# A C A D E M I C  C U R R I C U L U M  V I T A E

— Selections —

**LAURENCE I. GOULD**

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[Frequently Used Abbreviations: APS = American Physical Society,
AAPT = American Association of Physics Teachers]

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**EDUCATION** Ph.D. in Physics (Temple University, 1982)
M.A. in Physics (Temple University, 1975)
B.S. in Physics (Carnegie-Mellon University, 1964)

## EMPLOYMENT HISTORY

**1.** Professor of Physics [9/94]; Associate Prof. of Physics [9/89]; Assistant Prof. of Physics, University of Hartford [9/85]
**2.** Visiting Assistant Prof. of Physics; Temple University [1/82-6/85]
**3.** Assistant Prof. of Physics; Penn State University (Ogontz) [7/84-8/84]
**4.** Math Instructor; Philadelphia College of Textiles & Science [9/79-6/82]
**5.** Assistant Prof. of Physics; Beaver College [1/80-6/80]
**6.** Programmer and then Chief Programmer, Polytechnic Institute of New York [1/70-6/72]
**7.** Research Associate, promotion from Associate Engineer; Machlett Laboratories (now a division of Raytheon), Stamford, CT [9/67-11/69]
**8.** Copy Editor for the Physical Review; American Institute of Physics [9/64-6/66]

## ACADEMIC EXPERIENCE

Undergraduate courses taught include: *Interdisciplinary* —Seeing Through Symmetry (course created by me, All University Curriculum), Reasoning in Science, Science & Society (team taught). *Lower-level physics*—Musical Acoustics, Astronomy, Physics for Medical Technology, Physics for Radiology Technicians, Introductory Physics (calculus based 2-semester sequence). *Upper-level physics* —Introduction to Materials Science, Classical Mechanics, Special Theory of

Relativity, and Modern Physics I. *Independent-study* —Modern Physics II, Calculus of Variations (course combines the physics with its history) and Topics in General Relativity (course involved using the symbolic programming language MACSYMA™ along with the text "Gravitation" by Misner, Thorne and Wheeler), Computers in Physics and Physics Education (course created by me, involves the enhancement of both classroom skills and physics background through the integration of physics-based computer material in a laboratory setting). Graduate courses taught: Mathematical Physics (2-semester course), Practicum in Teaching Physics, and an independent-study course on the Nonlocal Variational Calculus.

**INVENTIONS**

"An Adaptable Flask" (1/14/61; patent not applied for).

**LANGUAGES**

Adequate speaking knowledge of German and some acquaintance with French and Spanish.

**RECREATIONAL ACTIVITIES**

Playing the violin, reading and writing poetry, swimming, and occasional bicycling and sailing.



# S C H O L A R S H I P

## A. PUBLICATIONS

1. Papers to Refereed Journals, to Conference Proceedings, and for Books

(a) "Snapshots of Symmetry in Einstein's Relativity"; Abstract in *Symmetry Festival 2006*; program and CD (Budapest, Hungary; 8/13/06).

(b) "Issues in Science and Religion: A Critical Evaluation," in *Science, Religion, and Society: History, Culture, and Controversy,* edited by Gary Laderman and Arri Eisen (M.E. Sharpe, NY, 2007) [Forward by the Dalai Lama], pp. 81 - 90 [invited].

(c) "Seeing Science Through Symmetry", in *Symmetries in Science XI*, edited by Bruno J. Gruber, Giuseppe Marmo, and Naotaka Yoshinaga (Kluwer Academic Publishers, Boston, 2004), pp. 227-238. [invited]

(d) "Aspects Of 'Seeing Through Symmetry' — An Interdisciplinary Multimedia Course", *Symmetry: Culture and Science* **14**, 99-105 (2003).

(e) "Integrating Science and Math into the Freshman Engineering Design Course" (with D. Pines, M. Nowak, H. Alnajjar, and D. Benardete), *Proceedings of the 2002 American Society for Engineering Education Annual Conference & Exposition* (June, 2002).

(f) "Seeing Through Symmetry — As Seen Through Its Labs," *Symmetry: Culture and Science* **8,** Nos. 3-4, pp. 401 - 408 (2001) [invited]

(g) "What Is Symmetry That Educators and Students Should Be Mindful Of It?" Book chapter for *Interdisciplinary General Education: Questioning Outside the Lines*, Marcia Bundy Seabury, Editor (College Entrance Examination Board, NY, 1999), pp. 105 - 122 [invited].

(h) "Faraday's Legacy: The Joys of Scientific Methodology," Guest Editorial for *QUANTUM* (November/December 1998), pp. 2–3.

(i) "Reflections of the Relevance of Nonlocality to Cognitive Science and the Philosophy of Mind," from *New Directions in Cognitive Science*, Proceedings of the International Symposium (Saariselka, 4-9 August 1995, Lapland, Finland), edited by Paavo Pylkkänen and Pauli Pylkkö (Finnish Artificial Intelligence Society, Helsinki, 1995), pp. 104 - 114. This article generalizes both the neural dynamical model and the ontological model through the replacement of interaction terms, in the fundamental dynamical equations of those theories, by integrals; thus yielding integro-differential equations as the more natural descriptors for brain processes.

(j) "Quantum Dynamics and Neural Dynamics: Some Analogies between the Formalisms of Bohm and Pribram," an invited paper (Fall 1994) for *Scale in Conscious Experience: Is the Brain too Important to be Left to Specialists to Study*, 3rd Appalachian Conference Proceedings on Behavioral Neurodynamics (Lawrence Erlbaum Associates, NJ, 1995), pp. 339 - 348. This demonstrates how it is possible to make advances in studying the neural dynamical formalism of Pribram, et al by casting that formalism into the framework of the ontological model of quantum theory as formulated by Bohm.

(k) "Computer Algebra for Lagrangian, Hamiltonian, and Autonomous Systems" (to be re-submitted). This describes, in part, how one can obtain symbolic solutions to any set of the fundamental equations of motion, Hamilton's equations, that are used to describe many-particle systems (such as those exhibiting chaos). A user-friendly program written in MACSYMA (and being converted into Maxima 5.12) enables one to obtain such solutions. The program also interrelates the Hamiltonian and Autonomous routines with those for Lagrangians.

(l) "Towards a More Causal Interpretation of Quantum Mechanics: The Ontological Interpretation of David Bohm," *Arkhimedes* **45**, No. 2, 144 - 157 (1993) [an international journal published by the Finnish Physical Societies and the Finnish Mathematical Society; with articles in Finnish, Swedish, and English]. This article brings in the relevant philosophy of science to explicate Bohm's causal interpretation of quantum mechanics.

(m) "Response to Mayants' Note on Bohm's Interpretation of Quantum Mechanics" (with B.J. Hiley, University of London), *Physics Essays* **6**, No. 1, 129 - 132 (March 1993): This paper clarifies David Bohm's "quantum potential" interpretation of Quantum Mechanics and answers one of its critics (L. Mayants).

(n) "Nonlocal Generalized Angular-Momentum Balance Laws and Equations of Motion," *International Journal of Engineering Science* **30**, 1417 - 1432 (1992): This research goes beyond the usual local treatments by showing how one can determine rotational properties

associated with a wide variety of nonlocal physical systems; such properties are, along with energy and momentum, very important for understanding physical systems. One of the applications is for multiparticle systems with "spin."

(o) "Balance Laws Associated with Nonlocal Equations of Motion for Theories Containing One Dependent Variable," *International Journal of Engineering Science* **28**, 459 - 468 (1990): This research is on the same topic as the following one but for systems described by equations of motion characterized by a single primary variable. One of the applications determines the energy associated with the membrane-like material covering the wing of an ultralight plane.

(p) "Nonlocal Conserved Quantities, Balance Laws, and Equations of Motion," *International Journal of Theoretical Physics* **28,** 335 - 363 (1989): This paper pertains to my formalism showing how the motion of a system can be used, more easily than current methods, to arrive at properties of the system which remain constant through time. An example given is in Quantum Mechanics where the system's motion, determined by a wave function from Schrödinger's equation, is used to obtain the system's energy. The value of this energy remains constant through time and represents important information for understanding the system. Consequently, some of the systems amenable to this formalism can be found at the atomic scale. Since atoms are constituents of human beings, as well as of galaxies, the research results can therefore lead to a better understanding of the nature of each of those systems.

(q) "Estimating the Speed and Distance of a Plane" (with C. Waiveris), *The Physics Teacher* **29,** 108 - 111 (1991): The article is based on a few years' research that includes determinations of the speed and distance of jet planes through simple measurements carried out by observers on the ground. It is thus an enjoyably instructive activity for both high school and college students.

(r) "Audio-Visual Aids in Materials Science and Engineering: A Current Overview," *Journal of Materials Education* **11,** 169 - 180 (1989): This paper not only explains the variety of multimedia aids useful in teaching Materials Science but also describes some utilized in my own teaching of the subject.

(s) "The SUNY Potsdam Miracle? Some Lessons for Physics," *Journal of College Science Teaching* **XXI**, 348 - 351 (1992): Describes the interactive methods and philosophy of teaching utilized by the mathematics department of the State University of New York at Potsdam. Describes how such techniques have been applied to my own classroom work for our first two introductory calculus-based physics courses.

(t) "Air Track with a Distributed Infrared Detector System" (with H. Workman), *American Journal of Physics* **56,** 739 - 744 (1988): This paper explains details of the novel computer-based infrared-detection air track system utilized in some of our introductory physics laboratories. It also describes and gives data for some of the experiments that have been done using this air track.

**B. LECTURES**

INVITED

1. Local and Professional Organizations and International Workshops

(a) “Albert Einstein: Myth and Magic,” Avery Heights retirement community (Hartford, CT; 8/22/05) — celebrating the 2005 Einstein Centennial Year.

(b) “Albert Einstein: Myth and Magic” [educational outreach celebrating the Einstein Centennial Year], Prosser Public Library (Bloomfield, CT; 3/22/05).

(c) “Research Activity in Computational Physics” for the Caltech/Jet Propulsion

Laboratory's Ultracomputing Group (June 2004; NASA-JPL, Pasadena, CA).

(d) "Seeing Science Through Symmetry: An Interdisciplinary Multimedia Course" for the *Symmetries in Science XIII* conference (Bregenz, Austria; 7/20-24/03).

(e) "A Quantum-Like Nonlocal Model with Possible Application to Brain States" for the international workshop: *Can there be a Science of Consciousness?* (University of Skövde, Sweden; 20 - 22 June 2000).

(f) "Continuous Weight Functions and Implications for Nonlocal Dynamical Equations and Balance Laws of some Quantum-like Neural Networks" for the Special Session on Field Computation (Continuum-Limit Neural Computation) at the 4th International Conference on Computational Intelligence and Neuroscience (Atlantic City, February 27 - March 3, 2000).

(g) "Computer Algebraic Run-Time Studies of some Nonlocal Associative Neural Networks" for the Special Sessions on Quantum and Neuro/Quantum Information Processing at the 4th International Conference on Computational Intelligence and Neuroscience (Atlantic City, February 27 - March 3, 2000).

(h) "Use of Generalized Nonlocality in Synergetic Associative Neural Networks" for the Connecticut Space grant College Consortium 1998 Conference (Legislative Office Building; Hartford, CT, November 2, 1998).

(i) "A Program for the Application of Generalized Nonlocality to the Study of Synergetic Associative Neural Networks" for the Neuro-Quantum Information Processing Session at the 3rd International Conference on Computational Intelligence and Neuroscience (Research Triangle Park, NC, October 24-28, 1998).

(j) "Reflections of the Relevance of Nonlocality to Cognitive Science and the Philosophy of Mind," *New Directions in Cognitive Science*, an International Symposium sponsored by The Academy of Finland Research Group in Cognitive Science (Saariselka, 4-9 August 1995, Lapland, Finland).

(k) "Computer Algebra for Lagrangian, Hamiltonian, and Autonomous Systems": Edelen Symposium at the 31st Annual Technical Meeting of the Society of Engineering Science (Texas A&M, 10/10-12/94).

(l) "Relating Nonlocal Equations of Motion to Gauge-Oriented Balance Laws" (International Summer School on Topology, Geometry and Gauging in Field Theoretic Models of Condensed Matter; Jablonna, Poland; 9/1/89).

(m)"Nonlocal Angular-Momentum Balance Laws and Equations of Motion": Eringen Symposium at the 28th Annual Meeting of the Society of Engineering Science (University of Florida at Gainesville, 11/6-8/91).

(n) Session titled "Keeping the Vision Alive: The Pursuit of Physics — A Female Perspective"; created, organized, and chaired for the AAPT Committee on Women in Physics — Winter Meeting of the AAPT (New Orleans, 1/4/93).

2. Universities and Colleges

(a) Presentation and Discussion Leader about "Global Warming" following the matinee of *An Inconvenient Truth* at Cine Studio (Trinity College; 9/9/06).

(b) "Albert Einstein: Myth and Magic" — university-wide talk (Department of Physics & Astronomy; Louisiana State University, Baton Rouge, LA; 3/23/06).

(c) "A Causal Program For Quantum Physics: De Broglie to Bohm" — quantum seminar (Department of Physics & Astronomy; Louisiana State University, Baton Rouge, LA; 3/24/06).

(d) “Albert Einstein: Myth and Magic”; Smith College (Northampton, MA; 11/14/05) — celebrating the 2005 Einstein Centennial Year.

(e) “Albert Einstein: Myth and Magic”; Quinebaug Valley Community College (Danielson, CT; 3/21/05) — celebrating the 2005 Einstein Centennial Year.

(f) “Wanderings Through Symmetry” — Physics Colloquium talk (University of Connecticut, Storrs, CT; 4/2/04).

(g) “Computer Algebra Program for Lagrangians, Hamiltonians, and Autonomous Systems” — informal seminar, Math Department (University of Arizona, Tucson, AZ; 12/6/02).

(h) "Can Quantum Physics Tunnel Its Way Into Consciousness?" — colloquium at Vassar College (Poughkeepsie, NY; 4/21/99).

(i) "Computer Algebra for Lagrangian, Hamiltonian, and Autonomous Systems" — seminar at the Jet Propulsion Laboratory (California Institute of Technology/NASA, Pasadena, 3/17/99).

(j) "Generalized Nonlocality, Brain Nets, and Neural Nets" — seminar at the Jet Propulsion Laboratory (California Institute of Technology/NASA, Pasadena, 3/18/99).

(k) "A Causal Program For Quantum Physics: De Broglie to Bohm" — seminar (Physics Department, Trinity College, 2/27/98).

(l) "Boundary Conditions Associated with a Class of Nonlocal Dynamical Equations" at the Fourth Meeting of Current Ideas in Mechanics and Related Fields (Collegium Maius of the Jagiellonian University, Krakow, 8/28/97).

(m)"Reflections of the Relevance of Nonlocality for Physics, Cognitive Science and the Philosophy of Mind: Bohm, Pribram and Beyond" — seminar (Department of Mathematics — Faculty of Mathematics and Physics — University of Ljubljana; Slovenia, 8/13/96).

(n) "Computer Algebra for Lagrangian, Hamiltonian and Autonomous Systems" — seminar (Department of Mathematics — Faculty of Mathematics and Physics — University of Ljubljana; Slovenia, 8/6/96).

(o) "Computer Algebra for Lagrangians, Hamiltonians, and Autonomous Systems" — colloquium lecture (Institute for Theoretical Physics, University of Helsinki, 8/15/95).

(p) "Using Competing Species towards a Nonlocal Model for Neural Nets" and "An Overall View of Quantum Mechanics"; at the international workshop titled "Brain, Mind and Physics" (Charles University; Prague, 9/13-17/93).

(q) "Physics and Philosophy concerning the Application of Variational Principles toward Relating Dynamical Equations to Conservation Laws" (Oxford University; England, 6/17/91).

(r) "Lecture Program in Finland" (September and October 1992):

i. "The Basic Features of the Ontological Interpretation of Quantum Theory in View of its Application in Connectionism" (Sept. 12th) and
ii. "The Situation in Modern Physics" (Sept. 14th);

(s) both for "Physicalism Connectionism and Consciousness: An International Symposium on the Foundations of Cognitive Science" [The University of Helsinki Centre for Continuing Studies, Siuntio].

i. "Bohm's Model of Quantum Reality" (Sept. 16th) [at a public seminar celebrating the publication of *Science, Order, and Creativity* by David Bohm and F. David Peat; University of Helsinki].
ii. "Relating Equations of Motion to Associated Balance and Conservation Laws" (Sept. 24th) [theoretical physics seminar, Research Institute for Theoretical Physics, University of Helsinki].

iii. "Towards a more Causal Interpretation of Quantum Mechanics: The Ontological Interpretation of David Bohm" (Sept. 24th) [Department of Philosophy seminar, University of Helsinki].

iv. "Causal Program for Quantum Mechanics: From de Broglie through Bohm" (Sept. 25th) [technical-physics seminar, Helsinki University of Technology].

v. "Philosophical Ideas in Bohm's Model of Quantum Physics" (Oct. 1st) [natural-philosophy seminar, University of Helsinki].

(t) "A Causal Program for Quantum Mechanics: From de Broglie through Bohm" (Five-College Faculty Seminar in the Foundations of Physics; Amherst College, 10/29/90).

(u) "Computer Algebra for Hamiltonian-like Systems" (Portsmouth Polytechnic Institute; England, 7/2/91).

(v) "Computer Algebra for Hamiltonian-like Systems" (Free-University of Berlin; Germany, 7/5/91).

(w)"Relating the Nonlocal Schroedinger Equation to its Associated Conservation Laws and Balance Laws: An Aspect of a General Formalism based on the Nonlocal Variational Calculus" (University of New Mexico; Albuquerque, 7/4/89).

**C. GRANTS**

1. Received

(a) Dean's Research Award for "Einstein Papers Research at Caltech: Einstein Attempts at a Nonlocal Unified Field Theory"; Einstein Papers Project (Caltech, Pasadena; 7/17 – 8/16/07)

(b) NASA EPSCoR Proposal, "Symbolic Computational Physics for Interdisciplinary Applications: Phase II" (3/4/04)

(c) NASA EPSCoR Proposal, "Symbolic Computational Physics for Interdisciplinary Applications" (4/30/02)

(d) Connecticut Space Grant College Consortium travel award — meeting for the continuation of joint research in the use of quantum neural networks for space exploration (Jet NASA/Propulsion Laboratory, California Institute of Technology, Pasadena; for academic year 2001-2002)

(e) Connecticut Space Grant College Consortium Curriculum Development award for "Visions of Space: A NASA-Based Inquiry-Oriented Multimedia Enhancement of Courses in Physics and Math" (5/2/00)

(f) Physics Department representative, for the NSF grant, "Integrating Engineering Design with Humanities, Sciences and Social Sciences," awarded to the College of Engineering (Spring 1999 –Spring 2001).

(g) International Center Faculty Grant; internationalize my Seeing Through Symmetry course through interaction with colleagues at the University of Skoevde, Sweden (academic year 1999-2000)

(h) Faculty Research Grant from the Connecticut Space Grant College Consortium for the project "Neuro-Quantum Information Processing for Space Microsystems and Space Science Data Analysis" with California Institute of Technology's NASA/Jet Propulsion Laboratory (4/29/99)

(i) Connecticut Space Grant College Consortium travel award — contact meeting for the possibility of joint research in the use of quantum neural networks for space exploration (Jet NASA/Propulsion Laboratory, California Institute of Technology, Pasadena, 3/10-22/99)

(j) Connecticut Space Grant College Consortium travel award to present a paper, "Use of Generalized Nonlocality in Synergetic Associative Neural Networks" at the 3rd International Conference on Computational Intelligence and Neuroscience (Research Triangle Park near Durham, NC, October 24-28, 1998)

(k) As Principal Investigator/Project Director, NSF Instrumentation and Laboratory Improvement Grant for my All University Curriculum course "Seeing Through Symmetry" (National Science Foundation; Washington, D.C.)

(l) Grant to the University of Hartford Sigma Xi Club to sponsor Sheila Tobias' lecture at our school (National Sigma Xi Office, Fall 1990)

**D. HONORS**

1. Yale Visiting Fellow (History of Science and Physics depts.), History of Science (1991/92); working in the area of symmetry in physics
2. Yale Visiting Fellow (Philosophy dept.), Foundations of Physics (1988/89); working in the foundations of relativity and of quantum theory
3. *Who'sWho in Science and Engineering, Who'sWho in the World*, and *Who'sWho in America*
4. The Connecticut Academy of Arts and Sciences (as of 11/13/96)
5. Member of Sigma Xi and President of the University of Hartford Chapter
6. Pi Mu Epsilon (national honorary mathematics society)

**E. REFEREEING**

Referee reports for: *Foundations of Physics*, *American Journal of Physics*, *Complexity*, *Mathematics Teacher*, *Journal of Information Sciences*, *Handbook of Chemistry and Physics*, *Visual Mathematics (electronic journal)*, *Reason Papers* (book), *Journal of Materials Education*, *AIP [American Institute of Physics] Press* (book), *University of Hartford Studies in Literature*, *New York State Mathematics Teachers' Journal*.

**F. CONSULTING**

1. Invited "opponent" (i.e., external examiner) for the public examination of a physics/philosophy doctoral dissertation entitled "Mind, Matter and Active Information - the Relevance of Bohm's Interpretation of Quantum Theory to Cognitive Science" (University of Helsinki; 9/11/92).
2. Advisor to The International Center for New Technologies in Education (U. of Hartford, Spring 1989); a collaboration between the University of Hartford and the Institute for New Technologies of the Academy of Sciences in Moscow
3. Scientist Advisor/lecturer, for the NSF-funded grant titled "Teachers, Technology, and Environmental Concerns: Formula for Real Science in the Elementary School" (University of Hartford; 1992 - 1995).

**G. PROFESSIONAL ORGANIZATIONS**

1. American Physical Society (Chair of the New England Section, 2004; was also Sec/Treas)
2. American Association of Physics Teachers
3. International Symmetry Association (Chairman of the Executive Board, since 2003; Budapest)
4. Engineering Applications Center (University of Hartford)

**H. COMPUTER WORK**

1. Extensive programming experience in the symbolic algebraic languages Macsyma and Maxima plus familiarity with Mathematica. (Past experience programming in BASIC, PL/I, FORTRAN and REDUCE.)

2. Use of mainframe and micro-computers (Vax, Mac, Windows, and Sun).

3. Experience with multimedia presentations using a variety of software packages.

4. Word processors (including MS Word, Excel, PowerPoint, and, formerly, WordPerfect)

5. Technical word processors (EXP and MathType for MS Word), and spread sheet programs (Excel and, earlier, LOTUS 1-2-3).

# T E A C H I N G

## A. LECTURES

INVITED

1. Professional Organizations

(a) "Snapshots of Symmetry in Einstein's Relativity" for the *Symmetry Festival 2006* of the International Symmetry Association (Budapest, Hungary; 8/12-18/06).

(b) "Aspects Of 'Seeing Through Symmetry' — An Interdisciplinary Multimedia Course", Plenary Lecture, for the *Symmetry Festival 2003* of the International Symmetry Association (Budapest, Hungary; 8/16-22/03).

(c) "Curriculum Development Grant Results" for NASA Awards meeting (Bradley Air and Space Museum, CT; 5/7/01)

(d) "Neuro-Quantum Information Processing for the Exploration of Space" for NASA Space Day poster session (Boston Museum of Science; 11/3/00).

(e) "Musical Symmetry" for the composers' forum series, Music for Our Time (The Hartford Conservatory, Hartford; 5/1/99).

(f) "Macsyma in Teaching Linear Algebra" for an evening seminar at the AMS/MAA summer Mathfest conference (University of Seattle; Washington, 8/11/96).

(g) "Seeing Through Symmetry Multimedia Presentation" to the Philomorph Society (Harvard University; Cambridge, 12/4/95).

(h) "Seeing Through Symmetry: A Multimedia Course" (talk co-authored with D. Buckley), at *Symmetry: Natural and Artificial*, Third Interdisciplinary Symmetry Congress and Exhibition of the International Society for the Interdisciplinary Study of Symmetry (14 - 20 August 1995, Washington, D.C.).

(i) "Seeing Through Symmetry" — a description of my course (East/West Invitational Seminar on New Technologies in Education; Charles University; Prague, Czechoslovakia; 8/20/91).

(j) "Update of Teaching Films for Materials Science and Engineering" (Meeting of the U.S. Materials Education Council; Boston, 11/28/89).

(k) "A-V Teaching Aids in Materials Science Education and Peripheral Topics on Applied Exterior Calculus and Nonlocal Continuum Mechanics" (Meeting of the U.S. Materials Education Council; Boston, 12/2/88).

(l) Report on the SUNY Potsdam math program and collaborative learning techniques

(Meeting of the U.S. Materials Education Council; Boston, 11/25/90).

(m)"The SUNY Potsdam Miracle? Some Lessons for Physics" (Joint Annual Meeting of the AAPT & the APS; Atlanta, 1/21-25/90).

(n) "Report on the Mathematics Program at SUNY Potsdam as a Model to Encourage Women in Physics" to the AAPT's Committee on Women in Physics (Summer Meeting of the AAPT at Cal Poly; San Luis Obispo, 6/28/89).

2. Universities (other than U. of H.)

(a) "Albert Einstein: Myth and Magic" — general talk (Trinity College; Hartford, 2/3/06).

(b) "Symmetry Demo" — luncheon presentation at the Wright Center for Innovative Science Education (Tufts University, 10/18/01).

(c) "Science Through Symmetry" — seminar (Physics Department, Trinity College, 10/5/01).

(d) "Seeing Through Symmetry" course lectures at the University of Skoevde (Skoevde, Sweden, 5/29-6/16/00).

(e) "Seeing Through Symmetry: An Interdisciplinary Multimedia Presentation": Physics Colloquium (Stockton State College, New Jersey, 2/28/00).

(f) "The Role of Assessment Tools in Educational Technology Learning Environments in the Biology Curriculum" (talk co-authored with D. Buckley), as well as "Symmetry in Physics & Biology — Part of a Multimedia Course" (talk co-authored with D. Buckley),to the Educational Technology group at the Weizmann Institute for Science (9/16/98, Rehovot, Israel).

(g) "Symbolic Computation: Applications of *Macsyma* & *Mathematica* in Physics and Earth Science": CCSU Public Science Lecture (Central Connecticut State University; 4/23/96).

(h) "Seeing Through Symmetry": Special Seminar (Department of Physics, University of Denver; 1/11/94).

(i)"Computers in Physics Education": Special Seminar (Department of Physics, University of Denver; 1/12/94).

3. University of Hartford

(a) "Percy Bysshe Shelley" for Survey of English Literature class (2/26/07).

(b) "Symmetry" lecture for a photography class (10/15/04)

(c) "Assessing the Scientific Evidence": lecture as participant in a Forum on Iraq (2/26/03).

(d) "Conservation Law Paradigms in Philosophy and Physics": lecture to "Mind and Nature" philosophy class (10/9/95).

(e) "Finland: A Journey into Academia, and Elsewhere!" to the Society of Physics Students (10/27/92).

(f) "To See a World in a Grain of Sand": Humanities Center Fellowship lecture (4/18/90).

(g) "Displays of Symmetry in Art and Nature": seminar for Student Fellows of the Humanities Center (10/13/89).

(h) "Science in the Renaissance" to a class on The Italian Renaissance (11/21/88).

4. Secondary Schools

(a) "Remarks on 'An Inconvenient Truth' and Related Issues"; a 1-hour presentation to students and faculty (about 100 attended) for a Global Warming Teach-In (E. O. Smith High School; Storrs, 4/25/07)

(b) Panel Discussion about Global Warming; I was one of the 2 'skeptics' for a Global Warming Teach-In (E. O. Smith High School; Storrs, 4/25/07)

(c) "Science versus Religion"; talk and discussion with high school students' Philosophy Club (Hall High School; West Hartford, 3/14/03)

(d) "Alice in Warpedspacetimeland: Relativity from S to G" to high school students and teachers (Granby Memorial High School; CT, 3/12/91).

(e) "The Cosmic Background Explorer" to a physics class (Weaver High School; Hartford, 3/8/90).

(f) "Black Holes, Relativity" to 11th and 12th grade students in a college note taking course (Manchester High School; CT, 5/30/89)

**B. DEVELOPMENT OF NEW TEACHING/ASSESSMENT MATERIALS**

1. "EROs Program": This linear algebra program enables the user to perform elementary row operations (EROs) on a matrix defined outside the program or within the program. It also saves the final matrix, obtained through the EROs, so the user can employ it in further calculations (e.g., the saved matrix can be used as input to a new run of the program).
2. "Seeing Through Symmetry": This course integrates disciplines from across the University in order to introduce students to fascinating ideas from the sciences and math. It has an original Syllabus and Laboratories have begun to acquire both national and international interest. The Symmetry Prod! lecture-note summary of certain physical concepts employed in the course enables students to re-create for themselves where symmetry concepts enter.
3. "Some Guides to using MACSYMA for Linear Algebra": An 8-page set of comments, along with computer-generated examples, so students can apply the symbolic-algebra software package to my Linear Algebra course (summer 1993).

*22 August 2007*