

# Lucy Frear Fortson

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## Education:

- 1984 B.A. Physics and Astronomy Smith College, Northampton, MA  
1991 Ph.D. Physics University of California, Los Angeles, CA

## Appointments (*Academic*):

- July 2014 - present** Associate Head of School, School of Physics and Astronomy, University of Minnesota  
**July 2017 - present** Full Professor of Physics, University of Minnesota  
**July 2010 - June 2017** Associate Professor of Physics, University of Minnesota  
**Oct 2004 - June 2010** Vice President for Research, Adler Planetarium  
**Dec 2001 - June 2010** Senior Research Associate, University of Chicago Department of Astronomy and Astrophysics  
**Dec 2001 - Oct 2004** Director of Astronomy, Adler Planetarium  
**Aug 1997 - Dec 2001** Astronomy Faculty Member, Adler Planetarium  
**Aug 1997 - Dec 2001** Research Scientist, University of Chicago Department of Astronomy and Astrophysics  
**1993 - 1997** Research Associate, University of Chicago, CASA-MIA experiment  
**1992 - 1993** Postdoctoral Associate, National Institute for Nuclear Physics (INFN) Frascati, ICARUS Solar Neutrino Experiment  
**1987 - 1991** Research Assistant, University of California, Los Angeles, UA1 Experiment, CERN

## Appointments (*Service*):

- 2017** Member, International Scientific Program Committee (ISPC) of the 35th International Conference on Cosmic Rays  
**2017** Chair, Local Organizing Committee (LOC) Citizen Science Association 2017 Conference, Minneapolis-St. Paul, May 2017.  
**2016** Member, Scientific Organizing Committee (SOC) of the European Week of Astronomy and Space Science (EWASS16).  
**2015 - present** Editor-in-Chief, the online journal *Citizen Science Today*.  
**2015 - present** External Faculty Member, *Human Computation Institute*.  
**2015** Member National Science Foundation Physics Division Committee of Visitors; Chair Particle Astrophysics Subpanel.  
**2015** Member, International Scientific Program Committee (ISPC) of the 34th International Conference on Cosmic Rays  
**2015** Editorial Board Member, the journal *Citizen Science: Theory and Practice*.  
**Nov. 2014 - present** Board Chair, Citizen Science Alliance.  
**Apr. 2014 - present** Member, Publications Advisory Board (PAB) of the Citizen Science Association  
**Mar. 2014 - present** Member, Advisory Board for the Journal of Human Computation  
**Dec. 2013 - present** Bell Museum Astronomy Exhibit Advisory Committee  
**Jan. 2012 - present** Member, Advisory Committee WGBH Boston, NovaLabs  
**Dec. 2011 - 2015** Member, LIGO Directorate's Program Advisory Committee (PAC)

**Appointments (*Service - continued*):**

<b>2010 - present</b>	Member ( <i>ad-hoc</i> ), Research Committee of the Adler Planetarium Board of Trustees
<b>2010 - present</b>	Advisory Board, KVA 265 - Science Through Art
<b>2009 - 2010</b>	Co-chair of the Astro2010 Decadal Survey Education and Public Outreach Study Group
<b>2009 - 2010</b>	National Optical Astronomy Observatory Education and Public Outreach Review Committee
<b>2008 - 2010</b>	NASA Advisory Council, Human Capital Committee
<b>2008 - 2010</b>	Advisory Committee, NSF-funded Center for Research Libraries, Long-Lived Data Collections: Models and Case Studies
<b>2008 - 2009</b>	Science Advisory Committee, ScienceChicago Project
<b>2007 - 2009</b>	International Year of Astronomy Organizing Committee, Subcommittee on Research Experiences for Students, Teachers, and Citizen-Scientists
<b>2004 - 2010</b>	Advisory Committee, Center for Elementary Math and Science Education, University of Chicago
<b>2006 - 2008</b>	NASA Advisory Council, Astrophysics Subcommittee
<b>2003 - 2006</b>	Math and Physical Science Advisory Committee, National Science Foundation

**Awards:**

<b>2016</b>	College of Science & Engineering Recipient of the University of Minnesota President's Community-Engaged Scholar Award
<b>2015</b>	Honorary Award, University of Minnesota Chapter of Sigma Xi
<b>2010</b>	NASA Exceptional Public Service Award

**Current Membership in Professional Associations and Societies:**

<b>2015</b>	Citizen Science Association
<b>2000</b>	American Astronomical Society
<b>1996</b>	American Physical Society

**Collaborations & Projects:**

<b>Nov 2014 - present</b>	Board Chair, Member Steering Committee, Citizen Science Alliance, <i>Zooniverse</i> Collaboration
<b>Nov 2014 - present</b>	Principal Investigator, Chair Leadership Team for <i>Zooniverse@UMN</i> Collaboration
<b>Jul 2010 - Nov 2014</b>	Executive Board Member, Project Manager, Citizen Science Alliance, <i>Zooniverse</i> Collaboration
<b>Jul 2010 - present</b>	Principal Investigator, CTA-US Collaboration Group (formerly AGIS Collaboration), University of Minnesota
<b>Jul 2010 - present</b>	Principal Investigator, VERITAS Collaboration Group, University of Minnesota
<b>Jan 2009 - Jun 2010</b>	Executive Board Member, Education Director, Citizen Science Alliance, <i>Zooniverse</i> Collaboration
<b>Oct 2007 - Jun 2010</b>	Principal Investigator, AGIS Collaboration Group, Adler Planetarium
<b>Jan 2006 - Jun 2010</b>	Principal Investigator, START Collaboratory Project, Adler Planetarium
<b>Oct 2004 - Jun 2010</b>	Principal Investigator, VERITAS Collaboration Group, Adler Planetarium

## Collaborations & Projects: (- continued):

**Jan 2000 - Oct 2004** VERITAS Collaboration Member, University of Chicago

**1997 - 2000** Principal Investigator, CASA-BLANCA experiment, University of Chicago

## Selected Publications *Science - Galaxy Evolution:*

- Dickinson, H. et al., *Galaxy Zoo: Morphological Classification of Galaxy Images from the Illustris Simulation*, The Astrophysical Journal, **853**, 194 (2018), arXiv:1801.08541.
- Simmons, B. D., et al., *Galaxy Zoo: quantitative visual morphological classifications for 48 000 galaxies from CANDELS*, Monthly Notices of the Royal Astronomical Society, **464**, 4420 (2017), arXiv:1610.03070.
- Willett, K. W. et al, *Galaxy Zoo: Morphological Classifications for 120,000 Galaxies in HST Legacy Imaging*, Monthly Notices of the Royal Astronomical Society **464**, 4176 (2017), arXiv:1610.03068.
- Holincheck, A. J., et al., *Galaxy Zoo: Mergers - Dynamical models of interacting galaxies*, Monthly Notices of the Royal Astronomical Society, **459**, 720 (2016), ArXiv:1604.00435.
- Banfield, J. K., et al., *Radio Galaxy Zoo: host galaxies and radio morphologies derived from visual inspection*, Monthly Notices of the Royal Astronomical Society, **453**, 2326 (2015), ArXiv:1507.07272.
- Willett, K. W., et al., *Galaxy Zoo 2: the dependence of the star formation-stellar mass relation on spiral disc morphology*, Monthly Notices of the Royal Astronomical Society, **449**, 820 (2015), ArXiv:1502.03444.
- Galloway, M., et al., *Galaxy Zoo: the effect of bar-driven fuelling on the presence of an active galactic nucleus in disc galaxies*, Monthly Notices of the Royal Astronomical Society, **448**, 3442 (2015), ArXiv:1502.01033.
- Schawinski, K., et al., *The green valley is a red herring: Galaxy Zoo reveals two evolutionary pathways towards quenching of star formation in early- and late-type galaxies*, Monthly Notices of the Royal Astronomical Society **440**, 889 (2014), ArXiv:1402.4814.
- Willett, K. W., et al., *Galaxy Zoo 2: detailed morphological classifications for 304 122 galaxies from the Sloan Digital Sky Survey*, Monthly Notices of the Royal Astronomical Society, **435**, 2835 (2013), ArXiv:1308.3496.
- Masters, K., et al., *Galaxy Zoo: bars in disc galaxies*, MNRAS, **411** Issue 3 (2011) pp. 2026.

## Selected Publications *Citizen Science & Zooniverse Projects or Infrastructure:*

- Beck, M., et al., *Integrating human and machine intelligence in galaxy morphology classification tasks*, 2018 MNRAS (accepted) arXiv:1802.08713.
- Bird, R., et al., *Muon Hunter: a Zooniverse project*, 2018 TAUP Conference Proceedings (accepted) arXiv:1802.08907.
- Wright, D., et al., *A transient search using combined human and machine classifications*, 2017 MNRAS **472**, p.1315 arXiv:1707.05223.
- Williams, A., et al., *A computational pipeline for crowdsourced transcriptions of Ancient Greek papyrus fragments*, 2014 IEEE International Conference on Big Data **1**, 100 (2014).
- Williams, A., et al., *Identification of Ancient Greek Papyrus Fragments Using Genetic Sequence Alignment Algorithms*, 2014 IEEE 10th International Conference on e-Science **2**, 5 (2014).
- Fortson, L., et al., *Galaxy Zoo: Morphological Classification and Citizen Science*, Chapter published in Advances in Machine Learning and Data Mining for Astronomy. Editors: Michael Way, Jeff Scargle, Ashok Srivastava, and Kamal Ali. arXiv:1104.5513; published 2012.

- Smith, A.M., et al., *Galaxy Zoo Supernovae*, MNRAS, **412** (2011) pp. 1309.

### Selected Publications *Science - Gamma-Ray Astrophysics:*

- Ahnen, M. L., et al., (Multi-collaboration paper), *Multiband variability studies and novel broadband SED modeling of Mrk 501 in 2009*, Accepted Astron. & Astrophys., (2017), arXiv:1612.09472.
- Abeysekara, A. U., et al., (VERITAS Collaboration, <http://veritas.sao.arizona.edu>), *A Luminous and Isolated Gamma-Ray Flare from the Blazar B2 1215+30*, Astrophys. Journal, **836** 205 (2017), arXiv:1701.01067.
- Archambault, S., et al., *Search for Magnetically Broadened Cascade Emission from Blazars with VERITAS*, Astrophys. Journal, **835** 288 (2017), arXiv:1701.00372.
- Abeysekara, A. U., et al., *A Search for Spectral Hysteresis and Energy-dependent Time Lags from X-Ray and TeV Gamma-Ray Observations of Mrk 421*, Astrophys. Journal, **834** 2 (2017), Arxiv:1611.04626.
- Abeysekara, A. U., et al., *VERITAS and multiwavelength observations of the BL Lacertae object 1ES 1741+196*, Monthly Notices of the Royal Astronomical Society, **459** 2550 (2016), Arxiv:1603.07286.
- Archambault, S., et al., *Discovery of Very High Energy Gamma Rays from 1ES 1440+122*, Monthly Notices of the Royal Astronomical Society, **461** 202 (2016).
- Fortson, L., for the VERITAS Collaboration, *Highlights of recent results from the VERITAS gamma-ray observatory*, Journal of Physics: Conference Series, **718** Issue 5, article id. 052013 (2016).
- Balokovic, M., et al., *Multiwavelength Study of Quiescent States of Mrk 421 with Unprecedented Hard X-Ray Coverage Provided by NuSTAR in 2013*, In press for publication in Astrophys. Journal (2016), Arxiv:1512.02235.
- Abeysekara, A. U., et al., *Gamma-Rays from the Quasar PKS 1441+25: Story of an Escape*, Astrophys. Journal Letters **815** L22 (2015), Arxiv:1512.04434.
- Weinstein, A. and Fortson, L., et al., *Testing a Novel Self-Assembling Data Paradigm in the Context of IACT Data*, Contribution to the 34th International Cosmic Ray Conference (2015), Arxiv:1509.02202.
- Aleksic, J., et al., *The 2009 multiwavelength campaign on Mrk 421: Variability and correlation studies*, Astronomy and Astrophysics **576** A126 (2015), Arxiv:1502.02650.
- Aleksic, J., et al., *Unprecedented study of the broadband emission of Mrk 421 during flaring activity in March 2010*, Astronomy and Astrophysics **578** A22 (2015), Arxiv:1412.3576.
- Archambault, S., et al., *Deep Broadband Observations of the Distant Gamma-Ray Blazar PKS 1424+240*, Astrophys. Journal Letters **785** L16 (2014), Arxiv:1403.4308.
- Acciari, V. A., et al., *Observation of Markarian 421 in TeV gamma rays over a 14-year time span*, Astroparticle Physics **54**, 1 (2014), ArXiv:1310.8150.
- Beatty, J. J., et al., *Snowmass Cosmic Frontiers 6 (CF6) Working Group Summary The Bright Side of the Cosmic Frontier: Cosmic Probes of Fundamental Physics*, (2013), ArXiv:1310.5662.
- Archambault, S., et al., *Discovery of a New TeV Gamma-Ray Source: VER J0521+211*, Astrophysical Journal **776**, 69 (2013), Arxiv:1308.5017.
- Dumm, J., & Fortson, L., *Gamma-ray Signatures of Ultra High Energy Cosmic Ray Line-of-sight Interactions*, (2013), ArXiv:1305.0253.

- Weinstein, A., Dumm, J., Fortson, L. & Mukherjee, R., *The impact of astrophysical particle acceleration on searches for beyond-the-Standard-Model physics*, (2013), ArXiv:1305.0082.
- Arlen, T., et al., *Rapid TeV Gamma-Ray Flaring of BL Lacertae*, *Astrophysical Journal* **762**, 92 (2013), ArXiv:1211.3073.
- Arlen, T., et al., *Constraints on Cosmic Rays, Magnetic Fields, and Dark Matter from Gamma-Ray Observations of the Coma Cluster of Galaxies with VERITAS and Fermi*, *Astrophys. J.*, **757** 123 (2012) (with C. Pfrommer and A. Pinzke).
- Aliu, E., et al. (VERITAS Collaboration), *Multiwavelength Observations of the AGN 1ES 0414+009 with VERITAS, Fermi-LAT, Swift-XRT, and MDM*, *Astrophys. J.*, **755**, 118 (2012).
- Aliu, E., et al. (VERITAS Collaboration), *Discovery of High-energy and Very High Energy  $\gamma$ -Ray Emission from the Blazar RBS 0413*, *Astrophys. J.*, **750**, 94 (2012).
- Willett, K., Nelson, T., & Fortson, L., *Environmental Clustering Properties of High-Energy Blazars*, American Institute of Physics Conference Series, edited by F. A. Aharonian, W. Hofmann, & F. Rieger (2012).
- Fortson, L. for the VERITAS Collaboration and Fermi-LAT Collaborators: James Chiang, Stephen Fegan, Berrie Giebels, Deirdre Horan, Grzegorz Madejski, David Paneque; *Results from VERITAS Observations on the Giant Flare from Mrk 421 in February 2010* American Institute of Physics Conference Series, edited by F. A. Aharonian, W. Hofmann, & F. Rieger (2012).
- Acciari, V.A., et al. (VERITAS Collaboration), *TeV and Multi-wavelength Observations of Mrk 421 in 2006-2008*, *Astrophys. J.*, **738**, 25 (2011).
- Acciari, V.A., et al. (VERITAS Collaboration), *The Discovery of  $\gamma$ -Ray Emission from the Blazar RGB J0710+591*, *Astrophys. J.*, **715** L49-L55 (2010).
- Acciari, V.A., et al. (VERITAS Collaboration), *Veritas 2008-2009 Monitoring of the Variable Gamma-ray Source M 87*, *Astrophys. J.*, **716** 819 (2010).
- Acciari, V.A., et al. (VERITAS Collaboration), *A connection between star formation activity and cosmic rays in the starburst galaxy M82*, *Nature*, **462** Issue 7274 (2009) pp. 770.
- Horan, D., et al., *Multiwavelength Observations of Markarian 421 in 2005 - 2006*, *Astrophys. J.*, **695** 596 (2009).
- Acciari, V.A., et al. (VERITAS Collaboration), *Discovery of Very High Energy Gamma-ray Radiation from the BL Lac 1ES 0806+524*, *Astrophys. J.*, **690** L126-L129 (2009).
- Acciari, V.A., et al. (VERITAS Collaboration) *VERITAS Discovery of  $>200$  GeV Gamma-Ray Emission from the Intermediate-Frequency-Peaked BL Lacertae Object W Comae*, *Astrophys. J.* **684** L73-L77 (2008).
- Fortson, L., Kildea, J., (VERITAS collaboration) *The AGN Monitoring Program with the Whipple 10m Observatory*, in proceedings of “Workshop on Blazar Variability across the Electromagnetic Spectrum”, PoS(BLAZARS2008)039 <http://pos.sissa.it/> (2008).
- Holder, J. et al. *The first VERITAS telescope*, *Astro. Part. Phys.*, **25** 391 (2006).
- Rebillot, P. et al. *Multiwavelength Observations of the Blazar Markarian 421 in 2002 December and 2003 January*, *Astrophys. J.*, **641** 740 (2006).
- Blazejowski, M., et al., *A Multiwavelength View of the TeV Blazar Markarian 421: Correlated Variability, Flaring, and Spectral Evolution*, *Astrophys. J.*, **630** 130 (2005) .
- Swordy, S. & Fortson, L. F., editors *The 2nd VERITAS Symposium on TeV Astrophysics of Extragalactic Sources*, *New Ast Rev*, **48** 321 (2004).

**Selected Publications** *Reviews, Editorials, Education and Outreach:*

- Fortson, L., et al., *Cosmology: A few words on infinity*, Nature, Volume 513, Issue 7519, pp. 485 (2014).
- Fortson, L., *Blazing the Trails: Essays by Leading Women in Science* pgs 114-123; Editors: Emma Ideal, Rhiannon Meharchand, July 2013.
- Fortson, L., SubbaRao, M., & Greenberg, G., *Using Collaborative Environments in Research-based Science Education*, Proc. Astro. Soc. Pac., **389** 239-243 (2008).
- Carney, K., Fortson, L., & Nichols, M., *CI-Team: Introducing Quasar Research to High School Science Teachers using the Cyber-infrastructure*, Proc. Astro. Soc. Pac., **389** 91-95 (2008).
- Fortson, L., *The Importance of Involving Research Scientists in Education and Outreach* NASA OSS Education & Public Outreach Conference; ASP Conf. Series, Vol. 319; Eds. C. Narasimhan, B. Beck-Winchatz, & I. Hawkins (2004).

### Research Activities:

- Dr. Fortson is Principal Investigator of the University of Minnesota group involved in the Very Energetic Radiation Imaging Telescope Array System (VERITAS) Collaboration. The primary science pursuits for the group are in studying very-high-energy  $\gamma$ -ray emission from Active Galactic Nuclei (AGN) used to understand the underlying emission mechanisms and black hole engine. The UMN group is the lead on organizing contributions for multi-wavelength campaigns on AGN targets. UMN is responsible for the standard analysis package, VEGAS, including implementation of new analysis techniques that increase overall sensitivity. Dr. Fortson currently serves as co-lead for the VERITAS Analysis Coordination Group; she also serves on the VERITAS Science Board. From 2013-2015 Dr. Fortson served as a member of the VERITAS Time-Allocation-Committee (TAC) and she served as the co-chair of the Blazar Science Working Group from 2005-2015. As an extension of the VERITAS work, the University of Minnesota is a member of the Cherenkov Telescope Array Collaboration, the next-generation high-energy ground-based gamma-ray array. UMN holds an NSF grant to investigate a novel prompt event reconstruction technique for potential use with CTA. Dr. Fortson is a member of the CTA Speaker and Publications Office (SAPO) as well as a member of the CTA Outreach Working Group. She currently holds a combined \$600,000 in research awards, primarily from NSF, for her work in gamma-ray astronomy.

- Dr. Fortson is currently the Board Chair and member of the Steering Committee for the Citizen Science Alliance which runs the *Zooniverse* Collaboration, an extension of the Galaxy Zoo Project ([www.galaxyzoo.org](http://www.galaxyzoo.org)). She also leads the *Zooniverse@UMN* effort funded through cross-campus contributions to develop and implement UMN-centric *Zooniverse* projects. Galaxy Zoo is the groundbreaking citizen science project that engaged more than 175,000 online volunteers to classify nearly one million galaxies from the SDSS database. Galaxy Zoo proved that, for some well-defined science problems, an analysis method incorporating humans as sophisticated computational algorithms can lead to important scientific results while at the same time engaging the public in the process of science. The *Zooniverse* ([www.zooniverse.org](http://www.zooniverse.org)) currently has nearly 1.5 million volunteers contributing to nearly 50 live projects. *Zooniverse* is funded through grants from NSF, NASA, NEH, Microsoft, Google, TED Foundation, Sloan Foundation and the Leverhulme Trust, UK to develop and maintain the back-end infrastructure to incorporate science datasets from across all research disciplines and to develop an education framework for *Zooniverse* projects. Dr. Fortson received a \$250,000 UMN Futures research grant in support of her work collaborating with members of the Minnesota Supercomputing Institute, UMN's department of Classics and Near Eastern Studies and Oxford University to develop algorithms derived from astrophysics and

biology to analyze transcribed greek letters from fragments of ancient Egyptian papyri through the Ancient Lives project on Zooniverse. This work led to the recent award from NEH on adding Coptic texts to the transcription framework. Dr. Fortson is PI of a recent NSF award to enable a combined system utilizing human and machine classifications to dynamically optimize knowledge discovery from large and complex data sets. Dr. Fortson is Co-PI on a recent \$625,000 award from NSF to continue Galaxy Evolution research with the crowdsourced data from Galaxy Zoo.

### **Leadership and Education Activities:**

Dr. Fortson has extensive experience in education, administration and leadership. She has served on multiple national and local advisory committees. As Vice President for Research at the Adler Planetarium and Astronomy Museum, Dr. Fortson oversaw the research and public engagement in research programs conducted by the fifteen researchers in the departments of Astronomy, History of Astronomy and Education. Her annual operating budget was over \$1.2 million including specific research and education projects. Dr. Fortson developed many of the Education & Public Outreach activities at the Adler. She has developed the themes, written content and interactives for three museum galleries covering over 10,000 square feet. She has been Project Director for three Planetarium shows in Adler's theaters. She developed the strategy to implement an astronomy data visualization team at the Adler (now the Space Visualization Laboratory). Dr. Fortson contributed to Adler's Teacher Professional Development programs through planning and participation as a content provider. She has given numerous lectures and presentations on astronomy and education topics to school classes, corporate events and continuing education groups. She has been featured in several newspaper articles (including the Chicago Tribune and New York Times), appeared on numerous television and radio programs as well as podcasts. At UMN, she has taught courses in introductory physics, undergraduate introduction to cosmology and best practices for teaching physics as well as an honors seminar on crowdsourcing. She has been working to introduce Zooniverse activities into the classroom at UMN to provide introductory level students with the opportunity to engage in the process of research

- Dr. Fortson has been a principal organizer and proceedings editor for several international level scientific conferences and workshops, including three Multiwavelength Campaign workshops for high energy astrophysics (e. g. "The 2nd Multiwavelength Workshop for the Next Generation Gamma-ray Experiments".) The most recent was "What are we Learning from the Gamma Ray Sky?" held at UMN October 2013. She also organized and chaired a special session "Keys to Classic Astrophysical Puzzles: High Energy Gamma-Rays with VERITAS and Beyond" at the January 2016 American Astronomical Society meeting.

- Dr. Fortson co-chaired the Astronomical Society of the Pacific's conference "EPO in a Changing World" Chicago, September 2007 and served on the program committee for the May 2008 ASP meeting held in conjunction with the 212th American Astronomical Society meeting. Dr. Fortson chaired the NASA Future Forum event hosted October 10th, 2008 at the Adler celebrating NASA's 50th Anniversary. This day-long event brought together educators, academics and corporate leaders from the Chicago area to participate in panel discussions focused on the impact of space science on our society.

### **Grant History (foundation and federal):**

### **Research Initiatives:**

- Principal Investigator ~\$60,000 NASA, *VERITAS Monitoring of the Periodic Blazar PG 1553+133 During Fermi-LAT Predicted Maximum*, (UMN) 2017
- Principal Investigator ~\$360,000 NSF, *Optimizing the Human-Machine System for Citizen Science*, (UMN) 2016
- Principal Investigator ~\$365,000 NSF, *Very High Energy Particle Astrophysics with VERITAS*, (UMN) 2014
- Co-Principal Investigator ~\$625,000 NSF, *Eyes on the future: optimizing science output for next generation surveys with joint crowdsourced and automated classification techniques*, (UMN) 2014
- UMN Principal Investigator ~\$171,500 NSF, *Collaborative Research: CDS&E: Investigating a Self-assembling Data Paradigm for Detector Arrays*, (UMN) 2014
- Principal Investigator ~\$58,500 UMN GIA program, *Using Crowdsourcing to Understand the Evolution of Galaxy Morphology*, (UMN) 2014
- Principal Investigator ~\$15,000 Harvard-Smithsonian Astrophysical Observatory, *VEGAS Software Maintenance*, (UMN) 2014
- Principal Investigator ~\$440,000 NSF, *Very High Energy Particle Astrophysics with VERITAS*, (UMN) 2011
- Principal Investigator ~\$1.9 million NSF, *CDI-Type II: Zooniverse - Conquering the Data Flood with a Transformative Partnership between Citizen Scientists and Machines*, (UMN/Adler) 2010
- Principal Investigator ~\$400,000 NSF, *TeV Studies of Active Galactic Nuclei and Starburst Galaxies with the VERITAS Gamma-ray Observatory*, (UMN/Adler) 2009
- Principal Investigator \$500,000 Brinson Foundation, *Astrophysics Research* (Adler) 2008
- Principal Investigator \$200,000 NSF, *Pointing Monitor System for the VERITAS Gamma-ray Observatory and TeV Studies of Active Galactic Nuclei*, (Adler) 2007
- Principal Investigator \$49,000 NSF, *BLANCA: Broad Lateral Non-Imaging Cherenkov Array*, 1996 (U of Chicago and Adler)

### **Citizen Science Projects & Infrastructure:**

- Co-Investigator ~\$30,000 UMN OVPR - Serendipity Grants, *Towards a Center for Citizen Science at the University of Minnesota*, (UMN) 2016
- Co-Investigator ~\$233,000 NSF, *The View from Behind the Curtain: Establishing a Database of Supreme Court Conference Note Transcriptions*, (UMN) 2015
- Co-Investigator ~\$89,000 NHPRC, *Decoding the Civil War: Engaging the Public with 19th Century Technology & Cryptography through Crowdsourcing and Online Educational Modules*, (UMN) 2015
- Principal Investigator ~\$20,000 Sloan Foundation (Roy Rosenzweig Center for History and New Media), *PressForward: Citizen Science Today*, (UMN) 2015
- Co-Principal Investigator ~\$220,000 NEH, *Digging into Data: Resurrecting Early Christian Lives*, (UMN) 2013
- Principal Investigator \$250,000 Minnesota Futures Research Grant, *The Data Deluge: Applying Data Processing Techniques Derived from Astrophysics Citizen Science Projects to Research Problems in Egyptian Papyrology*, (UMN) 2011
- Principal Investigator \$19,955 NSF, *Zooniverse US-UK Planning Meeting: Bringing together Science and Education Teams*, (Adler) 2009

### **Other:**

- Co-Investigator \$796,167 NSF, *STARS: Science Through Astronomical Research of Stars*, (AAVSO, Adler portion \$20,000) 2009



- Co-Investigator or Senior Staff on over \$7.3 million in foundation awards for Sky Theater and new Galaxies and Cosmology exhibit, 2008
- Principal Investigator \$270,763 NSF, *CI Team: Introducing High School Science Teachers to 21st Century Research Techniques made Possible by Cyberinfrastructure*, 2004
- Co-lead \$3 million, congressional mandate - NASA, Cyberspace Gallery (Adler), 1999

### Recent Invited Engagements:

- Invited speaker: University of California, Los Angeles, Department of Physics and Astronomy Colloquium, Los Angeles, CA November 3, 2017 *“To the Zooniverse and Beyond: How Crowdsourcing Science is Solving Big Data Problems in Astronomy ”*.
- Invited speaker (and co-organizer): Citizen Science Convergence Colloquium - UMN; May 6, 2016 *“Citizen Science 2.0: Pulling it all together”*.
- Invited speaker: Citizen Science 2.0 - SwissNex, San Francisco; April 8, 2016 *“To the Zooniverse and Beyond: the Future of Citizen Science”*.
- Invited speaker: David Cline Memorial Symposium, UCLA; February 20, 2016 *“Connections: David Cline through the lens of a UA1 graduate student ”*.
- Invited speaker: Conservation Biology Seminar (UMN); December 7, 2015 *“Zooniverse at your fingertips: A crowdsourcing solution for producing research with the data deluge”*.
- Invited speaker: University of Utah, High Energy Astrophysics Seminar; Salt Lake City, UT; November 6, 2015 *“Looking for evidence of secondary gamma rays in blazar spectra from cosmic ray line of sight interactions”*.
- Invited speaker: University of Utah, Department of Physics and Astronomy Colloquium, Salt Lake City, UT; November 5, 2015 *“To the Zooniverse and Beyond: How Crowdsourcing Science is Solving Big Data Problems in Astronomy ”*.
- Invited speaker: University of Utah, Center for Science and Mathematics Education (CSME) Seminar; Salt Lake City, UT; November 5, 2015 *“Education in and with the Zooniverse Citizen Science Platform”*.
- Invited participant: White House Citizen Science Forum and Workshop “Open Science and Innovation: Of the People, By the People, For the People”, The White House, Washington DC; September 30, 2015.
- Invited keynote speaker: Sigma Xi Annual Meeting Minnesota; May 3, 2015 *“Zooniverse at your fingertips: A crowdsourcing solution for producing research with the data deluge”*.
- Invited speaker: Department of Plant Biology Citizen Science Workshop; April 8, 2015 *“Zooniverse at your fingertips: Citizen Science: Involving an Engaged Public in Your Research Projects with Zooniverse”*.
- Invited speaker: Agricultural, Biological, and Environmental Sciences, UMN Libraries seminar; April 7, 2015 *“Zooniverse at your fingertips: A crowdsourcing solution for producing research with the data deluge”*.
- Invited speaker: Towards Big Steps Enabled by “Big Data Science”, Workshop organized by the National Science Foundation; Arlington, VA; January 29-30, 2015 *“Big Data Lessons from the Zooniverse”*.
- Invited speaker: Opportunities and Challenges of Citizen Science, ETH Zurich, Switzerland; January 22-23, 2015 *“To the Zooniverse and Beyond: The Future of Citizen Science”*.
- Invited speaker: American Association of University Women; January 19, 2015 *“A Brief Tour of the Zooniverse: How Crowdsourcing Science is Solving Big Data Problems in Research”*.
- Invited Keynote speaker 2014 International Conference on Collaboration Technologies and Sys-

tems, Minneapolis, MN; May 21, 2014 “*Talking in the Zooniverse: A Collaborative Tool for Citizen Scientists*”.

- Invited to organize two panels for the 26th Nobel Peace Prize Forum 2014: “Crowdsourcing to Create Common Ground” and presenter at both panels, March 8, 2014.
- Invited panelist for Graduate and Professional Education Assembly (UMN) panel: “Research and Scholarship using Digital Tools, Technologies and Approaches”, April 2, 2014; presented “*The Zooniverse at Your Fingertips: A Crowdsourcing Solution for Producing Research from the Data Deluge*”.
- Invited panelist for 2013 History of Science Society Annual Meeting panel: “Crowdsourcing Science: Science By the People?”; presented “The Zooniverse at Your Fingertips”, Nov 21, 2013
- Department of Astronomy, University of Maryland Oct 2, 2013 “What’s up in the Zooniverse? A partnership between humans and machines to get the most out of the flood of data”.
- Department of Physics, McGill University, Canada April 9, 2013 “What’s up in the Zooniverse? A partnership between humans and machines to get the most out of the flood of data”.
- University of Minnesota, School of Physics and Astronomy Colloquium, “The Changing View of Blazars from Gamma Ray Observations with VERITAS”, November 14, 2012.
- Summer 2012: Gordon Research Conference: “The Extreme Universe: The Science and Tools of High Energy Astrophysics in the Classroom”, and “The Zooniverse: Engaging with the Process of Research”.
- Spring 2012: The Snowbird Workshop on Dark Matter Observations through Gamma Rays: “VERITAS Constraints on Dark Matter from Observations of the Coma Cluster”.
- Spring 2012: Open Research & Learning: Collaboration, Connections and Communities; “Zooniverse and Open Access Data: Encouraging Public Participation in Research” UMN
- Spring 2011: Physics Department Colloquium, Case Western Reserve University: VERITAS and CTA
- Spring 2011: Astronomy Department Colloquium, Univ. of Wisconsin: VERITAS and CTA
- Spring 2011: Morgridge Institute Public Lecture, Univ. of Wisconsin: Zooniverse
- Spring 2011: Minnesota Astronomical Society, Public Lecture: Zooniverse
- Spring 2011: National Science Foundation lecture series: Zooniverse

### **Recent Service and Outreach Activities:**

- CSE/CLA Collaborative Research Showcase and  $C^3$  Initiative event: “The Zooniverse at Your Fingertips: Citizen Science: Involving an Engaged Public in Your Research Projects with Zooniverse”; May 11, 2015.
- Minnesota Institute for Astrophysics Public Lecture: To the Zooniverse and Beyond: How Crowdsourcing Science is Solving Big Data Problems in Astronomy, April 2015.
- CSE/CLA Collaborative Research Showcase and  $C^3$  Initiative planning and speaker (Ancient Lives Zooniverse project) 2014.
- UMN Writing Enriched Curriculum Program Liaison to School of Physics and Astronomy 2014-2017.
- UMN Graduate and Professional Education Assembly organizing committee 2014.
- UMN School of Physics and Astronomy Cosmology Seminar organizer Spring 2014.
- Hosted VERITAS Collaboration Meeting, Summer 2014.
- Minnesota Astronomical Society “The Changing View of Blazars from Gamma Ray Observations with VERITAS”, Nov 7, 2013.

- Invited presentation at Bell Museum “Insider’s Look at Andromeda & Citizen Science Kick-Off” co-presenting with Evan Skillman Oct 17, 2013.
- Organized Workshop: “What are we learning from the gamma-ray sky”, Oct 10-12, 2013 hosted by Fine Theoretical Physics Institute.
- Minnesota Speculative Fiction Writers “The Zooniverse at Your Fingertips”, Sept 21, 2013.
- Presentation to St Paul Academy Middle School on Zooniverse, January 2013.
- Organizer and presenter of Cherenkov Telescope Array exhibit, International Astronomical Union; Beijing, China, August 2012.
- Minnesota Astronomical Society “The New World of Gamma Ray Astronomy: TeV Astrophysics with VERITAS and Beyond”, November 1, 2012.
- Guest lecture for: EngL 8510 “Crowdsourcing Science with the Zooniverse” March 13, 2014.
- Guest lecture for: CSci 5125 “Crowdsourcing Science with the Zooniverse” May 1, 2013.
- Guest lecture for: Phys 3022 “Ultra High Energy Cosmic Rays” April 26, 2013.
- Guest lecture for: Phys 1401 “Zooniverse: Constructing a Virtual Facility to get the Best Science out of Citizen Science” Nov 1, 2011.
- Journal Club presentations: “Strong Evidence for Gamma-Ray Line Emission from the Inner Galaxy” Oct 4, 2012.
- Journal Club presentations: “Constraints on Dark Matter from the VERITAS Observations of the Coma Cluster”, March 2012.
- Journal Club presentations: “Dynamical Black Hole Masses of BL Lac Objects from the Sloan Digital Sky Survey”, April 7, 2011.

### **Course Assignments:**

- Fall 2014: HSEM 2519H - Honors Seminar on Crowdsourcing.
- Spring 2014, ‘16: Phys 3022 - Introduction to Cosmology.
- Fall 2010, ‘11, ‘12, ‘13: Phys 1101 - Introductory College Physics I.
- Spring 2012, ‘13: Phys 1102 - Introductory College Physics II.
- Fall 2011, ‘12: Phys 5071 - Best Practices in College Physics Teaching I.
- Spring 2012, ‘13: Phys 5072 - Best Practices in College Physics Teaching II.
- Fall 2010, Spring 2011: Physics 5980 - Introduction to Research Seminar I, II.

### **University, College or School Committees:**

- Fall 2012 - 2015: Member, University Faculty Senate.
- AY 2013-14: Member, Graduate Education and Professional Assembly event planning committee.
- Fall 2013 - present: Member, Bell Museum Astronomy exhibit UMN faculty consulting committee.
- Fall 2012 - Fall 2014: Chair, Undergraduate Education Committee.
- Fall 2011 - Spring 2012: Member, Undergraduate Education Committee.
- Fall 2011 - Spring 2013: Member, Graduate Recruitment Committee.

### **Graduate and Postdoctoral Advisors:**

Dr. David B. Cline, Thesis Advisor, UCLA.

Dr. Pio Picchi, Postdoctoral Advisor, ICARUS Collaboration, CERN.  
Dr. James Cronin, Postdoctoral Advisor, CASA-MIA Collaboration, University of Chicago.  
Dr. Rene Ong, Postdoctoral Advisor, CASA-MIA Collaboration, UCLA.

### **Postdoctoral Fellows Advised:**

Dr. David Steele, Adler Planetarium; currently research scientist Los Alamos National Laboratory  
Dr. Jeffrey Grube, Adler Planetarium; currently faculty Stephens Institute, New Jersey  
Dr. Niklas Karlsson, Adler Planetarium and UMN (now financial industry, Sweden)  
Dr. Marco Perale, UMN (now Marie Curie Fellow, Oxford University)  
Dr. James Brusuelas, UMN (now post-doctoral scholar, Oxford University)  
Dr. Jonathan Dumm, UMN (now Fellow, Oskar Klein Institute, Sweden)  
Dr. Thomas Nelson, UMN (now Research Faculty, University of Pittsburgh)  
Dr. Kyle Willett, UMN  
Dr. Cameron Rulten, UMN  
Dr. Hugh Dickinson, UMN

### **Graduate Students Advised:**

Dr. Joseph Fowler, faculty at Princeton University, now Research Scientist NIST  
Mr. Karlen Shahinyan, fifth year, UMN  
Ms. Melanie Galloway, fifth year, UMN  
Ms. Juliana Vievering, fourth year, UMN (Masters) - switched to Space Physics for PhD  
Mr. Amit Kapadia, UMN (Masters); now self-employed programmer  
Ms. Miranda Pihlaja Straub, sixth year UMN (Physics Masters, Education Department PhD program).

### **Undergraduate Students Advised:**

Ms. Caitlin Johnson, junior summer, senior year, UMN (2011-12) - now grad student at UCSC.  
Ms. Jasmine MacKenzie, freshman summer, sophomore year and summer, UMN (2011-12).  
Mr. Yinchuan Yu, sophomore year, UMN (2011).  
Mr. David Hung, senior thesis, UMN (2012).  
Mr. Andrew Sargent, junior summer, senior thesis, UMN (2012-13).  
Mr. Anthony Clasen, senior summer, research assistant, UMN (2012).  
Mr. Zachary Pace, REU summer, senior thesis, Univ. of Buffalo, NY (2013-14).  
Ms. Margaret Molter, REU summer, MacAlaster College, MN (2013).  
Ms. Staci Tiedeken, senior year research project, senior thesis, UMN (2014-15).  
Mr. Ryan Madden, senior year research project, senior thesis, UMN (2014-15).  
Ms. Katelyn Koiner, REU summer, Univ. of North Dakota, ND (2015).  
Mr. Michael Hank, freshman summer, sophomore, junior year, UMN (2013-16).  
Ms. Katherine Chworowsky, sophomore summer, UMN (2016).  
Mr. Matthew Urke, Wayzata High School junior summer (2016).  
Mr. Michael Laraia, freshman spring, summer, UMN (2017).