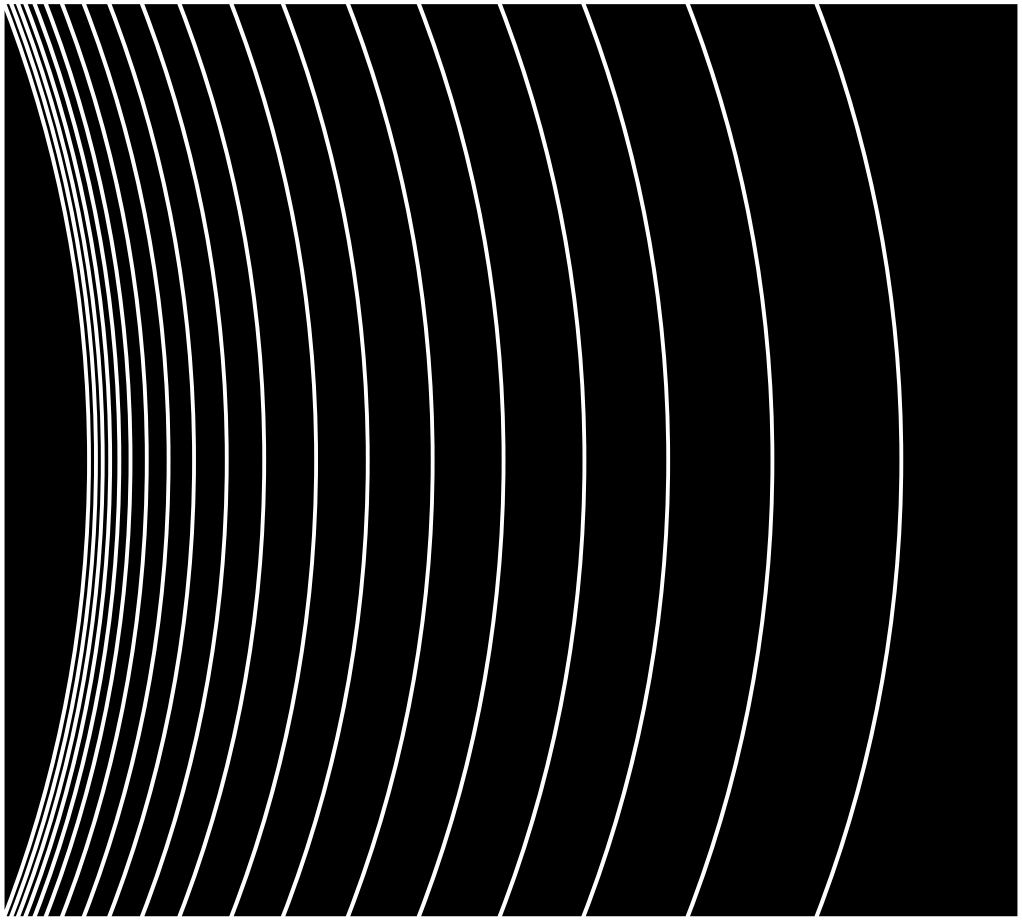
USNC-URSI National Radio Science Meeting

The National Academies of SCIENCES ENGINEERING MEDICINE

Board on International Scientific Organizations
U.S. National Committee for the International Union of Radio Science
National Academy of Sciences



4–8 January 2022

Boulder, Colorado, USA

Sponsored by the US National Committee for the

International Union of Radio Science

and CU Conference Services,

University of Colorado Boulder

www.nrsmboulder.org

UNITED STATES NATIONAL COMMITTEE
INTERNATIONAL UNION OF RADIO SCIENCE

National Radio Science Meeting
4–8 January 2022
University of Colorado Boulder

Meetings and Events Overview

[All times are in MST.]

TUESDAY, 4 January 2022

08:30 – 11:30	NRSM Short Course: "Joint MIMO-Radar-MIMO-Communications for Autonomous Vehicles"
12:30 – 14:20	NRSM Tutorial I: "HFSS Demo"
14:40 – 16:30	NRSM Tutorial II: "Near-Field Measurements - Principles & Demo" (In Person Only)
17:00 – 21:00	USNC-URSI Business Meeting

WEDNESDAY, 5 January 2022

08:00 – 08:10	NRSM Welcome & Opening Remarks
08:15 – 17:00	Vendor Booths
08:20 – 12:00	Technical Sessions
12:10 – 13:00	Women in Radio Science (WIRS) Invited Speaker
13:10 – 14:50	Technical Sessions
15:10 – 16:50	Student Paper Competition (SPC)
17:00 – 18:00	Commission Business Meetings (A, F)
18:00 – 19:00	Commission Business Meetings (C, E, J)
19:00 – 20:00	Meet & Greet with WIRS Speaker (Virtual Attendees)
19:00 – 21:00	Reception for On-Site Attendees

THURSDAY, 6 January 2022

08:00 – 11:30	Plenary Session
11:30 – 13:00	Student Mentoring Lunch
12:00 – 17:00	Vendor Booths
13:10 – 16:50	Technical Sessions
17:00 – 18:00	Commission Business Meetings (B, G)
18:00 – 19:00	Commission Business Meetings (D, H, K)
19:00 – 20:00	Women in Radio Science (WIRS) Business Meeting
20:00 – 21:00	WIRS Reception

FRIDAY, 7 January 2022

08:00 – 08:10	Closing Day Remarks
08:15 – 17:00	Vendor Booths
08:20 – 12:00	Technical Sessions
12:10 – 13:00	Ninth Hans Liebe Lecture
13:10 – 17:50	Technical Sessions

SATURDAY MORNING, 8 January 2022

08:00 – 11:00	USNC–URSI Executive Council Meeting

2022 National Radio Science Meeting Overview: Technical Program

	Time [MST] \ Room	105	150	151	155	200	245	265	1B40	1B51
Tuesday, 4 January	08:30–11:30	**Short Course Joint MIMO-Radar-MIMO-Communications for Autonomous Vehicles (Hybrid – Room 105)**								
	12:30–14:20	**Tutorial I HFSS Demo (Hybrid – Room 150)**								
	14:40–16:30	**Tutorial II Near-Field Measurements: Principles & Demo (In-Person Only - Room ECEE 1B95)**								
Wednesday, 5 January	08:00–08:10	**Opening Welcome (Streamed from Math 100 to all of the rooms)**								
	08:20–12:00	B1 - Antenna Theory, Design, and Measure-ments	F1* - Advances in GNSS-R and SoOp Systems: Techniques and Applications I	G1* - New Applications of SmallSat Sensors G2 - Meteoriods and Orbital Debris	A1 - Antennas A2 - Materials	B2 - Numerical Methods B4* - 5G and Millimeter Wave An-tennas and Applications	H1* - Heliospheric Observations of Waves in Plasmas	J1 - New Telescopes, Techniques, and Technol-ogies and Observatory Reports I	B3* - Complex EM and Meta Structures	D1 - Electronics and Photonics
	Lunch Break 12:10–13:00	**Women in Radio Science (WIRS) Invited Speaker (Math 100)**								
	13:10–14:50	B5* - Low-Profile Millime-ter-Wave/ Terahertz Antennas for Mobile and Space Applications	F2* - Advances in GNSS-R and SoOp Systems: Techniques and Applications II		A3* - Multiband Antenna Array Challenges and Solutions	B6 - Electro-magnetic Theory and Techniques	H2* - Active Experiments in Laboratory and Space Plasmas	J2 - New Telescopes, Techniques, and Technol-ogies, and Observatory Reports II	B7* - Multiscale and Stochastic Modeling in Computation-al Electromag-netics	D2* - Milli-meter-Wave and Terahertz Systems for Space Applications
	15:10–16:50	**Student Paper Competiton (Math 100)**								
	17:00		Commission F		Commission A					
	18:00	Commission C&E						Commission J		
	19:00–20:00	**WIRS Speaker Meet & Greet for all *Virtual* Attendees**								
	19:00–21:00	**Reception for all *In-Person* Attendees at the Byron R. White Stadium Club**								

Thursday, 6 January	08:20–11:30	**Plenary Session (Math 100) Meeting Highlight Plenary Talks Student Paper Competition Awards Ceremony**								
	Lunch Break 11:30–13:00	**Student Mentoring Luncheon (Math 100 – Lunch provided for all students, UNSC-URSI Officers, and Commission Chairs)**								
	Time \ Room	**105**	**150**	**151**	**155**	**200**	**245**	**265**	**1B40**	**1B51**
	13:50–16:50	A4* - Inventive Approaches in Advanced Communications K1* - Dosimetry and Exposure Assessment	F3 - Refractivity Characterization and Numerical Weather Prediction	G3 - Radar and Radio Techniques	C1 - Radar C2 - RF Spectrum	B8 - Analysis and Design of Antennas and RF Components	H3* - Lightning and Plasma Phenomena of the Thermosphere	J3 - New Telescopes, Techniques, and Technologies, and Observatory Reports III	B9* - Novel Electrically Small Antennas and Matching Networks	D3* - Broadband and Multiband Amplifiers
	17:00			Commission G					Commission B	
	18:00	Commission K					Commission H			Commission D
	19:00	**WIRS Business Meeting (Room 105)**								
	20:00	**WIRS In-Person Reception (KOBL S100)**								
Friday, 7 January	08:00–08:10	**Closing Day Remarks (Streamed from Math 100)**								
	08:20–12:00	K2 - Human Body Interactions with Antennas and Other Electromagnetic Devices	F4 - Microwave Remote Sensing of the Earth	G4 - Ionospheric Imaging G5 - Ionospheric Modeling and Data Assimilation	C3 - RF Antenna Design and Systems E1 - RF Spectrum and RF Systems in Noise	B10 - Antenna Arrays: Approaches, Realizations, and Applications	J4* - New SETI Technologies and Instrumentation	J5* - Imaging Black Holes: The EHT and Beyond I	B11* - Antennas and Systems for Specialized Platforms and Extreme/ Harsh Environments	
	Lunch Break 12:10–13:00	**Ninth Hans Liebe Lecture (Math 100)**								
	13:10–17:50	K3 - Electromagnetic Imaging and Sensing	F5 - Propagation and Remote Sensing in Complex and Random Media			J6* - New Frontiers in Solar Radiophysics†	H4* - Physics of the Radiation Belts	J7* - Imaging Black Holes: The EHT and Beyond II	B12 - Structures and Circuits for RF Sensing, Radar and STAR Applications	
* Indicates a Special Session										

International Union of Radio Science / Union Radio-Scientifique Internationale

Founded in 1919, the International Union of Radio Science (URSI) coordinates studies, research, applications, scientific exchange, and communication in all fields of radio science from telecommunications and radio astronomy to medicine. For further information on URSI, please visit www.ursi.org.

Both URSI and the U.S. National Committee (USNC) for URSI are organized into ten commissions:

Electromagnetic Metrology (Commission A)
Fields and Waves (Commission B)
Radiocommunication Systems and Signal Processing (Commission C)
Electronics and Photonics (Commission D)
Electromagnetic Environment and Interference (Commission E)
Wave Propagation and Remote Sensing (Commission F)
Ionospheric Radio and Propagation (Commission G)
Waves in Plasmas (Commission H)
Radio Astronomy (Commission J)
Electromagnetics in Biology and Medicine (Commission K)

About the USNC–URSI

The U.S. National Committee for URSI (USNC–URSI) is appointed by the National Academies of Sciences, Engineering, and Medicine, and represents U.S. radio scientists in URSI. It encourages studies in radio science, provides a forum for the dissemination of research findings, and provides an organizational infrastructure for the radio science community in the United States.

The USNC–URSI hosts the National Radio Science Meeting (NRSM) each January in Boulder, Colorado. This meeting is technically co–sponsored by the Antennas and Propagation Society of the Institute of Electrical and Electronics Engineers (IEEE/AP–S). The IEEE International Symposium on Antennas and Propagation and USNC–URSI Radio Science Meeting (RSM), co–sponsored by the IEEE/AP–S and USNC–URSI, is held each summer. Every five to eight years, a North American Radio Science Meeting (NARSM) is organized, co–sponsored by the U.S. and Canadian National Committees for URSI. The last NARSM was held virtually in Montreal, Quebec, Canada on 4–11 July 2020.

The international URSI General Assembly and Scientific Symposium (GASS) is held every three years in locations around the world. The 33rd URSI GASS was held in Rome, Italy, on 28 August–4 September 2021. Over 1000 papers were presented in technical sessions covering the areas of all ten URSI Commissions. The 34th URSI GASS will be held in Sapporo, Japan, on 19–23 August 2023.

In addition to the GASS, URSI holds two other flagship meetings every three years, the Atlantic Radio Science Conference (AT–RASC) and the Asia–Pacific Radio Science Conference (AP–RASC). The next AT–RASC meeting will be combined with the AP–RASC meeting and will be held on 29 May–3 June 2022 in Gran Canaria, Spain. Please visit www.ursi.org for more information on these URSI conferences.

For further information on USNC–URSI please visit www.usnc–ursi.org

U.S. National Committee Leadership and Commission Chairs (2022–2023)

Michael H. Newkirk
USNC Chair
Professional Staff
The Johns Hopkins University Applied Physics Laboratory
E-mail: Michael.Newkirk@jhuapl.edu

Jamesina Simpson
USNC Secretary and Chair-Elect
Associate Professor, Dept. of Electrical and Computer Engineering, University of Utah
E-mail: jamesina.simpson@utah.edu

Kathie Bailey
Director
Board on International Scientific Organizations
The National Academies
E-mail: KBailey@nas.edu

Christopher Anderson
Chair, Commission A
Assistant Professor
U.S. Naval Academy
E-mail: canderso@usna.edu

Greg Huff
Chair, Commission C
Associate Professor
The Pennsylvania State University
E-mail: ghuff@psu.edu

Robert Gardner
Chair, Commission E
Principle Research Engineer
Georgia Tech Research Institute
E-mail: Robert.Gardner@gtri.gatech.edu

Thomas Gaussiran
Chair, Commission G
Director, Space & Geophysics at ARL
University of Texas at Austin
E-mail: gauss@utexas.edu

Alyson Ford
Chair, Commission J
Asst. Director, Steward Observatory
University of Arizona
E-mail: alysonford@arizona.edu

Sembiam Rengarajan
USNC Immediate Past Chair
Professor, Department of Electrical and Computer Engineering,
California State University, Northridge
E-mail: srengarajan@csun.edu

Gary S. Brown
USNC Accounts Manager
Bradley Distinguished Professor of Electromagnetics, Virginia Polytechnic Institute & State University
E-mail: randem@vt.edu

Ana Ferreras
Senior Program Officer,
Board on International Scientific Organizations
The National Academies
E-mail: AFerreras@nas.edu

Branislav Notaros
Chair, Commission B
Professor
Colorado State University
E-mail: notaros@colostate.edu

Jonathan Chisum
Chair, Commission D
Assistant Professor
University of Notre Dame
E-mail: jchisum@nd.edu

Thomas Hanley
Chair, Commission F
Principal Professional Staff
Johns Hopkins University Applied Physics Lab.
E-mail: Thomas.Hanley@jhuapl.edu

Mark Golkowski
Chair, Commission H
Professor of Electrical Engineering
University of Colorado Denver
E-mail: mark.golkowski@ucdenver.edu

Asimina Kiourti
Chair, Commission K
Assistant Professor
The Ohio State University
E-mail: kiourti.1@osu.edu

Reyhan Baktur
Chair, Women in Radio Science Chapter
Associate Professor
Utah State University
E-mail: reyhan.baktur@usu.edu

In addition to the individuals listed above, the USNC–URSI Committee includes Members–at–Large, Society Representatives, Government Liaisons, Honorary Members, and U.S. scientists involved in international URSI roles. Other U.S. Scientists and staff members help USNC–URSI by having important supporting roles. These additional members of the USNC–URSI Committee and the supporting scientists and staff members are listed below

Members–at–Large

Susan Hagness
University of Wisconsin
1415 Engineering Drive
Madison, WI 53706
E–mail: susan.hagness@wisc.edu

Jeff Mangum
National Radio Astronomy Observatory
520 Edgemont Road
Charlottesville, VA 22903
E-mail: jmangum@nrao.edu

Chris Holloway
National Institute of Standards and Technology
325 Broadway
Boulder, CO 80305-3328
E-mail: christopher.holloway@nist.gov

Zoya Popovic
University of Colorado Boulder
Dept. of Electrical, Computer and Energy Engineering
Boulder, CO 80309–0425
E–mail: Zoya.Popovic@colorado.edu

Ozlem Kilic
University of Tennessee, Knoxville
Perkins Hall Room 101
1520 Middle Drive
Knoxville, TN 37996-2250
E-mail: okilic@utk.edu

Steven C. Reising
Colorado State University
Dept. of Electrical and Computer Engineering
1373 Campus Delivery
Fort Collins, CO 80523-1373
E-mail: Steven.Reising@ColoState.edu

Officers of International URSI

Piergiorgio L. E. Uslenghi
URSI President
University of Illinois at Chicago
Dept. of ECE, College of Engineering
Chicago, IL 60607–7053
E–mail: uslenghi@uic.edu

Patricia Doherty
URSI Vice-President
Boston College
Institute for Scientific Research
Chestnut Hill, MA 02467
E–mail: patricia.doherty@bc.edu

John L. Volakis
Chair, URSI Commission B
Florida International University
College of Engineering and Computing
Miami, FL 33174
E–mail: jvolakis@fiu.edu

Keith Groves
Vice-Chair, URSI Commission G
Boston College
Associate Director, Institute for Scientific Research
Email: keith.groves@bc.edu

W. Ross Stone
URSI Assistant Secretary General – GASS and Publications
Stoneware Limited
San Diego, CA 92106
E–mail: r.stone@ieee.org

Society Representatives

David DeBoer
American Astronomical Society (AAS)
University of California, Berkeley
Radio Astronomy Laboratory
Berkeley, CA 94720–3411
E–mail: ddeboer@berkeley.edu

Kshitija Deshpande
American Geophysical Union (AGU)
Assistant Professor of Engineering Physics
Department of Physical Sciences
Office: COAS 319.01
Embry-Riddle Aeronautical University
Phone: (386)226-7515
E-mail: deshpank@erau.edu

William J. Blackwell
American Meteorological Society (AMS)
Lincoln Laboratory
Massachusetts Institute of Technology
Lexington, MA 02420–9185
E–mail: wjb@ll.mit.edu

Danilo Erricolo
IEEE Antennas and Propagation Society (AP–S)
University of Illinois at Chicago
Dept. of Electrical Engineering and Computer Engineering
Chicago, IL 60607–7053
E–mail: derric1@uic.edu

V. Chandrasekar
IEEE Geoscience and Remote Sensing Society (GRSS)
Colorado State University
Dept. of Electrical and Computer Engineering
Fort Collins, CO 80523–1373
E–mail: chandra@engr.colostate.edu

Steven C. Reising
IEEE Microwave Theory and Techniques (MTT–S)
Colorado State University
Dept. of Electrical and Computer Engineering
Fort Collins, CO 80523–1373
E–mail: Steven.Reising@ColoState.edu

National Academies Representative

Mark J . Reid (NAS)
Harvard University
Center for Astrophysics
Cambridge, MA 02138
E–mail: mreid@cfa.harvard.edu

Government Liaisons

Ashley Vanderley
Program Manager, Electromagnetic Spectrum Management
Directorate for Mathematical and Physical Sciences
National Science Foundation
2415 Eisenhower Avenue, W-9132
Alexandria, Virginia 22314
E-mail: bevander@nsf.gov

Saba Mudaliar
Air Force Research Laboratory
22141 Avionic Circle
Wright-Patterson AFB, OH 45433-7318
Email: saba.mudaliar@us.af.mil

Katherine Mulreany
Program Officer
Office of Naval Research
875 N. Randolph St.
Arlington, VA 22203
Email: Katherine.mulreany@navy.mil

Steven Weiss
Army Research Laboratory
2800 Powder Mill Road
Adelphi, MD 20783-1138
Email: steven.j.weiss14.civ@mail.mil

Student Travel Program & Paper Competition

Erdem Topsakal
Virginia Commonwealth University
Dept. of Electrical and Computer Engineering
Richmond, VA 23284–3072
E–mail: etopsakal@vcu.edu

IEEE AP–S/USNC–URSI Joint Meetings Committee

W. Ross Stone (USNC–URSI Coordinator)
Stoneware Limited San Diego, CA 92106
E–mail: r.stone@ieee.org

Gary S. Brown
Virginia Polytechnic Institute & State University
Bradley Dept. of Electrical and Computer Engineering
Blacksburg, VA 24060–0111
E–mail: randem@vt.edu

Susan Hagness
University of Wisconsin
3423 Engineering Hall
Madison, WI 53706
E–mail: hagness@engr.wisc.edu

Yahya Rahmat–Samii
University of California, Los Angeles
Los Angeles, CA 91403 USA
E–mail: rahmat@ee.ucla.edu

Honorary Members

Chalmers Butler
Clemson University
Dept. of Electrical and Computer Engineering
Clemson, SC 29634–0915
E–mail: cbutler@eng.clemson.edu

Piergiorgio L. E. Uslenghi
University of Illinois at Chicago
Dept. of ECE, College of Engineering
Chicago, IL 60607–7053
E–mail: uslenghi@uic.edu

NRSM Conference Coordinator

Christina Patarino
University of Colorado Boulder
CU Conference Services
E–mail: nrsmboulder@colorado.edu

USNC–URSI would like to thank the following Special Session Organizers:

Mohammad Al-Khaldi
Chris Anderson
Oleksiy Agapitov
Reyhan Baktur
Tim Bastian
Nader Behdad
Paul Bernhardt
Rebecca Bishop
Stan Briczinkski
Berhanu Bulcha
Terry Bullett
Gary Bust
Roy Calfas
Filippo Capolino
Goutam Chattopadhyyay
Clara Chew
Andrew Chrysler
Sigrid Close
Chris Crabtree
David DeBoer
Kshitija Deshpande
Negar Ehsan
Vincent Fish
Alex Fletcher
Robert Gardner
David Giri
Scott Gleason
Ryan Green
Poorya Hosseini
Ashwin Iyer
David Jackson
Asimina Kiourti
David Kunkee
Justin Mabie
David Malaspina
Majid Manteghi
Robert Marshall
Robert McCoy
Kumar Mishra
Sidharth Misra
Jim Moran
Y. Jade Morton
Sima Noghanian
Eliana Nossa
Victor Pasko
Kristoff Paulson
Zoya Popovic
Marc Pulupa
Jeanne Quimby
Leonardo Ranzani
Fabiano Rodrigues
Sayan Roy
Johannes Russer
Jeffrey Shainline
M. R. Bhavani Shankar
Satish Sharma
Ting-Yen Shih
Carl Siefring
John Swaboda
Erdem Topsakal
Julio Urbina
Maria Usanova
Ryan Volz
Dan Werthimer
Ata Zadehgol
Kate Zawdi
Philip Zurek

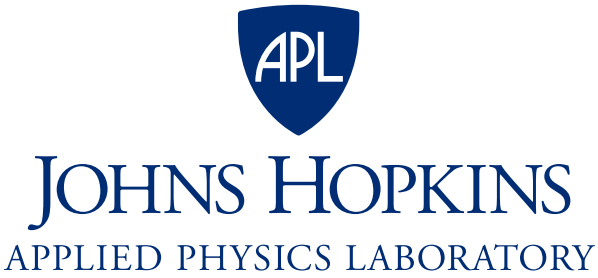
New for 2022

The 2022 NRSM is being held in a hybrid environment due to the ongoing COVID–19 pandemic and related restrictions on travel and large gatherings. USNC–URSI and CU Boulder will again be using the award–winning Whova Mobile Event App to provide a seamless, interactive agenda of meeting events for both in–person and online attendees, including the NRSM short course and tutorials, technical sessions, Plenary and Invited Speakers, Student Paper Competition and Virtual Exhibitor Booths.

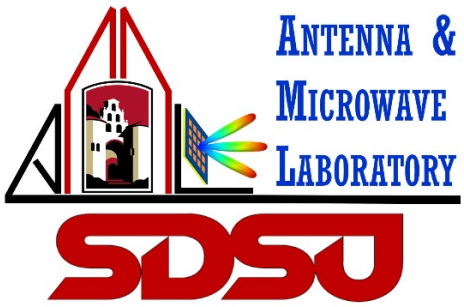
Authors have the option to have summaries archived in IEEE Xplore (subject to standard IEEE processing) through the technical co–sponsorship of the meeting by the IEEE Antennas and Propagation Society (IEEE/AP–S).

USNC–URSI would like to thank the following Sponsors for their support of the 2022 NRSM

Platinum Level ($3000)



Silver Sponsors ($1000)



Tuesday, January 4	08:30 - 11:30
Event	Room 105

Short Course

Joint MIMO–Radar–MIMO–Communications for Autonomous Vehicles

Kumar Vijay Mishra, United States CCDC Army Research Laboratory

Tuesday, January 4	12:30 - 14:20
Event	Room 150

Tutorial

HFSS Demo

Mark Commens, Principal Product Manager, Ansys HFSS

Tuesday, January 4	14:40 - 16:30
Event	ECEE 1B95

Tutorial

Near–Field Measurements: Principles & Demo

Jonathan Chisum, Notre Dame

Wednesday, January 5 08:20 - 11:40
B1 105

Antenna Theory, Design, and Measurements

Session Co-Chairs: Danilo Erricolo, University of Illinois Chicago; Dejan Filipovic, University of Colorado Boulder

B1.1 **08:20**
Inverse-design of Advanced Short Backfire Antennas with 100% Aperture Efficiency
Colin Mussman, Daniel Binion, Pingjuan Werner, Douglas Werner, Penn State, United States; Erik Lier, Thomas Hand, Lockheed Martin, United States

B1.2 **08:40**
An Ultra-Wideband Parallel Plate Sinuous Antenna for Direction Finding Applications
Alan Salari, Omid Manoochehri, Danilo Erricolo, University of Illinois Chicago, United States

B1.3 **09:00**
A Dual-Band Patch Antenna Employing a Folded Probe Feed for Non-Linear Radar Applications
Alex Bouvy, Nader Behdad, University of Wisconsin-Madison, United States

B1.4 **09:20**
ALBATROS antenna and front-end electronics development
Joelle-Marie Begin, McGill University, Canada

B1.5 **09:40**
On the Adaptation of Combined TEM-horn Loop Antenna to HF
Songyi Yen, Mohamed Elmansouri, Dejan Filipovic, University of Colorado Boulder, United States

Break **10:00**

B1.6 **10:20**
Radiation Pattern Reconfigurable Antenna using a Proximity-Coupled Sunflower-Shaped Patch
Hareth Abdalkarim, Brad Jackson, California State University, Northridge, United States

B1.7 **10:40**
Asymptotic Fields of Pure Magnetic Dipole Antenna via Spherical Azimuthal Electric Current Shell
David Garren, Naval Postgraduate School, United States

B1.8 **11:00**
Mechanically Configurable, Capacitively Coupled, Disk Loaded Monopole Driven Corner Reflector
Jonathan Lundquist, Lauren Linkous, Erdem Topsakal, Virginia Commonwealth University, United States

B1.9 **11:20**
Error Analysis of UAV-based Near-Field Antenna Measurements
Fabian T. Faul, Thomas F. Eibert, Technical University of Munich, Germany

Wednesday, January 5 08:20 - 12:00
F1 Special Session 150

Advances in GNSS-R and SoOp Systems: Techniques and Applications I

Session Co-Chairs: Mohammad Al-Khaldi, University Cooperation for Atmospheric Research; Clara Chew, University Corporation for Atmospheric Research; Scott Gleason, University Cooperation for Atmospheric Research

F1.1 **08:20**
Assessment of Dual-Polarization GNSS Measurements from a Mountaintop Dish Antenna
Brian Breitsch, James Brennan, Jade Morton, University of Colorado, Boulder, United States

F1.2 **08:40**
Experimental Analysis of Off-Specular Bistatic Scattering Using Ship-Based S-Band Reflectometer Measurements
Jeffrey Ouellette, Paul Hwang, David Dowgiallo, Jakov Toporkov, William Bounds, US Naval Research Laboratory, United States; Ethan Raines, Joel Johnson, The Ohio State University, United States

F1.3 **09:00**
Design and Implementation of a P-band Signals of Opportunity Receiver Operating from An Unmanned Aircraft System (UAS)
Preston Peranich, Johns Hopkins University, United States; Md Abdus Shahid Rafi, Mehmet Kurum, Mississippi State University, United States

F1.4 **09:20**
An Approach For The Mitigation of L-band SBAS Radio Frequency Interference Effects In The Calibration of CYGNSS's Level-1 Observables
Scott Gleason, Mohammad Al-Khaldi, University Cooperation for Atmospheric Research, United States; Tianlin Wang, The Ohio State University, United States; Christopher Ruf, Darren McKague, Anthony Russel, Dorina Twigg, University of Michigan, United States

F1.5 **09:40**
Forward Model Inversion Based Wind Retrieval For CYGNSS
Rajeswari Balasubramaniam, Christopher Ruf, Univ of Michigan, Ann Arbor, United States

Break **10:00**

F1.6 **10:20**
Investigation of CYGNSS-Enhanced Parametric Wind Fields on Storm Surge Modeling
Ethan Kubatko, Younghun Kang, Joel Johnson, The Ohio State University, United States; Mohammad Al-Khaldi, University Corporation for Atmospheric Research, United States

F1.7 **10:40**
River Slope Observation Using Spaceborne GNSS-R Carrier Phase Measurements
Yang Wang, Jade Morton, University of Colorado Boulder, United States

F1.8 **11:00**
An Intercomparison of Satellite-based Earth Observation Watermasks Derived from Global Navigation Satellite System Reflectometry (GNSS-R), Optical Sensors, and Synthetic Aperture Radar (SAR)
Gertrude Pavur, Hyunglok Kim, Venkataraman Lakshmi, University of Virginia, United States

F1.9 **11:20**
Intercomparisons of Spaceborne GNSS-R System Coherence Detection Methodologies Using Special and Standard CYGNSS Downlinks
Eric Loria, Marco Lavalle, Cinzia Zuffada, NASA Jet Propulsion Laboratory, United States; Ilaria Russo, Carmela Galdi, Maurizio di Bisceglie, Università degli Studi del Sannio, United States; Mohammad Al-Khaldi, Scott Gleason, UCAR, United States; Brandi Downs, Andrew O'Brien, Joel Johnson, The Ohio State University, United States; Valery Zavorotny, CIRES/ University of Colorado Boulder (Ret.), United States

F1.10 **11:40**
Estimation of Spaceborne GNSS-R Systems' Spatial Resolutions Under Dominantly Coherent Reflection Regimes Using CYGNSS Downlinks
Mohammad Al-Khaldi, Scott Gleason, University Cooperation for Atmospheric Research, United States; Joel Johnson, The Ohio State University, United States

Wednesday, January 5 08:20 - 09:20
G1 Special Session 151

New Applications of SmallSat Sensors

Session Co-Chairs: John Bradburn, University at Albany, State University of New York; Mehmet Ogut, Jet Propulsion Laboratory

G1.1 **08:20**
Enabling Low-power Radiometers with Machine Learning Calibration
John Bradburn, Mustafa Aksoy, University at Albany, State University of New York, United States; Paul Racette, Tim McClanahan, NASA Goddard Space Flight Center, United States; Sheri Loftin, ADNET Systems, Inc., United States

G1.2 **08:40**
ACCURACy: Adaptive Calibration of CubeSat Radiometer Constellations
John Bradburn, Mustafa Aksoy, University at Albany, State University of New York, United States

G1.3 **09:00**
Smart Ice Cloud Sensing (SMICES) SmallSat Instrument: Radiometer Electronics and Autonomous Capabilities
Mehmet Ogut, Xavier Bosch-Lluis, Isaac Ramos-Perez, Joelle Cooperrider, Pekka Kangaslahti, Alan Tanner, Qing Yue, Jason Swope, Peyman Tavallali, Steve Chien, Omkar Pradhan, Jet Propulsion Laboratory, United States; William Deal, Caitlyn Cooke, Northrop Grumman Aerospace Systems, United States

Wednesday, January 5 08:20 - 10:00
A1 155

Antennas

Session Co-Chairs: Jeanne Quimby, NIST; Chris Anderson, USNA

A1.1 **08:20**
Design of a Wideband, Dual-Polarized, High Gain and Power Quad-Ridge Horn Antenna
Dong-Chan Son, Mohamed Elmansouri, Ljubodrag Boskovic, Dejan Filipovic, University of Colorado Boulder, United States

A1.2 **08:40**
A Compact and Simple Prototype CPW-Fed Dual Band Antenna for ISM, Wi-Fi, and WLAN Applications
Syed Muhammad Rizvi Jarchavi, Beijing Jiaotong University, China; Musa Hussain, Bahria University Islamabad Campus, Pakistan; Syed Hamza Hassan Gardezi, University of Management and Technology, Pakistan; Mohammad Alibakhshikenari, Universidad Carlos III de Madrid, Spain; Francisco Falcone, Public University of Navarre (UPNA), Spain; Ernesto Limiti, University of Rome Tor Vergata, Italy

A1.3 **09:00**
Investigation of Creeping Wave Channel Variations during Hip Motion Activities
Daniel Agu, Yang Li, Baylor University, United States

A1.4 **09:20**
A High-Power UHF Antenna with Logarithmic Spiral Structure
Omid Manoochehri, Alan Salari, University of Illinois at Chicago, United States

A1.5 **09:40**
A Matched Dual-Band Waveguide to Improve Microwave Power Measurements using Rydberg Atoms
Amy Robinson, Zoya Popovic, University of Colorado, United States; Matthew Simons, Christopher Holloway, National Institute of Standards and Technology, United States

Wednesday, January 5 08:20 - 10:00
B2 200

Numerical Methods

Session Co-Chairs: Branislav Notaros, Colorado State University; Donald R. Wilton, University of Houston

B2.1 **08:20**
Time-Domain Field Solution for a Point Source Near a Complex Transformation Optics Flat Lens
Hayrettin Odabasi, Eskisehir Osmangazi Uiversity, Turkey; Fernando Teixeira, The Ohio State University, United States

B2.2 **08:40**
Exact Geometrical Optics Scattering by a DNG Prism of Triangular Equilateral Cross-Section Illuminated by Three Plane Waves
Piergiorgio L. E. Uslenghi, University of Illinois at Chicago, United States

B2.3 **09:00**
On the Maxwell Eigenvalue Problem and Exponential Convergence Through Adaptive Error Control in the Presence of Singularities
Jake Harmon, Jeremiah Corrado, Branislav Notaros, Colorado State University, United States

B2.4 **09:20**
Solving the Full Waveform Electromagnetic Inversion Enhanced by Efficient Progressive Transfer Learning
Yuchen Jin, Yuan Zi, Wenyi Hu, Yanyan Hu, Xuqing Wu, Jiefu Chen, University of Houston, United States

B2.5 **09:40**
Dimensionality Reduction (DR) Approach for Treating Singular and Near-Singular Multidimensional Integrals of Electromagnetics
Donald R. Wilton, University of Houston, United States; Francesca Vipiana, Javier Rivero, Politecnico di Torino, Italy; William A. Johnson, Consultant, United States; Michael A. Khayat, Independent Researcher, United States

Wednesday, January 5 08:20 - 12:00
J1 265

New Telescopes, Techniques, and Technologies and Observatory Reports I

Session Co-Chairs: Jeff Mangum, NRAO; Alyson Ford, University of Arizona

J1.1 **08:20**
Closure Phase in the Image Plane: Image Plane Self-Calibration
Chris Carilli, NRAO, United States; Nithyananda Thyagarajan, CSIRO, Australia; Bojan Nikolic, Cavendish Astrophysics, United Kingdom

J1.2 **08:40**
A General Theory of Calibration-invariant Observables in Co-polar and Full Stokes Radio Interferometry
Nithyanandan Thyagarajan, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia; Rajaram Nityananda, Azim Premji University, India; Joseph Samuel, International Centre for Theoretical Sciences, India

J1.3 **09:00**
A-to-Z Solver – Modeling the full Jones antenna aperture illumination pattern
Srikrishna Sekhar, Andrew Russ Taylor, Institute for Data Intensive Astronomy, South Africa; Preshanth Jagannathan, Sanjay Bhatnagar, National Radio Astronomy Observatory, United States

J1.4 **09:20**
Design Considerations for CHORD: the Canadian Hydrogen Observatory and Radio-transient Detector
Vincent MacKay, University of Toronto, Canada

J1.5 **09:40**
Recent Developments in the Array of Long Baseline Antennas for Taking Radio Observations from the Seventy-ninth parallel
Lawrence Herman, McGill University, Canada

Break **10:00**

J1.6 **10:20**
Hat Creek Radio Observatory (HCRO): A Prototype National Radio Dynamic Zone
David DeBoer, Steve Croft, Andrew Siemion, University of California, United States; Kevin Gifford, Arvind Aradhya, Mark Lofquist, Georgiana Weihe, University of Colorado, United States; Andrew Clegg, Google, United States; Wael Farah, Alexander Pollak, SETI Institute, United States; Tim O'Shea, Nathan West, DeepSig, United States

J1.7 **10:40**
An Advanced Low-band VHF Radar for Geospace, Cislunar, Planetary, Solar, and Astronomical Research
Brett Isham, Interamerican University of Puerto Rico, United States; Jason Kooi, Namir Kassim, Joseph Helmboldt, Juha Vierinen, Naval Research Laboratory, United States; Marco Milla, Instituto Geofisico del Peru, Peru; Michael Nolan, University of Arizona, United States; Michel Blanc, Observatoire Midi-Pyrénées, France; Wlodek Kofman, Universite Grenoble Alpes, France

J1.8 **11:00**
The MeerKAT Absorption Line Survey (MALS) : An Overview
Preshanth Jagannathan, National Radio Astronomy Observatory, United States; Neeraj Gupta, Inter University Center for Astronomy and Astrophysics, India

J1.9 **11:20**
Prototyping for large scale interferometric radio telescope arrays with the Deep Dish Development Array
Elizabeth Pieters, McGill University, Canada

J1.10 **11:40**
First Upper limits on the Cosmic Dawn from the HERA Phase II System
Aaron Ewall-Wice, UC Berkeley, United States

Wednesday, January 5 08:20 - 11:20
B3 Special Session 1B40

Complex EM and Meta Structures

Session Co-Chairs: Ashwin Iyer, University of Alberta; Filippo Capolino, University of California, Irvine

B3.1 08:20
Taylor-like Super-directive Patterns Enable Advanced Super-oscillatory Imaging
Haitang Yang, George Eleftheriades, University of Toronto, Canada

B3.2 08:40
Asymmetric Metamaterial-Lined Apertures for Plasmonic Phase-Gradient Optical Metasurfaces
Mitchell Semple, Ashwin K. Iyer, University of Alberta, Canada

B3.3 09:00
Highly Sensitive Exceptional Degeneracy in Coupled Transmission Lines With Balanced Gain and loss
Alireza Nikzamir, Hamidreza Kazemi, Tarek Mealy, Filippo Capolino, University of California, Irvine, United States

B3.4 09:20
Circuit Models for Electrically-Small Time-Varying Spherical Scatterers
Zachary Fritts, Anthony Grbic, University of Michigan, United States

B3.5 09:40
Tailoring Wireless Intra-Chip Communication Links Using a Programmable Metasurface
Mohammadreza F. Imani, Arizona State University, United States; Sergi Abadal, Univ. Politècnica de Catalunya, Spain; Philipp del Hougne, Université de Rennes 1, France

Break 10:00

B3.6 10:20
Anomalies in Light Scattering for Advanced Wireless Power Transfer
Alex Krasnok, Florida International University, United States

B3.7 10:40
A Multifunctional Integrated-Circuit Enabled Programmable Metasurface
Kypros M. Kossifos, Julius Georgiou, University of Cyprus, Cyprus; Marco A. Antoniades, Ryerson University, Canada

B3.8 11:00
A Hybrid Intelligent Surface with Simultaneous Sensing and Reconfigurable Reflection Capability
Idban Alamzadeh, Mohammadreza F. Imani, Arizona State University, United States; George C. Alexandropoulos, National and Kapodistrian University of Athens, Greece; Nir Shlezinger, Ben-Gurion University of the Negev, Israel

Wednesday, January 5 08:20 - 11:00
D1 1B51

Electronics and Photonics

Session Co-Chairs: Jonathan Chisum, University of Notre Dame; Leonardo Ranzani, Raytheon

D1.1 08:20
Integrated Random Projections with Disordered Photonic Lattices
Mohammad Ali Miri, City University of New York / Queens College, United States

D1.2 08:40
Photonic Integrated Circuits for Transmit and Receive RF Phased Arrays in the Millimeter Wave Region of the Spectrum
Dennis Prather, University of Delaware, United States; Timothy Creazzo, Edris Mohamed, Phase Sensitive Innovations, Inc, United States

D1.3 09:00
A Complete Antenna-coupled Nonlinear Receiver for Low-power Gigabit Millimeter-wave Wireless Communications
Nicholas Estes, Jonathan Chisum, University of Notre Dame, United States

D1.4 09:20
Enhanced Sensitivity of Gyrator-based Circuit at Exceptional Point Composed of Unstable Resonators
Kasra Rouhi, Alireza Nikzamir, Alexander Figotin, Filippo Capolino, University of California, Irvine, United States

D1.5 09:40
High-Power, Plasma-Switched, Lumped-Element Reconfigurable Impedance Tuner for Radar Transmitter Applications
Justin Roessler, Austin Egbert, Charles Baylis, Robert J Marks II, Connor Laktasic, Baylor University, United States; Zach Vander Missen, Alden Fisher, Mohammad Abu Khater, Dimitrios Peroulis, Purdue University, United States

Break 10:00

D1.6 10:20
Optimization Approach for a High Power Array Based System with Elementwise Power Amplifier Impedance Tuning using a Combination of Digital and Continuous Search Algorithms for 5G Systems
Adam Goad, Charles Baylis, Sarah Seguin, Robert J. Marks II, Baylor University, United States

D1.7 10:40
Tri-Band RF Switching with PIN Diodes
Javier Reyes, Marisol Roman, Anthony Nuñez, Elias Alwan, Florida International University, United States

Wednesday, January 5 10:20 - 11:20
G2 151

Meteoriods and Orbital Debris

Session Co-Chairs: Julio Urbina, The Pennsylvania State University; Alex Flectcher, NRL

G2.1 10:20
An AI-based Approach to Study Non-specular Meteor Trail Echoes
Freddy Galindo, Yanlin Li, Julio Urbina, The Pennsylvania State University, United States

G2.2 10:40
Do meteors radiate very-low-frequency radio emissions?
Paraksh Vankawala, Robert Marshall, University of Colorado Boulder, United States; Denis Vida, Peter Brown, Western University, United States

G2.3 11:00
Development of the Colorado Zephyr Meteor Radar Network
Nicholas Rainville, John Marino, Scott Palo, University of Colorado Boulder, United States

Wednesday, January 5 10:20 - 12:00
A2 155

Materials

Session Co-Chairs: Jeanne Quimby, NIST; Chris Anderson, USNA

A2.1 10:20
An investigation on using lightweighted Carbon- Epoxy Composites as Microstrip Patch Antenna substrate
Zahra Nazarijouybari, University of Maryland, College Park, United States

A2.2 10:40
On the Far-Field Characteristics of a 3D-printed Antenna Using Wood-Based PLA and Conductive Silver Nanoparticle Ink
Milad Mirzaee, Yanghyo Kim, Stevens Institute of Technology, United States

A2.3 11:00
Toward Fully Biodegradable and Renewable Antennas Using 3D Printing Technology
Milad Mirzaee, Yanghyo Kim, Stevens Institute of Technology, United States

A2.4 11:20
Microwave Characterization of NinjaFlex Filament Using Performance Probe for Developing 3D-Printed Wearable Antennas
Milad Mirzaee, Yanghyo Kim, Stevens Institute of Technology, United States

A2.5 11:40
A 3D-Printed Microwave Passive Sensor Using Fully Biodegradable and Renewable Materials
Milad Mirzaee, Yanghyo Kim, Stevens Institute of Technology, United States

Wednesday, January 5 10:20 - 12:00
B4 Special Session 200

5G and Millimeter Wave Antennas and Applications

Session Co-Chairs: Ting-Yen Shih, University of Idaho; Andrew Chrysler, Idaho State University

B4.1 10:20
A Compact Unit-cell Design for mmWave Reconfigurable Intelligent Surfaces
Aditya Shekhawat, Bharath G. Kashyap, Panagiotis C. Theofanopoulos, Anand Sengar, Georgios C. Trichopoulos, Arizona State University, United States

B4.2 10:40
Towards E-band Wavelength: 3D Printed Gaussian Corrugated Horn for Cassegrain Antenna Application
Javad Pourahmadazar, Concordia University, Canada; Reza Karimian, The George Washington University, United States; Mansoor Dashti Ardakani, INRS University, Canada

B4.3 11:00
Sub-mmW Travelling Wave Semiconductor Amplifier
Michail Anastasiadis, Shubhendu Bhardwaj, John L. Volakis, Florida International University, United States

B4.4 11:20
3D Non-Line-of-Sight Terahertz Imaging Using Mirror Folding
Yiran Cui, Georgios C. Trichopoulos, Arizona State University, United States

B4.5 11:40
Using Portable mmWave for See Through Wall Applications
Marvin Joshi, Abdel-Kareem Moadi, Aly Fathy, University of Tennessee, Knoxville, United States

Wednesday, January 5 10:20 - 11:40
H1 Special Session 245

Heliospheric Observations of Waves in Plasmas

Session Co-Chairs: David Malaspina, University of Colorado, Boulder; Kristoff Paulson, Center for Astrophysics | Harvard & Smithsonian

H1.1 **10:20**
Electron-Resonant Plasma Waves Driven by Pickup of Newly Formed Plasma in the Near Sun Solar Wind
David M. Malaspina, Adel Al-Ghazwi, Hsiang-Wen Hsu, University of Colorado, Boulder, United States; Guillermo Stenborg, Douglas Mehoke, Johns Hopkins University, Applied Physics Laboratory, United States; Mitchell Shen, Department of Astrophysical Sciences, Princeton University, United States; Stuart Bale, University of California, Berkeley, United States; Thierry Dudok de Wit, LPC2E, CNRS, CNES, and University of Orleans, Orleans, France, United States

H1.2 **10:40**
Flux rope merging and the structure of switchbacks in the solar wind
Oleksiy Agapitov, UC BERKELEY, United States; James F. Drake, Michael Swisdak, University of Maryland, United States; Tai Phan, Forrest Mozer, SSL, UC Berkeley, United States

H1.3 **11:00**
Study on the connection between the emission of near-fce harmonics and geometrical properties of the ambient magnetic field in the near-Sun environment
Sabrina F. Tigik, Andris Vaivads, KTH Royal Institute of Technology, Sweden; David M. Malaspina, University of Colorado, United States

H1.4 **11:20**
Recent Advances in Understanding Radiation Belt Electron Acceleration at Earth and Jupiter
Wen Li, Qianli Ma, Xiaochen Shen, Boston University, United States

Wednesday, January 5 12:10 - 13:00
Event Math 100

Women in Radio Science (WIRS) Invited Speaker

Launch Vehicle and Spacecraft Transmitter Electromagnetic Compatibility

Dawn H. Trout, Kennedy Space Center

Wednesday, January 5 13:10 - 14:50
B5 Special Session 105

Low-Profile Millimeter-Wave/Terahertz Antennas for Mobile and Space Applications

Session Co-Chairs: Satish Sharma, San Diego State University; Goutam Chattopadhyay, NASA-Jet Propulsion Laboratory

B5.1 **13:10**
Millimeter-Wave Tightly Coupled Dipole Arrays on a Ball Grid Array Package
Vignesh Monohar, Matthew Nichols, Satheesh Bojja Venkatakrishnan, John L. Volakis, Florida International University, United States

B5.2 **13:30**
Low Sidelobe Level Randomized Reconfigurable Reflective Surfaces under Oblique Incidence
Bharath G. Kashyap, Panagiotis C. Theofanopoulos, Georgios C. Trichopoulos, Arizona State University, United States

B5.3 **13:50**
Low-cost Ultra Wideband Millimeter Wave Arrays
Matthew Nichols, Satheesh Bojja Venkatakrishnan, John L. Volakis, Florida International University, United States

B5.4 **14:10**
6-12 GHz Transmit Phased Array Efficiency with Stepped Static Supply Modulation for Beam Shaping
Laila Marzall, Zoya Popovic, University of Colorado Boulder, United States

B5.5 **14:30**
Low-Probability-of-Intercept/Detect (LPI/LPD) Secure Communications Using Phased-Arrays Employing Side-Lobe Time Modulation
Jiahao Zhao, John H. Booske, Nader Behdad, University of Wisconsin-Madison, United States

Wednesday, January 5 13:10 - 14:50
F2 Special Session 150

Advances in GNSS-R and SoOp Systems: Techniques and Applications II

Session Co-Chairs: Mohammad Al-Khaldi, University Cooperation for Atmospheric Research; Clara Chew, University Corporation for Atmospheric Research; Scott Gleason, University Cooperation for Atmospheric Research

F2.1 **13:10**
Using Lidar Airborne data sets to understand the relationship between surface roughness and GNSS-R coherent returns over land
Alexandra Bringer, Tianlin Wang, Joel Johnson, The Ohio State University, United States

F2.2 **13:30**
Rough Surface Roughness Effect Retrieved from CYGNSS
Rashmi Shah, Xiaolan Xu, Simon Yueh, Jet Propulsion Laboratory, California Institute of Technology, United States

F2.3 **13:50**
Merging SMAP and CYGNSS Observations to Create Downscaled Brightness Temperature and Soil Moisture Products
Liza Wernicke, Eric Small, University of Colorado Boulder, United States; Clara Chew, University Corporation for Atmospheric Research, United States

F2.4 **14:10**
Soil Moisture Retrieval from CYGNSS Observations: Comparison of Results from a Physics-based Method and a Machine-learning-based Method
Amer Melebari, Erik Hodges, James D. Campbell, Mahta Moghaddam, University of Southern California, United States; Grigorios Tsagkatakis, Foundation for Research and Technology - Hellas, Greece; Ruzbeh Akbar, Massachusetts Institute of Technology, United States; Jeffrey P. Walker, Monash University, Australia

F2.5 **14:30**
Soil Moisture Retrievals Using Drone-Based Reflections of Electromagnetic Signals
Alexander Voronovich, Richard Lataitis, NOAA, United States

Wednesday, January 5 13:10 - 14:50
A3 Special Session 155

Multiband Antenna Array Challenges and Solutions

Session Co-Chairs: Chris Anderson, USNA; Amy Robinson, University of Colorado

A3.1 **13:10**
A Tri-Band Frequency Reconfigurable Patch Antenna Array for Sub-6GHz 5G Applications
Marisol Roman Guerra, Elias Alwan, Florida International University College of Engineering and Computing, United States

A3.2 **13:30**
Ultra-Wideband MIMO Antenna Realization for Indoor Ka-band Applications
Musa Hussain, Bahria university Islamabad Campus, Pakistan; Qaisar Abbas, University of Engineering and Technology, Pakistan; Syed Hamza Hassan Gardzi, University of Management and Technology, Pakistan; Mohammad Alibakhshikenari, Universidad Carlos III de Madrid, Spain; Francisco Falcone, Public University of Navarre (UPNA), Spain; Ernesto Limiti, University of Rome Tor Vergata, Italy

A3.3 **13:50**
Antenna Array for 5G Mobil Communication
Alberto Munoz, Abas Sabouni, Wilkes University, United States

A3.4 **14:10**
Alternative Ways to Feed the Arecibo Observatory Spherical Reflector
Mohamed Alkhatib, James Breakall, The Pennsylvania State University, United States; Omar Alzaabi, Khalifa University, United Arab Emirates

A3.5 **14:30**
Far Field EVM Estimation for Large Phased Arrays using Embedded Elements and Beam Squint Model
Dustin Brown, Yahya Rahmat-Samii, UCLA, United States

Wednesday, January 5 13:10 - 14:50
B6 200

Electromagnetic Theory and Techniques

Session Co-Chairs: David Jackson, University of Houston; Steven Weiss, The Army Research Lab

B6.1 13:10
Supercavity Modes in High-Index Resonators with Diverse Rotational Symmetry
Zahra Manzoor, Omer Yesilyurt, Alexander V. Kildishev, Dimitrios Peroulis, Purdue University, United States

B6.2 13:30
Extremely-Low Frequency (ELF) Radio Sensing of Unmanned Aerial Systems
Arjuna Madanayake, Hiruni Silva, FIU, United States; Soumyajit Mandal, Jarred Glickstein, Case Western Reserve University, United States

B6.3 13:50
Design and Manufacturing Analysis of Sub-Millimeter Wave Narrow-Band Filters for Direct-Detection Atmospheric Sounding Radiometers
Samantha Williams, Steven C. Reising, Yuriy Goncharenko, Colorado State University, United States

B6.4 14:10
RCS Reduction for a Monostatic Signal with Arbitrary Polarization Using Microstrip Antennas
Vani Vellanki, David Jackson, Daniel Onofrei, University of Houston, United States; Sohini Sengupta, Sonos, United States

B6.5 14:30
Matching Techniques for Microstrip Antennas in Classes Teaching Electromagnetics
Steven Weiss, The Army Research Lab, United States

Wednesday, January 5 13:10 - 14:30
H2 Special Session 245

Active Experiments in Laboratory and Space Plasmas

Session Co-Chairs: Chris Crabtree, US Naval Research Laboratory; Poorya Hosseini, Applied Physics Laboratory

H2.1 13:10
Understanding the VLF Bear Claw Captured by the DSX Spacecraft
Michael Starks, Jay Albert, Wm. Robert Johnston, Air Force Research Laboratory, United States; David Lauben, Ivan Linscott, Stanford University, United States; Umran Inan, Koc University, Turkey; Steve Stelmash, University of Massachusetts - Lowell, United States; James McCollough, US Department of Energy, United States

H2.2 13:30
Modeling the Formation, Evolution, and Measurement of a Rocket-Released Barium Cloud
Alex Fletcher, Gurudas Ganguli, Chris Crabtree, Carl Siefring, Rualdo Soto, Andrew Stephen Richardson, US Naval Research Laboratory, United States; Joseph Huba, Syntek Technologies, United States

H2.3 13:50
High Altitude Echoes in the Equatorial Topside Ionosphere
Sevag Derghazarian, Enrique Rojas, David Hysell, Charles Seyler, Cornell University, United States

H2.4 14:10
High Resolution ELF/VLF Time-of-Arrival Analysis at HAARP
Harrison Burch, Robert Moore, University of Florida, United States

Wednesday, January 5 13:10 - 14:50
J2 265

New Telescopes, Techniques, and Technologies and Observatory Reports II

Session Co-Chairs: Jeff Mangum, NRAO; Alyson Ford, University of Arizona

J2.1 13:10
Low Noise L-band RF-over-fiber Signal Transport for ALPACA on the GBT
Mitchell Burnett, Nathaniel Ashcraft, Spencer Ammermon, Brian Jeffs, Karl Warnick, Brigham Young University, United States

J2.2 13:30
RFI Mitigation with Neural Networks for the BMX Telescope
Benjamin Saliwanchik, Brookhaven National Laboratory, United States

J2.3 13:50
Array Element Coupling in Radio Interferometry: A Semi-Analytic Approach
Alec Josaitis, Eloy de Lera Acedo, University of Cambridge, United Kingdom; Aaron Ewall-Wice, University of California - Berkeley, United States

J2.4 14:10
SWRDS: SMT Wideband Radio Digital Spectrometer
Arash Roshanineshat, Dan Marrone, David Forbes, University of Arizona, United States

J2.5 14:30
Towards a New Arecibo Telescope for All Radar Science
Brett Isham, Interamerican University of Puerto Rico, United States; Christiano Brum, Francisco Cordova, Arecibo Observatory, United States; Juha Vierinen, University of Tromso, Norway; Michael Nolan, University of Arizona, United States; Anne Virkki, University of Helsinki, Finland; Marco Milla, Instituto Geofisico del Peru, Peru

Wednesday, January 5 13:10 - 14:50
B7 Special Session 1B40

Multiscale and Stochastic Modeling in Computational Electromagnetics

Session Co-Chairs: Ata Zadehgol, University of Idaho; Johannes Russer, Technical University of Munich

B7.1 13:10
FDTD Simulation of Stochastic Scattering Loss Due to Surface Roughness in Optical Interconnects
Brian Guiana, Ata Zadehgol, University of Idaho, United States

B7.2 13:30
RFID Tag Antenna Design based on the Theory of Characteristic Modes
Pallavi Sharma, Jennifer T. Bernhard, University of Illinois Urbana-Champaign, United States

B7.3 13:50
A Grid-Aligned TF/SF Plane Wave Source Condition for the Constraint-Preserving FVTD Method
Kaiser Niknam, Jamesina Simpson, University of Utah, United States

B7.4 14:10
Efficiency Benefits of Anisotropic hp-Refinement for CEM
Jeremiah Corrado, Jake Harmon, Branislav Notaros, Colorado State University, United States

B7.5 14:30
On the Parallel Performance of SPAI-FETD Solvers for Time-Domain Maxwell's Equations
Joonshik Kim, Fernando Teixeira, The Ohio State University, United States

Wednesday, January 5 13:10 - 14:50
D2 Special Session 1B51

Millimeter-Wave and Terahertz Systems for Space Applications

Session Co-Chairs: Negar Ehsan, NASA Goddard Space Flight Center; Berhanu T. Bulcha, NASA Goddard Space Flight Center

D2.1 13:10
μ-Spec On-Chip Spectrometers for the EXCLAIM Instrument
Emily M. Barrentine, Berhanu T. Bulcha, Giuseppe Cataldo, Negar Ehsan, Thomas Essinger-Hileman, James P. Hays-Wehle, Larry A. Hess, Mona Mirzaei, Omid Noroozian, Maryam Rahmani, Thomas R. Stevenson, Eric R. Switzer, Carolyn G. Volpert, Edward J. Wollack, NASA Goddard Space Flight Center, United States; Jake A. Connors, National Institute of Standards and Technology, United States; Trevor M. Oxholm, University of Wisconsin, United States

D2.2 13:30
Technology Maturation for Cloud Ice Radiometers
Pekka Kangaslahti, Erich Schlecht, Isaac Ramos, Javier Bosch, Mary Soria, Erika Hernandez, Jonathan Jiang, Jet Propulsion Laboratory, California Institute of Technology, United States; William Deal, Alex Zamora, Kevin Leong, Ben Gorospe, Alfonso Escorcia, Khanh Nguyen, Gerry Mei, Caitlyn Cooke, Maxwell Duffy, Northrop Grumman Corporation, United States

D2.3 13:50
Venus Wideband Submillimeter Heterodyne Spectrometer (V-WiSHeS): a Remote-Sensing Flight Instrument Targeting Venus' Middle Atmosphere
Carrie Anderson, Paul Racette, Negar Ehsan, Gordon Chin, Melissa Ugelow, Tilak Hewagama, NASA Goddard Space Flight Center, United States; Timothy Livengood, University of Maryland, United States

D2.4 14:10
Submillimeter Solar Observation Lunar Volatiles Experiment (SSOLVE)
Timothy Livengood, NASA GSFC/CRESST, United States; Carrie Anderson, Berhanu T. Bulcha, Gordon Chin, Negar Ehsan, Tilak Hewagama, Paul Racette, Geronimo Villanueva, NASA GSFC, United States

D2.5 14:30
Schottky Diodes based on Heterogeneous Integration for Submillimeter-Wave Metrology and Calibration
Robert M. Weikle II, Linli Xie, Michael Cyberey, University of Virginia, United States; Matthew Bauwens, Dominion MicroProbes, Inc., United States; Arthur Lichtenberger, Scott Barker, University of Virgiinia, United States

Wednesday, January 5	15:10 - 16:50
Event	Math 100

Student Paper Competition

Wideband, Electronically Reconfigurable Phased-Array Element with 1-Bit Phase Quantization and High Power Handling Capability

Zongtang Zhang, Advisor: Nader Behdad

Seeing Around Obstacles with Terahertz Waves

Yiran Cui, Advisor: Georgios Trichopoulos

Direction Finding Bandwidth Enhancement of a Machine Learning Retrofit Ultrawideband Array

Gaeron Friedrichs, Advisor: Dejan Filipovic

Non-Contact Heart Rate Estimation in Low SNR Environments Using mmWave Radar

C.J. Bauder, Advisor: A.E. Fathy

RFSoC-Based Digital Beamformer for Millimeter-Wave MIMO Applications

Kefayet Ullah, Advisor: John Volakis

Wednesday, January 5	17:00 - 18:00
Event	

Business Meetings

Commission A (Room 155)

Commission F (Room 150)

Wednesday, January 5	18:00 - 19:00
Event	

Business Meetings

Commissions C and E (Room 105)

Commission J (Room 265)

Wednesday, January 5	19:00 - 21:00
Event	

Receptions

WIRS Speaker Meet & Greet for all Virtual Attendees (online)

Reception for all In-Person Attendees (Byron R. White Stadium Club)

Thursday, January 6 08:00 - 11:30
Event Math 100

Plenary Session

RF Spectrum Use, Management, and Interference Mitigation

Plenary Introduction

Eric Mokole

Musings on Practical Radar Spectrum Sharing

Shannon Blunt, University of Kansas

Making Spectrum Better: Collaboration Opportunities between Radio Scientists and other Spectrum Users

Andy Clegg, Google and Baylor University

Maintaining Access to Spectrum for Astronomy and Passive Radio Science

Harvey Liszt, National Radio Astronomy Observatory

Student Paper Competition Awards

Thursday, January 6 13:10 - 14:50
A4 Special Session 105

Inventive Approaches in Advanced Communications

Session Co-Chairs: Chris Anderson, USNA; Amy Robinson, University of Colorado

A4.1 **13:10**
Reconfigurable Satellite Radios Using Machine Learning Algorithms
Michael Ortiz, Elias Alwan, Florida International University, United States

A4.2 **13:30**
A Robotic Antenna Alignment and Tracking System for Millimeter Wave Propagation Modeling
Bharath Keshavamurthy, Nicolo Michelusi, Arizona State University, United States; Yaguang Zhang, James Krogmeier, David Love, Purdue University, United States; Christopher Anderson, United States Naval Academy, United States

A4.3 **13:50**
RFSoC-Based Digital Beamformer for Millimeter-Wave MIMO Applications
Kefayet Ullah, Satheesh Bojja Venkatakrishnan, John L. Volakis, Florida International University, United States

A4.4 **14:10**
Doppler Frequency Shift Compensation in Millimeter-Wave Multi-Port Receiver Front-Ends
Mansoor Dashti Ardakani, INRS University, Canada; Marzie Tabatabaefar, Serioja Ovidiu Tatu, Institut National de la Recherche Scientifique (INRS), Canada

A4.5 **14:30**
Development of Quantum Field Probes for Reliable Channel Sounding Measurements
Alexandra Artusio-Glimpse, Matthew Simons, Vladimir Aksyuk, Christopher Holloway, NIST, United States; Amy Robinson, University of Colorado, United States; Daniel Lopez, Penn State, United States

Thursday, January 6 13:10 - 16:50
F3 150

Refractivity Characterization and Numerical Weather Prediction

Session Co-Chairs: Jonathan Z. Gehman, Johns Hopkins University Applied Physics Laboratory; Abby Anderson, NRLDC

F3.1 **13:10**
Improving Parametric Refractivity Models for Evaporation Ducts
Sarah Wessinger, Erin E. Hackett, Coastal Carolina University, United States; Tracy Haack, Naval Research Laboratory, United States

F3.2 **13:30**
A Fully Coherent Vertical Array for Evaporation Duct Height Estimation at Coastal Boundaries
Joe Vinci, Caglar Yardim, The Ohio State University, United States

F3.3 **13:50**
Global Sensitivity of X-band Propagation to Environmental Parameters in Evaporative Ducting Conditions
Douglas M. Pastore, Erin E. Hackett, Coastal Carolina University, United States

F3.4 **14:10**
Assessment of NWP/SLM Blend Algorithm Performance
Andrew Mahre, Jonathan Z. Gehman, Jonathan M. Pozderac, Thomas R. Hanley, Johns Hopkins University Applied Physics Laboratory, United States

F3.5 **14:30**
LATPROP Radar Data Collection for CLASI Experiment
DeGrafth Palmore, Caglar Yardim, Joshua Compaleo, The Ohio State University, United States

Break **14:50**

F3.6 **15:10**
Evaluating the Effects of Digital Elevation Models and Land Use Land Cover Models on Radio Frequency Electromagnetic Propagation Modeling for Over Land Applications
Abby Anderson, NRLDC, United States

F3.7 **15:30**
An Assessment of Theoretical Models of Sea Surface Roughness at Coastal Boundaries with the Aid of the Parabolic Equation
Elizabeth Shi, Calgar Yardim, Mark Andrews, Joe Vinci, Joel Johnson, Ohio State University, United States

F3.8 **15:50**
Exploring the Sensitivity of Simulated Radio Propagation Loss to NWP-Derived Modified Refractivity
Jacob Yung, Bay Systems Consulting, United States; David Flagg, Andrew Kammerer, James Doyle, U.S. Naval Research Laboratory, United States; Qing Wang, Naval Postgraduate School, United States; Denny Alappattu, NorthWest Research Associates, United States; Robert Burkholder, Caglar Yardim, Ohio State University, United States; Peter Rogowski, Tony de Paolo, Scripps Institution of Oceanography, United States; Katherine Mulreany, Office of Naval Research, United States

F3.9 **16:10**
Characterizing Heterogeneous Refractivity Conditions Along a Propagation Path from Gridded NWP Data
Paul Frederickson, Naval Postgraduate School, United States

F3.10 **16:30**
Effects of Climate Change on Radio-Wave Propagation
Jonathan Z. Gehman, Benjamin Sheppard, Ben Weaver, Jake Kovalic, Thomas R. Hanley, Johns Hopkins University Applied Physics Laboratory, United States

Thursday, January 6 13:10 - 14:50
C1 155

Radar

Session Co-Chairs: James Gowan; Robert Gardner, Georgia Tech Research Institute

C1.1 **13:10**
DISTRIBUTED SDR ARRAY FOR FORWARD-BASED OVER-THE-HORIZON-RADAR (OTHR)
Sean Ellison, Yan Li, Priscilla Tang, Minhtri Ho, Joseph McIlvenny, James Conroy, Johns Hopkins Applied Physics Lab, United States

C1.2 **13:30**
A Mobile, High Temporal and Spatial Resolution FMCW Channel Sounder
Carl L. Wolsieffer, Daniel J. Breton, Army Corps of Engineers, United States

C1.3 **13:50**
Limits on Available Monostatic RCS Observation Angles for Satellites
Robert Gardner, Georgia Tech Research Institute, United States

C1.4 **14:10**
FPGA Implementation of an Efficient Neural Network Model for Maximum Power Point Tracking
Dilruba Parvin, Omiya Hassan, Twisha Titirsha, Syed Kamrul Islam, University of Missouri, United States

C1.5 **14:30**
Non-Contact Heart Rate Estimation in Low SNR Environments Using mmWave Radar
Chandler Bauder, Aly Fathy, University of Tennessee Knoxville, United States

Thursday, January 6 13:10 - 16:10
B8 200

Analysis and Design of Antennas and RF Components

Session Co-Chairs: Satish Sharma, San Diego State University; Zoya Popovic, University of Colorado Boulder

B8.1 **13:10**
Magnetically Reconfigurable Band-Reject Metasurface Filter
Jack Eichenberger, Jize Dai, The Ohio State University, United States; Shuai Wu, Renee Zhao, Stanford University, United States; Nima Ghalichechian, Georgia Institute of Technology, United States

B8.2 **13:30**
Understanding the Far-Field Properties of Orbital Angular Momentum Beams through the Antenna Aperture Field Method
Anastasios Papathanasopoulos, Junbo Wang, Yahya Rahmat-Samii, UCLA, United States

B8.3 **13:50**
Exceptional Point of Degeneracy as a Desirable Point of Operation for Oscillator With Discrete Nonlinear Gain and Radiating Elements
Tarek Mealy, Alireza Nikzamir, Ahmed Abdelshafy, Filippo Capolino, University of California, Irvine, United States

B8.4 **14:10**
Front-End Isolation Circuit for Aperture-Level STAR Arrays
Seth Johannes, Zoya Popovic, University of Colorado Boulder, United States

B8.5 **14:30**
Tri-Band Quasi-FIR Microwave Filter with Parallel Switched Resonators for 5G New Radio Mission Critical Band Selectivity
Anthony Nuñez, Stavros Georgakopoulos, Elias Alwan, Florida International University, United States

Break **14:50**

B8.6 **15:10**
Modular 3D printed Antennas
Lauren Linkous, Jonathan Lundquist, Erdem Topsakal, Virginia Commonwealth University, United States

B8.7 **15:30**
Object-Oriented RF Effects Simulation
Robert Gardner, Georgia Tech Research Institute, United States

B8.8 **15:50**
GTRI Precision Effects Testbed
George Che, Robert Gardner, Gabriel Saffold, Georgia Tech Research Institute, United States

Thursday, January 6 13:10 - 14:10
H3 Special Session 245

Lightning and Plasma Phenomena of the Thermosphere

Session Co-Chairs: Mark Golkowski, University of Colorado Denver; Robert Marshall, University of Colorado Boulder

H3.1 **13:10**
Excitation of the Schumann Band by Q-bursts, N-bursts, and V-bursts
Quincy Flint, Robb Moore, University of Florida, United States

H3.2 **13:30**
Mesospheric Photochemistry Optimized for Lightning-Ionosphere Interactions and VLF Scattering Calculations
Joshua Santos, Robert Moore, University of Florida, United States

H3.3 **13:50**
Simulating Meteoroid Ablation on Picosecond Timescales
Gabrielle Guttormsen, UCLA, United States; Alex Fletcher, Naval Research Laboratory, United States; Meers Oppenheim, Boston University, United States

Thursday, January 6 13:10 - 16:30
J3 265

New Telescopes, Techniques, and Technologies and Observatory Reports III

Session Co-Chairs: Jeff Mangum, NRAO; Alyson Ford, University of Arizona

J3.1 **13:10**
First HERA Phase I Results: Improved Limits on the 21 cm Reionization Power Spectrum at z=8
Nicholas Kern, Massachusetts Institute of Technology, United States

J3.2 **13:30**
A Map of Diffuse Radio Emission at 182 MHz to Enhance Epoch of Reionization Observations in the Southern Hemisphere
Ruby Byrne, California Institute of Technology, United States; Miguel Morales, Bryna Hazelton, Ian Sullivan, University of Washington, United States; Nichole Barry, University of Melbourne, Australia; Christene Lynch, Jack Line, Curtin University, Australia; Daniel Jacobs, Arizona State University, United States

J3.3 **13:50**
Preliminary Field Results from the MIST Global 21cm Experiment
Ian Hendricksen, McGill University, Canada

J3.4 **14:10**
Lost Horizon: Quantifying the Effect of Local Topography on Global 21-cm Cosmology Data Analysis
Neil Bassett, Jack Burns, University of Colorado Boulder, United States; David Rapetti, NASA Ames Research Center, United States

J3.5 **14:30**
Electrical Characterization of the Soil for Sky Radio Measurements with the MIST Global 21-cm Experiment
Matheus Azevedo Silva Pessôa, McGill University, Brazil

Break **14:50**

J3.6 **15:10**
A Progress Report on PRIZM Data Analysis and Calibration
Kelly Foran, McGill University, Canada

J3.7 **15:30**
Drone Calibration for HIRAX and Other 21cm Experiments
Emily Kuhn, Yale University, United States

J3.8 **15:50**
RFI Measurement of a Drone Calibration System for 21cm Experiments
Anna R. Polish, Yale University, United States

J3.9 **16:10**
Evaluation of Antenna Beam Chromaticity for the MIST Global 21-cm Experiment
Christian Hellum Bye, University of California, Berkeley, United States

Thursday, January 6 13:10 - 15:30
B9 Special Session 1B40

Novel Electrically Small Antennas and Matching Networks

Session Co-Chairs: Ashwin K. Iyer, University of Alberta; Ting-Yen Shih, University of Idaho

B9.1 **13:10**
Approaching the Q Lower Bounds with an Inherently Matched and Highly Miniaturized Spherical Folded Dipole
Ashwin K. Iyer, University of Alberta, Canada; Sanghamitro Das, San Diego State University, United States

B9.2 **13:30**
Design of an Electrically Small Printed Square Loop Antenna
Nhat Truong, Sanghamitro Das, Satish Sharma, San Diego State University, United States

B9.3 **13:50**
Investigation of Overcoming the Chu Lower Bound on Quality Factor for Antennas Tuned with Highly Dispersive Lossy Material
Younes Ra'di, Ahmed Mekkawy, Andrea Alu, Advanced Science Research Center, City University of New York, United States

B9.4 **14:10**
Mutual Coupling Reduction of Miniaturized MM-wave ME-dipole Antennas using SRR Superstrate
Mehri Borhani Kakhki, Tayeb A. Denidni, University of Quebec, Canada; Abdolmehdi Dadgarpour, Abdel-Razik Sebak, Concordia University, Canada; Marco A. Antoniades, Ryerson University, Canada

B9.5 **14:30**
A Machine Learning Approach to Varactor Diode Modeling
Phillip Hagen, Qianyi Li, Ting-Yen Shih, University of Idaho, United States

Break **14:50**

B9.6 **15:10**
API Design for Machine-Learning-Based Automatic Synthesis of Practical Impedance Matching Circuits
Qianyi Li, Ting-Yen Shih, University of Idaho, United States

Thursday, January 6 15:10 - 16:30
K1 Special Session 105

Dosimetry and Exposure Assessment

Session Co-Chairs: Asimina Kiourti, ELECTROSCIENCE LABORATORY; Ifana Mahbub, University of North Texas

K1.1 **15:10**
Implementation of Polynomial Chaos Expansion Surrogate Model in SAR Statistical Studies
Botian Zhang, Yahya Rahmat-Samii, University of California, Los Angeles, United States

K1.2 **15:30**
Human vs. Rat Head Models for Wireless and Fully-Passive Brain Implant Design: A Comparative Study
Mihir N. Patil, Asimina Kiourti, ELECTROSCIENCE LABORATORY, United States

K1.3 **15:50**
The Design and SAR Analysis of a UWB Bow-tie Antenna for Wireless Wearable Sensors
Karthik Kakaraparty, Ifana Mahbub, University of North Texas, United States

K1.4 **16:10**
Extending Range of Wireless Power Transfer Using a Novel Intermediate Passive Loop with Coils
Bashir Morshed, Mahfuzur Rahman, Texas Tech University, United States

Thursday, January 6 15:10 - 16:50
G3 151

Radar and Radio Techniques

Session Co-Chairs: Thomas Gaussiran, UT Austin; Stan Briczinski, NRL

G3.1 **15:10**
SuperDARN Observations of STEVE
Gareth Perry, New Jersey Institute of Technology, United States; Bea Gallardo-Lacourt, NASA Goddard Space Flight Center, United States; William Archer, Canadian Space Agency, Canada; Simon Shepherd, Dartmouth College, United States; Ashton Reimer, SRI, United States; Megan Gillies, University of Calgary, United States

G3.2 **15:30**
On the Use of HAARP and the Kiwi Software-defined Receiver Network for HF Studies
Jordan Wiker, Brian Minch, Jonathan Z. Gehman, David Aylaian, Glenn Sugar, Aram Vartanyan, James Conroy, Johns Hopkins University Applied Physics Laboratory, United States

G3.3 **15:50**
DLITE: A Low-cost Radio Telescope Array for Ionospheric Remote Sensing
Joseph Helmboldt, Blerta Markowski, David Bonanno, Tracy Clarke, Brian Hicks, Namir Kassim, U.S. Naval Research Laboratory, United States; Jayce Dowell, Univeristy of New Mexico, United States; Gregory Taylor, University of New Mexico, United States

G3.4 **16:10**
Modulated pump power effects on VHF PMSE and associated dust charging process in space
Alireza Mahmoudian, University of Tehran, Iran; M J Kosch, SANSA, South Africa; Juha Vierinen, University of Tromso, Norway

G3.5 **16:30**
Characterization of the D-Region Ionosphere using Polarization Parameters
Hunter Burch, Robert Moore, University of Florida, United States

Thursday, January 6 15:10 - 16:50
C2 155

RF Spectrum

Session Co-Chairs: Lawrence Cohen, Naval Research Laboratory; Greg Huff, Pennsylvania State University

C2.1 **15:10**
Circuit Optimization of Non-Linear Transmit Amplifiers using Partial Load-Pull Extrapolation via Deep Image Completion
Austin Egbert, Charles Baylis, Robert J. Marks II, Baylor University, United States

C2.2 **15:30**
Directional Modulation and Array Impedance Tuning for Secure Radar and Communications
Adam Goad, Julian Alonzo, Austin Egbert, Sarah Seguin, Charles Baylis, Robert J. Marks II, Baylor University, United States; Moeness Amin, Villanova University, United States; Anthony Martone, Benjamin Kirk, DEVCOM Army Research Laboratory (ARL), United States

C2.3 **15:50**
Changepoint Detection for Real-Time Spectrum Sharing Radar
Samuel Haug, Austin Egbert, Robert J. Marks II, Charles Baylis, Baylor University, United States; Anthony Martone, Army Research Laboratory, United States

C2.4 **16:10**
Spectrum Sharing Broker for Active and Passive Devices Considering In-Band and Out-of-Band Emissions
Sarah Seguin, Kayla Sanders, Trevor Van Hoosier, Adam Goad, Charles Baylis, Robert J. Marks II, Baylor University, United States; Albin Gasiewski, Aravind Venkitasubramony, University of Colorado at Boulder, United States

C2.5 **16:30**
Adaptive Radio Frequency Interference Cancellation for Radio Science Observatories
Sharanya Srinivas, Frank D. Lind, John Swoboda, Philip J. Erickson, Kazunori Akiyama, Massachusetts Institute of Technology, United States

Thursday, January 6 15:10 - 16:30
D3 Special Session 1B51

Broadband and Multiband Amplifiers

Session Co-Chairs: Zoya Popovic, University of Colorado Boulder; Philip Zurek, University of Colorado Boulder

D3.1 **15:10**
State of the Art Transformer Enabled 2-20 GHz GaN MMIC Overview
Michael Roberg, Qorvo, United States

D3.2 **15:30**
Broadband RF Power Amplifier Architectures for Linear Concurrent Signal Transmission
Philip Zurek, Zoya Popovic, University of Colorado Boulder, United States

D3.3 **15:50**
GaAs MMIC Interferometer for Interference Cancellation
Paige Danielson, Megan Robinson, Zoya Popovic, University of Colorado Boulder, United States

D3.4 **16:10**
A 90-125 GHz Stacked PA in 130 nm InP HBT with 18.3 % peak PAE at 15.3 dBm Output Power
Vinay Iyer, Jay Sheth, Linsheng Zhang, Robert M. Weikle II, Steven Bowers, University of Virginia, United States

Thursday, January 6 17:00 - 18:00
Event

Business Meetings

Commission B (Room 1B40)

Commission G (Room 151)

Thursday, January 6 18:00 - 19:00
Event

Business Meetings

Commission D (Room 1B51)

Commission H (Room 245)

Commission K (Room 105)

Thursday, January 6 19:00 - 20:00

Event

Business Meetings

WIRS Business Meeting (Room 105)

Thursday, January 6 20:00 - 21:00

Event

Reception

WIRS In-Person Reception (KOBL S100)

Friday, January 7 08:20 - 12:00
K2 105

Human Body Interactions with Antennas and Other Electromagnetic Devices

Session Co-Chairs: Ryan Green, Mississippi State University; Erdem Topsakal, Virginia Commonwealth University

K2.1 **08:20**
Skin Acetone Sensing Based on PANI-CA Composites
Balaji Dontha, Asimina Kiourti, The Ohio State University, United States

K2.2 **08:40**
Analysis of a Wearable Joint Flexion Sensor Using Anatomical Tissue Models
Keren Zhu, Asimina Kiourti, The Ohio State University, United States; Michael Johnson, C.J. Reddy, Altair Engineering, Inc., United States

K2.3 **09:00**
Screen-Printed Frequency Selective Surfaces for Health and Communication Applications
McKenzie Piper, Joshua Piper, Erdem Topsakal, Virginia Commonwealth University, United States

K2.4 **09:20**
Using Anatomical Body Models to Simulate Antenna-Impregnated Fabrics that Monitor Child Height
Keren Zhu, Asimina Kiourti, The Ohio State University, United States; Michael Johnson, C.J. Reddy, Altair Engineering, Inc., United States

K2.5 **09:40**
Silver Ink-Based Thin Film Antennas for Wearable Stretch Sensor Applications
Ryan Green, Benjamin Wilkinson, Mississippi State University, United States; Jonathan Lundquist, Erdem Topsakal, Virginia Commonwealth University, United States

Break **10:00**

K2.6 **10:20**
Study of Electrical Properties of PEDOT:PSS Material and its Feasibility for Wireless Implantable Devices
Mohammad Moulod, Sharolyn Balbaugh, David Hoelzle, Asimina Kiourti, Jinghua Li, Félix Miranda, Ohio State University, United States

K2.7 **10:40**
On-Demand Current Pulse Activation of RF Monopole Antenna Biosensor Arrays with Nitrocellulose Membranes
Sindu Shanmugadas, Jonathan Lundsquit, Erdem Topsakal, Vitaliy Avrutin, Dr. Umit Ozgur, Virginia Commonwealth University, United States

K2.8 **11:00**
Combined Static Magnetic Fields and RF Fields effects on HT-1080 fibro sarcoma cells and role of Iron Sulphur Complexes on ROS production
Hakki Gurhan, Frank Barnes, University Colorado, United States

K2.9 **11:20**
Emission of Electric and Magnetic Fields from HD1080 Fibrosarcoma Cell And E-coli
Frank Barnes, Hakki Gurhan, Sahithi Kandala, Mark Hernandez, University of Colorado Boulder, United States

K2.10 **11:40**
Assessment of the Point Electrode Configuration in Electrical Impedance Myography Measurement for Early Stage Breast Cancer Detection
Md Al Amin Bhuiyan, Dhaka Community Medical College, Bangladesh; Md Nurul Anwar Tarek, Florida International University, United States; Mohammad A. Ahad, GEORGIA SOUTHERN UNIVERSITY, United States

Friday, January 7 08:20 - 11:40
F4 150

Microwave Remote Sensing of the Earth

Session Co-Chairs: David Kunkee, The Aerospace Corporation; Chris Ruf, University of Michigan

F4.1 **08:20**
Impacts of WSR-88D Supplemental Lower Elevation Angles on Quantitative Precipitation Estimating
Haonan Chen, Liangwei Wang, Zhe Li, Colorado State University, United States

F4.2 **08:40**
Examination of Transfer Learning Based Nowcasting in Different Geographical Regions
EunYeol Kim, Venkatachalam Chandrasekar, Colorado State University, United States

F4.3 **09:00**
Inpainting Polarimetric Radar Observations in Complex Environments
Songjian Tan, Haonan Chen, Shun Yao, Colorado State University, United States

F4.4 **09:20**
NowSRGAN: A Super-Resolution Generative Adversarial Network for Machine Learning Weather Radar Nowcasting
Jacob Garcia, Venkatachalam Chandrasekar, Colorado State University, United States

F4.5 **09:40**
Impact of Precipitation Regimes on Deep Learning-based Radar Nowcasting Performance
Shun Yao, Haonan Chen, Colorado State University, United States

Break **10:00**

F4.6 **10:20**
Enabling Temporal Observations of Cloud and Precipitation Processes from Constellations of Small Satellites: The Temporal Experiment for Storms and Tropical Systems – Demonstration (TEMPEST-D) Mission
Steven C. Reising, Venkatachalam Chandrasekar, Christian D. Kummerow, Wesley Berg, Chandrasekar Radhakrishnan, Colorado State University, United States; Shannon T. Brown, Todd C. Gaier, NASA/Caltech Jet Propulsion Laboratory, United States

F4.7 **10:40**
Antarctic Firn Characterization through Wideband Microwave Radiometry
Rahul Kar, Mustafa Aksoy, Dua Kaurejo, University at Albany,SUNY, United States

F4.8 **11:00**
Forward-Looking Millimeter-Wave Radiometers to Provide Advance Warning of Aircraft Icing Potential in Clouds
Renish Thomas, Yuriy Goncharenko, Steven C. Reising, Jonah Smith, Chaehyeon C. Nam, Samantha Williams, Laurel O'Brien, Michael M. Bell, Colorado State University, United States; James McDonald, Eric Pahlke, Richard Bateman, FIRST RF Corporation, United States

F4.9 **11:20**
Radio Frequency Interference Detection in Microwave Radiometry Using Bayesian Detection
Imara Mohamed Nazar, Mustafa Aksoy, University at Albany, United States

Friday, January 7 08:20 - 10:00
G4 151

Ionospheric Imaging

Session Co-Chairs: Thomas Gaussiran, UT Austin; Roy Calfas, Univ of Texas at Austin

G4.1 **08:20**
An MF/HF Radio Array for Radar and Radio Imaging of the Ionosphere
Brett Isham, Interamerican University of Puerto Rico, United States; Terence Bullett, University of Colorado, United States; Bjorn Gustavsson, University of Tromso, Norway; Emil Polisensky, Naval Research Laboratory, United States; Gebrab Zewdie, Arecibo Observatory, United States; Vasyl Belyey, Leiza Norouzi, private researcher, Norway; Jan Bergman, Swedish Institute of Space Physics, Sweden

G4.2 **08:40**
Resolving High-Latitude Plasma Density Structures using Advanced Modular Incoherent Scatter Radars and Novel Mapping Techniques
Lindsay Goodwin, Gareth Perry, New Jersey Institute of Technology, United States

G4.3 **09:00**
Ionospheric Imaging with the North American VLF Array
Joshua Covey, Robert Moore, University of Florida, United States

G4.4 **09:20**
Gaussian process model specification for 4-D wind field estimation using meteor radar network observations
Ryan Volz, Philip J. Erickson, Massachusetts Institute of Technology, United States; Oana Mirestean, Cornell University, United States; Jorge Chau, University of Rostock, Germany

G4.5 **09:40**
Morphological and spectral features of ionospheric structures at E- and F-region altitudes over Poker Flat analyzed using modeling and observations.
Pralay Raj Vaggu, Kshitija Deshpande, Embry Riddle Aeronautical University, United States; Seebany Datta-Barua, Aurora Lopez, Illinois Institute of Technology, United States; Gary Bust, James Conroy, JHUAPL, United States; Donald Hampton, Geophysical Institute, University of Alaska, United States

Friday, January 7 08:20 - 10:00
C3 155

RF Antenna Design and Systems

Session Co-Chairs: Dev Palmer, DARPA; Kumar Mishra, Army Research Laboratory

C3.1 **08:20**
Machine Learning for Microstrip Patch Antenna Design: Observations and Recommendations
Yiming Chen, Atef Elsherbeni, Colorado School of Mines, United States; Veysel Demir, Northern Illinois University, United States

C3.2 **08:40**
Next Generation RF and Microwave Antenna Predictive and Optimization Models
Sai Sampreeth Indharapu, Anthony N. Caruso, Kalyan C. Durbhakula, University of Missouri - Kansas City, United States

C3.3 **09:00**
Prior Knowledge based Inverse Parametric Modeling of UWB Band-Notched Antennas
Debanjali Sarkar, Taimoor Khan, Fazal Ahmed Talukdar, NIT Silchar, India; Sembiam R. Rengarajan, California State University, United States

C3.4 **09:20**
Direction Finding Bandwidth Enhancement of a Machine Learning Retrofit Ultrawideband Array
Gaeron Friedrichs, Mohamed Elmansouri, Dejan Filipovic, University of Colorado Boulder, United States

C3.5 **09:40**
A Novel MIMO System with Integrated Coupling Suppression Filter at W Band
Asif Hassan, Md Nurul Anwar Tarek, Sandhiya R. Govindarajulu, Elias A. Alwan, Florida International University, United States

Friday, January 7 08:20 - 12:00
B10 200

Antenna Arrays: Approaches, Realizations, and Applications

Session Co-Chairs: Nader Behdad, University of Wisconsin, Madison; Randy Haupt, Colorado School of Mines

B10.1 **08:20**
Application of Waveguide Simulators in the Design of Large, Wideband Phased Arrays with Asymmetric Antenna Elements
Collin Wallish, Songyi Yen, Dejan Filipovic, University of Colorado Boulder, United States

B10.2 **08:40**
A Particle Swarm Approach to Grating Lobe Suppression in an Aperiodic Vivaldi Array
Gregory Mitchell, Quang Nguyen, Army Research Laboratory, United States

B10.3 **09:00**
Sparse Circular Aperture Arrays Based on Poisson Disk Sampling
Travis Torres, Payam Nayeri, Randy Haupt, Colorado School of Mines, United States; Paolo Rocca, University of Trento, Italy

B10.4 **09:20**
A High-Power-Capable, Electronically-Reconfigurable, Phased-Array Unit Cell with 1-Bit Phase Quantization and 3:1 Bandwidth
Jinkai Wu, Zongtang Zhang, John Booske, Nader Behdad, University of Wisconsin, Madison, United States

B10.5 **09:40**
Sparse Cylindrical Arrays Based on the Low-Discrepancy Sobol Sequence Sampling
Travis Torres, Payam Nayeri, Randy Haupt, Colorado School of Mines, United States

Break **10:00**

B10.6 **10:20**
Wideband, Electronically Reconfigurable Phased-Array Element with 1-Bit Phase Quantization and High-Power Handling Capability
Zongtang Zhang, Meng Gao, Mohammad Mahdi Honari, John Booske, Nader Behdad, University of Wisconsin-Madison, United States

B10.7 **10:40**
Foldable, Ultra-Wideband Tightly Coupled Dipole Array (TCDA) with Integrated Planar Feed and LET Joint
Md Rakibul Islam, Vignesh Manohar, Satheesh B. Venkatakrishnan, John L. Volakis, Florida Internatinal University, United States

B10.8 **11:00**
Orbital Angular Momentum (OAM) Beams: Novel Mathematical Insights, Transmitarray Generation and Measurement Validation
Anastasios Papathanasopoulos, Yahya Rahmat-Samii, UCLA, United States

B10.9 **11:20**
Improved GRIN Lens Ray Tracing Using Uniform Asymptotic Physical Optics
Wei Wang, Jonathan Chisum, University of Notre Dame, United States

B10.10 **11:40**
High-Power-Capable, Electronically-Reconfigurable Reflectarray Antennas with Wideband 1- and 2-Bit Phase Quantization
Mohammad Mahdi Honari, John Booske, Nader Behdad, University of Wisconsin-Madison, United States

Friday, January 7 08:20 - 11:00
J4 Special Session 245

New SETI Technologies and Instrumentation

Session Co-Chairs: Dan Werthimer, University of California Berkeley; David DeBoer, University of California Berkeley

J4.1 **08:20**
Search for Extra-terrestrial Intelligence (SETI) using Interferometric Radio Telescopes with an Ethernet-based, Multi-user Observing System
Cherry Ng, University of Toronto, Canada

J4.2 **08:40**
The PANOSETI Transient Search Instrument
Dan Werthimer, University of California, Berkeley, United States

J4.3 **09:00**
White Rabbit: Precision Time and Frequency Distribution for Radio Astronomy and SETI
Wei Liu, Dan Werthimer, University of California, Berkeley, United States; Rick Raffanti, Techne Instruments, United States

J4.4 **09:20**
A Machine-Learning-Based Direction-of-Origin Filter for the Identification of Radio Frequency Interference in the Search for Technosignatures
Pavlo Pinchuk, Jean-Luc Margot, University of California, Los Angeles, United States

J4.5 **09:40**
Validation of the SETI@home Candidate Pipeline Using Synthetic Extraterrestrials
Eric Korpela, David Anderson, Jeff Cobb, Dan Werthimer, University of California, United States

Break **10:00**

J4.6 **10:20**
High Performance Pipelines for SETI Signal Processing
David MacMahon, University of California at Berkeley, United States

J4.7 **10:40**
Instrumentation Development for Radio Technosignature Searches at the Hat Creek Radio Observatory
Alexander Pollak, Wael Farah, Sarah Schoultz, SETI Institute, United States; Andrew Siemion, David DeBoer, University of California at Berkeley, United States; Jack Hickish, REAL-TIME RADIO SYSTEMS LTD, United Kingdom; Franklin Antonio, Qualcomm, Inc., United States

Friday, January 7 08:20 - 11:20
J5 Special Session 265

Imaging Black Holes: The EHT and Beyond I

Session Co-Chairs: James Moran, Harvard University; Vincent Fish, MIT Haystack Observatory

J5.1 **08:20**
The Event Horizon Telescope
Geoffrey Bower, ASIAA, United States

J5.2 **08:40**
Testing the Kerr nature of black holes with the Event Horizon Telescope
Lia Medeiros, Institute for Advanced Study, United States; Dimitrios Psaltis, Feryal Ozel, University of Arizona, United States; Pierre Christian, Fairfield University, United States

J5.3 **09:00**
Black hole images and movies from general relativistic MHD simulations
Jason Dexter, University of Colorado Boulder, United States

J5.4 **09:20**
Interferometric Imaging Techniques for the Event Horizon Telescope
Kazunori Akiyama, Massachusetts Institute of Technology, United States

J5.5 **09:40**
Calibration of the Event Horizon Telescope
Lindy Blackburn, Center for Astrophysics | Harvard & Smithsonian, United States

Break **10:00**

J5.6 **10:20**
Inference techniques for the Event Horizon Telescope
Dominic Pesce, Center for Astrophysics | Harvard & Smithsonian, United States

J5.7 **10:40**
Polarimetric Observations with the Event Horizon Telescope
Daniel Marrone, University of Arizona, United States

J5.8 **11:00**
Observations of Active Galactic Nuclei with the Event Horizon Telescope
Alan Marscher, Svetlana Jorstad, Boston University, United States

Friday, January 7 08:20 - 11:40
B11 Special Session 1B40

Antennas and Systems for Specialized Platforms and Extreme/Harsh Environments

Session Co-Chairs: Reyhan Baktur, Utah State University; David Jackson, University of Houston; Sima Noghanian, Phoenix Analysis and Design Technologies; Sayan Roy, South Dakota School of Mines

B11.1 **08:20**
Origami-Based Tightly Coupled Dipole Array for Small Satellites
Maxence Carvalho, John L. Volakis, FIU, United States

B11.2 **08:40**
Antenna Designs for CubeSat-Borne Continuous Wave Radar
Logan Voigt, Reyhan Baktur, Utah State University, United States

B11.3 **09:00**
Ultra-Lightweight Transmitarray Antenna Enabled by Charge-Programmed Three-Dimensional Multi-Material Printing
Junbo Wang, Ryan Hensleigh, Zhenpeng Xu, Anastasios Papathanasopoulos, Xiaoyu Zheng, Yahya Rahmat-Samii, University of California, Los Angeles, United States

B11.4 **09:20**
An Equivalent Circuit Analysis of Permanent Magnet Based VLF Transmitter
Ali Hosseini-Fahraji, Majid Manteghi, Virginia Polytechnic Institute and State University, United States

B11.5 **09:40**
Optically Transparent Frequency Selective Surfaces of Smart City Applications
Benjamin Wilkinson, Ryan Green, Mississippi State University, United States; Jonathan Lundquist, Erdem Topsakal, Virginia Commonwealth University, United States

Break **10:00**

B11.6 **10:20**
Optically Transparent Reflectarray Antenna (RAA) for Future Self-Powered Communication Systems
Asim Alkhaibari, Trung Dung Ha, Pai-yen Chen, University of Illinois at Chicago, United States

B11.7 **10:40**
A Comparative Study of Two Styles of Transparent Antennas under Vibration Seen in Automotive Environments
Benjamin Wilkinson, Ryan Green, Mississippi State University, United States; Jonathan Lundquist, Erdem Topsakal, Virginia Commonwealth University, United States

B11.8 **11:00**
Design of Low-Cost and Volume Environmental Test Bench for Evaluating RF Performance of Antennas Operating in Harsh Conditions
Ljubodrag Boskovic, Mohamed Elmansouri, Dejan Filipovic, University of Colorado Boulder, United States

B11.9 **11:20**
Bench Testing a System on Chip Adaptive Beamformer For GPS
Jakob Kunzler, Karl Warnick, Jacob Bartschi, Spencer Ammermon, Mitchell Burnett, Brigham Young University, United States

Friday, January 7 10:20 - 11:40
G5 151

Ionospheric Modeling and Data Assimilation

Session Co-Chairs: Justin Mabie, Colorado; James Conroy, Virginia Tech

G5.1 **10:20**
Inversion of Scintillation Events in the Auroral and Polar Cap Regions Using Analytical and Numerical Models
James Conroy, Bharat Kunduri, Amir Zaghloul, Virginia Tech, United States; Kshitija Deshpande, Embry-Riddle, United States; Roger Varney, SRI International, United States

G5.2 **10:40**
Constraining VLF Trans-Ionospheric Propagation Experiment Rocket (VIPER) Ionospheric Conditions with Ground-based VLF Transmitter Observations.
James Cannon, Wei Xu, Robert Marshall, University of Colorado Boulder, United States; John Bonnell, University of California Berkeley, United States

G5.3 **11:00**
A Multi-scale Dynamic Mode Decomposition of Ionospheric Profiles
Daniel Alford-Lago, Naval Information Warfare Center Pacific, United States; Christopher Curtis, San Diego State University, United States; Alexander Ihler, University of California Irvine, United States

G5.4 **11:20**
A New Routine to Simulate Plasma Density Measurements from Satellites: Application to the SPORT Project
Ana Paula Schuch, João Pedro Borher, Marco Ridenti, Willer Gomes, Aeronautics Institute of Technology, Brazil

Friday, January 7 10:20 - 11:40
E1 155

RF Spectrum and RF Systems in Noise

Session Co-Chairs: Greg Huff, Pennsylvania State University; Lawrence Cohen, Naval Research Laboratory

E1.1 **10:20**
Enabling Crucial Scientific and Military Systems for Coexistence with 5G
Charles Baylis, Sarah Seguin, Andrew Clegg, Robert J. Marks II, Baylor University, United States; Albin Gasiewski, Aravind Venkitasubramony, University of Colorado at Boulder, United States; Dimitrios Peroulis, Mohammad Abu Khater, Purdue University, United States

E1.2 **10:40**
Creation of a Spatial-Spectral Mask in a Spectrally Brokered System
Trevor Van Hoosier, Kayla Sanders, Charles Baylis, Sarah Seguin, Adam Goad, Robert J. Marks II, Baylor University, United States

E1.3 **11:00**
Preliminary study of Radio Frequency waves in hypervelocity impact plasma
Kimia Fereydooni, Nicolas Lee, Sigrid Close, Stanford University, United States

E1.4 **11:20**
Analysis and Mitigation of Self-Scattering for VLF Navigation Applications
Clint Snider, Robert Moore, University of Florida, United States

Friday, January 7 12:10 - 13:00
Event Math 100

Ninth Hans Liebe Lecture

Laboratory Spectroscopy of Atmospheric Gases in the Millimeter and Submillimeter Wave Range

Mikhail Tretyakov, Institute of Applied Physics, Russian Academy of Sciences, Moscow, Russia

Friday, January 7 13:10 - 16:30
K3 105

Electromagnetic Imaging and Sensing

Session Co-Chairs: Asimina Kiourti, ELECTROSCIENCE LABORATORY; Zoya Popovic, University of Colorado - Boulder

K3.1 **13:10**
A Coherent Model for Radiometric Core Body Temperature Sensing
Katrina Tisdale, Alexandra Bringer, Asimina Kiourti, The Ohio State University, United States

K3.2 **13:30**
New Approach on Transcranial Magnetic Stimulation Using Permanent Magnet Based Generator
Ali Hosseini-Fahraji, Majid Manteghi, Virginia Polytechnic Institute and State University, United States

K3.3 **13:50**
Broadband Probe for Subcutaneous, Noninvasive Thermometry
Kaitlin Hall, Megan Robinson, Robert Streeter, Gabriel Santamaria-Botello, Zoya Popovic, University of Colorado - Boulder, United States

K3.4 **14:10**
Denoising E-Textile Sensors for Real-World Kinematics Monitoring
Yuxuan Han, Vigyanshu Mishra, Asimina Kiourti, The Ohio State University, United States

K3.5 **14:30**
Recording Evoked Somatosensory Activity with a Multichannel Passive Wireless Neurosensing System
Carolna Moncion, Lakshmini Balachandar, Melany Gutierrez-Hernandez, Satheesh Bojja Venkatakrishnan, John L. Volakis, Jorge Riera, Florida International University, United States

Break **14:50**

K3.6 **15:10**
Passive Wireless Neurosensing Recorder Evaluation using Machine Learning for Somatosensory Evoked Potentials Recognition
Melany Gutierrez-Hernandez, Carolina Moncion, Satheesh Bojja Venkatakrishnan, John L. Volakis, Florida International University, United States

K3.7 **15:30**
Experimental Demonstration of Geometric Parameter Estimation of Hidden Objects in Layered Media
Kai Ren, Wentworth Institute of Technology, United States

K3.8 **15:50**
Ceramic and Plastic Antenna Design for Into-Body Radiation
Allyanna Rice, Asimina Kiourti, Ohio State University, United States

K3.9 **16:10**
Investigation of Intrabody Transmission Channel around the Human Body
Jose Alcala-Medel, Yang Li, Baylor University, United States

Friday, January 7 13:10 - 16:30
F5 150

Propagation and Remote Sensing in Complex and Random Media

Session Co-Chairs: Saba Mudaliar, Air Force Research Laboratory, Wright-Patterson AFB; Gary S. Brown, Virginia Polytechnic Institute and State University

F5.1 **13:10**
The effects of surface roughness in the surface spectral range of k(sub s) > 2k(sub o)
Gary S. Brown, Thaddeus Black, Virginia Polytechnic Institute and State University, United States

F5.2 **13:30**
Two-ray Propagation Model with Random Volumetric Scattering
Vladimir Ostashev, Daniel J. Breton, D. Keith Wilson, Carl L. Wolsieffer, U.S. Army Engineer Research and Development Center, United States

F5.3 **13:50**
L Band Non-Line of Sight Wave Propagation Reflected from a Tree Covered Mountainside
Can Suer, the George Washington University, United States; Roger H. Lang, George Washington University, United States; Carl L. Wolsieffer, Daniel J. Breton, U.S. Army Corps of Engineers - Engineer Research & Development Center, United States

F5.4 **14:10**
A Space-angle Discontinuous Galerkin Method for Two-Dimensional Radiative Transfer Equation with Reflective Boundary Conditions
Hang Wang, Reza Abedi, University of Tennessee Space Institute, United States; Saba Mudaliar, Air Force Research Laboratory, Wright-Patterson AFB, United States

F5.5 **14:30**
DNN Enabled Real-Time Modeling of EM LWD Tool Responses in Complex Subsurface Formations
Chaoxian Qi, Li Yan, Yuchen Jin, Xuqing Wu, Jiefu Chen, University of Houston, United States; Yueqin Huang, Cyentech Consulting LLC, United States

Break **14:50**

F5.6 **15:10**
Two-Potential Formulation for Scattering from an Inhomogeneous Layer
Saba Mudaliar, Air Force Research Laboratory, United States; Dilip Ghosh Roy, Utah Center for Advanced Imaging Research, United States

F5.7 **15:30**
Space Correlations Functions and Propagation Loss in a 2D-Trunk Dominated Forest
Saul Torrico, Comsearch, United States; Roger H. Lang, George Washington University, United States

F5.8 **15:50**
Design and Implementation of a Ground Penetrating Radar (GPR) from an Unmanned Aircraft System (UAS)
Matthew Duck, Ali Gurbuz, Mehmet Kurum, Mississippi State University, United States

F5.9 **16:10**
Transitional Reversible-Jump MCMC for Subsurface Characterization
Han Lu, Jiefu Chen, Xuqing Wu, Xin Fu, University of Houston, United States; Mohammad Khalil, Cosmin Safta, Sandia National Laboratories, United States; Yueqin Huang, Cyentech Consulting LLC, United States

Friday, January 7 13:10 - 17:50
J6 Special Session 200

New Frontiers in Solar Radiophysics

Session Co-Chairs: Tim Bastian, National Radio Astronomy Observatory; Marc Pulupa, UC Berkeley Space Sciences Laboratory

J6.1 **13:10**
Advances in Ground-Based Solar Radio Science
Dale E. Gary, New Jersey Institute of Technology, United States

J6.3 **13:50**
Science Highlights from the Expanded Owens Valley Solar Array
Bin Chen, New Jersey Institute of Technology, United States

J6.4 **14:10**
Large Microwave Flare Sources with Multi-loop Magnetic Reconnection observed by EOVSA Imaging Spectroscopy
Shaheda Begum Shaik, Dale E. Gary, NJIT, United States; Stephen White, Air Force Research Laboratory, Space Vehicles Directorate, United States

J6.5 **14:30**
A New Era of Solar Physics with Owens Valley Radio Observatory – Long Wavelength Array (OVRO-LWA)
Sherry Chhabra, George Mason University, United States; Dale E. Gary, Bin Chen, Center for Solar-Terrestrial Research, New Jersey Institute of Technology, United States; Brian O'Donnell, New Jersey Institute of Technology, United States; Gregg Hallinan, California Institute of Technology, United States; Marin Anderson, NASA Jet Propulsion Laboratory, United States

Break **14:50**

J6.6 **15:10**
Adding ALMA: Combining Millilmeter Observations with Optical and UV Diagnostics to Probe the Solar Chromosphere
Kevin Reardon, Momchil Molnar, Ryan Hofmann, National Solar Observatory, United States; Yi Chai, Dale E. Gary, New Jersey Institute of Technology, United States

J6.7 **15:30**
The Sun Radio Interferometer Space Experiment (SunRISE) Mission
Joseph Lazio, Andrew Romero-Wolf, James Lux, Jet Propulsion Laboratory, California Institute of Technology, United States; Justin Kasper, University of Michigan, United States; Tim Neilsen, Space Dynamics Laboratory, Utah State University, United States

J6.9 **16:10**
Parker Solar Probe and Solar Orbiter Observations of Solar Radio Bursts
Vratislav Krupar, University of Maryland, Baltimore County and NASA Goddard Space Flight Center, United States

J6.10 **16:30**
Frontiers in Faraday Rotation: Probing the Solar Wind Magnetic Field with the Very Large Array
Jason Kooi, Naval Research Laboratory, United States

J6.11 **16:50**
SunRISE Mission Overview: A Distributed Eye in the Sky for Radio Burst & SEP Sourcing
Alexander Hegedus, Justin Kasper, University of Michigan, United States; Joseph Lazio, Andrew Romero-Wolf, Jet Propulsion Laboratory, California Institute of Technology, United States

J6.12 **17:10**
Investigating Quiescent and Transient Magnetic Structures in the Inner Heliosphere using Faraday Rotation, the FETCH instrument on the MOST *awesome* mission Concept
Elizabeth Jensen, Planetary Science Institute, United States; Natchimuthuk Gopalswamy, Shing Fung, Lan Jian, Lihua Li, Teresa Nieves-Chinchilla, Lynn Wilson, NASA Goddard Space Flight Center, United States; Joseph Lazio, Jet Propulsion Laboratory, United States; Jason Kooi, Brian Wood, Naval Research Laboratory, United States; Megan Kenny, University of Colorado, Boulder, United States; Ward Manchester, University of Michigan, United States; Alexei Pevtsov, National Solar Observatory, United States; David Wexler, University of Massachusetts, Lowell, United States; Stuart Bale, University of California, Berkeley, United States; Tim Bastian, National Radio Astronomy Observatory, United States

J6.13 **17:30**
The Cubesat Radio Interferometry Experiment (CURIE)
David Sundkvist, University of California at Berkeley, United States

Friday, January 7 13:10 - 17:10
H4 Special Session 245

Physics of the Radiation Belts

Session Co-Chairs: Oleksiy Agapitov, University of California Berkeley; Maria Usanova, LASP

H4.1 **13:10**
Whistlers in the Large Magnetospheric Ducts
Anatoly V. Streltsov, Embry-Riddle Aeronautical University, United States

H4.2 **13:30**
FDTD Modeling of Whistler Mode Propagation in Field-Aligned Ducts in the Magnetosphere
Vijay Harid, Mark Golkowski, Aleksandr Anikevhich, Raahima Khatun-E-Zannat, University of Colorado Denver, United States; Oleksiy Agapitov, University of California Berkeley, United States; Ashanthi Maxworth, University of Southern Maine, United States; Poorya Hosseini, Johns Hopkins University Applied Physics Laboratory, United States

H4.3 **13:50**
Statistical Analysis of Whistler Wave Ducting Events
Daniel Williams, Anatoly V. Streltsov, Embry-Riddle Aeronautical University, United States

H4.4 **14:10**
Chorus and Hiss Spatial Scales in the Inner Magnetosphere: Statistics From Van Allen Proves Multi-Point Measurements
Oleksiy Agapitov, John Bonnell, UC BERKELEY, United States; Didier Mourenas, CEA, France; Anton Artemyev, UCLA, United States; Aaron Breneman, NASA Goddard Space Flight Center, United States; John Wygant, University of Minnesota, United States; George Hospodarsky, University of Iowa, United States

H4.5 **14:30**
Whistler Mode Chirped-Solitons as the Building Blocks of Chorus
Chris Crabtree, Gurudas Ganguli, Rualdo Soto, Luke Johnson, United States Naval Research Laboratory, United States; Sagada Penano, Syntek Technologies, United States

Break **14:50**

H4.6 **15:10**
On a transitional regime of electron resonant interaction with whistler-mode waves in inhomogeneous space plasma
Anton Artemyev, UCLA, United States

H4.7 **15:30**
2-Dimensional PIC simulations of Generation of Whistler waves by Nonlinear induced scattering
Rualdo SotoChavez, Chris Crabtree, Guru Ganguli, Alex Fletcher, US Naval Research Laboratory, United States

H4.8 **15:50**
Origin of Ultra-Low Frequency Waves Observed at Middle Latitudes During Substorms
Mergen Alimaganbetov, Anatoly V. Streltsov, Embry-Riddle Aeronautical University, United States

H4.9 **16:10**
ULF Waves and Currents in the Feedback Interactions between the Magnetosphere and Ionosphere near the Plasmapause
Anatoly V. Streltsov, Mergen Alimaganbetov, Embry-Riddle Aeronautical University, United States; Evgeny Mishin, USSF AFMC AFRL, United States

H4.10 **16:30**
Statistics of LF-MF auroral radio emissions observed at South Pole Station in 2020
James LaBelle, Dartmouth College, United States

H4.11 **16:50**
Simulations of energetic electron acceleration in the low-latitude boundary layer of Earth's magnetosphere
Allison Jaynes, Sanjay Chepuri, University of Iowa, United States; Vijay Harid, Mark Golkowski, University of Colorado Denver, United States; Poorya Hosseini, Drew Turner, Ian Cohen, Barry Mauk, JHU/APL, United States; Daniel Baker, University of Colorado Boulder, United States; Joseph Fennell, Aerospace Corp., United States; Trevor Leonard, NOAA/ University of Colorado Boulder, United States

Friday, January 7 13:10 - 16:10
J7 Special Session 265

Imaging Black Holes: The EHT and Beyond II

Session Co-Chairs: Vincent Fish, MIT Haystack Observatory; James Moran, Harvard University

J7.1 **13:10**
The next-generation Event Horizon Telescope Project
Sheperd Doeleman, Center for Astrophysics | Harvard & Smithsonian, United States

J7.2 **13:30**
MultiFrequency VLBI
Gopal Narayanan, Neal Erickson, Sandra Bustmante, University of Massachusetts, Amherst, United States

J7.3 **13:50**
Next-Generation Simulations of (ng)EHT Sources
Charles Gammie, University of Illinois at Urbana-Champaign, United States

J7.4 **14:10**
Next-Generation Event Horizon Telescope Site Survey
Alexander Raymond, Smithsonian Astrophysical Observatory, United States

J7.5 **14:30**
ngEHT Instrumentation
Kari Haworth, Center for Astrophysics | Harvard & Smithsonian, United States

Break **14:50**

J7.6 **15:10**
The Final Frontier: Exploring Space to Further Extract Science from Black Hole Images
Katherine Bouman, California Institute of Technology, United States

J7.7 **15:30**
Black Hole Shadows and Photon Rings: Science Opportunities for Space-VLBI
Michael Johnson, Center for Astrophysics | Harvard & Smithsonian, United States

J7.8 **15:50**
Beyond the One Ring: Detecting and Interpreting Photons Rings in M87
Avery Broderick, Perimeter Institute for Theoretical Physics / University of Waterloo, Canada

Friday, January 7 13:10 - 15:30
B12 1B40

Structures and Circuits for RF Sensing, Radar and STAR Applications

Session Co-Chairs: Dejan Filipovic, University of Colorado at Boulder; Aly Fathy, University of Tennessee, Knoxville

B12.1 **13:10**
Ultra-sensitive Radio-Frequency Sensors Enabled by Coherent Perfect Absorber-Laser
Minye Yang, Zhilu Ye, Pai-yen Chen, University of Illinois at Chicago, United States

B12.2 **13:30**
Design and Fabrication of High Performance, Low Profile Air-Filled Coaxial Diplexers Enabled by 3D Printing
Jake Cazden, Ljubodrag Boskovic, Isaiah Pisani, Dejan Filipovic, University of Colorado at Boulder, United States; Thomas Hand, Erik Lier, William Kefauver, Lockheed Martin Space Systems, United States

B12.3 **13:50**
1 GHz Coupling Suppression Circuit for Simultaneous Transmit and Receive System
Md Nurul Anwar Tarek, Anthony Nuñez, Elias Alwan, Florida International University, United States

B12.4 **14:10**
Equidistant Multi-Subject Vital-Sign Detection Using FMCW MIMO Radar
Abdel-Kareem Moadi, Marvin Joshi, Aly Fathy, University of Tennessee, Knoxville, United States

B12.5 **14:30**
Spatial Power Combining of Two GaN FET Grid Oscillators in an Over-Moded Rectangular Cavity
Jack Molles, Megan Robinson, Zoya Popovic, University of Colorado Boulder, United States

Break **14:50**

B12.6 **15:10**
Modeling and measurement of co-planar waveguide spin-wave transducers
David Connelly, Hadrian Renaldo O. Aquino, Maxwell Robbins, Gary H. Bernstein, Alexei Orlov, Wolfgang Porod, Jonathan Chisum, University of Notre Dame, United States; Gyorgy Csaba, Pazmany Peter Catholic University, United States

Author Index

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z