Robert A. Marshall

Associate Professor
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All elements conducted since receiving tenure in August 2022 are highlighted with blue numbers.

Highlights

- Principal Investigator, AEPEX CubeSat Mission (NASA Heliophysics): launched March 2026
- Principal Investigator, COSMO CubeSat Mission (NGA MagQuest): launched March 2026
- Principal Investigator, CANVAS CubeSat Mission (NSF): launched April 2026
- Instrument PI for upcoming IMPAX (NASA) and RADICALS (CSA) missions launching in Q4 2027
- Instrument PI, micro-Broadband Receiver on the VPM mission (AFRL): May 2011 – Sept 2020
- $22.6M total funding as PI at CU Boulder since 2015; $8.1M new funding since August 2022
- Supervised or co-supervised 16 PhD students since 2015; 9 completed PhDs, 5 MS theses
- NSF CAREER Award, 2021
- 112 Peer-reviewed publications; 4000+ citations; h-index = 35
- 38 Invited seminars and symposia

Education

- **Ph.D., Electrical Engineering**, Stanford University, June 2009
  Dissertation Advisor: Umran S. Inan
  Dissertation Title: VLF Radio Signatures of Transient Luminous Events Above Thunderstorms
- **M.S., Electrical Engineering**, Stanford University, 2004
- **B.S., Electrical Engineering**, University of Southern California, 2002, *Summa Cum Laude*

Professional Experience

- Jan 2024 – present: **Associate Director**, Colorado Center for Astrodynamics Research, CU Boulder
- July 2023 – present: **Associate Chair for Graduate Studies**, AES[1], CU Boulder
- August 2022 – present: **Associate Professor**, AES, CU Boulder
- Jan – July 2023: **Visiting Researcher**, Le Studium Institute for Advanced Studies, Orléans, France
- Aug 2015 – August 2022: **Assistant Professor**, AES, CU Boulder
- May – Aug 2015: **Visiting Assistant Professor**, AES, CU Boulder
- May 2013 – July 2015: **Research Associate**, Aeronautics and Astronautics, Stanford University
- May 2011 – Apr 2013: **Research Associate**, Electrical Engineering, Stanford University
- Oct 2009 – May 2011: **Research Scientist**, Center for Space Physics, Boston University
- June – Oct 2009: **Postdoctoral Scholar**, Electrical Engineering, Stanford University
- Jan 2003 – May 2009: **Research Assistant**, Electrical Engineering, Stanford University

[1] AES = Ann & H. J. Smead Department of Aerospace Engineering Sciences

Awards and Honors

- 2022 Outstanding Research Award, Aerospace Engineering Sciences, CU Boulder
- 2021 Provost's Faculty Achievement Award, CU Boulder
- 2021 NSF CAREER Award
- 2017 JGR-Space Physics Editor's Citation for Excellence in Refereeing
- 2011 International Radio Science Union (URSI) Young Scientist Award
- 2011 Winner, Andor Insight Awards, Scientific Imaging Competition (Physical Sciences)
- 2010 National Science Foundation CEDAR/GEM Postdoctoral Fellowship
- 2008 & 2004 American Geophysical Union (AGU) Outstanding Student Paper Award
- 2007 Gerald J. Lieberman Fellowship, awarded at Stanford for "demonstrated potential for leadership roles in the academic community"
- 2007 First Place, URSI Student Paper Competition; Ottawa, ON, Canada
- 2002–2005 Texas Instruments Stanford Graduate Fellowship

Publications and Presentations

Career publication statistics from Google Scholar citations index, as of September 2026:

Peer-reviewed Publications	112
Total Citations	4005
h-index	35
i10-index	84

26 publications since receiving tenure in August 2022; 1 paper accepted; 1 paper in review; 8 papers in preparation. Four papers were published prior to August 2022 but not considered in tenure review (magenta numbers).

Books & Book Chapters

1. Marshall, R. A. and C. Cully (2020), Atmospheric effects and signatures of high energy electron precipitation. In *The Dynamic Loss of Earth's Radiation Belts: From Loss in the Magnetosphere to Particle Precipitation in the Atmosphere*, Elsevier.
2. Kaeppler, S. R., E. Sanchez, R. H. Varney, R. Irvin, R. A. Marshall, J. Bortnik, A. S. Reimer, and P. Reyes (2020), Incoherent Scatter Radar Observations of 10-100 keV Precipitation: Review and Outlook. In *The Dynamic Loss of Earth's Radiation Belts: From Loss in the Magnetosphere to Particle Precipitation in the Atmosphere*, Elsevier.
3. U. S. Inan and R. A. Marshall (2011), *Numerical Electromagnetics: The FDTD Method*, Cambridge University Press: http://www.cambridge.org/gb/knowledge/isbn/item5760378/

Peer-Reviewed Journal Articles*

* Graduate student authors, for whom Dr. Marshall serves or served as the student's primary research supervisor, are highlighted **in bold**; postdoctoral scholars highlighted with underline.

113. **Vankawala, P.** and R. A. Marshall (2026), Computer Vision Detection and Classification of Plasma Waves in the Inner Magnetosphere, Journal of Geophysical Research: Machine Learning and Computation, *in review.*

112. Chen, L., G. D. Berland, R. A. Marshall, and J. Liang, Chorus wave-induced ionospheric variability, Geophysical Research Letters, *accepted*.

111. Shane, A. D., Marshall, R. A., & Ma, Q. (2026), Sensitivity of bounce-averaged diffusion coefficients to the latitudinal variability of lightning generated whistlers, Journal of Geophysical Research: Space Physics, 131, e2026JA035343, doi:10.1029/2026JA035343.

110. **Claxton, J. L.**, & Marshall, R. (2026), On the role of electron precipitation in excess radiation doses measured at aviation altitudes, Space Weather, 24, e2026SW004981, doi:10.1029/2026SW004981.

109. Gan, L., Cantwell, K., Li, W., Millan, R. M., Berland, G., Marshall, R., et al (2026), Test particle simulations of dual-component microbursts observed by BARREL: Effects of atmospheric backscattering and chorus elements. Journal of Geophysical Research: Space Physics, 131, e2025JA034703, doi:10.1029/2025JA034703.

108. **Claxton, J. L.**, and Marshall, R. (2026), Electron backscatter in energetic particle precipitation: Data analysis and simulation. Journal of Geophysical Research: Space Physics, 131, e2025JA034640, doi:10.1029/2025JA034640.

107. Clark, G., Kollmann, P., Kinnison, J., ... Marshall, R., et al (2026), Comprehensive Observations of Magnetospheric Particle Acceleration, Sources, and Sinks (COMPASS): A Mission Concept to Explore the Extremes of Jupiters Magnetosphere. Space Sci Rev 222, 15, doi:10.1007/s11214-025-01249-4.

106. **Cannon, J. M.**, R. Dick, B. Fragomeni, H. Gebhardt, S. Wankmueller, A. Tribble, S. Orlandella, M. Feinland, and R. A. Marshall (2025), A Modern VLF Radio Receiver Designed for the Array for VLF Imaging of the D-Region (AVID), IEEE Transactions on Geoscience and Remote Sensing, 63, doi:10.1109/TGRS.2025.3607146.

105. Shane, A. D., R. A. Marshall, A. M. Wold, X. C. Shen, and W. Li (2025), Lightning generated whistlers: Variability of eventbased wave distributions, Journal of Geophysical Research: Space Physics 130 (8), e2025JA034164.

104. **Chism, C. T.**, R. A. Marshall, A. Aguilar-Nadalini, S. Knappe, D. Malaspina, K. J. Hughes, M. Ellmeier, S. Wankmueller, C. Cunningham, T. Maydew, and O. Alem (2025), Design of a vectorized rubidium scalar magnetometer for SmallSat applications, Advances in Space Research, ISSN 0273-1177, doi:10.1016/j.asr.2025.07.011.

103. Cerfolli, L., J.-F. Ripoll, R. B. Horne, **A. M. Wold**, and R. A. Marshall (2025), Ray tracing of very low frequency waves produced by active experiments or lightning events at low Earth orbit, Comptes Rendus. Physique, Volume 26 (2025), pp. 285-294. doi:10.5802/crphys.238.

102. Teysseyre, P., C. Briand, R. Marshall and M. Cohen (2025), Effect of ground conductivity on VLF wave propagation, Radio Science, vol. 60, no. 3, pp. 1-16, March 2025, doi: 10.1029/2024RS008150.

101. Pan, Y., W. Xu, X. Gu, B. Ni, J. M. Pettit, H. Nesse, J. Feng, S. Wang, W. Cheng, H. Xu, W. Ma, D. Zhai, H. Shi, and R. A. Marshall (2025). WACCM simulation of polar ozone response to relativistic electron precipitation. Geophysical Research Letters, 52, e2024GL114012, doi:10.1029/2024GL114012

100. **Reid, R. A.**, and Marshall, R. (2025), An instrument concept for high-resolution observations of the solar wind electron strahl using coded aperture imaging. Earth and Space Science, 12, e2024EA003814, doi:10.1029/2024EA003814

99. Feinland, M., Blum, L. W., Marshall, R. A., Gan, L., Shumko, M., & Looper, M. (2024), Lightning-induced relativistic electron precipitation from the inner radiation belt. Nature Communications, 15(1), 8721.

98. **Wold, A. M.**, Marshall, R. A., Malaspina, D. M., & Shane, A. D. (2024), Prevalence and propagation of lightning-generated whistlers in Van Allen Probes EFW burst data. Journal of Geophysical Research: Space Physics, 129(9), e2024JA032781.

97. **Reid, R. A., Berland, G.**, & Marshall, R. (2024), Coded aperture imaging for electron pitch angle observations, Earth and Space Science, 11, e2024EA003641, doi:10.1029/2024EA003641

96. Capannolo, L., Marshall, R., Li, W., **Berland, G.**, Duderstadt, K., Sivadas, N., et al (2024), Unraveling the atmospheric energy input and ionization due to EMIC-driven electron precipitation from ELFIN observations. AGU Advances, 5, e2023AV001096, doi:10.1029/2023AV001096

95. **Vankawala, P. M.**, R. A. Marshall, D. Vida and P. Brown (2024), An observational investigation of very low frequency radio emissions originating from meteors. Planetary and Space Science, 245, 105892, doi:10.1016/j.pss.2024.105892.

94. **Tarnecki, L. K.**, Marshall, R. A., Brown, P., & Stober, G. (2024), Mass estimation from simultaneous optical and radar meteor observations. Journal of Geophysical Research: Space Physics, 129, e2023JA032281, doi:10.1029/2023JA032281

93. **Berland, G. D.**, Marshall, R. A., Capannolo, L., McCarthy, M. P., & Zheng, L. (2023), Kinetic modeling of radiation belt electrons with Geant4 to study energetic particle precipitation in Earth's atmosphere. Earth and Space Science, 10, e2023EA002987, doi:10.1029/2023EA002987

92. Shane, A. D., Marshall, R. A., Claudepierre, S. G., & Pettit, J. M. (2023), Electron lifetimes measured at LEO: Comparison with RBSP estimates and pitch angle resolved lifetimes. Journal of Geophysical Research: Space Physics, 128, e2023JA031679, doi:10.1029/2023JA031679.

91. **Juarez Madera, D.**, Marshall, R. A., Elschot, S., Kaeppler, S., Reyes, P., Varney, R. H., and Crew, A. B. (2023), Time-dependent inversion of energetic electron precipitation spectra from ground-based Incoherent Scatter Radar measurements. Journal of Geophysical Research: Space Physics, 128, e2022JA031000, doi:10.1029/2022JA031000.

90. **Tarnecki, L. K.**, Marshall, R. A., Fontanese, J., Sternovsky, Z., and Munsat, T. (2023), Experimentally derived luminous efficiencies for aluminum and iron at meteoric speeds. Geophysical Research Letters, 50, e2023GL103016, doi:10.1029/2023GL103016.

89. **Berland, G. D.**, R. A. Marshall, **C. Martin**, **J. Buescher**, R. A. Kohnert, S. Boyajian, C. M. Cully, M. P. McCarthy, and W. Xu (2023), The atmospheric X-ray imaging spectrometer (AXIS) instrument: Quantifying energetic particle precipitation through bremsstrahlung X-ray imaging. Review of Scientific Instruments, 94, 023103, doi:10.1063/5.0127272.

88. **Gasdia, F.**, and Marshall, R. A. (2023), A method for imaging energetic particle precipitation with subionospheric VLF signals. Earth and Space Science, 10, e2022EA002460, doi:10.1029/2022EA002460

87. Kaeppler, S. R., R. Marshall, E. R. Sanchez, **D. H. Juarez Madera**, R. Troyer, and A. N. Jaynes (2022), pyGPI5: A python D- and E-region chemistry and ionization model. Frontiers in Astronomy and Space Science, 9:1028042, doi:10.3389/fspas.2022.1028042.

86. Ma, Q., Xu, W., Sanchez, E. R., Marshall, R. A., Bortnik, J., Reyes, P. M., et al. (2022), Analysis of electron precipitation and ionospheric density enhancements due to hiss using incoherent scatter radar and Arase observations. Journal of Geophysical Research: Space Physics, 127, e2022JA030545, doi:10.1029/2022JA030545.

85. Sanchez, E. R., Ma, Q., Xu, W., Marshall, R. A., Bortnik, J., Reyes, P., et al. (2022), A test of energetic particle precipitation models using simultaneous incoherent scatter radar and Van Allen Probes observations. Journal of Geophysical Research: Space Physics, 127, e2021JA030179, doi:10.1029/2021JA030179

84. **Reid, R. A.**, Marshall, R. A., Starks, M. J., Usanova, M. E., Wilson, G. R., Johnston, W. R., et al. (2022), Active VLF transmission experiments between the DSX and VPM spacecraft. Journal of Geophysical Research: Space Physics, 127, e2021JA030087, doi:10.1029/2021JA030087.

83. Usanova, M. E., **Reid, R. A.**, Xu, W., Marshall, R. A., Starks, M. J., & Wilson, G. R. (2022), Using VLF transmitter signals at LEO for plasmasphere model validation. Journal of Geophysical Research: Space Physics, 127, e2022JA030345, doi:10.1029/2022JA030345.

82. Berge, N., Celestin, S., Garnung, M. B., Xu, W., Marshall, R. A., & Cummer, S. A. (2022), Modeling low-frequency radio emissions from Terrestrial Gamma ray Flash sources. Journal of Geophysical Research: Atmospheres, 127, e2021JD036040, doi:10.1029/2021JD036040.

81. Marshall, R. A., Sousa, A., **Reid, R.**, Wilson, G., Starks, M., Ramos, D., et al. (2021), The micro-Broadband Receiver (uBBR) on the Very-Low-Frequency Propagation Mapper (VPM) CubeSat, Earth and Space Science, 8, e2021EA001951.

80. **Antunes de Sá, A. L.**, Marshall, R., and Deierling, W. (2021), Energetic intracloud lightning in the RELAMPAGO field campaign, Earth and Space Science, 8, e2021EA001856, doi:10.1029/2021EA001856.

79. Xu, W., Marshall, R. A., Kero, A., and Sousa, A. (2021), Chemical response of the upper atmosphere due to lightning-induced electron precipitation, Journal of Geophysical Research: Atmospheres, 126, e2021JD034914, doi:10.1029/2021JD034914.

78. **Antunes de Sá, A.**, Marshall, R., and Deierling, W. (2021), Lightning Geolocation and Flash Rates from LF Radio Observations During the RELAMPAGO Field Campaign, Earth and Space Science, 8, e2021EA001813, doi:10.1029/2021EA001813.

77. Xu, W., Marshall, R. A., and Tobiska, W. K. (2021), A Method for Calculating Atmospheric Radiation Produced by Relativistic Electron Precipitation, Space Weather, 19, e2021SW002735, doi:10.1029/2021SW002735.

76. **Tarnecki, L. K.**, Marshall, R. A., Stober, G., and Kero, J. (2021), Meteoroid mass estimation based on single-frequency radar cross section measurements, Journal of Geophysical Research: Space Physics, 126, e2021JA029525, doi:10.1029/2021JA029525

75. **Gasdia, F.**, and Marshall, R. A. (2021), A New Longwave Mode Propagator for the Earth-Ionosphere Waveguide, IEEE Transactions on Antennas and Propagation, doi: 10.1109/TAP.2021.3083753.

74. Sugar, G., Marshall, R., Oppenheim, M. M., Dimant, Y. S., and Close, S. (2021), Simulation-derived radar cross sections of a new meteor head plasma distribution model, Journal of Geophysical Research: Space Physics, 126, e2021JA029171, doi:10.1029/2021JA029171.

73. Xu, W., Marshall, R. A., Bortnik, J., and Bonnell, J. W. (2021), An electron density model of the D- and E-region ionosphere for transionospheric VLF propagation, Journal of Geophysical Research: Space Physics, 126, e2021JA029288, doi:10.1029/2021JA029288.

72. Burns, S., **F. Gasdia**, J. J. Simpson, and R. A. Marshall (2021), 3-D FDTD Modeling of Long-Distance VLF Propagation in the Earth-Ionosphere Waveguide, IEEE Transactions on Antennas and Propagation, doi:10.1109/TAP.2021.3070621.

71. Nesbitt, S. W., P. V. Salio, E. Avila, P. Bitzer, L. Carey, V. Chandrasekar, W. Deierling, F. Dominguez, M. E. Dillon, C. M. Garcia, D. Gochis, S. Goodman, D. A. Hence, K. A. Kosiba, M. R. Kumjian, T. Lang, L. M. Luna, J. Marquis, R. Marshall, L. A. McMurdie, E. L. Nascimento, K. L. Rasmussen, R. Roberts, A. K. Rowe, J. J. Ruiz, E. F. M. T. São Sabbas, A. C. Saulo, R. S. Schumacher, Y. G. Skabar, L. A. Toledo Machado, R. J. Trapp, A. Varble, J. Wilson, J. Wurman, E. J. Zipser, I. Arias, H. Bechis, and M. A. Grover (2021), A storm safari in Subtropical South America: proyecto RELAMPAGO, Bulletin of the American Meteorological Society, doi:10.1175/BAMS-D-20-0029.1.

70. Borovsky, J. E., G. L. Delzanno, E. E. Dors, M. F. Thomsen, E. R.Sanchez, M. G. Henderson, R. A. Marshall, B. E. Gilchrist, G. Miars, B. E. Carlsten, S. A. Storms, M. A. Holloway, and D. Nguyen (2020), Solving the auroral-arc-generator question by using an electron beam to unambiguously connect critical magnetospheric measurements to auroral images, Journal of Atmospheric and Solar-Terrestrial Physics, Vol. 206, 105310, doi:10.1016/j.jastp.2020.105310.

69. Xu, W., Marshall, R. A., Tyssøy, H. N., and Fang, X. (2020), A generalized method for calculating atmospheric ionization by energetic electron precipitation, Journal of Geophysical Research: Space Physics, 125, e2020JA028482, doi:10.1029/2020JA028482.

68. **Antunes de Sà, A.**, R. A. Marshall, A. P. Sousa, **A. Viets**, and Deierling, W. (2020), An array of low-cost, high-speed, autonomous electric field mills for thunderstorm research, Earth and Space Science, 7, e2020EA001309, doi:10.1029/2020EA001309.

67. Marshall, R. A., W. Xu, T. Woods, C. Cully, A. Jaynes, C. Randall, D. Baker, M. McCarthy, H. E. Spence, **G. Berland**, **A. Wold**, and **E. Davis** (2020), The AEPEX Mission: Imaging Energetic Particle Precipitation in the Atmosphere through its Bremsstrahlung X-ray Signatures, Advances in Space Research, Vol. 66, Issue 1, pp. 66–82, doi:10.1016/j.asr.2020.03.003.

66. Sung, C. Y., P. Brown, and R. Marshall (2020), A two year survey for VLF emission from fireballs, Planetary and Space Science, 184, 104872.

65. **Antunes de Sá, A.**, and R. A. Marshall (2020), Lightning Distance Estimation Using LF Lightning Radio Signals Via Machine-Learned Models, IEEE Transactions on Geoscience and Remote Sensing, doi:10.1109/TGRS.2020.2972153.

64. Limonta, L., S. Close, and R. A. Marshall (2020), A technique for inferring lower thermospheric neutral density from meteoroid ablation, Planetary and Space Science, 180, doi:10.1016/j.pss.2019.104735.

63. Marshall, R. A., W. Xu, A. Sousa, M. McCarthy, and R. Millan (2019), X-ray signatures of lightning-induced electron precipitation, Journal of Geophysical Research: Space Physics, 124, doi:10.1029/2019JA027044.

62. **Gasdia, F.** and R. A. Marshall (2019), Assimilating VLF Transmitter Observations with an LETKF for Spatial Estimates of the D-region Ionosphere, IEEE Transactions on Geoscience and Remote Sensing, doi:10.1109/TGRS.2019.2957716.

61. Sanchez, E. R., A. T. Powis, I. D. Kaganovich, R. Marshall, P. Porazik, J. Johnson, M. Greklek-Mckeon, K. S. Amin, D. Shaw, and M. Nicolls (2019), Relativistic Particle Beams as a Resource to Solve Outstanding Problems in Space Physics, Front. Astron. Space Sci, 6, 71, doi: 10.3389/fspas.2019.00071.

60. Ramos, D., G. Wilson, A. Sousa, R. Marshall, K. Brunetto, J. Ballenthin, R. Kay, J. Patton, S. Quigley, J. Fennelly, M. Starks, T. Willet-Gies, S. Tullino, I. Linscott, and U. Inan (2019), A CubeSat receiver for the study of VLF-waves at LEO, Proc. SPIE 11131, CubeSats and SmallSats for Remote Sensing III, 111310P (30 August 2019), doi:10.1117/12.2530479.

59. Xu, W., R. A. Marshall, A. Kero, E. Turunen, D. Drob, J. Sojka, and D. Rice (2019), VLF Measurements and Modeling of the D-region Response to the 2017 Total Solar Eclipse, IEEE Transactions on Geoscience and Remote Sensing, 57, 10, doi:10.1109/TGRS.2019.2914920.

58. Xu, W., S. Celestin, V. P. Pasko, and R. A. Marshall (2019), Compton Scattering Effects on the Spectral and Temporal Properties of Terrestrial Gammaray Flashes, Journal of Geophysical Research: Space Physics, doi: 10.1029/2019JA026941.

57. Marshall, R. A., W. Xu, A. Kero, R. Kabirzadeh, and E. Sanchez (2019), Atmospheric Effects of a Relativistic Electron Beam Injected From Above: Chemistry, Electrodynamics, and Radio Scattering. Front. Astron. Space Sci. 6:6. doi: 10.3389/fspas.2019.00006.

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Conference Proceedings

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6. Ellmeier, M., R. Jimnez-Martnez, D. Allison, T. Maydew, J. Hughes, C. Chism, R. Marshall, O. Alem, and S. Knappe (2025), A compact vectorized magnetometer for measuring Earth's magnetic field in space, Proc. SPIE 13392, Quantum Sensing, Imaging, and Precision Metrology III, 133920A (19 March 2025); doi:10.1117/12.3053180
5. Marshall, R. A., **G. D. Berland**, J. Buescher, S. Regmi, R. A. Kohnert, A. Chandran, S. Boyajian, T. Woods, H. E. Spence, S. Smith, M. P. McCarthy, and C. M. Cully (2023), The AEPEX Mission: Imaging Energetic Particle Precipitation into Earths Upper Atmosphere, 37th Annual AIAA/USU Conference on Small Satellites, paper SSC23-WIV-01.

4. Marshall, R. A., **R. A. Reid**, **J. M. Cannon**, S. Wankmueller, **P. Vankawala**, S. Palo, D. M. Malaspina, T. Dudok de Wit, and G. Jannet (2022), The CANVAS Mission: Quantifying the Very-Low-Frequency Radio Energy Input from the Ground into the Earth's Magnetosphere, 36th Annual AIAA/USU Conference on Small Satellites, paper SSC22-WKVIII-06.
3. **Berland, G. D.**, R. A. Marshall, **C. Martin**, **D. Mhadgut**, **J. Buescher**, R. A. Kohnert, S. Boyajian, C. M. Cully, and M. P. McCarthy (2021), The AEPEX CubeSat Mission: Quantifying Energetic Particle Precipitation through Bremsstrahlung X-Ray Imaging, 35th Annual AIAA/USU Conference on Small Satellites, paper SSC21-XIII-01.
2. **Reid, R. A.**, R. A. Marshall, S. E. Palo, and D. M. Malaspina (2021), A Compact Five-Channel VLF Wave Receiver for CubeSat Missions, 35th Annual AIAA/USU Conference on Small Satellites, paper SSC21-VI-09.
1. Aboaf, A. P., E. S. Harrod, M. Zola, A. Prakash, S. E. Palo, R. Marshall, M. D. Pilinski, N. Rainville, A. Dahir, V. Nataraja, B. Schwab, A. Gardell, and L. Warshaw (2020), A Methodology for Successful University Graduate CubeSat Programs, 34th Annual AIAA/USU Conference on Small Satellites, paper SSC20-WKV-06.

Invited Seminars and Symposia

39. The Parallel Development of Three CubeSats with Three Distinct Mission Goals, *LASP Technology Seminar*, Laboratory for Atmospheric and Space Physics, Boulder, CO, March 3, 2026.
38. CubeSats for Space Science, *University of Texas San Antonio, Invited Seminar*, San Antonio, TX, February 20, 2026.
37. CubeSats for Space Science at CU Boulder, *Fédération Nanosats seminar series on CubeSats*, Virtual, December 11, 2025.
36. COSMO: Measuring and Monitoring the Earths Magnetic Field from Space, 13th Smead Symposium, Avon, CO, May 17, 2025.
35. Overview and Lessons Learned from the AEPEX Mission, *NASA SmallSat LEARN Forum*, Virtual, March 18, 2025.
34. Imaging Radiation Belt Precipitation from the Ground and from Space, *Boston University Space Physics Seminar*, Boston, MA, October 24, 2024.
33. The Ionosphere: Origins, Structure, and Variability, *Heliophysics Summer School lecture series*, Boulder, CO, August 21, 2024.
32. Imaging Radiation Belt Precipitation from the Ground and from Space, *CU AES Researchpalooza closing presentation*, Boulder, CO, February 9, 2024.
31. The Array for VLF Imaging of the D-region Ionosphere (AVID), *Hakai Institute*, Calvert Island, BC, Canada, August 10, 2023.
30. Imaging Energetic Particle Precipitation into Earth's Upper Atmosphere through Backscattered Hard X-rays, *University of Bergen*, Bergen, Norway, March 20, 2023.
29. Lightning-induced Electron Precipitation and its indirect effects on the upper atmosphere, *LPC2E Seminar series*, Orléans, France, March 7, 2023.
28. CubeSats for Heliophysics, *Le Studium seminar series*, Orléans, France, March 2, 2023.
27. Remote Sensing with Hard X-rays: The AEPEX CubeSat Mission, *CU Aerospace Remote Sensing seminar series*, Boulder, CO, December 5, 2022.
26. Energetic electron precipitation from the magnetosphere into the atmosphere: how to measure the effects in the ignorosphere, *Magnetosphere Online Seminar Series*, Virtual, August 29, 2022.
25. CubeSats for Space Science, *Taiwan Space Union*, Virtual, August 11, 2021.

24. A multi-pronged approach to measuring and understanding the D-region ionosphere, *Laboratory for Atmospheric and Space Physics Seminar*, Virtual, May 27, 2021.
23. Radiation Belt Precipitation into the Upper Atmosphere: Mesoscale Observations from Above and Below *NASA Goddard Heliophysics Seminar Series*, Virtual, May 12, 2021.
22. X-ray Imaging of Energetic Particle Precipitation from the Radiation Belts: The AEPEX CubeSat Mission, *NCAR High Altitude Observatory Colloquium*, Boulder, CO, November 4, 2020.
21. Characterization of Radiation Belt Electron Precipitation using Space-based X-ray Observations, *University of Minnesota, department of Physics and Astronomy*, Minneapolis, MN, February 18, 2020.
20. The AEPEX Mission: Imaging Radiation Belt Precipitation using Bremsstrahlung X-rays, *"Friends of the Magnetosphere" seminar at the Laboratory for Atmospheric and Space Physics*, Boulder, CO, January 28, 2020.
19. Climatology of Anthropogenic and Natural VLF wave Activity in Space (CANVAS), *Centre Nationale de la Recherche Scientifique*, Orléans, France, June 11, 2019.
18. Effects of the Lightning Electromagnetic Pulse in the Ionosphere and Magnetosphere, *SAINT International Workshop*, Leiden, Netherlands, January 30, 2019.
17. Thunderstorm Electrification, Lightning Flash Rates, and the RELAMPAGO Field Campaign, *Colorado School of Mines, Physics Department*, Golden, CO, October 2018.
16. Atmospheric Signatures and Diagnostics of Radiation Belt Electron Precipitation, *LASP Friends of the Magnetosphere (FOM)*, Boulder, CO, February 2018.
15. Lightning Effects in the Upper Atmosphere, Ionosphere, and Magnetosphere, *Presented at University of Alabama in Huntsville, Department of Atmospheric Sciences*, Huntsville, AL, October 2017.
14. Very-Low-Frequency Subionospheric Remote Sensing as a Diagnostic of D-region Ionosphere Variations, *Presented at Utah State University, Department of Physics*, Logan, UT, April 2017.
13. The Earth's Atmosphere as a Natural Source of X-ray Radiation, *Presented at the University of Western Ontario, Department of Physics and Astronomy*, London, ON, Canada, October 2016.
12. Atmospheric Signatures of Energetic Particle Precipitation in the Upper Atmosphere, *Presented at the National Center for Atmospheric Research (NCAR), High Altitude Observatory (HAO)*, Boulder, CO, September 2016.
11. The Earth's Atmosphere as a Natural Source of X-ray Radiation, *Presented at Dartmouth College, Plasma Seminar Series*, Hanover, NH, May 2016.
10. Lightning Effects in Space, *presented at CU Boulder, Department of Aerospace Engineering Sciences*, Boulder, CO, February 2015.
9. The Artificial Relativistic Electron Beam, *presented at CU Boulder and the Laboratory of Atmospheric and Space Physics (LASP)*, Boulder, CO, April 2014.
8. Numerical modeling of the lightning EMP and its interaction with the lower ionosphere, *presented at Lawrence Livermore National Laboratory (LLNL)*, Livermore, CA, January 2014.
7. Interactions between Lightning and the Lower Ionosphere, *presented for SESS Group, Stanford University*, Stanford, CA, November 29, 2011.
6. High-speed Imaging of Auroral and High-energy Particle Precipitation, *presented at KLA-Tencor*, Milpitas, CA, November 4, 2011.
5. Optical Signatures of Transmitter- and Lightning-induced Electron Precipitation, *presented for SESS Group, Stanford University*, Stanford, CA, September 22, 2010.
4. An Introduction to Near-Earth Space Physics, *presented at Bermuda College*, Bermuda, September 30, 2009.
3. Ionospheric Effects of Intense Lightning Discharges, *presented at Center for Space Physics, Boston University*, Boston, MA, September 9, 2009.

2. Ionospheric Effects of Intense Lightning Discharges, *presented at Geospace Studies Institute, SRI International*, Menlo Park, CA, March 12, 2009.

1. Ionospheric Effects of Intense Lightning Discharges, *presented at Institute for Geophysics and Planetary Physics, UCLA*, Los Angeles, CA, Feb 19, 2009.

Recent Conference Presentations led by Students & Postdocs

Talks since August 2022 led by PhD students and postdoctoral scholars.

49. **Vankawala, P. M.** and R. A. Marshall, "Exploring the Origins of Plasmaspheric Hiss With Computer Vision Guided Wave Classification" (Invited), URSI General Assembly, Krakow, Poland, August 2026.
48. **Kao, T. H.**, Chism, C., Kaplan, O., Ellmeier, M., Knappe, S., Hughes, J., and Marshall, R., "In-Orbit Calibration of Vectorized Rubidium Magnetometer onboard COSMO", EGU General Assembly, Vienna, Austria, May 2026.
47. **J. M. Cannon** and R. A. Marshall, Data assimilation of ground-based VLF sensors for spatially resolved D-region HF absorption map, Space Weather Workshop, Boulder, CO, April 2026.
46. **J. M. Cannon** and R. A. Marshall, The use of a local ensemble transform Kalman filter (LETKF) on data from the Array for VLF Imaging of the D-region, URSI National Radio Science Meeting (USNC-URSI NRSM), Boulder, CO, January 2026.
45. **Claxton, J. L.** and R. A. Marshall, Electron Backscatter in Energetic Particle Precipitation: Data Analysis and Simulation, AGU Fall Meeting, New Orleans, LA, December 2025.
44. **Kao, T. H.**, Chism, C., Ellmeier, M., Knappe, S., Hughes, J., and Marshall, R., "COSMO: A 6U CubeSat Mission for Measuring the Earths Magnetic Field by Using Vectorized Rubidium Scalars", AGU Fall Meeting, New Orleans, LA, December 2025.
43. **Spies, W.**, Marshall, R. A., McCarthy, M., & Cully, C., "The AEPEX Mission: Can Coded Aperture Optics Reveal Particle Precipitation Structures?", AGU Fall Meeting, New Orleans, LA, December 2025.
42. **Vankawala, P. M.** and R. A. Marshall, "Investigating the Origins of Plasmaspheric Hiss Using Computer VisionGuided Wave Classification", AGU Fall Meeting, New Orleans, LA, December 2025.
41. **Vankawala, P. M.** and R. A. Marshall, "Computer Vision Guided Detection of Plasma Waves in the Inner Magnetosphere", International Association of Geomagnetism and Aeronomy (IAGA) Conference, Lisbon, Portugal, September 2025.
40. **J. M. Cannon**, **R. Dick**, and R. A. Marshall, First results from the October 10-11 geomagnetic storm as seen by the Array for VLF Imaging of the D-region (AVID), in Geospace Environment Modeling (GEM) Workshop, Des Moines, IA, June 2025.
39. **Claxton, J. L.** and R. A. Marshall, Constraining and Simulating the Rate of Electron Backscatter in Energetic Particle Precipitation, GEM Workshop, Des Moines, IA, June 2025.
38. **Kao, T. H.**, Chism, C., Ellmeier, M., and Marshall, R., "Design, Test, Calibration, and Data Processing of the Vectorized Scalar Magnetometer Onboard COSMO", CEDAR Workshop, Des Moines, IA, June 2025.
37. **Spies, W.**, Marshall, R. A., McCarthy, M., & Cully, C., "The Atmospheric Effects of Precipitation through Energetic X-rays (AEPEX) Mission: How Coded Apertures can Spatially Resolve Energetic Particle Precipitation", GEM Workshop, Des Moines, IA, June 2025.
36. **Vankawala, P. M.** and R. A. Marshall, "A Computer Vision Guided Detection and Classification of Plasma Waves in the Inner Magnetosphere", GEM Workshop, Des Moines, IA, June 2025.
35. **J. M. Cannon**, **R. Dick**, and R. A. Marshall, Ground-based VLF remote sensing and the October 10-11 geomagnetic storm, Space Weather Workshop, Boulder, CO, April 2025.

34. **Claxton, J. L.** and R. A. Marshall, Use of Principal Component Analysis and Computer Vision to Identify Scattering Processes through Precipitating Particle Spectra, AGU Chapman Conference on Particle Precipitation, Melbourne, Australia, February 2025.
33. **Spies, W.**, Marshall, R. A., Berland, G., **Buescher, J.**, McCarthy, M., & Cully, C., "The AEPEX Mission: Bringing Magnetosphere-Atmosphere Coupling into Focus", AGU Chapman Conference on Particle Precipitation, Melbourne, Australia, February 2025.
32. **J. M. Cannon** and R. A. Marshall, First results from an Array for VLF Imaging of the D-region ionosphere, URSI National Radio Science Meeting (USNC-URSI NRSM), Boulder, CO, January 2025.
31. **J. M. Cannon**, R. A. Marshall, and **R. Dick**, First results from the Array for VLF Imaging of the D-region (AVID), AGU Fall Meeting, Washington, DC, December 2024.
30. **Claxton, J. L.** and R. A. Marshall, Steady-State Pitch Angle Distributions of Radiation Belt Electrons Subject to Multiple Bounces, AGU Fall Meeting, Washington, DC, December 2024.
29. **Vankawala, P. M.** and R. A. Marshall, "Computer Vision-Guided Analysis of Plasma Waves in the Inner Magnetosphere", AGU Fall Meeting, Washington, DC, December 2024.
28. **Wold, A, M.**, R. A. Marshall, and D. M. Malaspina, "Trans-ionospheric propagation and attenuation of very low frequency waves", AGU Fall Meeting, Washington, DC, December 2024.
27. Shane, A. D., Marshall, R. A., and **Wold, A. M.** Lightning-Generated Whistlers: Variability of Frequency and Wave Normal Angle Distributions, 11th VERSIM Workshop, Breckenridge, CO, October 2024.
26. **Vankawala, P. M.** and R. A. Marshall, "Computer Vision-Guided Analysis of Plasma Waves in the Inner Magnetosphere", 11th VERSIM Conference, Breckenridge, CO, October 2024.
25. **Wold, A, M.**, R. A. Marshall, and D. M. Malaspina, "Trans-ionospheric propagation and attenuation of very low frequency waves", 11th VERSIM Workshop, Breckenridge, CO, October 2024 (Invited).
24. Chism, C., Marshall, R., Knappe, S., Malaspina, D., Ellmeier, M., Aguilar-Nadalini, A., Wankmueller, S., Hughes, K.J., Alem, O. & Maydew, T., "Testing and evaluation of a vectorized Rubidium magnetometer developed for the Compact Spaceborne Magnetic Observatory (COSMO)", 45th COSPAR Scientific Assembly, Busan, South Korea, July 2024.
23. **Claxton, J. L.** and R. A. Marshall, EMIC-Induced Precipitation as Measured by ELFIN: Source Regions, Impacts, and Energy Dependence, GEM Workshop, Longmont, CO, June 2024.
22. **Spies, W.**, Marshall, R. A., Berland, G., **Buescher, J.**, McCarthy, M., & Cully, C., "Atmospheric X-ray Imaging Spectrometer (AXIS) Instrument Calibration and Implications for AEPEX Mission Science", GEM Workshop, Fort Collins, CO, June 2024.
21. **Vankawala, P. M.** and R. A. Marshall, "Computer Vision-Guided Analysis of Plasma Waves in the Inner Magnetosphere", GEM Workshop, Longmont, CO, June 2024.
20. **Wold, A, M.**, R. A. Marshall, and D. M. Malaspina, "Trans-ionospheric propagation and attenuation of very low frequency waves", GEM Workshop, Fort Collins, CO, June 2024.
19. **J. M. Cannon**, R. A. Marshall, and **R. Dick**, A mesoscale VLF receiver array for Imaging of the D-region ionosphere, Triennial Earth-Sun Summit, Dallas, TX, April 2024.
18. **J. M. Cannon**, R. A. Marshall, **R. Dick**, **B. Fragomeni**, S. Wankmueller, and **S. Orlandella**, A modern VLF receiver for use in an Array for VLF Imaging of the D-region, URSI National Radio Science Meeting (USNC-URSI NRSM), Boulder, CO, January 2024.
17. **R. Dick**, **J. M. Cannon**, R. A. Marshall, and H. Gebhardt, A modern vlf receiver for ionospheric science, Triennial Earth-Sun Summit 2024, Dallas, TX, 2024.
16. Shane, A. D., Marshall, R. A., Claudepierre, S. G., and Pettit, J. M. Electron lifetimes measured at LEO: Comparison with RBSP estimates and pitch angle resolved lifetimes, AGU Fall Meeting, San Francisco, CA, December 2023.
15. **Berland, G. B.**, R. A. Marshall, and A. Shane, "A Comparative Study of X-ray Production from Energetic Particle Precipitation in Planetary Atmospheres", AGU Fall Meeting, San Francisco, CA, December 2023.

14. Shane, A. D., Marshall, R. A., Claudepierre, S. G., and Pettit, J. M. Electron lifetimes measured at LEO: Comparison with RBSP estimates and pitch angle resolved lifetimes, GEM Workshop, San Diego, CA, June 2023.
13. **Reid, R. A.**, Marshall, R. A., **Berland, G.**, & Blum, L. W. (2023). "Exploring coded aperture imaging with the MiniPIX EDU for high-resolution radiation belt electron pitch angle observations", 24th International Workshop on Radiation Imaging Detectors, Oslo, Norway, June 2023.
12. **Wold, A, M.**, R. A. Marshall, A. Sousa, and D. M. Malaspina, "Validation of modeled lightning generated whistler energy from GLD360 to Van Allen Probes", GEM Workshop, San Diego, CA, June 2023.
11. **Chism, C.**, Marshall, R., Knappe, S., Malaspina, D., Ellmeier, M., **Aguilar-Nadalini, A.**, Wankmueller, S., Hughes, K.J., Alem, O. & Maydew, T., "A vectorized Rubidium magnetometer developed for the Compact Spaceborne Magnetic Observatory (COSMO)", 5th COSPAR Symposium, Singapore, April 2023.
10. **Vankawala, P. M.** R. A. Marshall,, D. Vida, and P. Brown, "Investigating Very-low-frequency Radio Emissions from Meteors", URSI National Radio Science Meeting, Boulder, CO, January 2023.
9. **J. M. Cannon**, W. Xu, R. A. Marshall, and J. W. Bonnell, VLF measurements and model comparisons from the VIPER sounding rocket, AGU Fall Meeting, Chicago, IL, December 2022.
8. Shane, A. D., **McMurchie, E.**, Marshall, R. A., and Pettit, J. M. Spatiotemporal Variations of Radiation Belt Electron Precipitation at LEO using REACH/POES, AGU Fall Meeting, Chicago, IL, December 2022.
7. Shane, A. D., Marshall, R. A., and **Wold, A. M.** GLD360 to RBSP: Mapping the Energy Input of Lightning Generated Whistlers into the Magnetosphere, AGU Fall Meeting, Chicago, IL, December 2022.
6. **Tarnecki, L. K.**, R. A. Marshall, Z. Sternovsky, T. L. Munsat, P. Brown, G. Stober, and J. Kero, "A Multipronged Approach for Determining Meteor Masses", AGU Fall Meeting, Chicago, IL, December 2022.
5. **Berland, G. B.** and R. A. Marshall, "Quantifying Uncertainty in Energetic Particle Precipitation Atmospheric Effects via GEANT4 Simulations", AGU Fall Meeting, Chicago, IL, December 2022.
4. **Reid, R. A.**, Marshall, R. A., Blum, L. W., & **Berland, G.**, "Pitch-angle resolved measurements of energetic electrons using coded aperture imaging", AGU Fall Meeting, Chicago, IL, December 2022.
3. **Wold, A, M.**, R. A. Marshall, A. Sousa, and D. M. Malaspina, "Validation of modeled lightning generated whistler energy from GLD360 to Van Allen Probes", AGU Fall Meeting, Chicago, IL, December 2022.
2. Shane, A. D., Marshall, R. A., and **Wold, A. M.** GLD360 to RBSP: Mapping the Energy Input of Lightning Generated Whistlers into the Magnetosphere, 10th VERSIM Workshop, Sodankyl a, Finland, November 2022.
1. **Wold, A, M.**, R. A. Marshall, A. Sousa, and D. M. Malaspina, "Determination of ducted propagation of lightning generated whistlers from Van Allen Probes burst data", VERSIM Workshop, Sodankylä, Finland, November 2022.

First-Author Conference Presentations

Numerous talks for which Dr. Marshall is listed as a co-author are not included. Graduate student authors, for whom Dr. Marshall serves or served as the student's primary research supervisor, are highlighted **in bold**; postdoctoral scholars highlighted with underline.

71. Marshall, R. A., D. M. Malaspina, T. Dudok de Wit, G. Jannet, and S. Wankmueller (2026), The Climatology of Anthropogenic and Natural VLF wave Activity in Space (CANVAS) CubeSat Mission, *URSI General Assembly*, Krakow, Poland, August 22, 2026.

70. Marshall, R. A., C. Colpitts, H. Spence, C. M. Cully, M. McCarthy, **W. Spies**, S. Elliot, A. Breneman, G. D. Berland, T. Woods, and A. Jaynes (2026), Quantifying energetic particle precipitation into the upper atmosphere via backscattered hard X-rays, *Japan Geosciences Union Annual Meeting*, Chiba, Japan, May 29, 2026, **Invited**.

69. Marshall, R. A., **J. M. Cannon**, **J. L. Claxton**, **A. M. Wold**, D. M. Malaspina, and T. Dudok de Wit (2026), Towards real-time observations of the D-region ionosphere and predictions of D-region radio wave absorption, *Japan Geosciences Union Annual Meeting*, Chiba, Japan, May 25, 2026, **Invited**.

68. Marshall, R. A., A. Shane, and **A. Wold** (2025), VLF Waves from Ground to Space: new and future insights from modeling, ground, and space-based observations, *AGU Fall Meeting*, New Orleans, LA, December 15, 2025, **Invited**.

67. Marshall, R. A. and C. Colpitts (2025), The IMPAX (Imaging Microburst Precipitation with Atmospheric X-Rays) CubeSat mission, *URSI Asia-Pacific Radio Science Conference*, Sydney, Australia, August 22, 2025.

66. Marshall, R. A., S. Knappe, J. Hughes, M. Ellmeier, **T.-H. Kao**, C. Chism, S. Wankmueller, and C. Cunningham (2025), A vectorized rubidium atomic magnetometer for low-Earth orbit field monitoring, *2025 HelioTech / Suborbital Symposium*, Laurel, MD, September 8, 2025.

65. Marshall, R. A., C. Cully, M. McCarthy, **G. Berland**, **R. Reid**, **W. Spies**, **B. Mascarenhas Pontes**, S. Wankmueller, and C. Cunningham (2025), Coded Aperture Imaging for X-rays and Energetic Electrons in Heliophysics Environments, *2025 HelioTech / Suborbital Symposium*, Laurel, MD, September 8, 2025.

64. Marshall, R. A. and **R. A. Reid** (2024), Coded Aperture Imaging of Energetic Electrons in the Solar Wind and Magnetosphere, *2024 Heliophysics Technology Symposium*, Wallops Island, Virginia, September 19, 2024.

63. Marshall, R. A., D. M. Malaspina, T. Dudok de Wit, Guillaume Jannet, C. Cunningham, and S. Wankmueller (2024), The CANVAS CubeSat Mission: Observing Lightning-Generated Whistlers and VLF Transmitters from Low-Earth Orbit, *11th VERSIM International Workshop*, Breckenridge, Colorado, October 2, 2024.

62. Marshall, R. A., S. Knappe, D. Malaspina, J. Hughes, **C. Chism**, M. Ellmeier, S. Regmi, A. Chandran, C. Cunningham, **A. Aguilar-Nadalini**, and S. Wankmueller (2024), The Compact Spaceborne Magnetic Observatory: Precise Measurements of the Earth's Magnetic Field from a 6U CubeSat Platform, *45th COSPAR Scientific Assembly*, Busan, South Korea, July 20, 2024.

61. Marshall, R. A., A. Chandran, S. Regmi, **G. Berland**, S. Boyajian, J. Buescher, H. Spence, C. Cully, M. McCarthy, T. Woods, and R. Kohnert (2024), Design and Development of teh Atmospheric Effects of Precipitation through Energetic X-rays (AEPEX) CubeSat Mission, *45th COSPAR Scientific Assembly*, Busan, South Korea, July 20, 2024.

60. Marshall, R. A., D. M. Malaspina, T. Dudok de Wit, G. Jannet, **J. M. Cannon**, M. Stratton, and S. Wankmueller (2023), Design and Performance of the Compact Five-channel VLF Wave Receiver on the CANVAS CubeSat Mission, *URSI General Assembly*, Sapporo, Japan, August 24, 2023.

59. Marshall, R. A., **J. M. Cannon**, and **F. Gasdia** (2023), Mesoscale D-region ionospheric imaging with an array of VLF receivers, *URSI General Assembly*, Sapporo, Japan, August 22, 2023.

58. Marshall, R. A., et al (2023), The AEPEX Mission: Imaging Energetic Particle Precipitation Into Earths Upper Atmosphere, *37th Annual AIAA/USU Conference on Small Satellites*, Logan, Utah, August 5, 2023.

57. Marshall, R. A., D. M. Malaspina, S. E. Palo, T. Dudok de Wit, G. Jannet, **R. A. Reid**, **J. M. Cannon**, S. Wankmueller, **P. Vankawala**, and **A. Aguilar-Nidalini** (2022), The CANVAS Mission: Quantifying the VLF Radio Energy Input from the Ground into the Earths Magnetosphere, *10th VERSIM workshop*, Sodankyla, Finland, November 9, 2022.

56. Marshall, R. A., **F. Gasdia**, and **J. M. Cannon** (2022), Imaging the D-region ionosphere over large scales using an array of VLF receivers, *10th VERSIM workshop*, Sodankyla, Finland, November 8, 2022.

55. Marshall, R. A., **R. A. Reid**, **J. M. Cannon**, S. Wankmueller, **P. Vankawala**, S. Palo, D. M. Malaspina, T. Dudok de Wit, and G. Jannet (2022), The CANVAS Mission: Quantifying the Very-Low-Frequency Radio Energy Input from the Ground into the Earth's Magnetosphere, *36th Annual AIAA/USU Conference on Small Satellites*, Logan, Utah, August 6, 2022.

54. Marshall, R. A. (2022), Imaging Energetic Particle Precipitation from Above: The AEPEX CubeSat Mission, *8th International HEPPA-SOLARIS Meeting*, Bergen, Norway, June 15, 2022.

53. Marshall, R. A., D. M. Malaspina, **R. Reid**, **P. Vankawala**, S. Wankmueller, **J. Cannon**, B. Nez, Z. Witte, T. Dudok de Wit, and G. Jannet (2022), Design and performance of the compact five-channel VLF receiver for the CANVAS CubeSat mission, *3rd URSI AT-AP-RASC Conference*, Gran Canaria, Spain, May 30, 2022.

52. Marshall, R. A., **P. Vankawala**, D. Vida, and P. Brown (2021), Do meteors radiate very-low-frequency radio emissions?, *URSI General Assembly*, Rome, Italy (and virtual), August 30, 2021, **Invited**.

51. Marshall, R. A., **R. Reid**, M. Usanova, M. Starks, and G. Wilson (2021), First observations and results from the very-low-frequency propagation mapper (VPM) cubesat mission, *USNC-URSI Radio Science Meeting*, Honolulu, HI, August 9, 2021, **Invited**.

Three talks (two of which were invited) in calendar year 2020 were cancelled due to the COVID-19 pandemic causing conference cancellations.

50. Marshall, R. A. and **A. Wold** (2019), Space Environment and Effects: an Undergraduate Course for both Potential Space Scientists and Casual Space Enthusiasts, *AGU Fall Meeting*, San Francisco, CA, December 12, 2019.

49. Marshall, R. A., W. Xu, A. P. Sousa, M. P. McCarthy, and R. M. Millan (2019), Modeling bremsstrahlung X-ray signatures of Lightning-induced electron precipitation in the upper atmosphere, *AGU Fall Meeting*, San Francisco, CA, December 9, 2019.

48. Marshall, R. A., W. Xu, **G. Berland**, **A. Antunes de Sa**, **E. Davis**, T. Woods, R. Kohnert, C. Randall, D. Baker, H. Spence, M. McCarthy, C. Cully, and A. Jaynes (2019), The Atmospheric Effects of Precipitation through Energetic X-rays (AEPEX) CubeSat mission, *4th COSPAR Symposium on Small Satellites*, Herzliya, Israel, November 4, 2019.

47. Marshall, R. A., A. Sousa, S. Palo, and D. Malaspina (2019), The Climatology of Anthropogenic and Natural VLF wave Activity in Space (CANVAS) CubeSat mission, *4th COSPAR Symposium on Small Satellites*, Herzliya, Israel, November 4, 2019.

46. Marshall, R. A., W. Xu, and **G. Berland** (2019), Towards Space-based Imaging of Radiation Belt Precipitation using Backscattered X-rays, *IUGG General Assembly*, Montréal, Canada, July 14, 2019.

45. Marshall, R. A., **L. K. Tarnecki**, Z. Sternovsky, T. Munsat, and M. DeLuca (2019), Improved Characterization of Meteor Luminous Efficiency through Laboratory Experiments *10th International Meteoroids Conference*, Bratislava, Slovakia, June 18, 2019.

44. Marshall, R. A., **A. Antunes de Sa**, **A. Viets**, A. Sousa, and W. Deierling (2019), Design of a Low-Cost, High-Speed Electric Field Mill for Continuous Electric Field Monitoring, *99th American Meteorological Society Annual Meeting*, Phoenix, AZ, January 7, 2019.

43. Marshall, R. A., **F. Gasdia**, and W. Xu (2018), Estimating Energetic Electron Precipitation Fluxes from Subionospheric Very-Low-Frequency Transmitter Signals, *7th International HEPPA-Solaris Workshop*, Roanoke, VA, June 11, 2018.

42. Marshall, R. A., W. Xu, **F. Gasdia**, D. Drob, A. Kero, and E. Turunen (2018), The D-region response to the 2017 Total Solar Eclipse: Observations and Modeling, *URSI Atlantic Radio Science Conference*, Gran Canaria, Spain, May 30, 2018.

41. Marshall, R. A., P. Brown, J. Kero, G. Stober, and C. Schult (2018), Meteor radar masses derived from dual-frequency head-echo observations and model inversion, *URSI Atlantic Radio Science Conference*, Gran Canaria, Spain, May 30, 2018, **Invited**.

40. Marshall, R. A., W. Xu, **F. Gasdia**, and A. Sousa (2018), Atmospheric Signatures of Radiation Belt Precipitation and their Relationship to Precipitating Flux and Spectra, *AGU Chapman Conference on Radiation Belt Dynamics*, Cascais, Portugal, March 8, 2018.

39. Marshall, R. A., W. Xu, A. Sousa, and A. Kero (2018), Secondary Effects of Lightning-induced Electron Precipitation: Chemical Effects, Optical Emissions, and X-rays, *URSI National Radio Science Meeting*, Boulder, CO, January 6, 2018, HEG1-5.

38. Marshall, R. A., E. Sanchez, A. Kero, E. Turunen, and D. Marsh (2017), Atmospheric Signatures and Effects of Space-based Relativistic Electron Beam Injection, *AGU Fall Meeting*, New Orleans, LA, December 11, 2017.

37. Marshall, R. A. (2017), Diagnostics of Relativistic Electron Beam Injection in the Upper Atmosphere, *Active Experiments in Space: Past, Present, and Future*, Santa Fe, NM, September 11, 2017.

36. Marshall, R. A., W. Xu, A. Kero, and E. Turunen (2017), Atmospheric Signatures and Diagnostics of Energetic Particle Precipitation, *URSI General Assembly*, Montreal, Canada, August 23, 2017.

35. Marshall, R. A. (2017), Meteor Head Echoes: Theory, Modeling, Observation, and Experiment, *CEDAR Annual Workshop*, Keystone, CO, June 22, 2017.

34. Marshall, R. A. (2017), Studying the D-region ionosphere response to the total solar eclipse through data and modeling, *CEDAR Annual Workshop*, Keystone, CO, June 23, 2017.

33. Marshall, R. A., T. Wallace, and M. Turbe (2017), Modeling VLF Transmitter Amplitude and Phase Variations in the Earth-Ionosphere Waveguide, *URSI National Meeting*, Boulder, CO, January 5, 2017.

32. Marshall, R. A., T. Wallace, and M. Turbe (2016), Finite Difference modeling of VLF Propagation in the Earth-Ionosphere Waveguide, *AGU Fall Meeting*, San Francisco, CA, December 15, 2016.

31. Marshall, R. A., S. Close, P. Brown, and Y. Dimant (2016), Characteristics of meteor plasma distributions from radar head echoes, *CEDAR Annual Workshop*, Santa Fe, NM, June 22, 2016.

30. Marshall, R. A. (2016), Atmospheric Response to Energetic Electron Precipitation: Ionization, optical emissions, x-rays, and backscatter, *6th International HEPPA-SOLARIS Workshop*, Helsinki, Finland, June 13, 2016.

29. Marshall, R. A., S. Close, P. Brown, and Y. Dimant (2016), Characteristics of meteor plasma distributions from radar head echoes, *Meteoroids 2016 Conference*, Noordwijk, Netherlands, June 8, 2016.

28. Marshall, R. A., S. Close, P. Brown, and Y. Dimant (2016), Effects of meteor head plasma distribution on head echo radar cross sections, *International Meteor Conference*, Egmond Aan Zee, Netherlands, June 4, 2016.

27. Marshall, R. A., **P. R. Blaes**, and U. S. Inan (2015), Global occurrence of Elves and lightning-induced heating of the ionosphere from ground-based observations, *AGU Fall Meeting*, San Francisco, CA, December 15, 2015.

26. Marshall, R. A. and S. Close (2015), Numerical modeling of radio wave scattering from meteor head plasma, *Radio Science Meeting (Joint with AP-S Symposium), 2015 USNC-URSI*, 19-24 July 2015; doi:10.1109/USNC-URSI.2015.7303538

25. Marshall, R. A., M. J. Nicolls, E. Sanchez, N. Lehtinen, and J. Nielson (2015), Effects of a Relativistic Electron Beam Interaction with the Upper Atmosphere: Ionization, X-Rays, and Optical Emissions, *AGU Fall Meeting*, San Francisco, CA, December 2014.

24. Marshall, R. A. and J. B. Snively (2013), Very-Low-Frequency Subionospheric Remote Sensing of Thunderstorm-driven Acoustic and Gravity Waves in the D-region, *AGU Fall Meeting*, San Francisco, CA, Dec 9-13, 2013, SA53A-06.

23. Marshall, R. A. (2013), Time-domain modeling of lightning, VLF transmitters, and their effects on the lower ionosphere, *CEDAR Annual Workshop*, Boulder, CO, June 22-28, 2013.

22. Marshall, R. A. (2012), Effects of Lightning Return Stroke Parameters on Radiated Fields, on the Ground and in the Ionosphere, *AGU Fall Meeting*, San Francisco, CA, Dec 6-10, 2012, AE43A-0241.

21. Marshall, R. A. (2012), High-speed Observations and Modeling of Elves and Associated Ionospheric Effects, *TEA-IS Workshop*, Málaga, Spain, June 17-22, 2012, **Invited**.

20. Marshall, R. A., S. Close, and U. S. Inan (2012), Subionospheric VLF Remote Sensing of Convective Gravity Waves and Acoustic Waves in the Lower Ionosphere, *CEDAR Workshop*, Santa Fe, NM, June 20-24, 2012.

19. Marshall, R. A. (2011), Lightning Interaction with the Lower Ionosphere: Elve Doublets and Ring Sprites, *AGU Fall Meeting*, San Francisco, CA, Dec 5-9, 2011, AE21A-0221.

18. Marshall, R. A. and U. S. Inan (2011), Model Estimates of Optical Emissions due to Lightning-Induced Electron Precipitation, *URSI General Assembly*, Istanbul, Turkey, August 15-19, 2011, GP2.40.

17. Marshall, R. A., J. Bortnik, and N. Lehtinen (2010), Optical Signatures of Lightning-Induced Electron Precipitation, *AGU Fall Meeting*, San Francisco, CA, Dec 13-17, 2010; AE13B-01, **Invited**.

16. Marshall, R. A. and U. S. Inan (2009), Ionospheric Effects of Cloud-to-ground and In-cloud Lightning Discharges, *AGU Chapman Conference on Effects of Thunderstorms and Lightning in the Upper Atmosphere*, State College, PA, May 10-14, 2009.

15. Marshall, R. A. and U. S. Inan (2008), Elves and Associated Ionospheric Density Perturbations due to Horizontal In-cloud Lightning EMP, *AGU Fall Meeting*, San Francisco, CA, Dec 10-14, 2008, Abstract AE13A-0300; *Outstanding Student Paper Award*.

14. Marshall, R. A. and U. S. Inan (2008), Early VLF Perturbations Driven by Lightning-EMP Generated Density Perturbations in the Ionosphere: Model Results, *URSI General Assembly*, Chicago, IL, USA, August 10-15, 2008; EGH-4.

13. Marshall, R. A. and U. S. Inan (2008), Dissociative Attachment as a Possible Cause of Early VLF Perturbations, *URSI National Radio Science Meeting*, Boulder, CO, USA, January 3-6, 2008; GH5-10.

12. Marshall, R. A. (2007), Observations and Statistics of Small-scale Streamer and Bead Features in Sprites; *Streamers, sprites, leaders, lightning: from micro- to macroscales*, Leiden, The Netherlands, Oct 8-12, 2007.

11. Marshall, R. A. and U. S. Inan (2007), The Association of Very-Low-Frequency Sferic Bursts with Sprites and Intra-cloud Lightning Activity, *URSI Joint National Radio Science Meeting*, Ottawa, ON, Canada, July 23-26, 2007; *First Place, Student Paper Competition*.

10. Marshall, R. A. and U. S. Inan (2006), Observations of Burst-like VLF Sferic Activity in Association with Sprites, *AGU Fall Meeting*, San Francisco, CA, Dec 11-15, 2006; AE51A-0263.

9. Marshall, R. A. and U. S. Inan (2006), Evidence for Direct Cloud-to-Ionosphere Electrical Connection through Sprite and Jet Processes, *CEDAR Workshop*, Santa Fe, NM, June 19-23, 2006; SPRT-06.

8. Marshall, R. A. and U. S. Inan (2006), Early/Fast VLF Perturbations caused by Scattering from Transient Luminous Events, *URSI National Radio Science Meeting*, Boulder, CO, January 4-7, 2006; H/G3-1, **Invited**.

7. Marshall, R. A. and U. S. Inan (2005), Measurements of Small-scale Features in Sprites: Sizes, Lifetimes and Propagation, *URSI General Assembly*, New Delhi, India, October 23-29, 2005; HGEP.8(0465), **Invited**.

6. Marshall, R. A. and U. S. Inan (2005), High-speed Measurements of Evolution and Propagation of Fine Structure in Sprites, *CAL Mid-Term Review and Science Meeting*, Elounda, Crete, Greece, June 20-24, 2005, talk D1-02.

5. Marshall, R. A. and U. S. Inan (2005), High-speed Measurements of Small-scale Features in Sprites: Sizes, Lifetimes and Propagation, *Ionospheric Effects Symposium*, Alexandria, VA, May 3-5, 2005; 1B-6 (A057).

4. Marshall, R. A. and U. S. Inan (2005), High-speed Telescopic Imaging of Sprites, *URSI National Radio Science Meeting*, Boulder, CO, January 5-8, 2005, oral presentation H/G7-7, **Invited**.

3. Marshall, R. A. and U. S. Inan (2004), Sprite observations from Langmuir Laboratory, New Mexico, *NATO Advanced Study Institute on Sprites, Elves, and Intense Lightning Discharges*, Corte, Corsica, France, July 21-25, 2004.

2. Marshall, R. A. and U. S. Inan (2004), High Time Resolution Telescopic Imaging of Fine Structure in Sprites, *AGU Fall Meeting*, San Francisco, CA, Dec 8-12, 2004, Abstract AE51A-09; *Outstanding Student Paper Award*.

1. Marshall, R. A., U. S. Inan, T. Neubert, A. Hughes, A. Collier, and T. H. Allin (2004), Optical Observations of Conjugate Sprites as Evidence for Geomagnetically Trapped Relativistic Electron Beams, *URSI National Radio Science Meeting*, Boulder CO, January 4-8, 2004, talk G/H1-3.

Externally Funded Research Projects at CU Boulder

New project starts since August 2022 in blue; many other earlier starts are on continuation funding.

30. Nowcasting Radio Blackouts at Mars Using a Physics-based Modeling Approach
PI: Robert Marshall
Prime Sponsor: NASA, SW R2O2R
Period of Performance: 01/01/2027 – 12/31/2028
Award Amount: $668,938

29. Development of a Compact, Wide-Field X-ray Navigation Sensor for Simultaneous Multi-Pulsar Tracking
PI: Robert Marshall
Prime Sponsor: NASA, NSTGRO (Student: Breno Mascarenhas Pontes)
Period of Performance: 09/29/2026 – 09/28/2030
Award Amount: $335,746

28. Imaging the D-Region Ionosphere Response to Solar Flares
PI: Robert Marshall
Prime Sponsor: NASA, FINESST (FI: James Cannon)
Period of Performance: 03/02/2026 – 03/01/2027
Award Amount: $50,000

27. MAGNETO: Magnetometer Array for Global Navigation and Earth-field Topology Observations from VLEO
PI: Jeramy Hughes; co-I: Robert Marshall
Prime Sponsor: USSF SBIR
Period of Performance: 01/01/2026 – 12/31/2027
Marshall Award Amount: $198,078

26. Ionospheric Characterization and Representation Using Symbolic regression of a learned-forecaster (ICARUS)
PI: Robert Marshall
Prime Sponsor: Northrop Grumman
Period of Performance: 05/22/2025 – 11/17/2025
Marshall Award Amount: $47,453

25. Alaska VLF Receivers Build and Installation
PI: Robert Marshall
Prime Sponsor: University of Alaska
Period of Performance: 02/07/2025 – 08/08/2025
Marshall Award Amount: $98,225

24. XRI-A Instrument Development for the RADICALS Mission
PI: Chris Cully (University of Calgary); co-I: Robert Marshall
Sponsor: University of Calgary
Period of Performance: 01/15/2025 – 12/31/2027
Marshall Award Amount: $560,918

23. GEM: Stochastic Parameterization of Lightning-Generated Whistler (LGW) Diffusion Coefficients
PI: Alex Shane; co-PI: Robert Marshall
Prime Sponsor: NSF, Geospace Environment Modeling (GEM)
Period of Performance: 07/01/2024 – 06/30/2026
Total Award Amount: $292,793
Marshall Award Amount: $15,160

22. Imaging Microburst Precipitation with Atmospheric X-ray Emissions (IMPAX) CubeSat Mission
PI: Chris Colpitts (University of Minnesota); co-I: Robert Marshall
Prime Sponsor: NASA, Heliophysics Flight Opportunities for Research and Technology
Period of Performance: 11/28/2023 – 11/27/2028
Total Award Amount: $3,612,666
Marshall Award Amount: $875,690

21. JUpiters Global maGnetic Environment and RadiatioN ObservaTory (JUGGERNOT)
PI: George Clark (JHU APL); co-PI: Robert Marshall
Prime Sponsor: NASA, Heliophysics Mission Concept Studies
Period of Performance: 09/01/2021 – 10/31/2022
Total Award Amount: $368,146
Marshall Award Amount: $20,000

20. Design of a novel imaging relativistic electron instrument for future radiation belt missions
PI: Robert Marshall
Prime Sponsor: NASA, FINESST (FI: Riley Anne Reid)
Period of Performance: 09/01/2021 – 08/31/2024
Total / Marshall Award Amount: $135,000

19. CAREER: Quantifying Radiation Belt Precipitation and Atmospheric Impacts through D-region Ionosphere Imaging
PI: Robert Marshall
Sponsor: NSF, Aeronomy
Period of Performance: 02/01/2021 – 01/31/2027 (NCE)
Total / Marshall Award Amount: $605,354
REU Supplement awarded May 2022: $90,600

18. Quantifying the Contributions of Radiation Belt Precipitation to the Effective Radiation Dose at Spacecraft and Aviation Altitudes
PI: Robert Marshall
Sponsor: NASA, Space Weather Operations-to-Research (SWO2R)
Period of Performance: 09/01/2020 – 08/31/2022
Total Award Amount: $499,995
Marshall Award Amount: $309,920

17. Lightning-induced Whistler waves in the Inner Magnetosphere and their effect on Radiation Belt Electrons
PI: Robert Marshall
Sponsor: NASA, Heliophysics Guest Investigators Open
Period of Performance: 04/01/2020 – 03/31/2023
Total Award Amount: $520,540
Marshall Award Amount: $443,423

16. Ground-based VLF and HF measurements in support of the VIPER sounding rocket experiment
PI: Robert Marshall
Sponsor: NSF, Aeronomy
Period of Performance: 03/15/2020 – 02/28/2022
Total / Marshall Award Amount: $82,931

15. VLF emission characteristics of meteors and lightning
PI: Robert Marshall
Sponsor: Northrop Grumman Corporation
Period of Performance: 12/26/2019 – 9/30/2021
Total / Marshall Award Amount: $135,000

14. Atmospheric Effects of Precipitation through Energetic X-rays (AEPEX) CubeSat Mission
PI: Robert Marshall
Sponsor: NASA, Heliophysics Technology and Instrument Development for Science
Period of Performance: 12/12/2019 – 12/11/2026 (NCE)

Total Award Amount: $4,544,281
Marshall Award Amount: $1,502,592

13. Next Generation Space Environment Technologies (NSET)
PI: Rick Quinn (AER); co-I: Robert Marshall
Prime Sponsor: Air Force Research Laboratory; Subaward Sponsor: Atmospheric and Environmental Research, Inc.
Period of Performance: 07/01/2019 – 08/31/2021
Total / Marshall Award Amount: $218,538

12. Climatology of Anthropogenic and Natural VLF wave Activity in Space (CANVAS) CubeSat Mission
PI: Robert Marshall
Sponsor: NSF, Atmospheric and Geospace Sciences
Period of Performance: 02/01/2019 – 07/31/2026 (NCE pending)
Total Award Amount: $1,196,654
Supplemental Award (03/01/2023): $204,539
Marshall Award Amount: $808,977

11. Meteor Plasma Formation and Dynamics with Implication for Radar Measurements
PI: Robert Marshall
Prime Sponsor: NSF, CEDAR
Period of Performance: 11/01/2018 – 10/31/2021
Total / Marshall Award Amount: $197,607

10. Improved Meteoroid Characterization through Laboratory Experiments, Modeling, and Ground-based Observations
PI: Robert Marshall
Prime Sponsor: NSF, Aeronomy
Period of Performance: 09/01/2018 – 08/31/2022
Total Award Amount: $645,134
Marshall Award Amount: $597,818

9. VIPER – VLF Trans-Ionospheric Propagation Experiment Rocket
PI: John Bonnell (Berkeley); co-I: Robert Marshall
Prime Sponsor: NASA, Heliophysics Low-Cost Access to Space; Subaward Sponsor: University of California Berkeley
Period of Performance: 07/01/2018 – 06/30/2021
Total Award Amount: $2,098,428
Marshall Award Amount: $194,833

8. Very Low Frequency Wave and Particle Precipitation Mapper (VPM)
PI: Robert Marshall
Prime Sponsor: Air Force Research Laboratory
Period of Performance: 11/09/2017 – 12/31/2018
Total / Marshall Award Amount: $102,501

7. Collaborative Research: Energetic Particle Precipitation Mechanisms in the Inner Magnetosphere: Van Allen Probes and Incoherent Scatter Radar Coordinated Measurements
co-PIs: Robert Marshall, Jacob Bortnik (UCLA), Ennio Sanchez (SRI)
Prime Sponsor: NSF, Magnetospheric Physics
Period of Performance: 09/01/2017 – 08/31/2021
Total / Marshall Award Amount: $120,791

6. Prevalence of Distinct Energetic Intra-Cloud Lightning Events and Their Connection to Terrestrial Gamma Ray Flashes
PI: Robert Marshall
Prime Sponsor: NASA, Earth and Space Science Fellowships (André Antunes de Sá)
Period of Performance: 09/01/2017 – 08/31/2020
Total / Marshall Award Amount: $135,000

5. Collaborative Research: Investigation of kinematic, microphysical and electrical processes leading to extreme lightning flash rates over Argentina using RELAMPAGO observations
co-PI: Robert Marshall, Wiebke Deierling (NCAR), Phil Bitzer (UAH), Larry Carey (UAH)
Prime Sponsor: NSF, Physical and Dynamic Meteorology
Period of Performance: 09/01/2017 – 08/31/2021
Total Award Amount: $550,643
Marshall Award Amount: $297,204

4. Quantifying the Contributions of Ionization Sources on the Formation of the D-region Ionosphere During the 2017 Solar Eclipse
PI: Robert Marshall
Prime Sponsor: NASA, Living With a Star
Period of Performance: 04/01/2017 – 03/31/2018
Total / Marshall Award Amount: $49,824

3. Spatial, Temporal, and Orientation Information in Contested Environments (STOIC)
PI: Michael Turbe (Leidos); co-I: Robert Marshall
Prime Sponsor: DARPA; Subaward Sponsor: Leidos Inc.
Period of Performance: 10/01/2015 – 01/31/2019
Total / Marshall Award Amount: $404,439

2. Thunderstorm Coupling to the Lower Ionosphere through Electromagnetic, Acoustic, and Gravity Waves
PI: Sigrid Close (Stanford); co-I: Robert Marshall
Prime Sponsor: NSF, CEDAR; Subaward Sponsor: Stanford University
Period of Performance: 09/01/2015 – 07/31/2017
Total / Marshall Award Amount: $116,357

1. Concept Development for Active Magnetospheric, Radiation Belt, and Ionospheric Experiments using In Situ Relativistic Electron Beam Injection
PI: Ennio Sanchez (SRI); co-I: Robert Marshall
Prime Sponsor: NSF, INSPIRE; Subaward Sponsor: SRI International
Period of Performance: 09/01/2015 – 08/31/2017
Total / Marshall Award Amount: $47,290

Challenge or Prize Awards

6. MagQuest Competition, Phase 4C: Launch, Commissioning, and Operations
Funding Source: National Geospatial Intelligence Agency (NGA)
Date: April 9, 2026
Marshall Award Amount: $306,800

5. MagQuest Competition, Phase 4B: Spacecraft and Mission Development
Funding Source: National Geospatial Intelligence Agency (NGA)
Date: September 1, 2023
Marshall Award Amount: $4,944,968

4. MagQuest Competition, Phase 4A: Instrument Development
Funding Source: National Geospatial Intelligence Agency (NGA)
Date: September 17, 2021
Marshall Award Amount: $3,423,000

3. MagQuest Competition, Phase 3: Critical Design
Funding Source: National Geospatial Intelligence Agency (NGA)
Date: October 13, 2021
Marshall Award Amount: $225,000

2. MagQuest Competition, Phase 2: Preliminary Design
Funding Source: National Geospatial Intelligence Agency (NGA)
Date: September 23, 2019
Marshall Award Amount: $200,000

1. MagQuest Competition, Phase 1: Concept Design
Funding Source: National Geospatial Intelligence Agency (NGA)
Date: June 6, 2019
Marshall Award Amount: $20,000

Internally Funded Research Projects at CU Boulder

3. Magnetic CubeSat Constellation for Advanced Navigational Models
Sponsor: CU Boulder Grand Challenge
Period of Performance: 09/01/2017 – 08/31/2021
Marshall Award Amount: $745,520

2. *ASEN 4519: Space Environment and Effects* (course development)
Sponsor: CU Boulder Space Minor
Start Date: 09/01/2017
Marshall Award Amount: $10,000

1. Integrated Remote and In-Situ Sensing (IRISS): Project Lightning
Sponsor: Research and Innovation Office, CU Boulder
Period of Performance: 01/01/2016 – 12/31/2016
Marshall Award Amount: $69,446

Intellectual Property

5. Software Package: J. L. Claxton and R. A. Marshall, Electron Precipitation Monte Carlo, published August 2025.

4. Hardware Design: J. M. Cannon, R. A. Marshall, and S. Wankmueller, the AVID VLF Receiver, published 2025.

3. Software Package: F. Gasdia and R. A. Marshall, Longwave Mode Propagator, published March 2021; last updated March 2024.

2. Software Package: R. A. Marshall, FDTD EMP Model, published 2014; last updated June 2026.

1. Patent: Robert A. Marshall, André Lucas Antunes de Sá, Austin P. Sousa, and Alec Viets. Compact, Low-Cost Electric Field Mill. Patent #16,852,498; issued July 1, 2022.

Courses Taught

† Denotes courses created or co-created
‡ Denotes courses significantly revised

Courses taught since receiving tenure in August 2022:

- Undergraduate: ASEN 2501†, *Introduction to Astronautics*, Fall 2025, Spring 2026, & Fall 2026
- Undergraduate: ASEN 3300, *Aerospace Electronics & Communications*, Spring 2025
- Undergraduate: ASEN 4018/4028, *Senior Design Projects I & II*, team advisor, AY 23–24
- Graduate: ASEN 5335‡, *Aerospace Environment*, Fall 2023 & 2024
- Graduate: ASEN 5440†, *Mission Design and Development for Space Sciences*, Fall 2025

- Graduate: ASEN 5018/6028, *Graduate Projects I & II* (coordinator), AY 2026-2027

Courses taught prior to receiving tenure in August 2022:

- Undergraduate: ASEN 3300, *Aerospace Electronics & Comm.*, Spring 2017 & 2018, Fall 2020 & 2021
- Undergraduate: ASEN 4018/4028, *Senior Design Projects I & II*, team advisor, AY 15–16, 16–17
- Undergraduate: ASEN 4519†, *Space: Environment and Effects*, Fall 2018
- Graduate: ASEN 5018/6028, *Graduate Projects I & II* (project advisor), AY 2017–2022
- Graduate: ASEN 5335‡, *Aerospace Environment*, Spring 2021 & 2022
- Graduate: ASEN 5440†, *Mission Design and Development for Space Sciences*, Fall 2017 & 2019
- Graduate: ASEN 5519†, *Space Mission Concept Development*, Fall 2015
- Graduate: EE 256, *Numerical Electromagnetics* (Stanford University), Summer 2008

Ph.D Theses Supervised

Ph.D theses by students for whom Dr. Marshall is or was the student's primary research supervisor.

16. Breno Mascarenhas Pontas, Aerospace Engineering Sciences, CU Boulder, Ph.D expected 2029
15. Tzu-Hsun Kao, Aerospace Engineering Sciences, CU Boulder, Ph.D expected 2028
14. Julia Claxton, Aerospace Engineering Sciences, CU Boulder, Ph.D expected 2027
13. Anant Telikicherla, Aerospace Engineering Sciences, CU Boulder, Ph.D expected 2027
12. Wyatt Spies, Aerospace Engineering Sciences, CU Boulder, Ph.D expected 2027
11. Paraksh Vankawala, Aerospace Engineering Sciences, CU Boulder, Ph.D expected 2026
10. James Cannon, Aerospace Engineering Sciences, CU Boulder, Ph.D expected 2026
9. Alexandra Wold, Aerospace Engineering Sciences, CU Boulder, **Ph.D completed** 2025
8. Carolina (Peña) Chism, Aerospace Engineering Sciences, CU Boulder, **Ph.D completed** 2024
7. Riley Reid, Aerospace Engineering Sciences, CU Boulder, **Ph.D completed** June 2024
6. Grant Berland, Aerospace Engineering Sciences, CU Boulder, **Ph.D completed** August 2023
5. Liane Tarnecki, Aerospace Engineering Sciences, CU Boulder, **Ph.D completed** August 2023
4. Forrest Gasdia, Aerospace Engineering Sciences, CU Boulder, **Ph.D completed** December 2021
3. André Antunes de Sá, Aerospace Engineering Sciences, CU Boulder, **Ph.D completed** May 2021
2. Diana Juarez Madera, Aeronautics & Astronautics, Stanford University, **Ph.D completed** May 2020
1. Austin Sousa, Electrical Engineering, Stanford University, **Ph.D completed** June 2018

M.S. Theses Supervised

Master's theses by students for whom Dr. Marshall is or was the student's primary research supervisor.

6. Darius Mirhosseini, Aerospace Engineering Sciences, CU Boulder, M.S. expected May 2027
5. Sierra Vesey, Aerospace Engineering Sciences, CU Boulder, M.S. **completed** May 2025
4. Maria Callas, Aerospace Engineering Sciences, CU Boulder, M.S. **completed** August 2023
3. Erin McMurchie, Aerospace Engineering Sciences, CU Boulder, M.S. **completed** December 2022
2. Jennifer Kampmeier, M.S., Aerospace Engineering Sciences, CU Boulder, **completed** May 2018
1. Stephen Jackson, M.S., Aerospace Engineering Sciences, CU Boulder, **completed** May 2017

Undergraduate Research Advisees

† CU Summer Program for Undergraduate Research (SPUR)
‡ Research Experience for Undergraduates (REU)
* Discovery Learning Apprenticeship (DLA)

39. Oliver Kaplan*, Aerospace Engineering Sciences, Fall 2025 – present
38. Caleb Bettcher*, Aerospace Engineering Sciences, Fall 2024 – Spring 2025
37. Erick White*, Aerospace Engineering Sciences, Fall 2024 – Spring 2025
36. Matayay Karuna†, Computer Science, Summer 2023 – Spring 2025
35. Ryan Dick‡, Astrophysics & Engineering Physics, Summer 2022 – Spring 2025
34. Ashton Tribble‡, Aerospace Engineering Sciences, Summer 2023 – Fall 2025
33. Thomas Collier*, Aerospace Engineering Sciences, Fall 2023 – Spring 2024
32. Courtney Hogan*, Aerospace Engineering Sciences, Fall 2023 – Spring 2024
31. Tsuening Lee*, Aerospace Engineering Sciences, Fall 2023 – Spring 2024
30. Andrew Miller*, Aerospace Engineering Sciences, Fall 2023 – Spring 2024
29. Hayden Gebhardt†, Aerospace Engineering Sciences, Summer 2023
28. Micah Bergeron†, Aerospace Engineering Sciences, Summer 2023
27. Bennett Frangomeni†, Software Engineering, Summer 2022 – Fall 2023
26. Sophia Orlandella†, Aerospace Engineering Sciences, Summer – Fall 2022
25. Kevin Pipich†, Aerospace Engineering Sciences, Summer – Fall 2022
24. Catherine Xiao†, Computer Science, Summer – Fall 2022
23. Max Feinland‡, Aerospace Engineering Sciences, Summer – Fall 2022
22. Maria Callas*, Aerospace Engineering Sciences, Fall 2021 – Spring 2022
21. Shawn Stone*, Aerospace Engineering Sciences, Fall 2021 – Spring 2022
20. Keith Poletti*, Aerospace Engineering Sciences, Summer 2020 – Spring 2021
19. Jett Moore*, Aerospace Engineering Sciences, Summer 2020 – Spring 2021
18. Logan Vangyia*, Aerospace Engineering Sciences, Fall 2020 – Spring 2021
17. Jash Bhalavat, Aerospace Engineering Sciences, Fall 2020 – Spring 2022
16. Conner Martin*, Aerospace Engineering Sciences, Spring 2020 – Spring 2021
15. Joseph Buescher*, Aerospace Engineering Sciences, Spring 2020 – Spring 2021
14. Dean Curtis, Engineering Physics, Fall 2019 – Spring 2020
13. Bruce Barnstable*, Aerospace Engineering Sciences, Fall 2019 – Spring 2020
12. Jaykob Velasquez*, Aerospace Engineering Sciences, Summer 2019 – Spring 2020
11. Brandon King†, Aerospace Engineering Sciences, Summer 2019
10. Haley Drexel†, Aerospace Engineering Sciences, Summer 2019
9. Elliott Davis, Aerospace Engineering Sciences, Fall 2018 – Spring 2020
8. Mark Zakhem, Electrical, Computer, & Energy Engineering, Fall 2018 – Spring 2019
7. Connor Myers*, Aerospace Engineering Sciences, Summer 2018 – Spring 2020
6. Matthew Funk*, Aerospace Engineering Sciences, Fall 2017 – Spring 2018
5. Catherine Witt*, Electrical and Computer Engineering, Fall 2017 – Spring 2018
4. Alec Viets, Aerospace Engineering Sciences, Summer 2017 – Summer 2018
3. Leina Hutchinson, Aerospace Engineering Sciences, Summer 2017

2. Noah Holland-Moritz*, Engineering Physics, Fall 2016 – Spring 2017
1. Joshua (Luke) Tafur, Aerospace Engineering Sciences, Spring 2016

Doctoral Thesis Committee Member

45. Nicholas Jones, Aerospace Engineering Sciences, CU Boulder, comprehensive exam Apr 15, 2026
44. Declan O'Brien, Aerospace Engineering Sciences, CU Boulder, comprehensive exam Dec 5, 2025
43. Tania Varesano, Aerospace Engineering Sciences, CU Boulder, comprehensive exam Nov 7, 2025
42. James Walker III, Aerospace Engineering Sciences, CU Boulder, comprehensive exam Oct 27, 2025
41. Nicholas Bartel, Aerospace Engineering Sciences, CU Boulder, comprehensive exam Sept 17, 2025
40. Grant Kirchhoff, Aerospace Engineering Sciences, CU Boulder, comprehensive exam Jan 24, 2025
39. Gary Sutliff, Aerospace Engineering Sciences, CU Boulder, comprehensive exam Nov 18, 2024
38. Robert Sewell, Ph.D, Aerospace Engineering Sciences, CU Boulder, May 2026
37. Kaylee Champion, Ph.D, Aerospace Engineering Sciences, CU Boulder, April 2026
36. Domenique Freund, Ph.D, Aerospace Engineering Sciences, CU Boulder, April 2026
35. Cole Tamburri, Ph.D, Astsrophysical and Planetary Sciences, CU Boulder, March 2026
34. Nicholas Nell, Ph.D, Aerospace Engineering Sciences, CU Boulder, October 2025
33. Yang Mei, Ph.D, Aerospace Engineering Sciences, CU Boulder, September 2025
32. Julian Hammerl, Ph.D, Aerospace Engineering Sciences, CU Boulder, June 2025
31. Martin Jenner, Ph.D, Sciences de la Terre et de l'Environnement, Université Paris Cité, Dec 2024
30. Vicki Herde, Ph.D, Aerospace Engineering Sciences, CU Boulder, November 2024
29. Daniel da Silva, Ph.D, Aerospace Engineering Sciences, CU Boulder, July 2024
28. John Marino, Ph.D, Aerospace Engineering Sciences, CU Boulder, April 2024
27. Ben Hogan, Ph.D, Aerospace Engineering Sciences, CU Boulder, December 2023
26. Arika Egan, Ph.D, Astrophysical and Planetary Sciences, CU Boulder, April 2023
25. Bill Goode, Ph.D, Aerospace Engineering Sciences, CU Boulder, December 2022
24. Bennet Schwab, Ph.D, Aerospace Engineering Sciences, CU Boulder, June 2022
23. Leng Ying Khoo, Ph.D, Aerospace Engineering Sciences, CU Boulder, January 2022
22. Mitchell Shen, Ph.D, Aerospace Engineering Sciences, CU Boulder, July 2021
21. Kieran Wilson, Ph.D, Aerospace Engineering Sciences, CU Boulder, May 2021
20. Miles Bengtson, Ph.D, Aerospace Engineering Sciences, CU Boulder, November 2020
19. JoAnna Fulton, Ph.D, Aerospace Engineering Sciences, CU Boulder, July 2020
18. Andrew Dahir, Ph.D, Aerospace Engineering Sciences, CU Boulder, December 2020
17. Michael DeLuca, Ph.D, Aerospace Engineering Sciences, CU Boulder, April 2020
16. Kun Zhang, Ph.D, Aerospace Engineering Sciences, CU Boulder, December 2020
15. Kevin-Druis Merenda, Ph.D, Physics, Colorado School of Mines, July 2020
14. Diana Juarez Madera, Ph.D, Aeronautics and Astronautics, Stanford University, June 2020
13. Robinson Wallace, Ph.D, Atmospheric and Ocean Sciences, CU Boulder, July 2020
12. Yining Shi, Ph.D, Aerospace Engineering Sciences, CU Boulder, December 2019
11. Rory Barton-Grimley, Ph.D, Aerospace Engineering Sciences, CU Boulder, May 2019
10. Alex Barrie, Ph.D, Aerospace Engineering Sciences, CU Boulder, September 2018

9. Austin Sousa, Ph.D, Aeronautics and Astronautics, Stanford University, June 2018
8. Saurabh Sanghai, Ph.D, Electrical, Computer, & Energy Engineering, CU Boulder, May 2018
7. Dilini Subasinghe, Ph.D, Physics and Astronomy, University of Western Ontario, December 2017
6. Derek Houtz, Ph.D, Aerospace Engineering Sciences, CU Boulder, May 2017
5. Evan Thomas, Ph.D, Physics, CU Boulder, May 2017
4. Greg Lucas, Ph.D, Aerospace Engineering Sciences, CU Boulder, May 2017
3. David Garrido López, Ph.D, Electrical, Computer, & Energy Engineering, CU Boulder, December 2016
2. Thomas Rogers, Ph.D, Astrophysics and Planetary Sciences, CU Boulder, July 2016
1. Patrick Blaes, Ph.D, Electrical Engineering, Stanford University, May 2015

Postdoctoral Fellows and Research Associates

6. Carolina Chism (Ph.D 2024, University of Colorado Boulder), August 2024 – February 2025
5. Grant Berland (Ph.D 2023, University of Colorado Boulder), August 2023 – December 2023
4. Alexander Shane (Ph.D 2022, University of Michigan), March 2022 – August 2024
3. Edwin Bernardoni (Ph.D 2022, University of Colorado Boulder), February 2022 – August 2023
2. Austin Sousa (Ph.D 2018, Stanford University), October 2017 – July 2020
1. Wei Xu (Ph.D 2015, Pennsylvania State University), January 2016 – July 2021

Professional Service Activities

17. URSI Chair for Commission H, 2026 – 2029 (incoming August 2026)
16. URSI Vice Chair for Commission H, 2023 – 2026
15. Conference Organizer and Host: 2024 VERSIM Conference, Breckenridge, CO
14. NSF GEM Focus Group co-Lead, *Comparative Magnetospheres*, 2022 – present
13. AIAA Small Satellite Technical Committee, 2022 – 2025
12. Session Organizer: URSI General Assembly, 2023 & 2026, and URSI AT-RASC Meeting, 2024
11. Session Organizer: AGU Fall Meeting, 2022 – 2025
10. AGU student poster judge at Fall Meeting every other year
9. NASA Review Panelist every year since 2014
8. NSF Review Panelist most years since 2016
7. Proposal reviews (2–4 per year) for NSF, NASA and international agencies
6. Journal reviews (8–10 per year) for Nature Communications; Science Advances; Journal of Geophysical Research (Atmospheres and Space Physics); Geophysical Research Letters; Earth and Space Science; Journal of Atmospheric and Solar Terrestrial Physics; Earth Moon and Planets; Icarus; Annales Geophysicae
5. Session Organizer: URSI General Assembly, 2021
4. Session Organizer: NSF CEDAR Workshop, 2015, 2016, 2017
3. Session Organizer: URSI National Radio Science Meeting, 2009, 2016 – 2019
2. Conference Organizer and Host: Stanford Meteor Environment and Effects (SMEE) Workshop, Stanford, CA, July 14-16, 2015

1. CEDAR and GEM student poster judge at numerous Annual Workshops

University Service Activities

11. Colorado Center for Astrodynamics Research (CCAR), Associate Director, January 2024 – present
10. AES Department, Associate Chair for Graduate Studies, July 2023 – present
9. College of Engineering and Applied Science, Graduate Education Committee, July 2023 – present
8. CU Boulder Campus, Provost Faculty Achievement Award Committee, 2022 – 2023
7. AES Department, Faculty Search Committee, Fall 2022 – Spring 2023
6. AES Department, Undergraduate Operations Committee, Fall 2021 – Spring 2022
5. AES Department, Undergraduate Curriculum Committee, Fall 2019 – Spring 2021
4. AES Department, Avionics and Instrumentation Curriculum Group Lead, Fall 2019 – Spring 2021
3. AES Department, Strategic Vision Committee, Fall 2017 – Spring 2019
2. AES Department, Graduate Committee, Fall 2016 – Spring 2018
1. AES Department, Focus Area Lead, Remote Sensing, Earth and Space Sciences (RSESS), Fall 2016 – Spring 2018

Professional Memberships

- Senior Member, American Institute of Aeronautics and Astronautics (AIAA)
- Senior Member, Institute for Electrical and Electronics Engineers (IEEE)
- Member, American Geophysical Union (AGU)
- Member, European Geophysical Union (EGU)
- Member, American Association for Engineering Education (ASEE)