

**MICHAEL K. SHEPARD**  
mshepard@bloomu.edu

**EDUCATION**

1994 Ph.D. Washington University, Earth and Planetary Sciences. Advisor, Raymond Arvidson.  
1984 B.S. Physics. Vanderbilt University

**POSITIONS**

2014- Chair, Department of Environmental, Geographical, & Geological Sciences  
2003- Professor, Bloomsburg University, Bloomsburg, Pennsylvania.  
2000-2003 Associate Professor, Bloomsburg University, Bloomsburg, Pennsylvania.  
1995-2000 Assistant Professor, Bloomsburg University, Bloomsburg, Pennsylvania.  
1999 NASA-ASEE Faculty Fellow Jet Propulsion Laboratory, Pasadena, California.  
1994-1995 Garber Postdoctoral Fellow, Smithsonian Institution, Washington, D. C.  
1994 Postdoctoral Research Associate, Washington University, St. Louis, Missouri.  
1990-1994 Research/Teaching Assistant, Washington University, St. Louis, Missouri.  
1984-1989 Nuclear Propulsion Officer, United States Navy.

**PROFESSIONAL SOCIETIES**

American Geophysical Union  
Division of Planetary Sciences, American Astronomical Society

**VISITING ASTRONOMER**

Arecibo Observatory, Puerto Rico,  
NASA Infrared Telescope Facility, Hawaii,

**PANELS AND COMMITTEES**

Bloomsburg University Curriculum Committee (BUCC, 2013-2015, 2016)  
Friends of the Bloomsburg Public Library (2010-, Secretary 2012-2016)  
NASA Planetary Geology and Geophysics Review Panel (various years)  
Bloomsburg University Tenure Committee (2003-2004)  
Mars Exploration Rover 2003 Landing Site Selection Committee (2001-2003)  
Chair, NASA Planetary Cartography and Geological Mapping Working Group (2000-2001)  
NASA Planetary Cartography and Geological Mapping Working Group (1997-2001)  
Bloomsburg University Faculty Professional Development Committee (1997-1998)  
Advisory Board Member, *Earth in Space*, American Geophysical Union, (1995-2000).  
Johns Hopkins Applied Physics Laboratory “Red Team” member (Aug 1997, June 1998)

**HONORS & AWARDS**

Asteroid 20392 MIKESHEPARD  
Bloomsburg University 175<sup>th</sup> Anniversary Faculty Speaker (2014).  
Maroon and Gold Quill Award, Friends of the Bloomsburg University Library (2013).  
Dean’s Award for Excellence in Teaching, Research, and Service (2011, 1998).  
Bloomsburg University Graduation Commencement Speaker, (Dec. 2005).  
NASA-ASEE Summer Faculty Fellowship (Summer, 1999) Jet Propulsion Laboratory

## **PUBLICATIONS AND PRESENTATIONS**

### **BOOKS**

Shepard, M.K. *Introduction to Planetary Photometry*. Cambridge University Press 2017.

Shepard, M.K. *Asteroids: Relics of Ancient Time*. Cambridge University Press 2015.

### **POPULAR PRESS**

Shepard, M.K. *Skill Builders: Introducing “The Star Deck”*, Night Sky, March/Apr 2007 (final issue).

Shepard, M. *Why do Asteroids Come in Pairs?* Sky and Telescope, December 2012.

Guest Columnist, Bloomsburg Press-Enterprise, (<http://www.pressenterpriseonline.com/>).

*The Curious Professor* – a 700 word science column. Weekly 2010, Biweekly 2011-2012, 2014-present

### **BOOK CHAPTERS**

Campbell, B. A., R. E. Arvidson, **M. K. Shepard**, and R. A. Brackett, *Surficial Geology of Venus*, in *Venus II*, University of Arizona Press, 1997.

### **PEER-REVIEWED JOURNAL ARTICLES**

Takir, D., Reddy, V., Sanchez, J., **Shepard, M.K.**, Emery, J.P. 2017. Detection of water and/or hydroxyl on asteroid (16) Psyche. *Astronomical Journal* 153, 6pp. DOI: 10.3847/1538-3881/153/1/31.

**Shepard, M.K.**, and 21 coauthors. 2017. Radar observations and shape model of asteroid 16 Psyche. *Icarus* 281, 388-403.

**Shepard, M.K.**, and 15 coauthors. 2015. A radar survey of M- and X-class asteroids III. Insights into their composition, hydration state, and structure. *Icarus* 245, 38-55. 10.1016/j.icarus.2014.09.016

Neeley, J.R., Clark, B.E., Ockert-Bell, M.E., **Shepard, M.K.**, Conklin, J., Cloutis, E.A., Fornasier, S., Bus, S.J. 2014. The composition of M-type asteroids II. Synthesis of spectroscopic and radar observations. *Icarus* 238, 37-50. 10.1016/j.icarus.2014.05.008

Johnson, J.R., **Shepard, M.K.**, Grundy, W.M., Paige, D.A., Foote, E.J. 2013. Spectrogoniometry and modeling of martian and lunar analog samples and Apollo soils. *Icarus* 223, 383-406. DOI: 10.1016/j.icarus.2012.12.004.

Domingue, D.L., Murchie, S.L., Denevi, B.W., Chabot, N.L., Blewett, D.T., Laslo, N.R., Vaughan, R.M., Kang, H.K, **Shepard, M.K.** 2011. Photometric correction of Mercury’s global color mosaic. *Planet. Space Sci.* 59, 1873-1887, DOI: 10.1016/j.pss.2011.03.014.

Brozovic, M. and 22 coauthors (including **Shepard, M.K.**) 2011. Radar and optical observations and physical modeling of triple near-Earth asteroid (136617) 1994 CC. *Icarus* 216, 241-256. DOI: 10.1016/j.icarus.2011.09.002.

Rivkin, A.S., Clark, B.E., Ockert-Bell, M., Volquardsen, E., Howell, E.S., Bus, S.J., Thomas, C.A., **Shepard, M.** 2011. Asteroid 21 Lutetia at 3 um: Observations with IRTF SpeX. *Icarus*, 216 62-68. DOI: 10.1016/j.icarus.2011.08.009.

**Shepard, M.K.**, Harris, A.W., Taylor, P.A., Clark, B.E., Ockert-Bell, M., Nolan, M.C., Howell, E.S., Magri, C., Giorgini, J.D., Benner, L.A.M. 2011. Radar observations of Asteroids 64 Angelina and 69 Hesperia. *Icarus* 215, 547-551. DOI: 10.1016/j.icarus.2011.07.027.

**Shepard, M.K.**, and Helfenstein, P. 2011. A laboratory study of the bidirectional reflectance from particulate samples. *Icarus* 215, 526-533. DOI: 10.1016/j.icarus.2011.07.033.

Helfenstein, P., and **Shepard, M.K.** 2011. Testing the Hapke photometric model: Improved version and the porosity correction. *Icarus* 215, 83-100. DOI: 10.1016/j.icarus.2011.07.002.

Souchon, A.L., Pinet, P.C., Chevrel, S.D., Daydou, Y.H., Baratoux, D., Kurita, K., **Shepard, M.K.**, Helfenstein, P. 2011. An experimental study of Hapke's modeling of natural granular surface samples. *Icarus* 215, 313-331. DOI: 10.1016/j.icarus.2011.06.023.

Ockert-Bell, M.E., Clark, B.E., **Shepard, M.K.**, Isaacs, R.A., Cloutis, E.A., Fornasier, S., Bus, S.J., 2010. The composition of M-type asteroids: Synthesis of spectroscopic and radar observations. *Icarus*, 210 674-692, DOI: 10.1016/j.icarus.2010.08.002.

**Shepard, M.K.**, Clark, B.E., Ockert-Bell, M., Nolan, M.C., Howell, E.S., Magri, C., Giorgini, J.D., Benner, L.A.M., Ostro, S.J., Harris, A.W., Warner, B.D., Stephens, R.D., Mueller, M. 2010. A radar survey of M- and X-class asteroids II. Summary and synthesis. *Icarus* 208, 221-237. DOI: 10.1016/j.icarus.2010.01.017.

Hapke, B., **Shepard, M.K.**, Nelson, R.M., Smythe, W.D., Piatek, J. 2009. A quantitative test of the ability of models based on the equation of radiative transfer to predict the bidirectional reflectance of a well-characterized medium. *Icarus*. 199, 210-218. DOI: 10.1016/j.icarus.2008.09.006.

Benner, L.A.M., Ostro, S.J., Magri, M., Nolan, M.C., Howell, E.S., Giorgini, J.D., Jurgens, R.F., Margot, J.L, Taylor, P.A., Busch, M.W., **Shepard, M.K.**, 2008. Near-Earth asteroid surface roughness depends on compositional class. *Icarus*. 198, 294-304. DOI: 10.1016/j.icarus.2008.06.010.

**Shepard, M.K.** and 19 coauthors. 2008. A radar survey of M- and X-class asteroids. *Icarus*, 195, 184-205.

**Shepard, M.K.**, Kressler, K.M\*, Clark, B.E., Ockert-Bell, M.E., Nolan, M.C., Howell, E.S., Magri, C., Giorgini, J.D., Benner, L.A.M., Ostro, S.J. 2008. Radar observations of E-class Asteroids 44 Nysa and 434 Hungaria. *Icarus*, 195, 220-225. DOI:10.1016/j.icarus.2007.12.018.

Ockert-Bell, M.E., Clark, B.E., **Shepard, M.K.**, Rivkin, A.S., Binzel, R.P., Thomas, C.A., DeMeo, F.E., Bus, S.J., Shah, S. 2008. Observations of X/M asteroids across multiple wavelengths. *Icarus* 195, 206-219.

**Shepard, M.K.**, and 16 coauthors. 2008. Multi-wavelength observations of Asteroid 2100 Ra-Shalom, *Icarus*, 193, 20-38. DOI:10.1016/j.icarus.2007.09.006

**Shepard, M.K.** and Helfenstein, P. 2007. A test of the Hapke photometric model. *J. Geophys. Res.* 112, E03001, DOI: 10.1029/2005JE002625.

Johnson, J.R., Sohl-Dickstein, J., Grundy, W.M., Arvidson, R.E., Bell, J., Christensen, P., Graff, T., Guinness, E.A., Kinch, K., Morris, R., **Shepard, M.K.** 2006. Radiative transfer modeling of dust-coated Pancam calibration target materials: Laboratory visible/near-infrared spectrogoniometry. *J. Geophys. Res.* 111, E12S07, DOI: 10.1029/2005JE002658.

**Shepard, M.K.**, J.L. Margot, C. Magri, M.C. Nolan, J. Schlieder\*, B. Estes\*, S.J. Bus, E.L. Volquardsen, A.S. Rivkin, L.A.M. Benner, J.D. Giorgini, S.J. Ostro, M.W. Busch 2006. Radar and infrared observations of binary near-Earth asteroid 2002 CE26. *Icarus* 184, 198-210.

**Shepard, M. K.**, L.A.M. Benner, S.J. Ostro, D.B. Campbell, J.F. Chandler, I.I. Shapiro. Radar detection of near-Earth asteroids 1915 Quetzalcoatl, 3199 Nefertiti, 3757 (1982 XB), and 4034 (1986 PA). *Icarus*, **172**, 170-178, 2004.

Clark, B.E., S.J. Bus, A.S. Rivkin, **M.K. Shepard**, S. Shah, X-type asteroid spectroscopy. *Astron. J.* **128**, 3070-3081, 2004.

Clark, B.E., S.J. Bus, A.S. Rivkin, T. McConnochie, J. Sanders, S. Shah, T. Hiroi, **M. Shepard**, E-type asteroid spectroscopy and compositional modeling. *J. Geophys. Res.*, **109**, 2004.

Johnson, J.R., W.M. Grundy, **M.K. Shepard**, Visible/near-infrared spectrogoniometric observations and modeling of dust-coated rocks. *Icarus*, **171**, 546-556, 2004.

Kehoe-Forutan, S.J., B.A. Campbell, **M.K. Shepard**. Penetrating the mystery beneath Millville Friends Meeting cemetery, *AGS Quarterly*, **28**, 11-12, 2004.

Campbell, B. A. and **M. K. Shepard**, Coherent and incoherent components in near-nadir radar scattering: Applications to radar sounding of Mars. *J. Geophys. Res.*, 108, 5132-5140, 2003.

Bell, J.F. III, S. W. Squyres, K.E. Herkenhoff, J.N. Maki, H.M. Arneson, D. Brown, S.A. Collins, A. Dingizian, S.T. Elliot, E.C. Hagerott, A.G. Hayes, M.J. Johnson, J.R. Johnson, J. Joseph, K. Kinch, M.T. Lemmon, R.V. Morris, L. Scherr, M. Schwochert, **M.K. Shepard**, G.H. Smith, J.N. Sohl-Dickstein, R.J. Sullivan, W.T. Sullivan, and M. Wadsworth, Mars Exploration Rover Athena Panoramic Camera (Pancam) investigation, *J. Geophys. Res.*, 108, 8063-8093, 2003.

Campbell, B.A., R.R. Ghent, and **M.K. Shepard**, Limits on inference of Mars small-scale roughness from MOLA data, *Geophys. Res. Letters*, 30, 1115, 2003

**Shepard, M. K.**, B. A. Campbell, M. H. Bulmer, T. G. Farr, L. R. Gaddis, J. J. Plaut, The roughness of natural terrain. A planetary and remote sensing perspective. *J. Geophys. Res.*, 106, 32777-32795, 2001.

- Shepard, M. K.**, L. A. M. Benner, S. J. Ostro, A. W. Harris, K. D. Rosema, I. I. Shapiro, J. F. Chandler, D. B. Campbell, 2000. Radar observations of asteroid 2100 Ra-Shalom, *Icarus*, **147**, 520-529, 2000.
- Shepard M. K.** and B. A. Campbell, Near-Nadir Microwave Scattering from a Self-Affine Fractal Surface, *Icarus*, **141**, 156-171, 1999.
- Shepard M. K.** and R. E. Arvidson, The Opposition Surge and Photopolarimetry of Fresh and Coated Basalts, *Icarus*, **141**, 172-178, 1999.
- Helfenstein, P. and **M. K. Shepard**, Submillimeter-Scale topography of Undisturbed Lunar Soils, *Icarus*, **141**, 107-131, 1999.
- Shepard M. K.** and B. A. Campbell, Shadows on a Planetary Surface and Implications for Photometric Roughness, *Icarus*, **134**, 279-291, 1998.
- Guinness, E. A., R. E. Arvidson, I. H. D. Clark, and **M. K. Shepard**, Optical Scattering Properties of Terrestrial Varnished Basalts Compared with Rocks and Soils at the Viking Lander Sites, *Journal of Geophysical Research*, **102**, 28,687-28,704, 1997.
- Campbell, B. A. and **M. K. Shepard**, Effect of Venus Surface Illumination on Photographic Image Texture, *Geophysical Research Letters*, **24**, 731-734, 1997.
- Campbell, B. A. and **M. K. Shepard**, Lava Flow Surface Roughness and Depolarized Radar Scattering, *Journal of Geophysical Research*, **101**, 18,941-18,952, 1996.
- Shepard, M. K.**, R. A. Brackett, and R. E. Arvidson, Self-Affine (Fractal) Topography: Surface Parameterization and Radar Scattering, *Journal of Geophysical Research*, **100**, 11,709-11,718, 1995a.
- Shepard, M. K.**, R. E. Arvidson, M. Caffee, B. Finkel, and L. Harris, Cosmogenic Exposure Ages of Basalt Flows: Lunar Crater Volcanic Field, Nevada, *Geology*, **23**, 21-24, 1995b.
- Pollack, J. B., M. E. Ockert-Bell, and **M. K. Shepard**, Viking Lander image analysis of Martian atmospheric dust, *Journal of Geophysical Research*, **100**, 5235-5250, 1995.
- Shepard, M. K.**, R. E. Arvidson, R. A. Brackett, and B. A. Fegley, A Ferroelectric Model for the Low Emissivity Highlands on Venus, *Geophysical Research Letters*, **21**, 469-472, 1994.
- Arvidson, R. E., R. A. Brackett, **M. K. Shepard**, N. R. Izenberg, B. Fegley, Jr., and J. J. Plaut, Microwave Signatures and Surface Properties of Ovda Regio and Surroundings, Venus, *Icarus*, **112(1)**, 171-186, 1994.
- Shepard, M. K.**, R. E. Arvidson, and E. A. Guinness, Specular Scattering from a Terrestrial Playa and Implications for Planetary Surface Studies, *Journal of Geophysical Research*, **98**, 18,707-18,718, 1993.
- Arvidson, R. E., **M. K. Shepard**, E. A. Guinness, S. B. Petroy, J. J. Plaut, D. L. Evans, T. G. Farr, R. Greeley, N. Lancaster, L. R. Gaddis, Characterization of Lava-Flow Degradation in the Pisgah and Cima Volcanic Fields, California, using Landsat Thematic Mapper and AIRSAR data, *Bulletin, Geological Society of America*, **105**, 175-188, 1993.

Campbell, B. A., R. E. Arvidson, and **M. K. Shepard**, Radar Polarization Properties of Volcanic and Playa Surfaces: Applications to Terrestrial Remote Sensing and Magellan Data Interpretation, *Journal of Geophysical Research*, 98, 17,099-17,113, 1993.

Arvidson, R. E., R. Greeley, M. C. Malin, R. S. Saunders, N. Izenberg, J. J. Plaut, E. R. Stofan, and **M. K. Shepard**, Surface Modification of Venus as Inferred from Magellan Observations of Plains, *Journal of Geophysical Research*, 97, 13,303-13,317, 1992.

**Shepard, M. K.**, R. E. Arvidson, E. A. Guinness, and D. W. Deering, Scattering Behavior of Lunar Lake Playa Determined from PARABOLA Bidirectional Reflectance Data, *Geophysical Research Letters*, 18, 2241-2244, 1991.

### **RESEARCH GRANTS**

2011-2012 **NASA Planetary Geology and Geophysics Program**  
*Remote Sensing of Planetary Surfaces*, \$51,815

2009-2012 **National Science Foundation, Astronomy & Astrophysics**  
*Collaborative Proposal RUI: Multi-wavelength Survey and Analysis of X/M/E Asteroids* with Dr. B. E. Clark (co-investigator, Ithaca College), \$133,284.

2008-2011 **NASA Planetary Geology and Geophysics Program**  
*Remote Sensing of Planetary Surfaces*, \$105,000

2006-2008 **National Science Foundation, Astronomy & Astrophysics**  
*Collaborative Proposal RUI: Multi-wavelength Survey and Analysis of X/M/E Asteroids* with Dr. B. E. Clark (co-investigator, Ithaca College), \$117,256.

2005-2007 **NASA Planetary Geology and Geophysics Program**  
*Remote Sensing of Planetary Surfaces*, \$105,000

2004-2005 **Bloomsburg University Research and Disciplinary Projects**  
*Radar Investigation of Asteroids* \$4,865

2003-2005 **National Science Foundation, Astronomy & Astrophysics**  
*Multi-wavelength Observations and Analysis of Asteroid 2100 Ra-Shalom*, with Dr. B. E. Clark (co-investigator, Ithaca College), \$71,800.

2002-2004 **NASA Planetary Geology and Geophysics Program**  
*Remote Sensing of Planetary Surfaces*, \$103,500

1999-2001 **NASA Planetary Geology and Geophysics Program**  
*Remote Sensing of Fractal Planetary Surfaces*, with Dr. B. Campbell, (co-investigator, Smithsonian Institute). \$146,000

1998-1999 **PASSHE Faculty Professional Development Grants**  
*Geomorphology from Space – Radar* \$2,100

1997-1998 **NASA Planetary Geology and Geophysics Program**  
*A Study of the Venusian Surface Utilizing a Self-affine Paradigm*, with B. Campbell (co-investigator, Smithsonian Institute), \$51,000.