

# Rachel L. Smith

## Curriculum Vitae

(Updated, 12/15/16)

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### CURRENT EMPLOYMENT

**Head, Astronomy & Astrophysics Research Laboratory**

**Curator of Meteorites**

North Carolina Museum of Natural Sciences

121 West Jones Street, Rm. 3802B

Raleigh, NC 27603

**Assistant Professor**

Department of Physics and Astronomy

Appalachian State University

Boone, NC 28608

Email: [rachel.smith@naturalsciences.org](mailto:rachel.smith@naturalsciences.org); [smithrl2@appstate.edu](mailto:smithrl2@appstate.edu)

Phone: 919.707.8239

### EDUCATION

**University of California, Los Angeles, Los Angeles, CA**

(2011) Doctor of Philosophy, Cosmochemistry/Astrochemistry (officially, Geochemistry)

Advisors: Prof. Edward D. Young (Geochemistry/Cosmochemistry, UCLA);

Dr. Klaus M. Pontoppidan (now, Space Telescope Science Institute); and

Prof. Mark Morris (Astronomy, UCLA)

*Thesis: High-resolution near-infrared observations toward protostellar objects as proxies for solar system chemical evolution*

**University of California, Los Angeles, Los Angeles, CA**

(2009) Master of Science, Cosmochemistry/Astrochemistry (officially, Geochemistry)

**Cornell University, New York State College of Veterinary Medicine, Ithaca, NY**

(1998) Doctor of Veterinary Medicine

**Cornell University, College of Agriculture and Life Sciences, Ithaca, NY**

(1995) Bachelor of Science

### AWARDS & HONORS

(2010) *Gordon A. McKay Award*, The Meteoritical Society

(2009) *Chambliss Astronomy Achievement Student Award*, American Astronomical Society

(2009) *Career Development Award*, Lunar and Planetary Institute

(2007) *Best Poster Award*, Kobe International School of Planetary Sciences 2007, Hyogo, Japan

### PUBLICATIONS (Peer-reviewed)

Smith R. L., Pontoppidan K. M., Young E. D. and Morris M. R. (2015) Heterogeneity in  $^{12}\text{CO}/^{13}\text{CO}$  abundance ratios toward solar-type young stellar objects. *The Astrophysical Journal* 813, 120.

Young E. D., Gounelle M., Smith R. L., Pontoppidan K. M., and Morris M. R., (2011). Astronomical oxygen isotopic evidence for supernova enrichment of the solar system birth environment by propagating star formation. *The Astrophysical Journal* 729, 43.

**Smith R. L.**, Pontoppidan K. M., Young E. D., Morris M. R. and van Dishoeck E. F. (2009) High-precision  $C^{17}O$ ,  $C^{18}O$  and  $C^{16}O$  measurements in young stellar objects: analogues for CO self-shielding in the early solar system. *The Astrophysical Journal* 701, 163-175.

Pumbwe L., Chang A., **Smith R. L.** and Wexler H. M. (2007) BmeRABC5 is a multidrug efflux system that can confer metronidazole resistance in *Bacteroides fragilis*. *Microb Drug Resist.* Summer;13(2):96-101.

Pumbwe L., Chang A., **Smith R. L.** and Wexler H. M. (2006) Clinical significance of overexpression of multiple RND-family efflux pumps in *Bacteroides fragilis* isolates. *J Antimicrob Chemother.* Sep;58(3):543-8.

Pumbwe L., Ueda O., Yoshimura F., Chang A., **Smith R. L.**, Wexler H.M. (2006) *Bacteroides fragilis* BmeABC efflux systems additively confer intrinsic antimicrobial resistance. *J Antimicrob Chemother.* Jul;58(1):37-46.

## AWARDED GRANTS

### Current:

(2016) Project years: 2017-2019 (3 years). PI. Smith, R.L. (PI), Guidpati, M., Willacy, K., Blake, G., Boogert, A., Pontoppidan, K. *Investigating Carbon Inheritance in the Early Solar Nebula: An Interdisciplinary Approach*. NASA Emerging Worlds Research Program. \$462,000.

(2015) Project years: 2016-2020 (5 years). Co-I, and NCMNS PI for subaward. *OpenSpace: An Engine for Dynamic Visualization of Earth and Space Science for Informal Education and Beyond*. PI, Rosamond Kinzler, American Museum of Natural History. Budget: \$6,289,489. NASA Science Mission Directorate Science Education Cooperative Agreement Notice (CAN).

### Past:

(2016) Summer 2017 Astrophysics Lab Intern funding, NASA North Carolina Space Grant Consortium. \$5,000. Role: PI and supervisor.

(2016) Office of Student Research/Undergraduate Research Award, Appalachian State University. Spring 2016, Student: Sarah Harvey. Project: *Detailed CO analyses of young stellar binaries and isolated cores using high-resolution spectroscopy*. \$1,000.

(2016) Summer Intern 2016, 3D Modeling of Museum Meteorites, Youth Advocacy Internship Office/Department of Environment and Natural Resources. \$3,300 (Step 1, approved; full funding pending budget allocation) Role: PI and co-supervisor), w/Eric Knisley.

(2015) Summer 2016 Astrophysics Lab Intern funding, NASA North Carolina Space Grant Consortium. \$6,000. Role: PI and supervisor.

(2015) Smith, R.L. *From Local Sky to Deep Space: Connecting Museum Visitors to Astronomy & Astrophysics*, NASA NC Space Grant Consortium, Education/Public Outreach Program. \$2,500 + \$2,515 in cost matching. Role: PI.

(2015) Summer 2015 Intern, Meteorite Curation and Astrophysics, Youth Advocacy Internship Office/Department of Environment and Natural Resources. \$3,300. Role: PI and supervisor.

(2014) Summer 2015 Astrophysics Lab Intern funding, NASA North Carolina Space Grant Consortium. \$5,000.  
Role: PI and supervisor.

(2014) Summer 2014 Astrophysics Lab Intern funding, NASA North Carolina Space Grant Consortium. \$6,000.  
Role: PI and supervisor.

(2014) Summer 2014 Intern, Astrophysics Lab, Youth Advocacy Internship Office/Department of Environment and Natural Resources, \$3,300.

(2014) Research and lab grant, Research and Collections, NC Museum of Natural Sciences, \$4,750.

(2013) Research and lab grant, Research and Collections, NC Museum of Natural Sciences, \$4,500.

(2012) **Smith, R.L.** NASA NC Space Grant Consortium, New Investigator Program. *Investigating solar system evolution using high-resolution spectroscopy and radiative transfer modeling* (Award#: NNX10AI68H), \$14,993 + \$7,500 in cost matching.  
Role: PI.

## AWARDED OBSERVING PROPOSALS

### Current:

(2016) Blake, G. A. and Smith, R. L. *Investigating Carbon Reservoirs in Protoplanetary Systems: A Study of Carbon Chemistry Across the Galaxy*. Keck Observing Program, Caltech Allocation Committee. 2017A, C295. 2 nights, May 12, July 2, 2017.

(2015) Co-I. PI, Adwin Boogert. Other Co-Is: Richter, M., Indriolo, N., DeWitt, C., Neufeld, D., Karska, A., Bergin, T. *The Mystery of Sulfur in Dense Environments: EXES Spectroscopy of Sulfur Dioxide toward Massive Protostars*. SOFIA. **Flew on March 21-22, 2016 flight as "guest investigator."**

### Past:

(2014) Blake, G., **Smith, R.**, Iopollo, S. *Observing Carbon Reservoirs Toward Massive Protostars: A Continuing Investigation of Protoplanetary Prebiotic Chemistry*. Keck Observing Program, Caltech Time Allocation Award (2014, Semester B, Award#: 2014B\_C238NS, 1 night, ~ \$100K in telescope time).  
Role: Co-I, led proposal writing, planned and led observing.

(2013) Blake, G., **Smith, R.**, Iopollo, S., *Carbon Reservoirs in High-UV Protostellar Environments: A Continuing Investigation of Solar System Chemistry*. Keck Observing Program, Caltech Time Allocation Award. (2014, Semester A, Award#: NIRSPEC 2014A\_C237NS, 1.5 nights, ~ \$150K in telescope time).  
Role: Co-I, Led proposal writing, planned and led observing.

(2011) **Smith, R.**, Blake, G. *Carbon chemistry in high-UV protostellar environments: an investigation of Solar System evolution*. Keck Observing Program, Caltech Time Allocation Award, (2012, Semester A, Award#: NIRSPEC 2012A\_C214NS, 1 night, ~ 100K in telescope time).  
Role: PI, Led proposal writing and submission, planned and led observing.

## **PUBLISHED SCIENTIFIC CONFERENCE PROCEEDINGS**

### **(2016)**

**Smith, R.L.**, Blake, G. A., Boogert, A.C.A., Pontoppidan, K. M., Lockwood, A. C. (2016) High-Resolution Observations of CO Toward Massive Young Stellar Objects: Investigations of Protoplanetary Carbon and Oxygen in the Galaxy, 47<sup>th</sup> Lunar and Planetary Science Conference (oral contribution).

### **(2015)**

**Smith, R.L.**, Blake, G. A., Boogert, A.C.A., Pontoppidan, K. M., Lockwood, A. C. (2015) Investigating Protoplanetary Carbon Reservoirs and Molecular Inheritance along a Galactic Gradient, 78<sup>th</sup> Meteoritical Society Meeting, Berkeley, CA, 2015 (oral contribution).

**Smith, R.L.**, Blake, G. A., Boogert, A.C.A., Pontoppidan, K. M., Lockwood, A. C. (2015) Investigating Molecular Inheritance of Carbon in Star-forming Regions along a Galactic Gradient, International Astronomical Union General Assembly, Honolulu, Hawaii, Aug. 2015 (poster contribution).

### **(2014)**

**Smith, R.L.**, Blake, G. A., Boogert, A.C.A., Pontoppidan, K. M., Lockwood, A. C. (2014). Investigating Protostellar Carbon Reservoirs with High-Resolution Spectroscopy Toward Massive Young Stellar Objects. 77<sup>th</sup> Meteoritical Society Meeting, Casablanca, Morocco, LPI, No. 1800, p. 5435 (oral contribution).

**Smith, R.L.**, Blake, G. A., Boogert, A.C.A., Pontoppidan, K. M., Lockwood, A. C. (2014). New observations of CO isotopologues toward massive protostars: an expanded view of molecular reservoirs in the galaxy. 45<sup>th</sup> Lunar and Planetary Science Conference, The Woodlands, TX, LPI, No. 1777, p. 2563 (oral contribution).

### **(2013)**

**Smith, R.L.**, Pontoppidan, K. M., Blake, G. A., Lockwood, A. C. (2013). Observations of carbon and oxygen isotopic heterogeneity toward protostars ranging in morphology and parent cloud. 44<sup>th</sup> Lunar and Planetary Science Conference, The Woodlands, TX, LPI, No.1719, p. 2698 (oral contribution).

**Smith, R.L.**, Pontoppidan, K. M., Blake, G. A., Boogert, A.C.A., Lockwood, A. C. (2013) Observations of isotopic heterogeneities toward embedded cores and binary systems: potential tracers of varying chemical evolutionary pathways in protostellar gas. Protostars and Planets VI, Heidelberg, July 15-20, 2013. Poster #1S027 (poster contribution).

### **(2011)**

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., and Morris, M. R. (2011). Observational signatures of carbon isotope ice-gas fractionation towards solar-type protostars. 42<sup>nd</sup> Lunar and Planetary Science Conference, The Woodlands, TX, LPI, No. 1608, p.1281 (oral contribution).

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., and Morris, M. R. (2011). Observations of <sup>12</sup>CO-<sup>13</sup>CO partitioning toward solar-type protostars as proxies for solar system chemical evolution. 74<sup>th</sup> Meteoritical Society Meeting, London, England, *Meteoritics & Planetary Science (Supplement)*, id. 5406 (oral contribution).

### **(2010)**

**Smith, R. L.**, Pontoppidan, K. M., Herczeg, G. J., and Young, E. D (2010). Observations Of Unusual Carbon Isotope Fractionation In Protostars Using VLT/CRIRES, American Astronomical Society, AAS Meeting #215, Washington, D.C., #369.06; Bulletin of the American Astronomical Society, Vol. 42, p.560 (oral contribution).

Young, E. D., **Smith, R. L.**, Gounelle, M., Morris, M. R., and Pontoppidan, K. M., Astronomical Oxygen Isotopic Evidence for Supernova Enrichment of the Solar System Birth Environment, American Astronomical Society, AAS Meeting #215, #334.01; Bulletin of the American Astronomical Society, Vol. 42, p.433.

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., and Morris, M. R. (2010). Observations of high  $^{12}\text{CO}/^{13}\text{CO}$  toward protostars and implications for the origin of the  $^{12}\text{C}/^{13}\text{C}$  ratio in the solar system, 41<sup>st</sup> Lunar & Planetary Science Conference, The Woodlands, TX, LPI Contribution No. 1533, p.2254 (oral contribution).

Young, E. D., **Smith, R. L.**, Gounelle, M., Morris, M. R., and Pontoppidan, K. M., The oxygen isotopic case for supernova enrichment of the solar system birth environment, 41<sup>st</sup> Lunar and Planetary Science Conference, The Woodlands, Texas. LPI Contribution No. 1533, p.1550.

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., and Morris, M. R. (2010). Observations of high  $^{12}\text{CO}/^{13}\text{CO}$  toward protostars and implications for the origin of the  $^{12}\text{C}/^{13}\text{C}$  ratio in the solar system, 41<sup>st</sup> Lunar & Planetary Science Conference, The Woodlands, TX, LPI Contribution No. 1533, p.2254 (oral contribution).

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., and Morris, M. R. (2010). New Insights on the Origin of the solar system  $^{12}\text{C}/^{13}\text{C}$  ratio using protostellar observations and radiative transfer modeling, Disks, Meteorites, Planetesimals Workshop, American Museum of Natural History, New York City, NY, 07/2010 (oral contribution).

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., and Morris, M. R. (2010). New  $^{12}\text{CO}/^{13}\text{CO}$  observations in young stellar objects and molecular clouds: implications for  $^{12}\text{C}/^{13}\text{C}$  in the early solar nebula. 73<sup>rd</sup> Meteoritical Society Meeting, New York City, NY, *Meteoritics & Planetary Science (Supplement)*, id. 5381 (oral contribution).

**Won the Gordon A. McKay Award** – given to the best oral presentation by a student at the annual meeting ([http://meteoriticalsociety.org/?page\\_id=64](http://meteoriticalsociety.org/?page_id=64)).

## (2009)

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., and Morris, M. R. (2010). Observations of high  $^{12}\text{CO}/^{13}\text{CO}$  toward protostars and implications for the origin of the  $^{12}\text{C}/^{13}\text{C}$  ratio in the solar system, 40<sup>th</sup> Lunar & Planetary Science Conference, The Woodlands, TX, id.1471 (oral contribution).

**Smith, R. L.**, Pontoppidan, K. M., and Herczeg, G. J. (2009). Observations of  $^{12}\text{C}/^{13}\text{C}$  fractionation in embedded protostars using VLT-CRIRES. American Astronomical Society, AAS Meeting #214, #422.05; Bulletin of the American Astronomical Society, Vol. 41, p.691 (poster contribution).

**Won the Chambliss Astronomy Achievement Student Award** -- given to recognize exemplary research by undergraduate and graduate students who present at one of the poster sessions at the meetings of the AAS (<http://aas.org/grants-and-prizes/chambliss-astronomy-achievement-student-awards>).

## (2008)

Young, E. D., **Smith, R. L.**, Gounelle, M., Morris, M. R., and Pontoppidan, K. M., Solar system oxygen isotope ratios: a consequence of Type II supernovae pollution, 39<sup>th</sup> Lunar and Planetary Science Conference, League City, Texas. LPI Contribution No. 1391., p.1329 (oral contribution).

## (2007)

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., Morris, M. R., van Dishoeck, E. F. (2007). Detection of rare CO isotopologues in protostellar disks: an infrared investigation of molecular self-shielding, The Chronology of Meteorites and the Early Solar System workshop, Kauai, Hawaii (poster contribution).

**Smith, R. L.**, Young, E. D., and Morris, M. R., and Pontoppidan, K. M. (2007) Detection of rare CO isotopologues in a protostellar disk: towards an astronomical approach to understanding oxygen isotopes in the solar system, 38<sup>th</sup> Lunar & Planetary Science Conference, League City, TX, LPI Contribution No. 1338, p.2293 (oral contribution).

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., Morris, M. R., van Dishoeck, E. F. (2007). Detection of Rare CO Isotopologues in Protostellar Disks Using CRIRES and NIRSPEC. American Astronomical Society, AAS Meeting #211, #50.01; Bulletin of the American Astronomical Society, Vol. 39, p.811 (poster contribution).

## COURSES TAUGHT (Current; Appalachian State University, new undergraduate courses)

*Astrobiology: Searching for Life in the Universe* (Gen Ed since 2016), Spring 2013; Spring 2014; Spring 2015, Spring 2016, Spring 2017.

*Star Formation*, Fall 2014, Fall 2015, Fall 2016.

## NON-PUBLISHED SCIENTIFIC PROCEEDINGS

### (2016)

Matchunis, K. and **Smith, R. L.** Analysis of  $[^{12}\text{C}^{18}\text{O}]/[^{12}\text{C}^{17}\text{O}]$  Abundance Ratios of Young Stellar Objects in the Local Solar Neighborhood. State of NC Undergraduate Research and Creativity Symposium, and NC Space Grant Undergraduate Student Symposium, NC Central University, Nov. 5 (poster contribution).

Boogert, A., Richter, M., DeWitt, C., Indriolo, N., Neufeld, D., Karska, A., Bergin, T., and **Smith, R.** EXES Observations of CH<sub>4</sub> and SO<sub>2</sub> Toward Massive Young Stellar Objects. *The Local Truth: Star-Formation and Feedback in the SOFIA Era – Celebrating 50 Years of Airborne Astronomy*. Pacific Grove, CA (oral contribution).

Harvey, S. and **Smith, R. L.** (2016) Detailed Analysis of Carbon Monoxide Isotopologues Toward Young Stellar Objects using High-Resolution Spectroscopy. Annual Celebration of Student Research and Creative Endeavors, Appalachian State University (poster contribution). ***Finalist for the Undergraduate Student Poster Competition.***

### (2015)

Harvey, S. (ASU student). and **Smith, R. L.** (2015) Identifying CO Isotopologues Toward Young Stellar Binaries and Isolated YSOs using High-Resolution Spectroscopy. State of NC Undergraduate Research and Creativity Symposium, and North Carolina Space Grant Board of Directors and Advisory Council, High Point University (poster contribution).

### (2014)

**Smith, R. L.** (2014) Exploring the solar system: Voyage to the Sun, Asteroid Belt, and Beyond. North Carolina Academy of Science, 111<sup>th</sup> Annual Meeting, North Carolina Museum of Natural Sciences (oral contribution).

### (2013)

**Smith, R.L.**, Pontoppidan, K. M., Blake, G. A., Boogert, A.C.A., Lockwood, A. C. (2013). Observations of isotopic heterogeneities toward embedded cores and binary systems: potential tracers of varying chemical evolutionary pathways in protostellar gas. Gordon Research Conferences, Origins of Solar Systems, Mt. Holyoke, MA (poster contribution).

**Smith, R.L.**, Pontoppidan, K. M., Blake, G. A., Boogert, A.C.A., Lockwood, A. C. (2013). Observations of spatial dispersion in C and O isotopic heterogeneity toward protostellar cores and binaries. ALMA Workshop, Hawaii (poster contribution).

**Smith, R.L.**, Pontoppidan, K. M., Blake, G. A., Boogert, A.C.A., Lockwood, A. C. (2013). Observations of unusual CO isotopologue abundances toward protostars. Workshop on Ice and Planet Formation, Lund Observatory, Lund, Sweden (oral contribution).

### (2011)

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., Morris, M. R., Herczeg, G. J., and van Dishoeck, E. F. (2011) Observations of CO isotopologues in young stellar objects and molecular clouds: implications for early solar system chemistry. Hawaii NASA Astrobiology Winter School (poster contribution).

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., and Morris, M. R. (2011) Observational signatures of  $^{12}\text{CO}$ - $^{13}\text{CO}$  partitioning in ice and gas toward local young stellar objects and molecular clouds. Gordon Research Conferences, Origins of Solar Systems, Mt. Holyoke, MA (poster contribution).

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., and Morris, M. R. (2011). Signatures of  $^{12}\text{CO}$ - $^{13}\text{CO}$  partitioning in ice and gas toward local young stellar objects and molecular clouds. International Astronomical Union symposium, The Molecular Universe, Toledo, Spain (poster contribution).

### (2010)

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., and Morris, M. R. (2010). Observational signatures of  $^{12}\text{CO}$ - $^{13}\text{CO}$  partitioning in ice and gas toward local young stellar objects and molecular clouds. Student Symposium, UCLA (oral contribution).

### (2009)

**Smith, R. L.**, Pontoppidan, K. M., Herczeg, G. J., and Young, E. D (2009). Observations of unusually high  $^{12}\text{C}/^{13}\text{C}$  fractionation in protostars using VLT-CRIRES. From Circumstellar Disks to Planetary Systems Workshop, Max-Planck-Institut für extraterrestrische Physik, Garching, Germany (poster contribution).

**Smith, R. L.**, Pontoppidan, K. M., Herczeg, G. J., and Young, E. D (2009). VLT-CRIRES observations of  $^{12}\text{C}/^{13}\text{C}$  fractionation in protostellar envelopes, Goldschmidt conference, Davos, Switzerland (oral contribution).

**Smith, R. L.**, Pontoppidan, K. M., Young, E. D., Morris, M. R., van Dishoeck, E. F., and Herczeg, G. J. (2009). Observations of rare CO isotopologues in young stellar objects using VLT-CRIRES: evidence of self-shielding in early solar system analogues, Gordon Research Conference, Origins of Solar Systems, Mt. Holyoke, MA (poster contribution).

## (2007)

**Smith, R. L.,** Pontoppidan, K. M., van Dishoeck, E. F., Young, E. D., and Morris, M. R. (2007)

Detection of rare CO isotopologues in protostellar disks: an infrared investigation of molecular self-shielding, Kobe International School of Planetary Sciences: The Origin and Evolution of Planetary Materials, Hyogo Japan. **Won Best Poster Award.**

## (1998)

**Smith, R. L.,** et al., Shell Repair in a Loggerhead Sea Turtle, American Association of Zoo Veterinarians, Omaha, NE, 1998 (oral contribution).

## Participant:

(2015) Supernova Fifty-One Erg Conference, NC State (invited participant).

(2012) Origins of Planetary Systems workshop, Weizmann Institute, Rehovot, Israel.

(2010) Extrasolar Planets and Habitability Summer School, UIMP, Santander, Spain.

## Travel Grants and Fellowships:

(2015) Travel grant, American Astronomical Society, for attending the IAU General Assembly 2015. \$1500.

(2014) Travel grant for Dr. Harold Connolly to present at Astronomy Days, NC Museum of Natural Sciences \$400.

(2010) NSF travel grant, 73rd annual meeting of the Meteoritical Society, New York City, NY

(2009) Travel grant, From Circumstellar Disks to Planetary Systems workshop, European Southern Observatory/Max-Planck-Institut für extraterrestrische Physik, Garching, Germany

(2009) Travel grant, Geochemical Society of America, Goldschmidt Conference, Davos, Switzerland

(2009) Travel grant, Gordon Research Conference, Origins of Solar Systems, Mt. Holyoke College, MA

(2009) Faculty Mini-Grant, Office of Instructional Development, UCLA

(2007) Travel grant, Kobe International School of Planetary Sciences, Hyogo, Japan

(2007) Travel grant, University of Hawaii, The Chronology of Meteorites and the Early Solar System workshop, `Kauai, Hawaii

(2006) Inter-departmental Cross-Training Fellowship, Dept. of Earth and Space Sciences, UCLA

Mark R. Morris, Dept. of Physics & Astronomy, project co-advisor. Project title: *Photochemistry and isotope fractionation in circumstellar disks: an astronomical approach to cosmochemical phenomena in early solar nebulae.*

## INVITED SCIENTIFIC PRESENTATIONS

(2016) Wake Forest University physics colloquium (11/30).

(2015) COSMS retreat, UNC-CH (5/7): "Elevator Pitch" on current research.

(2014) North Carolina Academy of Science, 111<sup>th</sup> Annual Meeting, NC Museum of Natural Sciences.

(2014) Science Lunch, NCMNS, for R&C staff.

(2013) Science Lunch, NCMNS, for R&C staff.

(2012) ASU Physics & Astronomy Colloquium, September, 2012.

(2012) North Carolina State University, Physics & Astronomy Journal Club, April. 2012.

(2012) American Museum of Natural History, New York City. Astrophysics Colloquium, Feb. 2012.

(2012) University of North Carolina at Chapel Hill. Astrophysics Colloquium, Feb. 2012.

(2010) Carnegie Institute of Washington, Astronomy Group seminar, January 2010.

(2010) Institute for Geophysics and Planetary Physics colloquium, UCLA.

(2009) California Institute of Technology, Journal Club seminar.

(2009) Presentation of latest CRIRES results, CRIRES team meeting, Max-Planck-Institut für extraterrestrische Physik, Garching, Germany, October, 2009.

(2009) Star and Planet Formation Group seminar, ETH, Zurich, Switzerland.



- (2008) Presentation of latest CRIRES results, SPITZER-IRS/CRIRES joint team meeting, California Institute of Technology, November, 2008.
- (2008) Presentation of latest CRIRES results, CRIRES team meeting, Max-Planck-Institut für extraterrestrische Physik, Garching, Germany, May, 2008.
- (2007) Presentation of latest CRIRES results, CRIRES team meeting, California Institute of Technology, September, 2007.

## INVITED OUTREACH (EXTERNAL)

### 2017

- (6/20) Tar Heel Gem and Mineral Club, Raleigh. Talk on *Meteorites and the Origin of Life on Earth and Beyond*.
- (2/8) Osher Lifelong Learning Institute (NCSU). Instructor, short course, *Space Travelers: Human endeavors to reach the stars*.

### 2016

- (12/1) Guest speaker, Space Explorers Club, Cardinal Gibbons High School
- (11/18-19) *The Planets Live!* Pre-concert program, NC Symphony, interview with Catherine Brand (host, NPR) for Symphony patrons, Duke Energy Performing Arts Center
- (7/11) American Museum of Natural History. *OpenSpace* team meeting, overview presentation of NCMNS participation with *OpenSpace* software.
- (5/12) Raleigh Astronomy Club. *Astronomy from the Stratosphere: Observing with EXES on SOFIA*.
- (4/25) Panelist: *The Future of Space*. Cary Academy
- (3/6) Bayport educational series lecture (Longboat Key, FL), *Exploring planetary systems and life beyond Earth*.
- (1/20) Osher Lifelong Learning Institute (NCSU). Instructor, short course, *Exploring planetary systems and life beyond Earth*.

### 2015

- (7/11) Host for inaugural Neutrino Day event. Includes guest scientists in physics and live-feeds to the Sanford Lab, South Dakota.
- (5/7) COSMS retreat, UNC-CH. Discussions with scientists and educators on important questions at the cutting-edge of physics, astrophysics, and outreach.
- (4/13) Celebrate Women in STEM Dinner, NCSU. Includes student mentoring.
- (3/4) Cleveland High School, Clayton, NC. Topic: Ethics of space exploration and planetary protection.
- (12/13) Dark Sky Observatory, ASU, Public Observing night. Guest astronomer for evening program.

### 2014

- (8/1) High school careers in math contributor (Print. contact, Trey Ferguson).
- (4/24) Siemens "Bring your child to work day." Presentation on research at museum, w/P. Treuthardt.
- (4/9) STEM EXPO, ASU. Meteorites and impact cratering presentation and activity, w/Anthony Love.
- (1/14) CHAOS astronomy club. Presentation of research.

### 2013

- (6/17) REU workshop, UNC: How to present to museum audiences.
- (6/14) Central NC Mineral Club presentation on research.
- (2/28) STEM conference, ASU. Short presentation on Astronomy & Astrophysics Lab.
- (1/16) Croasdaile Village, Topic: solar system exploration.

## POPULAR PUBLICATIONS

- (2016) NC Symphony, 2016-2017 Program, *The Planets: LIVE! An Out-of-this-World Partnership*. Provided images and captions, and made significant contributions to article text.

- (2016) **Smith, R. L.** Lab intern highlight: Elisabeth Panto, The Intern: State of North Carolina Internship Program. July 8 issue.
- (2016) **Smith, R. L.** Stratopsheric Adventure. *Naturalist*, Spring.
- (2016) **Smith, R. L.** Researcher gets a closer look at the stars. *News & Observer/Charlotte Observer*, April 16.
- (2015) **Smith, R. L.** July brings close peek at Pluto. *News & Observer; Charlotte Observer*, May 31.
- (2015) **Smith, R. L.** On the origin of the solar system: comet landing makes history. *Naturalist*, Winter.
- (2015) **Smith, R. L.** On the origin of the solar system: shedding new light on planet formation. *Naturalist*, Winter.
- (2015) **Smith, R. L.** Image of protostar suggests planets form earlier. *News & Observer; Charlotte Observer*, Jan 4.
- (2014) **Smith, R. L.** Scientists search for new Earths. *News & Observer; Charlotte Observer*, Aug 3.
- (2012) **Smith, R. L.** Chemical clues to solar system origins. *Naturalist*, Winter.
- (2013) **Smith, R. L.** Meet the Museum Scientists (biography). *Naturesearch* Newsletter. Issue 03.
- (2012) **Smith, R. L.** The Chemistry of forming solar systems, Current Research Briefs. Issue 02.
- (2011) Pontoppidan, K. M., van Dishoeck, E. F., Blake, G. A., **Smith, R.**, et al. 2011. Planet-forming regions at the highest spectral and spatial resolution with VLT–CRIRES. *The Messenger*, 143, 32-36.

### **Blogs:**

- (2012- present) **Smith, R. L.** 2012- present. Numerous astronomy-related blogs  
<http://naturalsciencesresearch.wordpress.com/author/rachel1010/>

### **Media Interviews:**

#### **2016**

- (11/15) North Carolina Symphony promotional video for Holst's *The Planets*:  
<http://www.ncsymphony.org/events/index.cfm?view=details&detailid=3223&eid=4194>
- (3/9) Time Warner Cable interview, taped. Topic: Transit of Mercury (during event)
- (3/7) WRAL Studio. Live. Topic: Transit of Mercury

#### **2015**

- (6/6) WRAL Studio. Live. Topic: International SUNDAY.
- (1/21) WNCN- NC Today. Live. Topic: meteorites and Astronomy Days.
- (1/21) Sci-Works Radio. Topic: my research and related topics. Two online interview postings.

#### **2014**

- (12/4) WRAL Weather segment. Live (and on WRAL Facebook page) w/Elizabeth Gardner. Topic: Orion launch.
- (6/7) WRAL Studio. Live. Topic: International SUNDAY.
- (1/23) WRAL Weather segment. Live w/Elizabeth Gardner. Topic: meteorites, Chelyabinsk.
- (1/17) News & Observer. Recorded. Topic: My research at museum.

#### **2013**

- (10/5) WRAL Studio. Live. Topic: International Observe the Moon Night.
- (9/5) WRAL Weather Segment w/Mike Maze. Topic: LADEE launch.
- (2/5) WRAL Weather Segment. Live. Topic: International Space Station.
- (5/18) WRAL Weather Segment. Live w/Mike Maze. Topic: Astronomy Days.

### **MUSEUM AND OUTREACH CONFERENCES**

#### **(2013)**

**Smith, R. L.** (Presenter and Session Leader), Horvath, J., Trautwein, M., Kwiek, N., Huffman, K. (2013). Integrating scientists and their research into the science museum matrix. Association of Science Technology Conferences, Albuquerque, N.M.

#### **(2012)**

**Smith, R. L.** (2012). The astronomy & space observation research laboratory: A new platform for communicating science to museum audiences. Astronomical Society of the Pacific, Tucso, AZ (poster contribution).

## CREATIVE ENDEAVORS & MENTORING

As Head of the Astronomy & Astrophysics Research Laboratory & Curator of Meteorites at the North Carolina Museum of Natural Sciences, highlights:

- ★ Developing ongoing vision for visitor engagement via glass-wall interface of the lab.
- ★ Mentoring students working and volunteering in the lab Astronomy & Astrophysics Lab.
- ★ Acquired new equipment for research and outreach:
  - Nikon polarizing light microscope for viewing meteorite thin sections (25 K, from Museum Director's fund).
  - H-alpha solar telescope for outreach programs and student projects (5 K, from ASU).
  - Celestron night-viewing scope w/filters (1.5 K, from Museum Director's fund).
  - Two 10-inch Meade night scopes for outreach programs (donations).
  - 4 LEED-grade desk lamps for lab (Exhibits fund).
  - Sony Camera 70 mm digital camera + accessories (for meteorite archiving and lab use)
- ★ Initiated and led new astronomy-themed special events:
  - Transit of Mercury (5/9/16) – observing and talks
  - Rosetta landing on comet (11/12/14) – presentation and live stream.
  - International Sun-Day at the museum - presentation and observing (6/22/14; repeated in 2015, 2016)
  - International Observe the Moon Night at the museum – presentation and observing (10/12/13).
  - Venus Transit event – observing, presentations and live-streaming (June 2012).
- ★ Facilitating ongoing connections with ASU and Dark Sky Observatory via live observing w/Dan Caton; new proposal development to set up.
- ★ Development and acquiring of new exhibits.
- ★ Label writing (Chelyabinsk meteorite display; meteorite label re-write).
- ★ Image acquisition: Chelyabinsk meteorite display case; meteorite label.
- ★ Astronomy Exhibit Cases: Glass Eagle Nebula (located artist, Alyssa Joy, and chose piece).
- ★ Astronomy Exhibit Cases: Glass Planet display (located artist, Alyssa Joy, chose pieces, installed with Exhibits team).
- ★ Regular “meet the scientist” presentations to museum public in Daily Planet Theater and Science Cafes on topics ranging from space missions, new discoveries, and personal research projects; invited presentations for community outreach.
- ★ Enabling connections with local REU groups at UNC and NC State, providing workshops on presenting science to the public.

As Assistant Professor at Appalachian State University, highlights:

- ★ Creating and teaching two undergraduate courses for the Department of Astronomy & Astrophysics: *Astrobiology: Searching for Life in the Universe*, Spring 2013; Spring 2014; Spring 2015; and *Star Formation*, Fall 2014.
- ★ Reconfiguring the Astrobiology course an Honors College Freshman Seminar, taught in Fall, 2014.
- ★ As of January, 2015, *Astrobiology: Searching for Life in the Universe* was approved by the University as a General Education course.

### Students Mentored in Astronomy & Astrophysics Lab:

Michael Tucker (ASU, 2016, Astrovisualization Summer Intern, AMNH grant)

Katherine Matchunis (ASU, 2016, Astrophysics Summer Intern, NC Space Grant)

Elisabeth Panto (ASU, 2016, Meteorite 3D Visualization/Curation Intern)

Sarah Harvey (ASU, 2015, Astrophysics intern, NC Space Grant)

Justin Garrett (NCSU, 2015 DENR-YAIO Summer Intern, Meteorite Curation)

Graham Henry (ASU, course credit)

Katherine Matchunis (ASU, 2015, research intern, stipend from ASU)

Robert Buhrman (NC State, undergraduate, 2014 ASTC and 2015 Astronomy Days volunteer; summer 2015)

Megan Kim (High school, 2015-present)  
Margie Bruff (Enlo High school, as of 2014- NC School for Science and Mathematics, 2012-present)  
Tara Miller (ASU, undergraduate, 2015 Astronomy Days volunteer)  
Timothy Stone (ASU, undergraduate, 2015 Astronomy Days volunteer)  
Lucas James (ASU, undergraduate, 2015 Astronomy Days volunteer)  
Quinlin Riggs (ASU, undergraduate, 2014 ASTC volunteer)  
Charles Kurgatt (ASU, MS student paid intern, 2014, NC Space Grant)  
Frank Luca (ASU, MS student paid intern, 2014, DENR-YAIO/NC Space Grant)  
Mithi de los Rayes (NC State, undergraduate, 2014)  
Benjamin Beaumont (NC State, undergraduate, 2013-2014)  
Christal Chowthin (NC State, undergraduate, 2013)  
Ryan Beauchemin (UNC, undergraduate, 2013)  
Sandra Blevins (visiting grad student, Catholic University/Space Telescope Science Institute, Summer 2012)  
Zachary deGraffenreid (NCCU, undergraduate, pursued MS, 2012-2013)  
Travis Berger (UNC, undergraduate)

### **Adult Volunteers in Lab:**

Margaret Gaines  
Anna Morris  
Ken McAdams  
Karen Warmbein

### **Other mentoring/service:**

#### **2017**

(1/28-29) Astronomy Days, NCMNS. Proposed selected topic, "Sun and Stars."

#### **2016**

(10/6) Interview for Teen Newsroom (NCMNS). Topic: Microbes in space.  
(6/14) Interview with Miranda Broussard for *AppTV* (ASU student) on NASA research  
(4/11) Kayla Gomez, interview for Women in Science student project  
(1/30-31) Astronomy Days, NCMNS. Proposed selected topic, "Search for Life Beyond Earth." Invited and hosted guest speakers, Dr. Seth Shostak (SETI) and Dr. Klaus Pontoppidan (STScI).  
(2/4) Space Grant Scholar student interview on STEM research, Kayla Gomez  
(2/17) Masters thesis (Museology) interview on visible labs in museums: Justine Lopez, University of Washington  
(2/19) Space Grant Scholar student interview on STEM research, Olivia Paschell

### **INVITED OUTREACH (NCMNS)**

#### **2017**

(1/28) Astronomy Days. How the Sun and other stars affect planets and (potential) life.

#### **2016**

(12/16) Member Holiday Party, lab tour and evening observing.  
(12/14) Lab tour, Mountain Sun School group.  
(5/9) Transit of Mercury: "Planet One: A Brief Tour of History and Discovery on Mercury"  
(4/23) Science-Technology Festival, NCMNS. Topic: Astronomy from the Stratosphere: High-Tech Observing on SOFIA  
(1/31) Astronomy Days. "Interstellar Travel" Daily Planet talk  
(1/30) Astronomy Days. The science of "The Martian" panelist

## 2015

- (12/2) BASF corp. evening event and lab tour
- (5/14) Court of Appeals, Lab tour
- (5/6) Capstone event for Museums Connect grant; lab tour for students
- (3/27) Interview for Teen TV. Topic: Space Exploration
- (4/16) NC School for Science and Mathematics, class lab tour and discussion
- (4/11) Science-Technology Festival, NCMNS. Topic: Technology of Keck telescope mirrors and data processing
- (3/2) Citizen Science Association – Lab tour and project discussion
- (3/2) DH Conley High School – Astronomy class lab tours
- (3/25) Interview with high school students for their Carl Sagan Legacy documentary
- (3/18) Introduction to Paul Bogard, author of “The End of Night”, NCMNS.
- (1/24-25) Astronomy Days, NCMNS. Topic: Comets and why Pluto is not a planet; introduced visiting astronaut, Andrew Feustel.

## 2014

- (12/4) NCMNS, Orion launch special presentation.
- (10/20) ASTC conference, NCMNS. Organized and led lab tours and programs, and solar observing.
- (8/1) Organizer and host: NC State REU presentations in Daily Planet (contact, John Blondin).
- (6/25) Intern communications workshop, “How to give a talk”, w/Brian Malow.
- (5/3) Science Saturday, NCMNS. Topic: Astronomy on the Edge: Latest discoveries from our Solar System to the beginning of the Universe.
- (4/17) Inaugural Astronomy member event, NCMNS, Tour of meteorite exhibit, lab, and observing program.
- (4/16) Cathedral school group, 1<sup>st</sup> grade, hosted visit to lab.
- (4/7) St. Mary’s High School visit to NCMNS, tour of lab, discussion of research.
- (1/25-26) Astronomy Days, NCMNS, presentation, tour of meteorite exhibit and lab; introduction of Russian Cosmonaut.
- (1/16) Science Café, NCMNS. Invited panelist, 2014 Year-in-review.

## 2013

- (12/5) Comet ISON, NCMNS, special presentation.
- (11/8) MAVEN launch, NCMNS, special presentation.
- (11/18) Harwood Montessori School visit to lab.
- (9/6) LADEE special presentation, NCMNS.
- (7/6) Organizer and host: UNC REU presentations in Daily Planet.
- (6/17) REU workshop, UNC: How to present to museum audiences.
- (4/2) Lab tour and discussion of research for Susan McCracken, Director of External Affairs, ASU.
- (3/27) Lab tour and discussion of research for Origin of Life course, Prof. Jonathan Lindsay, NCSU.
- (3/2) Science Saturday, NCMNS. Topic: Search for life in the Universe.
- (2/28) STEM conference, ASU. Short presentation on Astronomy & Astrophysics Lab.
- (2/5) ISS downlink w/astronaut John Marshburn. Provided introduction for audience prior to downlink, NCMNS.
- (1/27) Tour of lab and brief discussion of research with Dr. Jim Green, NASA HQ.
- (1/27) Astronomy Days presentation, NCMNS, Searching for life beyond Earth.

## 2012

- (12/12) Science Café, NCMNS. Searching for life in the Universe.
- (11/12) Teen Science Café, NCMNS.
- (9/13) Citizen Science Board, brief overview of research.
- (5/1) Hosted Astronaut Bill McArthur visit to lab; introduced presentation in theater.

## 2011

- (5/19-20) Astronomy Days presentation, NCMNS.

## **INVITED EXTERNAL OUTREACH PARTNERSHIPS**

- (2016) w/Roy Campbell, Chief of Exhibits and Digital Media at the NCMNS, partnership with the NC Symphony on providing imagery and video (created with our new *OpenSpace* project software) for the live performance of Holts', *The Planets* (performances on 11/18 and 11/19).
- (2015 – present) American Museum of Natural History, project in astrophysics visualization, with Dr. Denton Ebel, Curator (meteorites), Chair, Division of Physical Sciences, Curator-in-Charge, and Carter Emmart, Director of Astrophysics Visualization.
- (2015 – present) Institute for Cosmology, Subatomic Matter & Symmetries, with UNC at Chapel Hill, NC State University, Duke University, and Oak Ridge National Laboratory.

## **MUSEUM COMMITTEES**

- (2016) 50<sup>th</sup> Anniversary Moon Landing Commemoration Steering Committee (with historians from the NC Department of Cultural Resources)
- (2016) Impact Planning Workshop (museum evaluation project with Randi Korn & Associates)
- (2014-present) Museum-University Partnership Council
- (2013-present) Meteorite Exhibit renovation team
- (2015) Hiring committee for Science Historian joint appointment with NCSU
- (2014) Core Values Task Force
- (2012) Hiring committee for Astrophysics Lab Assistant Director

## **UNIVERSITY COMMITTEES**

- (2016) Morgan Lecture Speaker Series (speaker for 2017, Mike Brown, Caltech)

## **PAST ACADEMIC AND RESEARCH APPOINTMENTS**

- (2013- present) Visiting Scholar, Dept. of Astronomy & Astrophysics, UNC at Chapel Hill
- (2011-2012) Postdoctoral Scholar, California Institute of Technology, Pasadena California  
Blake Research Group, Astronomy & Astrochemistry, Planetary Science.
- (2005-2011) Graduate Student Researcher, UCLA  
Observations, data reduction and analysis of infrared spectra of CO isotopologues toward protostars and molecular clouds using CRILES and NIRSPEC. Taught myself IDL and coding to run the analyses.
- (2009) Teaching Fellow, Evolution of the Cosmos and Life, freshman cluster course, UCLA.
- (2005-2007) Teaching Assistant, Solar System and Planets; Oceanography.
- (2004-2005) Research Associate, VA Greater Los Angeles Healthcare System, Wadsworth Anaerobe Laboratory  
Microbiological genetic research and scientific writing; performing genetic deletions in *Bacteroides fragilis* to characterize membrane proteins and study the role of membrane pumps in drug efflux. Resulted in 3 co-authored publications.
- (2000-2002) Visiting Scientist, USGS, Astrogeology Team, Flagstaff, AZ  
Global impact cratering research with Dr. David Roddy; crater map development; hands-on impact cratering, Science Festival, Flagstaff, AZ.

- (1996) Field Researcher, The Bellairs Research Institute, McGill University, St. James, Barbados  
Barbados Sea Turtle Project: studying and monitoring the safety of nesting Hawksbill sea turtles, nest sites, eggs and hatchlings.
- (1993) Field Researcher, The School for Field Studies, Ecology of Endangered Sea Turtles, Costa Rica  
Studying Olive Ridley sea turtle nesting patterns; initiating a research project comparing adult female body size to egg count
- (1991-1993) Research Assistant, Cornell University, College of Veterinary Medicine, Ithaca, NY  
Equine Orthopedics, Equine Behavior, Canine Cardiology

## PAST NON-RESEARCH EMPLOYMENT

- (2004-2005) Freelance Exhibit Evaluator, Randi Korn & Associates, Inc., Alexandria, VA  
Remedial Evaluation: Visitor interviews, observation, and data collection  
Selected projects: *Sea Floor Science: Slopes, Slides, and Tsunamis* and *Lights! Cameras! Interaction!*  
Client: Ocean Institute, Dana Point, CA
- (2004) Freelance Exhibit Researcher/Concept Developer, BRC Imagination Arts, Burbank, CA  
Project: National Health Museum, Atlanta Georgia
- (2003-2004) *Associate Producer*, Chedd-Angier Production Company, Inc., Watertown, MA  
Content research and development, footage, image, and sound research and acquisition, label and proposal writing  
Selected projects:  
*The Search for Life Beyond Earth*. Client: New York Hall of Science. Opened fall, 2004  
*Kamikaze Experience*. Client: USS Intrepid Sea-Air-Space Museum. Opened spring, 2004  
*Adventures In Flight*, new gallery. Client: Virginia Air and Space Center. Opened 10/2003
- (2002-2003) Exhibit Developer, Jeff Kennedy Associates, Inc., Somerville, MA  
Content research and development, label and report writing, exhibit prototyping, object and image acquisition  
Selected projects:  
*The Search for Life Beyond Earth*. Client: New York Hall of Science. Opened fall, 2004  
*Connections*. Client: New York Hall of Science. Opened, fall, 2004  
*New England Economic Adventure*. Client: Federal Reserve Bank of Boston. Opened 10/2003  
*Addiction*. Client: Arizona Science Center. Opened January, 2003  
*Cosmic Questions*. Client: Harvard-Smithsonian Center for Astrophysics. Traveling; opened 9/2002  
*Molecules and Health*. Client: New York Hall of Science
- (1999-2002) Museum Educator, Museum of Life and Science, Durham, NC  
Exhibit and program development, program presentation and evaluation  
Selected projects, exhibits: *World Data*: software and data upgrade; *Sending Signals*: interactive live insect exhibit  
Selected projects, programs: Aquatic life, insect communication, planetary surfaces and solar system

## PAST COURSE DEVELOPMENT AND TEACHING

- (2008-2009) As Teaching Fellow (UCLA)

Developed and taught a seminar, *Exploring Life in the Universe*, for the undergraduate Evolution of the Cosmos and Life cluster course. Seminar was a combination of lectures, discussions, presentations and laboratory activities. Taught weekly lab sections for other parts of the other lecture portions course.

(2006-2007) As Teaching Assistant (UCLA)

Solar System and Planets, three quarters. Revised and taught weekly computer-based laboratory and discussion sections.

(2005) Teaching Assistant (UCLA)

Blue Planet: Introduction to Oceanography, Fall quarter. Taught weekly laboratory sections and designed laboratory evaluation tools.

## **PROFESSIONAL SERVICE**

(2016) Referee for ACS Omega (new journal from the American Chemical Society)

(2016) NC Space Grant proposal reviewer

(2016) Consultant on Earth's cycles and habitability for *Earth Moves* exhibit planning, Museum of Life and Science.

(2015) Moderator, State of NC Undergraduate Research and Creativity Symposium, High Point University

(2012-2015) NASA proposal review panelist

(2015) Judge of student papers for the Gordon A. McKay Award, 78<sup>th</sup> Annual Conference of the Meteoritical Society, UC Berkeley, Berkeley, CA

(2013) Judge of student papers for the Dwornik Award, Lunar and Planetary Science Conference

(2010) Conference session co-chair for session: Solar Systems Before and During Planet Formation, 73<sup>rd</sup> Annual Meeting of the Meteoritical Society, New York City, NY, with Prof. Fred Ciesla

(2009) Conference session co-chair for session: Early Nebula Processes and Models, 40<sup>th</sup> Lunar and Planetary Science Conference, The Woodlands, TX, with Dr. James Lyons

## **PROFESSIONAL MEMBERSHIPS**

Meteoritical Society; American Astronomical Society