Curriculum Vitae

Joel Giedt

Contact Information

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Education

PhD, MA **University of California, Berkeley,** Physics, 2002, 2000.
BS **San Francisco State University,** Physics, 1997.

Experience

Assistant Professor, **Rensselaer Polytechnic Institute, Physics,** 2007 to present.
Postdoctoral Research Associate, **Fine Theoretical Physics Institute, University of Minnesota, Minneapolis,** 2005-2007.
Postdoctoral Research Fellow, **University of Toronto, Canada,** 2002-2005.
Graduate Student Research Assistant, **University of California, Berkeley,** 1998-2002. Advisor: Mary K. Gaillard.
Undergraduate Student Research Assistant, **San Francisco State University,** 1995-1997. Advisor: Jeffery P. Greensite.

Awards, Honors and Affiliations

Member, American Physical Society.
Member, US Lattice Quantum Chromodynamics (USQCD).
Mentored Research Fellowship, UC Berkeley, 1999-2000.
Outstanding Graduate Student Instructor, UC Berkeley, 1998.
ΦBK, San Francisco State University, 1997.
First Place (1996) and **Honorable Mention** (1997), **CSU Student Research Competition,** Physical and Mathematical Sciences.
Department of Physics and Astronomy Scholarship Award, San Francisco State University, 1996 and 1993.

Conferences, Workshops and Seminars

- **XXV International Symposium on Lattice Field Theory, Regensburg, Germany, July 30 - Aug. 4, 2007.** Poster: "Power-counting theorem for staggered fermions."

- **The Physics and Mathematics of G_2 Compactifications,** University of Michigan, Ann Arbor, May 3-5, 2007.

- **The Many Faces of Quantum Fields,** Lorentz Center, Leiden, Netherlands, April 10-13, 2007. **Invited Keynote Speaker:** "The LHC, beyond the Standard Model, and nonperturbative tools."

- **Physics at the LHC: From Experiment to Theory** and **Monte Carlo Tools for Beyond the Standard Model Physics,** Princeton University, March 21-24, 2007.

- **XXIV International Symposium on Lattice Field Theory,** Tucson, Arizona, July 23-28, 2006. **Invited Plenary Speaker:** "Advances and applications in lattice supersymmetry."

- **Continuous Advances in QCD 2006,** William I. Fine Theoretical Physics Institute, University of Minnesota, Minneapolis, MN, May 11-14, 2006. *Talk:* "Staggered fermions and power-counting."

- **New Directions in Nonperturbative QCD,** European Centre for Theoretical Studies in Nuclear Physics and Related Areas, Trento, Italy, March 27-31, 2006. *Talk:* "Symmetry and scaling in the Q-exact lattice (2,2) 2d Wess-Zumino model."

- **XXIII International Symposium on Lattice Field Theory,** Trinity College, Dublin, Ireland, July 25-30, 2005. *Talk:* "Symmetry and scaling in the Q-exact lattice (2,2) 2d Wess-Zumino model."

- **QCD Review,** I gave a three hour lecture for graduate students of the High Energy Theory Group, University of Toronto, June 9, 2005.

- **Frontiers in Contemporary Physics,** Vanderbilt University, Nashville, TN, May 16-21, 2005. *Talk:* "String-inspired neutrino mass."

- **Third International String Phenomenology Conference,** University of Michigan, Ann Arbor, August 1-6, 2004. *Talk:* "Lack of Trinification in Z_3 Orbifolds of the $SO(32)$ Heterotic String."

- **XXII International Symposium on Lattice Field Theory,** Fermilab, Batavia, IL, June 22-26, 2004. *Talk:* "Deconstruction, 2d Lattice Super-Yang-Mills, and the Dynamical Lattice Spacing."

- **Second International String Phenomenology Conference,** University of Durham, UK, July 29 to August 4, 2003. *Talk:* "Lattice Supersymmetry and String Phenomenology."

- **Workshop on Baryogenesis,** University of Michigan, Ann Arbor, June 23-27, 2003. *Talk:* "Emergent Lattice Supersymmetry."

- **13th Workshop on Lattice Field Theory,** Yale University, New Haven, CT, April 30 to May 4, 2003. *Talk:* "Emergent Lattice Supersymmetry."

- **First International String Phenomenology Conference,** University of Oxford, UK, July 6-11, 2002. *Talk:* "D-Moduli Stabilization."

- **18th Pacific Coast Gravity Meeting,** U.C. Davis, March 29-30, 2002.

- **CP Violation Conference,** U. Michigan, Ann Arbor, Nov. 4-18, 2001. *Talk:* "CP Violation and Moduli Stabilization in Heterotic Orbifolds."

- **Physics and Astrophysics of Extra Dimensions,** International Workshop, Institut d'Astrophysique de Paris, Collège de France, May 17-22, 2001.

- **EURESCO 2001,** "From the Electroweak Scale to the Planck Scale," La Londe-les-Maures, France, May 11-16, 2001. *Talk:* "Systematic Studies of Heterotic Vacua."

- Invited talks at theory seminars (University of Wisconsin; McGill University; University of Toronto; Los Alamos National Laboratory; Syracuse University; University of Michigan, Ann Arbor; Jefferson National Laboratory; Brookhaven National Laboratory; University of Pennsylvania), and numerous seminar talks at home institutions (FTPI, University of Minnesota; University of Toronto; Lawrence Berkeley National Laboratory; University of California, Berkeley).

Research Interests

Joel Giedt

Motivations

The Standard Model of particle physics is an effective, cutoff theory. That this is true follows from the *triviality* of the Higgs and U(1)-hypercharge parts of the theory. In addition, there exists a well-known ugliness in the mass matrices. Extensions to the Standard Model, especially those that envision quantized gravity, are a key motivation for much of my research.

Extensions to the Standard Model vs. the Large Hadron Collider

With low luminosity data acquisition at 14 TeV center of mass energy scheduled to begin in the Summer of 2008, the Large Hadron Collider (LHC) will test many extensions to the Standard Model. In particular, many of the models that I have studied in my research career will be severely constrained or ruled out by the forthcoming data. I am currently studying LHC constraints on interesting models, including some that have received less attention [1]. Much of my time is presently spent understanding the relation between models of new physics and collider signatures. In the process, I have been integrating various collider event/detector simulation tools into my research.

Phenomenological models vs. string/M-theory

It is widely believed that string/M-theory represents a promising underlying theory for extensions to the Standard Model. Calculations in string/M-theory and its field theory limit, supergravity, comprise a *top-down* approach. It is a long-term project of mine to bridge the gap between string/M-theory and phenomenological *bottom-up* approaches.

Warped compactifications and AdS/CFT. Most recently I have studied AdS_5 models, similar to the Randall-Sundrum models, as they occur in Type IIB string theory [1,4]. I am particularly interested in models where the dual gauge theory is known and has $\mathcal{N} = 1$ supersymmetry, such as the Klebanov-Witten/Strassler constructions. We have developed phenomenological models with a compositeness scale at 10-100 TeV, and LHC signatures that are distinguishable from many other extensions to the Standard Model [1].

Heterotic phenomenology. For the heterotic string, I have studied CP violation [24], moduli stabilization [11,34,17,20,21], neutrino mass matrices [8], extended gauge symmetry [7], the unification problem [18], and the cosmological moduli problem [25].

Heterotic orbifolds. In conjunction with these phenomenological investigations, I extensively studied compactifications of the heterotic string [8,7,15,38,22,23].

Lattice supersymmetry

I am active in the application of lattice methods to strongly coupled supersymmetric field theories. These theories deserve intensive study because:

(1) Strongly coupled supersymmetric gauge theories play an important role in dynamical supersymmetry breaking, and low energy effective theories associated with string/M-theory.

(2) Super-Yang-Mills at large 't Hooft coupling plays a crucial role in the AdS/CFT correspondence.

(3) Many interesting nonperturbative phenomena occur in supersymmetric field theories: e.g., monopoles, chiral symmetry breaking, confinement and quantum moduli spaces.

Unfortunately, the lattice preserves only a discrete translation subgroup and therefore breaks supersymmetry.

Avoiding or limiting fine-tuning. Often in a lattice theory, there is a symmetry enhancement in the continuum limit, since it corresponds to a critical point. One can then hope to recover supersymmetry, even though it is not respected by the lattice theory itself. In [32,6,10] evidence was provided that this occurs in a two-dimensional lattice model. In [10] this was proven for a version of lattice supersymmetric quantum mechanics, and in [9] we presented a model that has just one counterterm, and analytically determined its value.

Deconstruction models. In [12,14,16,37] I have examined the so-called "deconstruction approach" to lattice field theory, as proposed by Kaplan and collaborators. Recently I wrote a review that concentrated on this topic [5].

Lattice superfields and renormalization. In [10], conditions were established that allow one to preserve some subset of the supersymmetry algebra exactly on the lattice. A superfield approach allowed us to discuss renormalization in general terms.

Other topics in lattice field theory

My interests in lattice field theory go beyond supersymmetry:

Confinement. I have studied mechanisms of confinement in lattice Yang-Mills, and was involved in some of the early simulation results on Z_N vortices in $SU(N)$ lattice gauge theory [35-28].

Chiral gauge theories on the lattice. In recent work with Erich Poppitz, I studied methods to put chiral gauge theories on the lattice using Ginsparg-Wilson fermions [2].

Staggered fermions. I have examined the fractional-root trick for staggered fermions [36]. A more extensive work was my recent proof of a power-counting theorem for staggered fermions [3].

Publications, Preprints and Other Works

Joel Giedt

Journal articles

1. Maxime Gabella, Tony Gherghetta and Joel Giedt, "A gravity dual and LHC study of single-sector supersymmetry breaking," *Physical Review* **D 76** (2007) 055001 [arXiv:0704.3571].

2. Joel Giedt and Erich Poppitz, "Chiral lattice gauge theories and the strong coupling dynamics of a Yukawa-Higgs model with Ginsparg-Wilson fermions," *Journal of High Energy Physics* **0710** (2007) 076 [arXiv:hep-lat/0701004].

3. Joel Giedt, "Power-counting theorem for staggered fermions," *Nuclear Physics* **B782** (2007) 134 [arXiv:hep-lat/0606003].

4. Tony Gherghetta and Joel Giedt, "Bulk fields in AdS_5 from probe D7 branes," *Physical Review* **D74** (2006) 066007 [arXiv:hep-th/0605212].

5. Joel Giedt, "Deconstruction and other approaches to supersymmetric lattice field theories," invited review, *International Journal of Modern Physics* **A21** (2006) 3039 [arXiv:hep-lat/0602007].

6. Joel Giedt, "R-symmetry in the Q-exact (2,2) 2d Lattice Wess-Zumino Model," *Nuclear Physics* **B726** (2005) 210-232 [arXiv:hep-lat/0507016].

7. Joel Giedt, "Lack of Trinification in Z_3 Orbifolds of the $SO(32)$ Heterotic String," *Modern Physics Letters* **A20** (2005) 2369 [arXiv:hep-ph/0402201].

8. Joel Giedt, Gordon L. Kane, Paul G. Langacker and Brent D. Nelson, "Massive Neutrinos and (Heterotic) String Theory," *Physical Review D* **71** (2005) 115013 [arXiv:hep-th/0502032].

9. Joel Giedt, Roman Koniuk, Erich Poppitz and Tzahi Yavin, "Less Naive About Supersymmetric Lattice Quantum Mechanics," *Journal of High Energy Physics* 12 (2004) 033 [arXiv:hep-lat/0410041].

10. Joel Giedt and Erich Poppitz, "Lattice Supersymmetry, Superfields and Renormalization," *Journal of High Energy Physics* 0409 (2004) 029 [arXiv:hep-th/0407135].

11. Mary K. Gaillard, Joel Giedt and Alex L. Mints, "Modular Invariant Gaugino Condensation in the Presence of an Anomalous $U(1)$," *Nuclear Physics* **B700** (2004) 205-270 [arXiv:hep-th/0312125].

12. Joel Giedt, "The Fermion Determinant in (4,4) 2d Lattice Super-Yang-Mills," *Nuclear Physics* **B674** (2003) 259-270 [arXiv:hep-lat/0307024].

13. Joel Giedt and Brent D. Nelson, "Instanton Effects and Linear-Chiral Duality," *Journal of High Energy Physics* **0405** (2004) 069 [arXiv:hep-th/0307224].

14. Joel Giedt, "Non-positive Fermion Determinants in Lattice Supersymmetry," *Nuclear Physics* **B 668** (2003) 138 [arXiv:hep-lat/0304006].

15. Joel Giedt, "Z_3 Orbifolds of the SO(32) Heterotic String: 1 Wilson Line Embeddings," *Nuclear Physics* **B 671** (2003) 133 [arXiv:hep-th/0301232].

16. Joel Giedt, Erich Poppitz, Moshe Rozali, "Deconstruction, Lattice Supersymmetry, Anomalies and Branes," *Journal of High Energy Physics* **0303** (2003) 035 [arXiv:hep-th/0301048].

17. Mary K. Gaillard and Joel Giedt, "More Modular Invariant Anomalous $U(1)$ Breaking," *Nuclear Physics* **B 643** (2002) 201 [arXiv:hep-th/0206249].

18. Joel Giedt, "Optical Unification," *Modern Physics Letters* **A 18** (2003) 1625-1633 [arXiv:hep-ph/0205224].

19. Joel Giedt, "Full Component Lagrangian in the Linear Multiplet Formulation of String-inspired Effective Supergravity," *Journal of Physics* **A 36** (2003) 1-23 [arXiv:hep-th/0205206].

20. Mary K. Gaillard and Joel Giedt, "Modular Invariant Anomalous $U(1)$ Breaking," *Nuclear Physics* **B 636** (2002) 365-384 [arXiv:hep-th/0204100].

21. Joel Giedt, "CP Violation and Moduli Stabilization in Heterotic Models," *Modern Physics Letters* **A 17** (2002) 1465-1473 [arXiv:hep-ph/0204017].

22. Joel Giedt, "Spectra in Standard-like Z_3 Orbifold Models," *Annals of Physics (N.Y.)* **297** (2002) 67-126 [arXiv:hep-th/0108244].

23. Joel Giedt, "Completion of Standard-like Embeddings," *Annals of Physics (N.Y.)* **289** (2001) 251-265 [hep-th/0009104].

24. Joel Giedt, "The KM Phase in Semi-Realistic Heterotic Orbifold Models," *Nuclear Physics* **B 595** (2001) 3-32 [hep-ph/0007193].

25. Mary K. Gaillard and Joel Giedt, "A D-Moduli Problem?" *Physics Letters* **B 479** (2000) 308-314 [hep-ph/0001219].

26. Jan Ambjørn, Joel Giedt and Jeff Greensite, "Vortex Structure vs. Monopole Dominance in Abelian-Projected Gauge Theory," *Journal of High Energy Physics* **02** (2000) 033 [hep-lat/9907021].

27. L. Del Debbio, M. Faber, J. Giedt, J. Greensite and Š. Olejník, "Detection of Center Vortices in the Lattice Yang-Mills Vacuum," *Physical Review* **D 58** (1998) 094501 [hep-lat/9801027].

28. Joel Giedt and Jeff Greensite, "Abelian Nature of Cooled $SU(2)$ Lattice Configurations," *Physical Review* **D 55** (1997) 4484 [hep-lat/9611002].

Conference and workshop proceedings

29. J. Giedt, "Power-counting theorem for staggered fermions," in Proceedings of XXV International Symposium on Lattice Field Theory, Regensburg, Germany, July 30 - Aug. 4, 2007, *Proceedings of Science* **LATTICE 2007** (2007) 262.

30. Joel Giedt, "Advances and applications in lattice supersymmetry," in Proceedings of XXIV International Symposium on Lattice Field Theory, Tucson, Arizona, July 23-28, 2006, *Proceedings of Science* **LAT2006** (2006) 008 [arXiv:hep-lat/0701006].

31. Joel Giedt, "Staggered fermions and power-counting," to appear in proceedings of Continuous Advances in QCD, 2006, University of Minnesota, Minneapolis, Minnesota, May 11-14, 2006.

32. Joel Giedt, "Symmetry and scaling in the Q-exact lattice (2,2) 2d Wess-Zumino model," proceedings of XXIII International Symposium on Lattice Field Theory, Trinity College, Dublin, Ireland, July 25-30, 2005, *PoS* **LAT2005** (2005) 270 [hep-lat/0508017].

33. Joel Giedt, "Lattice Supersymmetry and String Phenomenology," in *Proceedings of 2nd International Conference on String Phenomenology 2003, Durham, England, 29 Jul. to 4 Aug. 2003* [hep-ph/0309344].

34. Joel Giedt, "D-Moduli Stabilization," in *Proceedings of The First International Superstring Phenomenology Conference, Oxford, England, July 7, 2002,* editors S. A. Abel et al., World Scientific, New Jersey [hep-ph/0208004, extended version].

35. Jan Ambjørn, Joel Giedt and Jeff Greensite, "Vortex Structure in Abelian-Projected Lattice Gauge Theory," *Nuclear Physics Proceedings Supplement* **83** (2000) 467 [hep-lat/990801].

On-line unpublished works

36. Joel Giedt, "Toward a Systematic Analysis of the Fourth-Root Trick," hep-lat/0507002.

37. Joel Giedt, "Deconstruction, 2d Lattice Super-Yang-Mills, and the Dynamical Lattice Spacing," hep-lat/0405021.

38. Joel Giedt, "Heterotic Orbifolds," PhD Thesis, University of California, Berkeley, 2002 [hep-ph/0204315].

Recent preprints

39. Joel Giedt, "A deconstruction lattice description of the D1/D5 brane world-volume gauge theory," hep-lat/0605004.