

Christopher G. Tate

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PERSONAL STATEMENT

I have experience in radiation transport modelling, monte carlo computing, and remote sensing techniques and applications ranging from neutron spectroscopy to satellite, unmanned aerial vehicle, and ground-based imaging (visible, near-infrared, and thermal) spectroscopy. I have applied these techniques in both the martian and terrestrial settings to ascertain the amount of hydrogen in shallow planetary regoliths and the composition, presence of alteration minerals, and thermal inertias of geologic materials. I have taught courses including the topics of astronomy, physics, and remote sensing, which was particularly focused on data analysis methods of multispectral and hyperspectral remotely sensed images, and still enjoy participating in STEM educational outreach and volunteer activities. My research interests include integrating remote sensing technology and corresponding techniques into unmanned aerial systems to leverage the benefits of high-spatial and high-temporal resolution data in applications to specific problems. I am intrigued by this area of research because of the wide applicability of such technologies and techniques to everything from geologic and environmental remote sensing to humanitarian and disaster response efforts, which allows working in the field to be challenging, rewarding, and, ultimately, beneficial to many domains and applications.

EDUCATION

Ph.D. Physics
2012-2017
University of Tennessee
Knoxville, Tennessee

M.S. Physics
2010-2012
University of Tennessee
Knoxville, Tennessee

B.S. Physics, *Magna Cum Laude*
2005-2010
University of Tennessee
Knoxville, Tennessee

2001-2005
Central High School
Shelbyville, Tennessee

TECHINICAL EXPERIENCE MCNPX, IDL, ENVI, Python, Fortran, Mission Planner, ArcMap, Pix4D, DJI Go, MS Office

LICENSES

FAA 107 Remote Pilot (Issued 08/2017)

WORK EXPERIENCES

Oak Ridge National Laboratory Postdoctoral Research Associate
04/2019 to Present

- National Security Sciences Remote Sensing Group member and Special Communications and Autonomous Systems Group member
- Interact with team management, sponsors, and collaborators on developing research to meet specific science goals
- Support ORNL Unmanned Aerial Vehicle Remote Sensing and team projects through experimental design, data acquisition and implementation, and data analysis efforts
- Remote pilot

Oak Ridge National Laboratory ASTRO Postdoctoral Researcher/UAS Remote Sensing Science Team

03/2018 to 04/2019

- Interact with team management, sponsors, and collaborators on developing research to meet specific science goals
- Support ORNL Unmanned Aerial Vehicle Remote Sensing and team projects through experimental design, data acquisition and implementation, and data analysis efforts
- Remote pilot

University of TN Earth and Planetary Sciences Dept. Post Doctoral Research Associate

08/2017 to 3/2018

- Mars Science Laboratory Dynamic Albedo of Neutrons passive mode data analysis, archiving, and modelling as part of NASA Mars Data Analysis Program (MDAP) grant
- NASA Picasso SINGR Instrument development team for radiation transport modelling and field testing for active neutron die-away and gamma ray spectroscopy in CLYC scintillator material
- Study active sand dune morphology due to strong transient wind events using UAVs and derived products
- Backup remote pilot
- Mentor undergraduate student in research opportunities and methods

Mars Science Laboratory DAN Science Team Member

07/2012 to 03/2018

- Write and deliver tactical sequences to control DAN instrument onboard MSL rover *Curiosity*
- DAN passive mode data analysis and modelling
- Perform MSL rover tactical operations and onsite at NASA Jet Propulsion Laboratory and remotely

University of TN Physics Dept./Earth and Planetary Sciences Dept. Research Assistant

06/2009 to 05/2017

- Science Alliance Summer Research Fellowship (2009)
- Develop code and simulate various things, including the NNBar Experiment under supervision of Dr. Yuri Kamyshev (2009-2011)
- MCNPX modelling and study of remote detection of neutrons on planetary bodies under supervision of Dr. Jeffrey Moersch (2012-2017)

University of TN Earth and Planetary Sciences Dept. Teacher Assistant

01/2015 to 5/2017

- Geology 539 Remote Sensing lab instructor

- Teach graduate students ENVI software, remote sensing principles, and data analysis methods, involving visible, near-infrared, and thermal spectroscopy and 3D surface modelling

Life in the Atacama Project Science Team Member

01/2012 to 01/2016

- Participate in field data acquisition and analysis for both neutron spectrometer and visible/near-IR spectrometer
- Remote science team member

University of TN Physics Dept. Teacher Assistant

08/2010 to 08/2012

- Instruct and grade Physics 232/231 Engineering Physics class laboratory
- Instruct and grade Astronomy 151/152 Introductory Astronomy class laboratory, including in-class labs and telescope based labs

PUBLICATIONS

C. G. Tate, J. Moersch, I. Mitrofanov, M. Litvak, P. Bellutta, W.V. Boynton, D. Drake, B. Ehresmann, F. Fedosov, D. Golovin, C. Hardgrove, K. Harshman, D. M. Hassler, I. Jun, A.S. Kozyrev, D. Lisov, A. Malakhov, M. Mischna, M. Mokrousov, S. Nikiforov, A.B. Sanin, R. Starr, A. Vostrukhin, and C. Zeitlin (2019), Mars Science Laboratory Dynamic Albedo of Neutrons passive mode data and results from sols 753 to 1292: Pahrump Hills to Naukluft Plateau, *Icarus*, doi.org/10.1016/j.icarus.2019.04.029.

C. G. Tate, J. Moersch, I. Jun, I. Mitrofanov, M. Litvak, W.V. Boynton, D. Drake, F. Fedosov, D. Golovin, C. Hardgrove, K. Harshman, A.S. Kozyrev, R. Kuzmin, D. Lisov, E. Maclennan, A. Malakhov, M. Mischna, M. Mokrousov, S. Nikiforov, A.B. Sanin, R. Starr, and A. Vostrukhin (2018), Observed diurnal variations in Mars Science Laboratory Dynamic Albedo of Neutrons passive mode data, *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment*, doi.org/10.1016/j.nima.2018.02.100.

C. G. Tate, J. Moersch, I. Mitrofanov, M. Litvak, P. Bellutta, W.V. Boynton, D. Drake, B. Ehresmann, F. Fedosov, D. Golovin, C. Hardgrove, K. Harshman, D. M. Hassler, I. Jun, A.S. Kozyrev, D. Lisov, A. Malakhov, M. Mischna, M. Mokrousov, S. Nikiforov, A.B. Sanin, R. Starr, A. Vostrukhin, and C. Zeitlin (2017), Results from the Dynamic Albedo of Neutrons (DAN) Passive Mode Experiment: Yellowknife Bay to Amargosa Valley (Sols 201-753), *Icarus*, doi.org/10.1016/j.icarus.2017.08.022.

C. G. Tate, J. Moersch, I. Jun, D. W. Ming, I. Mitrofanov, M. Litvak, A. Behar, W.V. Boynton, L. Deflores, D. Drake, B. Ehresmann, F. Fedosov, D. Golovin, C. Hardgrove, K. Harshman, D. M. Hassler, A.S. Kozyrev, R. Kuzmin, D. Lisov, A. Malakhov, R. Milliken, M. Mischna, M. Mokrousov, S. Nikiforov, A.B. Sanin, R. Starr, A. Varenikov, A. Vostrukhin, and C. Zeitlin (2015) Water equivalent hydrogen estimates from the first 200 sols of Curiosity's traverse (Bradbury Landing to Yellowknife Bay): Results from the Dynamic Albedo of Neutrons (DAN) passive mode experiment, *Icarus*, 262, 102-123, doi:10.1016/j.icarus.2015.09.002.

Warren-Rhodes, K., K. Lee, S. Archer, D. Lacap, L. Ng-Boyle, D. Wettergreen, K. Zacny, C. Demergasso, J. Moersch, G. Chong, S. Vijayarangan, C. Thebes, M. Wagner, K. Tanaka, T. Hare, **C. Tate**, A.

Wang, J. Wei, G. Foil, N. Cabrol, and S. Pointing (2019), Subsurface microbial habitats in an extreme desert Mars-analogue environment, *Frontiers in Microbiology*, 10, 69, doi: 10.3389/fmicb.2019.00069.

Nowicki, S., L. Evans, R. Starr, J. Schweitzer, S. Karunatillake, T. McClanahan, J. Moersch, A. Parsons, and **C. Tate** (2017), Modeled Martian Subsurface Elemental Composition Measurements with the Probing In situ with Neutrons and Gamma-ray (PING) Instrument, *Earth and Space Science*, 10.1002/2016EA000162.

Litvak, M. L., I. G. Mitrofanov, C. Hardgrove, K. M. Stack, A. B. Sanin, D. Lisov, W. V. Boynton, F. Fedosov, D. Golovin, K. Harshman, I. Jun, A. S. Kozyrev, R. O. Kuzmin, A. Malakhov, R. Milliken, M. Mischna, J. Moersch, M. Mokrousov, S. Nikiforov, R. Starr, **C. Tate**, V. I. Tret'yakov, and A. Vostrukhin (2016), Hydrogen and Chlorine Abundances in the Kimberley Formation of Gale Crater Measured by the DAN Instrument Onboard the Mars Science Laboratory Curiosity Rover, *Journal of Geophysical Research: Planets*, 121, doi: 10.1002/2015JE004960.

Sanin, A. B., I.G. Mitrofanov, M.L. Litvak, D.I. Lisov, R. Starr, W. Boynton, A. Behar, L. DeFlores, F. Fedosov, D. Golovin, C. Hardgrove, K. Harshman, I. Jun, A.S. Kozyrev, R.O. Kuzmin, A. Malakhov, R. Milliken, M. Mischna, J. Moersch, M.I. Mokrousov, S. Nikiforov, V.N. Shvetsov, **C. Tate**, V.I. Tret'yakov, and A. Vostrukhin (2015), Data processing of the active neutron experiment DAN for a Martian regolith investigation, *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, 789, 114-127, doi:10.1016/j.nima.2015.03.085.

Litvak, M.L., I. G. Mitrofanov, A.B.Sanin, D. Lisov, A. Behar, W. V. Boynton, L. Deflores, F. Fedosov, D. Golovin, C. Hardgrove, K. Harshman, I. Jun, A. S. Kozyrev, A.S. Kozyrev, R.O. Kuzmin, A. Malakhov, R. Milliken, M. Mischna, J. Moersch, M. Mokrousov, S. Nikiforov, V.N.Shvetsov, K. Stack, R. Starr, **C. Tate**, V. I. Tret'yakov, A. Vostrukhin and MSL Science Team (2014), Local Variations of Bulk Hydrogen and Chlorine Content Measured at the Contact Between the Sheepbed and Gillespie Lake Units in Yellowknife Bay, Gale Crater, Using the DAN Instrument Onboard Curiosity, *Journal of Geophysical Research, Planets*, 119, doi:10.1002/2013JE004556.

Mitrofanov, I. G., M. L. Litvak, A. B. Sanin, R. Starr, D. I. Lisov, R. O. Kuzmin, A. Behar, W. 1280 V. Boynton, C. Hardgrove, K. Harshman, I. Jun, R. Milliken, M. A. Mischna, J. E. Moersch, and **C. G. Tate** (2014), Content of water and chlorine in the martian regolith along the first 1900 meters of the traverse of Curiosity, as measured by DAN instrument onboard the rover, *Journal of Geophysical Research Planets*, 119, 1284 doi:10.1002/2013JE004553, published online.

Jun, I., I. Mitrofanov, M.L. Litvak, A.B. Sanin, W. Kim, A. Behar, W.V. Boynton, L. DeFlores, F. Fedosov, D. Golovin, C. Hardgrove, K. Harshman, A.S. Kozyrev, R.O. Kuzmin, A. Malakhov, M. Mischna, J. Moersch, M. Mokrousov, S. Nikiforov, V.N.Shvetsov, **C. Tate**, V.I. Tret'yakov, and A. Vostrukhin (2013), Neutron background environment measured by the Mars Science Laboratory's Dynamic Albedo of Neutrons instrument during the first 100 sols, *Journal of Geophysical Research Planets*, 118(11):2400-2412, 10.1002/2013JE004510, 2013.

PRESENTATIONS

Tate, C., Kamyshev, Y. (2009, August). *Simulating the N-Nbar Experiment at NIST*. **Presented at** annual Science Alliance Summer Research Fellowship Program, University of Tennessee, Knoxville, TN.

Tate, C., Greene, G., Kamyshev, Y., Snow, W.M. (2010, November). *Adaptive Super Mirror for Neutron Focusing*. **Poster presented at** the annual IEEE Nuclear Science Symposium, Knoxville, TN.

Tate, C., Jun, I., Moersch, J., Hardgrove, C., Mischna, M., Litvak, M., Varenikov, A., Mitrofanov, I., and the MSL Science Team. (2013, March), *Diurnal Variations in MSL DAN Passive Measurements with Atmospheric Pressure and Soil Temperature*. **Poster presented at** Lunar and Planetary Sciences Conference, The Woodlands, TX.

Tate, C., Jun, I., Moersch, J., Hardgrove, C., Mischna, M., Litvak, M., Varenikov, A., Mitrofanov, I., and the MSL Science Team. (2013, October), *DAN Passive Data and Interpretations Sols 0-200*. **Poster presented at** Planet Mars IV Workshop, Les Houches, France.

Tate, C., Jun, I., Moersch, J., Hardgrove, C., Mischna, M., Litvak, M., Varenikov, A., Mitrofanov, I., and the MSL Science Team. (2014, March) *Water Equivalent Hydrogen Abundances Along the First 200 Sols of Curiosity's Traverse Using Passive Data From the Dynamic Albedo of Neutrons Experiment*. **Poster presented at** Lunar and Planetary Sciences Conference, The Woodlands, TX.

Tate, C., Jun, I., Moersch, J., Hardgrove, C., Mischna, M., Litvak, M., Varenikov, A., Mitrofanov, I., and the MSL Science Team. (2014, July) *MSL DAN Passive measurements and initial results through sol 402*. **Poster presented at** Eighth International Conference on Mars, Pasadena, CA.

Tate, C., Jun, I., Moersch, J., Hardgrove, C., Mischna, M., Litvak, M., Varenikov, A., Mitrofanov, I., and the MSL Science Team. (2014, December) *MSL DAN Passive Data and Interpretations*. **Poster presented at** American Geophysical Union Fall Meeting, San Francisco, CA.

Tate, C., Jun, I., Moersch, J., Hardgrove, C., Mischna, M., Litvak, M., Varenikov, A., Mitrofanov, I., and the MSL Science Team. (2015, March) *Estimating Thermal Conductivity from MSL DAN Passive Data*. **Poster presented at** Lunar and Planetary Sciences Conference, The Woodlands, TX.

Tate, C., Jun, I., Moersch, J., Hardgrove, C., Mischna, M., Litvak, M., Varenikov, A., Mitrofanov, I., and the MSL Science Team. (2016, January) *Remote Neutron Spectroscopy & MSL DAN Passive Data & Results*. **Invited Talk presented at** Southwest Research Institute Planetary Science Division Colloquium, Boulder, CO.

Tate, C., Jun, I., Moersch, J., Hardgrove, C., Mischna, M., Litvak, M., Mitrofanov, I., and the MSL Science Team. (2016, March) *Overview of MSL DAN Passive Results from Bradbury Landing to Amargosa Valley*. **Poster presented at** Lunar and Planetary Sciences Conference, The Woodlands, TX.

Tate, C., Jun, I., Moersch, J., Hardgrove, C., Mischna, M., Litvak, M., Mitrofanov, I., and the MSL Science Team. (2017, March) *Refined*

*Water Equivalent Hydrogen Estimates Using Passive Data From The MSL Dynamic Albedo of Neutrons Experiment: Sols 0 – 753, **Poster presented at Lunar and Planetary Sciences Conference, The Woodlands, TX.***

Tate, C., Cagle, N., Moersch, J., Jun, I., and Martin, A. (2018, March) *A Digital Archive for Mars Science Laboratory Dynamic Albedo of Neutrons Passive Mode Results. **Poster presented at Lunar and Planetary Sciences Conference, The Woodlands, TX.***

Tate, C., Moersch, J., Ewing, R., and McCarty, C. (2018, March) *Detailed Morphology of Barchan Dune Movement from a Single Wind Event Using UAV-Acquired Images, **Poster presented at Lunar and Planetary Sciences Conference, The Woodlands, TX.***

Tate, C., Jun, I., Moersch, J., Hardgrove, C., Mischna, M., Litvak, M., Mitrofanov, I., and the MSL DAN Team. (2019, March) *Mars Science Laboratory Dynamic Albedo of Neutrons Passive Mode Data and Results from Sols 753 to 1292: Pabrump Hills to Naukluft Plateau, **Poster presented at Lunar and Planetary Sciences Conference, The Woodlands, TX.***

HONORS AND AWARDS

NASA Group Achievement Award for MSL Prime Mission Science and Operations Team, 2015

University of Tennessee Department of Earth and Planetary Sciences Interdisciplinary Research Award, 2015

NASA Group Achievement Award for MSL Science Office Development and Operations Team, 2014

Sigma Pi Sigma (The Physics Honor Society), 2009

Volunteer Scholarship, 2005-2009

LEADERSHIP EXPERIENCES

National Honor Society Executive Board
08/2004 to 05/2005

Seminar in Student Leadership
02/2008 to 05/2008

VOLUNTEER EXPERIENCES

Great Smoky Mountains National Park Adopt A Trail Maintainer
05/2015 to Present

East Tennessee Community Shares Volunteer
08/2013 to Present

Shelbyville "Mission Possible" Local Community Service
05/2003 to 05/2005

