

LEO BELLANTONI
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Batavia IL 60510, USA
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Education:

Ph.D., May 1995, University of Wisconsin at Madison
Thesis: "The Production of Excited Charm Mesons in Semileptonic B Meson Decay"
Sau Lan Wu, Fermi Professor of Physics

Peace Corps Volunteer, Morogoro Tanzania 1985-1987

S.B. in Physics, May 1981, Massachusetts Institute of Technology
Thesis: "A Longitudinal Drift Particle Ionization Detector and Data Gathering System"
Professor Steve Steadman

Experience:

Staff Scientist II, Fermi National Accelerator Lab	2009-present
D0 Department Head	2012-2014
Staff Scientist I, Fermi National Accelerator Lab	2003-2009
Robert Wilson Fellow, Fermi National Accelerator Lab	1999-2003
Leon Lederman Fellow, Fermi National Accelerator Lab	1995-1999
Research Assistant, (ALEPH) University of Wisconsin	1988-1995
Teaching Assistant, University of Wisconsin	1987-1988
Engineer, Varian Associates, Gloucester, Massachusetts	1984-1985
Engineer, Control Data Corp., Lexington Massachusetts	1981-1984

Selected Publications:

Particle phenomenology

L.Bellantoni, J.Erler, J.J.Heckman and E.Ramirez-Homs, "Masses of a Fourth Generation with Two Higgs Doublets", *Phys. Rev.* **D86** (2012) 034022.

L.Bellantoni, "Inferred limits on lepton flavor violating decays of the K_s ", *Phys. Rev.* **D73** (2006) 014002.

Particle experimental results

L. Aliaga *et.al.*, "Neutrino Flux Predictions for the NuMI Beam", [arXiv:1607.00704](https://arxiv.org/abs/1607.00704).

V. Abazov *et.al.*, "Search for associated Higgs boson production using like charge dilepton events in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV", *Phys. Rev.* **D84** (2011) 092002.

A. Alavi-Harati *et.al.*, "Search for the Rare Decays $K_L \rightarrow \pi^0 \pi^0 \mu^+ \mu^-$ and $K_L \rightarrow \pi^0 \pi^0 X \rightarrow \pi^0 \pi^0 \mu^+ \mu^-$ ", *Phys. Rev. Lett.* **107** (2011) 201803.

A. Alavi-Harati *et.al.*, "Search for the Rare Decay $K_L \rightarrow \pi^0 e^+ e^-$ ", *Phys. Rev. Lett.* **93** (2004) 021805.

A. Alavi-Harati *et.al.*, "Search for $K_L \rightarrow \pi^0 e^+ e^-$ ", *Phys. Rev. Lett.* **86** (2001) 397-401.

A. Alavi-Harati *et.al.*, "Search for $K_L \rightarrow \pi^0 \mu^+ \mu^-$ ", *Phys. Rev. Lett.* **84** (2000) 5279-82.

D. Buskulic *et.al.*, "A Study of $D^{*+} \pi^-$ Production in Semileptonic B Decay", *Phys. Lett. B.* **345** (1995) 103-114.

D. Buskulic *et.al.*, "Heavy Flavor Production and Decay with Prompt Leptons in the ALEPH Detector", *Z. Phys.* **C62** (1994) 179-98.

D. Decamp *et.al.*, "A Search for pair-produced Charged Higgs Bosons in Z Decays", *Phys. Lett.* **B241** (1990) 623-34.

Particle experimental techniques

L. Aliaga *et.al.*, "MINERvA neutrino detector response measured with test beam data", *Nucl. Inst. Meth.* **A789** (2015) 28-42.

D. Buskulic *et.al.*, "Heavy Quark Tagging with Leptons in the ALEPH Detector", *Nucl. Inst. Meth.* **A346** (1994) 461-75.

L. Bellantoni, J.S. Conway, J.E. Jacobsen, Y.B.Pan, S.L. Wu, "Using Neural Networks with Jet Shapes to Identify b Jets in e^+e^- Interactions", *Nucl. Inst. Meth.* **A310** (1991) 618-22.

W.Atwood *et.al.*, "Performance of the ALEPH Time Projection Chamber", *Nucl. Inst. Meth.* **A306** (1991) 446-58.

Particle accelerator techniques

T.M.Austin, J.Cary, G. Werner, L. Bellantoni, *Comp. Sci. and Discovery*, **4** (2011) 015004.

T. Koeth, L. Bellantoni, H.T.Edwards, R.PFiiller, A.H.Lumpkin, J.Ruan "Emittance Exchange at the Fermilab A0 Injector", EPAC08-THPC020, Jun 26, 2008.

L.Bellantoni, H.Edwards, R.Wanzenberg, "Calculation of Asymptotic and RMS Kicks due to Higher Order Modes in the 3.9GHz cavity", FERMILAB-TM-2404-AD-APC-TD, March 2008.

C.Adolphsen *et.al.*, "Design of the ILC Crab Cavity System", EuroTeV Report 2007-010.

L.Bellantoni, G.Burt, "Wakefield Calculation for Superconducting TM_{110} Cavity Without Azimuthal Symmetry", FERMILAB TM-2356-AD-E-TD, August 2006.

G.Burt, A.Dexter, L.Bellantoni, P.Goudket, C.Beard, A.Kalinin, L.Ma, "Crab Cavity System for the ILC", *2005 ILC Physics and Detector Workshop and 2nd ILC Accelerator Workshop*, August 14-27, 2005, Snowmass Colorado.

L.Bellantoni, H.Edwards, T.Khabibouline and A.Rowe, "Field Flatness Tuning of TM_{110} Mode Cavities with Closely Spaced Modes", *11th Workshop on RF Superconductivity*, September 8-12 2003, Travemunde, Germany.

R.Wanzenberg, L.Bellantoni, H.Edwards, M.McAshan, "Design and Measurement of a Deflecting Mode Cavity for an RF Separator", and M.Champion, L.Bellantoni, T.Berenc, C.Diebele, H.Edwards, M.Foley, J.Fuerst, M.Kuchnir, A.Rowe, "Engineering Design and Prototype Tests of a 3.9GHz Transverse Mode Superconducting Cavity for a Radiofrequency Separated Kaon Beam", *Particle Accelerator Conference*, June 18-22 2001, Chicago Illinois.

Invited talks:

- "New Measurements with Photons", Moriond QCD 2013, LaThuile Italy, Mar 2013.
- "SUSY Results from the Tevatron", SUSY 2011, Fermilab, Aug 2011.
- "Beyond Standard Model Physics", FNAL Users Meeting, June 2010.
- "Searches for Beyond-Standard Model Physics", APS-DPF Plenary, Detroit, July 2009.
- "Search for $K_L \rightarrow \pi^0 \pi^0 \mu^+ \mu^-$ " at KTeV", APS-DPF Parallel Session, Detroit, July 2009.
- "ILC Crab Cavity Wakefields Analysis", ICFA Mini-Workshop on Deflecting/Crabbing Cavity Applications in Accelerators, Shanghai, China, April 2008; Chair Working Group 1 at the same conference.
- "Recent Results from KTeV", 40th Moriond Conference on Electroweak Interactions and Unified Theories, La Thuile Italy, March 2005.
- "Fermilab SRF Cavity R&D and Infrastructure", presentation to ITRP at DESY, April 2004.

Committees/panels:

- Fermilab Representative to D0 Institutional Board, 2012 onwards; D0 Authorship Committee 2012 onwards;
- Fermilab Committee on Scientific Appointments, 2010-12.
- Director's Review of LBNE Program, 2009.
- Operational Readiness Clearance Review Committee Chair, 2008 onwards.
- Scientific Committee, ICFA Mini-Workshop on Deflecting/Crabbing Cavities, Shanghai China, April 2008.
- Argonne APS Short pulse X-ray Deflecting Cavity RF Design Review. Aug. 2007.
- DOE SBIR program reviewer, 2007 onwards.
- Admissions Committee Illinois Math and Science Academy, 2004 onwards.

Summary of Phenomenological Research

Used sampling techniques to predict the masses of a possible 4th generation of standard model fermions in several different electroweak symmetry breaking scenarios, and found that to a great extent the Higgs sector has little impact on what the masses would be. The resulting publication also emphasized that existing experimental methods do have a shortcoming in their assumptions about final states and that remedies for this are already on hand.

Published a model independent derivation of the branching ratio limits for lepton flavor violation in the K_S system based on experimental limits on lepton flavor violation in K_L and K^+ decays. The resulting limits are no longer that far from what might be experimentally possible in LHCb!

Summary of Research with the MINERvA Collaboration

Hardware/Detector

Spokesman of the testbeam effort, leading a group of about 40 (with a core of about 15) scientists and engineers to design, install, commission, run and analyze data to validate the GEANT Monte Carlo simulation of the MINERvA detector. Key aspects of the the simulation, such as hadronic shower response, the behavior of electrons in the scintillator-only part of the detector need to be known to a few percent.

Summary of Research with the DØ Collaboration

Hardware/Detector

Performed the prototype bench tests and production mass-testing of the custom ASIC that is the analog front end of the central fiber tracker and preshower detectors. Devised testing procedure for the assembled boards and supervised a group of 3-4 students to test all the boards prior to their installation.

Algorithms/Analysis

Co-convended the DØ Calorimeter Algorithms group, with oversight of EM object, τ , and jet identification subgroups, as well as calorimeter calibration and missing E_T subgroups. This group also maintained the calorimeter calibration and was, in conjunction with the calorimeter operations group, responsible for maintaining calorimeter data integrity.

With other DØ physicists, set a limit on the production of a neutral scalar Higgs in association with a W^+ with leptonic decay modes. The search method is sensitive to both fermiphobic and standard model Higgs.

Co-convended the DØ QCD group 2013-4. In this role I aided the production of 13 publications.

Summary of Research with the KTeV Collaboration

Hardware/Detector

Coordinated the commissioning and installation of the Transition Radiation Detectors (TRDs) and their cable plant; created monitoring software and was responsible for the performance of this detector for the 1996-7 run.

Commissioned CAMAC based ADC system; designed and assembled a system to synchronize the data acquisition, HV, trigger system, and ADC monitoring software to the TeVatron beam spill time structure. Was responsible for the performance of this system for the 1996-7 run.

Run coordinator during 1999 run.

Analysis/Calibration

Motivated by the anomalous HyperCP result on $\Sigma \rightarrow p\mu\mu$, searched for $K_L \rightarrow \pi^0 \pi^0 \mu\mu$ and showed my result to the collaboration; I obtained $Br(K_L \rightarrow \pi^0 \pi^0 \mu^+ \mu^-) \leq 3 \times 10^{-10}$. This work was followed through on by a U.Va student, David Phillips, who presented the final result, based on the full dataset, $Br(K_L \rightarrow \pi^0 \pi^0 \mu^+ \mu^-) \leq 9.2 \times 10^{-11}$, and $Br(K_L \rightarrow \pi^0 \pi^0 X \rightarrow \pi^0 \pi^0 \mu^+ \mu^-) \leq 1.0 \times 10^{-10}$.

Searched for $K_L \rightarrow \pi^0 e^+ e^-$ and set a 90% C.L. limit of $Br(K_L \rightarrow \pi^0 e^+ e^-) \leq 5.6 \times 10^{-10}$; this preliminary result was shown at the 1999 Moriond conference. The final result on the full dataset, 2.8×10^{-10} , uses the same analysis methods as the preliminary result, and I played a large role in getting the final number out.

Introduced a second algorithm for particle identification with the TRDs, which became the more commonly used algorithm, as it had a substantially better rejection factor.

Analyzed the kinematics of the $K_L \rightarrow \pi^0 \mu^+ \mu^-$ mode and discovered that the phase space fiducial requirements essential to the $\pi^0 e^+ e^-$ mode are of little use in this mode. I developed the final set of numbers for publication of the result of the KTeV search for this mode in Physical Review Letters.

Summary of Research with the ALEPH Collaboration

Hardware/Detector

Designed tests for the FASTBUS interface to the ADC modules of the Time Projection Chamber; helped install and commission these modules; lead a small group that kept these electronics working and calibrated. Repaired faulty test pulse generation circuits. Between 1990 and 1994, assumed TPC coordinator responsibilities.

Analysis/Calibration

Searched for charged Higgs bosons in the 1989 LEP-I data, publishing a limit for the minimum possible mass of $H \rightarrow \tau^+ \tau^-$ close to the $M_Z/2$ kinematic bound.

Searched for $B \rightarrow D^{**} \ell \nu$ and found $Br(B \rightarrow D^{**0}(2420) \ell \nu X) = (0.48 \pm 0.21)\%$. There was no observable $D^{**}(2460)$ component. This result identified about 20% of the then-missing semileptonic branching ratio.

Measured the inclusive semileptonic branching ratio, $Br(B \rightarrow X \ell \nu)$, and, with a small group of collaborators, published this result, the lepton ID methods, and the purity and efficiency tests of

the lepton ID methods.

Developed feed-forward neural networks using back propagation for b jet identification in Higgs decays; this work required code optimization on a CRAY X-MP vector processing system.

Summary of Research with Particle Accelerator Physics and Technology

I was a lead developer of superconducting cavities that operate at 3.9GHz in the deflecting TM_{110} mode. These cavities were originally planned for installation (a) in the K^+ RF separated beamline for the CKM experiment and (b) in the A0 photoinjector as a beamslice diagnostic; later they were proposed for as the crab cavities of the ILC. I was the assistant project manager for the R&D work before the cancellation of the CKM experiment; this work had the intended side effect of providing the initial SRF technology base at Fermilab. I continued to work on this device towards its application as a beam slice diagnostic and as an ILC crab cavity until 2008.

Direct effort:

- o Did a complete analysis of both long-range and short-range wakefields of this cavity in its 13-cell version; applied the formalism developed for this to thoroughly analyze the HOM coupler requirements for the 3rd Harmonic cavities in the FLASH beamline.
- o Worked with Rutgers graduate student Tim Koeth as he built, assembled, tuned and tested in a beamline a 5-cell Cu version of the 3.9GHz deflecting mode cavity for the first demonstration of emittance exchange.
- o Provided support for cold tests of cavities in A0; measured and developed an effective remedy to (large) floor vibrations, mysterious or inadequate refrigeration system behavior, and a variety of RF measurement errors.
- o Extended the two-chain lumped equivalent element model of Bane & Gluckstern, and McAshan, to handle finite power dissipation, and with that model found that narrow mode spacing would make field flatness tuning difficult.
- o Developed a heat flow model that supported going to thicker walls for the cavities in order to provide much needed mechanical stiffening of the structure.
- o Took, analyzed, and modeled data describing the cooling of a niobium piece in a vacuum vessel after electron beam welding.

As a leader:

- o Validated the cavity design by reaching field strengths 50% over specification in a 3 cell thick wall prototype; the surface resistance also met spec.
- o Organized a workshop at FNAL in May 2006 on computational studies of 3.9GHz / crab cavities, and used this to help coalesce a group of people interested in working on this device. With that group, developed a beamline proposal and test sequence for the ILC Crab cavity R&D project in the New Muon/ILCTA facility.
- o Provided cost estimate for the crab cavity subsystem of the ILC, and drafted the RDR sections on this subsystem.
- o Investigated and fixed a range of quality control and manufacturing issues.

Summary of Research in Industry

I worked with Varian Associates and Control Data Corporation in the early 1980s to develop second generation electron beam microlithography machines for the VLSI industry. I studied the distortions in the beam deflection fields, and concluded that a major impediment was the buildup of thin insulating layers on the surface of the deflecting electrodes. Consequently, I did the first

research in this sector into the idea of cleaning the electron optics of these machines by creating an oxygen rich plasma inside the vacuum chamber.

Highlights of Teaching Experience

For two years I taught A-level physics and mathematics to about 40 students at Kilakala Secondary School in Morogoro, Tanzania, while I was in the Peace Corps. It was an extremely rewarding experience.

I helped launch the Phriendly Physics program, which helps elementary school teachers overcome their physics-phobias and upgrade the science content of their curricula. The program was so successful at the pilot stage that the administrator for that school district insisted in reserving all the available seats in the next year's program!

I have participated in a number of other lab-related outreach programs, including the Ask-A-Scientist program, and have been regularly involved in IMSA's applicant review process.

I introduced both high school students and their teachers to hands-on science in the DOE Honors and Topics in Modern Physics programs. Participants in these programs design and carry out their own research programs, studying cosmic rays, with a little help from a nearby physicist.