DAVID REYNA

Curriculum Vitae

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Academic Degrees

PhD — May 1998, Degree in physics from American University.

BS — June 1989, Degree in physics from Tufts University.

RESEARCH POSITIONS / EMPLOYMENT

June 2003 - Present

Assistant Physicist, Argonne National Laboratory

Development of Future Neutrino Experiments at Nuclear Reactors. I have been very involved with an international effort to work with low-energy neutrinos from nuclear power reactors. The copious production of electron anti-neutrinos at nuclear power stations allows the efficient and cost-effective development of high precision neutrino experiments. The recent observations of neutrino oscillations have led to the need for neutrino measurements at a precision level not attempted before. Since early in 2003 I have been a leading member of an international group which has been attempting to identify an optimal location and technique for measuring the value of θ_{13}, the last remaining parameter of the neutrino mixing matrix. A very promising situation has developed in France with the Double Chooz experiment. By returning to a previously used reactor neutrino laboratory, the experimental technique can be attempted with very minimal costs to setup the laboratory infrastructure.

An international collaboration has formed which includes members from France, Germany, Russia, Spain, the United Kingdom and the United States. Within the U.S. portion of the collaboration, consisting of about 40 physicists from 9 institutions, I have been very instrumental. In addition to supervising the Argonne task of designing the outer muon veto system, I was appointed to be the project manager overseeing the design and proposal of all U.S. experimental contributions. This entailed coordination of the technical and budgetary aspects of each working group as well as serving as the technical interface to the international project leadership in France.

In addition to my work with Double Chooz, I have also initiated an effort to locate a higher precision, second generation, experiment at the Angra dos Reis reactor facility in Brazil. After making contact with several Brazilian institutions in the summer of 2003, I have led the formation of an experimental collaboration. I was responsible for establishing the IV International Workshop on Low Energy Neutrino Experiments at the Angra dos Reis facility in February 2005. I continue to work with this group on R&D toward the initiation of an experiment which could begin taking data in 2015. In the meantime, I have guided them into joining the Double Chooz collaboration to increase their exposure within the international community.

My work within the reactor neutrino community has also brought me into contact with the international nuclear safeguards community. There is increasing interest, from the International Atomic Energy Agency and other monitoring agencies, for investigating the capabilities of neutrino

detection. By using a small neutrino detector at close distance (less than 50m) to the reactor core, the operation of a nuclear reactor can be monitored and it may even prove possible to estimate the quantity of plutonium produced. I have been a consultant for groups from Lawrence Livermore and Sandia National Laboratories which currently have a proof-of-principle small liquid scintillator detector deployed at a reactor in California. In addition, I have participated in workshops dedicated to such neutrino applications.

Development of Low-Noise Germanium Detector. Initiated by our mutual interest in the reactor monitoring mentioned above, I began a collaboration in late 2006 with J. Collar at the University of Chicago to develop a high-purity large-mass germanium detector which has sensitivity down to very low energy depositions. Developments in germanium purity and low-noise electronics provide the potential for this detector to allow the first-ever detection of coherent neutrino-nucleus scattering. The enhanced cross-section from this process would allow a 10 kg germanium detector to have the same or higher event rate as a 1-ton liquid scintillator detector. In addition, sensitivity to these very low nuclear recoils makes this technology an ideal choice for dark matter WIMP searches in the very difficult light-mass range of 1–10 GeV. In early 2007, I received independent R&D funding to pursue this detector development program and we expect to have the first prototype crystal ready for deployment in late 2007. After a first test in a low-background underground location where we hope to make a quick 2 order of magnitude improvement on the light-WIMP limits while we measure it's noise and background characteristics, we will deploy this prototype at a reactor facility in early 2008 and hope to extract a demonstrable coherent neutrino signal.

MINOS. In the summer of 2003 I was solely responsible for the complete installation of the MINOS near detector electronics. After completing testing, checkout and confirming full operability of the system under beam conditions, I trained younger members of the MINOS collaboration to take over day-to-day electronics responsibilities. I remain the final expert on diagnostics and work closely with the Argonne electronics group to diagnose reported anomalous behaviors. In addition, my responsibilities relative to the MINOS data acquisition system are on-going by providing on-call support and the expertise related to the design of the near detector system.

November 2000 - May 2003

Postdoctoral Appointee, Argonne National Laboratory (MINOS)

Near Detector Electronics. One of the most significant features of the MINOS experiment is its use of two separate detectors along the same path of an accelerator produced neutrino beam. By placing these detectors at very different distances from the neutrino source, many of the systematic unknowns can be eliminated or reduced. However, by placing the near detector very close to the source, the intensity of the neutrino beam will actually provide instantaneous event rates on the order of MHz. Thus, specialized electronics is required to handle the event rates and the total data throughput for a 1 kiloton detector.

My primary responsibilities were related to the testing, calibration, and general operation of the near detector electronics. This involved working closely with the electronics engineers on design: providing rapid feedback on the functionality and reliability of design modifications and writing specialized test algorithms to fully explore any weaknesses in the system. In addition, I created the software which provides the control and interface between the custom electronics and the MINOS data acquisition system, as developed at Rutherford Appleton Laboratory. This provided all the functionality for complete operation of the MINOS Near Detector data handling, diagnostics and calibrations.

In September of 2002, I was involved with the installation of the pre-production version of the electronics in a test-beam environment at CERN. I was a critical member of the experimental group: responsible for all checkout and diagnostics of the system during installation, and later for ensuring the quality of the data as it was acquired.

March 1998 - October 2000

DESY Fellow, Deutsches Elektronen-Synchrotron (H1)

SpaCal Coordinator. The SpaCal is a Lead and Scintillating Fiber calorimeter (Spaghetti Calorimeter) which is used as the primary electron identifier in the H1 detector. As a detector which was central to most of the triggering systems in H1, the coordinator position required active management of a group of approximately 50 people, including technicians, physicists, and 6 Ph.D. students, from 12 different international institutions to maintain optimal performance and effect quick repairs. In addition, the luminosity upgrade which HERA initiated during the 2000-2001 shutdown required that I perform a redesign of the SpaCal construction to accept additional beam magnets inside its existing structure. After acquiring approval from the laboratory management and a 200k DM budget, I initiated three additional construction projects at outside institutions. This design and construction proved successful in the ensuing 2001-2 run.

Physics Analysis. In the final year I was very involved with the diffractive analysis group serving as an independent internal referee on several analyses and initiating my own private analysis on Deeply Virtual Compton Scattering (DVCS). By the time I left, the existing (1997) data for DVCS had been released at the DIS2000 workshop and a small analysis group, including one Ph.D. student, had been formed to continue the analysis and increase the statistics with data from 1999 and 2000. The 1997 results were finally published in **Physics Letters B** in 2001.

July 1994 - February 1998

Research Assistant, The American University (SLAC-E154/E155)

Research for Ph.D. thesis on g_2^n data taken during the E154 experiment. E154 was a fixed target deep inelastic scattering experiment of polarized electrons on a polarized ^{3}He target, yielding the spin structure functions (g_1 and g_2) of the neutron. I was responsible for the calculation of polarized radiative corrections used in the analysis. Also, I had lead responsibility for the recording and analysis of the transverse data necessary for the measurement of g_2^n. In addition, I was able to extend my thesis results to provide the framework for the design and proposal of a SLAC extension to the subsequent E155 experiment. The extension, dedicated to the measurement of g_2 for both the proton and deuteron, was accepted by the SLAC directorate and performed in the spring of 1999.

Member of the electronics group during the construction of E154. I was responsible for the installation of an entirely new electronics and data acquisition system that departed from the previous philosophy of electronic design in End Station A. Previous designs were based on individual event triggering systems which were not adequate for the expected increased data rates for E154/E155. Personal contribution involved sole responsibility for the design and installation of the electronics triggering and timing systems that emphasized fast through-put and total signal integration while maintaining accurate time stamping of all events.

June 1993 - July 1994

Research Assistant, The American University (SLAC-E143)

Responsible for improvement and installation of calorimeter electronics. The installation of additional TDC modules for the shower counter detector required significant improvements in the signal timing and electronics, while maintaining the ability to measure 4 events per pulse.

January 1993 - June 1993

Teaching Assistant, The American University

Taught the recitation section for the second semester introductory physics course and served as an assistant for the intermediate undergraduate electricity and magnetism course. Responsibilities for the latter included grading, occasional tutoring support and all exam review sessions.

August 1989 - August 1992

Accelerator Systems Operator, Stanford Linear Accelerator Center

Responsible for the control and monitoring of all accelerator systems required for beam operation. In addition, a close relationship with accelerator physicists led to periodic accelerator physics research projects designed to better understand and improve the operation of the linear accelerator.

June 1988 - August 1988

Summer Intern, Francis Bitter National Magnet Lab

Worked closely with Tufts professor Dr. R. Guertin on the chemical doping of high-T_c super-conducting materials. Responsibilities included improvement of a data acquisition system, construction of material samples, and operation of individual experiments.

August 1985 - May 1987

Student Assistant, Tufts University

Constructed large scale cosmic ray detectors for the Tufts University High Energy Physics Department as part of their contribution to the SUDAN II proton decay project.

ADDITIONAL EDUCATION / SUMMER SCHOOLS

7/98 — CTEQ Summer School on QCD (Director: W.K. Tung)

7/96 — NATO-Advanced Summer Institute (Director: T. Ferbel)

6/94 — HUGS@CEBAF Summer School (Director: W. Buck)

1/92 — US Particle Accelerator School.

CONFERENCE TALKS AND SEMINARS

4/07 Physics Division Seminar, Argonne National Laboratory.
"Results from the First Year of MINOS"

11/06 Physics Department Colloquium, University of Notre Dame.
"The Angra Neutrino Project"

9/06 Applied Anti-Neutrino Workshop, Livermore, CA.
"Performance Comparisons of Safeguard Detector Designs"

6/06 Neutrino 2006, Santa Fe, NM.
"Status of Double Chooz"

2/06 Physics Department Colloquium, Drexel University.
"The Angra Neutrino Project"

2/06 2005 Aspen Winter Conference on Particle Physics.
"The Future of Neutrino Oscillation Measurements"

1/06 Dean's Special Seminar, College of Arts and Sciences, Drexel University.
"Guarding Nuclear Reactors with Ghosts"

3/05 Research Techniques Seminar, Fermi National Accelerator Laboratory.
"Double Chooz: A New Experiment to Measure θ_{13}"

2/05 IV Workshop on Future Low-Energy Neutrino Experiments, Angra dos Reis, Brazil.
"Shape Measurement with a Small Near Detector"
"Calibration System for the Double Chooz Experiment"

4/04 Physics Department Seminar, Northwestern University.
"Neutrinos at 1%: A Reactor Measurement of θ_{13}"

3/04 3rd Workshop on Future Low-Energy Neutrino Experiments, Niigata, Japan.
"Detailed Designs for the Angra Site"
"Some Thoughts about Increasing the Luminosity Goal"

10/03 Physics Division Seminar, Argonne National Laboratory.
"Neutrinos at 1%: A Reactor Measurement of θ_{13}"

10/03 Workshop on Future Low-Energy Neutrino Experiments, Munich, Germany.
"Angra dos Reis: The Brazilian Option"
"Kuo Sheng, Taiwan: Tunnel to the Future?"

10/03 XXIV Encontro Nacional de Físicade Partículas e Campos, Caxambu, Brazil.
"Neutrinos at 1%: A Reactor Measurement of θ_{13}"

9/03 "Neutrinos at 1%: A Reactor Measurement of θ_{13}"
Division Seminar, CBPF, Rio de Janiero, Brazil, Division of High Energy Physics.
Colloquium, Universidade de Saõ Paulo, Brazil, Instituto de Física Teórica.
Department Seminar, Universidade Estadual de Campinas (UNICAMP), Brazil, Department of Cosmic Rays.

5/03 Workshop on Future Low-Energy Neutrino Experiments, Tuscaloosa, AL.
"Baseline Optimization Studies"
"Other Sites from Around the World"

4/02 APS 2002 Conference, Albuquerque, NM.
"Event Separation in the MINOS Near Detector"

9/00 Diffraction 2000 Workshop, Cetraro, Italy.
"Diffractive Production of Real Photons"

7/00 QCD 2000 Conference, Montpellier, France.
"Structure Functions from HERA"

7/99 EPS-HEP 99 Conference, Tampere, Finland.
"New Results in eP Hadronic Final States from Diffractive Scattering and Leading Baryons"

10/96 APS-DNP Conference, Boston, MA.
"Measurement of the Neutron Spin Structure Function g_2^n and Asymmetry A_2^n at SLAC"