

# Shubhrangshu Dasgupta

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## Personal Details:

**Sex :** Male

**Date of Birth :** November 29, 1974

**Nationality :** Indian

**Marital Status:** Married

**Father's Name :** Late Pranab Dasgupta

**Address :** Department of Physics,  
Indian Institute of Technology – Ropar  
Nangal Road, Rupnagar, Punjab – 140 001, India

**Present Position :** Assistant Professor,  
Department of Physics,  
Indian Institute of Technology – Ropar  
Rupnagar, Punjab – 140 001, India

## Academic Records :

- 1. Ph.D. on Physical Sciences** (December, 2004)  
Quantum Optics and Quantum Information Group  
Physical Research Laboratory, Ahmedabad, India, 2004  
Advisor : **Prof. Girish S. Agarwal**  
Thesis title: **Studies in Coherent Control of Optical Processes**
- 2. M. Sc. In Physics, University of Burdwan, India, 1997**  
Special paper: Digital Electronics and Digital Communication Systems  
Project: Studies of properties of radiation field (Advisor: **Prof. P. K. Sengupta**)
- 3. B. Sc. In Physics, University of Burdwan, India, 1995**  
Special paper: Electronic Circuits and its Design

**Computer Skills :** **Programming Languages :** FORTRAN, Mathematica, Matlab  
**Plotting Packages :** XMGR, Mathematica, gnuplot, Matlab  
**Numerical Libraries:** IMSL, LAPACK, ARPACK, EISPACK  
**Platforms :** UNIX (IBM RISC System/6000), LINUX, WINDOWS

## Awards and Fellowships:

- Research Fellowship, Physical Research Laboratory, Ahmedabad, India, August, 1998
- Joint Entrance Screening Test, 1998
- Graduate Aptitude Test in Engineering, Indian Institute of Technology, India, February, 1998 (89.48 percentile)
- National Eligibility Test conducted jointly by Council of Scientific and Industrial Research and University Grant Commission, in June 1998
- National Scholarship, 1989

## Employment Details:

January, 2007- August, 2009	<b>Post-doctoral Fellow</b> , Chemical Physics Theory Group University of Toronto, Toronto, Canada (in association with <b>Prof. Paul Brumer</b> )
September, 2005- December, 2006	<b>Post-doctoral Fellow</b> , Department of Chemistry University of Southern California, Los Angeles, USA (in association with <b>Prof. Daniel A Lidar</b> )
April, 2004- August, 2005	<b>Post-doctoral Fellow</b> , Quantum Optics and Quantum Information Division, Physical Research Laboratory, Ahmedabad, India (in association with <b>Prof. Girish S. Agarwal</b> )
August, 2000- March, 2004	<b>Senior Research Fellow</b> , Quantum Optics and Quantum Information Division, Physical Research Laboratory, Ahmedabad, India (Advisor: <b>Prof. Girish S. Agarwal</b> )
August, 1998- July, 2000	<b>Junior Research Fellow</b> , Quantum Optics and Quantum Information Division Physical Research Laboratory, Ahmedabad, India (Advisor: <b>Prof. Girish S. Agarwal</b> )

## Research Interests:

- Coherent control in Quantum Optics
- Measurement of weak effects and precision spectroscopy
- Optical control in quantum dots
- Many body theory in Bose-Einstein condensate
- Quantum control of atomic and molecular processes

## Publications in peer-reviewed journals :

1. Improving the fidelity of quantum cloning by field-induced inhibition of the unwanted transition, *S. Dasgupta* and G. S. Agarwal, *Phys. Rev. A* **64**, 022315 (2001); Selected in *Virtual Journal of Quantum Information* **1**, August, 2001.

Fidelity of optimal universal cloning is known to be  $5/6$ . We show that the fidelity can be enhanced far beyond this limit (often unity) for long times by using coherent fields in context of cloning of a single photon in arbitrary mode by excited three-level atoms. It is possible by modifying the rate of spontaneous emission inside the cavity by Rabi cycling of atomic population.

2. Coherent medium as a polarization splitter of pulses, G. S. Agarwal and *S. Dasgupta*, *Phys. Rev. A* **65**, 053811 (2002). (Cited 3 times)

Two polarization components of a linearly polarized pulse can be well-separated in time by suitably modifying their susceptibilities inside a four-level atomic medium. This modification is possible by applying coherent fields in suitable atomic transitions.

3. Laser-induced breakdown of the magnetic-field-reversal symmetry in the propagation of unpolarized light, G. S. Agarwal and *S. Dasgupta*, *Phys. Rev. A* **67**, 023814 (2003). (Cited 4 times)

The intensities of an unpolarized light for magnetic field applied parallel and anti-parallel to the direction of propagation of the light through an atomic medium can be made different by applying a coherent field in suitable atomic transition. This effect, though similar to the well-known magneto-chiral anisotropy, is much larger due to its electric-dipole origin. Magnetic field is shown to act like a switch between transparency and opacity of the medium.

4. Magneto-optical rotation of nonmonochromatic fields and its nonlinear dependence on optical density, G. S. Agarwal and *S. Dasgupta*, *Phys. Rev. A* **67**, 063802 (2003). (Cited 1 times)

It is shown that the magneto-optical rotation angle of a non-monochromatic light propagating in direction of magnetic field varies nonlinearly with the optical density of the medium, unlike a monochromatic light. Results of our theoretical model are in conformity with the experimental results.

5. Superluminal propagation via coherent manipulation of Raman gain process, G. S. Agarwal and S. Dasgupta, Phys. Rev. A **70**, 023804 (2004). (Cited 11 times)

Application of coherent field to a Raman medium leads to superluminal propagation of light pulse. This effect is shown arising due to quantum interference unlike in the known experiments on superluminality.

6. Implementing Deutsch-Jozsa algorithm using light shifts and atomic ensembles, S. Dasgupta, A. Biswas, and G. S. Agarwal, Phys. Rev. A **71**, 012333 (2005); Selected in Virtual Journal of Quantum Information **5**, February, 2005. (Cited 4 times)

We show how dispersive interaction of a freely propagating photon with an atomic ensemble helps to implement the one-bit version of the Deutsch-Jozsa algorithm. As the ground states of the atoms are involved, decoherence will not affect the implementation process. The required one-bit operations can be performed using wave plates and microwave fields.

7. Quantum interferences from cross talk in  $J=1/2 \leftrightarrow J=1/2$  transitions, S. Dasgupta, Opt. Commun. **259**, 683 (2006).

We consider the possibility of a control field opening up multiple pathways and thereby leading to new interference and coherence effects. We illustrate the idea by considering the  $J = 1/2 \leftrightarrow J=1/2$  transition. As a result of the additional pathways, we show the possibilities of nonzero refractive index without absorption and gain without inversion. We explain these results in terms of the coherence by the opening of an extra pathway.

8. Decoherence-induced geometric phase in a multilevel atomic system, S. Dasgupta and Daniel A. Lidar, J. Phys. B **40**, S127 (Special issue on "Dynamical control of entanglement and decoherence by field-matter interactions") (2007). (Cited 2 times)

We consider the stimulated Raman adiabatic passage (STIRAP) in a three-level atom. Viewed as a closed system, no geometric phase is acquired. But in the presence of spontaneous emission and collisional relaxation we numerically show that a non-vanishing, purely real, geometric phase is acquired during STIRAP, whose magnitude grows with the decay rates. Thus the environment provides a mechanism for the generation of geometric phases which would otherwise require an extra experimental control knob.

## Papers submitted/in preparation :

1. Two-bit Deutsch-Jozsa algorithm using an atomic ensemble, *S. Dasgupta* and G. S. Agarwal, **arXiv**: quant-ph/0601105
2. Controllable decoherence in a two-dimensional double-well optical lattice, *S. Dasgupta*

## Contributed Papers :

1. Improvement of fidelity of quantum cloning using a control field, *S. Dasgupta*, in Proceedings of International Conference on Perspectives in Theoretical Physics, p. 43, held at Physical Research Laboratory, Ahmedabad, India, January 8-12, 2001.
2. Novel coherence effects in a four-level system induced by extra control Field, *S. Dasgupta*, in Proceedings of National Laser Symposium, held at Indian Institute of Technology, Kharagpur, India, December 22-24, 2003.
3. Implementation of Deutsch-Jozsa algorithm using AC Stark shifts, *S. Dasgupta*, in Proceedings of Summer School on Quantum Logic and Communications, Cargese, Corsica, France, August 16-28, 2004.
4. Enhanced magneto-optical rotation in driven atomic system, *S. Dasgupta* and G. S. Agarwal, in Proceedings of XV National Conference of Atomic and Molecular Physics, Physical Research Laboratory, Ahmedabad, India, December 20-23, 2004.
5. Two-bit Deutsch-Jozsa algorithm using atomic ensembles, *S. Dasgupta* and G. S. Agarwal, Eighth Annual SQuInT workshop, University of New Mexico, Albuquerque, February 17-19, 2006.
6. Slow light for studying quantum weak values, *S. Dasgupta* and G. S. Agarwal, 9<sup>th</sup> Rochester Conference on Coherence and Quantum Optics, University of Rochester, Rochester, New York, USA, June 10-13, 2007.
7. Decoherence-induced geometric phase in an open multilevel atomic system, *S. Dasgupta* and Daniel A. Lidar, 38<sup>th</sup> annual meeting of DAMOP, Calgary, Alberta, Canada, June 5-9, 2007.
8. Realization of weak values using electromagnetically induced transparency, *S. Dasgupta* and G. S. Agarwal, Cross-border workshop, University of Toronto, Toronto, Ontario, Canada, May 17-19, 2007.

## Conferences Attended :

1. National Laser Symposium, held at School of Physics, University of Hyderabad, Hyderabad, India, December 15-17, 1999.
2. International Conference on Perspectives in Theoretical Physics, held at Physical Research Laboratory, Ahmedabad, India, January 8-12, 2001.
3. 8<sup>th</sup> National Conference on Atomic and Molecular Physics, held at Indian Association for the Cultivation of Science, Calcutta, India, January 16-20, 2001.
4. SERC School on Precision Spectroscopy of Atoms, Molecules, and Bose Condensates, held at Indian Institute of Science, Bangalore, India, February 20 - March 12, 2003.
5. National Laser Symposium, held at Indian Institute of Technology, Kharagpur, India, December 22-24, 2003.
6. SERC School on Quantum Information and Quantum Optics, held at Physical Research Laboratory, Ahmedabad, India, February 1-14, 2004.
7. Summer School on Quantum Logic and Communication, held at Cargese, Corsica, France, August 16-28, 2004.
8. XV National Conference on Atomic and Molecular Physics, held at Physical Research Laboratory, Ahmedabad, India, December 20-23, 2004.
9. Workshop on Quantum Information, Computation, and Communications, Indian Institute of Technology, Kharagpur, India, February 15-18, 2005.
10. Eighth Annual SQuInT workshop, University of New Mexico, Albuquerque, February 17-19, 2006.
11. Cross-border workshop, University of Toronto, Toronto, Ontario, Canada, May 17-19, 2007.

## Invited Talks :

1. *Deutsch-Jozsa Algorithm*, in SERC School on Quantum Information and Quantum Optics, Physical Research Laboratory, Ahmedabad, India, February 1-14, 2004.

2. *Quantum Algorithms*, Colloquium in Physical Research Laboratory, Ahmedabad, India, October 6, 2004.
3. *Geometric phase in non-adiabatic processes in open quantum systems*, International Conference on Quantum Optics, Physical Research Laboratory, Ahmedabad, India, July 17-21, 2006.
4. *Measurement of geometric phase in adiabatic processes: A dynamical approach*, University of California, Riverside, USA, July 7, 2006.

## Contributed Talks :

1. *Magnetic-field reversal asymmetry in the propagation of unpolarized light as an effect of coherent control*, SERC School on Precision Spectroscopy of Atoms, Molecules, and Bose Condensates, held at Indian Institute of Science, Bangalore, India, February 20 - March 12, 2003.
2. *Implementation of Deutsch-Jozsa algorithm using atomic ensemble and a freely propagating photon*, Workshop on Quantum Information, Computation, and Communication, Indian Institute of Technology, Kharagpur, India, February 15-18, 2005.
3. *Decoherence-induced geometric phase in an open multilevel atomic system*, 38<sup>th</sup> annual meeting of DAMOP, American Physical Society, Calgary, Alberta, Canada, June 5-9, 2007.

## Academic Visits :

1. Visit to S. N. Bose Center for Basic Sciences, Kolkata, India, February 7-11, 2005, under the program 'Theoretical Physics Seminar Circuit' (TPSC).
2. Visit to Department of Electrical Engineering, University of California, Riverside, California, USA, July 7, 2006, **Host:** Prof. Alexander N. Korotkov.
3. Visit to Department of Physics, Oklahoma State University, Stillwater, Oklahoma, USA, August 27-31, 2007, **Host:** Prof. Girish S. Agarwal.

## Professional Experience:

I serve as a referee to Journal of Modern Optics, European Physics Journal D, and Physical Review A.

## **Teaching Experience:**

I have graded the course CHM 423F (Application of Quantum Mechanics) during Fall, 2007, in Department of Chemistry, University of Toronto.

I have taught PHL103 (Classical Mechanics) and PHL102 (Quantum Mechanics) to the undergrad students.