampling fraction to the performance requirements. In June of 1992 I tested the calorimeter at the AGS at Brookhaven National Laboratory. The results were excellent and were reported at a talk I gave at the *III International Conference on Calorimetry in High Energy Physics*. Unfortunately, the demise of the SSC eliminated the need for such a calorimeter and I discontinued working in this area.

TRAP Project (1990–1996)

In order to facilitate the design of the light guides for the PEPSCI calorimeter I wrote (with the help of several undergraduate physics majors) a ray tracing program which tracks light through various optical surfaces. The results were reported at a talk I gave at the *First International Conference on Calorimetry in High Energy Physics*. The program has been very useful and has been utilized for other projects, such as the design of the RICH for the P867 and SFT experiments, as well as for the design of light guides for the *HyperCP* hadronic calorimeter. The program has been used by high energy physicists at CERN, TRIUMPH, CEBAF, as well as other institutions.

UA6 Experiment (1985–1999)

UA6 was the first experiment to employ a gas-jet target inside a storage ring in conjunction with a fully instrumented magnetic spectrometer. The experiment made detailed comparisons of several different physical processes in pp and $\bar{p}p$ interactions at $\sqrt{s} = 24.3$ GeV at the Sp \bar{p} S collider at CERN in Geneva, Switzerland. These include direct photon production, J/ψ production, and low- t elastic scattering. I participated in all the runs of the experiment, first as a CERN fellow and then as an assistant professor at the University of Virginia. The last run ended in December 1990, marking the end of a very successful physics program. My major contributions to the experiment were the writing of the charged particle tracking code and the design and construction of an upgrade to the electromagnetic calorimeter. Highlights of the UA6 physics results include: (1) a new determination of the strong coupling constant from our direct photon cross sections: $\alpha_s(M_Z^2) = 0.1112 \pm 0.0016(\text{stat}) \pm 0.0033(\text{syst})_{-0.0034}^{+0.0077}(\text{theo})$; (2) the first direct comparison of direct photon production from pp and $\bar{p}p$ interactions, where the unique ability of the experiment to measure direct photons in both pp and $\bar{p}p$ collisions allowed us to isolate the contribution of leading-order diagram, the annihilation process $q + \bar{q} \rightarrow \gamma + g$; (3) a comparison of J/ψ production from incident protons and antiprotons; (4) a precise determination of the proton gluon distribution; (5) the measurement of the inclusive π^0 and η cross sections in $\bar{p}p$ and pp collisions; and (6) a precise comparison of $\bar{p}p$ and pp forward elastic scattering.

Fermilab Neutral Hyperon Group (1979–1984)

I collaborated on two experiments with the Fermilab Neutral Hyperon Group: a high statistics study of the β -decay of the Λ (E361) and the first precise measurement of the magnetic moments and polarization of the charged hyperons: Σ^- , Σ^+ , and Ξ^- (E620). The magnetic moment measurements showed that the naive quark model describes most of the salient features of hyperon magnetic moments, with the worst disagreement being $0.25 \mu_N$. They also showed the theory, however, to be incomplete and the discrepancy between experiment and theory remains a glaring reminder of our inability to fully understand the static properties of baryons.

The E620 experiment discovered polarization in the inclusive production of the Σ^+ , Σ^- , and Ξ^- hyperons. The Σ^+ and Σ^- hyperons were found to have large polarizations in a direction opposite to that of the Ξ^- (and the Λ). There is as yet no convincing theoretical understanding of the origin of the polarization. Indeed since these pioneering experiments further investigations of the hyperon polarization have only served to confuse the picture. The importance of these experiments was acknowledged by the awarding of the 1994 W.K.H. Panofsky Prize of the American Physical Society to L. Pondrom and T. Devlin of the neutral hyperon group.

Brookhaven Experiment E744 (1980–1984)

In this, my thesis experiment, I played a major role in the setting up and running of the experiment, as well as analysis of the data, in a small collaboration of eleven physicists and students. The polarization analysis of the Λ and the Σ^0 hyperons, carried out solely by me, involved the development of a new method to analyze the Σ^0 polarization through its decay product, the Λ . The experiment was the first to observe Σ^0 polarization and reveal it to be opposite in direction to the Λ as predicted by all models of hyperon polarization in inclusive production. It was also the first to measure the ratio of Σ^0 to Λ production.

RESEARCH GRANT SUPPORT

I am, and have been since its inception in 1997, the P.I. of the Task C grant from the US Department of Energy, which has received a total of \$7,020,000 in funding. We received \$2,148,700 this year, which supports the summer salary of myself and one-third of Robert Hirosky, three post-docs, one technician and a number of graduate and undergraduate students. In addition, from 1989 through 1996 I shared a grant with Profs. Conetti, Cox, and Nelson which received \$2,503,000 from the DOE and the Southern Association of High Energy Physicists (SAHEP). I have also received \$64,705 from the National Science Foundation while at the University of Virginia. A year-by-year itemization is given below.

2011

Sponsor: Department of Energy
 Title: University of Virginia Experimental High Energy Physics
 Amount: \$311,000 (P.I.)

Sponsor: Fermi National Accelerator Lab
 Title: NO ν A Experiment
 Amount: \$1,837,670 (P.I.)

2010

Sponsor: Department of Energy
 Title: University of Virginia Experimental High Energy Physics
 Amount: \$462,000 (P.I.)

Sponsor: Fermi National Accelerator Lab
 Title: NO ν A Experiment
 Amount: \$300,022 (P.I.)

2009

Sponsor: Department of Energy
 Title: University of Virginia Experimental High Energy Physics
 Amount: \$467,000 (P.I.)

Sponsor: Fermi National Accelerator Lab
 Title: NO ν A Experiment
 Amount: \$194,799 (P.I.)

2008

Sponsor: Department of Energy
 Title: University of Virginia Experimental High Energy Physics
 Amount: \$336,000 (P.I.)

Sponsor: Fermi National Accelerator Lab
 Title: NO ν A Detector Project
 Amount: \$51,718 (P.I.)

2007

Sponsor: Department of Energy
 Title: University of Virginia Experimental High Energy Physics
 Amount: \$330,000 (P.I.)¹

2006	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$364,000 (P.I.) ¹
2005	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$250,000 (P.I.) ²
2004	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$204,00 (P.I.) ²
2003	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$233,100 (P.I.) ²
2002	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$261,000 (P.I.) ² + \$352,000 ³
Sponsor:	National Science Foundation
Title:	Funding to Organize DPF2002 at The College of William and Mary
Amount:	\$18,000 ⁴
Sponsor:	Department of Energy
Title:	Funding to Organize DPF2002 at The College of William and Mary
Amount:	\$35,000 ⁴
2001	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$332,800 (P.I.) ² + \$405,400 ³
2000	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$281,000 (P.I.) ² + \$375,000 ³
1999	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$262,000 (P.I.) ² + \$360,000 ³
Sponsor:	Lawrence Berkeley National Laboratory
Title:	Physicist Staff Scientist
Amount:	\$36,000
1998	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$195,000 (P.I.) ² + \$320,000 ³

1997	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$195,000 (P.I.) ² + \$360,000 ³
1996	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$115,000 (P.I.) ² + \$575,000 ³
1995	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$115,000 (P.I.) ² + \$585,000 ³
1994	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$585,000 ³
1993	
Sponsor:	National Science Foundation
Title:	New Experiments to Revitalize Upper-Level Undergraduate Laboratories
Amount:	\$46,705 ⁵
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$610,000 ³
Sponsor:	Texas National Research Laboratory Commission
Title:	SAHEP Initiative for SSC Research and Education
Amount:	\$90,000 ³
Sponsor:	Superconducting Super Collider
Title:	CP Violation in Beauty Mesons
Amount:	\$32,754
Sponsor:	Superconducting Super Collider
Title:	High Resolution Electromagnetic Calorimeter Techniques
Amount:	\$16,000
1992	
Sponsor:	Department of Energy
Title:	University of Virginia Experimental High Energy Physics
Amount:	\$575,000 ³
Sponsor:	Texas National Research Laboratory Commission
Title:	SAHEP Initiative for SSC Research and Education
Amount:	\$277,000 ³

1991

Sponsor: Department of Energy
 Title: University of Virginia Experimental High Energy Physics
 Amount: \$430,000³

Sponsor: Texas National Research Laboratory Commission
 Title: SAHEP Initiative for SSC Research and Education
 Amount: \$118,000³

1990

Sponsor: Department of Energy
 Title: University of Virginia Experimental High Energy Physics
 Amount: \$255,000³

1989

Sponsor: Department of Energy
 Title: University of Virginia Experimental High Energy Physics
 Amount: \$208,000³

¹UVa HEP Task C: I am the P.I. with 33% Bob Hirosky.

²UVa HEP Task C: I am the P.I. with Ken Nelson.

³UVa HEP Task B: with Sergio Conetti, Brad Cox, and Ken Nelson.

⁴With P.Q. Hung *et. al.*

⁵With Bascom Deaver and Bellave Shivaram.

TALKS

2011

Accelerator Based Neutrino Physics at Fermilab

Invited Talk, 2011 BCVSPIN Advanced Study Institute in Particle Physics and Cosmology, Hue, Vietnam, July 27, 2011

Beyond $E=mc^2$: Using Rare Particle Decays to Probe the Energy Frontier

Invited Talk, 2011 BCVSPIN Advanced Study Institute in Particle Physics and Cosmology, Hue, Vietnam, July 27, 2011

Beyond $E=mc^2$: Using Rare Particle Decays to Probe the Energy Frontier

Seminar, Triangle Universities Nuclear Laboratory (TUNL), Durham, NC, February 24, 2011

2010

Beyond $E=mc^2$: Using Rare Particle Decays to Probe the Energy Frontier

Colloquium, University of Houston, Houston, TX, October 5, 2010

Mu2e: A High-Sensitivity Search for Charged Lepton Flavor Violation at Fermilab

Invited Talk, The 11th International Workshop on Tau Lepton Physics, Manchester, UK, September 13, 2010

Beyond $E=mc^2$: Using Rare Particle Decays to Probe the Energy Frontier

Seminar, Argonne National Laboratory, Argonne, IL, May 5, 2010

2009

Accelerator Based Neutrino Physics at Fermilab

Seminar, University of Illinois, Urbana-Champaign, IL, December 3, 2009

Charged Lepton Flavor Violation in Muon and Tau Decays

Invited Talk, Flavor Physics and CP Violation 2009 Conference, Lake Placid, NY, May 27 – June 1, 2009

Beyond $E = mc^2$: Using Rare Decays to Probe the Energy Frontier

Colloquium, College of William & Mary, Williamsburg, VA, May 19, 2009

Beyond $E = mc^2$: Using Rare Decays to Probe the Energy Frontier

Colloquium, Illinois Institute of Technology, Chicago, IL, April 25, 2009

Beyond $E = mc^2$: Using Rare Decays to Probe the Energy Frontier

Colloquium, James Madison University, Harrisonburg, VA, April 9, 2009

Beyond $E = mc^2$: Using Rare Decays to Probe the Energy Frontier

Colloquium, University of Virginia, Charlottesville, VA, March 20, 2009

Beyond $E = mc^2$: Rare Particle Decays

Invited Talk, American Associate for the Advancement of Science Annual Meeting, Chicago, IL, February 13, 2009

2008

Accelerator Based Neutrino Physics at Fermilab

Invited Talk, 75th Annual Meeting of the Southeastern Section of the American Physical Society, North Carolina State University, November 31, 2008

The Mu2e Detector

Talk, Fermilab Director's Review of Mu2e, Fermilab, Batavia, IL, September 26, 2008

The Mu2e Experiment

Invited Talk, MANX08 Meeting, Fermilab, Batavia, IL, July 15, 2008

A High-Sensitivity Search for Charged Lepton Flavor Violation at Fermilab

Invited Talk, 10th International Workshop on Neutrino Factories, Super beams and Beta Beams, Valencia, Spain, July 3, 2008

A High-Sensitivity Search for Charged Lepton Flavor Violation at Fermilab

Seminar, University of Minnesota, Minneapolis, MN, May 6, 2008

A High-Sensitivity Search for Charged Lepton Flavor Violation at Fermilab

Seminar, Duke University, Durham, NC, March 31, 2008

Prospects for a High-Sensitivity Lepton Flavor Violation Search at Fermilab

Invited Talk, Lake Louise Winter Institute 2008, Lake Louise, Canada, February 21, 2008

2007

The Search for New Physics in Hyperon Decays

Seminar, Carnegie Mellon University, Pittsburgh, PA, March 28, 2007

2006

The Search for New Physics in Hyperon Decays

Invited Talk, International Conference on Heavy Quarks and Leptons, Munich, Germany, October 16, 2006

The Search for CP Violation in Hyperon Decays

Invited Talk, BEACH06, Lancaster, UK, July 6, 2006

The Search for New Physics in Hyperon Decays

Invited Talk, Los Alamos National Laboratory, Los Alamos, NM, April 26, 2006

Hints of New Physics in the Decay $\Sigma^+ \rightarrow p\mu^+\mu^-$

Invited Talk, Rencontres de Moriond, La Tuile, Italy, March 12, 2006

2005

Cascade Physics with the HyperCP Spectrometer at Fermilab

Invited Talk, Cascade Physics: A New Window on Baryon Spectroscopy, Thomas Jefferson National Accelerator Facility, Newport News, VA, December 2, 2005

What's the Matter with Antimatter?

Invited Talk, Shenandoah Astronomical Society, Winchester, VA, May 2, 2005

Evidence for New Physics in the Decay $\Sigma^+ \rightarrow p\mu^+\mu^-$

Talk, APS April 2005 Meeting, Tampa Bay, FL, April 19, 2005

2004

Search for CP Violation in Hyperon Decays with the HyperCP Spectrometer at Fermilab

Talk, DPF 2004

Riverside, CA, August 27, 2004

Search for CP Violation in Hyperon Decays

Invited talk, XXIV Physics in Collision, Boston, MA, June 27, 2004

Search for CP Violation in Hyperon Decays with the HyperCP Spectrometer at Fermilab

Invited talk, DAΦNE 2004, Frascati, Italy, June 7, 2004

2003

Precision Measurements with the HyperCP Spectrometer at Fermilab

Seminar, Thomas Jefferson National Accelerator Facility, Newport News, VA, December 10, 2003

Precision Measurements with the HyperCP Spectrometer at Fermilab

Seminar, Brookhaven National Laboratory, Upton, NY, July 10, 2003

CKM: Attacking the Cabibbo-Kobayashi-Maskawa Matrix Using Charged Kaons at Fermilab

Seminar, Caltech, Pasadena, CA, May 27, 2003

2002

CKM: Attacking the Cabibbo-Kobayashi-Maskawa Matrix Using Charged Kaons at Fermilab

Talk, Division of Particles and Fields (DPF) Meeting, Williamsburg, VA, May 26, 2002

CKM: Attacking the Cabibbo-Kobayashi-Maskawa Matrix Using Charged Kaons at Fermilab

Seminar, Thomas Jefferson National Accelerator Facility, Newport News, VA, May 3, 2002

CKM: Attacking the Cabibbo-Kobayashi-Maskawa Matrix Using Charged Kaons at Fermilab

Seminar, University of Virginia, Charlottesville, VA, May 1, 2002

CKM: Attacking the CKM Matrix Using Charged Kaons at Fermilab

Seminar, University of Illinois, Urbana-Champaign, IL, April 8, 2002

FCNC Kaon Decays from HyperCP: $K^\pm \rightarrow \pi^\pm \mu^+ \mu^-$

Talk, XXXVIIth Rencontres de Moriond, Les Arcs, France, March 11, 2002

2001

Precision measurements with the HyperCP Spectrometer at Fermilab

Talk, SESAPS meeting, Charlottesville, VA, November 4, 2001

Report from the UMS Working Group

Talk, CKM Workshop, Ann Arbor, MI, July 26, 2001

Some Random Lessons from HyperCP

Talk, CKM Workshop, Ann Arbor, MI, July 23, 2001

Status of the UMS Spectrometer

Talk, CKM Workshop, Ann Arbor, MI, July 23, 2001

The Search for Direct CP Violation in Hyperon Decays: Results from the HyperCP Experiment

Talk, International Conference on High Energy Physics of the European Physical Society (EPS2001), Budapest, Hungary, July 12, 2001

The Upstream Magnetic Spectrometer

Talk, CKM Technical Review, Fermilab, Batavia, IL, May 15, 2001

2000

Results from the HyperCP Experiment at Fermilab: The Search for Direct CP Violation in Hyperon Decays

Talk, 14th International Spin Physics Symposium, Osaka, Japan, October 17, 2000

1999

Why we are Here: Cosmology Meets the Asymmetry Between Matter and Antimatter

Colloquium, Wayne State Univeristy, Detroit, MI, November 4, 1999

1998

Performance of the HyperCP Spectrometer

Fermilab Director's Review Presentation, Fermilab, Batavia, IL, December 8, 1998

Searching for Direct CP Violation with Hyperons: the HyperCP Experiment at Fermilab

Seminar, Univeristy of Chicago, Chicago, IL, November 23, 1998

Searching for Direct CP Violation with Hyperons: the HyperCP Experiment at Fermilab

Seminar, Cornell Univeristy, Ithaca, NY, November 20, 1998

Why we are Here: Cosmology Meets the Asymmetry Between Matter and Antimatter

Colloquium, New Mexico State Univeristy, Las Cruces, NM, November 13, 1998

The Search for Direct CP violation in Hyperon Decays: Results from the HyperCP Experiment at Fermilab

Talk, 3rd International Conference on Hyperons, Charm, and Beauty Hadrons, Genoa, Italy, July 2, 1998

Proposal to Continue the Study of Hyperon CP Violation in FY99

Fermilab HyperCP-99 PAC Presentation, Fermilab, Batavia, IL, May 15, 1998

Why we are here: Cosmology and the Asymmetry Between Matter and Antimatter

Invited talk, Society of Physics Students, University of Virginia, Charlottesville, VA, April 17, 1998

Proposal to Continue the Study of Hyperon CP Violation in FY99

Presentation to the Department of Energy, DOE, Germantown MD, March 3, 1998

Proposal to Continue the Study of Hyperon CP Violation in FY99

Fermilab HyperCP-99 PAC Presentation, Fermilab, Batavia, IL, January 9, 1998

1997

HyperCP Status Report

Talk, Fermilab All Experimenters Meeting, Fermilab, Batavia, IL, August 18, 1997

1996

CP Violation in Hyperon Decays

Talk, Workshop on Heavy Quarks at Fixed Target, St. Goar, Germany, October 4, 1996

Why we are here: Cosmology and the Asymmetry Between Matter and Antimatter

Invited talk, Society of Physics Students, University of Virginia, Charlottesville, VA, April 11, 1996

The HyperCP Experiment at Fermilab

Presentation for the DOE Review of Fermilab, Fermilab, Batavia, IL, April 2, 1996

1995

A New Method of Searching for Direct CP Violation: the HyperCP Experiment at Fermilab

Seminar, University of Maryland, College Park, MD, February 22, 1995

Why we are here: Cosmology and the Asymmetry Between Matter and Antimatter

Colloquium, College of William & Mary, Williamsburg, VA, February 10, 1995

A New Method of Searching for Direct CP Violation: the HyperCP Experiment at Fermilab

Seminar, Saclay, France, January 13, 1995

A New Method of Searching for Direct CP Violation: the HyperCP Experiment at Fermilab

EP Seminar, CERN, Geneva Switzerland, January 16, 1995

 1994

A New Method of Searching for Direct CP Violation: the HyperCP Experiment at Fermilab
Seminar, CEBAF, Newport News, VA, November 21, 1994

Unravelling the Mysteries of the Asymmetry Between Matter and Antimatter using Hyperons
Colloquium, University of Virginia, Charlottesville, VA, October 28, 1994

A New Fermilab Experiment to Search for CP Violation in Hyperon Decays
Talk, Eleventh International Symposium on High Energy Spin Physics, Indiana University, Bloomington, IN, September 20, 1994

A New Method of Searching for Direct CP Violation: the HyperCP Experiment at Fermilab
Seminar, Université de Lausanne, Lausanne, Switzerland, August 26, 1994

A New Method of Searching for Direct CP Violation: the HyperCP Experiment at Fermilab
Seminar, University of Trieste, Trieste, Italy, August 17, 1994

P871 – the Search for CP Violation in the Decays of $\Xi^-/\bar{\Xi}^+$ and $\Lambda/\bar{\Lambda}$ Hyperons
Presentation to the Fermilab Program Advisory Committee, Fermilab, Batavia, IL, April 7, 1994

P871 – the Search for CP Violation in the Decays of $\Xi^-/\bar{\Xi}^+$ and $\Lambda/\bar{\Lambda}$ Hyperons
Presentation to the Fermilab Appeal Committee, Fermilab, Batavia, IL, April 1, 1994

 1993

The Changing Art of the Modern Elementary Particle Experimentalist: How Particle Physics Experiments Became Big Science
Colloquium, Commonwealth Center for Literary and Cultural Change, University of Virginia, Charlottesville, VA, October 20, 1993

Summary Talk of the Electron and Gamma Identification Group
Workshop on B Physics at Hadron Accelerators, Snowmass, Colorado, July 1, 1993

Electromagnetic Calorimetry for the SSC
Talk, Workshop on B Physics at Hadron Accelerators, Snowmass, Colorado, June 29, 1993

Parasitic Extraction of Protons from the SSC Collider
Seminar, Accelerator Department, SSC Laboratory, Dallas, TX, June 2, 1993

Options for CP Violation at the SSC
Seminar, Physics Department, SSC Laboratory, Dallas, TX, May 19, 1993

Prospects for Detecting CP Violation at the SSC
Seminar, University of Texas, Austin, TX, May 3, 1993

The New Quest for CP Violation
Seminar, Université de Lausanne, Lausanne, Switzerland, March 26, 1993

1992

The Quest for CP Violation at the SSC

Seminar, University of Michigan, Ann Arbor, MI, October 12, 1992

The PEPSCI Calorimeter Project

Talk, III International Conference on Calorimetry in High Energy Physics, Corpus Christi, TX, October 2, 1992

Calorimetry at the SFT

Talk, Fixed Target B Physics Workshop, SSC Laboratory, Dallas, TX, June 30, 1992

The New Search for CP Violation

Colloquium, University of Virginia, Charlottesville, VA, April 13, 1992

Is Matter Really Different than Anti-matter?

Talk, Sigma Xi, University of Virginia, Charlottesville, VA, January 28, 1992

1991

Measuring the Amount of Glue Holding the Proton Together

Colloquium, College of William & Mary, Williamsburg, VA, January 11, 1991

1990

Monte Carlo Results on the Design of Light Guides for Scintillating Fiber Calorimeters

Talk, First International Conference on Calorimetry in High Energy Physics, Fermilab, Batavia, IL, October 30, 1990

1989

Direct Photon Physics from UA6

Seminar, University of South Carolina, Columbia, SC, May 4, 1989

Measuring the Amount of Glue Holding the Proton Together

Seminar, University of Virginia, Charlottesville, VA, January 26, 1989

Measuring the Amount of Glue Holding the Proton Together

Seminar, Fermilab, Batavia, IL, January 23, 1989

Physics with the Hydrogen Cluster-Jet Internal Target at the SPS Collider — CERN Experiment UA6

Talk, Topical Conference on Electronuclear Physics with Internal Targets, Stanford Linear Accelerator Center, Palo Alto, CA, January 10, 1989

————— **1988** —————

Measurement of the Ratio of Σ^0/Λ Inclusive Production and the Σ^0 and Λ Polarizations by 28.5 GeV/c Protons on Beryllium

Talk, Eighth International Symposium on High-Energy Spin Physics, Minneapolis, MN, Sept. 12–17, 1988

————— **1986** —————

Preliminary Results from Experiment UA6 on Inclusive π^0 , η , and γ Production from $\bar{p}p$ Collisions at $\sqrt{s} = 24.3$ GeV

Talk, Twenty-First Rencontre de Moriond, Les Arcs, Savoie, France, March 17, 1986

PUBLICATIONS

1. *Forward Neutron Production at the Fermilab Main Injector*, with T. S. Nigmanov *et al.*, Phys. Rev. D **83**, 012002 (2011).
2. *Study of the rare hyperon decay $\Omega^\mp \rightarrow \Xi^\mp \pi^+ \pi^-$* , with O. Kamaev *et al.*, Phys. Lett. B **693**, 236 (2010).
3. *Charged Kaon Mass Measurement using the Cerenkov Effect*, with N. Graf *et al.*, Nucl. Instrum. Meth. **A615**, 27 (2010).
4. *A High-Sensitivity Search for Charged Lepton Flavor Violation at Fermilab*, E.C. Dukes, in proceedings of “10th International Workshop on Neutrino Factories, Super beam and Beta beams”, June 30 – July 5, 2008, Valencia, Spain, PoS(Nufact08)110, 2009.
5. *Electromagnetic and hadron calorimeters in the MIPP experiment*, with T.S. Nigmanov, H.R. Gustafson, M.J. Longo, H.K. Park, D. Rajaram, C. Dukes, L.C. Lu, C. Materniak, K. Nelson, A. Norman, H. Meyer, A. Lebedev, S. Seun, N. Graf, J.M. Paley, G. Aydin, Y. Gunaydin, and D.E. Miller, Nucl. Instrum. Meth. **A**, (2009).
6. *Letter of Intent: Medium Energy Antiproton Physics at Fermilab*, with D.M. Asner *et al.*, FERMILAB-LOI-2009-04, February 5, 2009.
7. *Physics with a High Intensity Proton Source at Fermilab*, with J. Appel *et al.*, Fermilab-FN-0904, February 3, 2008.
8. *Letter of Intent: A Muon to Electron Conversion Experiment at Fermilab*, with E.J. Prebys *et al.*, FERMILAB-TM-2396-AD-E-TD, September 2007.
9. *Expression of Interest: A Muon to Electron Conversion Experiment at Fermilab*, with E.J. Prebys *et al.*, FERMILAB-TM-2389-AD-E, August 2007.
10. *Physics with a High Intensity Proton Source at Fermilab*, with Jeffrey Appel *et al.*, February 3, 2008.
11. *Proposal to Upgrade the MIPP Experiment*, D. Isenhower *et al.*, FERMILAB-PROPOSAL-0960, September 2006.
12. *Measurement of the α Parameter in the $\bar{\Omega}^+ \rightarrow \bar{\Lambda} K^+$ Decay*, with L.C. Lu *et al.*, Phys. Rev. Lett. **96**, 242001 (2006).
13. *Search for CP Violation in Hyperon Decays with the HyperCP Spectrometer at Fermilab*, E. Craig Dukes, Int. J. of Mod. Phys. A. **20**, 3510 (2005).
14. *Observation of Parity Violation in $\Omega^- \rightarrow \Lambda K^-$ Decays*, with L.C. Lu *et al.*, Phys. Lett. B **617**, 11 (2005).
15. *A Search for the Lepton-Number-Violating Decay $\Xi^- \rightarrow p \mu^- \mu^-$* , with D. Rajaram *et al.*, Phys. Rev. Lett. **94**, 181801 (2005).
16. *HyperCP: A high-rate spectrometer for the study of charged hyperon and kaon decays*, with R. Burnstein *et al.*, Nucl. Instrum. and Methods A **541**, 516 (2005).

17. *The FINeSSE Detector*, with S. Brice *et al.*, Nucl. Phys. Proc. Suppl. **139**, 317 (2005).
18. *Search for $\Delta S = 2$ Nonleptonic Hyperon Decays*, with C.G. White *et al.*, Phys. Rev. Lett. **94**, 101804 (2005).
19. *NOvA: Proposal to Build a 30 Kiloton Off-Axis Detector to Study $\nu_\mu \rightarrow \nu_e$ Oscillations in the Fermilab NuMI Beamline*, with D.S. Ayres *et al.*, hep-ex/0503053.
20. *Measurement of the α Asymmetry Parameter for the $\Omega^- \rightarrow \Lambda K^-$ Decay*, with Y.C. Chen *et al.*, Phys. Rev. D **71**, 051102(R) (2005).
21. *Evidence for the decay $\Sigma^+ \rightarrow p\mu^+\mu^-$* with H.K. Park *et al.*, Phys. Rev. Lett. **94**, 021801 (2005).
22. *Search for CP Violation in $\Xi^\pm \rightarrow \Lambda\pi^\pm \rightarrow p^\mp\pi^\pm\pi^\pm$ Decays*, with T. Holmstrom *et al.*, Phys. Rev. Lett. **93**, 262001 (2004).
23. *High statistics search for the $\theta^+(1.54)$ pentaquark state*, with M.J. Longo *et al.*, Phys. Rev. D **70**, 111101(R) (2004).
24. *The Search for CP Violation in Hyperon Decays*, E. Craig Dukes, hep-ex/0409014, Proceedings of XXIV Physics in Collision, Boston, 27–29 June, 2004.
25. *Search for CP Violation in Hyperon Decays with the HyperCP Spectrometer at Fermilab*, E. Craig Dukes, Proceedings of DAΦNE 2004: Physics at Meson Factories, Frascati, Italy, 7–11 June, 2004, Frascati Physics Series Vol. XXXVI (2004), ed. by F. Anulli, M. Bertani, G. Capon, C. Curceanu-Petrascu, F.L. Fabbri, and S. Miscetti, (INFN, 2004).
26. *New Measurement of $\Xi^- \rightarrow \Lambda\pi^-$ Decay Parameters*, with M. Huang *et al.*, Phys. Rev. Lett. **93**, 011802 (2004).
27. *Measurement of α_Ω in $\Omega^- \rightarrow \Lambda K^-$ Decays*, with L.C. Lu *et al.*, Proceedings of the 15th International Spin Physics Symposium (SPIN 2002), Long Island, NY, 9–14 September, 2002, AIP Conf. Prod. 675, 251 (2003), ed. by Y.I. Makdisi, A.U. Luccio, and W.W. MacKay, (AIP, New York, 2003).
28. *Two RICH Detectors as Velocity Spectrometers in the CKM Experiment*, with J. Engelfried *et al.*, Nucl. Instrum. Methods A **502**, 62 (2003).
29. *Observation of the Decay $K^- \rightarrow \pi^-\mu^+\mu^-$ and Measurements of the Branching Ratios for $K^\pm \rightarrow \pi^\pm\mu^+\mu^-$* , with H.K. Park *et al.*, Phys. Rev. Lett. **88** (2002) 111801.
30. *CP Violation in Hyperon and Charged Kaon Decays*, with M. Longo *et al.*, Proceedings of the 30th Conference on High-Energy Physics and Cosmology, Coral Gables, Fort Lauderdale, Florida, 12–16 December, 2001, AIP Conf. Prod. 624, 298 (2002), ed. by B.N. Kursunoglu, S.L. Mintz, and A. Perlmutter, (AIP, New York, 2002).
31. *Flavor Changing Kaon Decays from HyperCP: Measurements of the $K^\pm \rightarrow \pi^\pm\mu^+\mu^-$ Branching Ratios*, hep-ex/0205063. E.C. Dukes *et al.*, Proceedings of the 37th Rencontres de Moriond on Electroweak Interactions and Unified Theories, Les Arcs, France, 9–16 Mar. 2002, Ed. by J.T.T. Van, (Thê Giói, Vietnam, 2002), p. 93.
32. *Status of a Search for Direct CP Violation in Hyperon Decays*, E. Craig Dukes, International Europhysics Conference on HEP, Budapest, Hungary, July 12–18, 2001. JHEP hep2001/062 (2001).

33. *HyperCP at Fermilab — A Status Report*, with A. Chan *et al.*, International Conference on CP Violation: KAON2001, Pisa, Italy, June 12–17, 2001, Fermilab-Conf-01/321-E.
34. *Charged Kaons at the Main Injector (CKM)*, with J. Frank *et al.*, Fermilab Proposal P-905, 2 April 2001.
35. *HyperCP Experiment at Fermilab: Search for CP Violation in Hyperon Decays*, with N. Leros *et al.*, International Conference on CP Violation Physics (CPconf2000), Ferrara, Italy, 18–22 September 2000, Nucl. Phys. **99B** (Proc. Suppl.) (2001) 211.
36. *Hadroproduction of the χ_1 and χ_2 States of Charmonium in 800 GeV/c Proton-Silicon Interactions*, with T. Alexopoulos *et al.*, Phys. Rev. **D62**:032006 (2000).
37. *A High-Throughput Data Acquisition System for the HyperCP Experiment*, Y.C. Chen, K.C. Cheng, W.-S. Choong, E.C. Dukes, P. Gu, C. Ho, C. James, D.M. Kaplan, W.R. Luebke, K.B. Luk, K. Nelson, H. Rubin, J.P. Sheng, C.G. White, C.S. Yu, Nucl. Instrum. Methods **A455** (2000) 424.
38. *A New Determination of α_s using Direct Photon Production Cross Sections in pp and $\bar{p}p$ Collisions at $\sqrt{s} = 24.3$ GeV*, with M. Werlen *et al.*, Phys. Lett. **B452** 201, (1999).
39. *A Measurement of the $b\bar{b}$ Cross Section in 800 GeV/c pSi Interactions*, with T. Alexopoulos *et al.*, Phys. Rev. Lett. **82** (1999) 41.
40. *CP Violation in Strange Baryon Decays: A Report from Fermilab Experiment 871*, with C. James *et al.*, Proceedings of the “4th Workshop on Heavy Quarks at Fixed Target (HQ98)”, Fermilab, 10–12 October, 1998, Ed. by H.W.K. Cheung and J.W. Butler, (AIP, New York, 1999) p. 107.
41. *Search for CP Violation in Ξ and Λ Hyperon Decays: Status of the HyperCP Experiment*, Craig Dukes, Proceedings of the 3rd International Conference on Hyperons, Charm and Beauty Hadrons, Genoa, Italy, June 30 – July 3, 1998, Nuc. Phys. **B75** (Proc. Suppl.) (1999) 281.
42. *Search for Direct CP Violation in Λ and Ξ Hyperon Decays*, with C. White *et al.*, Proceedings of the 27th International Symposium on Multi-Particle Dynamics, Frascati, Italy, September 8–12, 1997, Nucl. Phys. **B71** (Proc. Suppl.) (1999) 451.
43. *Direct Photon Cross Sections in Proton-Proton and Antiproton-Proton Interactions at $\sqrt{s} = 24.3$ GeV*, with G. Balocchi *et al.*, Phys. Lett. **B436** 222, (1998).
44. *Search for Direct CP Violation in Decays of Hyperons*, with Y.C. Chen *et al.*, Proceedings of the International Conference on Hadron Structure (HS 98), Stara Lesna, Slovakia, September 7–13, 1998, p. 447-454.
45. *The Use of WLS Fibers in a Hadronic Calorimeter for the HyperCP Experiment*, with C. Durandet *et al.*, Proceedings of SCIFI97, a Conference on Scintillating and Fiber Detectors, Notre Dame University, South Bend, IN, November 2–6, 1997, edited by R. Ruchti and M. Wayne, (AIP, New York, 1998) p. 200-205.
46. *The HyperCP Hadronic Calorimeter*, with C. Durandet *et al.*, Proceedings of the 7th International Conference on Calorimetry in High Energy Physics (ICCHEP 97), Tucson, AZ,

- November 9–14, 1997, edited by E. Cheu, T. Embry, J. Rutherford, R. Wigmans, (World Scientific, Singapore, 1998) p. 281–285.
47. *LHCb Technical Proposal*, S. Amato *et al.*, CERN-LHCC-98-4, Feb. 1998, 180 pp.
 48. *Differential Cross Sections of J/Ψ and Ψ' in 800-GeV/c pSi Interactions*, with T. Alexopoulos *et al.*, Phys. Rev. **D55**, 3927 (1997).
 49. *Proposal to Continue the Study of Hyperon CP Violation in FY99*, with A. Chan *et al.*, FERMILAB-P-0871, Dec. 1997, 34pp.
 50. *The HyperCP Data Acquisition System*, with D.M. Kaplan *et al.*, Proceedings of the Sixth Annual LeCroy Conference on Electronics for Particle Physics, Chestnut Ridge, NY, May 28–29, 1997, ed. by G.J. Blonar and R.L. Sumner, LeCroy Research Systems.
 51. *Direct Photon Cross Sections for Proton-Proton and Antiproton-Proton Interactions at $\sqrt{s} = 23.3$ GeV*, with G. Ballocci *et al.*, Proceedings of the European Physical Society – HEP97, Jerusalem, 19–26 August 1997.
 52. *CP Violation in Hyperon Decays*, E.C. Dukes, Heavy Quarks at Fixed Target, Proceedings of the “1996 Workshop on Heavy Quarks at Fixed Target”, Rhinefels Castle, St. Goar, Germany, Oct. 3–6, 1996, ed. by L. Köpke (INFN Laboratori Nazionali di Frascati, 1997) p. 287.
 53. *Production of $J/\Psi, \Psi'$ and Υ in 800 GeV/c proton-silicon interactions*, with T. Alexopoulos *et al.*, Phys. Lett. **B374** (1996) 271.
 54. *Search for the Flavor Changing Neutral Current Decay $D^0 \rightarrow \mu^+ \mu^-$ in 800 GeV/c Proton-Silicon Interactions*, with T. Alexopoulos *et al.*, Phys. Rev. Lett. **77** (1996) 2381.
 55. *The Fermilab E771 Spectrometer — A Large Aperture Spectrometer to Study Charm and Beauty States as Detected by Decays into Muons*, with T. Alexopoulos *et al.*, Nucl. Instrum. Methods **A376** (1996) 375.
 56. *Simulation Studies of the Electromagnetic Energy Resolution of a Scintillating Fiber Calorimeter*, with P. Štavina *et al.*, Nucl. Instrum. Methods **A364** (1995) 124.
 57. *A New Fermilab Experiment to Search for Direct CP Violation in Hyperon Decays*, E.C. Dukes, Proceedings of the 11th International Symposium on High Energy Spin Physics, 1994, edited by Kenneth J. Heller and Sandra L. Smith (American Institute of Physics, Woodbury, New York, 1995) p. 697.
 58. *The Optical Trigger for the E871 Experiment*, with G. Charpak *et al.*, RD30 Note, March 16, 1995.
 59. *Extraction from TeV-range Accelerators Using Bent Crystal Channeling*, with R.A. Carrigan Jr. *et al.*, Nucl. Instrum. Methods **B90** (1994) 128,
 60. *Energy Resolution of a Lead Scintillating Fiber Electromagnetic Calorimeter*, with J. Budagov *et al.*, Nucl. Instrum. Methods **A343** (1994) 476.
 61. *Comparison of Direct Gamma Production in $\bar{p}p$ and pp Reactions and Determination of $\bar{\Lambda}_{MS}$ and the Gluon Structure Function*, with P. Oberson *et al.*, Phys. Atom. Nucl. **57**, (1994) 1624.

62. *Charmonium Production in 800 GeV/c pSi Interactions*, with T. Alexopoulos *et al.*, Proceedings of the XXVII Int. Conf. on High Energy Physics, Glasgow, UK, 20–27 July 1994, ed. by P.J. Bussey and I.G. Knowles, p. 1019.
63. *A Search for New Charmonium States Decaying into J/Ψ Plus Charged Pions*, with A. McManus *et al.*, Proceedings of the 8th Meeting of the Division of Particle and Fields of the APS, Albuquerque, NM, August 2–6, 1994, ed. by S. Seidel, p. 547.
64. *Search for the Flavor Changing Neutral Current Decay $D^0 \rightarrow \mu^+\mu^-$ in 800 GeV/c Proton-Silicon Interactions*, with G.H. Mo *et al.*, Proceedings of the 8th Meeting of the Division of Particle and Fields of the APS, Albuquerque, NM, August 2–6, 1994, ed. by S. Seidel, p. 957.
65. *High Mass Dimuon States Produced in 800 GeV/c pSi Interactions*, with G. Corti *et al.*, Proceedings of the 8th Meeting of the Division of Particle and Fields of the APS, Albuquerque, NM, August 2–6, 1994, ed. by S. Seidel, p. 1272.
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