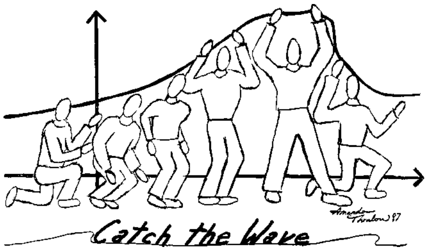

The Wave Packet

The UMD Physics Newsletter

Issue No. 10 ***Spring 2005*** ***http://www.d.umn.edu/physics/newslett/newslett.htm*** ***Editor: J.R. Hiller***

New Graduate Fellowship

Through major donations by alum Mylan Radulovich and matches by ExxonMobile, a new fellowship, the Mylan Radulovich Graduate Fellowship, has been established, with the first award to be made this year. Mr. Radulovich graduated from UMD in 1962 with a BA in Physics and is a retired executive of Exxon Corporation. In addition to the match from ExxonMobile, the size of the award is leveraged by a match from the Graduate School. Each award will provide a $4000 supplement to the Teaching or Research Assistantship annual stipend of a graduate student selected for particular promise, and is renewable for a second year. The award is an excellent way to attract and retain high-caliber graduate students. Referral of applicants to the graduate program is welcome, particularly for those worthy of this award.

Faculty in Flux

Starting in 2004, Bo Casserberg began the transition to retirement with a reduced work schedule, giving him greater freedom to pursue his interests in physics and the outdoors. To help fill the gap in our faculty, recent MS graduate Scott Haynes was hired as an instructor for the fall semester, and Jon Maps was voted Assistant Department Head. We are now searching for a tenure-track replacement, with a research area in experimental neutrino physics to collaborate with Alec Habig. This will expand our involvement with the MINOS project and its detector in the Tower-Soudan mine.

Habig is now only a formality away from being granted tenure with promotion to Associate Professor. This action has been approved at all levels on the Duluth campus and has only the formal Regents' vote to make it official.

To round out the major changes in faculty, we already have a new hire set to arrive for next year in a joint position with the Large Lakes Observatory. Jay Austin will join us as an Assistant Professor, coming from Old Dominion University to replace Brian May, who will be leaving at the end of this school year.

Howard and Agnes Hanson

As many of you already know, Professor Emeritus Howard Hanson and his wife Agnes both passed away in 2004. Howard helped found the department in 1947 and became its longest serving department head, from 1951 to 1984. He made substantial contributions to the development of the department and is someone frequently mentioned by alumni as an inspiring teacher. He led the department to its present size through addition of the graduate program and expansion of research activity while maintaining the primacy of the undergraduate teaching mission. Howard was inducted into the CSE Academy in its inaugural year of 2002. He and Agnes continued to visit the department on special occasions. The Howard G. Hanson Scholarship Fund was established in Howard's honor a few years ago and is now a memorial to them both. We thank all those who contributed to the Fund in their memory.

Inside this issue

Survey of Recent Graduates -- Please Respond!

This year, the department will go through an external review, which is something done for all departments at UMD on intervals of five to ten years. Our most recent review was in 1995. As a part of this process, we would like to collect career-related information from recent graduates. If your graduation year was 1995 or later, your copy of this newsletter should include a stamped return envelope. Please fill out the survey on pages 9 and 10 and return it by June 30, 2005 to John Hiller at Department of Physics, University of Minnesota Duluth, 1023 University Dr, Duluth MN 55812. We thank you for your time and effort in completing this important survey.

Honors and Awards

The **Outstanding Graduate Teaching Assistant** for 2003-2004 was **Scott Haynes**. Scott completed his MS in the summer of 2004 with a thesis supervised by Brian May. His research is described in the previous issue of the *Wave Packet*.

Daniel Gastler received the **Outstanding Academics Award** for 2003-2004. Dan completed his BS and entered the graduate program at Boston University. While at UMD, Dan spent several years working with Alec Habig on the Super-Kamiokande detector and computer code for Monte Carlo simulations.

A sophomore physics major, **Rosemary Smith,** was awarded the **Olson Scholarship** for 2004, to work with Habig on the MINOS project. She describes her work in this issue. **John Eastman** received the 2004 **Hanson Scholarship** and is working with Michael Sydor on detection of micron-sized particulates in water. They anticipate equipment needs, which will be funded by an award from the **Friebe Fund**.

Daniel Gastler, winner of the Outstanding Academics Award, and Professor Hiller.

Outstanding GTA Scott Haynes.

Hanson Scholar John Eastman.

Gift Funds

Gifts to the Physics Development Fund, the Donald Olson Memorial Scholarship Fund, the Howard Hanson Scholarship Fund, and the Friebe Award Fund may be sent to the Development Office, 315 Darland Administration Building, UMD, 10 University Drive, Duluth, MN 55812. The Development Fund is targeted at support of student research, through purchases of equipment and help with travel expenses, and of awards to undergraduates for superior performance. If you have questions or would like more information about making a gift of any type to the Physics Department, including estate planning, please contact us or the College's Development Officer, Tricia Bunten, at 218-726-6995 and tbunten@d.umn.edu, or go online at www.d.umn.edu/development/waystogive.html.

Olson Scholar Rosemary Smith.

Nu News

by Alec Habig

It is an exciting time in the neutrino research section of the UMD Physics Department. The MINOS (Main Injector Neutrino Oscillation Search) experiment has finally started to operate, after eleven years of design, construction, and preparation. While the experiment's two detectors have been working for some time observing cosmic rays and the neutrinos generated by cosmic ray collisions with our atmosphere, the goal of this experiment is to watch what happens to neutrinos as they travel from Fermilab (near Chicago) to the Soudan Mine Underground Lab in Soudan, MN (two-thirds of the way from Duluth to Ely). The neutrinos primarily used in this experiment are created by the NuMI beam at Fermilab, measured at the "Near Detector" there, then again 735 km to the north at the "Far Detector," 2341 feet below the surface in Soudan.

UMD students have played a large role in getting both detectors built. The Far Detector was completed in July of 2003, and the Near in September of 2004. In the meantime, the detectors have been observing the high energy cosmic-ray muons and neutrinos which manage to penetrate through all the rock and interact in the thousands of tons of steel and scintillator of which the detectors are built. This steady stream of data has allowed us to fine tune and really understand our instruments, as well as beat out any bugs that would prevent us from operating 24/7, something we will need to do for at least five more years to make the measurements of neutrino flavor-changing that are our goals. UMD students from Physics, Engineering, and Computer Science have helped to track down and fix problems, and to develop monitoring software to let us achieve the reliability we need. The current status is that all of our more than 18,000 electronics channels in the Far Detector are completely functional and busily taking data ~95% of the time (which rises to almost 100% when you count only the time which the beam itself is on!).

The first neutrino events from our beam were observed in January of this year in the Near Detector. As the beam was commissioned and brought carefully on-line, it became bright enough for the first neutrinos to be seen in Soudan in March. The beam fires a burst of around 20 trillion neutrinos every two seconds. Of those, one neutrino every few hours will actually interact in our 5,400 metric ton Far Detector, and we need to watch thousands of such events in order to make a precision measurement of how the neutrinos change ("oscillate") on their trip. This is an effect we continue to observe with the Super-Kamiokande experiment in Japan, by watching neutrinos made in cosmic ray showers. However, the only way to get a precise enough measurement to really constrain any Grand Unified Theories is to haul out the lessons we all learned in freshman lab and do a controlled experiment where we carefully measure the particles both before and after.

You can learn more about the experiment on the web at http://www-numi.fnal.gov/. One especially fun link shows you what our detector is currently seeing, a live event display at http://farweb.minos-soudan.org/events/LiveEvent.html. Most of the things you see on this page are the cosmic rays which cross our detector every couple of seconds, showing you why we need to be deep underground - the cosmic-ray rate at the surface is more than 100,000 times as great, which would swamp our neutrinos interacting only every few hours!

Also, if you are in northeastern Minnesota during the summer season, the State Park which hosts the Soudan Underground Lab now offers regular tours of the lab, in addition to the long-standing historical tours of the old iron mine itself, which many of you may have taken in the past with school or family. You can just stop by and take a tour. See the lab's website at http://www.soudan.umn.edu; the Park's website is linked from there.

The Water Column

by Brian May

Physical limnology continues to be an important component of research activity within the physics department. I have been focusing my efforts on understanding small-scale mixing processes and am also involved in a project to look at the influence of physical processes on biological productivity. Elise Ralph is back from a temporary assignment as program manager at the National Science Foundation - it is good to have her back in the department. Mike Sydor continues his focus on remote sensing of natural waters. John Sorensen has ongoing projects looking at mercury contamination in lakes north of Duluth and the distribution of contaminants in St. Louis River estuary.

This year saw the arrival of a significant piece of research instrumentation for use on Lake Superior. The Triaxus is a newly developed vehicle that is towed behind the research vessel Blue Heron. The Triaxus is shaped like a box-kite and uses its flaps to "fly" up and down through the water column. On-board instrumentation includes standard CTD sensors (conductivity, temperature, depth) and sensors to measure dissolved oxygen, phytoplankton concentration, zooplankton concentration and concentration of suspended sediments. Installation and operation of the Triaxus has proven to have its challenges. Nevertheless, the first successful research cruises with Triaxus were undertaken in the summer and fall of 2004. Working together with colleagues in the biology department, we are trying to determine the extent of mesoscale variability in phytoplankton and zooplankton concentrations and the effects of physical processes on these distributions. Preliminary data is in hand, while a Minnesota Sea Grant project will look at these issues in greater detail over the next two years.

Masters student Scott Haynes finished up his thesis work in the summer of 2004. Based on two months of temperature measurements obtained on a mooring in western Lake Superior, his thesis focused on characterizing the temporal variability of internal waves in the lake. Internal waves with vertical amplitudes up to roughly 30 meters were observed. On average, the energy levels were found to be half that of the Garrett-Munk spectrum, which is typically used to characterize oceanic internal waves. The peak energy was located near the inertial frequency (i.e., the natural frequency of oscillation on a rotating earth). The waves were separated into low-frequency and high-frequency components. Scott found that the low-frequency energy was concentrated in the upper part of the water column, while the high-frequency energy was more evenly distributed. A significant event was observed in which the stratification was eroded suddenly due to extremely strong wind forcing. This event was linked to an inversion in the buoyancy frequency profile. Because internal waves are constrained in frequency space to be between the inertial and buoyancy frequencies, this likely caused a separation of the water column into two independent wave guides.

Mike Sydor is currently working on the near-infrared volume absorption coefficient for particulate matter in Lake Superior and Duluth Harbor. Undergraduate physics student John Eastman is involved in this work as a UROP project. He is also applying these same optical techniques to work on phototreflectance from human tissue. Sheila Amenumey finished up a Masters in Physics dealing with measurement of 0-1° forward scattering from micron-sized particles suspended in water. Yuhu Yan completed a Masters in Water Resources Science on measurement of below and above surface remote sensing reflectance from Lake Superior. He is continuing on to pursue a PhD in Water Resources Science and successfully completed his oral preliminary examinations. He is submitting a paper on surface reflectance corrections for the remote sensing reflectance from Lake Superior, which will be presented at the Ocean Optics Meeting in May in Halifax, Nova Scotia.

John Sorensen is concluding a study with the National Park Service on the effects of water-level fluctuations on mercury accumulation in fish. While the creation of a reservoir is widely known to cause substantial increases in mercury concentrations throughout its food web, very little research has been directed toward the effects of subsequent manipulated water levels. The results of this study provide strong evidence that annual fluctuations in lake water levels have a significant impact on mercury concentrations in fish. For example, at one monitoring site, average mercury concentrations in young-of-the-year yellow perch ranged from 38 ng/g in 1998 to 200 ng/g in 2001, in response to markedly different water-level characteristics for the two years. In addition, John is working with area tribes in monitoring mercury levels in precipitation and reservation lakes. He also works with other local interests in providing hydrodynamic and water-quality modeling of the St. Louis River estuary. A recent publication on that work addresses how to specify boundary conditions when simulating extreme hydrodynamic events.

Catch Up with Past Grads

An update: Congratulations to Daniel Dale (BS '93) on the award of tenure and promotion to Associate Professor of Physics at the University of Wyoming.

Timothy Olson, MS '87

After graduating with an MS in physics from the University of Minnesota-Duluth in 1987, my family and I moved to Bozeman, Montana. I graduated with a Ph.D. in physics from Montana State University in 1990. My dissertation research was focused on the mathematical foundations of relativistic dissipative fluid theories, and the application of these theories to neutron stars, supernovae, the early universe, and the nuclear equation of state for relativistic heavy ion collisions. I decided to skip the postdoc route and went to work for EG&G Idaho at the Department of Energy's Idaho National Engineering Laboratory in Idaho Falls. I worked on the design of nuclear propulsion and power systems for future human missions to Mars. This was shortly after the first President Bush announced in 1989 his Space Exploration Initiative program for human exploration missions of the Moon and Mars. Following the Bush announcement there was a flurry of activity by NASA, the Department of Energy, and several aerospace contractors studying how best to fulfill the President's vision. A highlight of my employment at INEL was working on studies to support the Stafford Commission in their development of recommendations for returning humans to the Moon and going on to Mars. Congress and President Clinton did not support President Bush's vision and the SEI program was canceled in early 1993.

I left EG&G in 1993 and joined Systems Integration Corporation, a small startup engineering services company also located in Idaho Falls, Idaho. I worked there for two years on the design of various engineering fluid-flow systems before moving on to Salish Kootenai College in western Montana in 1995, where I continue to work today. SKC is a small, private four-year college on the Flathead Indian Reservation about an hour north of Missoula. The enrollment is about 1200 and around 80% Native American. SKC is only 27 years old and has experienced substantial program growth in the last ten years. I have taught a large number of different courses in mathematics, physics, astronomy, engineering, and computer science. My primary administrative responsibility is department head for SKC's two-year engineering AS degree, which is designed to prepare students to transfer on to baccalaureate engineering programs elsewhere.

I have had the opportunity to stay active in research at SKC through several research grants from NASA and NSF. Until recently I've worked mainly on neutron star astrophysics and gravitational wave astronomy. I was a member of the LIGO Scientific Collaboration for three years and participated in several of the science data runs of the LIGO gravitational wave observatories. If you ever get a chance to tour the LIGO observatories in either Washington state or Louisiana, you will be impressed by their massive scale. The core of each of the observatories is an interferometer with 4-km long arms. The vacuum systems for the beam tubes and the optical assemblies are the largest in the world, and the seismic isolation systems are similarly impressive.

I recently resigned from the LIGO collaboration to pursue a new research direction and opportunity - Mars was calling me again. I am now a co-investigator for one of the instruments on the Mars Science Laboratory, the MAHLI (MArs Hand Lens Imager) instrument. The MSL is the next rover mission to Mars scheduled for launch in late 2009 with the landing in late 2010. The MSL mission goal is to assess the past and present suitability of Mars as a habitat for life (the MSL website is mars.jpl.nasa.gov/missions/future/msl.html). The MSL rover will be designed to operate for at least one year, and hopefully for several years. The MAHLI instrument is a digital camera that will be mounted on the end of the rover arm. It is designed to give a view of Martian rocks and soils at the scale of a geologist's hand lens. Participation on a MSL mission science team will be a test of endurance. We began NASA-funded work on the MAHLI instrument in January 2005, and this work will continue through surface operations on Mars and science data analysis, at least through 2013.

My daughter Erica was two years old when we left Duluth for Montana. Now she is a sophomore at the University of Pennsylvania and will spend next year in England at Oxford University in a junior year abroad program. My wife Karen works as a registered nurse. We live on a small ranch with three dogs and two horses.

Jay Lyle, BS '89

I received my B.S. (Applied Physics) in November of 1989. The economy at that time was starting to sink into recession. In addition, defense spending was down, so, with jobs scarce, I applied at a security guard company for a temporary job. The owner instead asked me if I wanted to be an undercover private detective. I found that irresistible and rode out the recession as a crime fighter (more on this later)

Shortly thereafter, I moved to the Twin Cities to look for work when I noticed an advertisement for an entry level Pascal programmers. My job search for appropriate employment was unfruitful during the recession, and I was becoming accustomed to sending out the usual cover letter and resume. This time, I spiced up the usual cover letter/resume package with a printout of my UROP Project computer program. It was written in Pascal. I wrote on the code printout "this program solves the time-dependent Schrodinger equation with a chaotic potential, deep stuff (smiley face)." I almost instantly received a call for an interview. They told me at the interview that they just wanted to see what kind of fellow would program such a thing (quantum chaos). They hired me on the spot, and I programmed there for about a year.

Between my first programming job and now, I worked at several companies including American Hardware Insurance, ValueRx, IQ Marketing and Sun Country Airlines. Realizing that "job jumping" does not look good on the resume, I took a job at a large consulting company called Compuware. I figured that while working for a consulting company, I could work at many different companies but ultimately be working for the one firm.

Compuware sent me out to 3M to convert an NT-based Demand Planning system to UNIX. What was to be a six-month contract turned out to be a five-year job. 3M Management was impressed with my Computational Physics work and decided to utilize me as a Tech Lead during the rollout of a new Demand Planning system. "Demand Planner" is a three-dimensional database (geography, product, and time) that creates an unconstrained demand plan based upon a sophisticated statistical engine (in addition to the usual average, trend, and seasonality, it has additional functionality like intermittent demand, related demand etc). The system would pick up these trends based upon history and create a forecast. Depending on other factors (such as promotional programs and other events like 9-11 and volcanic eruptions, which might, for example, increase demand for gas masks), planners can override the plan. During these implementations, one needed to have a good grasp of mathematics to which my Physics education (especially computational physics) helped immensely.

Unfortunately, the latest recession caused money problems at my consulting firm, and I decided to take a new job at HighJump Software. HighJump software makes Supply Chain Execution software so it was right up my alley. Ironically, shortly after I joined HighJump Software, 3M purchased HighJump, and I ended up back at 3M as a regular employee! I have also found that HighJump has a 2% Physics major rate: 4 out of 200 people are Physics majors!

During my entire IT/Computer career, I worked part time at JCPenney in Loss Prevention, catching internal and external thieves. I did the work purely because I enjoyed it and ultimately caught hundreds of thieves (which leads me to my latest career move, remember my first job out of college was Private Detective). I have recently accepted a leadership position at Aspect Loss Prevention. The fit was perfect. (I've been seeking a way to combine my passion for detecting fraud with my technical skills.) Aspect Loss Prevention makes software that analyzes Point of Sale data to detect internal theft. Since I have a passion for detecting theft, the decision to move was an easy one.

I live in Shakopee with my lovely wife Mary (homemaker) and 3 children (Natalie, age 7, and twin boys Nathan and Nicholas, age 4) where I continue to pursue Physics related avocations though Amateur Radio and Amateur Astronomy. I am also a regular at Joe Wivoda's annual Physics camping trip (several Physics majors setting up Joe's Teepee (traditional Native American dwelling) is quite a spectacle). See http://www.wivoda.com/physics/index.html.

Zhenzeng Tang, MS '96

I was admitted in the Physics graduate program at UMD in the fall of 1994. My project advisor was Professor Maps. I really enjoyed every bit of the life in Duluth, although I had to often stay late to finish the Quantum Mechanics and Computational Physics homework for Professor Hiller (it turned out, I am the immediate beneficiary looking back today) and help my landlord shovel snow after severe winter snowstorms.

I graduated in July 1996. Before I came to UMD, I had several years experience in Nondestructive Evaluation (NDE). By definition, NDE is examination of an object or material with technology that does not affect the object's future usefulness. Ancient Chinese, when trading grain for a bowl (before the existence of currency), would test the bowl for cracks by knocking on it and listening to the sound. NDE is a very broad, interdisciplinary field that plays a critical role in assuring that structural components and systems perform their function in a reliable and cost effective fashion. My major focus is in Ultrasonic NDE, a technique that employs ultrasonic wave propagation phenomena to achieve the goal of material integrity interrogation.

The academic training by the UMD Physics Department and my previous experience definitely helped me get a Research Assistantship from Northwestern University, where I studied three and half years with Professor Achenbach. I successfully completed a project "Ultrasonic Nondestructive Evaluation of Adhesive Bond Degradation," sponsored by NASA Langely Research Center, and obtained my PhD in Theoretical and Applied Mechanics in November 1999. While at Northwestern, I got married, in the summer of 1997.

My first job in the United States was with Physical Acoustics Corporation (PAC), Princeton Junction, New Jersey, where I spent five years as an Ultrasonic Software Scientist. PAC is a primary NDE instrumentation integration and manufacturing company with special focus on Acoustic Emission and Ultrasonic Testing. It gave me plenty of opportunities with enterprise and government turn-key system integration and software development.

I have recently relocated to Houston due to a job change. Now I am working as a Senior NDE engineer/scientist in the Research/Development department of Shaw Pipeline Services, a division of Canadian based ShawCor Inc. I find the new job very interesting and challenging. My current project is dealing with using diffracted ultrasound to qualitatively and quantitatively identify the flaws in the girth weld in pipeline industries.

I have always maintained a close tie with UMD Physics department, especially with Professor Hiller and Maps. My wife has never been in Duluth area, but I often speak highly of Duluth, UMD, and Lake Superior. I don't think I will have many chances to see snow here in Houston and hope the next time we see snow will be on the campus of UMD.

Student Research Projects

Rosemary Smith, Olson Scholar

I had the opportunity to work on the MINOS (Main Injector Neutrino Oscillation Search) Project in the summer of 2004. This project looks for oscillations (a change in flavor) of neutrinos as they are shot through the earth from Fermilab (near Chicago) to the Soudan Underground Mine in Minnesota. There is a detector at Fermilab to sample the flavor of the neutrinos in the beam and also a detector in Soudan to sample the neutrinos after their trip through the earth. I had the good fortune to work at both ends of the experiment. At the Far Detector in Soudan, Minnesota, I was able to help with the little tweaks that needed to be made before the beam came on. There was always at least one channel on one phototube that was malfunctioning or one board that was not reading out correctly. Visiting physicists and the crew down in the mine taught me how to solve many of these problems.

I also helped with another project while I was there in Soudan. The Soudan2 proton decay detector was housed in a cavern adjacent to the MINOS detector. This 1,000 ton detector had been sitting dormant for a few years, and the collaboration proposed to use the space where it sits for a low-background counting facility. However, before the new facility came in, the old had to go out. So, I and a couple of other undergraduates set to work clearing the 15-year-old dust and dead bats from the structure. Under the muck, we discovered a fascinating world of electronics. Every piece of the detector needed to be taken apart with care so that they could take the parts up the shaft of the mine and possibly reuse them on another project.

At Fermilab, I was able to help with the installation of the Near Detector. I wired up the iron planes with optical fibers and tested the phototubes for light leaks, among many other tasks. It was important that every little thing was done perfectly so that they can collect the best possible neutrino data. My favorite part of the whole experience this summer was living, working, and hanging out with physicists from all over the world.

Eric W. Grashorn, MS '05

The land of parched prairies and fertile farmland offers an insipid backdrop for the vast realms of the unknown that are explored herein. The bison perform their coarse ballet amongst B-fields and B-physics proposals. A search for antimatter is hardly interrupted by subtle antiestablishment voices. A hardworking, sunburned producing class is untroubled by the worries of the heliophobic academes slavishly striving in their ivory and concrete tower, rising fifteen stories above this endless plain. In the heartland, fifteen stories reaches nearly to the sky and patrols with vigilance like a lidless red eye.

The juxtaposition of physics in the farmland is one of the things that makes Fermi National Accelerator Laboratory in Batavia, IL so unique. I spent a summer there learning arcane experimental procedure against a tableau of the simple life of America's breadbasket. The worries of experimental physics seem so great on the one hand, and yet so useless compared to cares of a failed harvest that could spell income loss for the farmer and hunger for the consumer. To experience this dichotomy is refreshing for one embedded in the battle against ignorance.

The work I have done as a part of the Main Injector Neutrino Oscillation Search (MINOS) collaboration at times seems exciting despite its white on white veneer in print. While at Fermilab I spent time 100 meters underground in the Near Detector Hall smearing silicone grease on carefully tuned fiber optical cable and attaching said cable to twenty-foot octagonal slabs of steel. The detector is assembled in vertical slices like a loaf of bread, and it is cabled one plane at a time. Once a plane is finished it gets hidden by the next, and any mistakes that were made in the cabling process get tucked away until they bring nightmares to the data analysis a year later. It makes one more leery of putting indelible fingerprints on a $150 million federally funded project.

Since the summer I have devoted my time to a simple Monte Carlo simulation of cosmic ray muons in the MINOS Far detector in Soudan, MN. This simulation will provide a vital calculation of the background of the muon sky, from which rips in this seemingly smooth fabric can be deduced. For years it has been assumed that cosmic rays came to the earth at random from any point in the sky. This makes sense since there is a galactic magnetic field that acts as an accelerator to a charged particle. There is no reason that there should be a preferential direction from which particles should emanate, for if there was a point source of these particles, the signal would be obscured. Despite this, the Soudan 2 collaboration suggested that there does exist a point source of cosmic rays. Since that announcement in the 1980's, other experiments have tried in vain to verify their assertion. By subtracting away my simulation of a uniform cosmic muon background from nearly two years worth of data, I hope to uncover this elusive feature of the galaxy.

Muon astronomy is a very small part of the diverse group that makes up MINOS, and it is the intersection of sundry ideals that drive discovery. MINOS truly is juxtaposition; of landscapes, landmarks and ways of life, which is appropriate in physics: a juxtaposition of ideals tempered with reality.

Andrew Clough, MS student

Since my second year as an undergraduate here at UMD, I have been working under the supervision of Dr. Alec Habig. I am using the Super-Kamiokande neutrino detector to look for astrophysical point sources of neutrinos. In other words, I am trying to do astronomy with neutrinos instead of the conventional method of using electromagnetic waves. There are two energy regimes where one can do neutrino astronomy: low energy (around 10 MeV) where solar and supernova neutrinos can be found, and a higher energy region (starting around 1GeV) where one might be able to distinguish possible astrophysical neutrinos and atmospheric neutrinos from spatial and temporal proximity. The astrophysical neutrinos would come from natural accelerators such as pulsars, where the neutrinos come from unstable particles decaying. I am looking for these higher energy point sources.

While an undergraduate, I worked out the coordinate transformations from what we see at Super-Kamiokande to a sky plot where the stars and galaxies have fixed coordinates (over short time spans). Once in these coordinates, looking for multiple events near a single point is fairly simple. These types of searches have been done by other neutrino experiments, and I was hoping to be able to modify some of the search techniques.

Having been a graduate student for the past two years, I can tell you that it isn't that simple. I neglected to mention that there is a large background to this search, the atmospheric neutrinos. It is important to optimize such searches to maximize the signal to noise ratio, which means we need to know how far away from possible sources we need to look. I have known this for a while, but didn't think too much of it because in my undergraduate work I was trying to confirm the results that other graduate students found.

It wasn't until last summer that I realized how little I actually knew. While at a summer school in Erice, Sicily, I saw an equation relating the angle between the incident neutrino and outgoing charged particle to the neutrino energy. Since we cannot detect neutrinos directly and must rely on these charged particles from neutrino interactions, that such a relation exists didn't surprise me, but the values did. It didn't agree with the values I had been using, and I needed to know why. It turns out that the equation I saw was for a different type of neutrino interaction than the ones that we see in the data sample I am using from Super-Kamiokande.

Since then, my main focus has been shifted away from simply modifying search techniques and is now on justifying the sizes of the search regions that we use. When I started working on this as an undergraduate project, I never thought that I would be studying the scattering angles from neutrino interactions. Then again, I never would have thought that I would be going to Sicily because of my research either.

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Survey of Recent Graduates *(1995 or later)*

Department of Physics, University of Minnesota Duluth, 1023 University Drive, Duluth Minnesota 55812

Name: ____ *Phone:* ___________________

Address: ____ *E-mail:* ___________________

____

UMD Degree(s): ________________ *and year(s)* ____________________

Major(s): _________________ *Minor(s):* ______________________

Education after graduation from UMD:

Degree(s) _________________ *and year(s)* _______________

University ____ *Major(s)* ______________________

Current employer: ____

Job description: ____

____

How do you rate the education in physics that you got at UMD?

Excellent _____ *Good* _____ *Fair* _____ *Poor* _____

What are the UMD Physics Department's major strengths?

What are the major weaknesses?

What changes do you recommend we make in our courses and programs?

Other comments? (Use the back of this sheet or other sheets if you like.)

This page is left intentionally blank, for additional survey comments.

Spring 2005 UMD Physics Newsletter Response Form

Name:__________________________

Address:____

Phone:__________________________

E-mail:__________________________

Employer:____

Title:___________________________

Do you wish to be added to the alumni web directory?_____

(The URL is http://www.d.umn.edu/physics/contact/alumni.htm.)

Are you willing to serve as a career information resource for physics students?_____

(The current list is at http://www.d.umn.edu/physics/career/alum-res.htm.)

Would you like to be featured in the next newsletter?_____

My nominee for the CSE Academy is ________________________________because:

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Tell us about yourself:____

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Send your reply by one of the following means:

- mail to University of Minnesota Duluth, Department of Physics, 371 MWAH, 1023 University Drive, Duluth, MN 55812.
- fax to 218-726-6942.
- e-mail to jhiller@d.umn.edu.
- web page form at the URL http://www.d.umn.edu/physics/response.html.

Thanks!! We'll enjoy hearing from you!

Lost Addresses

If anyone knows a current address for someone on the list below, please send it in or have the person get in touch. Thanks!

James C. Anderson, BA '50
Todd A. Bleifuss, BS '83
Leeka Z. Gwanganalie, MS '91
Judith A. Holmbeck, BA '68
James D. Johnson, BA '54
Michael R. Jones, BA '69
Kambiz Khosroshahroudi, BS '85
Nagi Keung Lee, BA '71
Zhongwei Liang, MS '98
Mohd I. Mohdyusof, BS '86
Yaseen S. Murayed, BS '85
Charles C. Nelson, BA '58
Gerald D. Nelson, BA '60
Anthony K. Quick, BS '92
Daniel Shaffer, MS '96
Haichuan Tan, MS '96
Dale O. Wick, BA '59