Ashutosh Kotwal

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Professional Preparation

University of Pennsylvania	Electrical Engineering	B.S.E., Summa Cum Laude, 1988
University of Pennsylvania	Finance	B.S.Econ., Summa Cum Laude, 1988
Harvard University	Physics	Ph.D., 1995

Appointments

2014-present	Fritz London Distinguished Professor of Physics, Duke University
2012-2015	Associate Chair, Department of Physics, Duke University
2010-2014	Professor of Physics, Duke University
2005-2010	Associate Professor of Physics, Duke University
1999-2005	Assistant Professor of Physics, Duke University
1995-1998	Research Associate in Physics, Columbia University

Fellowships, Awards and Grants

- Fellow of the Maharashtra Academy of Sciences, India, 2013.
- Dean's Leadership Award, Duke University, 2013.
- Fellow of the American Association for the Advancement of Science, 2012.
- Program Director and Principle Investigator of Duke High Energy Physics, 2009-2015.
- Fellow of the American Physical Society, 2008.
- Alfred P. Sloan Foundation Fellow, 2000.
- Department of Energy Outstanding Junior Investigator Award, 2000.

Leadership Activities

- US Coordinator of global Very High Energy Collider (100 TeV) Project, 2014-present.
- Head of Future Collider Facilities Group, Fermilab[1], 2014-present.
- US ATLAS[2] Physics Advisor for LHC, 2013-2014.
- Electroweak Physics Co-convener, DPF[3] Study for Long Range Planning, 2013.
- Chair, Information Technology Advisory Committee, Duke University, 2012-2013.
- Chair and Vice-Chair, DPF Nominations Committee, 2010-2011.
- Chair, Fermilab Users Executive Committee, 2008-2009.
- Co-leader of the CDF[4] Offline Analysis and Computing Project, 2004-2006.

[1] Fermi National Accelerator Laboratory
[2] LHC Experiment
[3] Division of Particles and Fields, American Physical Society
[4] Collider Detector at Fermilab

– Co-convener of the CDF Electroweak Physics group, 2002-2004.
– Co-founder of the Tevatron Electroweak Working Group.
– Co-leader of CDF Simulation Group, 2003-2004.
– Co-convener of the DØ[5] Electroweak Physics group, 1997-1998.

Advisory and Review Committees

– ATLAS Upgrade Physics Subcommittee, 2013-2015.
– DoE[6] Selection Committee, Early Career Award, 2013.
– ATLAS Forward Physics Upgrade Review Committee, 2012.
– US-ATLAS Upgrade Review Committee, 2011-2012.
– Information Technology Advisory Committee, Duke University, 2010-2013.
– DoE Selection Committee, Outstanding Junior Investigator Award, 2008.
– Fermilab Users Executive Committee, 2007-2009.
– Joint DoE/NSF[7] Review Committee of US LHC Software and Computing Project, 2007.
– Open Science Grid Council, 2004-2007.
– Fermilab Collider Physics Task Force, 2005.
– Reviewer, Physics Letters B and Physical Review Letters.
– Reviewer, research proposals for U.S. Department of Energy and Research Corporation.
– External Evaluator, Academy of Finland and Portuguese Foundation of Science and Technology, 2013.

Conference and Workshop Organization

– Co-Convener, Workshop on "Probing Dark Matter at Very High Energy *pp* Colliders", Fermilab, December 2015.
– Co-Convener, Workshop on "Electroweak Phase Transition and Baryogenesis at Very High Energy *pp* Colliders", University of Massachusetts, Amherst, September 2015.
– Co-Convener, Workshop on "Future of High Energy Physics", Hong Kong University of Science and Technology, January 2015.
– Program Committee, US-ATLAS Workshop, University of Washington, August 2014.
– Organizer, Workshop on Electroweak Physics, DPF Study for Longe Range Planning, Duke University, February 2013.
– "Higgs and New Physics" session convener, European Physical Society, July 2011.
– Organizer, W Mass Workshop at Fermilab, October 2010.
– Chair, Program & Organizing Committees, Fermilab Annual Users Conference, June 2009.
– Co-convener, Electroweak Physics session, DPF Conference, July 2009.
– Member, International Advisory Committee, Hadron Collider Physics Conference 2004-2008.

[5]Collider Experiment at the Fermilab Tevatron accelerator
[6]US Department of Energy
[7]US National Science Foundation

– Chair, Hadron Collider Physics Symposium, Duke University, 2006.
– Organizing Committee, Precision Electroweak Physics Workshop, Fermilab, 2004.
– Co-convener, Very Large Hadron Collider Benchmarks Group, Snowmass Workshop 2001.
– Organizing Committee, Workshop on Monte Carlo Generator Physics for Run 2 at the Tevatron, 2001.

Selected Publications

- A. V. Kotwal with G. Aad *et al.* [ATLAS Collaboration], "A search for $t\bar{t}$ resonances using lepton-plus-jets events in proton-proton collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector", JHEP **1508**, 148 (2015).

- B. Auerbach, S. Chekanov, J. Lobe, J. Proudfoot, A. V. Kotwal, "Sensitivity to new high-mass states decaying to $t\bar{t}$ at a 100 TeV Collider", Phys. Rev. **D91**, 034014 (2015).

- A. V. Kotwal, S. Chekanov, M. Low, "Double Higgs Boson Production in the 4τ Channel from Resonances in Longitudinal Vector Boson Scattering at a 100 TeV Collider", Phys. Rev. **D91**, 114018 (2015).

- Ian Hinchliffe, Ashutosh Kotwal, Michelangelo L. Mangano, Chris Quigg, Lian-Tao Wang, "Luminosity goals for a 100-TeV *pp* collider", Int. J. Mod. Phys. A **30**, 1544002 (2015).

- A. V. Kotwal with G. Aad *et al.* [ATLAS Collaboration], "Observation and measurement of Higgs boson decays to WW^* with the ATLAS detector", Phys. Rev. **D 92**, 012006 (2015).

- Ashutosh V. Kotwal and Christopher Hays, "Drift Chamber Alignment using Cosmic Rays", Nucl. Inst. Meth. Phys. Res. **A 762**, 85 (2014).

- A. V. Kotwal with T. Aaltonen *et al.* [CDF Collaboration], "A precise measurement of the W-boson mass with the Collider Detector at Fermilab", Phys. Rev. **D 89**, 072003 (2014).

- Ashutosh V. Kotwal and Christopher Hays, "Electromagnetic Shower Properties in a Lead-Scintillator Sampling Calorimeter", Nucl. Inst. Meth. Phys. Res. **A 729**, 25 (2013).

- A. V. Kotwal with T. Aaltonen *et al.* [CDF Collaboration and DØ Collaboration], "Combination of CDF and DØ W boson mass measurements", Phys. Rev. D **88**, 052018 (2013).

- A. V. Kotwal with G. Aad *et al.* [ATLAS Collaboration], "A search for $t\bar{t}$ resonances in the lepton plus jets final state with ATLAS using 4.7 fb^{-1} of *pp* collisions at $\sqrt{s} = 7$ TeV", Phys. Rev. **D 88**, 012004 (2013).

- A. V. Kotwal with G. Aad *et al.* [ATLAS Collaboration], "A particle consistent with the Higgs Boson observed with the ATLAS Detector at the Large Hadron Collider", Science **338**, 1576-1582 (2012).

- A. V. Kotwal with G. Aad *et al.* [ATLAS Collaboration], "Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC", Phys. Lett. **B716** (2012) 1-29.

- A. V. Kotwal with G. Aad *et al.* [ATLAS Collaboration], "A search for $t\bar{t}$ resonances with the ATLAS detector in 2.05 fb^{-1} of proton-proton collisions at $\sqrt{s} = 7$ TeV", Eur. Phys. J. **C72** (2012) 2083.

- A. V. Kotwal with T. Aaltonen *et al.* [CDF Collaboration], "Precise measurement of the W-boson mass with the CDF II detector", Phys. Rev. Lett. **108**, 151803 (2012).

- A. V. Kotwal with G. Aad *et al.* [ATLAS Collaboration], "Combined search for the Standard Model Higgs boson using up to 4.9 fb^{-1} of pp collision data at $\sqrt{s} = 7$ TeV with the ATLAS detector at the LHC", Phys. Lett. **B 710**, 49 (2012).

- A. V. Kotwal with G. Aad *et al.* [ATLAS Collaboration], "Search for the Higgs boson in the $H \to WW^* \to l\nu l\nu$ decay channel in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector", Phys. Rev. Lett. **108**, 111802 (2012).

- A. V. Kotwal with T. Aaltonen *et al.* [CDF Collaboration], "Search for the Standard Model Higgs Boson Produced in Association with a Z Boson in $p\bar{p}$ Collisions at $\sqrt{s} =$ 1.96 TeV", Phys. Lett. **715** (2012) 98-104.

- A. V. Kotwal with G. Aad *et al.* [ATLAS Collaboration], "Search for contact interactions in dilepton events from pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector", Phys. Lett. **B712** (2012) 40-58.

- A. V. Kotwal with G. Aad *et al.* [ATLAS Collaboration], "Search for high-mass resonances decaying to dilepton final states in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector", JHEP **1211** (2012) 138.

- A. V. Kotwal with G. Aad *et al.* [ATLAS Collaboration], "Search for dilepton resonances in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector", Phys. Rev. Lett. **107**, 272002 (2011).

- A. V. Kotwal with G. Aad *et al.* [ATLAS Collaboration], "Search for a heavy gauge boson decaying to a charged lepton and a neutrino in 1 fb^{-1} of pp collisions at $\sqrt{s} = 7$ TeV using the ATLAS detector", Phys. Lett. **B705**, 28 (2011).

- A. V. Kotwal with G. Aad *et al.* [ATLAS Collaboration], "Search for high mass dilepton resonances in pp collisions at $\sqrt{s} = 7$ TeV with the ATLAS experiment", Phys. Lett. **B700**, 163 (2011).

- A. V. Kotwal with T. Aaltonen *et al.* [CDF Collaboration], "Search for High Mass Resonances Decaying to Muon Pairs in $\sqrt{s} = 1.96$ TeV $p\bar{p}$ Collisions", Phys. Rev. Lett. **106**, 121801 (2011).

- A. V. Kotwal with T. Aaltonen *et al.* [CDF Collaboration], "Improved Search for a Higgs Boson Produced in Association with $Z \to l^+l^-$ in proton-antiproton Collisions at $\sqrt{s} = 1.96$ TeV", Phys. Rev. Lett. **105**, 251802 (2010).

- A. V. Kotwal with T. Aaltonen *et al.* [CDF Collaboration], "Measurement of the top quark mass with dilepton events selected using neuroevolution at CDF", Phys. Rev. Lett. **102**, 152001 (2009).

- A. V. Kotwal with T. Aaltonen *et al.* [CDF Collaboration], "Search for High-Mass Resonances Decaying to Dimuons at CDF", Phys. Rev. Lett. **102**, 091805 (2009).

- A. V. Kotwal with T. Aaltonen *et al.*, [CDF Collaboration], "A Search for the Higgs Boson Produced in Association with $Z \to l^+l^-$ Using the Matrix Element Method at CDF II", Phys. Rev. D **80**, 071101 (R) (2009).

- C. Hays, A. V. Kotwal, O. Stelzer-Chilton, "New Techniques in the Search for Z' Bosons and Other Neutral Resonances", Mod. Phys. Lett. **A 24**, 2387 (2009).

- A. V. Kotwal and J. Stark, "Measurement of the W boson mass at the Tevatron", Ann. Rev. Nucl. Part. Sci. **58** (2008).

- A. V. Kotwal with T. Aaltonen *et al.* [CDF Collaboration], "First Run II Measurement of the W Boson Mass at the Fermilab Tevatron", Phys. Rev. D **77**, 112001 (2008).

- A. V. Kotwal with T. Aaltonen *et al.* [CDF Collaboration], "First measurement of the W boson mass in run II of the Tevatron", Phys. Rev. Lett. **99**, 151801 (2007).

- A. V. Kotwal with A. Baranovski *et al.*, "CDF II production farm project", Nucl. Instrum. Meth. **A 572**, 399 (2007).

- A. V. Kotwal with A. Abulencia *et al.* [CDF Collaboration], " Precision measurement of the top-quark mass from dilepton events at CDF II", Phys. Rev. D **75** , 031105(R) (2007).

- A. V. Kotwal with D. Acosta *et al.* [CDF Collaboration], "Search for excited and exotic muons in the $\mu\gamma$ decay channel in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV", Phys. Rev. Lett. **97**, 191802 (2006).

- A. V. Kotwal with J. Antos *et al.*, "Data processing model for the CDF experiment", IEEE Trans. Nucl. Sci. **53**, 2897 (2006).

- A. V. Kotwal with D. Acosta *et al.* [CDF Collaboration], "Search for long-lived doubly-charged Higgs bosons in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV", Phys. Rev. Lett. **95**, 071801 (2005).

- A. V. Kotwal with D. Acosta *et al.* [CDF Collaboration], "Search for excited and exotic electrons in the $e\gamma$ decay channel in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV", Phys. Rev. Lett. **94**, 101802 (2005).

- A. V. Kotwal with C. Hays *et al.*, "Inside-out tracking at CDF", Nucl. Instrum. Meth. **A 538**, 249 (2005).

- A. V. Kotwal with D. Acosta *et al.* [CDF Collaboration], "Search for doubly-charged Higgs bosons decaying to dileptons in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV", Phys. Rev. Lett. **93**, 221802 (2004).

- A. V. Kotwal with V. M. Abazov *et al.* [CDF Collaboration and DØ Collaboration and Tevatron Electroweak Working Group], "Combination of CDF and DØ Results on W boson mass and width", Phys. Rev. D **70**, 092008 (2004).

- Sabine Hossenfelder, Marcus Bleicher, Stefan Hofmann, Horst Stocker (Frankfurt U.), Ashutosh V. Kotwal (Duke U.), "Black Hole Relics in Large Extra Dimensions", Phys. Lett. B **566**, 233 (2003).

- A. V. Kotwal, H. K. Gerberich and C. Hays "Identification of cosmic rays using drift chamber hit timing", Nucl. Instrum. Meth. **A 506**, 110 (2003).

- Ashutosh V. Kotwal and Christopher Hays, "Production and Decay of Spinning Black Holes at Colliders and Tests of Black Hole Dynamics", Phys. Rev. D **66**, 116005 (2002).

- A. V. Kotwal with T. Affolder *et al.* [CDF Collaboration], "Search for Quark-Lepton Compositeness and a Heavy W$'$ Boson using the $e\nu$ Channel in $p\bar{p}$ Collisions at $\sqrt{s} = 1.8$ TeV", Phys. Rev. Lett. **87**, 231803 (2001).

- R. M. Thurman-Keup, A. V. Kotwal, M. Tecchio and A. Byon-Wagner, 'W Boson Physics at Hadron Colliders", Rev. Mod. Phys. **73**, 267 (2001).

- A. V. Kotwal with B. Abbott *et al.* [DØ Collaboration], "Measurement of the W Boson Mass using Electrons at Large Rapidities", Phys. Rev. Lett. **84**, 222 (2000) and Phys. Rev. D. **62**, 092006 (2000).

- A. V. Kotwal with B. Abbott *et al.* [DØ Collaboration], "Measurement of the High Mass Drell-Yan Cross Section and Limits on Quark-Electron Compositeness Scales", Phys. Rev. Lett. **82**, 4769 (1999).

- A. V. Kotwal with M. R. Adams *et al.* [E665 Collaboration], "Proton and Deuteron Structure Functions in Muon Scattering at 470 GeV", Phys. Rev. D **54**, 3006 (1996).

Selected Preprints

- A. V. Kotwal with the ATLAS Collaboration, "Beyond Standard Model Higgs boson searches at a High-Luminosity LHC with ATLAS", ATL-PHYS-PUB-2013-016 (October, 2013).

- A. V. Kotwal and D. Wackeroth and M. Baak *et al*, "Study of Electroweak Interactions at the Energy Frontier", arXiv:1310.6708 (October, 2013).
- A. V. Kotwal with C. Degrange *et al.*, "Studies of Vector Boson Scattering And Triboson Production with DELPHES Parametrized Fast Simulation for Snowmass 2013", arXiv:1309.7452 (October, 2013).
- A. V. Kotwal with the ATLAS Collaboration, "Studies of Vector Boson Scattering And Triboson Production with an Upgraded ATLAS Detector at a High-Luminosity LHC", ATL-PHYS-PUB-2013-006 (June, 2013).
- A. V. Kotwal with the ATLAS Collaboration, "Studies of Sensitivity to New Dilepton and Ditop Resonances with an Upgraded ATLAS Detector at a High-Luminosity LHC", ATLAS-PHYS-PUB-2013-003 (February, 2013).

Collaborators and Other Affiliations

- The ATLAS collaboration, since 2010 (co-author of 444 publications)
- The CDF collaboration, since 1999 (co-author of 418 publications)
- The DØ collaboration, since 1995 (co-author of 135 publications)
- The E665 collaboration, since 1990 (co-author of 9 publications)
- Graduate and postdoctoral advisors: F. Pipkin, R. Wilson, P. M. Tuts
- Ph.D. thesis advisees: B. Cerio, H. K. Gerberich, C. Pollard, Y. Zeng
- Masters thesis advisees: J. P. Tuttle, R. Shekhar
- Postdoctoral advisees: C. P. Hays, B. Jayatilaka, S. Li

Presentations

- "Electroweak Measurements and the Scale of New Physics", Chicago-Beijing Workshop on Circular Electron-Positron Higgs Factory, September 2015.
- "Experiments at a Very High Energy pp Collider", Hong Kong University of Science and Technology, January 2015.
- "Electroweak Measurements and the Scale of New Physics", Institute of High Energy Physics, Beijing, July 2014.
- "The Higgs boson, Dark Matter and Black Holes at the LHC", Colloquium at Tsinghua University, Beijing, July 2014.
- "Standard Model Physics at Hadron Colliders", CTEQ Summer School Lectures, Peking University, Beijing, July 2014.

- "Beyond Standard Model Higgs Boson Searches at ATLAS", International Symposium on Particles, Strings and Cosmology (PASCOS2013), Taipei, November 2013.
- "Precision Electroweak Measurements at the Energy Frontier", Workshop on Determining the Next Energy Scale in HEP, University of Pittsburgh, November 2013.
- "Precision Electroweak Measurements at the Energy Frontier", DPF Long Range Study, Minneapolis, August 2013.
- "The Physics Case for the High-Luminosity Upgrade of the LHC", US ATLAS Workshop, Argonne National Laboratory, July 2013.
- "Hadron Collider Physics", Lectures at Canadian Summer School for Particle Physics, July 2013.
- "W Boson Mass Measurement", Plenary talk at the Large Hadron Collider Physics Conference, Barcelona, May 2013.
- "The Physics Case for the Energy Frontier", Discussion Panel, Brookhaven National Laboratory, April 2013.
- "Precision Measurement of the W Boson Mass at the Tevatron and LHC", QCD@LHC Workshop, Michigan State University, August 2012.
- "Precision Measurements at Hadron Colliders", Joint CERN-Fermilab Hadron Collider Physics Summer School, August 2012.
- "A New Precision Measurement of the W Boson Mass at CDF", Joint Theoretical-Experimental Physics Seminar, Fermilab, February 2012; Research Progress Meeting at LBNL, March 2012; Seminar at University of Chicago, April 2012.
- "The Higgs boson, Dark Matter and Black Holes: Revolutionizing the Laws of the Universe with the LHC", Sathey College, Mumbai, July 2011; Garware College, Pune, June 21, 2011.
- "Precision Measurements and the Higgs Boson", Indian Institute of Science Education and Research, Pune, June 2011; Inter University Center for Astronomy and Astrophysics, Pune, June 2011.
- "Precision Electroweak Physics at CDF", Workshop on Precision LHC Physics at LPNHE, Universits Paris VI et Paris VII, France, December 2010.
- "Precision Tests of the Standard Model", Invited Plenary talk at the 22^{nd} Rencontres de Blois, July 2010.
- "Measurement of the W boson mass at CDF", Brookhaven National Laboratory, June 24, 2010.
- "Precision Measurements in High Energy Physics and the Higgs Boson", Colloquium at UNC Wilmington, January 2010.

- "W Mass Measurements at the Tevatron and LHC", Joint Theoretical/Experimental Physics Seminar at University of Maryland & Johns Hopkins University, November 2009.

- "Measurement of the W boson mass at the Tevatron", DESY Hamburg and Zeuthen, July, 2009.

- "Standard Model physics at the Tevatron", Plenary talk at the Phenomenology 2009 Symposium, May 2009.

- "Status and Prospects of Standard Model Electroweak Physics", Invited Plenary talk at the DAE Symposium on High Energy Physics, Varanasi, India, December 2008.

- "Search for the Higgs Boson", Seminar at the Inter-University Centre for Astronomy and Astrophysics, Pune, India, December 2008.

- "Search for Dimuon Resonances", Seminar at the Tata Institute of Fundamental Research, Mumbai, India, December 2008.

- "Standard Model Measurements and Higgs Searches at the Tevatron", Invited Plenary talk at the SLAC Summer Institute, Stanford, July 2007.

- "The First Run 2 Measurement of the W Boson Mass by CDF", Invited Plenary talk, LoopFest VI Conference, "Radiative Corrections for the LHC and ILC", Fermilab, April 2007.

- "The First Run 2 Measurement of the W Boson Mass by CDF", High Energy Physics Seminars: University of California, Santa Barbara, May 2008; University of Rochester, November 2007; Stony Brook University, October 2007; Cornell University, May 2007; Northwestern University, April 2007; Princeton University, April 2007; Yale University, March 2007; Harvard University, March 2007; University of Chicago, February 2007.

- "Science Results from Computing Grids", Invited Plenary talk, Open Science Grid All-Hands Meeting, San Diego Supercomputer Center, March 2007.

- "The First Run 2 Measurement of the W Boson Mass by CDF", Invited Plenary talk, ATLAS Overview Collaboration Meeting, February 2007.

- "The First Run 2 Measurement of the W Boson Mass by CDF", Invited Plenary talk, Aspen Winter Conference, January 2007.

- "The First Run 2 Measurement of the W Boson Mass by CDF", Joint Theoretical-Experimental Physics Seminar, Fermilab, January 2007.

- "Searching for Doubly-Charged Higgs Bosons", Colloquim at Northern Illinois University, September 2006.

- "The W Mass Measurement at the Tevatron and Lessons for ATLAS", Invited talk at the ATLAS Collaboration Meeting, February 2005.

- "Searching for Doubly-Charged Higgs Bosons", Colloquim at Texas A & M University, October 2004.
- "Overview of the Tevatron Physics Program", Invited Plenary talk at the TeV4LHC Conference, Fermilab, September 2004.
- "Results and Plans of the Tevatron Electroweak Working Group", Invited Plenary talk at the Hadron Collider Physics Conference (HCP2004), Michigan State University, June 2004.
- "The W Boson Mass Measurement at the Tevatron", Invited Plenary talk at the "Zero to Z^0: Precision Electroweak Physics" Conference, Fermilab, May 2004, and member of discussion panel.
- "Electroweak Physics at the Tevatron", Invited Review talk at American Physical Society - Division of Particles and Fields Conference, Philadelphia, April 2003.
- "Review of Electroweak Physics at the Tevatron and Prospects for Run 2", XXX International Conference on High Energy Physics, Osaka, July 2000.
- "A New Measurement of the W Boson Mass at DØ", Stanford Linear Accelerator Center and Lawrence Berkeley Laboratory, June 1999.
- Plenary Speaker at QCD and Weak Boson Physics Workshop, Fermilab, March 1999.
- "W Mass Measurement at DØ using Forward Detectors", Joint Theoretical-Experimental Physics Seminar, Fermilab, February 1999.
- "Search for Quark-Electron Compositeness at DØ", Workshop on New Strong Dynamics, Fermilab, October 1998.
- "W Boson Physics at the Tevatron", XXIX International Conference on High Energy Physics, Vancouver, July 1998.

Research Interests

Prof. Ashutosh Kotwal's research focuses on the physics of fundamental particles and forces at high energies. He was instrumental with his team in discovering the Higgs boson at the Large Hadron Collider. The Higgs boson arises from a completely new mechanism, never before seen in Nature, to impart mass to all fundamental particles. While this discovery has solved a major fifty-year old puzzle in fundamental physics, it has brought a new set of questions to the fore. How does the Higgs boson happen to have just the required properties? What is Dark Matter, how is it related to normal matter and how is it produced? Is there a connection between Dark Matter and the Higgs boson? Finally, why is there more matter than anti-matter in the Universe, when the experimentally tested theory of particle physics called the Standard Model predicts that there should be no such imbalance?

Prof. Kotwal is pursuing these questions experimentally using two approaches - precision measurements of fundamental parameters, and direct searches for new particles and forces.

Prof. Kotwal is the US Coordinator of a global effort to build a very large hadron collider of 100-200 TeV in collision energy, in a circular tunnel of 100-200 km in circumference. This project is about five times bigger and 10 times higher energy than the LHC. In connection with this responsibility, he is also serving as the Head of the Future Collider Facilities Group at the Fermi National Accelerator Laboratory (Fermilab) in the US. He is heading an international study group of 300 physicists who are producing quantitative physics publications on the discovery potential of this future collider, and developing detector concepts using futuristic technology. Europe, China and the United States have shown interest in hosting this huge collider. Prof. Kotwal is coordinating this project with the leaders of US National Laboratories, the European CERN Laboratory and the Institute of High Energy Physics in China.

In his own research, Prof. Kotwal leads the world in measuring very precisely the mass of the W boson, which is sensitive to the quantum mechanical effects of new particles or forces. In particular it is directly connected to the mysterious properties of the Higgs boson. If the latter are derived from a new, super-strong force hiding at very small distances, the quantum fluctuations associated with this new force will be revealed in a measurable change in the W boson mass.

Using the data from the CDF and D0 experiments at Fermilab, Prof. Kotwal has repeatedly published the world's best measurements of the W boson mass. Most recently he achieved a precision of 0.02%, and it predicted the mass of the Higgs boson before its discovery at the LHC. Since the Higgs boson mass turned out to be in the range predicted by Prof. Kotwal, his measurement provides a spectacular confirmation of the Higgs theory.

Prof. Kotwal's publications describe how he has progressively improved the experimental techniques for the W boson mass measurement. He now leads the effort to further improve on this precision, which can prove the existence of new particles or forces associated with the Higgs boson.

Prof. Kotwal and his collaborators have also published the most precise measurements of the top quark mass in the dilepton channel. His latest measurement used, for the first time in particle physics, neural network algorithms based on biological evolution. This method showed how to solve certain optimization problems based on ensemble properties.

Prof. Kotwal developed improved techniques to search for the Standard Model Higgs

boson. On the CDF experiment at Fermilab, he published three papers describing the search for the Higgs boson, each time using more advanced techniques. He used one of these techniques for the first time in the ATLAS experiment at the LHC to search for the Higgs boson in a mode not yet observed.

Prof. Kotwal also works with his students, post-docs and collaborators on searches of rare, exotic signatures of new interactions. He has published searches for charged and neutral gauge bosons mediating new weak forces, the Higgs boson in theories that extend the Standard Model, and excited states of Standard Model fermions. These particles are predicted in theories where the weak interaction has both left-handed and right-handed couplings (as is indicated by recent data on neutrino oscillations), in supersymmetric theories which impose a fermion-boson duality, and in grand unified theories.

On the the ATLAS experiment at the LHC, Prof. Kotwal has performed detailed studies of the silicon and transition radiation detectors. His students have published searches for new particles decaying to top quarks as well as Higgs boson measurements. He wrote the first three ATLAS papers on searches for heavy resonances decaying to leptons.

In addition to his experimental research, Prof. Kotwal has done theoretical work in the phenomenology of black holes in extra spatial dimensions. Extra spatial dimensions have been motivated by string theory and to explain why the gravitational force is so much weaker than the electromagnetic force at large distances. In this scenario it is possible for the gravitational force to be strong in the high energy regime of particle colliders, leading to the production of black holes. Prof. Kotwal has published a theoretical analysis of the production and decay of rotating black holes and their experimental signatures. Prof. Kotwal has also co-authored a paper on black hole relics, which are postulated to resolve the "information paradox" - after the black hole evaporates by Hawking radiation, where is all the information swallowed by the black hole during its lifetime? The information may remain locked up in these black hole remnants.