

Ayush Gupta, Curriculum Vita

Contact Information

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Education

- PhD** Electrical Engineering, University of Maryland (UMD), College Park, MD Aug. 2006
Dissertation Title: Interaction of Intense Short Laser Pulses with Gases of
Nanoscale Atomic and Molecular Clusters
Committee Chair: Prof. Thomas M. Antonsen, Jr.
- B.Tech. (Hons.)** Electronics and Electrical Communications Engineering, Jun. 2000
Indian Institute of Technology (IIT), Kharagpur, India.
Dissertation Title: Mutual coupling between two waveguide fed apertures
Committee Chair: Prof. Ajay Chakraborty

Teaching Positions

Spring 2009	Instructor	Phys161 (Gen. Phys.: Mechanics & Particle Dynamics)
Fall 2008	Instructor	Phys 121/122 Laboratory (Fundamentals of Physics)
Fall 2007	Instructor	Phys 115 (Inquiry into Physics)
Spring 2007	Teaching Assistant	Phys 115 (Inquiry into Physics)
Fall 2006	Teaching Assistant	Phys 121 (Fundamentals of Physics I)
Fall 2005	Facilitator	EDPL 338 (Inter-Group Dialog) [now EDHI338]
Spring 2005	Facilitator	EDPL 338 (Inter-Group Dialog) [now EDHI338]

Research Positions

- Research Associate** Aug. 2006- Present
Physics Education Research Group, University of Maryland, College Park
Project Director, Improving students' mathematical sense-making in engineering: Research and development. NSF EEC-0835880. *Andy Elby, PI.* (Sept. 2009-present)
- Graduate Research Assistant** Jan. 2001-Aug. 2006
Plasma Theory Group, Institute for Research in Electronics and Applied Physics,
University of Maryland, College Park
- Graduate Research Assistant** Aug. 2000-Dec. 2000
Maryland Optics Group, University of Maryland, College Park
- Undergrad. Research Assistant** Jul. 1999-Jun. 2000
Microwave Laboratory, Indian Institute of Technology, Kharagpur, India
- Intern** May 1999-Jun. 1999
Beam Physics Group, Variable Energy Cyclotron Center, Kolkata, India
- Intern** Dec 1998
Raman Research Institute, Bangalore, India

Awards/Honors

- Ranked in top 1%, Joint Entrance Examination of the Indian Institutes of Technology, 1996.
- Jagdish Bose National Science Talent Search Award, 1996 – a science talent award at the college freshman level.

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Research Interests

Cognitive Models of learning and knowledge organization
Cognitive Linguistics: how to infer cognitive structure from verbal expression?
Impact and use of mathematics in learning physics
Complex Dynamics of student behaviors and reasoning in active learning environments

Professional Service

- Reviewer: The Journal of the Learning Sciences, Physics Education Research Conference, International Conference on Learning Sciences, National Association of Research in Science Teaching, Physics of Plasmas.
- Volunteer Assistant Instructor (discussion sessions) for Phys 273 (Waves), Spring 2007, University of Maryland, College Park.
- Student representative on the Graduate Studies and Research Committee, Department of Electrical and Computer Engineering, University of Maryland (2002-2003).
- Treasurer and Vice President, Electrical and Computer Engineering Graduate Student Association, University of Maryland (2001-2003). Organized social and academic activities for graduate students, helped design and conduct surveys to assess graduate student needs.

Leadership/Organization

- Moderated a reading group on Cognitive Linguistics at University of Maryland (Spring 2008)
- Initiated a dialogue program in the Dept. of Electrical and Computer Engineering, Univ. of Maryland (Fall 2005) for increasing communication between students from different cultures. Formed and led a committee of 6 students, designed a needs-assessment survey, and acquired approval and funding for the program.
- Vice President, KhushDC – a social and support group for LGBTQ South Asians (Aug. 2003- 2005). Overhauled organizational structure by creating By-laws, and Administration Policies. Organized three fund-raisers, raising about \$5,000 from community sources. Built up a formal membership base with 40 new regular members and 150 new online members.

Professional Memberships

Member, American Association of Physics Teachers (AAPT)
Member, American Association for the Advancement of Sciences (AAAS)
Member, International Society for the Learning Sciences (ISLS)

Visa Status

H1-B Visa with I-94 valid till 08/31/2009; Extension beyond 08/31/2009 possible.

Peer-Reviewed Publications

11. Gupta, A., Hammer, D., & Redish, E. F. (In preparation).
Variability in Learners' Ontologies in Physics: A Toy Model
Intend to Submit to: Cognition and Instruction
10. Gupta, A., Hammer, D., & Redish, E. F. (Under Review).
The Case for a Dynamic Model of Expert and Novice Ontologies in Physics.
The Journal of the Learning Sciences. Under review.
Available online at <http://arxiv.org/abs/0802.4278>
9. Gupta, A., Hammer, D., & Redish, E. F. (2008).
Towards a Dynamic Model of Learners' Ontologies in Physics.
Proceedings of the 2008 International Conference for the Learning Sciences.
8. Gupta, A., Redish, E. F., & Hammer, D. (2007).
Coordination of Mathematical and Physical Resources by Physics Graduate Students.
AIP Conf. Proc. 951, 104-107. 2007 Physics Education Research Conference.
Available online at <http://arxiv.org/abs/0803.0012>
7. Conlin, L., Gupta, A., Scherr, R., & Hammer, D. (2007).
The Dynamics of Students' Behaviors and Reasoning during Collaborative Physics Tutorial Sessions.
AIP Conf. Proc. 951, 69-72. 2007 Physics Education Research Conference.
Available Online at <http://arxiv.org/abs/0803.0323>
6. Palastro, J. P., Antonsen, T. M., & Gupta, A. (2007).
Dielectric Properties of Laser Exploded Clusters.
Physics of Plasmas, 14, 033105.
5. Gupta, A., Antonsen, T. M., Palastro, J., Taguchi, T., & Milchberg, H. M. (2006).
Effect of Pulse Width on Resonant Heating of Laser-Irradiated Argon and Deuterium Cluster.
Physical Review E, 74, 046408.
4. Antonsen, T. M., Gupta, A., Palastro, J. P., Milchberg, H. M., & Taguchi, T. (2005).
Resonant Heating of a Cluster Plasma by Intense Laser Light.
Physics of Plasmas, 12, 056703.
3. Kim, K., Alexeev, I., Antonsen, T. M., Gupta, A., Kumarappan, V., & Milchberg, H. M., (2005).
Spectral Redshifts in Intense Laser-Cluster Interaction.
Physical Review A, 71, 011201(R).
2. Gupta, A., Antonsen, T. M., & Milchberg, H. M. (2004).
Propagation of Intense Short Laser Pulses in a Gas of Atomic Clusters",
Physical Review E, 70, 046410.
1. Kim, K., Alexeev, I., et. al. (2004).
Gases of Exploding Laser-heated Cluster Nanoplasmas as a Nonlinear Optical Medium.
Physics of Plasmas, 11, 2882.

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Invited Talks

6. Understanding Student Difficulties in Learning Physics
Classroom Readiness for STEM Volunteers Program: Seminar Series
Northrup Grumman, Baltimore, MD. November, 2008.
5. Expert-Novice Ontologies in Physics
Illinois Physics Education Research Group,
University of Illinois, Urbana-Champaign, IL. April, 2008.
4. Expert-Novice Ontologies in Physics
Education Research Collaborative (ERC) at TERC,
Cambridge, MA. March, 2008.
3. Interaction of Atomic and Molecular Clusters with Intense Laser Pulses
Tech-X Corporation,
Boulder, CO. July, 2006
2. Interaction of Atomic and Molecular Clusters with Intense Laser Pulses
Department of Radiation Oncology and Molecular Radiation Sciences, Johns Hopkins University,
Baltimore, MD. April, 2006.
1. Interaction of Atomic and Molecular Clusters with Intense Laser Pulses
Laboratory of Biological Modeling, NIDDK, National Institutes of Health,
Bethesda, MD. February, 2006.

Contributed Talks with Published Abstracts (Presenter Underlined)

20. Novice Ontologies in Physics
Ayush Gupta, David Hammer, Edward F. Redish
APT 2008 Summer Meeting, Edmonton, Canada, July, 2008.
19. Towards a Dynamic Model of Learners' Ontologies in Physics
Ayush Gupta, David Hammer, & Edward F. Redish
2008 International Conference for the Learning Sciences, Utrecht, Netherlands, June, 2008.
18. Case Studies in Learners' Ontologies in Physics
Ayush Gupta, David Hammer, & Edward F. Redish
APT 2008 Winter Meeting, Baltimore, MD, January 2008.
17. Student Models of Electric Current: An Ontological Analysis.
Ayush Gupta, Edward F. Redish, & David Hammer
APT 2007 Summer Meeting, Greensboro, NC, July 2007.
16. Revisiting the Ontological Characterization of Physics Concepts.
Edward F. Redish, Ayush Gupta, & David Hammer
APT 2007 Summer Meeting, Greensboro, NC. (APT 2007 Program Guide, BE11, pp. 57)
15. Student's Patterns of Reasoning and Behavior During Physics Tutorials.
Luke D. Conlin, Ayush Gupta, Rachel E. Scherr, & David Hammer
APT 2007 Summer Meeting, Greensboro, NC. (APT 2007 Program Guide, BE02, pp. 56.)
14. An Example of Multiple Mathematical Justifications in Student Thinking.
Thomas Bing, Ayush Gupta, & Edward F. Redish,
APT 2007 Summer Meeting, Greensboro, NC. (APT 2007 Program Guide, EF04, pp. 88.)

Contributed Talks with Published Abstracts (Presenter Underlined) (Contd.)

13. Intense laser cluster Interaction: Quasi-monoenergetic high energy ion production
Ayush Gupta, Thomas Antonsen, J. P. Palastro, & T. Taguchi
American Physical Society, 48th Ann. Meeting of the Division of Plasma Physics, Philadelphia, Nov. 2006.
12. Laser-irradiated Atomic Clusters: Resonant Heating, High Energy Ions and Fusion Yield
Ayush Gupta, J. P. Palastro, Thomas Antonsen, H. Milchberg, & T. Taguchi
33rd IEEE International Conference on Plasma Science, Traverse City, MI, Jun. 2006.
11. Linear Absorption Mechanisms in a Laser Exploded Cluster
J. P. Palastro, Thomas Antonsen, & Ayush Gupta
33rd IEEE International Conference on Plasma Science, Traverse City, MI, Jun. 2006.
10. Intense Laser-Cluster Interaction: Effect of Hot Electrons on Propagation and Studies with Longer Pulse widths
Ayush Gupta, Thomas Antonsen, T. Taguchi, J. Palastro, & H. Milchberg
American Physical Society, 47th Ann. Meet. of Division of Plasma Physics, Denver, CO, Oct. 2005.
9. Dielectric Response of a Laser-Exploded Cluster to a Perturbing Field
J. Palastro, Thomas Antonsen, & Ayush Gupta
American Physical Society, 47th Ann. Meet. Of Division of Plasma Physics, Denver, CO, Oct. 2005.
8. Signatures of Non-linear Resonance in Laser Irradiated Cluster Plasma
Ayush Gupta, Thomas Antonsen, J. P. Palastro, T. Taguchi, & H. M. Milchberg
American Physical Society, 46th Ann. Meet. Of Division of Plasma Physics, Savannah, GA, Nov. 2004.
7. Dielectric Properties of Laser Exploded Clusters
J. P. Palastro, Thomas Antonsen, & Ayush Gupta
American Physical Society, 46th Ann. Meet. Of Division of Plasma Physics, Savannah, GA, Nov. 2004.
6. Resonant Heating of a Cluster Plasma by Intense Laser Light
T. Taguchi, T. Antonsen, A. Gupta, & H. Milchberg
Conference on Lasers and Electro-Optics/International Quantum Electronics Conference (CLEO/IQEC), San Francisco, CA, May 2004.
5. Self-Guiding and Frequency Shifts of Intense Laser Pulses Propagating in Clustered Gases
K. Y. Kim, V. Kumarappan, A. Gupta, T. Antonsen, H. Milchberg, A. Faenov, & T. Pikuz
Conference on Lasers and Electro-Optics/International Quantum Electronics Conference (CLEO/IQEC), San Francisco, CA, May 2004.
4. Interaction of Intense Short Laser Pulse with Cluster Plasma
Ayush Gupta, T. Taguchi, Thomas Antonsen, & H. Milchberg
34th Anomalous Absorption Conference, Gleneden Beach, OR, May 2004.
3. Propagation of Intense Short Laser Pulses in Gases of Atomic Clusters
Ayush Gupta, Thomas Antonsen, & H. Milchberg
American Physical Society, 45th Ann. Meet. of Division of Plasma Physics, Albuquerque, NM, Oct. 2003.
2. Self-Phase Modulation and Coupling of Intense Laser Pulses into Plasma Waveguides Produced in Clustered Gases
K. Y. Kim, H. Milchberg, V. Kumarappan, I. Alexeev, A. Gupta, T. M. Antonsen
American Physical Society, 45th Ann. Meet. of Division of Plasma Physics, Albuquerque, NM, Oct. 2003.
1. Resonant Heating of a Cluster Plasma by Intense Laser Light
T. Antonsen, T. Taguchi, A. Gupta, H. Milchberg
American Physical Society, 45th Ann. Meet. of Division of Plasma Physics, Albuquerque, NM, Oct. 2003.

Contributed Posters

13. Gupta, A., Hammer, D., Redish, E. F. (2009).
Ontologies of Physics Concepts: Variability and Local Coherences
AERA 2009 Annual Meeting, San Diego, CA.
12. Gupta, A., Hammer, D., Redish, E. F. (2008).
Ontologies in Physics: A Toy Model
APT 2008 Summer Meeting, Edmonton, Canada.
11. Gupta, A., Redish, E. F., & Hammer, D. (2008).
Case Studies in Learners' Ontologies in Physics.
APT 2008 Winter Meeting, Baltimore, MD.
10. Conlin, L., Gupta, A., Scherr, R., & Hammer, D. (2008).
Framing and Reasoning in Tutorials over the course of a semester.
APT 2008 Winter Meeting, Baltimore, MD.
9. Gupta, A., Redish, E. F., Hammer, D. (2007).
Coordination of Mathematical and Physical Resources by Physics Graduate Students.
2007 Physics Education Research Conference, Greensboro, NC.
8. Redish, E. F., Gupta, A., & Hammer, D. (2007).
Towards a Dynamic Model of Expert and Novice Ontologies in Physics.
2007 Physics Education Research Conference, Greensboro, NC.
7. Conlin, L., Gupta, A., Scherr, R., & Hammer, D. (2007).
The Dynamics of Students' Behaviors and Reasoning during Collaborative Physics Tutorial Sessions.
APT 2007 Summer Meeting & 2007 Physics Education Research Conference, Greensboro, NC.
6. Bing, T., Gupta, A., & Redish, E. F. (2007).
Different Types of Mathematical Justification in Upper Level Physics.
APT 2007 Summer Meeting & 2007 Physics Education Research Conference, Greensboro, NC.
5. Redish, E. F., Gupta, A., & Hammer, D. (2007).
Towards a Dynamic Model of Expert and Novice Ontologies in Physics.
Foundations and Frontiers in Physics Education Research Conference, Bar Harbor, ME.
4. Antonsen, T. M., Gupta, A., et. al. (2004).
Gases of Exploding Clusters as a Nonlinear Optical Medium.
31st IEEE International Conference on Plasma Science, Baltimore, MD.
3. Gupta, A., Antonsen, T. M., et. al. (2003)
Self Focusing in Cluster Plasma.
Conference on Lasers and Electro-Optics/International Quantum Electronics Conference (CLEO/IQEC), Baltimore, MD.
2. Gupta, A., Antonsen, T. M., et. al. (2002).
Self Focusing in Cluster Plasma.
American Physical Society, 44th Annual Meeting of the Division of Plasma Physics, Orlando, FL.
1. Gupta, A., Antonsen, T. M., & Milchberg, H. M. (2001).
Self Focusing in Cluster Plasma.
American Physical Society, 43rd Annual Meeting of the Division of Plasma Physics, Long Beach, CA.

Research Projects

Project Director, Improving students' mathematical sense-making in engineering: Research and development. NSF EEC-0835880. *Andy Elby, PI.* (Sept. 2009-present)

For engineers, effective use of mathematics is more than manipulating equations and applying algorithms; it involves mathematical sense-making, looking for coherence and meaning partly by translating back and forth between symbolic relations on the page and relations (causal and functional) in the world. Mathematical sense-making is central to students' success with modeling and design. Yet, many engineering students have trouble with it.

Typical engineering students first grapple extensively with mathematical descriptions of the world in the introductory physics courses they take as prerequisites for their majors. Those physics courses can forge or harden students' attitudes and approaches toward math. This project, a collaboration among the University of Maryland Departments of Physics, Mechanical Engineering, and Electrical & Computer Engineering, addresses two research questions:

- 1) What factors contribute to students' difficulties with mathematical sense-making?
- 2) Can redesigned introductory physics courses improve students' mathematical sense-making and overall performance in their later engineering courses?

Research Associate, Toward a new conceptualization of what constitutes progress in learning physics, K-16: Resources, frames, and networks. NSF REC/ROLE 0440113. *David Hammer, PI.* (Sept. 2006-present)

Learners' Ontologies in Physics: A Dynamic Systems View: Developing a dynamic account of the ontology of naïve physics reasoning, how students classify features of the world as entities vs. processes vs. events and how those classifications affect students' explanations and problem-solving. This work involves (1) building a phenomenology of the patterns and transitions in ontologies evident in student reasoning, and (2) using that phenomenology as a basis for modeling cognitive structure and dynamics. Instructionally, this research could inspire strategies to harness students' everyday ontological resources to make learning science a more meaningful and connected experience for them.

Modeling the coupled dynamics of student behaviors and reasoning during collaborative learning activities: Investigating how students' non-verbal behaviors (posture, gesture, vocal register, visual focus) influence and are influenced by the substance of their reasoning during collaborative group work. Our analysis reveals a dynamic coupling of students' behaviors, epistemic framings (ways of approaching knowledge generation) and physics reasoning. This has instructional implications, by identifying easy-to-spot behaviors that tend to indicate the presence of productive student reasoning.

Research Associate, Learning the Language of Science: Advanced Math for Concrete Thinkers. NSF, DUE 05-24987. *Edward F. Redish, PI.* (Sept. 2006-present)

In a small study, we investigated the dynamics of how graduate students coordinate their mathematics and physics knowledge within the context of solving a homework problem for a plasma physics survey course. Students were asked to obtain the complex dielectric function for a plasma with a specified distribution function and find the roots of that expression. While all the 16 participating students obtained the dielectric function correctly in one of two equivalent expressions, roughly half of them (7 of 16) failed to compute the roots correctly. All seven took the same initial step that led them to the incorrect answer. There was a perfect correlation between the specific expression of dielectric function obtained and the student's success in solving for the roots. We analyzed student responses in terms of a resources framework and suggest routes for future research.

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Graduate Research: Analytical-computational models of laser-irradiated gases of atomic clusters.

Thomas M. Antonsen, PI. (Jan. 2001-Jun. 2006)

Developed a model of interaction of intense laser pulses with a nano-scale atomic cluster, explaining the mechanism of laser-energy absorption by the cluster. This is of interest in generation of x-ray radiation for tomography/lithography, high-energy ions and electrons for particle acceleration, and as a potential tabletop neutron source. Developed the first self-consistent simulations for propagation of laser pulses through clustered gases, predicting parameter ranges for optimizing laser pulse guiding through clustered gases, an issue of major interest for laser-based accelerators.