

# Michael Andrew DuVernois

School of Physics and Astronomy  
116 Church St. SE  
University of Minnesota—Twin Cities  
Minneapolis, MN 55455

Phone: (612) 624-6844  
Fax: (612) 624-4578  
E-Mail: [duvernoi@physics.umn.edu](mailto:duvernoi@physics.umn.edu)  
URL: <http://www.physics.umn.edu/~duvernoi/>

## RESEARCH EXPERIENCE

- 2000-  
current     **Assistant Professor**  
School of Physics and Astronomy, University of Minnesota, Minneapolis, MN  
Research Focus: Experimental particle astrophysics
- Pierre Auger Observatory for the highest energy cosmic rays
  - *HEAT*, *HEAT-pbar*, & *CREAM* cosmic-ray balloon payloads
  - Cosmic rays with the MINOS far detector
  - *ACCESS*, *ANITA*, and *EPLUS* experiment design studies
  - Detector and detector electronics research
- 1996-  
2000     **Research Associate** (Prior to 9/99: Postdoctoral Research Fellow), Advisor: James J. Beatty  
Department of Physics, The Pennsylvania State University, University Park, PA
- *HEAT*, *HEAT-pbar*, & *CREAM* cosmic-ray balloon payloads
  - Pierre Auger Observatory for the highest energy cosmic rays
- 1991-  
1996     **Graduate Research Assistant**, Advisor: John A. Simpson  
 Enrico Fermi Institute, The University of Chicago, Chicago, IL  
Thesis: *On the Galactic cosmic ray manganese*
- *Ulysses*, *CRRES*, *IMP-8*, *EHIC*, and *Pioneer 10* high-energy particle telescopes
  - Cosmic-ray propagation, elemental and isotopic composition, and solar modulation
- 1988-  
1991     **Research Assistant**  
Department of Physics, The Georgia Institute of Technology, Atlanta, GA
- Semiclassical chaos, Thesis: *Semiclassical diamagnetic coulomb problem* (T. Uzer)
  - Computational nonlinear optics of statistically rough surfaces (K. O'Donnell)
  - Theory of nuclear velocity-dependent psuedo-potentials (H. Valk)

## TEACHING EXPERIENCE

### University of Minnesota

- Physics 1001W, Energy and the Environment
- Honors physics discussion sections

### Penn State University

- Physics of Music—designed and taught a demonstration- and project-based curriculum

### University of Chicago

- Teaching assistant for Introductory Physics, “Physics for Poets,” and Quantum Mechanics
- Organized a new set of “standard problems” for the introductory physics sequence

### Copernican Space Science Center, Planetarium and Observatory, New Britain, CT

- Researched, wrote, and delivered public multimedia planetarium productions

## **EDUCATION**

**Ph.D.** Physics: University of Chicago, August 1996

**M.S.** Physics: University of Chicago, March 1995

**B.S.** Physics, with Highest Honors: Georgia Institute of Technology, June 1991

## **PRINCIPAL RESEARCH INTERESTS**

- Astroparticle physics: cosmic ray abundances, antimatter, highest energy events, & neutrinos
- Particle physics detectors: water Cherenkov, thin calorimetry, transition radiation, & electronics
- Space physics: cosmic rays in the heliosphere, solar modulation, & geomagnetic effects
- Astrophysics: charged particle acceleration, Galactic magnetic fields, & Galactic nucleosynthesis

## **OTHER RESEARCH INTERESTS**

- Advanced technologies for the detection of landmines in support of humanitarian demining
- Architectural & musical acoustics

## **TEACHING INTERESTS**

- Introductory physics taught in the instructional laboratory setting
- Nuclear and particle astrophysics: nucleosynthesis and Galactic chemical evolution
- Advanced experimental laboratory course: graduate and undergraduate
- Acoustics for both physics and music students

## **AFFILIATIONS**

American Physical Society, Sigma Xi, American Astronomical Society, Institute of Navigation

## RESEARCH FOCUS

### Cosmic rays, particle astrophysics, non-accelerator particle physics, neutrino astrophysics

- Pierre Auger Observatory examining the highest energy cosmic rays: Participated in the design study, electronics planning and prototyping, and physics simulations of the ground array, especially for the Gamma-Ray Burst & neutrino triggers. Involved with the construction of the engineering prototype detectors and installation in the field. Subtask leader for surface electronics installation, field-deployment, and environmental testing.
- Cosmic ray physics with the MINOS detector systems: Co-coordinator of cosmic-ray analysis for the MINOS project.
- *HEAT* balloon magnet spectrometer project studying antimatter in the cosmic rays: Worked on data analysis for 1994 & 1995 electron & positron, atmospheric secondaries (electrons, muons, and neutrinos), and heavy nuclei studies and electronics, detector design, construction, and testing and data analysis for the 1999 & 2000 antiproton flights.
- *CREAM* Ultra-Long Duration Balloon (ULDB) cosmic ray calorimeter: Designing and building hardware and software data acquisition systems.
- Cosmic ray theory: Continued studies of the Galactic propagation of radioactive isotopes, electrons, and antiprotons in the cosmic rays under realistic physics models of the interstellar medium.
- Detector experience includes: scintillation time-of-flight systems, magnet spectrometers using drift-tube hodoscopes, energy-loss detectors using both silicon and wire chambers, high-voltage control systems, sampling hadronic and electromagnetic calorimetry, transition radiation detectors, water Cherenkov detectors, RF Cherenkov, and atmospheric fluorescence

## PUBLICATION LIST

### REFERRED JOURNAL ARTICLES (\*\*\*) UNIVERSITY OF MINNESOTA)

- 1 "Semiclassical treatment of avoided crossings in the quadratic Zeeman spectrum of hydrogen," M. A. DuVernois, J. L. Boorstein, and T. Uzer. *Phys. Rev. A*, **47**, 53 (1992)
- 2 "The elemental composition of the Galactic cosmic ray source: Ulysses high-energy telescope results," M. A. DuVernois and M. R. Thayer. *Ap.J.*, **465**, 982 (1996)
- 3 "Galactic cosmic ray C, N, O, Ne, Mg, and Si isotopes from the CRRES ONR-604 experiment," M. A. DuVernois, M. García-Muñoz, J. A. Simpson, and M. R. Thayer. *Ap.J.*, **466**, 457 (1996)
- 4 "Cosmic ray measurement of the  $^{54}\text{Mn}$   $\beta^-$  partial half-life," M. A. DuVernois. *Phys. Rev. C.*, **54**, R2134 (1996)
- 5 "Secondary/primary ratios of Galactic cosmic ray elements: A self-consistent propagation scheme for Ulysses HET data," M. A. DuVernois, J. A. Simpson, and M. R. Thayer. *Astro. & Astrophys.*, **316**, 555 (1996)
- 6 "Galactic cosmic ray manganese: Ulysses HET results," M. A. DuVernois. *Ap.J.*, **481**, 241 (1997)
- 7 "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. J. Chaput, S. Coutu, G. A. de Nolfo, M. A. DuVernois, D. Ellithorpe, 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 (HEAT Collaboration). *Ap.J.*, **498**, 779 (1998)
- 8 "Cosmic ray reentrant electron albedo: High-Energy Antimatter Telescope balloon measurements from Fort Sumner, New Mexico," S. W. Barwick et al. (HEAT Collaboration). *J.G.R.*, **103**, No. A3, 4817 (1998)
- 9 "The cosmic-ray radioactive nuclide  $^{36}\text{Cl}$  Galactic and its propagation in the Galaxy," J. J. Connell, M. A. DuVernois, and J. A. Simpson. *Ap.J.L.*, **509**, L97 (1998)
- 10 "A water tank Cherenkov detector for very high-energy astroparticles," P. Bauleo et al. (Pierre Auger Collaboration). *Nucl. Inst. Methods A*, **406**, 69 (1998)
- 11 "The Pierre Auger Cosmic Ray Observatory," C. O. Escobar (Auger Collaboration), *Rad. Phys. & Chem.*, **51**, 705 (1998)
- 12 "Cosmic-ray positrons: Are there primary sources?" S. Coutu et al. (HEAT Collaboration). *Astropart. Phys.* **11**, 429 (1999)
- 13 "Atmospheric muons," S. Coutu et al. (HEAT Collaboration). *Phys. Rev. D*, **62**, 032001 (2000)
- 14 "LPM effect and pair production in the geomagnetic field: A signature of ultra high energy photons in the Pierre Auger Observatory," X. Bertou et al. (Auger Collaboration). *Astropart. Phys.*, **14**, 121 (2000)

\*\*\*

- 15 “Cosmic-Ray Electrons and Positrons from 1 to 100 GeV: Measurements with HEAT and Their Interpretation,” M. A. DuVernois et al. (HEAT Collaboration). *Ap.J.*, **559**, 296 (2001)
- 16 “Measurement of the Cosmic-Ray Antiproton-to-Proton Abundance Ratio between 4 and 50 GeV,” A. S. Beach et al. (HEAT Collaboration), *Phys. Rev. Letters*, **87**, 271101 (2001)
- 17 “MINOS Detectors for Neutrino Interactions,” K. Lang et al. (MINOS Collaboration). *Nucl. Inst. Methods A*, **461**, 290 (2001)
- 18 “The Fluorescence Detector Prototype for the Auger Project: Optical System,” G. Borreani et al. (Auger Collaboration). *Nucl. Inst. Methods A*, **461**, 577 (2001)
- 19 “Remote Particle Density Calibration of a Water Cherenkov Detector Using Crossing-through Muons,” P. Bauleo et al. (Auger Collaboration). *Nucl. Inst. Methods A*, **463**, 175 (2001)
- 20 “Second-level Trigger in the Pierre Auger Fluorescence Detector,” Z. Szadkowski (Auger Collaboration). *Nucl. Inst. Methods A*, **465**, 540 (2001)
- 21 “A Thinning Method Using Weight Limitation for Air-Shower Simulations,” M. Kobal (Auger Collaboration). *Astropart. Phys.*, **15**, 259 (2001)
- 22 “CREAM balloon experiment,” E. S. Seo et al. (CREAM Collaboration). *Adv. Sp. Res.*, In Press (2002)
- 23 “Evidence for a feature in the cosmic-ray positron fraction,” A. S. Beach et al. (HEAT Collaboration). *Phys. Rev. Letters*, In submission (2002)
- 24 “Proton and helium cosmic-ray spectra from the HEAT experiment,” M. A. DuVernois et al. (HEAT Collaboration). *Ap.J. Letters*, In submission (2002)
- 25 “Site Survey and Sites for the Pierre Auger Observatory,” I. Allekotte et al. (Auger Collaboration). *J. Phys. G*, In submission (2002)

## BOOKS

*Topics in cosmic-ray astrophysics*, ed. M. A. DuVernois. Nova Science Press (Volume 230: Horizons in World Physics). New York (1999) ISBN 1-56072-658-X

*Energy and the Environment*, ed. M. A. DuVernois. Wiley Publishing (2002)

## REVIEW PAPERS (\* REFERRED, \*\*\* UNIVERSITY OF MINNESOTA)

- 1\* “Cosmic ray radioactive isotope tracers of Galactic propagation,” M. A. DuVernois. *New Vistas in Astrophysics*, 11th Course of the Cosmic Ray Summer School, Ed. M. Shapiro and J. Wefel, p. 255 (1998)
- 2 “Measuring the Highest Energy Cosmic Rays: The Auger Project,” J. Matthews (Auger Collaboration). *Towards the Millennium in Astrophysics*, Ed. M. Shapiro, R. Silberberg, and J. Wefel, p. 49 (1998)

- 3 “Understanding elemental and isotopic anomalies in the Galactic cosmic ray source,” M. A. DuVernois in *Topics in Cosmic-ray Astrophysics*, ed. M. A. DuVernois, Nova Science Press, New York (1999)
- 4 “Cosmic ray annotated bibliography,” M. A. DuVernois in *Topics in Cosmic-ray Astrophysics*, ed. M. A. DuVernois, Nova Science Press, New York (1999)
- 5 “Cosmic ray radioactive isotopes and cosmic ray nucleosynthesis,” M. A. DuVernois, in *Final Report of the Workshop on Gamma Ray Line Astronomy*, ed. R. Diehl, Max Planck Institute, Garching, Germany, MPE, **274**, 31 (1999)
- \*\*\*
- 6\* “Cosmic-ray source abundances and nucleosynthesis,” M. A. DuVernois, *The Radioactive Galaxy: Third Workshop on Gamma Ray Line Astronomy*, ed. R. Diehl, Special issue of *New Astronomy Reviews* (2001)

**CONFERENCE PROCEEDINGS (PAPERS ONLY, NO ABSTRACTS, \*\*\* UNIVERSITY OF MINNESOTA)**

- 1 “The isotopic composition of Ne, Mg, and Si cosmic rays from the ONR-604 experiment on the CRRES mission,” M. A. DuVernois, M. García-Muñoz, K. R. Pyle, and J. A. Simpson. *23<sup>rd</sup> International Cosmic Ray Conference Proceedings* (Calgary), **1**, 563 (1993)
- 2 “Ulysses high energy telescope elemental measurements: Secondary to primary ratios of Galactic cosmic rays,” M. A. DuVernois, J. A. Simpson, and M. R. Thayer. *24th International Cosmic Ray Conference Proceedings* (Rome), **2**, 589 (1995)
- 3 “Galactic cosmic ray source elemental composition,” M. A. DuVernois. In *Cosmic Abundances*, S. Holt and G. Sonneborn, Eds., *Astronomical Society of the Pacific Conference Proceedings*, **99**, 385 (1996)
- 4 “Radioactive isotopes in the cosmic rays,” M. A. DuVernois. *Nucl. Phys. (4th Annual Nuclei in the Cosmos Conference Supplement)*, **A621**, 52c (1997)
- 5 “The extremely high energy cosmic rays and the Auger Observatory project,” M. Boratov. (Auger Collaboration). *Nucl. Phys. (Proceedings supplement)*, **B48**, 488 (1996)
- 6 “The Pierre Auger Project,” P. M. Mantsch (Auger Collaboration). *Proc. of the Intl. Symp. on Extremely High Energy Cosmic Rays: Astrophysics and Future Observatories*, Tokyo, 213 (1997)
- 7 “Simulations of the proposed Auger water Cerenkov ground array,” C. Pryke (Auger Collaboration). *Proc. of the Intl. Symp. on Extremely High Energy Cosmic Rays: Astrophysics and Future Observatories*, Tokyo, 286 (1997)
- 8 “The Pierre Auger Project hybrid concept,” B. R. Dawson (Auger Collaboration). *Proc. 32<sup>nd</sup> Recontres de Moriond*, Les Arcs, France, 235 (1997)
- 9 “Highest energy cosmic rays and the Auger Project,” P. Sommers (Auger Collaboration). *Proc. 9<sup>th</sup> Jorge Andre Swieza Summer School*, Capos de Jardo, Brazil, (1997)
- 10 “The Pierre Auger Observatory,” C. Hojvat (Auger Collaboration). *Proc. 32<sup>nd</sup> Recontres de Moriond*, Les Arcs, France, (1997)

- 11 “Understanding elemental and isotopic abundance anomalies in the Galactic cosmic rays,” M. A. DuVernois. *25th International Cosmic Ray Conference Proceedings* (Durban), **4**, 361 (1997)
- 12 “Comparison of computational techniques for low-energy cosmic ray transport,” M. A. DuVernois. *25th International Cosmic Ray Conference Proceedings*, **4**, 297 (1997)
- 13 “The cosmic ray  $^{36}\text{Cl}$  chronometer : Ulysses HET results,” M. A. DuVernois, J. J. Connell, and J. A. Simpson. *25th International Cosmic Ray Conference Proceedings*, **3**, 397 (1997)
- 14 “Cosmic-ray positrons: Are there primary sources?” S. Coutu et al. (HEAT Collaboration). *25th International Cosmic Ray Conference Proceedings*, **4**, 213 (1997)
- 15 “Energy spectra of electrons and positrons from 1 to 100 GeV,” D. Müller et al. (HEAT Collaboration). *25th International Cosmic Ray Conference Proceedings*, **4**, 237 (1997)
- 16 “Secondary and reentrant albedo electrons in the atmosphere,” G. A. de Nolfo et al. (HEAT Collaboration). *25th International Cosmic Ray Conference Proceedings*, **2**, 373 (1997)
- 17 “The Pierre Auger Observatory Project: An overview,” M. Boratov (Auger Collaboration). *25th International Cosmic Ray Conference Proceedings*, **5**, 205 (1997)
- 18 “Simulated performance of the Auger Observatory water Cherenkov arrays,” C. L. Pryke (Auger Collaboration). *25th International Cosmic Ray Conference Proceedings*, **5**, 209 (1997)
- 19 “Simulated performance of the Auger Observatory hybrid detectors,” B. R. Dawson and C. L. Pryke (Auger Collaboration). *25th International Cosmic Ray Conference Proceedings*, **5**, 213 (1997)
- 20 “Shower characteristics of the Auger prototype water Cherenkov detector observed at Akeno Giant Air Shower Array (AGASA),” N. Sakaki, T. Kutter, C. Pryke, and N. Nagano (Auger Collaboration). *25th International Cosmic Ray Conference Proceedings*, **5**, 217 (1997)
- 21 “Development of water Cherenkov detectors at Fermilab for the Pierre Auger Project,” P. O. Mazur et al. (Auger Collaboration). *25th International Cosmic Ray Conference Proceedings*, **5**, 225 (1997)
- 22 “Triggering and data acquisition systems for the Auger Observatory,” D. Nitz (Auger Collaboration). *25th International Cosmic Ray Conference Proceedings*, **5**, 293 (1997)
- 23 “Proposed fluorescence detectors for the Auger Observatory,” B. R. Dawson, P. E. Fick, K.-H. Kampert, and P. Sommers (Auger Collaboration). *25th International Cosmic Ray Conference Proceedings*, **5**, 377 (1997)
- 24 “Auger: What, why, and how?” C. L. Pryke (Auger Collaboration). *Workshop on observing the highest energy particles ( $>10^{20}$  eV) from space*, College Park, Maryland (1997)
- 25 “The Pierre Auger Observatory,” C. Hojvat (Auger Collaboration). *Very High Energy Phenomena in the Universe*, Editions Frontieres, Ed. Y. Giraud-Heraud and J. Tran Thanh Van, p. 223 (1997)
- 26 “The Pierre Auger Observatory Hybrid Concept,” B. Dawson (Auger Collaboration). *Very High Energy Phenomena in the Universe*, Editions Frontieres, Ed. Y. Giraud-Heraud and J. Tran Thanh Van, p. 235 (1997)

- 27 “Energy spectra of air shower muons as a function of atmospheric depth,” S. Coutu et al. (HEAT Collaboration). *29<sup>th</sup> International Conference on High Energy Physics (IHEPC 98) Proceedings*, **1**, 666 (1998)
- 28 “The HEAT magnet spectrometer: Design and performance,” S. Coutu et al. (HEAT Collaboration). *Proceedings of the workshop on Balloon-borne and Space-based Calorimetry*, Texas Tech, Lubbock (1998)
- 29 “The Pierre Auger Project: An observatory for measuring extremely high-energy cosmic rays,” D. Zavrtanik (Auger Collaboration). *2<sup>nd</sup> Latin American Sym. on High Energy Phys.*, San Juan, Puerto Rico, *AIP Conf. Proc.* **444**, 95 (1998)
- 30 “Extremely high-energy cosmic rays and the Auger observatory,” M. Boratav (Auger Collaboration). *IEEE Trans. Nucl. Sci.*, **45(3)** (1998)
- 31 “Triggering and data acquisition systems for the Auger Observatory,” D. Nitz (Auger Collaboration). *IEEE Trans. Nucl. Sci.*, **45**, 1824 (1998)
- 32 “An overview of the Pierre Auger Project,” D. Nitz (Auger Collaboration). *19<sup>th</sup> Texas Symposium on Relativistic Astrophysics and Cosmology*, ed. J. Paul, T. Montmerle, and E. Aubourg, Paris (1998)
- 33 “The Pierre Auger Observatory,” C. Hojvat, *Astrophysics from Antarctica*, ed. R. Landsberg and G. Novak, ASP Conf. Series, **141**, 344 (1998)
- 34 “The Highest Energy Cosmic Rays and the Auger Project,” A. A. Watson (Auger Collaboration). *Nucl. Phys. B (Proc. Suppl.)*, **60(3)**, 171 (1998)
- 35 “The Auger Project and the detection of UHECRs,” C. K. Guerard (Auger Collaboration). *Frontier Objects in Astrophysics and Particle Physics*, *Nucl. Phys. B (Proc. Suppl.)*, **75**, 380 (1999)
- 36 “Neutrino capabilities of the Pierre Auger Observatory,” S. Coutu et al. (Auger Collaboration). *23<sup>rd</sup> Johns Hopkins Workshop on Current Problems in Particle Theory-Neutrinos in the Next Millennium*, Baltimore (1999)
- 37 “Thinning of high-energy cosmic-ray showers,” M. Kobal et al. (Auger Collaboration). *8<sup>th</sup> International Conference on Calorimetry in High-Energy physics (CALOR 99)*, Lisbon (1999)
- 38 “Neutrino capabilities of the Auger detector,” P. Billoir (Auger Collaboration). *Venice Neutrino Workshop Proceedings* (1999)
- 39 “The HEAT-pbar cosmic ray experiment,” C. R. Bower et al. (HEAT Collaboration). *26<sup>th</sup> International Cosmic Ray Conference Proceedings* (Salt Lake City), **5**, 13 (1999)
- 40 “Particle identification with the HEAT wire chamber stacks,” A. Labrador et al. (HEAT Collaboration). *26<sup>th</sup> International Cosmic Ray Conference Proceedings*, **3**, 97 (1999)
- 41 “Electron and positron spectra from the HEAT magnet spectrometer,” M. A. DuVernois et al. (HEAT Collaboration). *26<sup>th</sup> International Cosmic Ray Conference Proceedings*, **3**, 49 (1999)

- 42 “Atmospheric muon spectra from the HEAT magnet spectrometer,” S. Coutu et al. (HEAT Collaboration). *26<sup>th</sup> International Cosmic Ray Conference Proceedings*, **2**, 68 (1999)
- 43 “Cosmic Ray Energetics and Mass (CREAM): A detector for cosmic rays near the knee,” J. J. Beatty et al. (CREAM Collaboration). *26<sup>th</sup> International Cosmic Ray Conference Proceedings*, **5**, 61 (1999)
- 44 “An ULDB mission to study high energy cosmic rays,” E. S. Seo et al. (CREAM Collaboration). *26<sup>th</sup> International Cosmic Ray Conference Proceedings*, **3**, 207 (1999)
- 45 “The Auger fluorescence detector prototype telescope,” H. Bluemer et al. (Auger Collaboration). *26<sup>th</sup> International Cosmic Ray Conference Proceedings*, **5**, 345 (1999)
- 46 “Auger front-end ASIC simulations,” R. Meyhandan et al. (Auger Collaboration). *26<sup>th</sup> International Cosmic Ray Conference Proceedings*, **5**, 340 (1999)
- 47 “Thinning of high-energy cosmic-ray air-showers,” M. Kobal et al. (Auger Collaboration). *26<sup>th</sup> International Cosmic Ray Conference Proceedings*, **1**, 490 (1999)
- 48 “Calibration of WCDs (Water Cerenkov Detectors) for the Auger Observatory,” J. C. D’Olivo et al. (Auger Collaboration). *26<sup>th</sup> International Cosmic Ray Conference Proceedings*, **2**, 36 (1999)
- 49 “A new Ronchi tester to the mirrors of the fluorescence detector of the Pierre Auger Observatory (PAO),” J. M. Nunez-Alfonso et al. (Auger Collaboration). *26<sup>th</sup> International Cosmic Ray Conference Proceedings*, **5**, 425 (1999)
- 50 “Recent results on the operation of a Cherenkov detector prototype for the Pierre Auger Observatory,” M. Alarcon et al. (Auger Collaboration). *Part. and Fields, 8<sup>th</sup> Mexican School*, AIP Conference Series, **490**, 313 (1999)
- 51 “Simulations of the surface detector of the Pierre Auger Observatory—Calibration and monitoring,” M. Medina et al. (Auger Collaboration). *Part. and Fields, 8<sup>th</sup> Mexican School*, AIP Conference Series, **490**, 388 (1999)
- 52 “Optical alignment of segmented mirrors to the fluorescence detectors of the Pierre Auger Observatory (PAO),” A. Cordero-Davila et al. (Auger Collaboration). *26<sup>th</sup> International Cosmic Ray Conference Proceedings*, **5**, 437 (1999)
- 53 “The Pierre Auger Observatory,” A. Zepeda (Auger Collaboration). *Proc. VII Mexican Workshop on Part. and Fields*, AIP Conference Series, **531**, 280 (2000)
- 54 “Neutrinos and the Pierre Auger Experiment,” H. Wilczynski (Auger Collaboration). *Proc. Cracow Epiphany Conf. on Neutrinos in Physics and Astrophysics, Acta Physica Polonica B*, **31**, 1403 (2000)
- 55 “Cosmic-Ray Energetics and Mass (CREAM) balloon experiment,” E. S. Seo et al. (CREAM Collaboration). *COSPAR-2000* (2000)
- \*\*\*
- 56 “The Pierre Auger Observatory,” D. Zavrtanik (Auger Collaboration). *Nucl. Phys. B (Proc. Suppl.)*, **85**, 324 (2000)

- 57 “Scientific solutions to humanitarian demining,” M. A. DuVernois, *New Ethical Challenges in Science and Technology*, Sigma Xi Conference Proceeding (2000)
- 58 “Cosmic-ray electrons,” D. Mueller (HEAT Collaboration). *Bern Cosmic Ray Symposium*, ISSI Conference Proceedings (2001)
- 59 “Atmospheric secondary cosmic rays,” M. A. DuVernois (HEAT Collaboration), *VIIIth Joint International Symposium on Atmospheric & Ocean Optics: Atmospheric Physics*, SPIE Conference Proceedings (2001)
- 59 “Cosmic Ray Energetics and Mass (CREAM): Study of backscatter effect,” Y. J. Han et al. (CREAM Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 2150 (2001)
- 60 “Cosmic Ray Energetics and Mass: Expected performance,” H. S. Ahn et al. (CREAM Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 2159 (2001)
- 61 “Cosmic Ray Energetics and Mass: Configuration and progress on construction and testing,” O. Ganel et al. (CREAM Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 2163 (2001)
- 62 “Cosmic Ray Energetics and Mass (CREAM): Study of backscatter effect,” Y. J. Han et al. (CREAM Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 2150 (2001)
- 63 “Cosmic-ray air-shower timing experiment: A small prototype ‘Linsley-effect’ detector,” M. A. DuVernois. *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 877 (2001)
- 64 “Splash and reentrant albedo observations of electrons and positrons at a 4.2 GV vertical magnetic cutoff,” M. A. DuVernois et al. (HEAT Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 4003 (2001)
- 65 “Absolute rigidity spectra of protons and helium nuclei from 16 to 250 GV,” M. A. DuVernois et al. (HEAT Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 1618 (2001)
- 66 “Positron measurements with the HEAT-pbar instrument,” S. Coutu et al. (HEAT Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 1687 (2001)
- 67 “Detection of cosmic-ray antiprotons with the HEAT-pbar instrument,” S. Nutter et al. (HEAT Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 1691 (2001)
- 68 “The cosmic-ray antiproton to proton ratio from 4.5 to 50 GV,” J. Musser et al. (HEAT Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 1684 (2001)
- 69 “Education and public outreach for the Pierre Auger Observatory,” G. Snow (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 726 (2001)
- 70 “A PLD implementation of the Pierre Auger Observatory first level trigger,” Z. Szadkowski et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 781 (2001)
- 71 “Surface detector calibration for the Auger Observatory,” H. Salazar et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 752 (2001)

- 72 “Layout of the Pierre Auger Observatory,” A. Etchegoyen (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 703 (2001)
- 73 “Implementation of the first level trigger for the Auger Observatory surface array,” D. Nitz (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 773 (2001)
- 74 “Neutrino sensitivity and background rejection of the Auger Observatory,” A. Letessier-Selvon et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 722 (2001)
- 75 “Atmospheric monitoring for the Auger Fluorescence Detector,” J. A. J. Matthews et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 745 (2001)
- 76 “Optical components for the fluorescence detectors of the Pierre Auger experiment,” H. Klages et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 764 (2001)
- 77 “The aperture, sensitivity, and precision of the Auger fluorescence detector,” R. Cester (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 711 (2001)
- 78 “Status of the Auger engineering array,” I. Allekotte et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 730 (2001)
- 79 “Neutrinos at the Auger detector,” A. Letessier-Selvon et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 1204 (2001)
- 80 “Optics and mechanics of the Auger fluorescence detector,” G. Matthiae (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 733 (2001)
- 81 “Surface detector construction and installation at the Auger Observatory,” C. Escobar et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 749 (2001)
- 82 “Auger front-end ASIC simulations,” R. Meyhandan et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 777 (2001)
- 83 “Hybrid aperture and precision of the Auger observatory,” B. Dawson et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 714 (2001)
- 84 “Pierre Auger atmospheric monitoring LIDAR system,” A. Filipcic et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 784 (2001)
- 85 “The Auger fluorescence detector electronics,” H. Gemmeke (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 737 (2001)
- 86 “Communications in the Auger Observatory,” P. D. J. Clark et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 765 (2001)
- 87 “Survey of the Pierre Auger Observatory,” M. Dova (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 699 (2001)
- 88 “The aperture and precision of the Auger surface array,” M. Ave et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 707 (2001)

- 89 “Calibration of the Auger fluorescence telescopes,” H. Klages (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 741 (2001)
- 90 “Surface detector electronics for the Pierre Auger Observatory,” T. Suomijarvi (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 756 (2001)
- 91 “First measurements with the Auger fluorescence detector data acquisition system,” H. Gemmeke et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 769 (2001)
- 92 “Photon/hadron separation with the Auger Observatory,” P. Billoir et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 718 (2001)
- 93 “Performance of optical pass-band interference filter for the Auger fluorescence detectors,” E. Fokitis et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 667 (2001)
- 94 “Simulation of the atmospheric fluorescence from EAS for calculation of the photoelectrons at the PMT photocathode of FD,” A. Geranios et al. (Auger Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 671 (2001)
- 95 “Present status of the MINOS experiment,” K. Ruddick (MINOS Collaboration). *Proc. 27<sup>th</sup> Intl. Cosmic Ray Conf.*, 1259 (2001)
- 96 “The puzzle of ultra-high energy cosmic rays and the Pierre Auger Project,” F. Montanet (Auger Collaboration), *Proc. 8<sup>th</sup> Intl. Symp. On Particles, Strings, and Cosmology, PASCOS-2001* (2001)
- 97 “Pierre Auger Observatory: Status and prospects,” M. Boratov (Auger Collaboration), *Proc. Intl. Work. Extremely High Energy Cosmic Rays—Experiments, Theory, and Future Directions, ICRR* (2001)
- 98 “The Pierre Auger Observatory: Status Report,” B. Revenu (Auger Collaboration), *Semaine de l’Astrophysique Francaise*, Ed. Societe Francaise d’Astronomie et d’Astrophysique, **SF2A-2001**, 140 (2001)
- 99 “Highest energy cosmic rays and the Auger Observatory,” A. Letessier-Selvon (Auger Collaboration). *7<sup>th</sup> Taipei Astrophys. Work. On Cosmic Rays in the Universe*, ASP Conference Proc., **241**, 27 (2001)
- 100 “Status of the MINOS experiment,” S. Wojcicki (MINOS Collaboration). *Nucl. Phys. B (Proc. Suppl.)*, **91**, 216 (2001)
- 101 “MINOS: The Main Injector Neutrino Oscillation Search,” A. Weber (MINOS Collaboration). *Nucl. Phys. B (Proc. Suppl.)*, **98**, 57 (2001)
- 102 “Status of the MINOS Experiment,” V. Paolone (MINOS Collaboration). *Nucl. Phys. B (Proc. Suppl.)*, **100**, 197 (2001)
- 103 “MINOS far detector: Construction & QA testing,” L. Mualem et al. (MINOS Collaboration). *CALOR-2002 Proc.* (2002)
- 104 CREAM CALOR-2002

**OTHER PAPERS AND REPORTS (\*\*\*) UNIVERSITY OF MINNESOTA)**

- 1 "EHIC (NOAO-13) high energy telescope calibration and Monte Carlo energy loss analysis," M. A. DuVernois and E. Murphy, University of Chicago, LASR technical report (1994)
- 2 "Energy loss mechanisms, algorithms, and tables, for electrons in solid-state particle detectors," M. A. DuVernois, University of Chicago, LASR technical report (1995)
- 3 "Range and stopping of electrons and ions in matter," M. A. DuVernois, University of Chicago, LASR technical report (1995)
- 4 "On the Galactic cosmic ray manganese," M. A. DuVernois. Ph.D. Thesis, The University of Chicago, Enrico Fermi Institute Publication #96-027 (1996)
- 5 "Pierre Auger Observatory design report, 2nd edition," Auger Collaboration. Fermi National Accelerator Laboratory Technical Report (1996, with updates 1997)
- 6 "Some issues for salt in water Cherenkov tanks," M. A. DuVernois. Giant Airshower Project (Auger Observatory) Technical Notes, GAP 97-051 (1997)
- 7 "Photomultiplier tube and photodiode options for the surface detectors," M. A. DuVernois and A. S. Beach. Giant Airshower Project (Auger Observatory) Technical Notes, GAP 97-066 (1997)
- 8 "Gamma-ray burst detection with the surface array," M. A. DuVernois and J. J. Beatty. Giant Airshower Project (Auger Observatory) Technical Notes, GAP 97-068 (1997)
- 9 "Notes on global navigation satellite service (GNSS) for the Auger Observatory," M. A. DuVernois. Giant Airshower Project (Auger Observatory) Technical Notes, GAP-98-007 (1998)
- 10 "Digital Elevation Maps of the Southern Site," M. A. DuVernois, Giant Airshower Project (Auger Observatory) Technical Notes, GAP-98-024 (1998)
- 11 "Solution to the Certicom ECCp-97 (Elliptic Curve Cryptosystem) Problem," R. Harley et al. (ECCp-97 Collaboration). British Telecom Technical Computer Security Memorandum (1998)
- 12 "Solution to the Certicom ECC2k-95 (Elliptic Curve Cryptosystem) Problem," R. Harley et al. (ECC2k-95 Collaboration). British Telecom Technical Computer Security Memorandum (1998)
- 13 "An ACCESS data management facility hardware and software plan," M. A. DuVernois and S. Coutu. Penn State Particle Astrophysics technical note (1999)
- 14 "CREAM prototype tubes and paddles: Test results," S. Nutter and M. A. DuVernois. Penn State Particle Astrophysics technical note (1999)
- 15 "Solution to the Certicom ECC2-97 (Elliptic Curve Cryptosystem) Problem," R. Harley et al. (ECC2-97 Collaboration). INRIA, French National Institute for Research in Computer Science, technical note (1999)

- 16 “International GRB coordination with the Auger Observatory,” M. A. DuVernois. Giant Airshower Project (Auger Observatory) Technical Notes, GAP-2000-014 (2000) and update GAP-2001-008 (2001)
- 17 “Global navigation satellite service update,” M. A. DuVernois. Giant Airshower Project (Auger Observatory) Technical Notes, GAP-2000-015 (2000) and update GAP-2001-009 (2001)
- 18 “Ultralong duration ballooning (ULDB) flight computing,” M. A. DuVernois. Penn State Particle Astrophysics technical note (2000)
- 19 “Humanitarian demining—Science, politics, economics, and people,” M. A. DuVernois, *Penn State Alumni Magazine* (2000)
- 20 “CREAM flight computing design and status,” M. A. DuVernois and S. Coutu. Penn State Particle Astrophysics technical note (2000)
- \*\*\*
- 21 “PC/104 Ultra-Long Duration Ballooning (ULDB) computer system,” M. A. DuVernois. University of Minnesota technical note (2001)
- 22 “CREAM computing Interface Control Document (ICD),” M. A. DuVernois, University of Minnesota & NASA-WFF technical note (2001)
- 23 “Pierre Auger Observatory: Technical Design Report (TDR),” Auger Collaboration, Fermi National Accelerator Technical Report (2001)
- 24 “CREAM data formats and commanding ICD,” M. A. DuVernois, University of Minnesota & NASA-WFF technical note (2001)
- 25 “Southern site magnetic field survey,” M. A. DuVernois, Giant Airshower Project (Auger Observatory) Technical Notes, GAP-2001-010 (2001)
- 26 “Southern site RF background survey and implications for radio detectors,” M. A. DuVernois, Giant Airshower Project (Auger Observatory) Technical Notes, GAP-2001-011 (2001)
- 27 “Animal visitation frequency at EA surface detectors, or, how soon will that cable get munched?” M. A. DuVernois, Giant Airshower Project (Auger Observatory) Technical Notes, GAP-2001-013 (2001)
- 28 “Surface detector temperature profiles in summer,” M. A. DuVernois, Giant Airshower Project (Auger Observatory) Technical Notes, GAP-2001-014 (2001)
- 29 “Critical Design Review (CDR) findings for the Pierre Auger Observatory surface detector systems,” J. Cronin, M. A. DuVernois, B. Fick, and R. Stanek, Fermilab CDR SDE technical note (2001)
- 30 “Critical Design Review (CDR) findings for the Pierre Auger Observatory site preparation and deployment task,” J. J. Beatty, M. A. DuVernois, B. Fick, H. Kages, and A. Watson, Fermilab CDR Deploy/Install technical note (2001)
- 31 “CREAM data Interface Control Document (ICD),” M. A. DuVernois, University of Minnesota & NASA-WFF technical note (2001)

- 32 “Auger off-road guide,” M. A. DuVernois and M. L. Johnson, Giant Airshower Project (Auger Observatory) Technical Notes, GAP-2002-015 (2002)
- 33 “Pierre Auger Observatory in action,” P. Mantsch (Auger Collaboration). *CERN Courier*, **42**, 11 (2002)
- 34 “Pierre Auger Observatory PMT handling guidelines,” M. A. DuVernois, Giant Airshower Project (Auger Observatory) Technical Notes, GAP-2002-014 (2002)

**CONFERENCE, WORKSHOP, AND COLLOQUIUM TALKS (\* INVITED CONFERENCE TALKS, \*\*\* UNIVERSITY OF MINNESOTA)**

- 1 “Numerical treatment of light scattering from statistically random gratings,” American Physical Society, Southeast Section Meeting, 1990
- 2 “Isotopic composition of the Ne, Mg, and Si cosmic rays from the ONR-604 experiment on the CRRES mission,” 23rd International Cosmic Ray Conference, 1993
- 3 “Ulysses high energy telescope elemental measurements: secondary to primary ratios of galactic cosmic rays,” 24th International Cosmic Ray Conference, 1995
- 4 “Galactic cosmic ray source elemental composition,” October Astrophysics Conference in Maryland, “Cosmic Abundances,” 1995
- 5-7 “Galactic cosmic ray manganese,” “Elemental abundance anomalies in the cosmic rays,” and “A cosmic ray measurement of the  $\beta$ - partial half-life of  $^{54}\text{Mn}$ ,” American Physical Society, April Meeting, 1996
- 7 “Cosmic ray radioactive isotope measurements,” Workshop on Galactic Gamma-ray Line Astronomy, Clemson University, 1996
- 8 “Low energy cosmic ray measurements from the Ulysses HET,” Penn State University, High-Energy Physics Colloquium, 1996
- 9 “Low energy cosmic ray measurements from the Ulysses HET,” University of Utah, Physics Colloquium, 1996
- 10 “Cosmic ray radioisotope studies,” University of Iowa, Physics Colloquium, 1996
- 11 “Radioactive isotopes in the cosmic rays,” 4th International Nuclei in the Cosmos Meeting, 1996
- 12 “Low-energy cosmic ray isotope and element measurements,” University of Michigan, High-Energy Physics Colloquium, 1996
- 13-15 “Understanding elemental and isotopic abundance anomalies in the galactic cosmic rays,” “Comparison of computational techniques for low-energy cosmic ray transport,” and “The cosmic ray  $^{36}\text{Cl}$  chronometer: Ulysses HET results,” 25th International Cosmic Ray Conference, 1997
- 16 “Solar power requirements for cosmic ray magnet spectrometer payloads,” NASA Ultra-long Duration Ballooning Panel, 1997

- 17 "Electron and positron spectra from 1-100 GeV: HEAT balloon measurements," American Physical Society, April Meeting, 1998
- 18\* "Galactic cosmic ray radioactive isotopes," 11th Course of *New Vistas in Astrophysics*, Erice, Italy, 1998
- 19 "Cosmic ray antimatter," Penn State University, High-Energy Physics Colloquium, 1998
- 20-21 "Cosmic ray antimatter: The complete adventures of HEAT, the High Energy Antimatter Telescope" and "The Pierre Auger Project and the highest energy cosmic rays," Notre Dame University, Colloquium and Astrophysics Seminar, 1999
- 22 "Unconventional sources of cosmic-ray positrons," American Physical Society, Centennial Meeting, 1999
- 23 "Electron and positron spectra from 1-100 GeV: HEAT magnet spectrometer measurements," 26th International Cosmic Ray Conference, 1999
- 24 "Cosmic ray antimatter: The HEAT experiment, scientific ballooning, WIMPs, and you," Case Western Reserve University, Colloquium, 1999
- 25\* "Cosmic-ray radionuclei," Radioactives in the Galaxy II (Workshop of Gamma-ray Line Astronomy in the Galaxy), Ringberg Castle (Max Planck), Tegernsee, Germany, 1999
- 26 "The cosmic rays: 10 decades in time, 15 decades in energy, and 32 decades in abundance," University of Minnesota, Astrophysics Seminar, 2000
- 27 "Cosmic rays: History, spectra, and abundance," University of Alabama at Tuscaloosa, Colloquium, 2000
- 28 "Cosmic-ray proton and helium spectra," American Physical Society, April Meeting, 2000
- 29 "Cosmic-ray astrophysics," Penn State University Astronomy Department Open House, 2000
- \*\*\*
- 30 "50 Joules: The highest energy cosmic rays and the Pierre Auger Observatory," University of Minnesota, School of Physics and Astronomy Colloquium, 2000
- 31 "Cosmic-ray abundances and the particle-astrophysics/space-physics connection," University of Minnesota Space Physics Seminar, 2000
- 32 "50 Joules: The highest energy cosmic rays and the Pierre Auger Observatory," University of Connecticut Physics Colloquium, 2000
- 33 "Cosmic ray physics: Balloons and the Auger Observatory," Minnesota Astronomical Society public lecture, 2000
- 34 "Pierre Auger Observatory and the highest energy cosmic rays," Georgia Institute of Technology Physics Colloquium, 2000

- 35\* “Cosmic ray source abundances and Wolf-Rayet & supernovae production,” Radioactives in the Galaxy III (Workshop of Gamma-ray Line Astronomy in the Galaxy), Ringberg Castle (Max Planck), Tegernsee, Germany, 2001
- 36 “Pierre Auger Observatory and the highest energy cosmic rays,” University of Oregon Physics Colloquium, 2001
- 37\* “Acoustic detection of the cosmic radiation,” 2<sup>nd</sup> Annual Sound & Vibration Conference West, Los Angeles, CA, 2001
- 38 “Cosmic-ray astrophysics,” Northwestern University, Department of Physics Seminar, 2001
- 39-41 “Cosmic-ray air-shower timing experiment: Prototype ‘Linsley-effect’ detector,” “Splash and reentrant electron albedo at 4.2 GV vertical geomagnetic cutoff,” and “Absolute proton and helium nuclear spectra from 16 to 250 GV,” 27<sup>th</sup> International Cosmic Ray Conference, 2001
- 42 “Pierre Auger Observatory and the highest energy cosmic rays,” University of Minnesota—Duluth Physics Colloquium, 2002
- 43 “Pierre Auger Observatory—First events,” Fermi National Accelerator Lab Seminar, 2002
- 44\* “Research papers in the large physics lecture course,” Teaching Across the Physical Sciences, University of Chicago, 2002
- 45 “Pierre Auger Observatory and the highest energy cosmic rays,” University of Illinois at Chicago Physics Colloquium, 2002
- 46-47 “Hybrid fluorescence and surface detector data in the Pierre Auger Observatory,” and “A novel timing detector for cosmic-ray air-shower studies,” SPIE—Astronomical Detectors & Techniques, Hawaii, 2002

## **Research Activities since 1 July 1999 (Most important first)**

### **Pierre Auger Observatory**

The engineering array (prototype detectors) for the southern hemisphere portion of the Pierre Auger Observatory is under construction. I have been active in the field testing and installing electronics, performing RFI/EMI measurements, and performing environmental tests of detector subsystems. The Central Data Acquisition System (CDAS) and high-level software triggers are the main design areas for my work at the moment. At Minnesota we are running detector and air shower simulations, and operating a test facility for Auger production electronics and detector components. Data analysis of the first events as well as gamma-ray burst triggers and neutrino triggers are being performed at Minnesota. I am leading the electronics installation and environmental testing program for the experiment.

### **MINOS**

I have been selected as the co-coordinator for the science analysis of cosmic-ray events in the MINOS far detector. This is one of two analysis programs which will take advantage of the detector which will be available far in advance of the Fermilab beam availability. The detector has one unique feature of large underground calorimeters, and that is a magnetic field. This field will allow for novel measurements of the muon charge ratio for air-showers near the knee of the cosmic-ray spectrum.

### **CREAM**

At Minnesota, I have become a subcontractor for Penn State's contribution to this balloon experiment designed to measure the chemical composition of the cosmic rays up to 10s of TeV (far above previous direct measurements). The Minnesota responsibilities include the flight computer and data acquisition hardware and software systems, the ground support computer, and flight field operations. Construction is underway and a beam calibration of the detector system was conducted at CERN during August and September of 2001. Further calibrations will be performed with a proton beam (June 2002) and heavy ion beam (September 2002) at CERN.

### **HEAT-pbar/HEAT**

The antiproton version of the HEAT magnet spectrometer was designed and built in part by myself while I was at Penn State. The experiment was flown from Fort Sumner, NM in May of 1999 and again in May of 2000. A third flight is scheduled for the Spring of 2002. I have led the data analysis effort on the atmospheric secondary particles and the second (confirming) pass on the antiproton data. An upgrade of the time-of-flight system was designed at Minnesota and was installed in June of 2001. Field operations, power systems, cryogenics, and the time-of-flight are principal Minnesota hardware responsibilities. I have also been involved with data analysis for the electron and positron flights of the HEAT magnet spectrometer. This work is largely finished with the submissions of papers on the electron & positron spectra, atmospheric muons & the atmospheric neutrino anomaly, air-shower magnetospheric albedo particles, and interpretation of results. A final paper on the proton & helium spectra was submitted early in 2002.

### **Detector research**

A new detector concept for observing extensive air showers using only a small number of small detectors combined with fast timing electronics is being tested. A paper was presented on this approach at the International Cosmic Ray Conference (August 2001) and another will be presented at the SPIE Astronomical Telescopes meeting in August 2002.

### **Theory**

Ongoing work on the theory of cosmic-ray acceleration and nucleosynthesis was summarized in an invited talk in Germany (May 2001) and in a paper to be submitted (2002). Other work is being conducted on simulations of the highest energy cosmic rays and the propagation of antiprotons and electrons in the Galaxy.

## Most significant papers (chronological order, \*\*\* University of Minnesota)

- “The elemental composition of the Galactic cosmic ray source: Ulysses high-energy telescope results,” M. A. DuVernois and M. R. Thayer. *Ap.J.*, **465**, 982 (1996)

This work represents the current, state-of-the-art, in measurements of the chemical composition of the cosmic-ray source. It utilizes a relatively simple propagation scheme to convert high-precision measurements of the cosmic rays within the heliosphere into derived source abundances at the cosmic-ray source. Such source determinations then allow for a comparison of the cosmic-ray composition with the solar system, various meteoritic, and derived nucleosynthetic source abundance patterns. This work has strongly reinforced the view that the cosmic-ray source elemental composition must be understood in terms of chemical fractionation during acceleration and has strengthened new models (of Ellison, for example) of cosmic-ray acceleration from dust grains as well as the interstellar medium.

- “Galactic cosmic ray manganese: *Ulysses* HET results,” M. A. DuVernois. *Ap.J.*, **481**, 241 (1997)  
One of the two papers derived directly from my Ph.D. thesis, this work details the observations and interpretation of the three isotopes of manganese observed in the cosmic rays. Stable  $^{55}\text{Mn}$  compared to iron provides a simple, but not unique, determination of the amount of matter traversed by the GeV cosmic rays. Electron-capture  $^{53}\text{Mn}$  allows for a measurement of the time between cosmic-ray nucleosynthesis and acceleration (although the data here is insufficient to go beyond just placing a limit), and on the degree to which cosmic rays undergo stochastic acceleration during propagation.  $^{54}\text{Mn}$  is the truly interesting case—this isotope decays in the lab via electron capture, but in the fully-stripped cosmic rays undergoes beta decay at an unmeasured rate. This beta-decay allows for a chronometer measurement to be made—how long have the iron-group cosmic rays been propagating through the Galaxy and through what average density? This work also stimulated fundamental nuclear physics measurements of the laboratory beta decay of  $^{54}\text{Mn}$ .

- “Cosmic-ray positrons: Are there primary sources?” S. Coutu et al. (HEAT Collaboration). *Astropart. Phys.* **11**, 429 (1999)

Using data from the 1994 and 1995 HEAT balloon flights, a slight excess of positrons above basic Leaky Box propagation predictions is noted. This excess is interesting as it is a possible signature of primary positrons emitted by an unknown source. Among the models predicting primary positrons near 7-10 GeV are several models of WIMP annihilation in the Galactic halo. Additional measurements with a new experiment are underway to verify or refute this preliminary finding.

- “Atmospheric muons,” S. Coutu et al. (HEAT Collaboration). *Phys. Rev. D*, **62**, 032001 (2000)

Air showers in the atmosphere initiated by high-energy cosmic rays generate neutrinos as well as charged particles. These neutrinos are the basis of the “atmospheric neutrino anomaly” which has suggested mass-mixing of neutrino flavors and therefore neutrino oscillations. A direct test of the models used for atmospheric production of neutrinos is possible by examining the muons as a function of atmospheric depth using the accent data from the HEAT magnet spectrometer as the muons are produced in numbers proportional to the atmospheric neutrinos. HEAT results indicate that some of the modeling work (e.g., TARGET simulations of Gaisser & Stanev) agree quite well with observations and imply the continued existence of the atmospheric neutrino anomaly.

\*\*\*

- “Cosmic ray electron and positron spectra from 1 to 100,” M. A. DuVernois et al. (HEAT Collaboration). *Ap.J.*, **559**, 296. (2001)

This work is the central science of the HEAT experiment and is an important, high-resolution, measurement of the cosmic-ray lepton component. The electrons and positrons, due to their rapid energy-loss mechanisms, sample an entirely different regime than the hadrons during their Galactic propagation. This work has shown that a unified model of hadronic and leptonic propagation in the Galaxy can fit the observed data. It also rules out most of the “exotic” models of primary positrons in the Galaxy other than the models mentioned above (*Astropart. Phys.* **11**, 429).

## Pierre Auger Observatory Collaboration

December 2001

Spokesman Emeritus: James W. Cronin (Chicago)

Spokesman: Alan A. Watson (Leeds)

Co-Spokesman: Hans Bluemer (Karlsruhe)

Collaboration Board Chairlady: Teresa Dova (La Plata)

Collaboration Board Co-Chairman: Paul Sommers (Utah)

Collaboration members:

**Argentina:** Ernesto Altmann, P. Alvarez, Pablo Bauleo, C. Bonifazi, Alberto Etchegoyen, R. Eusebi, Norberto Fazzini, Armando Ferrero, Alberto Filevich, A. Reguera, Analia Cillis, Maria Teresa Dova, Luis N. Epele, Christian Grunfeld, Monica Manceñido, Analisa Mariazzi, Norberto Martinez, Esteban Roulet, Sergio J. Sciutto, Alejandro Veiga. Ingomar Allekotte, Gualberto Avila, Luis Masperi, Milva Orsaria, Adrian Rovero; **Australia:** Roger W. Clay, Bruce R. Dawson, Martin Debes, Russell Pace, Greg J. Thornton; **France:** Claude Boutonnet, Jean-Michel Brunet, Jean-Noël Capdevielle, Stéphane Colonges, Fabrice Cohen, Bernard Courty, Laurent Guglielmi, Jean-Jacques Jaeger, Benoît Revenu, Gérard Tristram, Jack Waisbard, Xavier Bertou, Pierre Billoir, Murat Boratav, Alain Castera, Pierre Da Silva, Sylvie Dagoret-Campagne, Olivier Deligny, Cyril Lachaud, Antoine Letessier-Selvon, Denis Allard, Alexandre Creusot, Bernard Genolini, Françoise Lefebvre, Isabelle Lhenry-Yvon, Thi Nguyen Trung, Etienne Parizot, Joël Pouthas, Tiina Suomijärvi, Jean-Noël Albert, Rene Bilhaut, Alain Cordier, Estelle Cormier, Paul Eschstruth, Oleg Lodygensky, Nathalie Playez, Jacques Rypko, Marcel Urban, François Meyer, Emmanuel Tisserand, Philip Tuckey, François Vernotte, Alain Vincent, Michel Vincent; **Germany:** Hans Bluemer, Erhard Bollmann, Thomas Csabo, Achim Grindler, Rainer Gumbsheimer, Dieter Heck, Helmut Hucker, Bianca Keilhauer, Heiko Kern, Hans-Otto Klages, Jonny Kleinfeller, Hermann-Josef Mathes, Peter Matussek, Ingrid Michel-Piper, Markus Risse, Gerd Schleif, Thomas Thouw, Mathias Balzer, Rudolf Berg, Dietmar Bormann, Hartmut Gemmeke, Helmut Giraud, Mathias Kleifges, Andreas Kopmann, Norbert Kunka, Alexandre Menchikov, Bernd Osswald, Uwe Rimmel, Denis Tscherniakhovski, Norbert Barenthien, Carlos Guérard, Karl-Heinz Kampert, Bianca Keilhauer, S. Ostapchenko, Lorenzo Perrone; **Italy:** Carla Aramo, Roberto Fonte, Antonio Insolia, D.Nicotra, Guido Raia, Daniel V. Camin, M. Lapolla, V. Grassi, V.Scherini, Paolo Cattaneo, Pier Francesco Manfredi, Lodovico Ratti, Pedro Facal San Luis, E.Kemp, Giorgio Matthiae, Paolo Privitera, Gaetano Salina, S.Argiró, Giovanni Borreani, N.Cartiglia, Rosanna Cester, A.De Capoa, M.Leigui de Oliveira, F.Marchetto, D.Maurizio, Miguel Mostafa, Ezio Menichetti, Nadia Pastrone, Marco Aglietta, Mario Bertaina, Antonella Castellina, Andrea Chiavassa, Walter Fulgione, Piera Luisa Ghia, Carlo Morello, Gianni Navarra, Carlo Vigorito; **Poland:** Dariusz Gora, Piotr Homola, Marek Kutschera, Jan Pekala, Barbara Wilczynska, Henryk Wilczynski, Wlodzimierz Bednarek, Maria Giller, Jerzy L. Kacperski, Zbigniew Szadkowski, Wieslaw Tkaczyk; **Slovenia:** Andrej Filipcic, Matej Horvat, Darko Veberic, Danilo Zavrtnik, Marko Zavrtnik; **United Kingdom:** Maximo Ave, Paul Clark, Johannes Knapp, Jeremy Lloyd-Evans, Mansukh Patel, Vance Tunnicliffe, Peter Walker, Alan Watson; **United States:** Katsushi Arisaka, Chris Jillings, William Slater, Arun Tripathi, Jeffrey Brack, Uriel Nauenberg, Robert Ristinen, John Harton, James Sites, David Warner, Robert Wilson, James W. Cronin, Brian Fick, Mike Albrow, Richard Andrews, Eileen Berman, Dean Hoffer, Hank Glass, Carlos Hojvat, Paul Mantsch, Peter Mazur, Hal Spinka, Lou Voyvodic, Alexandra Goodwin, James M. Matthews, Megan McEwen, Roger McNeil, Rishi Meyhandan, Troy Porter, Joe Darling, A.Dorofeev, Bob Nemiroff, David Nitz, Bruce Rafert, Steve Ruotsala, Zbigniew Szadkowski, M.Trombley, Byron Dieterle, John Matthews, Steve Riley, Michael Roberts, Patrick Allison, Sanjeevi Atulugama, James Beatty, Stephane Coutu, Michael DuVernois, Stéphanie Jaminion, Chihwa Song, George Cassiday, Paul Sommers, Daniel Claes, Gregory R. Snow, Luis Anchordoqui, Marie Machacek, Thomas McCauley, Thomas Paul, John Swain, Lucas Taylor.

**The MINOS Collaboration**  
**Main Injector Neutrino Oscillation Search**  
 December 2001

P. Adamson<sup>16</sup>, K.V. Alexandrov<sup>14</sup>, T. Alexopoulos<sup>32</sup>, G.J. Alner<sup>24</sup>, B. Anderson<sup>16</sup>, K. Anderson<sup>7</sup>,  
 C. Andreopoulos<sup>2</sup>, D. Attree<sup>16</sup>, F. Avignone<sup>25</sup>, S. Avvakumov<sup>26</sup>, D.S. Ayres<sup>1</sup>, B. Baller<sup>7</sup>,  
 B. Barish<sup>4</sup>, M. Barker<sup>21</sup>, P.D. Barnes Jr.<sup>15</sup>, G. Barr<sup>21</sup>, W.L. Barrett<sup>1,31</sup>, E. Beall<sup>18</sup>, B. Becker<sup>18</sup>,  
 A. Belias<sup>24</sup>, T.J. Bergfeld<sup>25</sup>, R. H. Bernstein<sup>7</sup>, G.J. Bock<sup>7</sup>, D.J. Boehnlein<sup>7</sup>, D. Bogert<sup>7</sup>,  
 P.M. Border<sup>18</sup>, C. Bower<sup>11</sup>, E. Buckley-Geer<sup>7</sup>, A. Byon-Wagner<sup>7</sup>, T.R. Chase<sup>18</sup>, S. Chernichenko<sup>23</sup>,  
 S. Childress<sup>7</sup>, B.C. Choudhary<sup>4</sup>, J.H. Cobb<sup>21</sup>, J.D. Cossairt<sup>7</sup>, H. Courant<sup>18</sup>, G. Crone<sup>16</sup>,  
 A. Dabrowski<sup>20</sup>, D. DeMuth<sup>18</sup>, A. De Santo<sup>21</sup>, M.V. Diwan<sup>3</sup>, G. Drake<sup>1</sup>, R. Ducar<sup>7</sup>, T. Durkin<sup>24</sup>,  
 M. DuVernois<sup>18</sup>, R. Edgecock<sup>24</sup>, A. Erwin<sup>32</sup>, E. Falk Harris<sup>27</sup>, G.J. Feldman<sup>8</sup>, T.H. Fields<sup>1</sup>,  
 H.R. Gallagher<sup>30</sup>, Yu. Gilitsky<sup>23</sup>, N. Giokaris<sup>2</sup>, A. Godley<sup>25</sup>, J. Gogos<sup>18</sup>, M.C. Goodman<sup>1</sup>,  
 N. Grossman<sup>7</sup>, J.J. Grudzinski<sup>1</sup>, V.J. Guarino<sup>1</sup>, Yu. Gutnikov<sup>23</sup>, A. Habig<sup>19</sup>, D. Harris<sup>7</sup>,  
 P.G. Harris<sup>27</sup>, J. Hartnell<sup>24</sup>, E.P. Hartouni<sup>15</sup>, R. Hatcher<sup>7</sup>, S. Hayden<sup>18</sup>, R. Heinz<sup>11</sup>, K. Heller<sup>18</sup>,  
 C. Howcroft<sup>5</sup>, T. Hu<sup>9</sup>, J. Hylen<sup>7</sup>, G. Irwin<sup>26</sup>, C. James<sup>7</sup>, L. Jenner<sup>16</sup>, D. Jensen<sup>7</sup>, T. Joffe-Minor<sup>1</sup>,  
 T. Kafka<sup>30</sup>, S.M.S. Kasahara<sup>18</sup>, J. Kilmer<sup>7</sup>, V. Kochetkov<sup>12</sup>, G. Koizumi<sup>7</sup>, S. Kopp<sup>29</sup>,  
 M. Kordosky<sup>29</sup>, M. Kostin<sup>29</sup>, D. Krakauer<sup>1</sup>, Y.F. Lai<sup>9</sup>, K. Lang<sup>29</sup>, C. Laughton<sup>7</sup>, A. Lebedev<sup>8</sup>,  
 R. Lee<sup>8</sup>, P.J. Litchfield<sup>24</sup>, J. Liu<sup>29</sup>, N.P. Longley<sup>17</sup>, P. Lucas<sup>7</sup>, S. Madani<sup>24</sup>, E. Maher<sup>18</sup>,  
 V. Makeev<sup>7</sup>, W.A. Mann<sup>30</sup>, A. Marchionni<sup>7</sup>, M.L. Marshak<sup>18</sup>, J. McDonald<sup>22</sup>, J.R. Meier<sup>18</sup>,  
 E. Melnikov<sup>23</sup>, G.I. Merzon<sup>14</sup>, M.D. Messier<sup>8</sup>, D.G. Michael<sup>4</sup>, R.H. Milburn<sup>30</sup>, L. Miller<sup>13</sup>,  
 W.H. Miller<sup>18</sup>, S.R. Mishra<sup>25</sup>, P.S. Miyagawa<sup>21</sup>, J. Morfin<sup>7</sup>, R. Morse<sup>27</sup>, L. Muallem<sup>18</sup>, S. Mufson<sup>11</sup>,  
 J. Musser<sup>11</sup>, D. Naples<sup>22</sup>, C. Nelson<sup>7</sup>, J.K. Nelson<sup>7,18</sup>, H. Newman<sup>4</sup>, F. Nezirick<sup>7</sup>, R.J. Nichol<sup>16</sup>,  
 T.C. Nicholls<sup>24</sup>, W. Oliver<sup>30</sup>, V. Onuchin<sup>23</sup>, V. Paolone<sup>22</sup>, A. Para<sup>7</sup>, T. Patzak<sup>6</sup>, G.F. Pearce<sup>24</sup>,  
 N. Pearson<sup>18</sup>, C.W. Peck<sup>4</sup>, C. Perry<sup>21</sup>, E.A. Peterson<sup>18</sup>, D.A. Petyt<sup>24</sup>, A. Pla-Dalmau<sup>7</sup>,  
 R.K. Plunkett<sup>7</sup>, M. Proga<sup>29</sup>, D.R. Pushka<sup>7</sup>, D. Rahman<sup>18</sup>, R.A. Rameika<sup>7</sup>, A.L. Read<sup>7</sup>, B. Rebel<sup>11</sup>,  
 D.E. Reyna<sup>1</sup>, C. Rosenfeld<sup>25</sup>, K. Ruddick<sup>18</sup>, V.A. Ryabov<sup>14</sup>, R. Saakyan<sup>16</sup>, M. Sanchez<sup>30</sup>,  
 N. Saoulidou<sup>2</sup>, J. Schneps<sup>30</sup>, P.V. Schoessow<sup>1</sup>, V. Semenov<sup>23</sup>, S.-M. Seun<sup>8</sup>, P. Shanahan<sup>7</sup>,  
 I. Shein<sup>23</sup>, W. Smart<sup>7</sup>, V. Smirnitsky<sup>12</sup>, C. Smith<sup>16</sup>, P.N. Smith<sup>27</sup>, A. Soldatov<sup>23</sup>, A. Sousa<sup>30</sup>,  
 B. Speakman<sup>18</sup>, N.I. Starkov<sup>14</sup>, P. Sullivan<sup>21</sup>, M. Szeleper<sup>20</sup>, N. Tagg<sup>21</sup>, R.L. Talaga<sup>1</sup>, X.J. Tang<sup>22</sup>,  
 E. Tetteh-Lartey<sup>28</sup>, J. Thomas<sup>16</sup>, M.A. Thomson<sup>5</sup>, J.L. Thron<sup>1</sup>, N. Tobien<sup>7</sup>, D.N. Tovee<sup>16</sup>,  
 R. Trendler<sup>7</sup>, J. Trevor<sup>4</sup>, I. Trostin<sup>12</sup>, V.A. Tsarev<sup>14</sup>, G. Tzanakos<sup>2</sup>, G. Unel<sup>20</sup>, J. Urheim<sup>18</sup>,  
 A. Usachev<sup>23</sup>, T. Vahle<sup>29</sup>, K. Vaziri<sup>7</sup>, M.M. Velasco<sup>20</sup>, C. Velissaris<sup>32</sup>, V. Verebrysov<sup>12</sup>, B. Viren<sup>3</sup>,  
 L. Wai<sup>26</sup>, C.P. Ward<sup>5</sup>, D.R. Ward<sup>5</sup>, A. Weber<sup>21</sup>, R.C. Webb<sup>28</sup>, A. Wehmann<sup>7</sup>, N. West<sup>21</sup>,  
 C. White<sup>10</sup>, R.F. White<sup>27</sup>, R. Wildberger<sup>18</sup>, S.G. Wojcicki<sup>29†</sup>, D.M. Wright<sup>15</sup>, X.M. Xia<sup>9</sup>,  
 W.G. Yan<sup>9</sup> and R. Zwaska<sup>29</sup>.

† Spokesman

Argonne<sup>1</sup> - Athens<sup>2</sup> - Brookhaven<sup>3</sup> - Caltech<sup>4</sup> - Cambridge<sup>5</sup> - Collège de France<sup>6</sup> -  
 Fermilab<sup>7</sup> - Harvard<sup>8</sup> - IHEP-Beijing<sup>9</sup> - IIT<sup>10</sup> - Indiana<sup>11</sup> - ITEP-Moscow<sup>12</sup> -  
 James Madison<sup>13</sup> - Lebedev<sup>14</sup> - Livermore<sup>15</sup> - UCL-London<sup>16</sup> - Macalester<sup>17</sup> -  
 Minnesota<sup>18</sup> - Minnesota-Duluth<sup>19</sup> - Northwestern<sup>20</sup> - Oxford<sup>21</sup> - Pittsburgh<sup>22</sup> -  
 Protvino<sup>23</sup> - Rutherford<sup>24</sup> - South Carolina<sup>25</sup> - Stanford<sup>26</sup> - Sussex<sup>27</sup> -  
 Texas A&M<sup>28</sup> - Texas-Austin<sup>29</sup> - Tufts<sup>30</sup> - Western Washington<sup>31</sup> - Wisconsin<sup>32</sup>