

**ANDREW DAVID TOMASCH**

**Birth**            January 4, 1959

**Birthplace**    Encino, California

**Education**

B. S. in Physics, University of Notre Dame 1980, with high honors

M.A. Astronomy, Indiana University 1985

Ph.D. Physics, Boston University May, 1988

**Positions**

April 2008-Present

University of Michigan: Lecturer II, Department of Physics

September 2005-April 2008

University of Michigan: Lecturer I, Department of Physics

July 1992-September 2005

University of Michigan: Assistant Research Scientist, Department of Physics

Feb. 15 - March 31 1996

Pennsylvania State University: Visiting Assistant Professor of Physics

May 1988-July 1992

University of Michigan: Postdoctoral Research Fellow

October 1985-May 1988

Boston University: Graduate Research Assistant

1983- October 1985

Indiana University: Graduate Research Assistant

1981-1983

Indiana University: Graduate Teaching Assistant

1980-1981

University of New Hampshire: Graduate Teaching Assistant

**Professional Societies**

Member: American Association of Physics Teachers (AAPT).

Member: Physics Instructional Resource Association (PIRA).

## Professional Activities

1984-1988: Ph.D. work at Boston University. Designed, built, and flew the first cosmic ray magnet spectrometer (PBAR) to employ drift tube tracking in the field of a two-coil superconducting magnet. Developed both the magnet and tracking chambers for the PBAR balloon payload. Successful flight of PBAR in 1987 demonstrated that the previously reported antiproton flux below 1 GeV was in error, and that the antiproton abundance falls steeply below 1 GeV as expected from the kinematics of antiproton production near threshold in the lab frame. Awarded Ph.D. for PBAR work.

May 1988: Joined the University of Michigan Physics department as a postdoctoral fellow.

1988-1992: Managed the integration and flight of the Superconducting Magnet Instrument for Light Isotopes (SMILI). Two successful balloon flights yielded new data on the  $^3\text{He}/^4\text{He}$  ratio in the primary cosmic rays up to energies of  $\sim 2$  GeV/nucleon. SMILI employed the same magnet as developed for the PBAR experiment, with newly constructed drift tube tracking arrays mounted outside the magnet cryostat and precision time-of-flight scintillators. Ph.D. awarded to Shawn McKee (University of Michigan) for SMILI work.

July 1992: Promoted to Assistant Research Scientist, College of Literature, Science, and the Arts.

1992-2001 design, construction, testing and flight of a new magnet spectrometer for the High Energy Antimatter Telescope (HEAT). Developed, constructed, tested, and flew a new superconducting magnet with  $\sim 15$  times the aperture and  $\sim 3$  times the field integral of the PBAR system, and a new tracking system comprised of 479 high-precision drift tubes each attaining a single-point tracking accuracy of  $70 \mu\text{m}$ . Developed original Monte Carlo software to study the analyzing power of the spectrometer as a function of coil dimensions, tracking accuracy and placement, as well as trajectory through the aperture. Wrote original software to calculate the resultant magnetic field produced by an arbitrary superposition of single-loop coil elements. This software was used to verify the magnetic field distribution predicted by magnet vendors, as well as to produce the field maps for the Monte Carlo of prospective spectrometer designs and the actual final magnet coils. Performed extensive Monte Carlo studies of many prospective spectrometer designs to determine the final coil/tracking system design. Designed the support structure for the magnet coils, and supervised all engineering analysis (finite element, etc.) performed to verify that the design would meet the stringent dimensional stability requirements for stable magnet operation. Supervised engineering analysis of the cryostat to ensure survival of balloon parachute deployment. The first cryostat constructed failed due to mis-fabrication (defective welds). Subsequent independent engineering investigation showed the failure was solely due to defective welding (weld strength at 10% of base metal strength). No design flaws were found, and only one minor design change was recommended. Supervised the construction and testing of the second, highly successful cryostat. Developed all systems for cryogenic refill, gas system refill, ground support, and cryostat/gondola safety venting used aboard the HEAT payload. These systems were developed so that all cryogenic and gas service could be accomplished with the payload housed within the flight gondola, as well as magnet charging operations. Designed and built the drift tube tracking hodoscope, comprised of 479 thin-walled

plastic drift tubes assembled to a positional tolerance of 12 microns. Designed and fabricated custom injection-molded wire placement pins. Supervised mold construction and injection molding of the pins. Surveyed the pins under a microscope to improve wire placement accuracy. Surveyed the completed instrument to a measured wire placement accuracy of 5 microns using industrial metrology techniques. Developed extensive special tooling and jigs for assembly of the completed hodoscope. Developed special gluing techniques which produced both gas-tight end closures, and conductive ground connection to the drift tube cathode material. Developed and supervised the manufacture of special ultra-thin (15 micron) walled conductive plastic tubing, produced by spiral winding. Designed all hodoscope sub-components, and personally assembled all tubes in specially developed precision jigs. Personally assembled the integrated hodoscope. Supervised seven hourly workers (students and hired helpers) in various fabrication, metrology and testing positions. This new spectrometer exhibited a typical analyzing power of 170 GV (as predicted by design studies/Monte Carlo done by Tomasch), and represented a major advancement in the state of the art. First balloon flight in 1994 yielded new data on the positron abundance up to 50 GeV in the primary cosmic rays, including the identification of a possible positron excess at  $\sim 8$  GeV. A second flight from Canada extended the measurements to lower cutoff rigidities and improved the statistical significance of the positron measurements. Subsequently, the instrument was re-fitted with 140 multiwire proportional chambers used to measure the Lorentz factor of incoming particles by multiple ionization sampling. Supported all HEAT balloon flights in the field, including all cryogenic operations, magnet charging, pre-flight preparation, flight operations, and recovery. Successful balloon flight data has provided new measurements of the Cosmic Ray antiproton abundance up to 50 GeV. The final flight attempt in September 2001 was unsuccessful due to all balloon operations being grounded as a result of the September 11 terror attacks. Ph.D.s awarded to Chris Chaput (University of Michigan), Georgia DeNolfo (Washington University at St. Louis), Eric Schneider (UC Irvine), and Eric Torbet (University of Chicago) for HEAT positron studies. Ph.D. awarded to Amit Bhattacharyya (Indiana University) for HEAT antiproton studies. The Heat Pbar Experiment is intact and currently stored in 1228 PRL.

2001-September 2005: Joined the Supernova Acceleration Probe (SNAP) effort, taking primary responsibility for the mechanical and thermal interfaces for SNAP near-infrared (NIR) devices tested in the Michigan NIR test facility. Developed numerous custom interfaces and enclosures for both Rockwell and Raytheon NIR test devices. Successfully modified the SDSS Drift Scan Dewar for use with the Michigan spot projection system for measuring the intra-pixel variation of SNAP NIR devices. Developed training materials, procedures, and documentation for the Electrostatic Discharge (ESD)-safe handling of SNAP devices in the Michigan NIR test facility. Procured and set up all necessary ESD-safe infrastructure for the Michigan NIR lab. Set up ESD-safe clean facility for chip handling. Developed automated systems for the re-supply of liquid nitrogen to the NIR test Dewars.

September 2005-Present: Lecturer I in the Department of Physics at the University of Michigan.

Winter Semester 2008: Currently course leader for Physics 125 (Mechanics, Waves and Sound), two lecture sections and three discussion sections taught twice weekly. This is the third time teaching both lecture and discussion for Physics 125.

April 2008-Promoted to Lecturer II subsequent to three-year major performance review

May-August 2008: Appointed to teach one section of Physics 127 Mechanics Lab for the 2008 spring term, participate in the re-writing of the Physics 127 manual, construct additional copies of the inclined plane and rotating bar experiments, construct the newly developed electrostatic force balance experiment for the Physics 128/241 courses, develop a new lab to replace radioactive decay for Physics 128 lab, develop new labs for Physics 127 and refurbish all experiments for the introductory lab program as required.

## Publications

“Response of High Resolution Drift Tubes to Relativistic Heavy Ions”, A. Tomasch, S.P. Ahlen, C.R. Bower, P.B. Price, M.H. Salamon, G. Tarlé, J. Musser, and H. Crawford, *Nucl. Instr. and Meths.*, **A241**, 265 (1985).

“A Water Cherenkov Counter Sensitive to Nonwavelength-shifted Ultraviolet Cherenkov Photons”, C.R. Bower, R.M. Heinz, J. Reynoldson, S. Mufson, J. Petrakis, S.P. Ahlen, J.J. Beatty, A. Tomasch, S. Barwick, G. Gerbier, D. Lowder, H.S. Park, P.B. Price, M.H. Salamon, J. Musser, and G. Tarlé, *Nucl. Instr. and Meths.*, **A252**, 112 (1986).

“A New Limit on the Low Energy Antiproton/Proton Ratio in the Galactic Cosmic Radiation”, S.P. Ahlen, S. Barwick, J.J. Beatty, C.R. Bower, G. Gerbier, R.M. Heinz, D. Lowder, S. McKee, S. Mufson, J.A. Musser, P.B. Price, M.H. Salamon, G. Tarlé, A. Tomasch, and B. Zhou, *Phys. Rev. Lett.*, **61**, 145 (1988).

“Energy and Flux Measurements of Cold-Fusion Neutrons Using Deuterated Liquid Scintillator”, D.A. Roberts, F.D. Becchetti, E. Ben-Jacob, P. Garik, J. Musser, B. Orr, G. Tarlé, A. Tomasch, J.S. Holder, D. Redina, B. Heuser, and G. Wicker, *Phys. Rev. C*, **42**, 1809 (1990).

“Limits on the Antiproton/Proton Ratio in the Cosmic Radiation from 100 MeV to 1580 MeV”, M.H. Salamon, S. McKee, J.A. Musser, G. Tarlé, A. Tomasch, C.R. Bower, R.M. Heinz, J.L. Miller, S.L. Mufson, S.W. Barwick, G. Gerbier, D.M. Lowder, P.B. Price, B. Zhou, J.J. Beatty, and S.P. Ahlen, *Astrophys. J.*, **349**, 78 (1990).

“PBAR: A Superconducting Magnet Spectrometer for Cosmic Ray Antiproton Studies”, A. Tomasch, S.P. Ahlen, S.W. Barwick, J.J. Beatty, C.R. Bower, G. Gerbier, R.M. Heinz, D.M. Lowder, S. McKee, S.L. Mufson, J.A. Musser, P.B. Price, M.H. Salamon, G. Tarlé, and B. Zhou, *Nucl. Inst. and Meth.*, **A294**, 627 (1990).

“High Resolution Drift Tube Hodoscopes for Cosmic Ray Studies”, A.D. Tomasch, for the PBAR, SMILI, and HEAT Collaborations, *Nucl. Inst. and Meth.*, **A323** (1992) 65-70.

“The Cosmic Ray  ${}^3\text{He}/{}^4\text{He}$  Ratio From 100 MeV/amu to 1600 MeV/amu”, J.J. Beatty, C.R. Bower, J. Clem, D.J. Ficenece, T.G. Guzik, R.M. Heinz, M. Lijowski, S. McKee, J.W. Mitchell, S.L. Mufson, J. Musser, S. Nutter, J. Pitts, G.M. Spiczak, G. Tarlé, S. Tobias, A. Tomasch, and J.P. Wefel, *Ap. J.* **413**, 268-280 (1993).

“Balloon Observations of Galactic Cosmic Ray Helium Before and During a Flare Induced Forbush Decrease”, J.J. Beatty, C.R. Bower, J. Clem, D.J. Ficenec, T.G. Guzik, R.M. Heinz, M. Lijowski, S. McKee, J.W. Mitchell, S.L. Mufson, J. Musser, S. Nutter, J. Pitts, G.M. Spiczak, G. Tarlé, S. Tobias, A. Tomasch, and J.P. Wefel, *Geophys. Res. Lett.* **20**, 1743 (1993).

“Flight Performance of EXAM -- a Balloon Borne Detector to Search for Extragalactic Antimatter”, S.P. Ahlen, D. Loomba, A. Marin, B. Zhou, Y.D. Hee, P.B. Price, D.P. Snowden-Ifft, C.R. Bower, J. Musser, T.E. Coan, G. Tarlé, A. Tomasch, M.H. Salamon, J.J. Beatty, and D.J. Crary, *Nucl. Instr. and Methods.*, **A 345**, 156 (1994).

“Cosmic Ray Positrons at High Energies: A New Measurement”, S.W. Barwick, J.J. Beatty, C.R. Bower, C. Chaput, S. Coutu, G. de Nolfo, D. Ficenec, J. Knapp, D.M. Lowder, S. McKee, D. Müller, J.A. Musser, S.L. Nutter, E. Schneider, S.P. Swordy, K.K. Tang, A.D. Tomasch, and E. Torbet, *Phys. Rev. Lett.*, **75** 390 (17 July 1995).

“Measurements of the Cosmic Ray Positron Fraction From 1 to 50 GeV”, S.W. Barwick, J.J. Beatty, A. Bhattacharyya, C.R. Bower, C. Chaput, S. Coutu, G. De Nolfo, J. Knapp, D.M. Lowder, S. McKee, D. Müller, J.A. Musser, S.L. Nutter, E. Schneider, S.P. Swordy, G. Tarlé, A.D. Tomasch, and E. Torbet, *Ap. J. Lett.*, **482**, L191-L194, 20 June (1997).

“The High Energy Antimatter Telescope (**HEAT**): An Instrument for the Study of Cosmic-Ray Positrons”, S.W. Barwick, J.J. Beatty, C.R. Bower, C. Chaput, S. Coutu, G. De Nolfo, D. Ellithorpe, D. Ficenec, J. Knapp, D.M. Lowder, S. McKee, D. Müller, J.A. Musser, S.L. Nutter, E. Schneider, S.P. Swordy, K.K. Tang, G. Tarlé, A.D. Tomasch, and E. Torbet, *Nucl. Inst. & Meth.*, **A 400** 34-52 (1997).

“The Energy Spectra and Relative Abundances of Electrons and Positrons in the Galactic Cosmic Radiation”, S.W. Barwick, J.J. Beatty, C.R. Bower, C. Chaput, S. Coutu, G. De Nolfo, M.A. DuVernois, D. Ficenec, J. Knapp, D.M. Lowder, S. McKee, D. Müller, J.A. Musser, S.L. Nutter, E. Schneider, S.P. Swordy, G. Tarlé, A.D. Tomasch, and E. Torbet, *Ap. J.*, **498**, No. 2, 779-789 (1998).

“The Cosmic-ray Reentrant Electron Albedo: **HEAT** Balloon Measurements from Ft. Sumner, NM”, S.W. Barwick, J.J. Beatty, C.R. Bower, C. Chaput, S. Coutu, G.A. De Nolfo, M.A. DuVernois, D. Ficenec, J. Knapp, D.M. Lowder, S. McKee, D. Müller, J.A. Musser, S.L. Nutter, E. Schneider, S.P. Swordy, G. Tarlé, A.D. Tomasch, and E. Torbet, *Journal of Geophysical Research*, **103**, No. A3, 4817-4823 March 1 (1998).

“The Energy Spectra and Relative Abundances of Electron and Positrons in the Galactic Cosmic Radiation”, S. Barwick, J. Beatty, C. Bower, C. Chaput. S. Coutu, G. de Nolfo, D. Ellithorpe, D. Ficenec, J. Knapp, D. Lowder, S. McKee, D. Müller, J. Musser, S. Nutter, E. Schneider, S. Swordy, K. Tang, G. Tarlé, A. Tomasch and E. Torbet, *Ap. J.* **498**, 779-789 (1998).

“Cosmic Ray Positrons: Are There Primary Sources?”, S. Coutu, *et al.* (HEAT Collaboration), *Astroparticle Physics* **11**, 429-435 (1999).

“Energy Spectra, Altitude Profiles and Charge Ratios of Atmospheric Muons”, S. Coutu, *et al.* (HEAT Collaboration), *Phys. Rev. D* **62**, Vol. 62, 032001-1–9 (2000).

“Measurement of the Cosmic-Ray Antiproton Abundance Ratio between 4 and 50 GeV”, A.S. Beach, *et al.* (HEAT Collaboration), *Phys. Rev. Lett.* **87**, 271101 (2001).

“Cosmic-Ray Electrons and Positrons from 1-100 GeV: Measurements with HEAT and their Interpretation”, M. A. DuVernois, S. W. Barwick, J. J. Beatty, A. Bhattacharyya, C. R. Bower, C. J. Chaput, S. Coutu, G. A. de Nolfo, D. M. Lowder, S. McKee, D. Muller, J. A. Musser, S. L. Nutter, E. Schneider, S. P. Swordy, G. Tarle, A. D. Tomasch, and E. Torbet, *Ap. J.* **559**, 296-303 (2001).

“Cosmic-Ray Electrons and Positrons from 1-100 GeV: Measurements with HEAT and their Interpretation”, M. A. DuVernois, *et al.* (HEAT Collaboration), *Ap. J.* **559**, 296-303 (2001).

“Measurement of the Cosmic-Ray Antiproton-to-Proton Abundance Ratio between 4 and 50 GeV”, A. S. Beach, *et al.* (HEAT Collaboration), *Phys. Rev. Lett.* **87**, 271101, 1 – 4 (2001). Also featured in Nature Physics Portal Research Highlights “Balloon Settles Debate” (Dec 10, 2001).

“New Measurement of the Altitude Dependence of the Atmospheric Muon Intensity”, J.J Beatty, S. Coutu, S.A. Minnick, A. Bhattacharyya, C.R.Bower, J.A. Musser, S.P. McKee, M. Schubnell, G. Tarlé, A.D. Tomasch, A.W. Labrador, D. Müller, S.P. Swordy, M.A. DuVernois, and S.L. Nutter, *Phys. Rev. D* **70**, 092005 (2004).

“New Measurement of the Cosmic-Ray Positron Fraction from 5 to 15 GeV”, J.J. Beatty, *et al.*, (HEAT Collaboration), *Phys. Rev. Lett.* **93**, 241102 (2004).

“Weak Lensing from Space I: Instrumentation and Survey Strategy”, J. Rhodes, *et al.* (SNAP Collaboration), *Astroparticle Physics*, **20**, 377-389 (2004).

“Sub Pixel Response Measurement of Near-Infrared Sensors”, N. Barron, M. Borysow, K. Beyerlein, M. Brown, W. Lorenzon, M. Schubnell, G. Tarlé, A. Tomasch and C. Weaverdick, *Publications of the Astronomical Society of the Pacific*, **119**: 466-475, 2007 (April).

## **In Preparation**

“A Simple and Inexpensive Apparatus to Demonstrate the Magnetic Force on a Current-Carrying Wire Element”, A. Tomasch, D. Gerdes and M. Love, to be submitted to *The Physics Teacher* (2008).

“A Simple Apparatus to Demonstrate the Energy Stored in a Capacitor”, A. Tomasch, D. Gerdes, R. Armen and M. Love, to be submitted to *The Physics Teacher* (2008).

## Conference Proceedings

“The PBAR Project: A Cosmic Ray Antiproton Detector”, M.H. Salamon, P.B. Price, D.M. Lowder, H.S. Park, S. Barwick, G. Gerbier, S.P. Ahlen, A. Tomasch, R. Heinz, S. Mufson, C.R. Bower, J. Reynoldson, J. Petrakis, G. Tarlé, J. Musser, and I. Rasmussen, *Proc. of the XXIII Internat. Conf. on High Energy. Phys.*, World Scientific Publishing Co. Pte Ltd., **II**, 1302 (1987).

“SMILI: A Superconducting Magnet Instrument of Light Isotopes”, J.J. Beatty, S.P. Ahlen, A. Tomasch, C.R. Bower, R.M. Heinz, S.L. Mufson, J. Petrakis, J. Reynoldson, T.G. Guzik, J. Mitchell, J.P. Wefel, J. Musser, and G. Tarlé, *Proceedings of the 20<sup>th</sup> International Cosmic Ray Conf. (Moscow)*, **2**, 374 (1987).

“Low Energy Antiprotons in the Cosmic Rays: A New Upper Limit”, S.P. Ahlen, S. Barwick, J.J. Beatty, C.R. Bower, G. Gerbier, R.M. Heinz, D. Lowder, S. McKee, S. Mufson, J.A. Musser, P.B. Price, M.H. Salamon, G. Tarlé, A. Tomasch, and B. Zhou, *Antimatter 87 Conference Proceedings*, Karlsruhe, Federal Republic of Germany (1987).

“Low Energy Antiprotons in the Cosmic Rays”, S.P. Ahlen, S. Barwick, J.J. Beatty, C.R. Bower, G. Gerbier, R.M. Heinz, D. Lowder, S. McKee, S. Mufson, J.A. Musser, P.B. Price, M.H. Salamon, G. Tarlé, A. Tomasch, and B. Zhou. *Cosmic Gamma Rays and Cosmic Neutrinos*, (eds. M.M. Shapiro and J.P. Wefel), (1988).

“Current Progress of the SMILI Light Isotope Spectrometer Program”, A. Tomasch, B. Zhou, S.P. Ahlen, S.W. Barwick, J.J. Beatty, C.R. Bower, R.M. Heinz, D.M. Lowder, S. McKee, S.L. Mufson, J.A. Musser, P.B. Price, and G. Tarlé, *Proceedings of the 21st International Cosmic Ray Conference*, Adelaide Australia **3**, (1990), p. 35.

“A High Resolution Rigidity Spectrometer for Cosmic Ray Antiproton Studies”, A. Tomasch, B. Zhou, S.P. Ahlen, S.W. Barwick, J.J. Beatty, C.R. Bower, R.M. Heinz, D.M. Lowder, S. McKee, S.L. Mufson, J.A. Musser, P.B. Price, and G. Tarlé, *Proceedings of the 21st International Cosmic Ray Conference*, Adelaide Australia **4**, (1990), p. 414.

“Preliminary Results from the Automated Scan of CR-39 Plastic Aboard the EXAM (EXtragalactic Anti Matter) Detector”, S.P. Ahlen, S.W. Barwick, J.J. Beatty, T.E. Coan, D. Crary, T. Karakashian, D.M. Lowder, A. Marin, J.A. Musser, G. Patterson, P.B. Price, D.P. Snowden-Ifft, G. Tarlé, A. Tomasch, and B. Zhou, *Proceedings of the 21st International Cosmic Ray Conference*, Adelaide Australia **3**, (1990), p. 304.

“New Limits on the Low Energy  $\bar{p}/p$  Ratio in the Cosmic Radiation”, S.W. Barwick, S.P. Ahlen, J.J. Beatty, C.R. Bower, R.M. Heinz, D.M. Lowder, S. McKee, J.L. Miller, S.L. Mufson, J.A. Musser, P.B. Price, M.H. Salamon, G. Tarlé, A. Tomasch, and B. Zhou, *Proceedings of the 21st International Cosmic Ray Conference*, Adelaide Australia **3**, (1990), P. 273.

“HEAT; A High Energy Antimatter Telescope”, D. Müller, S.P. Ahlen, S.W. Barwick, J.J. Beatty, A. Borione, D. Ficenece, D. Levin, D.M. Lowder, S. McKee, T. Miller, J.A. Musser, P.B. Price, S. Swordy, K.K. Tang, G. Tarlé, A.D. Tomasch, and E. Torbet, *Proceedings of the 22nd International Cosmic Ray Conference*, Dublin Ireland, **2**, 177 (1991).

“A New Superconducting Magnet Based Rigidity Spectrometer for the HEAT Balloon Instrument”, A.D. Tomasch, S.P. Ahlen, S.W. Barwick, J.J. Beatty, A. Borione, D. Ficene, D. Levin, D.M. Lowder, S. McKee, T. Miller, D. Müller, J.A. Musser, P.B. Price, S. Swordy, K.K. Tang, G. Tarlé, and E. Torbet, *Proceedings of the 22nd International Cosmic Ray Conference*, Dublin Ireland, **2**, 181 (1991).

“A New Measurement of the Ratio  $^2\text{H}^1\text{H}$  in the Cosmic Radiation Below 1 GeV/amu”, S.P. Ahlen, S.W. Barwick, J.J. Beatty, C.R. Bower, D. Ficene, G. Gerbier, R.M. Heinz, D.M. Lowder, S. McKee, J.L. Miller, S.L. Mufson, J.A. Musser, P.B. Price, M.H. Salamon, A.D. Tomasch, G. Tarlé, and B. Zhou, *Proceedings of the 22nd International Cosmic Ray Conference*, Dublin Ireland, **1**, 600 (1991).

“A Measurement of the  $^3\text{He}^4\text{He}$  Ratio in the Cosmic Radiation from 100 MeV/amu to 500 MeV/amu”, S.P. Ahlen, J.J. Beatty, C.R. Bower, J. Clem, D.J. Ficene, T.G. Guzik, R.M. Heinz, M. Lijowski, S. McKee, J.W. Mitchell, S.L. Mufson, J.A. Musser, S.L. Nutter, J.J. Pitts, G. Spiczak, S.M. Tobias, G. Tarlé, A.D. Tomasch, J.P. Wefel, and B. Zhou, *Proceedings of the 22nd International Cosmic Ray Conference*, Dublin Ireland, **1**, 607 (1991).

“A Measurement of the  $^3\text{He}^4\text{He}$  Ratio in the Cosmic Radiation from 500 MeV/amu to 1100 MeV/amu”, S.P. Ahlen, J.J. Beatty, C.R. Bower, J. Clem, D.J. Ficene, T.G. Guzik, R.M. Heinz, M. Lijowski, S. McKee, J.W. Mitchell, S.L. Mufson, J.A. Musser, S.L. Nutter, J.J. Pitts, G. Spiczak, S.M. Tobias, G. Tarlé, A.D. Tomasch, J.P. Wefel, and B. Zhou, *Proceedings of the 22nd International Cosmic Ray Conference*, Dublin Ireland, **1**, 611 (1991).

“Interpretation of the  $^3\text{He}^4\text{He}$  Ratio in the Cosmic Radiation from 100 MeV/amu to 1100 MeV/amu”, S.P. Ahlen, J.J. Beatty, C.R. Bower, J. Clem, D.J. Ficene, T.G. Guzik, R.M. Heinz, M. Lijowski, S. McKee, J.W. Mitchell, S.L. Mufson, J.A. Musser, S.L. Nutter, J.J. Pitts, G. Spiczak, S.M. Tobias, G. Tarlé, A.D. Tomasch, J.P. Wefel, and B. Zhou, *Proceedings of the 22nd International Cosmic Ray Conference*, Dublin Ireland, **1**, 615 (1991).

“SMILI (Superconducting Magnet Instrument for Light Isotopes) A Balloon Borne Magnet Spectrometer”, S.P. Ahlen, J.J. Beatty, C.R. Bower, J. Clem, D.J. Ficene, T.G. Guzik, R.M. Heinz, M. Lijowski, S. McKee, J.W. Mitchell, S.L. Mufson, J.A. Musser, S.L. Nutter, J.J. Pitts, G. Spiczak, S.M. Tobias, G. Tarlé, A.D. Tomasch, J.P. Wefel, and B. Zhou, *Proceedings of the 22nd International Cosmic Ray Conference*, Dublin Ireland, **2**, 563 (1991).

“The Cosmic Ray  $^3\text{He}^4\text{He}$  Ratio From 100 MeV/amu to 1600 MeV/amu”, D.J. Ficene, S.P. Ahlen, J.J. Beatty, C.R. Bower, J. Clem, T.G. Guzik, R.M. Heinz, M. Lijowski, S. McKee, J.W. Mitchell, S.L. Mufson, J. Musser, S. Nutter, J.J. Pitts, G.M. Spiczak, G. Tarlé, S. Tobias, A. Tomasch, J.P. Wefel, and B. Zhou, *Proceedings of the 23rd International Cosmic Ray Conference*, Calgary, Canada, **1**, 515 (1993).

“Modulation Effects of the 4-Sept-1989 Forbush Decrease on Cosmic Ray Helium 1200-2000 MV”, S.P. Ahlen, J.J. Beatty, C.R. Bower, J.M. Clem, D.J. Ficenec, T.G. Guzik, R.M. Heinz, M. Lijowski, S. McKee, J.W. Mitchell, S.L. Mufson, J. Musser, S. Nutter, J.J. Pitts, G.M. Spiczak, G. Tarlé, S. Tobias, A. Tomasch, J.P. Wefel, and B. Zhou, *Proceedings of the 23rd International Cosmic Ray Conference*, Calgary, Canada, **3**, 707 (1993).

“HEAT -  $e^\pm$ : Accelerator Calibration Results”, E. Torbet, S.W. Barwick, J. Beatty, C.R. Bower, G. de Nolfo, D. Ellithorpe, D.J. Ficenec, D. Levin, D.M. Lowder, J. Lynch, S. McKee, T. Miller, D. Müller, J.A. Musser, S. Nutter, P.B. Price, A. Richards, E. Schneider, S.Swordy, K.K. Tang, G. Tarlé, and A.D. Tomasch, *Proceedings of the 23rd International Cosmic Ray Conference*, Calgary, Canada **2**, 496 (1993).

“Spatial Resolution Tests Using a Prototype Cosmic-Ray Hodoscope”, S.W. Barwick, J. Beatty, C.R. Bower, G. de Nolfo, D. Ellithorpe, D.J. Ficenec, D. Levin, D.M. Lowder, J. Lynch, S. McKee, T. Miller, D. Müller, J.A. Musser, S. Nutter, P.B. Price, A. Richards, E. Schneider, S.Swordy, K.K. Tang, G. Tarlé, A.D. Tomasch, and E. Torbet, *Proceedings of the 23rd International Cosmic Ray Conference*, Calgary, Canada, **2**, 492 (1993).

“Monte Carlo Calculations of Atmospheric Electrons Compared with Data from HEAT”, G. de Nolfo, S.W. Barwick, J.J. Beatty, C.R. Bower, C. Chaput, S. Coutu, D. Ficenec, J. Knapp, D.M. Lowder, S. McKee, D. Müller, S.L. Nutter, E. Schneider, S.P. Swordy, K.K. Tang, G. Tarlé, A.D. Tomasch, E. Torbet, *Proceedings of the 24<sup>th</sup> Int. Cosmic Ray Conf.* (Rome), **1**, 589 (1995).

“The Cosmic Positron Fraction: Implications of a New Measurement”, D. Müller, S.W. Barwick, J.J. Beatty, C.R. Bower, C. Chaput, S. Coutu, G. de Nolfo, D. Ficenec, J. Knapp, D.M. Lowder, S. McKee, S.L. Nutter, E. Schneider, S.P. Swordy, K.K. Tang, G. Tarlé, A.D. Tomasch, E. Torbet, *Proceedings of the 24<sup>th</sup> Int. Cosmic Ray Conf.* (Rome), **3** 13 (1995).

“Measurement of the  $\mu^+\mu^-$  Ratio as a Function of Depth in the Atmosphere”, E. Schneider, S.W. Barwick, J.J. Beatty, C.R. Bower, C. Chaput, S. Coutu, G. de Nolfo, D. Ficenec, J. Knapp, D.M. Lowder, S. McKee, D. Müller, S.L. Nutter, S.P. Swordy, K.K. Tang, G. Tarlé, A.D. Tomasch, E. Torbet, *Proceedings of the 24<sup>th</sup> Int. Cosmic Ray Conf.* (Rome), **1**, 690 (1995).

“The Relative Fluxes of Protons and Helium Nuclei up to 100 GeV/n”, S.P. Swordy, S.W. Barwick, J.J. Beatty, C.R. Bower, C. Chaput, S. Coutu, G. de Nolfo, D. Ficenec, J. Knapp, D.M. Lowder, S. McKee, D. Müller, S.L. Nutter, E. Schneider, K.K. Tang, G. Tarlé, A.D. Tomasch, E. Torbet, *Proceedings of the 24<sup>th</sup> Int. Cosmic Ray Conf.* (Rome), **2**, 653 (1995).

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“Flight Performance of the HEAT Rigidity Spectrometer”, A.D. Tomasch, S.W. Barwick, J.J. Beatty, C.R. Bower, C. Chaput, S. Coutu, G. de Nolfo, D. Ficenec, J. Knapp, D.M. Lowder, S. McKee, D. Müller, S.L. Nutter, E. Schneider, S.P. Swordy, K.K. Tang, G. Tarlé, E. Torbet, *Proceedings of the 24<sup>th</sup> Int. Cosmic Ray Conf.* (Rome), **3**, 599 (1995).

“Flight Performance and Electron-Hadron Separation of the HEAT- $e^\pm$  Experiment”, E. Torbet, S.W. Barwick, J.J. Beatty, C.R. Bower, C. Chaput, S. Coutu, G. de Nolfo, D. Ficenc, J. Knapp, D.M. Lowder, S. McKee, D. Müller, S.L. Nutter, E. Schneider, S.P. Swordy, K.K. Tang, G. Tarlé, A.D. Tomasch, *Proceedings of the 24<sup>th</sup> Int. Cosmic Ray Conf.* (Rome), **3**, 603 (1995).

“The Atmospheric Background of Protons and Deuterons Measured at 5 g/cm<sup>2</sup>”, J.P. Wefel, S.P. Ahlen, J.J. Beatty, C.R. Bower, J. Clem, D.J. Ficenc, N. Greene, T.G. Guzik, R.M. Heinz, M. Lijowski, D. Loomba, S. McKee, J.W. Mitchell, S.L. Mufson, J. Musser, S. Nutter, G.M. Spiczak, G. Tarlé, and A. Tomasch, *Proceedings of the 24<sup>th</sup> International Cosmic Ray Conference*, Rome, Italy, **2**, 634 (1995).

“Measurements of Cosmic Ray Helium During the 1991 Solar Maximum”, J.P. Wefel, S.P. Ahlen, J.J. Beatty, C.R. Bower, J. Clem, D.J. Ficenc, N. Greene, T.G. Guzik, R.M. Heinz, M. Lijowski, D. Loomba, S. McKee, J.W. Mitchell, S.L. Mufson, J. Musser, S. Nutter, G.M. Spiczak, G. Tarlé, and A. Tomasch, *Proceedings of the 24<sup>th</sup> International Cosmic Ray Conference*, Rome, Italy, **2**, 630 (1995).

“The High Energy Antimatter Telescope (HEAT): Basic Design and Performance”, S. Coutu, S.W. Barwick, A. Bhattacharyya, J.J. Beatty, C.R. Bower, C. Chaput, G. de Nolfo, D. Ellithorpe, D. Ficenc, J. Knapp, D.M. Lowder, S. McKee, D. Müller, J.A. Musser, S.L. Nutter, E. Schneider, S.P. Swordy, K.K. Tang, G. Tarlé, A.D. Tomasch, and E. Torbet, *Proceedings of the SPIE Meeting, Technical Conference on Gamma Ray and Cosmic Ray Detectors, Techniques, and Missions*, 2806 (1996).

“Measurements of the Cosmic Ray Positron Fraction With the HEAT Spectrometer”, J.A. Musser, S.W. Barwick, J.J. Beatty, A. Bhattacharyya, C.R. Bower, C. Chaput, S. Coutu, G.A. De Nolfo, J. Knapp, D.M. Lowder, S. McKee, D. Müller, S.L. Nutter, E. Schneider, S.P. Swordy, G. Tarlé, A.D. Tomasch, and E. Torbet, *Proceedings of the 25<sup>th</sup> International Cosmic Ray Conference*, Durban, South Africa, **4**, 209 (1997).

“Energy Spectra of Electrons and Positrons From 5-100 GeV”, D. Müller, S.W. Barwick, J.J. Beatty, A. Bhattacharyya, C.R. Bower, C. Chaput, S. Coutu, G. De Nolfo, M.A. DuVernois, D. Ficenc, J. Knapp, D.M. Lowder, S. McKee, J.A. Musser, S.L. Nutter, E. Schneider, S.P. Swordy, G. Tarlé, A.D. Tomasch, and E. Torbet, *Proceedings of the 25<sup>th</sup> International Cosmic Ray Conference*, Durban, South Africa, **4**, 237 (1997).

“Relative Abundances of Positive and Negative Muons in the Atmosphere”, G. Tarlé, S.W. Barwick, J.J. Beatty, A. Bhattacharyya, C.R. Bower, C. Chaput, S. Coutu, G. De Nolfo, J. Knapp, D.M. Lowder, S. McKee, D. Müller, J.A. Musser, S.L. Nutter, E. Schneider, S.P. Swordy, A.D. Tomasch, and E. Torbet, *Proceedings of the 25<sup>th</sup> International Cosmic Ray Conference*, Durban, South Africa, **6**, 321 (1997).

“Cosmic Ray Positrons: Are there Primary Sources?”, S. Coutu, S.W. Barwick, J.J. Beatty, A. Bhattacharyya, C.R. Bower, C. Chaput, G. De Nolfo, M.A. DuVernois, D. Ficenc, J. Knapp, D.M. Lowder, S. McKee, D. Müller, J.A. Musser, S.L. Nutter, E. Schneider, S.P. Swordy, G. Tarlé, A.D. Tomasch, and E. Torbet, *Proceedings of the 25<sup>th</sup> International Cosmic Ray Conference*, Durban, South Africa, **4**, 213 (1997).

“Secondary and Re-Entrant Albedo Electrons in the Atmosphere”, G. De Nolfo, S.W. Barwick, J.J. Beatty, A. Bhattacharyya, C.R. Bower, C. Chaput, S. Coutu, M.A. DuVernois, J. Knapp, D.M. Lowder, S. McKee, D. Müller, J.A. Musser, S.L. Nutter, E. Schneider, S.P. Swordy, G. Tarlé, A.D. Tomasch, and E. Torbet, *Proceedings of the 25<sup>th</sup> International Cosmic Ray Conference*, Durban, South Africa, **2**, 373 (1997).

“Energy Spectra of Air Shower Muons as a Function of Atmospheric Depth”, S. Coutu, *et al.* (HEAT Collaboration), *Proceedings of the 29<sup>th</sup> Inter. Conf. on High Energy Physics*, Vancouver, Canada (1998).

“The HEAT-PBAR Cosmic Ray Antiproton Experiment”, C.R. Bower, *et al.* (HEAT Collaboration), *Proceedings of the 26<sup>th</sup> International Cosmic Ray Conference*, Salt Lake City, UT, **5**, 13-16 (1999).

“Air Shower Muons, and the Atmospheric Neutrino Puzzle”, S. Coutu, *et al.* (HEAT Collaboration), *Proceedings of the 26<sup>th</sup> International Cosmic Ray Conference*, Salt Lake City, UT, **2**, 68-71 (1999).

“Electron and Positron Energy Spectra: HEAT Magnet Spectrometer Results”, M.A. DuVernois, *et al.* (HEAT Collaboration), *Proceedings of the 26<sup>th</sup> International Cosmic Ray Conference*, Salt Lake City, UT, **3**, 49-52 (1999).

“Particle Identification With the HEAT dE/dX vs. Rigidity Detector System”, A.W. Labrador, *et al.* (HEAT Collaboration), *Proceedings of the 26<sup>th</sup> International Cosmic Ray Conference*, Salt Lake City, UT, **3**, 97-100 (1999).

“Energy Spectra of Air Shower Muons as a Function of Atmospheric Depth”, S. Coutu, *et al.* (HEAT Collaboration), *Proceedings of the 19th International Conference on High Energy Physics*, Vancouver, Canada, **1**, 666-670 (1999).

“ECCO: Th/U/Pu/Cm Dating of Galactic Cosmic Ray Nuclei”, A.J. Westphal, B.A. Weaver, M. Solarz, G. Dominguez, N. Craig, J.H. Adams, L.M. Barbier, E.R. Christian, J.W. Mitchell, W.R. Binns, M.H. Israel, J.R. Cummings, R.A. Leske, R.A. Mewaldt, S.M. Schindler, E.C. Stone, M.E. Wiedenbeck, T. Doke, N. Hasebe, T. Hayashi, K. Ogura, G. Tarlé, A. Tomasch, M. Schubnell, H. Tawara, *Proceedings of the 27<sup>th</sup> International Cosmic Ray Conference*, Hamburg, Germany, (2001).

“Positron Measurements with the HEAT-pbar Instrument”, S. Coutu, A.S. Beach, J.J. Beatty, A. Bhattacharyya, C.R. Bower, M.A. DuVernois, A. Labrador, S.P. McKee, S.A. Minnick, D. Müller, J.A. Musser, S.L. Nutter, M. Schubnell, S.P. Swordy, G. Tarlé, and A. Tomasch, *Proceedings of the 27<sup>th</sup> International Cosmic Ray Conference*, Hamburg, Germany, 1687-1690 (2001).

“Absolute Rigidity Spectra of Protons and Helium from 16-250 GV”, M.A. DuVernois, J.J. Beatty, C. Bower, S. Coutu, S. McKee, D. Müller, J.A. Musser, S. Nutter, S. Swordy, G. Tarlé, and A. Tomasch, *Proceedings of the 27<sup>th</sup> International Cosmic Ray Conference*, Hamburg, Germany, 1618-1621 (2001).

“Splash and Reentrant Albedo Observations of Electrons and Positrons at a 4.2 GV Vertical Magnetic Cutoff”, M.A. DuVernois, A.S. Beach, J.J. Beatty, A. Bhattacharyya, C. Bower, S. Coutu, S.P. McKee, D. Müller, J. Musser, S. Nutter, M. Schubnell, S. Swordy, G. Tarlé, and A. Tomasch, *Proceedings of the 27<sup>th</sup> International Cosmic Ray Conference*, Hamburg, Germany, 4003-4006 (2001).

“Detection of Cosmic-Ray Antiprotons with the HEAT-pbar Instrument”, S.L. Nutter, A.S. Beach, J.J. Beatty, A. Bhattacharyya, C.R. Bower, S. Coutu, M.A. DuVernois, A.W. Labrador, S.P. McKee, S.A. Minnick, D. Muller, J.A. Musser, M. Schubnell, S.P. Swordy, G. Tarlé, and A.D. Tomasch, *Proceedings of the 27<sup>th</sup> International Cosmic Ray Conference* Hamburg, Germany, 1691-1694 (2001).

“The Cosmic Ray Antiproton Ratio from 4.5 to 50 GV”, J. Musser, A.S. Beach, J.J. Beatty, A. Bhattacharyya, C. Bower, S. Coutu, M.A. DuVernois, S.P. McKee, D. Müller, S. Nutter, M. Schubnell, S. Swordy, G. Tarlé, and A. Tomasch, *Proceedings of the 27<sup>th</sup> International Cosmic Ray Conference*, Hamburg, Germany, 1684-1687 (2001).

“High Energy Antimatter Telescope (HEAT): Basic Design and Performance”, S. Coutu, *et al.* (HEAT Collaboration), *Proc. of the SPIE Meeting: Gamma-Ray and Cosmic-Ray Detectors, Techniques and Missions*, Denver, 2806, 113 (1996).

“SNAP Near Infrared Detectors”, G. Tarlé, *et al.* (SNAP Collaboration), *Proceedings of SPIE, Astronomical Telescopes and Instrumentation*, Hawaii 4850-131 (2002).

“Overview of the SuperNova/Acceleration Probe (SNAP)”, (G. Aldering, *et al.* (SNAP Collaboration), *Proceedings of SPIE, Astronomical Telescopes and Instrumentation*, Hawaii 4835-21 (2002).

“Wide-field Surveys from the SNAP Mission”, A. Kim, *et al.* (SNAP Collaboration), *Proceedings of SPIE, Astronomical Telescopes and Instrumentation*, Hawaii 4836-10 (2002).

“An Integral Field Spectrograph for SNAP Supernova Studies”, A. Ealet, *et al.* (SNAP Collaboration), *Proceedings of SPIE, Astronomical Telescopes and Instrumentation*, Hawaii 4850-165 (2002).

“SNAP Telescope”, M. Lampton, *et al.* (SNAP Collaboration), *Proceedings of SPIE, Astronomical Telescopes and Instrumentation*, Hawaii 4849-29 (2002).

“Antimatter Measurements with HEAT and the Dark Matter Connection”, S. Coutu, *et al.* (HEAT Collaboration), *Proceedings of the IV<sup>th</sup> International Workshop on the Identification of Dark Matter*, York, UK (2002), World Scientific, N. Spooner & V. Kudryavtsev eds., 483-488 (2003).

“Measurement of the Cosmic-Ray Antiproton Energy Spectrum with HEAT-pbar”, S. Swordy, *et al.* (HEAT Collaboration), *Proceedings of the 28th International Cosmic Ray Conference*, Tsukuba, JaPan (2003).

“Energy Spectra and Charge Ratios of Atmospheric Muons”, S.A. Minnick, *et al.* (HEAT Collaboration), *Proceedings of the 28th International Cosmic Ray Conference*, Tsukuba, Japan (2003).

## **Talks**

“A High Resolution Rigidity Spectrometer for Cosmic Ray Antiproton Studies”, poster presentation at the 21st International Cosmic Ray Conference Adelaide, Australia (1990).

“HEAT: A High Energy Antimatter Telescope”, colloquium given at the Louisiana State University Department of Physics, (Sept 24, 1991).

“HEAT: A High Energy Antimatter Telescope”, astrophysics seminar given at the University of Michigan, (October 18, 1991).

“Magnet Spectrometers and Cosmic Rays: Light Isotopes and the Antiproton Puzzle”, colloquium given at Oakland University Department of Physics, (October 24, 1991).

“A New Superconducting Magnet Based Spectrometer for the HEAT Balloon Instrument”, presented at the 22nd International Cosmic Ray Conference Dublin, Ireland (1991).

“A New Measurement of the Ratio  $^2\text{H}^1\text{H}$  in the Cosmic Radiation Below 1 GeV/amu”, presented at the 22nd International Cosmic Ray Conference Dublin, Ireland (1991).

“SMILI (Superconducting Magnet Instrument for Light Isotopes) A Balloon Borne Magnet Spectrometer”, presented at the 22nd International Cosmic Ray Conference Dublin, Ireland (1991).

“High Resolution Drift Tube Hodoscopes for Cosmic Ray Studies”, A. Tomasch for the PBAR, SMILI, and HEAT collaborations, presented at the 1992 Vienna Wire Chamber Conference, (February 1992).

“Spatial Resolution Tests Using a Prototype Cosmic-Ray Hodoscope”, presented at the 23rd International Cosmic Ray Conference, Calgary, Canada (1993).

“Tracking Down Positrons at 120,000 Feet: The HEAT Experiment”, colloquium given at Case Western Reserve University, February 15, 1994.

“An Introduction to Astroparticle Physics”, guest lectures for the Astronomy 405 Class “High Energy Astrophysics”, presented at the University of Michigan November 28 and 30 (1994).

“Tracking Down Positrons at 120,000 Feet: First Results From the HEAT Experiment”, colloquium given at the University of Maryland Department of Physics March 15 (1995).

“Tracking Down Positrons at 120,000 Feet: First Results From the HEAT Experiment”, departmental colloquium given at the University of Michigan Department of Physics March 29 (1995).

“Flight Performance of the HEAT Rigidity Spectrometer”, presented at the 24<sup>th</sup> International Cosmic Ray Conference (Rome), September (1995).

“Tracking Down Antimatter at 120,000 Feet: Particle Astrophysics Aboard High Altitude Balloons”, presented to the University of Michigan Lowbrow Astronomy Club, July 17, 1998.

“Tracking Down Antimatter at 120,000 Feet: Positron and Antiproton Studies with the HEAT Instrument”, colloquium presented to the Hope College Department of Physics, Holland Michigan, November 2, 2001.

“The Golden Age of Ballooning: Particle Astrophysics Aboard High Altitude Balloons”, presented to the University of Michigan chapter of the Society of Physics Students, December 6, 2005.

“An Apparatus to Demonstrate the Energy Stored in a Capacitor”, platform presentation at the American Association of Physics Teachers (AAPT) summer meeting, Syracuse NY (July 2006).

“Higher, Faster, Longer: From the Physics of Model Rockets to Rocket Science”, Saturday Morning Physics lecture series, University of Michigan (October 2006).

“The HEAT Antimatter Balloon Apparatus”, presented to Professor Fred Becchetti’s freshman seminar class, February 15, 2008.

## **Workshops**

“A Research Base Enhancement (RBE) for the study of Cosmic Ray Antiparticles”, presented at the Workshop on Galactic Cosmic Rays, March 16-17 Washington DC (1992).

July 2006: Instructor for the American Association of Physics Teachers (AAPT) workshop for introductory physics laboratory courses. Demonstrated three new experiments: Capacitor work-energy, the magnetic field for a straight wire and the magnetic force on a current-carrying wire in a magnetic field.

July 2007: Instructor for the American Association of Physics Teachers (AAPT) workshop for introductory physics laboratory courses. Demonstrated the complete suite of six Magnetic Fields and Forces experiments developed for the Physics 128/Physics 241 laboratory courses, as well as a new prototype Electrostatic Fields and Forces experiment demonstrating the validity of Gauss' Law for predicting the electrostatic force between charged parallel plates.

March 2008: Participated in the CRLT workshop "Teaching With Lecture Response Units".

April 2008: Participant in the MERLOT online teaching tools seminar and demonstration hosted by CRLT and presented by Perry Samson, U. of M. AOSS department.

May 2008: Round table discussion leader at the CRLT "Preparing Future Faculty" seminar.

July 2008: Instructor for the American Association of Physics Teachers (AAPT) workshop for introductory physics laboratory courses. Demonstrated an improved prototype Electrostatic Fields and Forces experiment demonstrating the validity of Gauss' Law for predicting the electrostatic force between charged parallel plates.

## **Grants**

1991: Recipient of an APS travel grant to attend 22nd International Cosmic Ray Conference.

1996-1999: Co-Investigator NASA Grant NAGW-1642 "HEAT: A High Energy Antimatter Telescope."

2006: Recipient of a Lecturers' Professional Development Fund grant from the Center for Research on Learning and Teaching (CRLT) at the University of Michigan.

## **Awards**

July 2006: Recipient of two awards in the American Association of Physics Teachers (AAPT) annual laboratory apparatus competition at the AAPT summer meeting in Syracuse NY. Second prize was awarded to "A Simple and Inexpensive Apparatus to Demonstrate the Force on a Current-Carrying Wire Segment". Third place was awarded to "A Simple Apparatus to Demonstrate the Energy Stored in a Capacitor". Both experiments are currently used in the Physics 128/241 laboratory course at the University of Michigan.

March 2007: Cited for "Inspirational teaching and mentorship" at the Delta Delta Delta sorority annual faculty dinner.

July 2008: Recipient of an award in the American Association of Physics Teachers (AAPT) annual laboratory apparatus competition at the AAPT summer meeting Edmonton Alberta, Canada. Third prize was awarded to "An Apparatus for the Study of Electrostatic Forces Between Charged Parallel Plates". This apparatus will be manufactured during the summer of 2009 for introduction into the Physics 128/241 laboratory course during the fall 2009 semester at the University of Michigan.

## **Committees**

Past Member of the NASA Cosmic Ray Roadmapping Committee (CRRC).

2003-Present: Member of the departmental Physics Olympiad Committee, University of Michigan.

2007: Member of the departmental Introductory Course Committee, University of Michigan department of physics.

2007: Member of the local organizing committee for the 2009 American Association of Physics Teachers (AAPT) summer meeting to be held in Ann Arbor in July of 2009.

2008: Member of the departmental Introductory Course Committee, University of Michigan department of physics.

2008-Present: Member of the local organizing committee for the 2009 American Association of Physics Teachers (AAPT) summer meeting to be held in Ann Arbor in July of 2009.

## **Teaching**

Winter Semester 2009, the University of Michigan: Course leader for Physics 106. Developed seven new labs, five mechanics, one on buoyancy and one on hydrostatics and fluid flow, which were successfully introduced into the course as part of a complete course revision which will continue throughout the semester. Also teaching three sections of Physics 125 discussion for Professor Roberto Merlin.

Fall Semester 2008, the University of Michigan: Six sections of Physics 125 discussion for Professor R. Akhoury. Also provided primary support setting up and maintaining the CTools website for the course. Ratings for excellence as a teacher: discussion section 003: 5.00/5.00; discussion section 004: 4.89/5.00; discussion section 005: 4.96/5.00; discussion section 009: 4.88/5.00; discussion section 010: 4.93/5.00; discussion section 012: 4.97/5.00. Also audited Physics 106 in preparation for teaching and revising the course during the winter 2009 semester.

Spring Semester 2008, the University of Michigan: One section of Physics 127 lab. Rating for excellence as a teacher: 4.33/5.00.

Winter Semester 2008, the University of Michigan: Course leader for Physics 125 (Introductory Mechanics, Waves and Sound). Two lectures and three discussion sections taught twice weekly. Responsible for all course administration, internet-based course resources and oversight of three discussion instructors. Ratings for excellence as a teacher: lecture section 001: 4.48/5.00; lecture section 002: 4.65/5.00; discussion 006: 4.76/5.00; discussion section 007: 4.90/5.00; discussion section 008: 4.79/5.00.

Fall Semester 2007, the University of Michigan: Course leader for Physics 125 (Introductory Mechanics, Waves and Sound). Two lectures and three discussion sections taught twice weekly. Responsible for all course administration, internet-based course resources and oversight of three discussion instructors. Ratings for excellence as a teacher: lecture section 001: 4.65/5.00; lecture section 002: 4.59/5.00; discussion section 006: 4.74/5.00; discussion section 007: 4.87/5.00; discussion section 008: 4.66/5.00.

Spring Semester 2007, the University of Michigan: Three sections of Physics 241 Lab (Introductory Electricity and Magnetism). Ratings for excellence as a teacher: section 101: 4.25/5.00; section 102: 4.50/5.00; section 103: 4.32/5.00.

Winter Semester 2007, the University of Michigan: Course leader for Physics 125 (Introductory Mechanics, Waves and Sound). Two lectures and three discussion sections taught twice weekly. Responsible for all course administration, internet-based course resources and oversight of three discussion instructors. Overall average rating for excellence as a teacher: Lecture: 4.62/5.00 for two sections totaling approximately 400 students. Discussion: 4.76/5.00 averaged over three discussion sections of approximately 35 students.

Fall Semester 2006, the University of Michigan: Six discussion sections for Physics 125 (Introductory Mechanics, Waves and Sound) for Sa-Lin Bernstein. Overall average rating for excellence as a teacher: 4.70/5.00 averaged over six sections of approximately 35 students each.

Spring Semester 2006, the University of Michigan: Three sections of Physics 241 Lab (Introductory Electricity and Magnetism). Overall average rating for excellence as a teacher: 4.36/5.00 averaged over three sections of 20 students each.

Winter Semester 2006, the University of Michigan: Five Discussion Sections for Physics 240 (Introductory Electricity and Magnetism) for Professor Dave Gidley and one Section of Physics 241 Laboratory (Introductory Electricity and Magnetism) for Professor Dave Gerdes. Overall average rating for excellence as a teacher: Discussion: 4.88/5.00 averaged over five sections of approximately 35 students. Lab: 4.80/5.00 for one section.

Fall Semester 2005, the University of Michigan: Six Discussion Sections for Physics 240 (Introductory Electricity and Magnetism) for Professor Tim McKay. Overall average rating from student evaluations for excellence as a teacher: 4.72/5.00 averaged over six sections of approximately 30 students each.

Fall Semester 2001, the University of Michigan: Three Discussion Sections for Physics 140 (Introductory Mechanics) under the direction of Professor Jim Allen. Overall average rating from student evaluations for excellence as a teacher: 4.29/5.00 averaged over three sections of approximately 30 students each.

Summer 2004, the University of Michigan: supervised REU student Ken Beyerlein, who designed and constructed a special dark enclosure for the SNAP quantum efficiency (QE) apparatus as well as researching the performance of available monochromator systems for possible use in the SNAP QE system.

Winter semester 2005, the University of Michigan: mentored Darshan Karwat, a second-year engineering student, in mechanical design/drawing using Autocad to develop a prototype SNAP NIR filter mount, in collaboration with B. Bigelow.

### **Special Training**

1988-Present: Trained in the safe handling and usage of check sources and survey meters by the University of Michigan Radiation Safety Service (RSS). Procedures reviewed annually.

2003: Trained in the safe operation of overhead cranes.

February 2005: Trained in the safe handling and storage of compressed gases and cryogenics.

June 2005: Excel I, training seminar at the University of Michigan IT Education Services Facility, room 2078 CSSB.

June 2005: Effective Web Design I, training seminar at the University of Michigan IT Education Services Facility, room 2078 CSSB.

June 2005: Getting Started in Web Publishing at Michigan, training seminar at the University of Michigan IT Education Services Facility, room 2078 CSSB.

June 2005: Excel II, training seminar at the University of Michigan IT Education Services Facility, room 2078 CSSB.

June 2005: Word I, training seminar at the University of Michigan IT Education Services Facility, room 2078 CSSB.

July 2005: Dream Weaver I, training seminar at the University of Michigan IT Education Services Facility, room 2078 CSSB.

July 2005: Word II, training seminar at the University of Michigan IT Education Services Facility, room 2078 CSSB.

### **University Service**

Winter Semester 2007: Service on the Center for Research on Teaching and Learning (CRLT) review panel for Lecturer's Professional Development fund grants.

### **Departmental Service**

2003: Joined the Physics Olympiad committee and developed the highly successful "Hot Air Balloon" event, where high school students construct hot air balloons from paper and compete to

see which team can loft the greatest mass of sand to a minimum altitude in five minutes. The event was successfully run as part of the 2003, 2004 and 2005 Physics Olympiad hosted by the Department of Physics. Constructed all necessary equipment and procured all necessary supplies for the event. Developed test questions for the quiz portion of the event.

Provided all necessary training for the student assistants running the event. Personally ran the 2005 event. Eleven teams successfully competed in the event, which ran on time and without problems. <http://phys-advlab.physics.lsa.umich.edu/Olympiads/Hot%20Air%20Balloons.htm>

August 2005: Submitted a new Physics Olympiad event, the “Delta Dart Dash” to the Physics Olympiad Committee for possible inclusion in the 2006 Physics Olympiad. The event requires the students to construct two simple rubber-powered model airplanes and keep one airplane in flight continuously for the greatest possible fraction of the allotted flight window.

September 2005-Present: Assisting Professor Dave Gerdes in the redevelopment and refurbishment of the Physics 241/128 (introductory Electricity and Magnetism) lab course experiments. I have developed a prototype experiment for the measurement of dielectric constants using a parallel plate capacitor and an apparatus to demonstrate the energy stored in a capacitor by doing mechanical work with a servo motor and gearbox. I have also developed a simple Oersted apparatus and an apparatus to demonstrate the magnetic force on a current carrying wire. To date five new experiments have been successfully introduced into the course using apparatus I have developed. I have overseen the construction of these experiments by undergraduates. Current development work is for a new Faraday’s Law experiment, a Snell’s Law/Brewster angle experiment and an electrostatic force balance.

January 16, 2006: Presented a lecture demonstration exhibition and physics quiz for students of the International Academy High School.

May 2006: Successfully ran the “Delta Dart Dash” event for the University of Michigan physics department Physics Olympiad.

Fall Semester 2006: Physics Help Room Coordinator, University of Michigan department of physics. Initiated a project to use voluntary anonymous attendance information from students and instructors to better match staffing levels to student demand.

May 2007: Successfully ran the “Hot Air Balloon” event for the University of Michigan physics department Physics Olympiad.

Winter Semester 2007: Member Physics Introductory Course Committee.

Fall Semester 2007: Member Physics Introductory Course Committee.

Fall Semester 2007: Physics Help Room Coordinator, University of Michigan department of physics.

2007-Present: Member of the local organizing committee for the 2009 American Association of Physics Teachers (AAPT) summer meeting to be held in Ann Arbor in July of 2009.

May 2008: Successfully ran the “Glider Shootout” event for the University of Michigan physics department Physics Olympiad.

December 2008: Developed a new event “The ROG Ramble” for the May 2009 University of Michigan physics department Physics Olympiad.

December 2008: Built fourteen new jet-propelled wooden cars for the new “Newton’s Laws of Motion” experiment for Physics 106. This experiment was successfully introduced during the winter 2008 semester.

2008: Member of the local organizing committee for the 2009 American Association of Physics Teachers (AAPT) summer meeting to be held in Ann Arbor in July of 2009.

Fall Semester 2008: Physics Help Room Coordinator, University of Michigan department of physics.

2007-Present: Development of physics-themed window displays to generate interest in physics among the general public. Displays are currently on view in the outside windows of the undergraduate laboratory suite. A new large-large screen monitor has been installed and I continue solicit and update content for presentation on this new display.

### **Public Outreach**

“Tracking Down Antimatter at 120,000 Feet: Particle Astrophysics Aboard High Altitude Balloons”, a public lecture presented to the Rotary Club of Livonia Michigan, August 18, 1997.

Summer 2002: Assisted Professor Tarlé in teaching a summer course for elementary school students entitled “The Physics of Flight” at the Emerson School. The students studied a variety of aerodynamic principles and phenomena by building hot-air balloons, model rockets, and rubber-powered model airplane. Took major responsibility for overseeing the model airplane segment, including the choice of model, construction supervision, and flight adjustment. Developed a fin jig in collaboration with Professor Tarlé to aid the students in the construction of their model rockets. Published the jig design in *Sport Rocketry*, the official publication of the National Association of Rocketry (September/October 2003).

Summer 2003: Again assisted Professor Tarlé with the Emerson School “Physics of Flight” class. Developed an entirely new student project, consisting of simple altimeter constructed from a plastic pill bottle and a rubber membrane. Developed a custom model rocket to carry the altimeter project. Optimized the rocket design to limit the performance to that which could readily be flown in the limited space of the school yard available. Developed a special u-tube manometer for the calibration of the altimeter units. Produced custom kits for the altimeter units and the payload rocket. Supervised the students in the altimeter assembly and rocket flights. Each student was able to fly their rocket and produce a measurement of the altitude attained. The success rate was above 90%.

2003-Present: Active in organizing and running the annual Physics Olympiad for the University of Michigan physics department and FOCUS. New events under development for balloon-launched gliders and wire-guided rocket-powered vehicles.

October 2006: “Higher, Faster, Longer: From the Physics of Model Rockets to Rocket Science”, Saturday Morning Physics lecture series, University of Michigan Physics Department.

March 2006: Interviewed for a segment on the ratemyprofessors.com “Professors Strike Back” video web page.

### **Community Service**

March 5, 2005: Assisted in a special “build and take” program for the Knights of Truth Lutheran youth organization of the Holy Cross Lutheran Church of Livonia Michigan. For this program, children and their fathers built simple model airplanes in a single afternoon and then flew them in the church recreation room. Provided materials, tools, and supervision during the building session. Gave a special lecture and flight demonstration for the participants. Assisted each father-child team with the proper flight adjustment of their finished model. Success rate was 100%. Every model flew successfully.

May 21, 2005: Ran a special “build and take” program for the Oakland County Parks Department, as part of their “Lyon Oaks Appreciation Day”. For this program, children and an adult guardian (parent, grandparent) built simple model airplanes and then flew them in the park. Each child received individual personal instruction regarding both the construction and flight adjustment of their models. Each child was provided with additional supporting materials, including a fact sheet describing where additional suitable model kits and supplies could be obtained, as well as a sheet of model building tips, additional rubber motors, and clay for adjusting their models. Provided materials, tools, and supervision during the building session. Wrote and provided the fact sheets. Donated model kits, and supplies. Eight children participated, and all successfully flew their models. Coverage of this event will be broadcast in an upcoming segment of “Get Up Get Out”, a special children’s activity program produced by Detroit Public Broadcasting station WTVS. <http://www.GetUpGetOut.org>

December 2004--2006: Mentorship in the “Wright Stuff” Science Olympiad event for students from the Brighton School District by serving as an advisor to them and their team mentor.