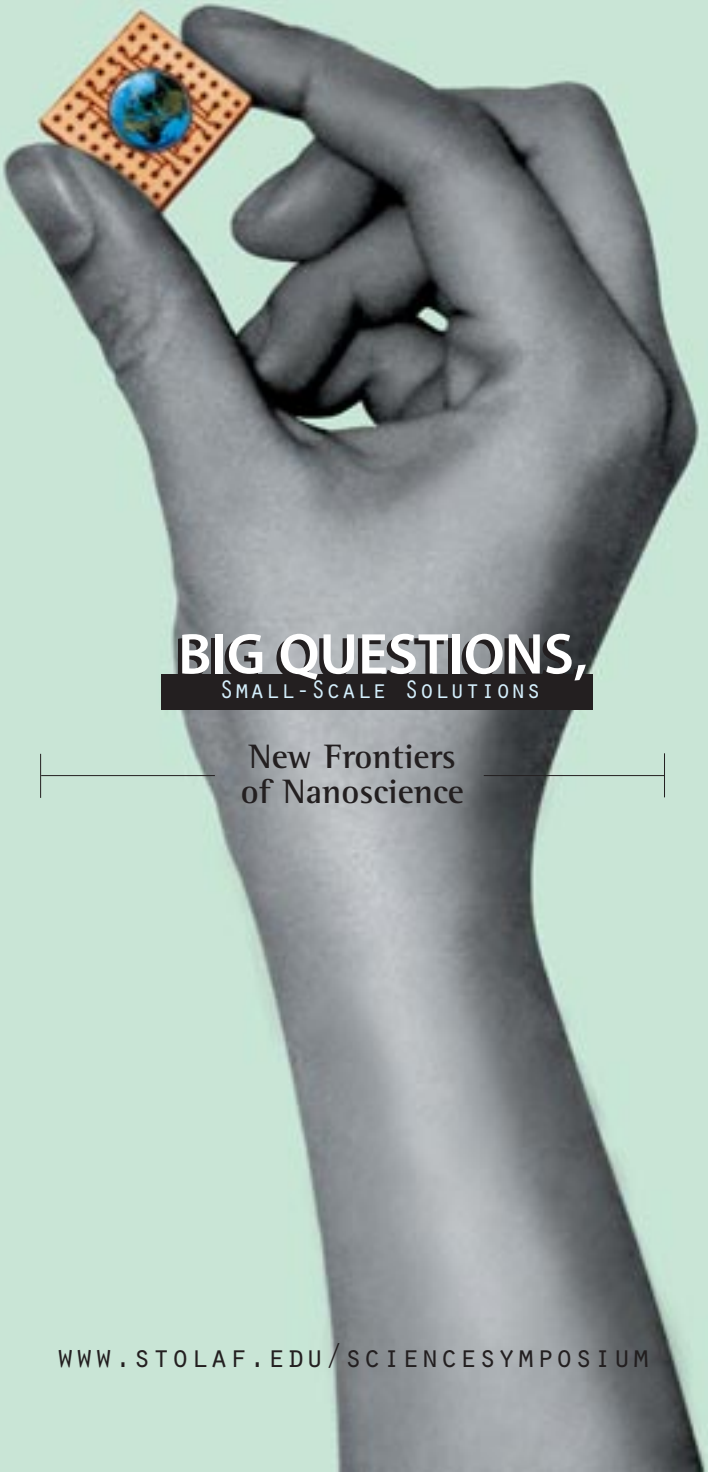
3RD ANNUAL SCIENCE SYMPOSIUM

FRIDAY, MAY 3, 2002



BIG QUESTIONS,
SMALL-SCALE SOLUTIONS

New Frontiers
of Nanoscience

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Schedule of Events

9 a.m. – Student Posters on Display

Crossroads, Buntrock Commons

Posters available for public viewing from 9 a.m. Friday through 11 a.m. Saturday. Student presenters available from 4:45 – 6 p.m. Friday.

10:10 a.m. – Honors Day Convocation

Boe Memorial Chapel

10:40 a.m. – Honors Day Reception

Crossroads, Buntrock Commons

2 p.m. – Introduction and Welcome

Science Center 280

Wesley Pearson, professor of chemistry & Hardy Distinguished Professor of Natural Sciences;
James L. Pence, Provost and Dean of the College

2:15 p.m. – Plenary Address I

Science Center 280

Nanoshells: Nanotechnology for the "Real World"

Naomi J. Halas, Ph.D., professor of electrical and computer engineering, professor of chemistry, Rice University, Fellow in the American Physical Society.

3:30 p.m. – Plenary Address II

Science Center 280

Building a Quantum Computer Atom by Atom

Christopher Monroe, Ph.D., associate professor of physics, University of Michigan, Ann Arbor, 2001 I. I. Rabi Prize Winner — American Physical Society.

4:45 p.m. – Poster Session

Crossroads, Buntrock Commons

Students present project results from work covering a variety of subjects.

7:30 p.m. – Plenary Address III

Science Center 280

Nanofluidics: Molecular Transport in Confined Spaces

J. Michael Ramsey, Ph.D., corporate research fellow, leader of the Laser Spectroscopy and Chemical Microtechnology Group, Chemical Sciences Division, Oak Ridge National Laboratory.

8:30 p.m. – Closing Remarks

Science Center 280

Wesley Pearson, professor of chemistry &
Hardy Distinguished Professor of Natural Sciences;
David Van Wylen, Associate Dean, Faculty of Natural Sciences and Mathematics

About the Symposium

In 1999, in anticipation of the college's 125th anniversary, a group of faculty and students recognized the need for ways to celebrate the contributions of the natural sciences and mathematics to St. Olaf, the study of the liberal arts and to society. Out of that grew the vision for this symposium, which has three principle goals: to highlight undergraduate research in biology, chemistry, mathematics, physics, psychology and related subjects; to provide the greater community with an opportunity to explore a topic in contemporary research; and to enable the St. Olaf community and the public to interact with invited guests working at the forefront of their fields. On Honors Day each year, people gather to celebrate science, engage in fellowship and learn from one another.

NANOSCIENCE — the study of structures or systems 1000 times smaller than the diameter of a human hair — is an emerging and exciting broad area of inquiry. Activities and advances in nanoscience will impact our current view of computing, material design and manufacturing, fluidics, photonics, medicine and natural products. Three distinguished scientists will share their views of some of the most exciting approaches and key issues during this Honors Day Symposium.

NAOMI J. HALAS (Rice University) will describe nanoparticle systems involved in manipulating, trapping or generating light and the pitfalls and possible applications of these materials.

CHRISTOPHER MONROE (University of Michigan) will share with us his insights about how a future generation of computers will store and process information using individual atoms or ions, thus leading to an exponential increase in speed over today's computers.

J. MICHAEL RAMSEY (Oak Ridge National Laboratory) will explore the transport of fluids through fabricated nanoconduits — the means by which our bodies move fluid and accompanying molecules to specific locations — in terms of how these systems function on this small scale.

ST. OLAF STUDENT SCIENTISTS will present their work at a poster session. Projects cover a wide range of areas including molecular biology, the basis of perception, surface chemistry, atomic structure, paleo-ecology and applied mathematics.

This symposium is funded by the Paul & Mildred Hardy Distinguished Professorship in the Sciences and gifts from alumni/ae, parents and friends of the college. The artwork was created by Inger Deede (St. Olaf '01) and graphic designer Catherine Schmitt.

The Speakers

NAOMI J. HALAS, Ph.D., professor of electrical and computer engineering, professor of chemistry, Rice University, Fellow of the American Physical Society.

Nanoshells: Nanotechnology for the "Real World"
The promise of nanotechnology to fundamentally change the world around us is daunting: the goal of creating new materials and devices "from the bottom up" is essentially an exploratory science, whose relevance in our daily lives may be years away. How scientists and engineers transition new discoveries made at the nanoscale into useful materials and devices, how these so-called "revolutionary" discoveries are integrated into current technologies, and how they master the ultimate and final challenge of the commercial marketplace is a grand transition that is currently a national focus. In my talk I will discuss some of our own work which has begun to make the transition into the real world: metal nanoshells, a unique approach to manipulating light and color, and how this new nano-tool can be used in applications that may directly touch people's lives.

Halas graduated from LaSalle University with a degree in chemistry. She earned both her master's and Ph.D. degrees in physics at Bryn Mawr College, then moved to AT&T Bell Laboratories for postdoctoral study. The Halas Nanophotonics Group is a multidisciplinary research team which designs metal nanoshells; applications of her work have been featured in Discover Magazine, Forbes, Scientific American *and* Business Week.

CHRISTOPHER MONROE, PH.D., ASSOCIATE PROFESSOR OF PHYSICS, UNIVERSITY OF MICHIGAN, ANN ARBOR, 2001 I. I. RABI PRIZE WINNER — AMERICAN PHYSICAL SOCIETY.

Building a Quantum Computer Atom by Atom

A quantum computer can store and process quantum mechanical superpositions of numbers, leading to an exponential speedup over conventional computers for certain algorithms. However, the prospects for constructing a quantum computer are highly speculative, owing to the extremely fragile nature of quantum superpositions. A quantum computer is nothing more than a smaller (and more humane) implementation of Schroedinger's famous "Cat Paradox." If one is ever built, it will strongly impact both computer science and quantum mechanical foundations. Leading physical candidates for quantum computation involve exotic systems such as individual trapped atoms, where the isolation from the environment is unparalleled. Experiments are reported in this context, where simple quantum logic gates have been demonstrated. The outlook for large-scale quantum computing with individual atoms and alternative technologies will be discussed.

Monroe received his undergraduate degree from the Massachusetts Institute of Technology and went on to do graduate work in physics at the University of Colorado. After a postdoctoral fellowship at the National Institute of Standards and Technology (NIST) he joined the Ion Storage Group at NIST as a staff physicist. There he co-led a team that demonstrated the first quantum logic gate and later demonstrated the basic hardware for a four-bit quantum computer. At the University of Michigan he leads an effort to scale up the trapped-atom quantum computer.

J. MICHAEL RAMSEY, PH.D., CORPORATE RESEARCH FELLOW, LEADER OF THE LASER SPECTROSCOPY AND CHEMICAL MICROTECHNOLOGY GROUP, CHEMICAL SCIENCES DIVISION, OAK RIDGE NATIONAL LABORATORY.

Nanofluidics: Molecular Transport in Confined Spaces

The transport of fluids through nanoscopic conduits has received very little attention although it is fundamental to life. We call the fabrication of such conduits and the active transport of fluid through them nanofluidics. Detailed understanding of nanofluidic transport will likely lead to revolutionary technological capabilities. For example, the design of artificial cellular receptors may result in sensitive and inexpensive sensors for chemical and biological agents or the ability to sequence single molecules of DNA at rates many orders of magnitude faster than presently possible.

Understanding of molecular transport in nanoscopic domains requires probing fundamental questions in the fields of fluid dynamics and statistical physics. Developed theories have not been tested with experimental fluidic systems, and fundamental assumptions of fluid dynamics have not been investigated on a nanoscale. Interesting phenomena become apparent as channel dimensions are reduced to the nanometer scale. Recent experiments and future possibilities will be discussed.

Ramsey received his B.S. in chemistry from Bowling Green State University and earned his Ph.D. in chemistry from Indiana University. After a postdoctoral fellowship at Oak Ridge National Laboratory, he became a permanent staff member. Presently, he directs a group of 26 staff scientists, engineers and postdoctoral fellows engaged in laser and nanoscience research.