

# Sumanta Tewari

## Curriculum Vitæ

**Name:** Sumanta Tewari

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### Education

**1997:** Received M.Sc ('Integrated M.Sc', directly after high school) in physics from the Indian Institute of Technology (IIT), Kanpur, India.

**June 13, 2003:** Received Ph.D (advisor: Prof. Sudip Chakravarty, "*Theory of the d-density wave order in relation to the high- $T_c$  cuprate superconductivity*" ) in physics from the University of California, Los Angeles, USA.

### Research Interests

- Multiferroic materials, magnetism, and magnetic superconductors
- Josephson junction arrays and superconducting devices
- High- $T_c$  cuprate superconductivity
- Topological quantum computation
- Ultra cold atoms in optical lattices

## Teaching Experience

- 1998-1999: Teaching associate in the Department of Physics, UCLA. Sample courses: Classical Mechanics, Waves and Oscillations.
- 1999-2000: Teaching fellow in the Department of Physics, UCLA. Sample courses:
  - ‘Quantum Mechanics’ with Prof. Sudip Chakravarty; ‘Certificate for Teaching Excellence’ awarded by the Dept. of Physics, UCLA.
  - ‘Solid State Physics’ with Prof. Chetan Nayak; ‘Certificate for Teaching Excellence’ awarded by the Dept. of Physics, UCLA.

## Awards and Achievements

- Governor’s Gold Medal, 1990, awarded by the Government of West Bengal, India, for securing 1st rank in the state of West Bengal, among approximately 350,000 students, in the statewide high school (class X) examination.
- Certificate of Excellence, 1992, awarded by the Government of West Bengal, India, for securing 8th rank in the state of West Bengal in the statewide senior high school (class XII) examination.
- Certificate of Academic Excellence, 1996, awarded by the Director of the Indian Institute of Technology, Kanpur.
- Certificate of Teaching Excellence, 1999, 2000, awarded by the Department of Physics, University of California, Los Angeles.
- Department Research Fellowship, Department of Physics, University of California, Los Angeles.
- **Institute for Complex Adaptive Matter (ICAM)** Junior Exchange Fellowship (2007).

## Positions Held

- 2000-2003: Research Assistant, Dept. of Physics, University of California, Los Angeles, Los Angeles, CA.
- 2003-2004: Research Associate, Department of Physics and Materials Science Institute, University of Oregon, Eugene, OR.
- 2004-Present: Research Associate, Department of Physics, University of Maryland, College Park, MD.

- Visiting Scientist, Aspen Center for Physics, Aspen, CO (“Coherence and Dissipation in Quantum Systems”, Summer, 2004).
- Visiting Scientist, Kavli Institute of Theoretical Physics (KITP), University of California, Santa Barbara (UCSB), Santa Barbara, CA (“Quantum Phase Transitions”, Jan/Feb, 2005).
- Visiting Scientist, KITP, UCSB, Santa Barbara, CA (“Topological Phases and Quantum Computation”, Feb. - May, 2006).
- Visiting Scientist, Department of Physics, University of California, Berkeley, CA (Aug/Sep, 2006).
- Visiting Scientist, KITP, UCSB, Santa Barbara, CA (“Strongly Correlated Phases in Condensed Matter and Degenerate Atomic Systems”, Jan. - March, 2007).
- Institute for Complex Adaptive Matter (ICAM) Junior Exchange Fellow (2007).
- Visiting Scientist, KITP, UCSB, Santa Barbara, CA (“ $\text{Sr}_2\text{RuO}_4$  and Chiral P-Wave Superconductivity”, Dec., 2007).

## Talks at Conferences and Schools

- “Topology and statistics in superconductors: Non-Abelian matter and quantum computation” – **Invited Talk**, KITP, UCSB, Santa Barbara, CA (March, 2007), video recording at <http://online.kitp.ucsb.edu/online/coldatoms07/tewari/>.
- “Topology and statistics in superconductors: Non-Abelian matter and quantum computation” – **Invited Talk**, University of Waterloo, Ontario, Canada (Feb., 2007).
- “Topology and statistics in superconductors: Non-Abelian matter and quantum computation” – **Invited Talk**, University of Denver, Denver, CO (Feb., 2007).
- “Chiral p-wave superconductivity: Non-Abelian statistics and quantum computation” – **Invited Talk**, CMTC symposium, University of Maryland, College Park, MD (Nov., 2006).
- “Chiral p-wave superconductivity: Non-Abelian statistics and quantum computation” – **Invited Talk**, Johns Hopkins University, Baltimore, MD (Oct., 2006).

- “Living in dimension lower than meets the eye: Sliding phases in classical and quantum statistical mechanics” – **Invited Talk**, University of Virginia, Charlottesville, VA (Aug., 2006).
- “Non-Abelian braiding statistics of vortices in a  $p_x + ip_y$  superconductor” – **Invited Talk**, Third *Feynman Festival*, University of Maryland, College Park, MD (Aug., 2006).
- “Living in dimension lower than meets the eye: Sliding phases in classical and quantum statistical mechanics” – **Invited Talk**, University of California, Riverside, CA (May, 2006)
- “Stabilizing half-quantum vortices in strontium ruthenate thin films: Non-Abelian braiding statistics of vortices in a p-wave superconductor” – **Invited Talk**, KITP, UCSB, Santa Barbara, CA (April, 2006).
- “Living in dimension lower than meets the eye: Sliding phases in classical and quantum statistical mechanics” – **Invited Talk**, McMaster University, Ontario, Canada (Feb., 2006).
- “Living in dimension lower than meets the eye: Sliding phases in classical and quantum statistical mechanics” – **Invited Talk**, Indian Institute of Science (IISc.), Bangalore, India (December, 2005).
- “Non-Abelian braiding statistics of vortices in a  $p_x + ip_y$  superconductor” – **Invited Talk**, Tata Institute of Fundamental Research (TIFR), Mumbai (Bombay), India (December, 2005).
- “Living in dimension lower than meets the eye: Sliding phases in classical and quantum statistical mechanics” – **Invited Talk**, Tata Institute of Fundamental Research (TIFR), Mumbai (Bombay), India (December, 2005).
- “Spontaneous Flux Lattices in Ferromagnetic Spin-Triplet Superconductors” – **Invited Talk**, ‘10th International Vortex Workshop, IVW 2005’, Tata Institute of Fundamental Research (TIFR), Mumbai (Bombay), India (January, 2005).
- “Floating phase in a dissipative Josephson junction array” – **Invited Talk**, Aspen Center for Physics, Aspen, CO (August, 2004).
- “Non-Abelian braiding statistics of vortices in a  $p_x + ip_y$  superconductor” – The 2006 March APS Meeting, Baltimore, MD.
- “Floating Phase in a dissipative Josephson-junction array” – The 2005 March APS Meeting, Los Angeles, CA.

- “Spontaneous flux lattice in ferromagnetic spin-triplet superconductors” – The 2004 March APS Meeting, Montreal, Canada (talk given in absence of coauthor).
- “Crossover and scaling in a two-dimensional field-tuned superconductor” – The 2004 March APS Meeting, Montreal, Canada.
- “Infrared Hall angle in the  $d$ -density wave state: a comparison of theory and experiment” – The 2004 March APS Meeting, Montreal, Canada (talk given in absence of coauthor).
- “Sharp signature of the  $d$ -density wave quantum critical point in the Hall coefficient of the Cuprates” – Supplementary talk, The 2002 March APS Meeting, Indianapolis, IN.
- “Collective modes in the  $d$ -density wave state of the Cuprates” – The 2002 March APS Meeting, Indianapolis, IN.
- “Spin and current correlation functions in the  $d$ -density wave state of the Cuprates” – The 2001 March APS Meeting, Seattle, WA.

## Publications

### • Physical Review Letters

- **Sumanta Tewari**, C. W. Zhang, S. Das Sarma, C. Nayak, Dung-Hai Lee, “Testable signatures of quantum non-locality in a two-dimensional chiral p-wave superconductor”, *Phys. Rev. Lett.* (in press, 2007); arXiv:cond-mat/0703717.
- Chuanwei Zhang, **Sumanta Tewari**, S. Das Sarma, “Bell’s inequality and universal quantum gates in a cold atom chiral fermionic p-wave superfluid”, *Phys. Rev. Lett.* **99**, 220502 (2007).
- **Sumanta Tewari**, S. Das Sarma, Dung-Hai Lee, “An index theorem for the Majorana zero modes in chiral p-Wave superconductors”, *Phys. Rev. Lett.* **99**, 037001 (2007); reprinted in the August, 2007 issue of *Virtual Journal of Quantum Information* (Ed. David P. DiVincenzo) ([www.vjquantuminfo.org](http://www.vjquantuminfo.org)); reprinted in the July 30, 2007 issue of *Virtual Journal of Nanoscale Science and Technology* (Ed. David Awschalom) ([www.vjnano.org](http://www.vjnano.org)).
- **Sumanta Tewari**, S. Das Sarma, Chetan Nayak, C. W. Zhang, and P. Zoller, “Quantum computation using vortices and Majorana zero modes of a  $p_x+ip_y$  superfluid of fermionic cold atoms”, *Phys. Rev. Lett.* **98**, 010506 (2007); reprinted in the Jan. 22, 2007 issue of *Virtual Journal of Nanoscale Science and Technology* (Ed. David

Awschalom) ([www.vjnano.org](http://www.vjnano.org)); reprinted in the Jan., 2007 issue of *Virtual Journal of Quantum Information* (Ed. David P. DiVincenzo) ([www.vjquantuminfo.org](http://www.vjquantuminfo.org)).

- **Sumanta Tewari**, V. W. Scarola, T. Senthil, and S. Das Sarma, “Emergence of artificial photons in an optical lattice”, *Phys. Rev. Lett.* **97**, 200401 (2006).
- **Sumanta Tewari**, D. Belitz, and T. Kirkpatrick, “Blue quantum fog: Chiral condensation in quantum helimagnets ”, *Phys. Rev. Lett.* **96**, 047207 (2006).
- **Sumanta Tewari**, D. Belitz, T. Kirkpatrick , and John Toner, “Spontaneous flux lattices in ferromagnetic spin-triplet superconductors”, *Phys. Rev. Lett.* **93**, 177002 (2004).
- Sudip Chakravarty, Chetan Nayak, **Sumanta Tewari**, Xiao Yang, “Sharp signature of DDW quantum critical point in the Hall coefficient of the cuprates”, *Phys. Rev. Lett.* **89**, 277003 (2002).

#### • Physical Review B and E (Rapid Communications)

- Sankar Das Sarma, Chetan Nayak, and **Sumanta Tewari**, “Proposal to stabilize and detect half-quantum vortices in strontium ruthenate thin films: Non-Abelian braiding statistics of vortex matter in a  $p_x+ip_y$  superconductor” *Phys. Rev. B* **73**, 220502 (Rapid Communication) (2006); reprinted in the June, 2006 issue of *Virtual Journal of Quantum Information* (Ed. David P. DiVincenzo) ([www.vjquantuminfo.org](http://www.vjquantuminfo.org)); **covered in the Search & Discovery section of Physics Today, December 2006, Page 23.**
- **Sumanta Tewari**, John Toner, and Sudip Chakravarty, “Floating Phase in a dissipative Josephson-junction array”, *Phys. Rev. B* **72**, 060505 (Rapid Communication) (2005); reprinted in the August 29, 2005 issue of *Virtual Journal of Nanoscale Science and Technology* (Ed. David Awschalom) ([www.vjnano.org](http://www.vjnano.org)); reprinted in the September 1, 2005 issue of *Virtual Journal of Applications of Superconductivity* (Ed. John R. Clem) ([www.vjsuper.org](http://www.vjsuper.org)).
- Sudip Chakravarty, **Sumanta Tewari**, and Chetan Nayak, “Angle-resolved photoemission spectra in the cuprates from the  $d$ -density wave theory”, *Phys. Rev. B* **68**, 100504 (Rapid Communication) (2003).
- Indranil Paul, **Sumanta Tewari**, and J. K. Bhattacharjee, “Kardar-Parisi-Zhang equation and the  $\delta$ -expansion”, *Phys. Rev. E* **55**, 2097 (Rapid Communication) (1997).

## • Physical Review B

- **Sumanta Tewari**, John Toner, and Sudip Chakravarty, “The nature and boundary of the floating phase in a dissipative Josephson-junction array”, Phys. Rev. B **73**, 064503 (2006).
- **Sumanta Tewari**, Sudip Chakravarty, John Ove Fjaerestad, Chetan Nayak, and Richard S. Thompson, “Infrared Hall angle in the  $d$ -density wave state: a comparison of theory and experiment”, Phys. Rev. B **70**, 014514 (2004).
- **Sumanta Tewari**, “Crossover and scaling in a two-dimensional field-tuned superconductor”, Phys. Rev. B **69**, 014512 (2004).
- **Sumanta Tewari** and S. Chakravarty, “ Collective modes in the  $d$ -density wave state of the cuprates”, Phys. Rev. B **66**, 054510 (2002).
- **Sumanta Tewari**, H.-Y. Kee, C. Nayak, and S. Chakravarty, “Spin and current correlation functions in the  $d$ -density wave state of the cuprates”, Phys. Rev. B **64**, 224516 (2001).

## • Other journals

- Chuanwei Zhang, V.W. Scarola, **Sumanta Tewari**, S. Das Sarma, “Anyonic braiding in optical lattices ”, Proceedings of the National Academy of Sciences (PNAS) (USA) **104**, 18415 (2007).
- Masaki Oshikawa, Yong Baek Kim, Kirill Shtengel, Chetan Nayak, **Sumanta Tewari**, “Topological degeneracy of non-Abelian states for dummies”, Annals of Physics **322**, 1477 (2007).
- **Sumanta Tewari** and John Toner, “Dissipate locally, couple globally: a sharp transition from decoupling to infinite range coupling in Josephson arrays with on-site dissipation”, Europhysics Letters, **74**, 341 (2006).

## • Submitted preprints

- Chuanwei Zhang, **Sumanta Tewari**, John Toner, S. Das Sarma, “Ginzburg-Landau theory for the conical cycloid state in multiferroics: Applications to  $\text{CoCr}_2\text{O}_4$ ”, submitted to Phys. Rev. Lett.; arXiv:0710.4550.
- **Sumanta Tewari**, Chuanwei Zhang, John Toner, S. Das Sarma, “Goldstone modes and electromagnon fluctuations in the conical cycloid state of a multiferroic”, submitted to Phys. Rev. Lett.; arXiv:0710.4551.
- **Sumanta Tewari**, C. W. Zhang, V. Yakovenko, S. Das Sarma, “Time-reversal symmetry breaking by a  $(d + id)$  density-wave state in underdoped cuprate superconductors”, submitted to Phys. Rev. Lett.; arXiv:0711.2329.

## List of Referees

- Sudip Chakravarty, Distinguished Professor, Physics and Astronomy, University of California, Los Angeles, CA 90095 (sudip@physics.ucla.edu, 310-825-4974).
- John J. Toner, Professor, Department of Physics, University of Oregon, Eugene, OR 97403 (jjt@darkwing.uoregon.edu, 541-346-0979).
- Sankar Das Sarma, Distinguished University Professor, Condensed Matter Theory Center, Dept. of Physics, University of Maryland, College Park, MD 20742 (dassarma@physics.umd.edu, 301-405-6145).
- Chetan Nayak, Microsoft Research, University of California, Santa Barbara, CA 93106, and Professor, Department of Physics, University of California, Los Angeles (nayak@kitp.ucsb.edu, 310-206-2863).
- D. Belitz, Professor and Associate Dean for Natural Sciences, Department of Physics, University of Oregon, Eugene, OR 97403 (belitz@physics.uoregon.edu, 541-346-4738).
- Dung-Hai Lee, Professor, University of California, Berkeley, CA 94720 (dunghai@berkeley.edu, 510-642-0567).
- T. Senthil, Associate Professor, Department of Physics, Massachusetts Institute of Technology, Cambridge, MA 02139-4307 (senthil@mit.edu, 617-253-6831).
- S. A. Kivelson, Professor, Department of Physics, Stanford University, Stanford, CA 94305-4045 (kivelson@stanford.edu, 650-723-1974).