

ROBERT CRAIG GROUP

Curriculum Vitae

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RESEARCH EXPERIENCE

Assistant Professor of Physics : University of Virginia 8/2010 – present
(Position joint with Fermilab)

Leader in the low-mass Higgs search at the CDF experiment where evidence was first reported for a particle decaying to b -quark pairs and produced in association with a vector boson. Leader in R&D efforts for the cosmic ray veto system of the Mu2e experiment, and computing efforts for the NO ν A experiment. Served as convener of the Higgs analysis group at CDF experiment and the computing group at the NO ν A experiment.

Research Associate: Fermilab 12/2006 – 8/2010

Contributed to the first observation of electroweak top quark production and the search for the Higgs boson produced in association with a W boson. Worked to expand the muon acceptance in these analyses and improve the purity of the muon triggers. Coordinated the simulation of event samples for the Higgs discovery group and served as convener for the Single Top and WH analysis groups. Directed undergraduate students on cosmic ray veto studies for the mu2e experiment, and a search for Higgs bosons decaying into two photons.

EDUCATION

Ph.D. in Physics, Dec. 2006. (GPA=4.0) Gainesville, FL
University of Florida

Advisor: Richard D. Field and Konstantin Matchev

Thesis: *Inclusive Jet Production using the Midpoint Algorithm in Run II at CDF*

M.S. in Physics, Aug. 2001. (GPA=3.8) Tallahassee, FL
Florida State University

Advisor: Harrison B. Prosper

B.A. in Physics, May 1999. Due West, SC
Erskine College

RESEARCH AND EXPERIMENTAL HIGHLIGHTS

CDF Experiment

Convener of the CDF Higgs Discovery Group: May 2011 - present

I am serving as the leader of the search for the Higgs boson at the CDF experiment. During my term we searched the full dataset from the Tevatron dataset and found a 2.5 sigma deviation that could be consistent with a standard model Higgs boson.

Convener of the $WH \rightarrow \ell\nu b\bar{b}$ analysis group: Sept. 2009 - May 2011

Over the few years we have improved the sensitivity of the $WH \rightarrow \ell\nu b\bar{b}$ by more than 50% beyond what is expected from adding additional luminosity. I led the effort to add many of these analysis improvements in order to give the Tevatron the best possible chance of finding evidence of the Higgs boson with its full dataset.

Convener of the single top group: May 2008 - Sept. 2009

Managed and coordinated the efforts of the single top analysis group of the CDF experiment. In my convenership we observed single top quark production for the first time, and made the most precise measurement to date of the single top production cross section and the CKM matrix element V_{tb} .

Led effort for UVa to join CDF experiment: Oct. 2010

The University of Virginia group is officially a member of the CDF collaboration.

Observation of electroweak single top production:

Directed a graduate student on the development of an analysis method employing boosted decision trees to search for single top production. Developed a method to take muon events which did not trigger the CDF data acquisition system by using an alternative trigger based on missing transverse energy and jets. This method to acquire additional signal acceptance improved sensitivity to single top by about 15 % and has been adopted by other groups at CDF. Combined the three single top results using a technique based on best linear unbiased estimators which resulted in an additional 9 % improvement to sensitivity. These efforts contributed to the first observation of electroweak single top production by the CDF experiment.

Search for standard model Higgs boson:

Applied the matrix element and boosted decision tree techniques, which were developed for the single top analysis, to a search for the Higgs boson produced in association with a W boson. Worked to combine this result with a sister analysis based on neural networks. Published the combined result in PRL as the most sensitive Tevatron low-mass Higgs boson search to date.

Muon trigger improvements:

Designed, implemented, and tested new triggers for muons located in gap regions of the CDF muon systems. One new trigger uses coincidence with a set of scintillators which was installed, but not previously used by CDF. Studied and calibrated the trigger timing gates and counter efficiencies of this detector system. Derived a map between the scintillators and more standard muon detectors and implemented this mapping into a new trigger algorithm. These improved triggers increase signal acceptance for the Higgs boson and single top search channels by about 15 %.

Higgs group Monte Carlo coordinator: 2007 - 2008

Generated simulated Higgs boson signal events and advised analysis groups on their use for all Higgs boson searches at the CDF experiment. Designed, instituted, and maintained an automated web tool which made new samples available to the experiment.

QCD studies 2005 - 2009

- Measured the inclusive jet cross section in the forward region of the CDF detector for the first time with a cone algorithm.
- Measured the properties of the underlying event in CDF collisions.
- Managed the data samples of the QCD physics group at the CDF experiment.
- Used the technique of dijet P_T -balancing to test and maintain the jet energy relative corrections used to equalize the CDF calorimeter response in pseudo-rapidity.

Mu2e Experiment: 2009 - present

Level-3 manager for fabrication of the cosmic ray veto system.

Led high school and undergraduate students on assembly and commissioning of a prototype cosmic ray veto detector for the mu2e experiment.

DØ Experiment

Monitoring and control tools: 2000 - 2001

Developed graphical user interface tools in the PYTHON programming language to monitor and control DØ detector components. Specifically, involved in the calorimeter and the silicon track trigger monitoring tools.

Other Efforts

Computing accomplishments: 2002 - 2006

- Installed and maintained the software of the CDF experiment on a computing cluster at the University of Florida. Maintained Monte Carlo generator tools which were used for validation and tuning of the Monte Carlo in preparation for its use by the CDF and CMS experiments.
- Developed and investigated tools for accessing parton density functions. Specifically an interface to the Les Houche Accord was developed so that it could be used trivially with the common Monte Carlo programs PYTHIA and HERWIG.

Phenomenology of supersymmetry: 2003 - 2004

- Developed a technique for use by LHC experiments to extract the mass of the supersymmetric particles using the shapes of various kinematic distributions.
- Led a student on the development a web-based tool which calculates supersymmetric mass spectra and cross sections SUPERSIM.

MENTOR EXPERIENCE

I am currently contributing to the supervision of two students on their thesis and two other students have recently defended. I have a history of success at receiving support for and directing undergraduate and high school students on research projects in experimental particle physics. Recently, I started a new summer research program for undergraduate physics majors in which two students each summer engage in an intense research experience at Fermilab.

Postdoctoral Researchers

Yuri Oksuzian, University of Virginia, Summer 2010 - current

Yuri optimized the b -jet tagging strategy of the low-mass Higgs effort at CDF. This work resulted in significant gains in the sensitivity of the Higgs search at the Tevatron. Yuri also continues to play a leading role in the R&D efforts for the cosmic ray veto system of the mu2e experiment. During the Summer of 2010, 2011, and 2012 Yuri was the leader of several undergraduate and high school students on these efforts. Yuri was selected as a 2011 URA Visiting Scholar and received \$20,000 to support his research efforts at Fermilab.

Graduate Students

Will Henderson, University of Virginia, Ph.D. expected 2017

I actively recruited Will and he joined our graduate program. He spent the summer of 2012 at Fermilab working on the NOvA experiment before starting classes.

Hao Liu, University of Virginia, Ph.D. expected 2014

Search for Low-Mass Higgs bosons at CDF. Hao worked at Fermilab from May 2011 through March 2012 to improve the sensitivity of the CDF experiment to a Low-Mass Higgs boson. He will complete his thesis work with the measurement of the s-channel single top production cross section over the next two years.

Karen Bland, Baylor University, Ph.D. expected Summer 2012

Search for Higgs bosons decaying into diphotons. Karen is focused on optimizing a standard model search by improving photon ID efficiency and background rejection. She was honored for her efforts with the chance to give the Fermilab "Wine and Cheese" seminar on her work in the Summer of 2011.

Barbara Alvarez, Universidad de Oviedo, Spain; Ph.D. completed 2010

Search for Higgs produced in association with a W boson. Barbara is focusing her efforts on improving the jet energy resolution information which is used in the matrix element analysis.

Bruno Casal, Universidad de Cantabria, Spain; Ph.D. completed 2009

Observation of Single Top Quark production. Bruno is focused his efforts on improving muon signal acceptance, polarization studies, and optimizing search techniques using boosted decision trees.

Undergraduate and High School Students

Research Adventure in Particle Physics at Fermilab:

- David Wilson (Summer 2012): Studies of the CDF energy scan data
- Alyssa Henderson(Summer 2012): R&D for the Mu2e Cosmic Ray Veto System

Directed Research Of UVa Physics Major (Summer 2011 - May 2012):

- David Abbott: Studied the sensitivity of plastic scintillator to fast neutrons. David presented his work at 2011 SESAPS and 2012 APS. He recieved a travel award from UVA and from APS to attend the APS meeting, was awarded an award for best undergraduate oral presentation at APS, and has been accepted into graduate school for physics.

Directed Research of Two UVa Physics Majors (2011):

- Jeff Lansford: Analysed data taken by a cosmic ray veto prototype for the Mu2e experiment
- Eric Nguyen: Considered design issues and made CAD drawings for the cosmic ray veto prototype for the Mu2e experiment

High School Students on Mu2e (Summer 2009 and 2010): Led local high school students on R&D for the cosmic ray test stand of the Mu2e experiment.

IMSA Student at CDF (2007 - 2009): Supervised an Illinois Math and Science Academy high school student on an analysis of CDF data which searched for the Higgs boson decaying to two photons. The student has been extremely successful and we have published two papers in PRL based on his efforts.

Italian Summer Student at CDF (2008): Wrote a proposal for and then supervised a participant of the INFN-DOE Summer Students program from Pisa, Italy on an analysis of CDF data which searched for double dijet mass resonances.

SULI Summer Student at CDF (2008): Wrote a proposal for and then supervised a participant of the DOE's Science Undergraduate Laboratory Internships program on an analysis of CDF data which searched for double dijet mass resonances.

Pre-Service Teaching Internship at CDF (2007): Wrote a proposal for and supervised a participant of the DOE's Pre-Service Teaching internship student on an analysis of CDF data which searched for the Higgs boson decaying to two photons. The student was successful at setting the strongest limit to date on fermiophobic Higgs models from a hadron collider.

REU Summer Student at the University of Florida (2003): Supervised a student from the NSF Research Experiences for Undergraduates, REU, program at the University of Florida. The student developed a web-based tool which calculates supersymmetric mass spectra and cross sections.

HONORS AND AWARDS

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| Nominated as Mead Honored Faculty | 2012 |
| URA Visiting Scholar Award (for post-doc) The URA awarded Yuri Oksuzian an award of \$20,000 to support our groups efforts at Fermilab | 2011 |
| Outstanding Mentor Award DOE Office of Science, for mentoring students on the CDF experiment | 2009 |
| Alumni Fellowship Department of Physics, University of Florida | 08/2002 – 08/2006 |
| DPF Travel Award Awarded to attend the April APS meeting in Dallas, TX | Spring 2006 |
| UF College of Liberal Arts and Science Travel Award Awarded to attend the Pheno 2006 meeting in Madison, WI | Spring 2006 |
| DPF Travel Award Awarded to attend the April APS meeting in Tampa, FL | Spring 2005 |
| REU Summer Research Fellowship Awarded for summer research at Florida State University | Summer 1999 |
| Marsh W. White Award (Sigma Pi Sigma) For design of a functional Foucault pendulum to be displayed publicly at Erskine College | 1999 |

FUNDING

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| DoE UVA Intensity Frontier Task – \$1,100,000: 2012-2015 (+1 co-PI) |
| Fermilab Travel – \$15,000: 2012 |
| Dean’s Travel Award – \$800: 2012 |
| Mead Honored Faculty – \$3000: 2012 |
| DoE Supplementary for work on CDF experiment – \$13,000: 2012-2013 |
| Jefferson Trust Grant for Summer Program – \$28,800: 2012-2015 |
| HEET equipment funds – \$17,000: 2011 (+1 co-PI) |
| Fermilab Travel – \$25,000: 2011 |
| DoE Supplementary for work on CDF experiment – \$45,000: 2011-2012 |
| Undergraduate and Graduate student Travel Awards – \$1300: 2011-2012 |
| URA Visiting Scholar Award (faculty host) – \$20,000: 2011-2012 |
| HEET equipment funds – \$23,000: 2010 (+1 co-PI) |
| Start-up funds from UVA – \$250,000: 2010-2013 |

CONFERENCE TALKS AND SEMINARS

“Higgs Boson Searches at the CDF Experiment”

Colloquium, University of Virginia, Sep. 2012

“Recent Results from the Tevatron”

Workshop on The LHC, Particle Physics, and the Cosmos, Auckland, New Zealand, July 2012

“Tevatron Higgs Searches: Past and Future”

Invited, The Next Stretch of the Higgs Magnificent Mile, Chicago, IL, May 2012

“Higgs Boson Search Results Using the Full Tevatron Dataset”

Invited, APS April Meeting, Atlanta, GA, April 2012

“Charged Lepton Flavor Violation Discussion Summary Report”

Invited, Intensity Frontier Workshop, Rockville, MD, Nov. 2011

“The Impact of Higgs Searches at the Tevatron in the LHC Era”

– Invited, South Eastern section of APS (SESAPS), Roanoke, VA, Oct. 2011
– Physics Seminar, James Madison University, Oct. 2011

“Search for neutral Supersymmetric Higgs bosons in $b\bar{b}(b)$ final states at the Tevatron”

Meeting APS Division of Particles and Fields, Brown University, Aug. 2011

“Status and Summary of the Mu2e Experiment”

– Meeting of the APS Division of Particles and Fields, Brown University, Aug. 2011
– Invited, Fermi National Accelerator Laboratory, Users’ Meeting, June 2011

“Low-mass Higgs Searches at the Tevatron”

Workshop on Higgs Cross Sections for the LHC, Brookhaven National Laboratory, NY, May 2011

“Searches for New Physics at the Tevatron”

Plenary talk, DIS2011, Newport News, VA, April 2011

“Recent Studies of the Underlying Event from CDF”

Northwestern University HEP Seminar, Evanston, IL, May 2010

“The Race for the Higgs Boson”

March 2010
– University of Virginia physics colloquium
– University of Alabama physics colloquium

“A Foundation for Low-Mass Higgs Searches”

Lawrence Berkeley National Laboratory, CA, Jan. 2010

“R&D Plans for the Cosmic Ray Veto System”

Mu2e Collaboration Meeting, Rice University, Jan. 2010

“Status of Low-Mass Higgs Searches at the Tevatron”
SLAC Experimental Seminar, Menlo Park, CA, November 2009

“Lighting up the Higgs sector with photons at CDF”
– Notre Dame HEP Seminar, Notre Dame, IN, November 2009
– University of Wisconsin HEP Seminar, Madison, WI, April 2009

“Low Mass Higgs Boson Search Improvements at CDF”
Tevatron Higgs Workshop, Fermilab, May 2009

“The Observation of Single Top Production at the Tevatron”
April 2009
– University of Victoria HEP Seminar, Victoria, Canada
– TRIUMF National Lab Seminar, Vancouver, Canada

“The Race for the Higgs Boson”
FIU Physics Colloquium, Miami, FL, April 2009

“Searching for the Higgs One Single Top at a Time”
January-February 2009
– FSU HEP Seminar, Tallahassee, FL
– MSU HEP Seminar, East Lansing, MI
– Michigan HEP Seminar, Ann Arbor, MI

“Higgs Searches at CDF”
Lake Louise Winter Institute, Alberta, Canada, February 2009

“Status of Higgs Searches at CDF”
February - March 2008
– Instituto de Fisica de Cantabria HEP Seminar, Santander, Spain
– University of Florida HEP Seminar, Gainesville, FL

“Recent QCD Results from the Tevatron”
January - February 2008
– XXII Rencontres de Physique de la Vallee d’Aoste, La Thuile, Italy
– Argonne HEP Seminar, Argonne National Lab

“The Inclusive Jet Cross Section at CDF”
February-September 2006
– FSU HEP Seminar, Tallahassee, FL
– Seminar at the Enrico Fermi Institute, Chicago, IL
– Vanderbilt Nuclear and Particle Physics Seminar, Nashville, TN
– Pheno Symposium, Madison, WI
– University of Florida HEP Seminar, Gainesville, FL
– APS April Meeting, Dallas, TX
– CDF Collaboration meeting, FNAL, IL
– UF-FSU Phenomenology Symposium, Tallahassee, FL, December 2004

“PDF use from the Tevatron to the LHC”
– TeV4LHC Workshop, FNAL, IL, November 2005
– South Eastern CMS Physics Workshop, Gainesville, FL, May 2006

WORKSHOPS AND SUMMER SCHOOLS

The Hadron Collider Physics Summer School (HCPSS)

Fermilab, August 9 - 18, 2006

Theme: *“Physics Potential of the First Years of the LHC”*

Theoretical Advanced Study Institute (TASI) Summer School

Boulder, CO, University of Colorado, June 4 - July 1, 2006

Theme: *“Exploring New Frontiers Using Colliders and Neutrinos”*

MEMBERSHIP AND LEADERSHIP

Elected member of the Fermilab Users' Executive Committee (2012 - 2014)

Higgs Analysis Group Co-convener of CDF experiment (2011 - 2012)

Tevatron New Phenomenon/Higgs Working Group (2011-2012)

WH and Single Top Sub-group Co-convener of CDF experiment (2008 - 2011)

Executive Board member for the CDF Experiment (2011 - 2012)

L3 manager of Fabrication for Cosmic Ray Veto of the Mu2e experiment (2011 -)

National Scholars Honor Society (inducted 2007)

Phi Kappa Phi Honor Society (inducted 2006)

American Physical Society (lifetime member)

APS Division of Particles and Fields

Philomathean Literary Society, President (1999), Vice President (1998)

Kappa Mu Epsilon, Mathematics Honor Society, President (1999, Erskine College)

Sigma Pi Sigma, Physics honor society

FNAL Garden Club (2007-2009)

FNAL Golf League: Arrowhead League Champions 2008 and 2009

Robert Craig Group

PUBLICATION LIST

Publications in Refereed Journals

- [1] “*Search for Resonant Top-antitop Production in the Semi-leptonic Decay Mode Using the Full CDF Data Set*”, Submitted to PRL, arXiv:1211.5363
- [2] “*Evidence for a particle produced in association with weak bosons and decaying to a bottom-antibottom quark pair in Higgs boson searches at the Tevatron*”, Phys. Rev. Lett. 109, 071804 (2012)
- [3] “*Search for a Higgs boson in the diphoton final state using the full CDF data set*”, Physics Letters B 717 (2012) 173181
- [4] “*Combined search for the standard model Higgs boson decaying to a bb pair using the full CDF data set*”, Phys. Rev. Lett. 109, 111802 (2012)
- [5] “*Search for the standard model Higgs boson decaying to a bb pair in events with one charged lepton and large missing transverse energy using the full CDF data set*”, Phys. Rev. Lett. 109, 111804 (2012)
- [6] “*Search for the standard model Higgs boson produced in association with a W^\pm boson with 7.5 fb^{-1}* ”, Phys. Rev. D 86, 032011 (2012)
- [7] “*Search for a Higgs Boson in the Diphoton Final State in $p\bar{p}$ at $\sqrt{s} = 1.96 \text{ TeV}$* ”, Phys. Rev. Lett. 108, 011801 (2012)
- [8] “*Search for a Higgs Boson produced in Association with a W Boson Using a Method Based on Matrix Element Techniques*”, Phys. Rev. D. 85, 072001 (2012)
- [9] “*Observation of Single Top Quark Production and Measurement of V_{tb} with CDF*”, Phys. Rev. D. 82, 112005 (2010)
- [10] “*Measurement of the $WW+WZ$ Production Cross Section Using a Matrix Element Technique in Lepton + Jets Events*”, Phys. Rev. D. 82, 112001 (2010)
- [11] “*Studying the Underlying Event in Drell-Yan and High Transverse Momentum Jet Production at the Tevatron*”, Phys. Rev. D. 82, 034001 (2010)
- [12] “*Measurement of the WW and WZ production cross section in $\ell\nu jj$* ”, Phys. Rev. Lett. 104, 101801 (2010)
- [13] “*Search for Standard Model Higgs Bosons in $WH \rightarrow \ell\nu b\bar{b}$* ”, Phys. Rev. Lett. 103, 101802 (2009)
- [14] “*Observation of Single Top Quark Production*”, Phys. Rev. Lett. 103, 092002 (2009)
- [15] “*Search for a Fermiophobic Higgs Boson Decaying into Diphotons at CDF*”, Phys. Rev. Lett. 103, 061803 (2009)
- [16] “*Measurement of Single Top Quark Production at CDF*”, Phys. Rev. Lett. 101, 250601 (2008)
- [17] “*The Inclusive Jet Cross Section Using the Midpoint Algorithm in RunII at CDF*”, Phys. Rev. D78, 052006 (2008)

In addition to the publications listed above, I have been a member of the CDF author list since January 2006 with over 285 publications and more than 10000 citations (based on the SPIRES - High-Energy Physics Literature Database). I have also made major contributions to almost 100 unpublished notes documenting my work for the CDF, Mu2e, and NOvA collaborations.

Conference Proceedings and Non-refereed Publications

- [1] “*Updated Combination CDF and D0 Searches for Standard Model Higgs Boson Production with up to 10.0 fb⁻¹ of Data*”, Tevatron New Phenomena and Higgs Working Group, arXiv:1207.0449 (2012)
- [2] “*Fundamental Physics at the Intensity Frontier*”, Intensity Frontier Workshop, arXiv:1205.2671 (2012)
- [3] “*Combined CDF and D0 Search for Standard Model Higgs Boson Production with up to 10.0 fb⁻¹ of Data*”, Tevatron New Phenomena and Higgs Working Group, arXiv:1203.3774 (2012)
- [4] “*Combined CDF and D0 measurement of WZ and ZZ production with b-tagged jets*”, Tevatron New Phenomena and Higgs Working Group, arXiv:1203.3782 (2012)
- [5] “*Status of Higgs Boson and Other New Physics Searches at the Tevatron*”, Contributed to the proceedings of XIX International Workshop on Deep-Inelastic Scattering and Related Subjects, Newport News, VA, 2011
- [6] “*Combined CDF and D0 Upper Limits on Standard Model Higgs Boson Production with up to 8.6 fb⁻¹ of Data*”, Tevatron New Phenomena and Higgs Working Group, arXiv:1107.5518 (2011)
- [7] “*Combined CDF and D0 upper limits on Fermiophobic Higgs Boson Production with up to 8.2 fb⁻¹ of Data*”, Tevatron New Phenomena and Higgs Working Group, arXiv:1109.0576 (2011)
- [8] “*Combined CDF and D0 Searches for the Standard Model Higgs Boson Decaying to Two Photons with up to 8.2 fb⁻¹ of Data*”, Tevatron New Phenomena and Higgs Working Group, arXiv:1107.4960 (2011)
- [9] “*Higgs Boson Searches at CDF*”, Contributed to Lake Louise Winter Institute, arXiv:0905.4267 (2009)
- [10] “*Combination of CDF and DØ Single Top Quark Cross Sections Measurements*”, Tevatron New Phenomena and Higgs Working Group, arXiv:0908.2171 (2009)
- [11] “*Combination of Single Top Quark Production Results from CDF*”, Contributed to ICHEP 2008, arXiv:0809.4670 (2008)
- [12] “*Recent QCD Studies at the Tevatron*”, Contributed to XXII Rencontres de Physique de la Vallee d’Aoste, arXiv:0804.4494 (2008)
- [13] “*PDF use from the Tevatron to the LHC*”, Contributed to TeV4LHC workshop, QCD Group Report, hep-ph/0605240 (2005)
- [14] “*Slepton Mass Measurements at the LHC II*”, Contributed to TeV4LHC workshop, Exotics Group Report, hep-ph/0608322 (2005)
- [15] “*Slepton Mass Measurements at the LHC*”, Contributed to Linear Collider Workshop, hep-ph/0507002 (2005)
- [16] “*PYTHIA Tune A, HERWIG, and JIMMY in Run 2 at CDF*”, Contributed to Hera and the LHC workshop, hep-ph/0510198 (2005)
- [17] “*The Les Houches Accord PDFs (LHAPDF) and LHAGLUE*”, Contributed to Hera and the LHC workshop, hep-ph/0508110 (2005)