



## Commission GASS 2023 Report

### Commission E

#### 1. Elections of Commission Officers

There were four available candidates for the position of Vice Chair: Dr. Chaouki Kasmi (France), Prof. Yasuhide Hobara (Japan), Dr. Suraya Mubeen (India) and Dr. Andrew S. Podgorski (Poland). The vote was cast online and the results transmitted by the URSI board. Dr. Chaouki Kasmi was declared elected as the Vice Chair of Commission E for the upcoming triennium.

For the position of second Early Career Representative, three candidates were available: Dr. Flávio Miguel da Silva Jorge (Portugal), Dr. Fernando Albarracin (Colombia), Dr. Islem Yahi (France). The vote was also cast online and Dr. Flávio Miguel da Silva Jorge was declared elected as the second Early Career Representative of Commission E for the upcoming triennium.

The Early Career Representative of the last triennium, Prof. Riccardo Trincherro, agreed to also serve as Early Career Representative for the upcoming triennium.

#### 2. Review of Terms of Reference

The current Terms of Reference are as follows:

*Commission E promotes research and development in:*

- *Terrestrial and planetary noise of natural origin, seismic-associated electromagnetic fields;*
- *Man-made electromagnetic environment;*
- *The composite noise environment;*
- *The effects of noise on system performance;*
- *The effects of natural and intentional emissions on equipment performance;*
- *The scientific basis of noise and interference control, electromagnetic compatibility;*
- *Spectrum management.*

However, during the commission meetings in GASS 2021 (Rome), several members expressed their mixed feeling about these terms. The terms chosen, although they basically contain the main aspects of Commission E, are not very contemporary and may not be very attractive and meaningful to new generations of researchers. We have therefore asked the Technical Advisory Committee to work on updating these terms, taking into account the suggestions made during the commission E meetings.

The work group dedicated to the formulation of the new Terms of Reference agreed on what the following text.

*The Commission deals with the study, modelling and characterization of:*

- *electromagnetic noise of natural origin;*
- *man-made electromagnetic noise, both intentional and unintentional;*
- *complex electromagnetic systems and environment;*

*by using measurement, deterministic, statistical, stochastic and machine learning techniques. Further, the Commission promotes research and development in:*

- *the effects of noise on system performance;*
- *electromagnetic eavesdropping and EM cybersecurity;*
- *hardware and software techniques for the suppression and mitigation of*



- electromagnetic interference;*
- *the scientific basis, standardization and metrology of electromagnetic compatibility;*
- *the efficient use and management of radiofrequency spectrum.*
- 

### 3. Any changes/confirmation in Working Groups and other organizations

The subject of Electromagnetic Environment and Interference is of concern within many disciplines of Radio Science. This is reflected in a number of working groups with focus on particular topics. These are outlined below with the names of contact persons and, where available, a brief description of the relevant topics. The scope of working groups is the study of particular scientific subjects. Typical activities of the working groups include the organization of sessions for various conferences, workshops, and meetings.

A number of Working Groups have been established to provide focus on a number of activities relevant to the topics of Commission E. These are outlined below, together with the relevant contact persons.

#### 3.1. E1. Terrestrial and Planetary Electromagnetic Noise Environment

Co-Chairs: C. Price (Israel), Y. Hobara (Japan), A.P. Nickolaenko (Ukraine), and K. Hattori (Japan)

This WG deals with the study on the characteristics of natural electromagnetic noise taking place not only in the terrestrial, but also in the planetary environment. The most well-known EM noise is the atmospheric radio noise from the lightning discharges (so-called sferics in a wide frequency range from DC to VHF). Some examples of topical subjects on sferics are (1) monitoring of global lightning activity as studied by high frequency noise and Shumann resonance phenomena in the ELF band and (2) ELF transients related with the optical emissions in the mesosphere due to the lightning. Higher frequency lightning emission provides us with the information on the fine structure of lightning electrical structure, while lower frequency noise provides us with the macroscopic nature of lightning. The noise coming from the ionosphere/magnetosphere will be discussed as well; micro pulsations in the ULF range, VLF/ELF emissions and HF emissions due to the plasma instabilities in the space. The radio noise environment on other planets is also of interest to this group. We are particularly interested in using natural EM observations in monitoring, detecting and forecasting natural hazards, such as thunderstorms, severe weather, space weather and seismic events.

Contacts: [cgprice@gmail.com](mailto:cgprice@gmail.com), [hobara@ee.uec.ac.jp](mailto:hobara@ee.uec.ac.jp), [hattori@earth.s.chiba-u.ac.jp](mailto:hattori@earth.s.chiba-u.ac.jp), [sashanickolaenko@gmail.com](mailto:sashanickolaenko@gmail.com)

#### 3.2. E2. Intentional Electromagnetic Interference

Co-Chairs: Richard Hoad (UK) and W. Radasky (US)

This WG studies the area of intentional electromagnetic interference (IEMI), which is defined by the IEC as the “Intentional malicious generation of electromagnetic energy introducing noise or signals into electric and electronic systems, thus disrupting, confusing or damaging these systems for terrorist or criminal purposes.”

Aspects of these studies include:

the electromagnetic threat weapons and their characteristics, the coupling to electronic systems through both radiated and conducted transients, the vulnerability of equipment and systems including jamming, denial of service, upset and damage, the use of detectors to recognize and to mitigate attacks, and the protection of equipment and systems.

Contacts: [rhead@qinetiq.com](mailto:rhead@qinetiq.com), [wradasky@aol.com](mailto:wradasky@aol.com)



### 3.3. E3. High Power Electromagnetics

Co-Chairs: R.L. Gardner (U.S.A) and F. Sabath (Germany)

The objective is to encourage research in high power electromagnetics (HPE). The technical area of HPE consists of the physics and engineering associated with electromagnetic sources where nonlinear effects associated with high-field regions (and air breakdown) must be included in the analysis and design. This includes (but is not limited to) EMP simulators, high-power narrowband and meso-band sources and antennas, and hyperband (impulse) sources and antennas. It also includes the environment near lightning channels and in nuclear EMP source regions. In some cases it includes the high field regions on, or in targets because of local field enhancement.

Contacts: [Robert.Gardner@GTRI.GaTech.edu](mailto:Robert.Gardner@GTRI.GaTech.edu), [Frank.Sabath@t-online.de](mailto:Frank.Sabath@t-online.de)

### 3.4. E4. Lightning Discharges and Related Phenomena

Chair: V. A. Rakov (USA) and T. Morimoto (Japan)

The lightning discharge is one of the two natural sources of electromagnetic interference (EMI), the other one being the electrostatic discharge. Electric and magnetic fields generated by lightning represent a serious hazard to various systems, particularly those containing sensitive electronics. This WG focuses on the characterization of lightning and its interaction with engineering systems and with the environment, as well as on lightning detection and testing. It covers all aspects of lightning research, including observations, field and laboratory experiments, theoretical studies, and modeling.

Contacts: [rakov@ece.ufl.edu](mailto:rakov@ece.ufl.edu), [morimoto@ele.kindai.ac.jp](mailto:morimoto@ele.kindai.ac.jp)

### 3.5. E5. Interaction with, and Protection of, Complex Electronic Systems

Co-Chairs: I. Yahi (France), C. Kasmi (France) and R. Trinchero

This working group studies the various electronic and electromagnetic aspects related to the interaction with, and protection of, complex electronic systems. The focus is the analysis of the various coupling paths and their associated transfer functions into complex electronic systems, as formalized in the framework of electromagnetic topology. Analytical, numerical, and measurement techniques are used to characterize the electromagnetic fields and currents in a complex environment. In the analysis, special attention is placed on the emergence of new technologies, and the inclusion of advanced materials and communication systems.

Contacts: [islem.yahi@tii.ae](mailto:islem.yahi@tii.ae), [Chaouki.kasmi@tii.ae](mailto:Chaouki.kasmi@tii.ae), [riccardo.trinchero@polito.it](mailto:riccardo.trinchero@polito.it)

### 3.6. E6. Spectrum Management

Co-Chairs: J.P. Borrego (Portugal), Flavio Miguel da Silva Jorge (Portugal)

The E6 focus is on sound scientific spectrum management for improved utilization of the radio frequencies for protection wireless communications service and radio sciences. The goal is to assure further development of radio sciences and communication services, unobstructed by potential radio interference due to unwanted energy in the form of out-of-band and in-band encroaching and deleterious in-band and out-of-band emissions. The electromagnetic spectrum is treated as a limited natural resource with a multitude of competing demands for access to it and use of it. Spectrum management seeks innovative means and technologies for adequate co-existence of all of them taking into account the need of protection of new and incumbent wireless and wired communication services, systems and equipment, with special focus on science services and those that use passive technologies.



Contacts: [jose.borrego@anacom.pt](mailto:jose.borrego@anacom.pt), [Flavio.Jorge@ext.esa.int](mailto:Flavio.Jorge@ext.esa.int), [flaviojorge@ua.pt](mailto:flaviojorge@ua.pt)

### **3.7. E7. Electromagnetic Compatibility in Wired and Wireless Systems**

Co-Chairs: F. Rachidi (Switzerland), V. Deniau (France) and F. Gronwald (Germany)

The intensive use of the electromagnetic spectrum for communications has resulted in issues of compatibility and interoperability between different users. In addition the continual increase in operating frequency of products and higher frequency sources of disturbances (such as Ultra-Wide Band systems) resulted in an increase of potential EMC problems in communication systems and the use of power lines for carrying data is adding to interference problems. Potential remedies are also addressed.

Contacts: [farhad.rachidi@epfl.ch](mailto:farhad.rachidi@epfl.ch), [frank.gronwald@uni-siegen.de](mailto:frank.gronwald@uni-siegen.de), [virginie.deniau@univ-eiffel.fr](mailto:virginie.deniau@univ-eiffel.fr),

### **3.8. E8 Stochastic Techniques in EMC**

Co-Chairs: L. Arnaut (UK), S. Pignari (Italy), and R. Serra (Netherlands)

Commission E: Joint Working groups

Contacts: [l.arnaut@gmul.ac.uk](mailto:l.arnaut@gmul.ac.uk), [luk.arnaut@nottingham.ac.uk](mailto:luk.arnaut@nottingham.ac.uk), [sergio.pignari@polimi.it](mailto:sergio.pignari@polimi.it), [r.serra@tue.nl](mailto:r.serra@tue.nl)

### **3.9. EB Chaos and Complexity in EM**

Co-Chairs: G. Gradoni (UK), and A. Sihvola (Finland)

Wave complexity underpinned by fully developed, partial and transient chaos is becoming permanent in multi-component electromagnetic systems operating at electrically large scales. Statistical methods have been developed to tackle those systems and their specific engineering structures occurring in electromagnetic compatibility, electronics circuits as complex sources of radiated emissions, wireless communications including massive MIMO systems, etc. Recent studies in wave chaos have attracted researchers in electromagnetic theory and universal statistical properties have been used to study large electromagnetic systems without solving the full-wave problem. Hybrid methods combining full wave algorithms with newborn statistical methods are emerging in the EM wave modeling arena. System specific components need detailed treatment while deformed and irregular parts of EM environments can be treated statistically because of their mixing behavior. Furthermore, statistical sources can be treated through semi-classical as well as random matrix theories. Novel theoretical models have been developed describing fields through complicated electromagnetic environments – including electromagnetic reverberation chambers - also accounting for coupling through apertures and including losses at both microwave and mmWave regimes, as well as complex placement of wires and cables within EM environments. Uncertainties arising within cabling and radiating systems can be described through the polynomial chaos method.

Contacts: [Gabriele.Gradoni@nottingham.ac.uk](mailto:Gabriele.Gradoni@nottingham.ac.uk), [ari.sihvola@aalto.fi](mailto:ari.sihvola@aalto.fi)

### **3.10. EHG Solar Power Satellite**

Chair: H. Matsumoto (Japan), Co-Chair for Commission E: J. Gavan (Israel), Co-Chair for Commission H: K. Hashimoto (Japan)

Contacts: [gavan@hit.ac.il](mailto:gavan@hit.ac.il)

### **3.11. GEH Seismo Electromagnetics (Lithosphere-Atmosphere-**



### **Ionosphere Coupling)**

Co-Chair for Commission G: S. Pulinets (Russia), Co-Chair for Commission E: M. Y. Hobara (Japan), Co-Chair for Commission H: H.Rothkaehl (Poland)

Contacts: [pulse@rssi.ru](mailto:pulse@rssi.ru), [hobara@ee.uec.ac.jp](mailto:hobara@ee.uec.ac.jp)

### **3.12.GJFEH Interdisciplinary Space Weather**

Co-Chair for G: I. Stanislawska (Poland), Co-Chair for J: R. Fallows (Netherlands)

Contacts: [fallows@astron.nl](mailto:fallows@astron.nl)

### **3.13.URSI/IAGA VLF/ELF Remote Sensing of the Ionosphere and Magnetosphere (VERSIM)**

Chair for URSI (Commissions E,G,H): M. Clilverd (UK), IAGA Chair: J. Bortnik (USA)

Contacts: [jbortnik@gmail.com](mailto:jbortnik@gmail.com),

## **4. Technical Advisory Committee**

The major role of the Technical Advisory Committee (TAC) of Commission E is supposed to advise Commission Officers on essential issues relevant to the Commission, to help make up scientific programs of URSI flagship conferences, to promote contributions to the flagship conferences, and to help review the contributed papers.

Several Commission E members volunteered to contribute to the previously constituted TAC, which is now composed by the following colleagues:

Philippe Besnier France - [philippe.besnier@insa-rennes.fr](mailto:philippe.besnier@insa-rennes.fr)

Luk Arnaut (United Kingdom) - [l.arnaut@qmul.ac.uk](mailto:l.arnaut@qmul.ac.uk)

Gabriele Gradoni (United Kingdom) - [Gabriele.Gradoni@nottingham.ac.uk](mailto:Gabriele.Gradoni@nottingham.ac.uk)

Jose Borego (Portugal) - [jose.borrego@anacom.pt](mailto:jose.borrego@anacom.pt)

Sergio Pignari (Italy) - [sergio.pignari@polimi.it](mailto:sergio.pignari@polimi.it)

Frank Gronwald (Germany) - [frank.gronwald@uni-siegen.de](mailto:frank.gronwald@uni-siegen.de)

Yasuhide Hobara (Japan) - [hobara@ee.uec.ac.jp](mailto:hobara@ee.uec.ac.jp)

Virginie Deniau (France) - [virginie.deniau@univ-eiffel.fr](mailto:virginie.deniau@univ-eiffel.fr)

Felix Vega (United Arab Emirates) - [felix.vega@tii.ae](mailto:felix.vega@tii.ae)

## **5. Preparation of Future Meetings/Identification of meetings to be supported (cfr. Commission budget)**

Commission E will support the following meetings in the current triennium:

- Fourth URSI Atlantic Radio Science Conference (URSI AT-RASC), May 19<sup>th</sup> – 26<sup>th</sup>, 2024, to be held in the ExpoMeloneras Convention Centre, Gran Canaria, Spain.
- 2025 URSI Asia-Pacific Radio Science Conference (AP-RASC 2025), August 2025, Sydney, Australia
- XXXVI URSI General Assembly and Scientific Symposium (URSI GASS), August 15<sup>th</sup> – 22<sup>nd</sup> 2026, Krakow, Poland.

## **6. Proposed sessions and conveners for AT-RASC 2024**

It is proposed to use the following structure as a basis for the next AT-RASC 2024. Of course, the short courses, tutorials, and workshops will be updated according to current topics of interest. Proposed sessions and conveners, at the time of writing, then include the following:



## **6.1. Sessions of Commission E only**

E01: EMC Analytical, Numerical and Machine Learning Modeling in complex systems (Riccardo Trincherò, Christophe Guiffaut, Chaouki Kasmi)

E02: EMC Measurement techniques (Carlo Carobbi, Ramiro Serra)

E03: Stochastic/Statistical Techniques in EMC (Luk Arnaut, Sebastien Lalléchère, Chaouki Kasmi, Sergio Pignari)

E04: HPEM, Intentional EMI (Felix Vega, Nicolas Mora)

E05: EMC and EMI in Wired and Wireless Communications (Virginie Deniau, Frank Gronwald)

E06: Time Reversal in Electromagnetics (Sebastiene Lallechere, Farhad Rachidi, Marcos Rubinstein)

E07: Lightning and related phenomena (Farhad Rachidi, Marcos Rubinstein, Takeshi Morimoto)

E08: Electromagnetic interference at PCB, package, and chip level: Signal and Power Integrity (Francesco de Paulis, Riccardo Trincherò)

E09: Open session (Chaouki Kasmi, Carlo Carobbi)

## **6.2. Joined Sessions organized by Commission E:**

EAB1: Wave Chaos of Complex Systems (Gabriele Gradoni, Steve Anlage, Luca Bastianelli)  
EACFJ1: Spectrum management and Utilization (José Pedro Borrego, Flavio Miguel da Silva Jorge)

EBC1: Wave modelling of novel wireless systems (Gabriele Gradoni, Luca Bastianelli)

EC: EM Security of Cyber-physical systems and Wireless Technologies (Yuichi Hayashi, Chaouki Kasmi, Virginie Deniau)

EFGH1: Natural Electromagnetic Noise and Radio Sensing Applications in Terrestrial Planetary Environments (Yasuhide Hobara, Colin Price, Martin Fullekrug, Tomoo Ushio)

EJGF1: Machine learning and signal processing to analyze and mitigate EMI (Virginie Deniau, Riccardo Trincherò, Kevin Vinsen, Kaushal Bush, Hariharan Krishnan, Paolo de Matthaëis)