

Contributions to Human Resource Development

Education

Post-doctoral associates

Post-doctoral associates often make up the backbone of any research projects, bringing to that project both experience and an essentially uninterrupted concentration of time and effort. At the same time, these associates mature into independent researchers making recognized and often seminal contributions to the field of nuclear physics. By working along with graduate students, they also provide a crucial link in the chain of passing skills and practical knowledge to the next generation.

IUCF typically supports 5 post-doctoral associates at any one time. One of these, Chris Polley, has a Langer Fellowship that involves both additional compensation and a small research fund over which the fellow has complete discretion. Presently, Chris is devoting his effort toward the MiniBooNE project and concentrating on data analysis.

During the period of this award, we have had three post-docs working with the STAR project where they do shift work, support the maintenance and operation of the endcap electromagnetic calorimeter, and analyze data. One has left to take a position elsewhere, and we are seeking a replacement. One post-doc is shared between the preparation of the neutron spin rotation experiment for NIST and the analysis of the d+d elastic scattering data from the Cooler (a part of the charge symmetry breaking experiment).

As much as possible, we encourage post-docs to give presentations at conferences and to discuss their work within collaboration meetings. Some have also given seminars, particularly at nearby colleges where they also get the chance to interact with undergraduates and to discuss the potential of working in basic science.

Graduate students

The combination of a variety of research projects and a full-service laboratory makes IUCF an excellent place to obtain a Ph.D. in nuclear physics. Graduate students can become involved with the phases of research projects and gain experience with project development, hardware design and construction, experimental operation, data reduction and analysis, and publication.

With 14 students associated with the nuclear physics grant during the reporting period, IUCF now has a healthy number of students associated with all of the major research activities. As we approach the production of usable polarized proton data with the STAR detector at RHIC, the number of students associated with this project has risen to three. There are six students involved with the experiments involving cold neutrons, divided between the parity violation experiment at Los Alamos and the neutron spin rotation experiment being prepared for NIST. The MiniBooNE experiment has supported three students, one of whom is now resident at Fermilab. There is one student associated with polarimeter development for the storage ring EDM search who will likely switch to another project due to the lengthened timescale for funding the EDM ring. We expect that more of the students will start to be resident away from IUCF for at least a part of their research time. The next such project is the neutron spin rotation

experiment that will be installed at NIST in early 2006. Three students (Chris Bass, Jaiwei Mei, and Da Luo) will be a part of that on-site effort.

Of particular importance for the development of students, both locally and elsewhere, will be the hosting of the National Nuclear Physics Summer School in the summer of 2006. This traveling school brings together graduate students with a group of topical leaders who will introduce them to the areas of current interest across the spectrum of nuclear physics research. Holding this school at Indiana makes it possible for all of our students to attend and to meet their peers from other institutions.

Nuclear physics faculty members have been involved through the Physics Department on the committees that recruit and select graduate students for the department. A number of years ago, these functions were split so that more effort could be devoted to contacting prospective American students and encouraging them to apply for advanced study to Indiana.

There was one student thesis completed during the period of this report:

Anton Konychev

“Large Impact Parameters in the Collins-Soper-Sterman Resummation Formalism”

Advisor: Steven Vigdor

August, 2005

Two other these students finished their dissertations since the last Annual Report was compiled. They are:

Greg Hansen

“A Radiometric Measurement of Neutron Flux in a Liquid ^3He Target”

Advisor: W. Michael Snow

September, 2004

Michael Gericke

“The Weak Interaction between Nucleons and Parity Violation in Cold Neutron Capture”

Advisor; W. Michael Snow

November, 2004

Undergraduate students

Undergraduate students are often a valuable source of help in the laboratory. We have been able to support three students from the grant. This gives the students an opportunity to see research first hand and to become involved with projects before graduation.

Part of the faculty responsibility is the development of new curricula for the Physics Department. The Department has recently started a new series of courses called the Applied Physics Option. Hans Meyer is developing one of the courses in this new series.

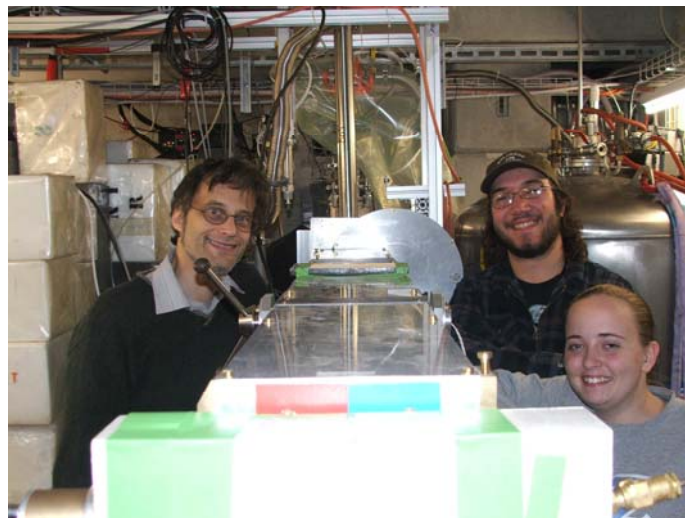
In addition, various members of the physics faculty take the opportunity to get involved with undergraduates and to introduce them to the physics opportunities at IUCF. The pictures below illustrate this activity.

Figure 1: Rex Tayloe helps to coordinate the Physics Club for undergraduates in the Physics Department. Along with Mike Snow, Rex led a tour of Fermilab. The students on the tour are shown here in front of the bubble chamber on exhibit.



Figure 2. Hans Meyer brought the students in his Advanced Physics Lab (Physics 451) to the RERP area at IUCF. There they spent two days setting up an experiment on $p+p$ elastic scattering at 205 MeV. The students observed the effects of relativity on the scattering process as they participated in all phases of the experiment.

Figure 3. Andrew Bever and Sarah Carlson, pictured with Mike Snow next to a neutron polarization analyzer, are sophomore undergraduate students at DePauw University who worked for a week in an experiment on the FUNSPIN beamline at the Paul Scherrer Institut in Villigen, Switzerland as part of their undergraduate lab class at dePauw.



One activity, the annual Physics Department Open House, is used both as a window to show the general public interesting facts about physics and as a recruiting tool for bringing high school students to Indiana University. Physics classes at surrounding high schools arrange to bring their students by bus to the campus for a day of fun and activities. In Figure 4, Mike Snow is seen leading one of the Open House demonstrations. (For more information, visit the news story at <http://www.iucf.indiana.edu/news/news.php?story=30>).

Additional information on outreach to undergraduates and the REU program are covered in later sub-sections.

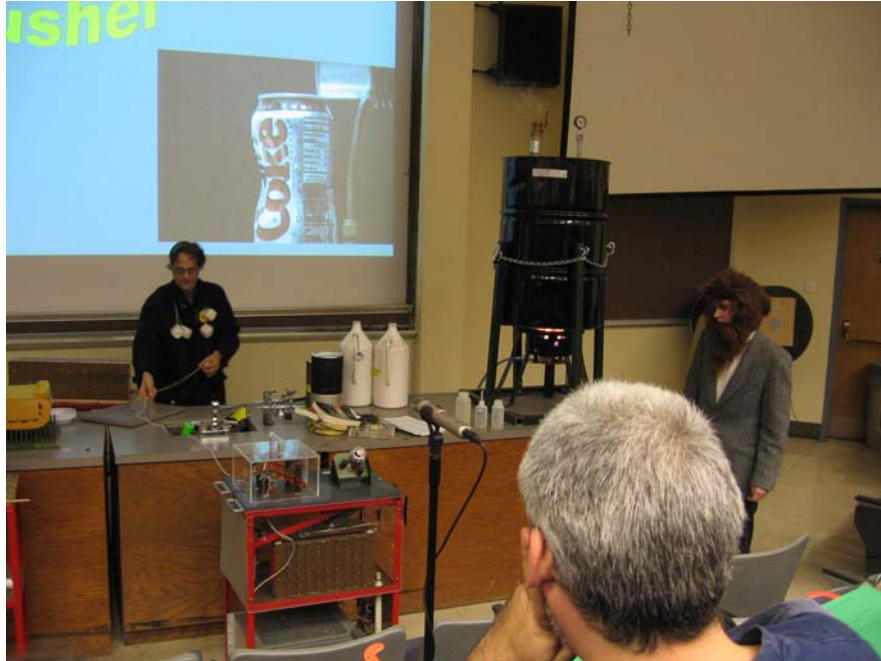


Figure 4. Mike Snow is the faculty advisor for the IU Physics and Astronomy club. Among other things the club is responsible for presenting two one-hour shows at the Physics Department Open House, typically to a packed auditorium of about 150 people. This year's show resurrected Galileo, Newton, Maxwell, and Einstein in a competition to decide once and for all who was the greatest physicist of all time, with Heisenberg as the emcee (Einstein won). The picture shows Heisenberg (sporting fuzzy dice) and Maxwell (bearded) preparing to launch an empty Coke can into the audience using electromagnetic induction.

Research Experience for Undergraduates

Each year the Research Experiences for Undergraduates (REU) program at the Indiana University Cyclotron Facility brings about a dozen undergraduates to Bloomington for a ten-week program. Its aim is to introduce promising students to a research environment with the hope that they will be encouraged to pursue a career in the sciences. Students are placed with advisors, usually selected from the faculty and staff of the Cyclotron Facility or the Nuclear Theory Center, who supervise them in special projects during the course of the summer. In addition to the research project, the program at IUCF includes special seminars, a machine shop course, lessons in scientific computation, a discussion of scientific ethics, and social activities. This summer, fifteen students were supported by NSF-REU funds, including 9 students working on projects at IUCF and 6 students working on projects at the IU Department of Physics. There were several other IU undergraduate students in the laboratory working on projects related to LENS and the MPRI facility.

The students from the summer, 2005 program who worked on projects associated with IUCF are listed below, along with their home institutions, project titles, and advisors. Two of the students, Tim Harrington-Taber and Dan Passmore, worked on projects directly supported by the Nuclear Physics contract. Two other students, David Seal and Paul Stonaha, worked on projects related to the construction of the Low Energy Neutron Source (LENS).

Courtney Buckey, Ohio Northern University

“The Feasibility of Developing an X-ray Based Quality Assurance Tool for Patient Proton Range Compensators” Advisor: Jonathan Farr

Jessica Fagerstrom, Claremont McKenna College

“Development of a Computer-Controlled Asymmetric X-ray Collimator”

Advisor: Niek Schreuder

Timothy Harrington-Taber, Cornell College

“Developing a Capacitive Liquid Level Sensor for the Neutron Spin Rotation Experiment”

Advisor: Mike Snow

Mathew Hodek, Bowling Green State University

“USB Control of Multiplexed Shaper Electronics for a Segmented Silicon Array”

Advisors: Romualdo de Souza and Sylvie Hudan

Maciej Karcz, Loyola University of Chicago

“Quark Confinement in SU(2) Lattice Gauge Theory via Simulated Gluon Field Potentials”

Advisors: Adam Szczepaniak and Patrick Bowman

Joseph Pacold, Indiana University (Bloomington)

“Studies of QCD Strings”

Advisor: Adam Szczepaniak

Daniel Passmore, University of Tennessee (Knoxville)
“SciBath, a 3D Liquid Scintillator Neutrino Detector”
Advisor: Rex Tayloe

David Seal, University of Utah
“Optical Beam Profile Monitor for LENS”
Advisors: Vladimir Derenchuk and Keith Solberg

Paul Stonaha, Alfred University
“Design of a Tilted-Pole Adiabatic RF Neutron Spin Flipper for Zero-Field Spin-Echo Applications” Advisor: Mark Leuschner

Outreach Activities

The members of the nuclear physics group each devote a fraction of their time to outreach activities aimed at explaining what we do and how it impacts the lives of a wide variety of people, including the members of our local community, K-12 students and teachers, and other people on the Indiana University campus. Our outreach activities include facility tours, high school student and teacher programs, IU and national (REU) undergraduate programs, and outreach to the Bloomington community. During the past year, a significant upgrade of the IUCF and nuclear physics website was made. This new website features links to descriptions of active experiments, recent nuclear physics group publications, our graduate and post-doctoral programs, and a number of our outreach activities. This new material is expected to help us expand both the number and the types of people we are able to impact.

The impressive infrastructure at IUCF is a great attraction for tours from middle and high schools. It also plays an important part in the annual Physics and Astronomy Open House (see earlier sub-section for pictures). These tours are provided throughout the year and are frequently conducted by faculty, post-docs and students from the nuclear physics group. During the calendar year 2005, tours of the facility were conducted for over 700 visitors. This year we reestablished IUCF tours during the annual Physics Open House and provided tours for close to 100 people from the local community. In one case, the tour for a Boy Scout troop (#133 from Carmel, IN) involved demonstrations of the inverse square law and shielding for radiation (see the IUCF Web news at <http://www.iucf.indiana.edu/news/news.php?story=33>), both of which were requirements for the completion of a merit badge in nuclear physics.

Members of the nuclear physics faculty participate in a number of programs aimed at establishing direct connections with pre-college students and teachers in order to improve participation and retention of personnel in fields of science and engineering. The “College of Arts and Sciences Summer Pre-college Institute” is directed at eleventh- and twelfth- graders looking to get an early taste of the university by working with an IU professor on a summer project. We have hosted several students from this program. The most recent one, who worked with Rex Tayloe on a neutrino detector project, is currently an IU undergraduate physics major

and is an IU STARS (Science, Technology, and Research Scholars) awardee (also with Rex Tayloe). Tayloe has also been the faculty liaison for the past three years for the “IU Advanced College Project”, a partnership between IU and select high schools in Indiana, Ohio and Michigan. This program offers college credit to high school seniors who take calculus-based Introductory Physics (P221) with their high school physics teacher. The faculty liaison oversees the program, trains the teachers and conducts annual site visits to the participating schools. New teachers are trained in a summer workshop and all teachers attend an annual workshop, both held on the IU-Bloomington campus. The workshops also offer an opportunity for the teachers to learn about research in the Physics Department and at IUCF. Under Tayloe’s leadership, this ACP program has grown substantially in the last three years.

We are also expanding our “Scholars in the Schools” program in which faculty, post-docs or graduate students present classroom programs and/or mini-workshops. One member of the faculty regularly attends the annual career day at a local high school and talks about physics and math. Recently, an open letter to high school science teachers, that invites them to either bring their science class to IUCF or have a physicist visit their school, was published in the newsletter of the Hoosier Association of Science Teachers (HASTI, see www.hasti.org). We hope that this invitation will increase our contacts with potential undergraduate physics majors. At the HASTI annual meeting last February, one of us presented a workshop with an Indianapolis, high-school physics teacher on a proposal to develop a “Virtual Physics Teacher’s Lounge”, a new website that would provide a forum for classroom physics teachers to share ideas with IU physics faculty on inquiry and problem-based learning techniques.

In the near future we plan to increase our outreach activities in the local community by strengthening our involvement with the WonderLab science museum in Bloomington. Proposed areas of assistance include the development of hands-on exhibits and demonstrations that can be used by the museum staff during hands-on programs for visiting school groups.

Diversity

The IU nuclear physics group is committed to building an environment that fosters increased participation by under-represented groups in the physical sciences. Toward this end, we adopted in March 2003 a plan entitled “Improving Minority Representation within the Experimental Nuclear Physics Group. The cornerstone of this plan is the “deliberate recruitment” of minority candidates, including women, into all ranks from faculty down to undergraduates.

An important first step in this direction, which was described in our proposal last year, was to hire two outstanding, articulate faculty from these groups, Manuel Calderon de la Barca Sanchez and Chen-Yu Liu, both of whom provide exceptional matches with our overall research interests and goals. Calderon regularly attends the National Conference of the Society for the Advancement of Chicanos and Native Americans in Science and recently hired a promising Zairean post-doc of African descent, Pibero Djawotho. Liu is currently reviewing candidates for a post-doc position associated with her research program. In addition to helping us attract post-doc and graduate student candidates from a broader pool of potential candidates, we also expect

that Calderon and Liu will serve as role models for female and minority post-docs and graduate students already here.

We actively seek minority candidates for the nuclear physics group throughout the year. We currently have one female post-doctoral assistant (out of 4 total) and two female graduate students (out of a dozen total) associated with the group. In our current search to fill a post-doc position, two (out of 5 total) of the candidates invited to interview were female. Also, two new female graduate students joined our group this year.

In order to increase the number of minority students with access to IUCF, we submitted a new proposal for an NSF-funded REU site partnership with Tennessee State University, an urban, minority-serving, land-grant university founded in 1912 and located in Nashville. The primary goal of the proposal, "REACHing Minorities and Women", is to establish a pipeline of future competent scientific personnel in physics and astronomy by bringing minority students and their teachers to IU Bloomington during the summer semester and by working cooperatively to develop and implement a research infrastructure at TSU during the academic year. This proposal was approved last spring and last summer one faculty member and two students from TSU were in Bloomington during the summer semester. One of our faculty members also attended the Joint Annual Conference of the National Society of Black Physicists and the National Society of Hispanic Physicists last spring (Orlando, 2005).