Physics News

MICHIGAN TECH PHYSICS DEPARTMENT NEWSLETTER

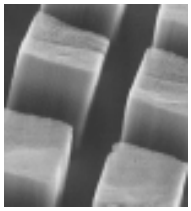
Fall 2004 Volume 6

A note from the chair

By Dr. Ravi Pandey
Professor and Chair

An interesting event of the past year was the recognition of the entire Physics Faculty by the Guinness World Records—the faculty from 1901 that is: Fred McNair, James Fisher, Nathan Osborne, and Elmer Grant. They have been recognized for the World's longest pendulum: 4440 feet which was constructed in the #4 Tamarack Mine shaft as part of an effort to understand some of the difficulties encountered when surveying such a deep shaft. Please visit **http://www.phy.mtu.edu/alumni/history/** to read brief biographies of our distinguished professors. Prof. Bryan Suits came across this exciting information while putting together this webpage. This webpage also includes the timeline of our departmental history and details of the changing MTU campus.

During the past year, several innovations have been introduced in teaching introductory physics courses by Profs. Weidman and Jaszczak. Among these is the use of multimedia tools to get the student's response for conceptual questions during the lecture. I am also particularly proud of the revised laboratory curriculum, which was updated and modernized by Profs. Cantrell and Meyer. Our research activities have grown in parallel, with new research grants to Prof. Cantrell in the areas of heterogeneous nucleation and Prof. Yap to investigate electronic properties of carbon-based nanotubes. The most exciting event for the department occurred when Prof. Kostinski was selected to receive Michigan Tech's 2004 Research Award. Prof. Kostinski has kept himself busy, receiving about $1 million over the last 15 years for what he calls "'cheap' theoretical research" in numerous fields, as well as 15 years of continuous support from the National Science Foundation.



New faculty members have further enriched our department. With an interest in experimental Astro-Particle Physics, Prof. Brian Fick will play a major role in the Pierre Auger Cosmic Ray Observatory to study of the universe's highest energy particles. Ranjit Pati joins us as an assistant professor to start a new research program in molecular electronics. This year also brings a new class of promising undergraduate students to our department. We are pleased to note that the freshman class of twenty-three includes six women.

Professor Don Daavettila had successful heart bypass surgery, and he is recovering satisfactorily at home. We all extend our warmest regards to him and hope for his speediest possible recovery.

In these changing times we need our alumni more than ever. Your continued support and interest is important for us to maintain educational opportunities for our undergraduate and graduate students. Your involvement will be most appreciated by us.

Best wishes for a joyous holiday season and a happy and prosperous New Year.

Current Research: Ranjit Pati

By Ranjit Pati

Molecular Spintronics-A new generation of electronics device: In recent years, the dramatic advancements in experimental techniques and the success of measuring electron transport through a single or at best a few molecules have kindled the hope of realizing molecular scale electronics devices. However, almost all of these experiments rely only on the *charge* state of the electron to understand the device characteristics. In addition to *charge*, electron has *spin*, which can be used to control the electrical conduction in a molecular circuit.

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Current Research: Ranjit Pati

Continued from page 1

This has not been addressed by the Molecular Electronics community. When electrons at a molecule-solid interface are preferentially aligned (up or down), the resistance they experience while transported through a non magnetic medium (such as a molecule) is different from the case with randomly oriented (unpolarized) electrons at the contact. In principle, one could manipulate these quantum spin states of the electron at the contact points to control the device characteristics, leading to what is known as *spintronics*.

For example, when spin alignments between the contacts are parallel, the conductance is significantly higher as compared to the case when the spin alignments are anti parallel. This effect of a huge change in resistance, referred to as *giant magneto resistance (GMR) or spin valve* effect, has been demonstrated only in magnetic-non magnetic hetero structures. Spin polarization has been found to survive for a long period of time in highly conjugated molecular systems, which offers a promising usage of molecules as spacers between the two magnetic contacts for its potential application in nanoscale *GMR* device. For the *first time,* by exploiting the quantum spin state of the electron, Pati and his collaborators from Rensselaer Polytechnic Institute have modeled a *new generation* of molecular scale *spintronics* devices[1] with prominent *spin valve* effect—adding a new chapter to the emerging field of molecular electronics.

First principles density functional calculations, where the spin polarization effect can be explicitly included, are utilized for the modeling. Their novel architecture is shown in the Fig. 1. They found that the current for a parallel (ON) alignment of the spins at opposite ends of the molecular wire is significantly higher than for the anti-parallel (OFF) alignment. The change in resistance between the two configurations is found to be ~98%. This type of theoretical proposal[1] of using an organic molecular spacer as an interconnect in a *spin valve* has recently been confirmed by the experimental demonstration of giant magnetoresistance in an organic spin valve[2], suggesting predictive capabilities of computational simulations.

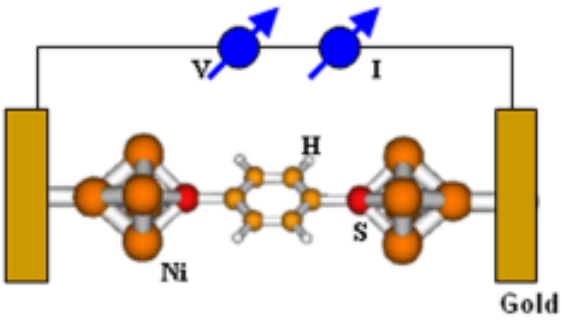


Fig 1: Molecular spin valve

1. R. Pati, L. Senapati, P. M. Ajayan, and S. K. Nayak, "First principles calculations of spin-polarized electron transport in a molecular wire: Molecular spin valve", Phys. Rev. B, **68**, (2003) 100407 R.
2. Z. H. Xiong, D. Wu, Z. V. Vardeny, and J. Shi, "Giant magnetoresistance in organic spin-valves" Nature, **427** (2004) 821.

Awards and Achievements

Professor Alex Kostinski received Michigan Tech's 2004 Research Award. Colleagues cite him as a "Scientist for All Seasons." Kostinski's somewhat nomadic interests in science have earned him admiration from other scientists in such fields as encompassed optics, astronomy, fluid mechanics, atmospheric science, radar meteorology and polarized waves. They use not only words like "brilliant", "revolutionary", and "best" to describe Alex Kostinski, but also "considerate", "kind", and "courageous". Kostinski's comment: "I like to change fields."

The Night Sky Live received the 2004 Science & Technology Web Award: ASTRONOMY from Scientific American on October 4, 2004.

Physics graduate student Jacob Fugal won 2nd place for his poster presentation at the Great Midwestern Space Grant Regional Meeting in Chicago, IL on November 4-6, 2004. The same poster won Best Overall at MTU's GSC 2004 Poster Session. Physics grad student Teboh Roland placed third in the GSC competition.

Mike Ftaclas and Jason Kestner received the 2004 Ian W. Shepherd Award for most outstanding physics graduates.

Events

The Physics Picnic held in August was attended by many faculty, staff, graduate and undergraduate students. Our group is growing and diversifying more each year.

The MTU Open House held on Sept. 25, 2004, broke attendance records again this year. Many families visited the Physics Booth at the Expo and toured the nanotechnology, introductory physics, and night sky observing labs.

Department Update

Dr. Brian Fick joins the department as an Associate Professor of Physics. His field is Experimental Astro-Particle Physics. He was formerly at the Enrico Fermi Institute at the University of Chicago. Dr. Fick is working in conjunction with the Pierre Auger Cosmic Ray Observatory, a multinational research initiative utilizing the largest observatory in the world.

Dr. Ranjit Pati joins us as a new Assistant Professor of Physics. He holds a degree in Theoretical Condensed Matter Physics. Dr. Pati was previously a Research Associate at RPI in New York. His specialty is Molecular Electronics, or Moletronics, which aims to maximize the miniaturization of electronic circuits. He is teaching Computational Methods in Physics this semester.

Dr. David Nitz was promoted from Associate Professor to Associate Professor with tenure. Dr. Uli Hansmann was promoted from Associate Professor to Professor.

Professor of Physics J. Bruce Rafert, formerly Dean of the Graduate School, has left MTU for a similar position at Clemson University. He remains an adjunct faculty member of the Physics Dept.

In this academic year, two faculty members are on sabbatical leave. Professor Shaw is visiting Cornell University, and Professor Hansmann is in Germany.

Pamm Besmer has retired as a secretary in Physics after many years of dedicated service.

Kathy Wollan recently joined the Physics Department as a Secretary 3 after an extended leave of absence to care for her dying mother. She had been in the ME-EM Department for 8.5 years prior to her leave. Kathy has spent most of her life in the Copper Country and presently lives in Dollar Bay (in a home right across from where she grew up!). She has two grown children: Kristin Lortie (husband Chuck) who is a Project Engineer in Denver, Colorado and Joshua Wollan (wife Alicia) who is a Civil Engineer in South Bend, Indiana. Kathy comes from a large family and enjoys gatherings of happy times with them all. She also is a classical pianist, spends much time reading, enjoys good movies and traveling. Kathy is glad to be back at MTU.

Recent Degree Recipients

2004	**Destination**
Qiang Yang, PhD	University of Idaho
Weidong Yang, PhD	Michigan Tech
Lakshman Kumar Vanga, MS	Michigan Tech
Youshi Mi, MS	Jackson, Michigan
Sreenivasulu Vutukuri, MS	Alabama, near Huntsville
Alex Sergeyev, MS	Michigan Tech
Andrew Fleming, BS	Columbia University
Mike Ftaclas, BS	
Jason Kestner, BS	University of Michigan
Tim Lapham, BS	
Nick Lightfoot, BS	
Chris Occhipinti, BS	North Carolina State

Personal Response System

For the first time in Physics, students in the large lecture halls are using Personal Response Systems. The units are wireless handheld transmitters which enable the students to respond immediately to displayed questions. The responses are collected and statistics are projected immediately afterward. The feedback provides an instant diagnostic for the instructor concerning typical misconceptions and errors on the part of the students. The lecture proceeds with the goal of addressing these issues, giving students timely assistance in problem areas. PRS devices are being used in PH2100 and PH1110 this semester. Dr. Bob Weidman is initiating the use of this technology in the large lecture halls, and Dr. Ed Nadgorny is using it for a smaller class. The technology was piloted in a summer course by Dr. John Jaszczak.

Research Sponsorship

Research funding in the department exceeded $470,000 since January. External sponsors include the National Science Foundation, US Department of Energy, US Department of Army, Office of Basic Energy Sciences, Naval Research Lab, and Michigan Space Grant Consortium. Michigan Tech funding includes the Century II Campaign Endowed Equipment Fund and the Research Excellence Fund.

Thanks!

We extend our deepest appreciation to friends and alumni who have made recent gifts or pledges directly to the department. We appreciate your continued interest in the Department of Physics at Michigan Technological University.

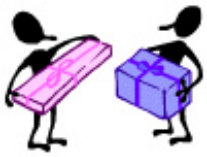
Alumni

Thomas & Mitzi Brayak '70
Robert & Faye Brooke '57
Pamela & Floyd Croy '66
John & Patricia Erwin '49
Thomas & Judith Essig '63
John & Eugenia Evans '50
Walter & Edith Gabriel '48
Charles G. Garrow '66
Frank & Shirley Hastedt '58
Loren & Kathleen Isley '60
Jerry W. Kortge '67
Gordon & Carla Lyon '64
Marcus & Lisa Niessen '81
Donald & Ann Parry '84
Gerald & Barbara Phillips '70
Allen & Joyce Pudvan '57
Michael & Mary Ellen Teneyck '64
C. John & Kathryn Umbarger '64
William E. Wuerthele '66
Charles & Mary Zeigler '66

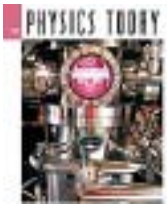
Did you know that Fisher Hall and McNair Hall are named after physicists?

Friends

Gary P. Agin
Keith & Wilma Baldwin
Winifred & Frank Blackford
Dow Corning Foundation
Paul & Elsie Hinzmann
John & Sherry Jaszczak
Edward & Nina Nadgorny
J. Bruce & Donna Rafert
Thomas & Sharon Silvis



If you wish to make an apple pie truly from scratch, you must first invent the universe.
-Carl Sagan



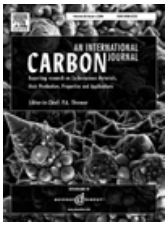
Faculty Write Book Chapters

Several of the physics faculty have demonstrated such global expertise in their fields that they have contributed chapters to books and encyclopedias. Dr. Yoke Khin Yap published a book chapter in the *Encyclopedia of Nanoscience and Nanotechnology*. This is the world's first encyclopedia ever published in the field of nanotechnology. It contains 419 chapters written by experts from 35 countries. Dr. Yap is the author of a chapter "Boron-Carbon Nitride Nanohybrids," printed in volume 1 of the Encyclopedia.

Dr. Miguel Levy authored a book chapter in *Wafer Bonding*, published by Springer-Verlag. Book topics include bonding-based fabrication methods of silicon-on-insulator, photonic crystals, VCSELs, SiGe-based FETs, MEMS together with hybrid integration and laser lift-off. The chapter entitled "Single-Crystal Lithium Niobate Films by Crystal Ion Slicing" by M. Levy and A. M. Radojevic is the twelfth of fourteen chapters.

Dr. Edward Nadgorny authored a book chapter in the *Dekker Encyclopedia of Nanoscience and Nanotechnology*. This reference identifies current challenges and development paths sure to influence fields ranging from materials and surface science, chemistry, and biomedicine to computer technology, information processing, and mechanical, optical, and electrical engineering. Dr. Nadgorny of the Department of Physics and Associate Professor Jaroslaw Drelich of the Department of Materials Science and Engineering at Michigan Tech wrote the chapter "Laser-Based Deposition Technique: Patterning Nanoparticles into Microstructures".

Making the Cover



A photograph of graphite cones appeared on the covers of 15 issues of the journal CARBON in 2004. The photo was taken by Dr. John Jaszczak, Associate Professor of Physics at MTU, and Dr. George Robinson, curator of the A. E. Seaman Mineral Museum.

A plasma chamber made the cover of the July 2004 issue of *Physics Today*. This chamber is identical to one used currently in the Materials Physics and Laser Physics Lab. A small set of such chambers was manufactured about 10 years ago by a consortium of several universities and National Labs, including Michigan Tech.

Staff Spotlight

David H. Cook
Master Machinist

Dave Cook joined the Department of Physics about 7 years ago as our Master Machinist II. In addition to his regular duties as machinist, he is a Journeyman Tool and Die Maker and serves as Research Engineer, Mechanical Designer, Chemical Hygiene Officer, and Laser Safety Officer.

Dave works closely with faculty, researchers, and graduate students doing the designing, machining and assembly of projects for research laboratories, teaching labs, and demonstration projects as well as performing safety inspections of laboratory facilities. He especially enjoys working with students—mentoring them in the shop arena and spending time with them on weekends taking them boating and fishing, etc.

Dave has helped place the Michigan Tech Department of Physics on the world map with his work on CONCAM (see www.nightskylive.net). As a co-inventor of CONCAM, he has done the mechanical design, engineering, machining and construction of units that have been deployed at some of the world's foremost observatories. Several of the units were built with the assistance of some of his students from PH5920. To date ten CONCAMS have been deployed and are operational with more in the planning stages. A more advanced unit called an All Sky Monitor (ASM) has been deployed at the Auger Observatory in Argentina and another in Colorado.

Dave has also assisted in the introduction and development of the Isle Royale Institute—a strategic partnership between Isle Royale National Park and MTU—to develop a major international education and research center at the island. In addition, he has been involved with the "Rockets for Schools" program, the Remote Sensing Hyperspectral Imaging Unit, the atmospheric probe with a digital in-line holographic camera system, and numerous other research projects.

As the keeper and co-founder (with Raymond Shaw) of the "Stick in the Beehive Award," Dave periodically awards temporary custody of the departmental travelling trophy to any deserving person who happens to be "stirring things up" in the Physics Department. Plans are underway to build an upgraded award as a campus-wide travelling trophy.

nano.mtu.edu

MTU has acquired a new subdomain, nano.mtu.edu, to reflect the rapidly growing interest in nanoscale research and education on campus. The subdomain constitutes an index which ties together research, education, facilities, and publications for all nano-related entities at Michigan Tech. This site will be closely tied in with the proposed Multi-Scale Technologies Institute (MuSTI). The subdomain lists new nano courses, a nano minor, a nano enterprise program, labs, and recent sponsored projects. The nano.mtu.edu subdomain is hosted by the Physics Department.

NSF NUE Initiative

The NSF-funded Nanotechnology Undergraduate Education initiative will continue into Spring 2005. This educational grant, with PI John Jaszczak, is responsible for Fundamentals of Nanoscale Science and Engineering, Societal Implications of Nanotechnology, an engineering exploration called Exploring Nanoscale Science & Technology Through Carbon Nanotubes, invited speakers such as Yury Gogotsi (who presented "*In-situ* Fluid Studies in Multi-walled Carbon Nanotubes"), a nano animation gallery, and design of the proposed nano minor. Grant participants are inter-departmental.

Faculty Spotlight

Will H. Cantrell II
Assistant Professor
PhD, University of Alaska Fairbanks

"I am fascinated by the fact that you can help water freeze by putting a film of a long chain alcohol on its surface. Somehow that two-dimensional crystal of alcohol persuades the water, which is notoriously uncooperative when it comes to freezing, to settle down and form a crystal of its own. Why the alcohol film is so good at getting water to freeze is the focus of my current research. The answer will help us understand the more general phenomenon of first order phase transitions, which is important in areas as diverse as medicine, food packaging, and the transport of oil in pipelines."
-cantrell@mtu.edu

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Current position/employer _____	☐	☐
Degree and year _____	☐	☐
Address _____	☐	☐
Phone _____	☐	☐
Email/website _____	☐	☐
Other information _____	☐	☐

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Feel free to attach information.

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