

Andrew D. Bacher

Professor of Physics

While an undergraduate at Harvard, Andy Bacher was enticed into nuclear physics during a visit by Cal Tech's legendary astrophysicist Willy Fowler, who described how the Sun obtains its energy from nuclear reactions. The next year Andy began graduate work at Cal Tech with Tom Tombrello. His thesis experiment, a measurement of one of the hydrogen-burning reactions that powers the Sun ($3\text{He}+3\text{He}\rightarrow_4\text{He}+2\text{p}$), introduced Andy to the study of nuclear resonances. In 1967 Andy became a postdoctoral physicist at the Lawrence Radiation Laboratory where he continued working on light-ion reactions, but at higher energies and using the newly commissioned polarized ion beam as a more discerning way to understand nuclear structure.

A discussion with IU's Larry Langer convinced Andy that the plan to construct a medium energy separated-sector cyclotron here made even higher quality data on nuclear reactions possible. Andy joined the IU physics faculty in January 1971. At first he worked as a visitor at the Texas A&M Cyclotron laboratory, this time applying polarization techniques to the rich field of inelastic scattering and the structure of nuclear excited states. Once the IU Cyclotron Facility (IUCF) was running, and especially with polarized proton beams, Andy focused on getting the best possible data of this sort in an energy range essentially untouched by earlier high-resolution measurements.

The initial work with Peter Schwandt and Guy Emery investigated proton elastic scattering. Later Andy worked with Cathy Olmer on inelastic scattering, exploiting the resolution then available with the new magnetic spectrometer. He built connections to theorists interested in the new data, including IU's own George Walker. Andy's connections with Los Alamos helped to bring Joel Moss and Tom Carey to IUCF to launch a program in polarization transfer measurements. Soon, IU physicists Ed Stephenson and Scott Wissink became involved. This program improved after IUCF built the K600, a much higher resolution spectrometer for polarization measurements that yielded the best data ever obtained at intermediate energies for individual nuclear states.

During the 1980s, Hans Meyer acquired lead-glass detectors to measure the gamma rays produced by neutron-proton fusion. Those detectors were also ideal for observing uncharged pion decay. Andy, along with Bob Pollock, supervised Mark Pickar's Ph. D. thesis on pion production in proton-deuteron fusion. A conference attended by Mark and Andy on future physics with the IUCF storage ring raised the possibility that these detectors could see pions from deuteron-deuteron fusion, a process previously unobserved because it violated the principle of charge symmetry. There was encouragement from theorists who saw new ways to test chiral perturbation theory. But the turning point was a theory paper by Anders Gårdestig discounting a French discovery claim for this process. Anders' further calculations, made at Andy's request, showed that an observation at IUCF was possible. A team was assembled, and after two months of data taking in 2002, a first

observation of this rare reaction was in hand. Its formal report in 2003 was noted by the American Physical Society as one of the two best experiments in nuclear physics for that year and by *Discover Magazine* as one of the 100 best experiments in all of science.

Over the last decade, Andy's leadership has ensured that the NSF-sponsored Research Experiences for Undergraduates (REU) program continues and remains a vital success, providing summer research projects to about 15 physics undergraduates each year, mainly from outside IU. The REU program has truly been essential for the personal development of scores of young physics students into the next generation of scientists and teachers, and the IU program has received national renown. Andy has taken REU students to conferences to present their research, sent students to Japan for research experiences, and found ways to include more women and minorities.

He has served as a valued mentor to many young physicists, helping them through both good times and bad. Through his good humor, and his caring and concern about them as people, not just scientists, Andy has encouraged them to develop from young physicists into valued university colleagues.

Andy is fundamentally committed to teaching and is always available for his students, any day or hour. His course, *Energy in the Twenty-First Century*, allows students to apply physics to the real-world problems of energy use, environmental protection, and realistic future planning. Andy's commitment to teaching and learning extend beyond his own classes, as he has worked to improve the Physics Forum, a large room where undergraduates can study and get free tutoring help from physics graduate students and faculty. Through his efforts, Andy has brought the Physics Forum to a new and higher level of operation, with more resources for IU students.

Andy is well known for his inherent love of a broad range of physics beyond his own efforts. At IUCF, he organized weekly lunch meetings to discuss new experimental results, maintaining the vital contact between physicists and technicians within the lab.

Over the years, Andy has helped physicists, especially from outside IU, in their IUCF research efforts. Andy's friendly face and his genuine caring about their brief time at IU have helped to make their research time as effective as possible.

Throughout his entire career of research, teaching, and service, Andy has continually strived to make the university a better place for both students and colleagues.

Catherine Olmer and Edward Stephenson