Gustavo Burdman

Research Description

The current focus of my research interests is centered around physics beyond the Standard Model. This involves building models in order to address fundamental questions unanswered in the SM, such as the origin of fermion masses, electroweak symmetry breaking and charge quantization; as well as the consideration of the constraints on these theories arising from existing experiments and the predictions for signals at current and future facilities such as the Tevatron at Fermilab, the Large Hadron Collider at CERN, the proposed e^+e^- Linear Collider, as well as B factories. I have experience in all these three complementary aspects of beyond the SM physics. I am also exploring, as I did in past work, the possibility of using astrophysical beams (high energy cosmic rays and neutrinos) in order to explore the frontiers of particle physics at experiments that are either under construction or at the proposal stage.

For instance, recently I have started working on models with (large and small) extra dimensions. With Y. Nomura I have built models [37] where the Higgs doublet is a component of gauge fields in five dimensions. We show that, for certain choices of the gauge group it is possible to put matter in the bulk and at the same time obtain the observed fermion masses, thereby overcoming known and longstanding obstacles to putting matter in the bulk in this context.

I have also worked on the bulk SM in the Randall-Sundrum scenario and studied the electroweak precision constraints on this promising class of models [36]. These also lead to interesting flavor violation in the third generation quarks resulting in very interesting phenomenology in CP asymmetries in B decays [40]. Finally, with Nomura, I am considering scenarios without a Higgs boson in the low energy spectrum [43], studying electroweak precision and flavor observables in the AdS/CFT correspondence.

I am also currently finishing a study, with B. Dobrescu and E. Pontón, of flat universal extra dimensions [41]. In particular the case of two flat extra dimensions has received some attention due to the fact that the proton lifetime can be made compatible with experimental bounds, as well as the fact that, in this scecnario, there may be a rationale for the existance of three generations of fermions. Our initial study aims at obtaining the basic field theoretical construction that in turn will allow us to set up the phenomenology of these models at colliders.

The physics of extra dimensions has made available new theoretical tools for attacking old questions in particle physics, such as the hierarchy problem. Even

more recently, a new alternative to solve the hierarchy problem has been proposed: the so called "little Higgs" models. They constitute a very minimal extension of the SM in order to stabilize the weak scale. I am currently working on the phenomenology of this scenario at colliders [38]. I expect to continue exploring these exciting new areas in the future.

I have also worked on models of electroweak symmetry breaking based on gauged family symmetry [25] as well as Topcolor models involving additional fermion doublets. I have explored various model building possibilities, as well as their direct and indirect signals at present colliders, such as the Tevatron and LEP as well as at the LHC and lepton colliders [27, 28, 29].

Regarding indirect probes for new physics at low energies, I have a investigated the potential of flavor physics. Processes involving flavor changing neutral currents (FCNC) such Rare B, Charm and Kaon decays, D^0-$\bar{D}^0$ mixing, etc., have a great potential as tests of the SM as well as of its extensions. I have worked on two aspects of this question. The first one is the study of the FCNC effects in various extensions of the SM, and the impact of the associated phenomenology on model building. Some examples of this line of work can be seen in [13, 17, 18, 22, 23, 24, 31, 32], where the emphasis has been mostly on theories with dynamical electroweak symmetry breaking and supersymmetry, although more recently I examined the impact of flavor physics in models with extra dimensions (Eg. in [36, 40]). I have recently completed a review article, in collaboration with I. Shipsey from CLEO, on D^0-$\bar{D}^0$ mixing and rare charm decay [39] where the emphasis is on the impact these measurements could have in our search for new physics and in general as tests of the SM.

The other aspect of flavor physics concerns the endemic hadronic uncertainties that are present in heavy flavor processes such as rare B decays, and that compromise our ability to extract information on the interesting short distance physics from the measured quantities. Relying on controlled approximations such as Heavy Quark Effective Theory and Chiral Perturbation Theory, I have contributed to the progress made in the last few years in trying to reduce such uncertainties (Eg. [2, 6, 7, 11, 12, 14, 21, 30]).

Finally, the advent of a wealth of data from Cosmology and Astroparticle physics experiments has a great potential to change the way we think about particle physics. I have already explored this connection in the past [20]. Currently, in collaboration with I. Albuquerque and Z. Chacko, I am studying the possibility of observing signals for supersymmetry at astroparticle physics experiments [42]

Publications

[43] *Holographic Theories of Electroweak Symmetry Breaking without a Higgs*, G. Burdman and Y. Nomura, **hep-ph/0312247**, accepted for publication in Phys. Rev. **D**.

[42] *Neutrino Telescopes as a Direct Probe of Supersymmetry Breaking*, I. Albuquerque, G. Burdman, Z. Chacko, **hep-ph/0312197**, acceptetd for publication in the Physical Review Letters.

[41] *Gauge Field Theory on a Square* G. Burdman, B. Dobrescu and E. Pontón, in preparation.

[40] *Flavor Violation in Warped Extra Dimensions and CP Asymmetries in B Decays* G. Burdman, **hep-ph/0310144**, accepted for publication in Physics Letters **B**.

[39] $D^0 - \bar{D}^0$ *Mixing and Rare Charm Decays.* G. Burdman and I. Shipsey, Ann. Rev. Nucl. Part. Sci. **53**, 431 (2003).

[38] *Collider Tests of Little Higgs Models*, G. Burdman, M. Perelstein and A. Pierce, Phys. Rev. Lett. **90**, 241802 (2003).

[37] *Unification of Gauge and Higgs Fields in Five Dimensions*, G. Burdman and Y. Nomura, Nucl. Phys. B **656**, 3 (2003).

[36] *Constraints on the Bulk Standard Model in the Randall-Sundrum Scenario*, G. Burdman, Phys. Rev. D **66**, 076003 (2002).

[35] *Report of Snowmass 2001 working group E2: Electron positron colliders from the ϕ to the Z*, G. Burdman, J. Butler, I. Shipsey, H. Yamamoto (conveners) *et al.*, hep-ex/0201047, to appear in the proceedings of the Snowmass 2001 Workshop on the future of High Energy Physics, Snowmass, CO, July 1-20 2001.

[34]*B Physics at the Tevatron: Run II and Beyond*, K. Anikeev *et al.*, Report to the Workshop on B Physics at the Tevatron: Run II and Beyond, Batavia, Illinois; FERMILAB-Pub-01/197.

[33] *Rare B decays beyond $B \to X_s\gamma$*, G. Burdman, LBNL-49221, in the proceedings of the 9th International Symposium on Heavy Flavor Physics, Pasadena, California, 10-13 Sep 2001.

[32] *Rare Charm Decays in the Standard Model and Beyond*, G. Burdman, E.

Golowich, J. Hewett and S. Pakvasa, LBNL-49074, Phys. Rev. **D66**, 014009 (2002).

[31] $B^0 - \bar{B}^0$ *Mixing Constrains Topcolor-assisted Technicolor* , G. Burdman, K. Lane and T. Rador, Phys. Lett. **B514**, 41 (2001).

[30] *Semileptonic Form-factors from* $B \to K^*\gamma$ *in the Large Energy Limit*, G. Burdman and G. Hiller, Phys. Rev. **D63**, 113008, 2001

[29] *Flavor Gauge Bosons at the Tevatron*, G. Burdman, R. S. Chivukula and N. Evans, Phys. Rev. **D62**, 075007, (2000).

[28] *Precision Bounds on Flavor Gauge Bosons*, G. Burdman, R. S. Chivukula and N. Evans, Phys. Rev. **D61**, 035009 (2000).

[27] *Scalars from Top-condensation Models at Hadron Colliders*, G. Burdman, Phys. Rev. Lett. **83**, 2888 (1999).

[26] *Theoretical Issues in Rare K and B Decays*; MADPH-98-1093, proceedings of the 4th Workshop on Heavy Quarks at Fixed Target (HQ98), Batavia IL, 10-12 October 1998.

[25] *Flavor Universal Dynamical Electroweak Symmetry Breaking*; G. Burdman and N. Evans, Phys. Rev. **D59**, 115005 (1999).

[24] *Anomalous Couplings of the Third Generation in Rare B Decays*; G. Burdman, M. C. González-García and S. F. Novaes, Phys. Rev. **D61**, 114016 (2000).

[23] *Triple Gauge Boson Couplings in Rare B and K Decays*, G. Burdman, Phys. Rev. **D59**, 035001 (1999).

[22] *Constraints on Strong Dynamics from Rare B and K Decays*, G. Burdman, MADPH-98-1039. Presented at the Workshop on Physics at the First Muon Collider and at the Front End of the Muon Collider, Batavia, IL, 6-9 Nov 1997.

[21] *Short Distance Coefficients and the Vanishing of the Forward-Backward Asymmetry in* $B \to V\ell^+\ell^-$ *Decays* ; G. Burdman, Phys. Rev. **D57**, 4254 (1998).

[20] *The Highest Energy Cosmic Rays and Particle Physics* ; G. Burdman, F. Halzen and R. Gandhi, Phys. Lett. **B417**,107 (1998).

[19] *Constraints on Semileptonic Form-factors from Dispersive Sum Rules* ; G. Burdman, preprint MADPH-97-1008, to appear in the Proceedings of the 2nd International Conference on B Physics and CP Violation, Honolulu, Hawaii, 24-28 March 1997.

[18] *Effects of the Electroweak Symmetry Breaking Sector in Rare B and K decays*; G. Burdman, Phys. Lett. **B409**, 443 (1997).

[17] *Model-independent Constraints on Topcolor from R_b*, G. Burdman and D. Kominis, Phys. Lett. **B403**, 101 (1997).

[16] *Strong Coupling Electroweak Symmetry Breaking*, T. Barklow *et al.*, in the Proceedings of the DPF/DPB Summer Study on High Energy Physics, Snowmass, Colorado, June 25 - July 12 1996.

[15] *Topcolor Models and Scalar Spectrum*; G. Burdman, preprint MADPH-96-971, in Proceedings of the DPF/DPB Summer Study on High Energy Physics, Snowmass CO, June 25 - July 12 1996.

[14] *Dispersive Approach to Semileptonic Form-Factors in Heavy to Light Meson Decays*; G. Burdman and J. Kambor, Phys. Rev. **D55**, 2817 (1997).

[13] *GIM Violation and New Dynamics of the Third Generation*; G. Buchalla, G. Burdman, C.T. Hill and D. Kominis, Phys. Rev. **D53**, 5185 (1996).

[12] *Potential for Discoveries in Charm Meson Physics*; G. Burdman, FERMILAB-CONF-95-281-T, proceedings of the Workshop on the Tau Charm Factory, Argonne, IL, June 21-23, 1995, AIP press.

[11] *Testing the Standard Model in $B \to K^{(*)}\ell^+\ell^-$*; G. Burdman, Phys. Rev. **D52**, 6400 (1995).

[10] *Radiative Weak Decays of Charm Mesons*; G. Burdman, E. Golowich, J. Hewett and S. Pakvasa, Phys. Rev. **D52**, 6383 (1995).

[9] *Radiative Leptonic Decays of Heavy Mesons*; G. Burdman, T. Goldman and D. Wyler, Phys. Rev. **D51**, 111 (1995).

[8] *Charm Mixing and CP Violation in the Standard Model*; G. Burdman, FERMILAB-Conf-94/200, contributed to the proceedings of the workshop Charm2000, June 7-9 1994, Fermilab, Batavia, Illinois, FERMILAB-Conf-94/190.

[7] *Heavy to Light Semileptonic Transitions in the Heavy Quark Effective Theory*; G. Burdman, Z. Ligeti, M. Neubert and Y. Nir, Phys. Rev. **D49**,

2331 (1994).

[6] *Union of Chiral and Heavy Quark Symmetries*; G. Burdman and J. F. Donoghue, Phys. Lett. **B280**, 287 (1992).

[5] *Two-Component Semileptonic Form-Factors*; G. Burdman and J. F. Donoghue, Phys. Rev. Lett. **68**, 2887 (1992).

[4] *On the Extraction of V_{cb} from Semileptonic B Decays*; G. Burdman, Phys. Lett. **B284**, 133 (1992).

[3] *B-Meson CP Violation without Flavor Identification*; G. Burdman and J. F. Donoghue, Phys. Rev. **D45**, 187 (1992).

[2] *Reliable Predictions in Exclusive Rare B Decays*; G. Burdman and J. F. Donoghue, Phys. Lett. **B270**, 55 (1991).

[1] *Semileptonic $b \to u$ Decays*; C. Ramirez, J. F. Donoghue and G. Burdman, Phys. Rev. **D41**, 1496 (1990).

Invited Conference Talks

2003

- *"Flavor Violation in Warped Extra Dimensions"*, presented at the Workshop on the Discovery Potential of an Asymmetric B Factory at $10^{36} cm^{-2} s^{-1}$ Luminosity, SLAC, Palo Alto, October 22-24 2003.
- *"Gauge-Higgs Unification in Five Dimensions"*, presented at SUSY 2003, The 11th Annual International Conference on Supersymmetry and the Unification of the Fundamental Interactions, Tucson, Arizona, June 5-10 2003.
- *"Rare Charm Decays in the Standard Model and Beyond"*, presented at the Workshop on the Discovery Potential of an Asymmetric B Factory at $10^{36} cm^{-2} s^{-1}$ Luminosity, SLAC, Palo Alto, May 8-10 2003.
- *"B Physics and Theories Beyond the Standard Model"*, plenary talk presented at the Workshop on the Discovery Potential of an Asymmetric B Factory at $10^{36} cm^{-2} s^{-1}$ Luminosity, SLAC, Palo Alto, May 8-10 2003.

2002

- *"Constraints on the Bulk Standard Model in the Randall-Sundrum Scenario"*, presented at the Meeting of the Division of Particles and Fields of the American Physical Society, DPF 2002, Williamsburg, VA, May 24-28 2002.
- *"Rare Charm Decays and D^0-$\bar{D}^0$ Mixing"*, invited talk in the Flavor Physics and CP Violation (FPCP) Conference, University of Pennsylvania, Philadelphia, PA, May 16-18 2002.

2001

- *"Rare B Decays Beyond $b \to s\gamma$*, presented at the 9th Symposium on Heavy Flavor Physics, Caltech, Pasadena, September 10-13 2001.
- *"Precision Charm Weak Decays in the Standard Model and Beyond"*, presented at the Workshop Snowmass 2001: The Future of Particle Physics, Snowmass, June 30 - July 21 2001.
- *"Rare B Decays: a Theoretical Overview"*, presented at the Workshop Snowmass 2001: The Future of Particle Physics, Snowmass, June 30 - July 21 2001.

- *"Chiral Logarithms in Heavy Meson Decays: Impact on the Chiral Extrapolation on the Lattice"*, presented at the Workshop Snowmass 2001: The Future of Particle Physics, Snowmass, June 30 - July 21 2001.

- *"Semileptonic Decays: From Charm to Beauty"*, presented at the Workshop on Prospects of CLEO/CESR at 3 GeV $< E_{cm} <$ 5 GeV, Ithaca, May 5-7 2001.

2000

- *"Theoretical Aspects of CP Violation and Rare Decays"*, presented at the APS spring meeting, Long Beach, California, April 29 to May 2, 2000.

1999

- *"Rare B Decays at the Tevatron"*, presented at the Workshop on B Physics at the Tevatron in RunII, Batavia, IL September 23-25 1999.

- *"Signals for Dynamical Electroweak Symmetry Breaking at the Tevatron in Run II"*, presented at the Workshop on New Strong Dynamics at the Tevatron RunII, Batavia, IL, April 9-10 1999.

1998

- *"Single Top Production in Topcolor Models"*, presented at the Workshop on Top Physics at the Tevatron RunII, Batavia, IL, October 16-18 1998.

- *"Signals for Topcolor Models"*, presented at the Workshop on New Strong Dynamics at the Tevatron RunII, Batavia, IL, October 30-31 1998.

- *"Theoretical Issues in Rare K, D and B Decays"*, presented at the Workshop on Heavy Quarks at Fixed Target, Batavia, IL, October 9-12 1998.

- *"New Ideas in Dynamical Electroweak Symmetry Breaking"*, presented at the Linear Collider Workshop, Keystone, CO, September 26-29 1998.

- *"Heavy to Light Semileptonic Form-factors from Dispersive Sum Rules"*, presented at the Workshop on Lattice QCD and the Standard Model, Columbus, OH, April 17 1998.

1997

- *"Constraints on Strong Dynamics from Rare B and K Decays"*, presented at the Workshop on Physics at the First Muon Collider and at the Front End of the Muon Collider, Batavia, IL, 6-9 Nov 1997.
- *"Signals for a Strongly Coupled Electroweak Symmetry Breaking Sector in Rare B and K Decays"*, presented at the BaBar Physics Workshop, Caltech, Pasadena, CA, September 22-24 1997.
- *"Extracting Short Distance Information in Exclusive Rare B Decays"*, presented at the BaBar Physics Workshop, Caltech, Pasadena, CA, September 22-24 1997.
- *"Constraints on Semileptonic Form-factors from Dispersive Sum Rules"*, presented at the 2nd International Conference on B Physics and CP Violation , Honolulu, HI, 24-28 March 1997.

1996

- *" Standard Model and Non-Standard Model Effects on Charm Mixing"*, talk given at the Workshop on Heavy Quark Physics at C-Zero, Batavia, IL December 4-6 1996.
- *"Topcolor Models and Scalar Spectrum"*, talk given at 1996 DPF Summer Study on New Directions for High-energy Physics, Snowmass, CO, 25 Jun - 12 Jul 1996.
- *"Model Independent Constraints on Heavy-to-Light Semileptonic Form-factors"*, presented at the International Phenomenology Symposium, Madison, WI, April 1-3 1996.

1995

- *"Potential for Discoveries in Charm Meson Physics"*, presented at the Workshop on the Tau Charm Factory, Argonne, IL, Jun 21-23, 1995.
- *"Testing the Standard Model in Rare B Decays"*, presented at the LAFEX International School on High Energy Physics, Rio de Janeiro, Brasil, February 8-18 1995.

1994

- *"Radiative Leptonic Decays of Heavy Mesons"*, talk given at the 8th APS meeting of the Division of Particles and Fields, Albuquerque, NM, August 2-6 1994.
- *"Charm Mixing and CP Violation in the Standard Model"*, presented at Workshop on the Future of High Sensitivity Charm Experiments, Batavia, IL, 7-9 Jun 1994.