

I. Joseph Kroll

Education

Harvard University, Ph.D. in Physics, 1989.
University of California, Berkeley, B.A. in Physics,
summa cum laude, 1982.



Professional Experience

Professor, University of Pennsylvania, 2006-present.
Associate Professor (with tenure), University of Pennsylvania, 2001-2006.
Assistant Professor, University of Pennsylvania, 1997-2001.
Scientific Associate, Wilson Fellow, Fermilab, 1993-1997.
Research Associate, University of Chicago, 1989-1992.
Research Assistant, Harvard University, 1984-1989.
Teaching Assistant, Harvard University, 1983.
Research Assistant, Univ. of California, Los Angeles, 1982-1983.

Honors and Awards

Fellow of the American Physical Society 2009

Nominated by: Division of Particles and Fields

Citation: *For major contributions to the observation and measurement of B_s - B_s bar mixing, including early recognition of the importance of the measurement, proposal and construction of the CDF time-of-flight system to improve particle identification, studies of B -tagging, and leadership during the final phases of the measurement.*

High Energy and Particle Physics Prize from the European Physical Society, 2013, co-recipient with the ATLAS and CMS Collaborations for *an outstanding contribution to High Energy Physics for the discovery of a Higgs boson, as predicted by the Brout-Englert-Higgs mechanism.*

High Energy and Particle Physics Prize from the European Physical Society, 2019, co-recipient with the CDF and D0 Collaborations for *the discovery of the top quark and the detailed measurements of its properties.*

Outstanding Junior Investigator, Department of Energy, 1998-2001.

Wilson Fellow, Fermilab, 1993-1997.

Department Citation, Physics, University of California, Berkeley, 1982.

Phi Beta Kappa, University of California, Berkeley, 1982.

Research Experience

My research is in experimental particle physics. I have worked on both hadron colliders and electron-positron colliders. My interests have spanned precision tests of the electroweak model, flavor physics studies—particularly the physics of hadrons containing b quarks—and searches for the Higgs boson and particles not contained in the standard model.

I began this career between undergraduate and graduate school, when I spent one year at CERN working on the CERN ISR experiment R608 (supervisor: Peter Schlein). As a graduate student, I worked on the UA1 experiment on the CERN Sp \bar{p} S collider. I measured strange-particle production in minimum-bias events, and I participated in the study of events with large missing transverse energy, which led to the first observation of $W \rightarrow \tau\nu$ and limits on a fourth-generation heavy lepton and supersymmetric particles (squarks and gluinos). My dissertation was the search for long-lived strongly-produced heavy particles in proton-antiproton collisions at $\sqrt{s} = 630$ GeV (advisor: Carlo Rubbia).

As a post-doc at the University of Chicago (supervisor: Jim Pilcher), I worked on the OPAL experiment at the CERN Large Electron Positron collider. I performed searches for heavy neutral leptons, organized electron identification in hadronic events (Chicago was responsible for the presampler, which played an important role in electron identification) and used electrons to measure the branching ratio of $Z \rightarrow b\bar{b}$, a unique and important test of the electroweak model.

In 1993 I moved to Fermilab as a Wilson Fellow, and I worked on the CDF experiment during both Run I and Run II of the Tevatron. In Run I, I focused on B physics, in particular, the first search for $B \rightarrow \mu^+\mu^-$ and the development of b flavor tags (first application of jet-charge at a hadron collider), which were used in measurements of B^0 flavor oscillations and the first measurement of the CP asymmetry in $B^0 \rightarrow J/\psi K_s^0$ at a hadron collider. I co-convened the CDF B physics group during a particularly active period from 1996 to 1998. In 1997 I moved to the University of Pennsylvania (Penn) as a tenure-track assistant professor.

In Run II of the Tevatron, I led the proposal for a time-of-flight detector (TOF) for CDF. The primary motivation for the TOF was same-side flavor tagging with kaons for B_s^0 . I was awarded an Outstanding Junior Investigator award by the Department of Energy for this work. I co-led the construction and installation of the TOF, and I co-led the precise measurement of Δm_s and the observation of B_s^0 flavor oscillations. The two papers in *Physical Review Letters* that report these measurements have over 1 000 citations combined. In recognition of this work, I was elected a Fellow of the American Physical Society. I also worked on searches for the Higgs boson. In 2003 I co-led the Higgs Sensitivity Study, a joint study with D \emptyset , and I worked on searching for associated production of the Higgs boson using the all-hadronic channel. In addition, I participated in the first upgrade of the second level of the CDF trigger.

In 2007 I joined the ATLAS experiment at the Large Hadron Collider at CERN located in Geneva, Switzerland. Penn joined ATLAS in 1994 and has made major contributions to the Transition Radiation Tracker (TRT) in electronics, data acquisition, commissioning

and maintenance and offline calibration, performance and alignment. I first focused on the TRT alignment, an effort I initiated when I joined ATLAS. This role expanded in Run 1 to include work on the entire inner-detector alignment. In Run 2, my group continued to play an important role in the inner-detector alignment and had front-line responsibility for the TRT alignment. We were leaders in electron identification, both for online event selection (the trigger) and offline data analysis for physics. In Run 1 we made major improvements to the cut-based electron particle identification (PID) and developed the likelihood-based electron PID. My post-doc, Mauro Donega co-led the e/gamma combined-physics performance group. In Run 2, we were the primary group responsible for both the offline and online (HLT) electron PID. We led the creation of the framework that is used to determine electron efficiencies in both data and simulation (and the associated scale factors).

My physics focus in Run 1 was the search for and discovery of the standard model Higgs boson in the decay channel $H \rightarrow WW^{(*)} \rightarrow \ell'\nu\nu'$. I was selected to be one of the five editors of the eight-four page article published in Physical Review D on the final LHC Run 1 measurement of the Higgs boson couplings using the WW^* final state; at that time this was the most precise measurement of these couplings from a single final state. My students worked on measurements of the WW production cross section, the discovery and measurement of the Higgs boson in the WW^* and ZZ^* channels and the search for $t\bar{t}H$ production in multilepton final states.

Using the data set from Run 2 of the LHC, my group has been searching for solutions to the hierarchy problem: why the Higgs boson mass is small. One possible solution is the existence of supersymmetric particles (SUSY). My group has focused on the supersymmetric partner of the top quark (the stop) and electroweakly-produced gauginos, the partners of the weak intermediate vector bosons and the Higgs boson. In the stop quark search we had a leading role in the signature based on one prompt lepton, large missing transverse energy and multiple jets with high transverse momentum with at least one jet identified as originating from a b quark. In the search for gauginos, we are focused on signatures involving two and three charged prompt leptons in both uncompressed and compressed-mass scenarios. To develop our understanding of trilepton signatures, we co-led the first measurement of the $W^\pm Z$ boson pair production cross section at the new center-of-mass energy of 13 TeV. I also had a student engaged in searching for gauginos in hadronic final states, particularly final states with jets from b -quarks. This student took part in the measurement the efficiency of the b -jet identification algorithms in the flavor tagging combined performance group. My post-doc, Dr. Keisuke Yoshihara, held several leadership roles in the ATLAS SUSY physics group, including co-convening the SUSY Background Forum.

I also had a student engaged in searches for high-mass and low-mass diphoton resonances, and I had a student working on the measurement of the production same-charge W boson pairs (W^+W^+ and W^-W^-), which is particularly interesting final state for advancing our understanding of electroweak symmetry breaking and the Higgs mechanism.

I am deeply involved in electronics for the silicon-strip-based part of the upgraded Phase 2 tracker (ITk-strips) for ATLAS, which will be installed in the later part of this decade. I am the Level-4 manager in US ATLAS for ITK-strip application specific integrated circuits

(ASICs). This means I provide the faculty oversight of the design, production and testing of two ASICs: the Autonomous Control and Monitoring chip (AMACStar) and the Hybrid Controller Chip (HCCStar); both ASICs are being designed by our instrumentation specialists at Penn.

Since May 2013 I have served as a member of the US ATLAS Analysis Support Panel and the US ATLAS Speakers Committee. From March 2011 to March 2013, I was a member of the twelve-person ATLAS publication committee. I served as one of two proceedings monitors for ATLAS from April 2012 to September 2012.

Activities in the Particle Physics Community

I have been an active member of the particle physics community, particularly in conference organization. My most notable effort was in co-leading the organization of ICHEP 2008, which was held in Philadelphia at Penn. I also had a major role in the creation of the conference series on Flavor Physics and CP Violation (FPCP), which was first held at Penn in 2002. I served on the 2010 and 2009 APS W.K.H. Panofsky Prize in Experimental Particle Physics Selection Committee. I have served as a reference for *Physical Review Letters*, *Physical Review D* and *Physics Letters B*. I have reviewed proposals for the US Department of Energy, the United States-Israel Binational Science Foundation (BSF), Canada and Switzerland.

Teaching Experience

I have focused on the two-semester introductory sequence in physics for scientists and engineers: Physics 140/150 on Newtonian mechanics and Physics 141/151 on electricity and magnetism. For more than two decades I have taught Physics 364/564, an electronics course for physicists. In recent years I have been alternating with Senior Lecturer Dr. William Ashmanskas. Together we initiated and oversaw the creation of a new laboratory space in David Rittenhouse Laboratory for this course. The webpages for recent versions of this course may be found at http://www.hep.upenn.edu/Classes/Phys364_fall120/ and http://www.hep.upenn.edu/Classes/Phys364_fall119/. In Fall 2020, I offered an entirely online version of Physics 364, which used the Digilent Electronics Explorer board to construct and study circuits, and CircuitLab, an online web-based circuit simulation platform. The students did all of the laboratory exercises at home. Currently I am teaching an online version of Physics 414/521, a course on experiments in modern physics.

I make use of new teaching methods including active learning and flipped classrooms. I participated in the 2016-2017 SAIL seminar for faculty that was organized by Bruce Lenthall in the Center for Teaching and Learning at Penn. I attended the 2016 AAPT Experienced Teacher Workshop <https://www.aapt.org/Conferences/efw.cfm>, March 18-20, College Park, MD. I co-authored a paper with my Penn colleagues E. Mele and D. Durian that has been accepted for publication in the American Journal of Physics: *Resolving Tensions Surrounding Massive Pulleys*, arXiv:2010.05240 [physics.ed-ph].

I have served as a premajor advisor since the 1998-1999 academic year. This role involves acting as a faculty advisor to a group of ten first-year students or sophomores.

Mentoring of Younger Scientists

I take particular pride in the effort I have made to mentor young scientists both at Penn and at other academic institutions.

Over the past two decades, I have recruited a large number of Penn undergraduate students who took my electronics course to work with our instrumentation group that is a cornerstone of the Penn experimental particle physics effort. Many of these undergraduates have gone on to graduate school. Some are even faculty at top tier Universities, *e.g.*, Alex High who is now an assistant professor at the University of Chicago.

I try to give my graduate students and post-docs the freedom to choose their own research projects, while providing guidance that ensures they make choices that can help advance their scientific careers or future employment ambitions. Many of my graduate students have gone on to extremely competitive, prestigious fellowships and eventually to tenure-track faculty positions at major research universities. Similarly, several of my post-docs now hold faculty positions or permanent staff positions at particle physics laboratories.

Working in large experimental collaborations has provided the opportunity to work not only with Penn post-docs and graduate students, but also with young scientists from other academic institutions and laboratories. In some cases I have played a very important role in advancing their careers by providing substantial career advice and guidance as well as letters of recommendation. (A list of these researchers can be provided upon request.) I have continued to advise and support former members of the Penn collider physics effort. I have also been asked to serve as an external member of dissertation committees for graduate students at other academic institutions in the ATLAS collaboration.

Current and Past Postdoctoral Fellows

Jeffrey Shahinian, ATLAS, current.

Keisuke Yoshihara, ATLAS, postdoctoral researcher, Iowa State.

Tae Min Hong (primary supervisor E. Lipeles), ATLAS, Assistant Professor, Pittsburgh.

Zachary Marshall, ATLAS, Staff Scientist, LBNL.

Mauro Donega, ATLAS, Senior Research Scientist, ETH Zurich.

Aart Heijboer, CDF II, Staff Scientist NIKHEF, the Netherlands.

Rudolf Oldeman, CDF II, Faculty at University of Cagliari, Italy.

Matthew Jones, CDF II, Associate Professor, Purdue University.

Current Graduate Students

Luis Felipe Gutierrez Zagazeta (3rd Year)

Sicong Lu (3rd Year)

Past Graduate Students

Racheal Creager, May 2020, ATLAS,

Searching for supersymmetry in boosted fully-hadronic final states with b-jets and calibrating b-jet identification using spatially matched muons at the ATLAS detector.

CERN-THESIS-2020-035, <https://cds.cern.ch/record/2718459?ln=en>

Machine Learning Engineer, Iterable.

Will DiClemente, May 2019, ATLAS,

Measurement of electroweak production of same-charge W boson pairs at ATLAS.

CERN-THESIS-2019-037, <https://cds.cern.ch/record/2674035>.

Data Scientist, Comcast.

Joey Reichert, May 2019, ATLAS,

Electron Identification, Electronics Upgrades, and Electroweak Supersymmetry at ATLAS.

CERN-THESIS-2019-027, <https://cds.cern.ch/record/2672349?ln=en>.

Karl Berkelman Research Fellowship in experimental particle physics, Cornell University.

Rob Fletcher, 2018, ATLAS,

A search for new low-mass diphoton resonances at ATLAS and an investigation into using Gaussian process regression to model non-resonant two-photon Standard Model backgrounds,

CERN-THESIS-2018-322, <https://cds.cern.ch/record/2653797?ln=en>.

Current position: Primary Data Scientist, Esri, Redlands, CA.

Kurt Brendlinger, 2016, ATLAS,

Physics with electrons in the ATLAS detector,

CERN-THESIS-2016-144, <https://cds.cern.ch/record/2228644?ln=en>

2016 ATLAS Thesis Award, 2016 Springer Thesis Award.

Current position: Fellowship at DESY (on ATLAS), Hamburg, Germany,

Christopher Lester, 2015, ATLAS,

A search for the Higgs boson produced in association with top quarks in multilepton final states at ATLAS,

CERN-THESIS-2015-100, <https://cds.cern.ch/record/2037201?ln=en>,

Current position: Director of Data Science and Research at CareJourney.

John Alison, 2012, ATLAS,

The Road to Discovery : Detector Alignment, Electron Identification, Particle Misidentification, WW Physics, and the Discovery of the Higgs Boson,

CERN-THESIS-2012-295, <https://cds.cern.ch/record/1536507?ln=en>

2013 ATLAS Thesis award, 2013 Springer Thesis Award.

Current position: Assistant Professor of Physics, Carnegie Mellon University

Denys Usynin, 2006, CDF II,

Study of Charged Particle Species Produced in Association with B₀, B⁻, and B_s Mesons in proton-anti-proton collisions at $\sqrt{s} = 1.96$ TeV,

FERMILAB-THESIS-2005-68, <http://inspirehep.net/record/702174>,

Director of Development, FINCAD, UK www.fincad.com

Chunhui Chen, 2003, CDF II,
A Measurement of the direct charm meson production cross-section at CDF II,
FERMILAB-THESIS-2003-14, <http://inspirehep.net/record/621039>,
Professor of Physics, Iowa State.

Owen Long (co-advised with Nigel Lockyer), 1997, CDF I,
A Proper Time Dependent Measurement of Δm_d Using Jet Charge and Soft Lepton Flavor Tagging,
FERMILAB-THESIS-1998-18, <http://inspirehep.net/record/454573>
Professor of Physics, University of California, Riverside.

Dissertation Committees at the University of Pennsylvania (a partial list)

Tanner Kaptanoglu (advisor: J. Klein), 2020, SNO+, Advanced Detector R & D
Leigh Schaefer (advisor: E. Thomson), 2019, ATLAS.
Elodie Resseguie (advisor: E. Lipeles), 2019, ATLAS.
Theodore Herwig (advisor: E. Lipeles), 2019, ATLAS.
Eric Marzec (advisor: J. Klein), 2019, SNO+.
Khilesh Mistry (advisor: H. H. Williams), 2019, ATLAS.
William Balunus (advisor: E. Lipeles), 2018, ATLAS.
Rehan Deen (advisor: B. Ovrut), 2018, Theoretical Particle Physics.
Zain Saleem (advisor: M. Cvetič), 2016, Theoretical Particle Physics.
Elizabeth Hines (advisor: E. Thomson), 2015, ATLAS.
Austin Purves (advisor: B. Ovrut), 2015, Theoretical Particle Physics.
Alexander Tuna (advisor: H. H. Williams), 2015, ATLAS.
Rami Vanguri (advisor: E. Lipeles), 2015, ATLAS.
Richard Bonventre (advisor: J. Klein), 2014, SNO.
James Saxon (advisor: H. H. Williams), 2014, ATLAS.
Douglas Schaefer (advisor: E. Lipeles), 2014, ATLAS.
Joshua Kunkle (advisor: E. Lipeles), 2013, ATLAS.
Ryan Reece, 2013 (advisor: H. H. Williams), ATLAS.
Jennifer Mosher (advisor M. Sako), 2013, Astrophysics.
Dominick Olivito (advisor: E. Thomson), 2012, ATLAS.
Timothy Shokair (advisor: E. Beier), 2012, SNO.
Anna Grassellino (advisor: N. Lockyer), 2011, Accelerator Physics.
Erin Buckley (advisor: A. Yodanis), 2011, Medical Physics.
Michael Hance (advisor: H. H. Williams), 2011, ATLAS.
Daniel Jacobs, (advisor: J. Aquirre), 2011, Astrophysics.
Elisabetta Pianori (advisor: N. Lockyer), 2011, CDF.
Tatiana Rodriguez (advisor: N. Lockyer, E. Lipeles), 2011, CDF.
Federica Bianco (advisor: C. Alcock), 2010, Astrophysics.
Justin Keung (advisor: E. Thomson), 2010, CDF.
Michael Fischbein (advisor: M. Drndić), 2009, Condensed Matter Physics.

Danvers Johnston (advisor: A. Johnson), 2008, Condensed Matter Physics.
Laura Marian (advisor: G. Bernstein), 2008, Astrophysics.
Hans Stabenau (advisor: B. Jain), 2008, Astrophysics.
Yanjun Tu (advisor: N. Lockyer), 2008, CDF.

Dissertation Committees at other Institutions

Keisuke Yoshihara, 2014, University of Tokyo, ATLAS,
Measurement of the Higgs Boson Couplings using the $WW^ \rightarrow l\nu l\nu$ Final State*, CERN-THESIS-2014-151, <https://cds.cern.ch/record/1955933?ln=en>.

Jan Kuechler, 2018, Wuppertal University, ATLAS,
Search for Partners of the Top Quark with the ATLAS Experiment,
CERN-THESIS-2018-155, <https://cds.cern.ch/record/2638106?ln=en>.

Selected Publications

1. *Search for new phenomena with top quark pairs in final states with one lepton, jets, and missing transverse momentum in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, ATLAS Collaboration, G. Aad *et al.*, submitted to J. High Energ. Phys., e-Print: arXiv:2012.03799 [hep-ex].
2. *Alignment of the ATLAS Inner Detector in Run-2*, ATLAS Collaboration, G. Aad *et al.*, Eur. Phys. J. C **80** (2020) 1194.
3. *Search for chargino-neutralino production with mass splittings near the electroweak scale in three-lepton final states in $\sqrt{s} = 13$ TeV pp collisions with the ATLAS detector*, ATLAS Collaboration, (M. Aaboud *et al.*), submitted to Phys. Rev. D. e-Print: arXiv:1912.08479 [hep-ex].
4. *Searches for electroweak production of supersymmetric particles with compressed mass spectra in $\sqrt{s} = 13$ TeV pp collisions with the ATLAS detector*, ATLAS Collaboration, (M. Aaboud *et al.*), Phys. Rev. D **101** 052005 (2020). e-Print: arXiv:1911.12606 [hep-ex].
5. *Observation of electroweak production of a same-sign W boson pair in association with two jets in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, ATLAS Collaboration, (M. Aaboud *et al.*), Phys. Rev. Lett. **123**, 161801 (2019).
6. *Electron reconstruction and identification in the ATLAS experiment using the 2015 and 2016 LHC proton-proton collision data at $\sqrt{s} = 13$ TeV*, ATLAS Collaboration (M. Aaboud *et al.*), Eur. Phys. J. C **79** (2019) 639.
7. *Search for electroweak production of supersymmetric particles in final states with two or three leptons at $\sqrt{s} = 13$ TeV with the ATLAS detector*, ATLAS Collaboration (M. Aaboud *et al.*), Eur. Phys. J. C (2018) 78: 995.

8. *Search for electroweak production of supersymmetric states in scenarios with compressed mass spectra at $\sqrt{s} = 13$ TeV with the ATLAS detector*, ATLAS Collaboration (M. Aaboud *et al.*), Phys. Rev. D **97** 052010 (2018).
9. *Search for top-squark pair production in final states with one lepton, jets, and missing transverse momentum using 36fb^{-1} of $\sqrt{s} = 13$ TeV pp collision data with the ATLAS detector*, ATLAS Collaboration (M. Aaboud *et al.*), J. High Energ. Phys. (2018) 2018: 108.
10. *Electron efficiency measurements with the ATLAS detector using 2012 LHC proton-proton collision data*, ATLAS Collaboration (M. Aaboud *et al.*), Eur. Phys. J. C **77** 195 (2017).
11. *Performance of the ATLAS Transition Radiation Tracker in Run 1 of the LHC: tracker properties* ATLAS Collaboration (M. Aaboud *et al.*), JINST **12** P05002 (2017).
12. *Search for top squarks in final states with one isolated lepton, jets, and missing transverse momentum in $\sqrt{s} = 13$ TeV pp collisions with the ATLAS detector*, ATLAS Collaboration (M. Aaboud *et al.*), Phys. Rev. D **94**, 052009 (2016).
13. *Measurement of the $W^{\pm}Z$ boson pair-production cross section in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS Detector*, ATLAS Collaboration (M. Aaboud *et al.*), Phys. Lett. B **762** (2016) p. 1–22.
14. *Observation and measurement of Higgs boson decays to WW^* with the ATLAS detector*, ATLAS Collaboration (G. Aad *et al.*), Phys. Rev. D **92**, 012006 (2015).
15. *A particle consistent with the Higgs Boson observed with the ATLAS Detector at the Large Hadron Collider*, ATLAS Collaboration (G. Aad *et al.*), Science **338**, 1576 (2012).
16. *Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC*, ATLAS Collaboration (G. Aad *et al.*), Phys. Lett. B **716**, 1 (2012).
17. *Search for the Standard Model Higgs boson in the $H \rightarrow WW^{(*)} \rightarrow \ell\nu\ell\nu$ decay mode with $4.7/\text{fb}$ of ATLAS data at $\sqrt{s} = 7$ TeV*, ATLAS Collaboration (G. Aad *et al.*), Phys. Lett. B **716**, 62 (2012)
18. *Search for the Higgs boson in the $H \rightarrow WW^{(*)} \rightarrow \ell\nu\nu$ decay channel in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector*, ATLAS Collaboration (G. Aad *et al.*), Phys. Rev. Lett. **108**, 111802 (2012).
19. *Measurement of the WW Cross Section in $\sqrt{s} = 7$ TeV pp Collisions with ATLAS*, ATLAS Collaboration (G. Aad *et al.*), Phys. Rev. Lett. **107**, 041802 (2011).
20. *A Search for the Associated Production of the Standard-Model Higgs Boson in the All-Hadronic Channel*, T. Aaltonen *et al.* (CDF Collaboration) Phys. Rev. Lett., **103**, 221801 (2009).

21. *Particle physicists measure matter antimatter flip*, J. Kroll, Phys. World **19N7**, p. 32-34 (2006).
22. *Observation of B_s^0 - \bar{B}_s^0 Oscillations*, A. Abulencia *et al.* (CDF Collaboration) Phys. Rev. Lett. **97**, 242003 (2006).
23. *Measurement of the B_s^0 - \bar{B}_s^0 Oscillation Frequency*, A. Abulencia *et al.* (CDF Collaboration), Phys. Rev. Lett. **97**, 062003 (2006).
24. *CDF level 2 trigger upgrade*, K. Anikeev *et al.*, IEEE Trans. Nucl. Sci. **53**, p. 653-658 (2006).
25. L. Babukhadia *et al.* (CDF and DØ Collaborations) *Results of the Tevatron Higgs Sensitivity Study*, FERMILAB-PUB-03-320-E, Oct. 2003, 64pp, unpublished.
26. *Measurement of Prompt Charm Meson Production Cross Sections in $p\bar{p}$ Collisions at $\sqrt{s} = 1.96$ TeV*, D. Acosta *et al.* (CDF Collaboration) Phys. Rev. Lett. **91**, 241804 (2003).
27. *Front-end electronics for the CDF-II time-of-flight system*, C. Chen, M. Jones, W. Kononenko, J. Kroll, G.M. Mayers, F.M. Newcomer, R.G.C. Oldeman, D. Usynin, R. Van Berg, IEEE Trans. Nucl. Sci. **50**, p. 2486-2490 (2003).