

**Curriculum Vitae**  
**Christopher D. Ball, Ph.D., PMP**  
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ElectroScience Laboratory, The Ohio State University, 1330 Kinnear Road, Columbus, OH 43212  
(614) 292-5752

**EDUCATION**

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Doctor of Philosophy	The Ohio State University, Physics	August 1998
Master of Science	The Ohio State University, Physics	August 1994
Bachelor of Arts	Harvard University, Physics	May 1992

**PROFESSIONAL EXPERIENCE**

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Research Scientist	The Ohio State University, ElectroScience Lab	Jan 2016 – present
President	Optimal Scientific LLC	Aug 2015 – present
Research Leader	Battelle Memorial Institute	Jan 2009 – Aug 2015
Senior Research Scientist	Battelle Memorial Institute	Sept 2004 – Dec 2008
Principal Research Scientist	Battelle Memorial Institute	July 2000 – Aug 2004
Visiting Scientist (postdoc)	Harvard-Smithsonian Center for Astrophysics	Sept 1998 – June 2000
NASA Research Fellow	The Ohio State University, Dept. of Physics	Sept 1994 – Aug 1998
Teaching Assistant	The Ohio State University, Dept. of Physics	Sept 1993 – May 1994
Student Researcher	Harvard University, High Energy Physics Lab	June 1991 – Aug 1992

**RESEARCH HIGHLIGHTS**

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- ***Handheld Spectroscopic Sensor for Food and Agriculture Applications (OSU)*** Co-Principal Investigator on several projects to develop a handheld sensor based on infrared spectroscopy and advanced chemometric algorithms to quantify the presence of various constituents of food and agricultural products. Examples include amino acids and protein in soybeans (funding from the Ohio Soybean Council and USDA SBIR – sub to SK Infrared LLC), oats (funding from industry sponsor), barley, and cannabis.
- ***CubeSat Development (OSU)*** Project manager for the CubeRRT mission, a small satellite (CubeSat) equipped with a microwave radiometer and digital backend processor to test RF interference mitigation on a spaceborne platform. Coordinated development efforts at NASA Goddard Space Flight Center, NASA Jet Propulsion Laboratory, and Blue Canyon Technologies to ensure efficient and effective integration of payload and spacecraft systems.
- ***Simulation Toolset for Adaptive Remote Sensing (OSU)*** Co-Principal Investigator on a NASA-funded project to develop software libraries to support simulations of next generation satellite remote sensing capabilities, including adaptive sensing, resource-constrained platforms (i.e., CubeSats), and constellations of satellite platforms.
- ***Laser Imaging of Methane Leaks (OSU)*** Project manager and technical contributor on industry-funded project to develop laboratory demonstration of a laser-based infrared imaging technology to detect and quantify methane leaks in or near homes or businesses.

- **Dielectric Resonator Antenna Coupled Antimonide Detector (OSU)** Project manager and technical resource on NRO-funded Director's Innovation Initiative project and separate ARO-funded project to research and develop a novel infrared detector technology based on a deep sub-wavelength superlattice detector with signal enhancement by a coupled dielectric antenna structure.
- **Field Programmable Short Wave Infrared Photodetectors (OSU)** Project manager for a NASA SBIR funded project, in association with SK Infrared LLC, to develop a short wave infrared detector that can be programmed via bias voltage setting to operate in a high gain mode (avalanche photodiode) or high dynamic range mode (PIN diode) for star tracking and optical communications applications.
- **Submillimeter Wave Spectroscopic Sensor for Ambient Air Monitoring (OSU)** Co-Principal Investigator and project manager on an EPA-funded effort to investigate detection feasibility for several toxic pollutants (including formaldehyde, acrolein, and other carbonyls). Designed, developed, and tested a field deployable prototype submillimeter wave sensor for ambient air monitoring applications.
- **Agricultural Sensors (Optimal Scientific LLC)** Worked with the Ohio Soybean Council to identify and assess sensor technologies that can be deployed in the field in near-term (1-2 years). Specific applications include disease detection, nutrient deficiency characterization, insect/pest infestation, and soil quality analysis. Interfaced with farmers, crop advisors, trade organizations, researchers, and commercial vendors to acquire and assess technical and operability requirements.
- **Mission Adaptable Chemical Sensor (Battelle)** Led Battelle's participation in the development of the DARPA-funded, sub-millimeter wave Mission Adaptable Chemical Sensor (MACS). Collaborated with Prof. Frank De Lucia's group in the OSU Dept. of Physics. Managed DARPA seedling to assess MACS system for monitoring exhaled breath for disease and exposure diagnostics.
- **100 Gb/s Wireless Communication Link (Battelle)** Managed project to develop a millimeter wave communication technology with very high data rates under the DARPA 100G program. Used high order modulation techniques coupled with a photonic-based mmW generation approach to produce a prototype link with exceptional performance capability. Directed customized FPGA and digital logic implementations to manage high speed flow of data.
- **Terahertz Research and Development (Battelle)** Served as primary technical point of contact for Battelle's terahertz technology development efforts. Led several research initiatives, including spectral signature library and sensor development activities.
- **Buried and Surface IED and Explosive Hazard Detection and Localization (Battelle)** Managed sensor phenomenology and performance modeling studies for Army Research Laboratory. Modeled performance for a variety of sensors, including metal detector and ground penetrating radar systems, to detect buried explosive threats. Provided support to enhance sensor testing operations by developing artificial soils with high magnetic susceptibility.
- **Joint Biological Tactical Detection System Competitive Prototyping Effort (Battelle)** Served as project manager. Directed fabrication and delivery of 11 prototypes based on optical Raman spectroscopy as well as base station communications nodes. Provided test and training support.

- **Assessment of Remote Sensing Technology for Oil Detection (Battelle)** Participated in multiple studies of current and emerging remote sensing technologies that can detect oil spills, including airborne and satellite-based active and passive optical systems, radar systems, and microwave radiometer. Assessed key performance parameters, operations and maintenance information, and total ownership costs in order to provide guidance on future oil spill response operations.
- **Standoff Chemical and Biological Agent Detection Assessment (Battelle)** Conducted Analysis of Alternatives phase of a Joint Services program to field a next-generation, battlefield standoff chemical agent detection system. Provided performance, operability, supportability, safety, and technology readiness assessments of a variety of lidar, passive infrared, and radar systems.
- **Development of Hyperspectral Analysis Algorithms and Tools (Battelle)** Developed new algorithms for hyperspectral image analysis, particularly for the identification of trace gas constituents and hard target materials within complex data sets. Implemented several algorithms for atmospheric compensation and spectral identification.
- **M\*ACH Development (Battelle)** Supported the development of the MASINT Analysis of Competing Hypotheses (M\*ACH) tool for the interpretation and assessment of highly complex intelligence data. Assessed evidentiary value of technical intelligence against established intelligence requirements by investigating all possible hypotheses that can be supported or refuted by the signature data.
- **Infrared Spectroscopy (Battelle)** Served as Technical Lead for developing quantitative infrared spectral signature libraries. Developed laboratory capability, in conjunction with PNNL and NIST, for measuring highly toxic compounds with low vapor pressures. Measured signatures relevant to industrial process monitoring. Managed project that measured infrared through visible spectral signatures of solid and liquid explosives and related materials.
- **Laser Spectroscopy (Harvard-Smithsonian Center for Astrophysics)** Performed research on exotic carbon chains by laser spectroscopy. Constructed and operated spectrometers based on Nd:YAG, tunable dye, and excimer lasers. Used multiple spectroscopy techniques to probe molecules produced in high voltage discharge. Compared spectral signatures with optical telescope data to identify origins of the mysterious Diffuse Interstellar Bands.
- **Millimeter Wave Spectroscopy (OSU - Graduate research)** Conducted laboratory investigations of atmospheric and interstellar molecules using millimeter and sub-millimeter wave spectroscopy. Developed novel spectrometers based on klystrons, backward wave oscillators, and solid-state oscillators. Developed simulation, analysis, and control software.

## COMMITTEES AND SERVICE ACTIVITIES

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### **Ohio State University Activities**

- **Awards Committee, ElectroScience Laboratory (2017-present)** Chair of the ESL Awards Committee, which evaluates nominations for internal laboratory awards as well as promotes ESL faculty, staff, and students for university-wide and national awards.
- **Community Building Committee, ElectroScience Laboratory (2016-present)** Chair of a committee to identify ways for ESL faculty, staff, and students to increase interactions socially and professionally in order to foster stronger lab cohesiveness.

- **Mentorship, Columbus City Schools (2016-present)** Serve as a mentor for senior high school students at risk of not graduating. Meet weekly with two students at Whetstone HS to discuss short term goal of graduating successfully and longer term goals for life after graduating.
- **Mentorship, OSU Alumni Association Young Alumni Academy (2016-2017)** Served as a mentor for a local young alumnus, conducted regular meetings, provided career advice.
- **Presentation judge, Hayes Research Forum (2016-present)** Serve as a judge for graduate student presentations in the engineering section of the Hayes Research Forum. Offer feedback on effective presentation style and technical content.

#### **Battelle Committees**

- **Senior Technical Council, Tactical Systems Business Unit (2012-2015)** Served as chair of Technical Investment Committee (2012-2014) and chair of the Senior Technical Council (2014-present). Provide guidance to management on technology development strategy, evaluate IR&D proposals, assess IP portfolio, and recommend capital improvements.
- **Air Quality and Regulatory Compliance Strategy Team (2011-2013)** Participated in strategy meetings, advised on repurposing of military/intelligence sensors for environmental applications.
- **Achievement Awards Committees (2011-2015)** Served on multiple committees to evaluate individual and team nominations for internal Battelle Achievement Awards.
- **Line of Business Committees (2009-2012)** Served on two committees devoted to establishing Battelle lines of business in Critical Infrastructure and Environmental R&D.
- **IR&D Advisory Board (2008-09)** Served on advisory board for a strategically important sensor development project funded through Battelle's Internal Research and Development portfolio.
- **Intelligence Community Strategy Teams (2008-2013)** Served on multiple strategy development teams aimed at positioning Battelle for growth in the intelligence community sector, including Measurement and Signatures Intelligence strategy team, Intelligence Futures Group, and Strategic Implementation Team focused on a specific client.
- **Sensors and Communication Systems Team Lead (2007-2015)** Assisted with line management functions (signature authority, staff mentoring, personnel reviews, hiring decisions).

#### **Government Committees and Service**

- **Ohio Federal Research Network (2018-2019)** Served as co-Lead for the C4ISR Center of Excellence. Provide technical and programmatic oversight for sponsored university research project on Human Centered Big Data.
- **ODNI IC S&T Strategic Plan – Industry Guidance (2015)** Provided novel sensor expertise and investment recommendations to the Office of the Director of National Intelligence.

- **Joint Improvised Explosive Device Defeat Organization Lab-focused Mini-Technology Outreach Conference (2012)** Provided subject matter expertise and strategic recommendations on remote sensing technologies for detection of explosives under varying mission-relevant scenarios.
- **Intelligence Community iD8 Panel (2009)** Served on intelligence community panel to evaluate S&T skills, capabilities, and technologies relevant to North Korea.
- **Department of Energy Proposal Reviews (2007-10)** Evaluated technical proposals submitted for DoE SBIR funding. Wrote detailed evaluation and made recommendations on funding.

#### **AWARDS AND ACKNOWLEDGMENT**

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- 2019 ElectroScience Laboratory, Above & Beyond – Researcher award
- 2019 NASA, Group Achievement Award – CubeRRT Mission Team
- 2019 Ohio Technology & Engineering Educators Association, Best Technology Exhibit for the Technology and Engineering Showcase – OSU CubeRRT Team
- 2008 DIA Signatures Support Program, Next Generation Signatures Award – Terahertz Measurement and Signatures Methodologies
- 2005 Battelle, Key Contributor Award – Gorilla Project
- 2002 Battelle, Key Contributor Award – Artemis Analysis of Alternatives Project

#### **ADDITIONAL CAPABILITIES AND TRAINING**

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- Member IEEE
- Member Project Management Institute (PMI)
- Project Management Professional (PMP) – Project Management Institute (2011, recertified 2014, 2017)
- Advanced Project Management certification - Center for Systems Management (2002)
- ISO 9001 certified Quality System – annual training, audit support
- French language - dictionary knowledge

#### **PATENTS**

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U.S. Patent Pending. Application PCT/US2020/03 4009 “Spectroscopic sensor for screening nutritional and quality traits of soybeans,” Filed May 21, 2020.

U.S. Patent Pending (provisional). Application 16/780,821 “3D subwavelength photonic detector coupled with dielectric resonator antenna,” Filed February 3, 2020.

U.S. Patent Pending (utility). Application 16/840,941 “Laser Imaging of Gases for Real-Time Determination of Concentration and Location,” Filed April 6, 2020.

#### **SELECTED PUBLICATIONS**

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*Note: Throughout my career at Battelle, I had very few opportunities to publish research in the open literature due to security classification, ITAR, or company proprietary reasons. Some unclassified reports may be made available with permission from the funding sponsor.*

Joel T. Johnson, Chris Ball, Chi-Chih Chen, Christa McKelvey, Graeme Smith, Mark Andrews, Andrew O’Brien, Landon Garry, Sidharth Misra, Rudi Bendig, Carl Felten, Shannon Brown, Robert F. Jarnot, Jonathon Kocz, Kevin Horgan, Jared F. Lucey, Joe Knuble, Mike Solly, C. Duran-Aviles, Jinzheng Peng,

Damon Bradley, Jeffrey R. Piepmeier, Doug Laczkowski, Matt Pallas, Nick Monahan, and Ervin Krauss, "Real-time detection and filtering of Radio Frequency Interference on-board a spaceborne microwave radiometer: the CubeRRT mission," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 13, pp. 1610-1624, 2020, doi: 10.1109/JSTARS.2020.2978016.

Kazemi, A., Shu, Q., Dahiya, V., Taghipour, Z., Paradis, P., Ball, C., Ronningen, T., Zollner, S., Young, S., Budhu, J., Grossklaus, K., Vandervelde, T., Grbic, A., Krishna, S., "Subwavelength antimonide infrared detector coupled with dielectric resonator antenna," *Proc. SPIE 11002, Infrared Technology and Applications XLV*, 1100221 (7 May 2019); doi: 10.1117/12.2518807

Weatherall, J.C., Barber, J., Brauer, C.S., Johnson, T.J., Ball, C.D., Smith, B.T., Cox, R., Steinke, R., McDaniel, P., Wasserzug, L. (2012) "Adapting Raman Spectra from Laboratory Spectrometers to Portable Detection Libraries." *Applied Spectroscopy* 67(2): 149-157.

Neese, Christopher F., Medvedev, Ivan R., Plummer, Grant M., Frank, Aaron J., Ball, Christopher D., and De Lucia, Frank C. (2012). "A Compact Submillimeter/Terahertz Gas Sensor with Absolute Specificity and ppt Sensitivity." *IEEE Sensors* 12(8): 2565-2574.

Ball, Christopher D., T.J. Ronningen, and Lee C. Oesterling (2009). "Terahertz spectral signatures of explosive materials and precursors." *Proc. SPIE 7324: 0Z-1 - 0Z-12*.

Ball, Christopher D., Michael C. McCarthy and Patrick Thaddeus (2000). "Laboratory detection of a molecular band at  $\lambda 4429$ ." *Ap. J.* 529: L61-L64.

Ball, Christopher D., Michael C. McCarthy and Patrick Thaddeus (2000). "Cavity ringdown spectroscopy of the linear carbon chains HC<sub>7</sub>H, HC<sub>9</sub>H, HC<sub>11</sub>H, and HC<sub>13</sub>H." *J. Chem. Phys.* 112: 10149-10155.

Ball, Christopher D., Michael C. McCarthy and Patrick Thaddeus (2000). "Laser spectroscopy of the carbon chains HC<sub>7</sub>H and HC<sub>9</sub>H." *Astrophys. J. Lett.* 523: L89.

Ball, Christopher D., Marcus Mengel, Frank C. De Lucia and David E. Woon (1999). "Quantum scattering calculations for the H<sub>2</sub>S - He system between 1 - 600 K in comparison with pressure broadening, shift, and time resolved double resonance experiments." *J. Chem. Phys.* 111: 8893-8903.

Ball, Christopher D. and Frank C. De Lucia (1999). "Direct observation of  $\Lambda$ -doublet and hyperfine branching ratios for rotationally inelastic collisions of NO-He at 4.2 K." *Chem. Phys. Lett.* 300: 227-235.

Ball, Christopher D., Dutta, J.M., Beaky, Matthew M., Goyette, T.M., De Lucia, Frank C. (1999) "Variable-temperature pressure broadening of H<sub>2</sub>S by O<sub>2</sub> and N<sub>2</sub>." *J. Quant. Spectrosc. Rad. Trans.* 61(6): 775.

Ball, Christopher D. and Frank C. De Lucia (1998). "Direct Measurement of Rotationally Inelastic Cross Sections at Astrophysical and Quantum Collisional Temperatures." *Phys. Rev. Lett.* 81(2): 305-308.

Ball, Christopher D., Frank C. De Lucia, D. Risal, A. Ruch, H. Sheng, Y. Abebe, P. A. Farina and A. W. Mantz (1996). "Performance characteristics of a low temperature cell for collisional cooling experiments." *Proc. SPIE 2834*: 102.

Ball, Christopher D., J. M. Dutta, Thomas M. Goyette, Paul Helminger and Frank C. De Lucia (1996).

"Pressure Broadening of SO<sub>2</sub> by N<sub>2</sub>, O<sub>2</sub>, He, and H<sub>2</sub> between 90 and 500 K." J. Quant. Spectrosc. Rad. Trans. 56: 109.

## **SELECTED PRESENTATIONS**

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J. Budhu, A. Grbic, N. Pfiester, C. Ball, K.-K. Choi, S. Krishna, "Dielectric resonator antenna coupled infrared antimonide photodetectors," (accepted paper) IEEE AP-S/URSI Conference, Montreal, Quebec, Canada, July 2020.

Pfiester, N., Budhu, J., Lee, S., Dahiya, V., Choi, K.-K., Ball, C., Young, S., Grbic, A., Krishna, S., "Optical properties of III-V superlattices for the design optimization of antenna-coupled detectors," SPIE DCS meeting 2020 (submitted October 2019).

C. Ball, B. Ringel, R. Fink, Z. Taghipour, T.J. Ronningen, S. Krishna, J. Delombard, D. Mooney, M. Sullivan, "Laser imaging sensor for standoff methane detection," Consortium on Electromagnetics and Radio Frequencies (CERF) Technical Meeting, Columbus, OH, August 2019.

C. Ball, A. Kazemi, Q. Shu, V. Dahiya, Z. Taghipour, T.J. Ronningen, S. Krishna, S. Young, J. Budhu, A. Grbic, "Enhanced infrared sensor performance using a dielectric resonator antenna coupled antimonide detector (DRACAD)," Consortium on Electromagnetics and Radio Frequencies (CERF) Technical Meeting, Columbus, OH, August 2019.

A. O'Brien, G. E. Smith, C. Ball, J. DeLong, M. A. Shattal, R. Linnabary, and J. T. Johnson, "Multiplatform mission planning and operations simulation environment for next generation small satellite missions," Small Satellite Conference, Logan, UT, August 2019.

J. DeLong, M. A. Shattal, A. O'Brien, C. Ball, J. T. Johnson, and G. E. Smith, "Fully adaptive cloud profiling radar simulation," IEEE International Geoscience and Remote Sensing Symposium (IGARSS), Yokohama, Japan, July 2019.

R. Linnabary, A. O'Brien, G. Smith, C. Ball, and J. Johnson, "Open source software for simulating collaborative networks of adaptive sensors," IEEE International Geoscience and Remote Sensing Symposium (IGARSS), Yokohama, Japan, July 2019.

Sidharth Misra, Joel Johnson, Mark Andrews, Christopher Ball, Rudi Bendig, Shannon Brown, Quenton Bonds, Lauren Burton, Chi-Chih Chen, Joelle Cooperrider, Carlos Duran-Aviles, Carl Felten, Matthew Fritts, J. Landon Gary, Kevin Horgan, Robert Jarrot, Jonathon Kocz, Joseph Knuble, Ervin Kraus, Doug Laczkowski, Heather Lim, Daniel Lu, Jared Lucey, Christa McKelvey, Shawn McMurphy, Andrew O'Brien, Matthew Pallas, Prashanth Pandian, Jinzheng Peng, Jeffrey Piepmeier, Rick Raffanti, Graeme Smith, Michael Solly, Charles Turner, "CubeRRT: first ever demonstration of spaceborne on-board radio frequency interference filtering technology," IEEE International Geoscience and Remote Sensing Symposium (IGARSS), Yokohama, Japan, July 2019.

C. Ball, G. Smith, A. O'Brien, J.T. Johnson, J. DeLong, M. Abu Shattal, R. Linnabary, S. Musko, "Simulation Toolset for Adaptive Remote Sensing (STARS)," IEEE National Aerospace & Electronics Conference, Dayton, OH, 2019.

R. Linnabary, G. E. Smith, A. O'Brien, C. Ball, and J. T. Johnson, "Using cognitive communications to increase the operational value of collaborative networks of satellites," 2nd IEEE Cognitive Communications Applications for Aerospace Workshop (CCAAW), Cleveland, OH, 2019.

G. Smith, A. O'Brien, C.D. Ball, S. Musko, J. DeLong, M. Abu Shattal, R. Linnabary, J.T. Johnson, "A Simulation Toolset for Adaptive Remote Sensing (STARS)," Earth Science Technology Forum, Mountain View, CA, June 2019.

C.D. Ball, J.T. Johnson, C. J. McKelvey, C.-C. Chen, A.J. O'Brien, G.E. Smith, M. Andrews, J.L. Garry, S. Misra, R.M. Bendig, C. Felten, S.T. Brown, R. Jarnot, J. Kocz, D.C. Bradley, P.N. Mohammed, K.A. Horgan, M.A. Fritts, J.F. Lucey, C.E. Duran-Aviles, M.A. Solly, Q. Bonds, J.R. Piepmeier, D. Laczkowski, M. Pallas, E. Krauss, "Status of the CubeSat Radiometer Radio Frequency Interference Technology Validation (CubeRRT) Mission," American Meteorological Society, Phoenix, AZ, January 2019.

C.D. Ball, C.N. Neese, Y.H. Helal, I.C. MacGregor, D.M. Shelow, "Development of a field portable submillimeter wave sensor prototype for real time detection of formaldehyde and other carbonyls at ppb concentration in ambient air," National Ambient Air Monitoring Conference, Portland, OR, August 2018.

C. Ball, J. T. Johnson, C.-C. Chen, A. O'Brien, G. E. Smith, C. McKelvey, M. Andrews, J. L. Garry, S. Misra, R. Bendig, C. Felten, S. Brown, R. Jarnot, J. Kocz, K. Horgan, M. Fritts, J. Lucey, C. Duran-Aviles, M. Solly, J. Piepmeier, D. Laczkowski, M. Pallas, E. Krauss, "The CubeSat Radiometer RFI Technology Validation (CubeRRT) Mission: Instrument Pre-Launch Testing and Project Status," Small Satellite Conference, Logan, UT, August 2018.

C. McKelvey, C. Ball, J. T. Johnson, C.-C. Chen, A. O'Brien, G. E. Smith, M. Andrews, J. L. Garry, S. Misra, R. Bendig, C. Felten, S. Brown, R. Jarnot, J. Kocz, K. Horgan, M. Fritts, J. Lucey, C. Duran-Aviles, M. Solly, J. Piepmeier, D. Laczkowski, M. Pallas, E. Krauss, "The CubeSat Radiometer RFI Technology Validation (CubeRRT) Mission: Testing and Operations Planning," IEEE International Geoscience and Remote Sensing Symposium (IGARSS), Valencia, Spain, July 2018.

G. Smith, A. Mitchell, C. Ball, A. O'Brien, and J. T. Johnson, "Fully adaptive remote sensing observation system simulation experiments," IEEE International Geoscience and Remote Sensing Symposium (IGARSS), Valencia, Spain, July 2018.

G.E. Smith, A. O'Brien, C.D. Ball, J. DeLong, A. Mitchell, M. Shattal, J.T. Johnson, "Progress in the Development of the Simulation Toolset for Adaptive Remote Sensing," Earth Science Technology Forum, Silver Spring, MD, June 2018.

C. Ball, J. T. Johnson, C.-C. Chen, A. O'Brien, G. E. Smith, C. McKelvey, M. Andrews, J. L. Garry, S. Misra, R. Bendig, C. Felten, S. Brown, R. Jarnot, J. Kocz, K. Horgan, M. Fritts, J. Lucey, C. Duran-Aviles, M. Solly, J. Piepmeier, D. Laczkowski, M. Pallas, E. Krauss, "The CubeSat Radiometer RFI Technology Validation (CubeRRT) Mission: Instrument Pre-Launch Testing and Project Status," Earth Science Technology Forum, Silver Spring, MD, June 2018.

C.F. Neese, Y. Helal, C.D. Ball, I.C. MacGregor, D.M. Shelow, "Near-real Time Field-portable Submillimeter-wave Spectrometer for the Measurement of Formaldehyde and Other Carbonyls at Trace



(~ppb) Levels in Ambient Air,” Workshop on Sampling and Analytic Advances in Formaldehyde and Other Carbonyl Compounds’ Determination in Air, San Diego, CA, April 2018.

J.T. Johnson, C.D. Ball, C.C. Chen, A. O’Brien, G.E. Smith, C. McKelvey, M. Andrews, J.L. Garry, S. Misra, R. Bendig, C. Felten, S. Brown, R. Jarnot, J. Kocz, K. Horgan, M. Fritts, J.F. Lucey, Q. Bonds, C. Duran-Aviles, M. Solly, D.C. Bradley, P.N. Mohammed, J.R. Piepmeier, D. Laczowski, M. Pallas, E. Krauss, “The CubeSat Radiometer Radio Frequency Interference Technology (CubeRRT) Validation Mission: Instrument Pre-Launch Testing and Project Status,” MicroRad 2018, Cambridge, MA, March 2018.

C. Ball, C. Chen, A. O’Brien, G. Smith, C. McKelvey, M. Andrews, J.L. Garry, J. Johnson, S. Misra, R. Bendig, C. Felten, S. Brown, R. Jarnot, J. Kocz, D. Bradley, P. Mohammed, J. Lucey, K. Horgan, Q. Bonds, C. Duran-Aviles, M. Solly, M. Fritts, J. Piepmeier, M. Pallas, E. Krauss, D. Laczowski, “Impact of the CubeSat Radiometer Radio Frequency Interference Technology Validation (CubeRRT) mission on future resource-constrained science missions,” American Geophysical Union (AGU) Fall Meeting, New Orleans, LA, December 2017.

C. Ball, C. Chen, A. O’Brien, G.E. Smith, C. McKelvey, M. Andrews, J.L. Garry, J.T. Johnson, S. Misra, R. Bendig, C. Felten, S. Brown, R. Jarnot, J. Kocz, D. Bradley, P. Mohammed, J. Lucey, K. Horgan, M. Fritts, Q. Bonds, C. Duran-Aviles, M. Solly, J.R. Piepmeier, D. Laczowski, M. Pallas, E. Krauss, “The CubeSat Radiometer Radio Frequency Interference Technology Validation (CubeRRT) Mission,” 5th Workshop on Advanced RF Sensors and Remote Sensing Instruments (ARSI’17), Noordwijk, Netherlands, September 2017.

J.T. Johnson, C.C. Chen, A. O’Brien, G.E. Smith, C. McKelvey, M. Andrews, C. Ball, J.L. Garry, S. Misra, S. Brown, J. Kocz, R. Jarnot, D.C. Bradley, P.N. Mohammed, J.F. Lucey, J.R. Piepmeier, K. Horgan, M. Solly, J. Knuble, “The CubeSat Radiometer Radio Frequency Interference Technology Validation (CubeRRT) Mission,” XXXIInd International Union of Radio Science General Assembly & Scientific Symposium (URSI-GASS), Montreal, Canada, August 2017.

C. Ball, C. Chen, A. O’Brien, G. Smith, C. McKelvey, M. Andrews, J.L. Garry, J. Johnson, S. Misra, S. T. Brown, R. Jarnot, J. Kocz, D. Bradley, P. Mohammed, J. Lucey, K. Horgan, Q. Bonds, C. Duran-Aviles, M. Solly, J.R. Piepmeier, M. Pallas, E. Krauss, “Development of the CubeSat Radiometer Radio Frequency Interference Technology Validation (CubeRRT) System,” IEEE International Geoscience and Remote Sensing Symposium (IGARSS), Fort Worth, TX, July 2017.

J.T. Johnson, C.D. Ball, C.C. Chen, A. O’Brien, G.E. Smith, C. McKelvey, M. Andrews, J.L. Garry, S. Misra, S. Brown, R. Jarnot, J. Kocz, D.C. Bradley, P.N. Mohammed, J.F. Lucey, K. Horgan, Q. Bonds, C. Duran-Aviles, M. Solly, J.R. Piepmeier, M. Pallas, E. Krauss, “Development of the CubeSat Radiometer Radio Frequency Interference Technology Validation (CubeRRT) System,” Earth Science Technology Forum 2017 (ESTF2017), Pasadena, CA, June 2017.

J.T. Johnson, C.C. Chen, A. O’Brien, G.E. Smith, C. McKelvey, M. Andrews, C. Ball, S. Misra, S. Brown, J. Kocz, R. Jarnot, D.C. Bradley, P.N. Mohammed, J.F. Lucey, J.R. Piepmeier, K. Horgan, M. Solly, “The CubeSat Radiometer Radio Frequency Interference Technology Validation (CubeRRT) Mission,” USNC-URSI National Radio Science Meeting, Boulder, CO, January 2017.

J.T. Johnson, C. Ball, C.C. Chen, C. McKelvey, M. Andrews, G. Smith, A. O’Brien, L. Garry, S. Misra, R. Jarnot, J. Kocz, S. Brown, J.R. Piepmeier, K. Horgan, J. Lucey, L.R. Miles, D. Bradley, P. Mohammed, M.

Solly, "The CubeSat Radiometer Radio Frequency Interference Technology Validation (CubeRRT) Mission," American Geophysical Union (AGU) Fall Meeting, San Francisco, CA, December 2016.

J.T. Johnson, C.C. Chen, A. O'Brien, G.E. Smith, C. McKelvey, M. Andrews, C. Ball, S. Misra, S. Brown, J. Kocz, R. Jarnot, D.C. Bradley, P.N. Mohammed, J.F. Lucey, J.R. Piepmeier, K. Horgan, M. Solly, "The CubeSat Radiometer Radio Frequency Interference Technology Validation (CubeRRT) Mission," Coexisting with Radio Frequency Interference (RFI 2016), Socorro, NM, October 2016.

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