

Wade Cameron Fisher

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Education

Ph.D. (Physics), Princeton University, December 2004

B.S. Summa cum Laude (Physics), University of Minnesota, June 2000

Positions Held

Assistant Professor, Michigan State University, August 2009 to present

Leon Lederman Fellow, Fermi National Accelerator Laboratory, May 2005 to August 2009

Postdoctoral Researcher, Princeton University, December 2004 to May 2005

Research Associate, Princeton University, June 2000 to December 2004

Honors and Awards

International School of Subnuclear Physics New Talent Award, 2007

Princeton University Research Tuition Award, 2002

Barry M. Goldwater Scholarship in Science, 1999

A. O. C. Nier Undergraduate Scholarship in Physics, 1998

Research Experience

Assistant Professor, 2009-Present

- I am co-convener of the Higgs boson physics group at the $D\bar{0}$ experiment at the Fermilab Tevatron collider.
- I am the principal contact for the $D\bar{0}$ experiment for the ongoing work in the Tevatron New Phenomena/Higgs Working Group, evaluating combined CDF+ $D\bar{0}$ results for Higgs searches.
- My research interests are in Higgs boson searches and the associated precision measurements necessary to improve the search for the Higgs boson.

Leon Lederman Fellow, Fermilab 2005-2009

- At Fermilab's $D\bar{0}$ experiment, I supervise all searches for Higgs bosons decaying to bottom quark pairs ($H \rightarrow b\bar{b}$). In this role, I coordinate the efforts of more than thirty students and researchers to maximize the reach of $D\bar{0}$'s search for Higgs bosons, which is a key aspect of the Tevatron physics program.

- I am convener of the Tevatron Higgs New Phenomena Working Group. I coordinate the efforts of analyzers in the $D\bar{0}$ Higgs-physics group to generate a single combined upper limit on the production cross section from many mutually-exclusive searches. To optimize the overall reach for the Higgs boson, I further work with representatives from Fermilab's CDF experiment to generate a single result for the Tevatron. This effort has recently provided the Tevatron's first exclusion in mass for a Higgs boson near $\simeq 170 \text{ GeV}/c^2$.
- I direct a data analysis providing the Tevatron's first evidence of diboson production in lepton+quark jets decays ($WW/WZ \rightarrow \ell\nu q\bar{q}$). Using $D\bar{0}$ data, my work implements a range of unique analysis techniques, including a novel Random Forest Decision Tree event classification scheme. These techniques improve the observed significance of the diboson signal to over four standard deviations, a 70% increase over previous efforts. In addition, this work offers an essential test of data analysis and statistical techniques used in all aspects of the Tevatron Higgs search, and has set a precedent for precision data modeling at $D\bar{0}$. The diboson first evidence paper has been submitted to Physical Review Letters.
- At the $D\bar{0}$ experiment, I designed a statistical software package for calculating cross sections, confidence levels, confidence limits, and the statistical significance of measurements. This ongoing work represents an evolution beyond the statistical tools used for Higgs searches at the Large Electron Positron (LEP) collider, and is utilized extensively in $D\bar{0}$ measurements and searches. In this work, I have pioneered the introduction of novel techniques that improve the power of searches in the presence of large systematic uncertainties. This software is also being applied in the design of searches for new phenomena at the Large Hadron Collider (LHC).
- As an outreach activity, I author articles for general audiences on results from $D\bar{0}$ analyses for the publication "Fermilab Today". These weekly articles are part of Fermilab's program to promote public interest and awareness of science. I also regularly participate in public lectures on science and high energy physics.
- From 2005 to 2008, I coordinated the data quality monitoring efforts for the CMS hadron calorimeter (HCAL) subdetector group. This effort was focused on the commissioning efforts taking place at the CERN facility outside Geneva. In addition to work specific to the HCAL subdetector, I was also involved in the development of the core monitoring software of CMS data quality.
- I convened the CMS HCAL Data Quality Board, with the goal of anticipating problems related to the operation of the HCAL subdetector. This board is also charged with reviewing, developing and implementing solutions to faults observed in the monitoring of data quality.

Graduate Research Assistant, Princeton University 2000-2004

Advisor: Prof. Christopher Tully, Princeton University

- At the $D\bar{0}$ experiment, I performed a search for anomalous heavy-flavor quark production in association with a W boson. This search was designed to test Standard Model (SM) predictions for heavy-flavor quark production at the Tevatron, which is a crucial ingredient for precision measurements of top-quark properties and for Higgs boson searches. My analysis addressed results from the CDF collaboration in Run I of the Tevatron in which an anomalous rate was observed for W +heavy-flavor quark production. This work excluded the previous CDF results and was published in Physical Review Letters.
- I was a member of the Tevatron Higgs Sensitivity Study Working Group. This group produced an estimate of the sensitivity for Higgs boson searches in Run II of the Tevatron. My primary role was to develop the analysis methods for a $ZH \rightarrow \nu\nu b\bar{b}$ Higgs search. Using novel optimization and neural network (NN) techniques, my design outperformed previous analyses by a factor of 40% in sensitivity. I also extended the NN improvements to the CDF collaboration's $WH \rightarrow \ell\nu b\bar{b}$ analysis, achieving an increase in sensitivity by a factor of 150%. I was instrumental in combining the results of the individual studies, which together demonstrated a great improvement over previous estimates of the potential for finding a SM Higgs at the Tevatron. These results were presented recently to the Director of the Office of Science at the Department of Energy, and published in the Fermilab report FERMILAB-PUB-03-320-E.
- I designed and implemented data acquisition software for testbeam studies of the CMS HCAL subdetector. The software was based on a library which defined an application-program interface for making VME bus accesses optimized primarily for speed. The library was the foundation for software drivers written for

the VME hardware components used in the CMS HCAL readout. The software was used in a broader data acquisition scheme to collect data during CMS HCAL testbeam runs. This work was performed in collaboration with Dr. Jeremy Mans.

- Within the L3 experiment at the LEP collider, I performed a search for Higgs bosons decaying to electroweak vector boson pairs, which was an important complement to LEP's search for the SM Higgs. I studied the final states $(Z)H \rightarrow (Z)WW \rightarrow (\nu\nu)q\bar{q}\ell\nu$ and $(\ell\bar{\ell})q\bar{q}q\bar{q}$, two of the six dominant channels for $ZH \rightarrow ZWW$ production. I developed novel techniques for identifying $Z \rightarrow \ell\bar{\ell}$ decays and an innovative reduction method for the dominant SM WW background process. Both searches were further enhanced with the application of NNs and were ultimately published along with four other $ZH \rightarrow ZWW$ search channels in Physics Letters B. This work was performed in collaboration with Dr. Jeremy Mans.

Undergraduate Research Assistant, University of Minnesota 1998-2000

- As an undergraduate research assistant, I participated in the study of hybrid photo-diodes (HPDs) for the CMS HCAL subdetector. I worked to design a test stand for making detailed characterizations of individual HPDs, which was used to map the performance of over 5000 HPDs needed for the HCAL subdetector. I further participated in the CMS HCAL testbeams, in which HPD performance was measured for the full readout path. This work was performed under the supervision of Prof. Priscilla Cushman.
- My senior thesis research involved designing and fabricating radiation-hard, semi-transparent semiconductor photodetectors, intended primarily for *in situ* alignment of CMS muon detectors in concert with a fixed laser reference. These devices were made by layering amorphous silicon and indium tin oxide on a crystal substrate. I designed a computer model of the passage of light through the semi-transparent layers to optimize the fabrication process. This work was supervised by Prof. Roger Rusack.

Selected Publications

1. "Combination of Tevatron searches for the standard model Higgs boson in the W^+W^- decay mode", V. M. Abazov *et. al.* [DØ Collaboration], Submitted for publication to Physical Review Letters.
2. "Search for Higgs boson production in dilepton plus missing energy final states with 5.4 fb^{-1} of $p\bar{p}$ collisions at $\sqrt{s} = 1.96 \text{ TeV}$ ", V. M. Abazov *et. al.* [DØ Collaboration], Submitted for publication to Physical Review Letters.
3. "Measurement of trilinear gauge boson couplings from $WW+WZ \rightarrow \ell\nu jj$ events in $p\bar{p}$ collisions at $\sqrt{s} = 1.96 \text{ TeV}$ ", V. M. Abazov *et. al.* [DØ Collaboration], Phys. Rev. D **80**, 053012 (2009); FERMILAB-PUB-09-376-E; arXiv.org:0907.4398.
4. "Evidence of $WW + WZ$ production with lepton + jets final states in $p\bar{p}$ collisions at $\sqrt{s} = 1.96 \text{ TeV}$ ", V. M. Abazov *et. al.* [DØ Collaboration], Phys. RevLett. **102**, 161801 (2009); FERMILAB-PUB-08-457-E(2008); arXiv.org:0810.3873.
5. "Combined CDF and DØ Upper Limits on Standard Model Higgs Boson Production at High Mass (155-200 GeV/c^2) with 3 fb^{-1} of data," Tevatron New Phenomena Higgs Working Group [CDF and DØ Collaborations], FERMILAB-PUB-08-270-E(2008); arXiv:hep-ex/0808.0534.
6. "Combined CDF and DØ Upper Limits on Standard Model Higgs-Boson Production," Tevatron New Phenomena Higgs Working Group [CDF and DØ Collaborations], FERMILAB-PUB-09-060-E; arXiv:hep-ex/0903.4001.
7. "A combined search for the standard model Higgs boson at $\sqrt{s} = 1.96 \text{ TeV}$ ", V. M. Abazov *et. al.* [DØ Collaboration], Phys. Lett. B **663** 26 (2008); arXiv:hep-ex/0712.0598.
8. "Systematics and limit calculations," W. Fisher, FERMILAB-TM-2386-E(2006)

9. "A search for anomalous heavy-flavor quark production in association with W bosons," V. M. Abazov *et al.* [DØ Collaboration], *Phys. Rev. Lett.* **94** 152002 (2005); arXiv:hep-ex/0411084; W. Fisher, FERMILAB-THESIS-2005-06(2005).
10. "Data acquisition software for CMS HCAL testbeams," J. Mans and W. Fisher, arXiv:physics/0306093; CHEP-2003-TUGT005(2003).
11. "Results of the Tevatron Higgs sensitivity study," L. Babukhadia *et al.* [CDF and DØ Working Group Members], FERMILAB-PUB-03-320-E(2003).
12. "Search for a Higgs boson decaying to weak boson pairs at LEP," P. Achard *et al.* [L3 Collaboration], *Phys. Lett. B* **568** 191 (2003); arXiv:hep-ex/0307010.

Conferences and Invited Talks

- Fermilab Summer Internships in Science and Technology Lectures, "Tevatron Collider Physics," 2008.
- Michigan State University HEP Seminar, "The Standard Model Higgs Search at the Tevatron," 2008.
- International School of Subnuclear Physics, "The Standard Model Higgs Search at the Tevatron," 2007.
- Fermilab Joint Experimental-Theoretical Seminar, "Higgs Searches at DØ," 2007.
- PhyStat 2007, LHC Workshop on Statistical Issues for LHC Physics, "Experience from Tevatron Searches."
- Michigan State University HEP Seminar, "The Standard Model Higgs Search at the Tevatron," 2007.
- University of Maryland / Johns Hopkins Joint HEP Seminar, "The Standard Model Higgs Search at the Tevatron," 2007.
- Joint Meeting of Pacific Region Particle Physics Communities (DPF2006+JPS2006), Honolulu, HI, "Limits on Standard Model Higgs Production," 2006.
- Michigan State University HEP Seminar, "The DØ Higgs Search", 2006.
- APS/DPF, Riverside, CA, "Search for Anomalous Heavy-Flavor Jet Production in Association with W Bosons at DØ," 2004.