



Commission A Triennial Report 2021-2023

Prof. Nuno Borges Carvalho

Chair Commission A

Terms of Reference

The current Terms of Reference for Commission A (Electromagnetic Metrology) result from the revision made at the commission Business Meeting during the GASS2021. The Terms of Reference are intended to include broader areas related to the science of measurements for various electromagnetic research fields. The following is the current Terms of Reference.

The commission promotes research and development of the field of measurement standards and physical constants, calibration and measurement methodologies, improved quantification of accuracy, traceability, and uncertainty. Areas of emphasis are:

- the development and refinement of new measurement techniques and calibration standards, including techniques for antennas;
- primary standards, including those based on quantum phenomena, and the realization and dissemination of time and frequency standards;
- characterization of the electromagnetic properties of materials, physical constants, and the properties of engineered materials, including nanotechnology;
- methodology of space metrology and electromagnetic dosimetry, and measurements for health diagnostics, applications, and biotechnology, including bio-sensing;
- measurement in advanced communication systems and other applications.

The commission fosters accurate and consistent measurements needed to support research, development, and exploitation of electromagnetic technologies across the spectrum and for all Commissions.

Individual reports from national commissions:

Several National Commission A committees reported the following activities:

- EuMW 2021 CSs on 'Measurements for 5G and 6G Systems' and 'Advances in mmWave Antennas'



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- Revision of IEEE 1720 antenna on 'OTA Testing' and 'Facility comparison campaign' (2022 - present)
 - Three-year EURAMET project (Oct. 2022 – Sept. 2025) on 'Metrology for Emerging Wireless Standards'
 - AMTA 2023 (Oct. 2023) CS on 'Recent European activities on antenna measurements (EurAAP/EuCAP CS)'
 - 2022.10.01 - Launching the METROLOGIA EM website (UNDER CONSTRUCTION) <https://em-metrology.pl>. The website contains information on:
 - Scientific and organizational activity of the Commission A URSI – Poland.
 - Links to related scientific publications and conference presentations.
 - Tutorials describing the applied research methods related to electromagnetic metrology, those used to determine the quality parameters of soil and materials of agricultural origin.
 - 12-14.09.2022 – International Conference MIKON 2022, Gdansk, Poland
 - 14.09.2022 Plenary lecture by Dr. Arkadiusz Lewandowski (Vice-Chair of Commission A – Electromagnetic Metrology of URSI-Poland; "Advances in soil moisture measurements with the use of microwave techniques".
 - 17.05.2022 – Scientific Seminar under patronage of the Chair of Commission A of URSI-Poland
 - Wojciech Skierucha – welcome speech and information about URSI.
 - Lecture "Soil Water (Moisture) Content: Measurement Principles, State of the Art and Future Opportunities" by Prof. Scott B. Jones, Utah State University, Logan, USA.
 - 25.04.2022 – online meeting of PKLN URSI.
 - At the invitation of the chairman of URSI-Poland, Prof. Józef Modelski, the chairman of Commission A, prof. Wojciech Skierucha gave a lecture entitled "Electromagnetic metrology in agriculture", which presented:
 - Results of the study of broadband (10 kHz – 20 GHz) electrical properties of multiphase materials (eg. soil and agricultural materials for further processing and storage) and the influence of the electromagnetic field on the germination and development of plants.
 - Methodology of broadband measurement of electrical and physicochemical properties of tested materials.
 - Construction and calibration of used sensors and meters working in the techniques of TDR – time domain reflectometry and FDR – frequency domain reflectometry.
 - Effects of the implementation of scientific research in the monitoring of water content in soil and agricultural materials.
 - 14.04.2022 – participation in the on-line meeting of the International Commission A – Electromagnetic Metrology, chaired by the chairman of the Commission A, Prof. Nuno Borges



- Carvalho (Portugal). Topics covered:
- Participation in the 3rd URSI Atlantic / Asia-Pacific Radio Science Meeting – 2022, 29 May – 3 June 2022, Gran Canaria, Spain.
 - Tutorials on broadband electromagnetic measurements, e.g. using VNAs. Vice-Chairman of Commission A, Dr. Amitava Sen-Gupta from India appealed to participants to provide links to free information materials).
- 15-16.11.2021 : 13th International Conference on Agrophysics: Agriculture in Changing Climate (ICA 2021), Lublin, - honorary patronage of the National Committee of URSI Poland (150 participants, 70 foreign guests from 30 countries)
 - Session: Climate and Agriculture, Chairs – Prof. Taro Palosou, Prof. Zuzana Hlaváčová, Prof. Scott Jones, 16.11.2021, 12:45 – 17:05
 - Z. Hlaváčová, P. Hlaváč, E. Ivanišová. 2021. Food electrical properties investigation and application. Keynote lecture.
 - S.B. Jones, W. Sheng. 2021. Quality assessment needs for soil water content sensors. Keynote lecture.
 - 30.09.2021; International Workshop on Dielectric Measurements and Moisture Sensing, IA PAN Lublin.
 - Organizational patronage of the Chairman of Commission A – URSI Polska
 - participants: Multiwave Technologies, Marseille, France; Institute Fresnel, Marseille, France; AGH University of Science and Technology; Warsaw University of Technology, Tespol Engineering; Bydgoszcz University of Technology; Lublin University of Technology; University of Life Sciences in Wroclaw; Institute of Agrophysics PAS in Lublin,
 - 9 oral presentations, presentation of soil moisture measurement equipment, public discussion.
 - 09-11.06.2021; Scientific Workshops Broadband dielectric spectroscopy in agricultural applications, IA PAN Lublin.
 - organizational patronage of the Chairman of the Commission A of URSI – Poland,
 - 7 oral presentations, presentation of soil moisture measurement equipment, public discussion.
 - The CSIR-NPL is India's "National Measurement Institute" (NMI) and is the custodian of "National Standards", by an act of Parliament, with a responsibility of the dissemination of measurements to the needs of the country apart from being a premier research laboratory for the fundamental and emerging field of Physical Sciences.

NPLI is actively involved all major areas of Time & Frequency metrology. Realization and dissemination of Indian Standard Time (IST) is one the main mandate. CSIR-NPL has established a 'Primary Timescale' and a 'Backup timescale' for generating UTC (NPLI), which is kept traceable (using ultra-precise satellite links) to the Coordinated Universal Time (UTC) provided by International Bureau of Weights and Measurers (BIPM) located in Sevres, France. The IST (i.e. UTC (NPLI) plus 5:30 hours), generated using a bank of caesium clocks and hydrogen masers, is traceable to UTC within few (<5) nanoseconds. The dissemination of IST is done through satellite and internet (NTP) at present. CSIR-NPL has been providing IST traceability to ISRO via satellite



links (CVGNSS and TWSTFT). Strengthening of timescales and evolution of time dissemination methods is a continuous activity at CSIR-NPL.

Another major activity is R&D on atomic clocks. India's first Cs fountain primary frequency standard, with an accuracy of a few parts in 10⁻¹⁵, was developed at CSIR-NPL. The fountain was successfully compared with fountains from PTB Germany, SU Russia and NIM China and was approved as a Primary Frequency Standard (PFS) by BIPM in 2015. During the last couple of years, efforts have been put to make NPLI-CsF1 operational. It is expected to start contributing to UTC within one year. Apart from NPLI-CsF1, second Cesium fountain clock and single trapped Ytterbium ion based optical clock are also under development at NPLI.

Another activity at CSIR-NPL towards the realization of RF E- field strength measurement, by utilizing the characteristics of Rydberg alkali atoms, is also being pursued. This technique relies on various quantum phenomena like Electromagnetically Induced Transparency (EIT) and Autler-Townes Splitting (ATS), which are observed in Rydberg alkali atoms under the continuous exposure of laser and RF fields. Apart from regular calibration and testing, some R&D is also being done in the area of Magnetic Metrology.

For more information, please visit:

<https://www.nplindia.org/index.php/science-technology/indian-standard-time-metrology-division/>

- ISRO Telemetry, Tracking and Command Network (ISTRAC), Bengaluru

Major responsibility of ISTRAC-ISRO is to provide tracking support for all the satellite and launch vehicle missions of ISRO. The major objectives of the centre are: carrying out mission operations of all operational remote sensing and scientific satellites, providing Telemetry, Tracking and Command (TTC) services from launch vehicle lift-off till injection of satellite into orbit and to estimate its preliminary orbit in space and hardware and software developmental activities that enhance the capabilities of ISTRAC for providing flawless TTC and Mission Operations services. Towards, these objectives, ISTRAC has established a network of ground stations at Bengaluru, Lucknow, Mauritius, Sriharikota, Port Blair, Thiruvananthapuram, Brunei, Biak (Indonesia) and the Deep Space Network Stations. Time synchronization among these ground stations is done using atomic clocks.

For more details, please visit: <https://www.isro.gov.in/about-isro/isro-telemetry-tracking-and-command-network-istrac>

- National Atmospheric Research Laboratory (NARL), Tirupati

National Atmospheric Research Laboratory (NARL) at Gadanki near Tirupati, an autonomous society supported by DOS, is a centre for atmospheric research. It is engaged in studies of various atmospheric, weather and climate processes through ground and space based remote



and in situ sensing by means of radio, optical and sound waves. Atmospheric radars in HF, VHF and L bands, Lidars in UV, VIS/NIR bands and a sodar are routinely operated along with various in-situ measuring instruments. A high power 53 MHz Mesosphere-Stratosphere-Troposphere (MST) Radar was established here in 1992 as a national facility for atmospheric research.

NARL has now become one of the prime centers for atmospheric research in the country and operates a state-of-the-art MST radar, Rayleigh/ Mie Lidar, Boundary Layer Lidar, Sodium Lidar, Lower Atmospheric Wind Profiler, Sodar, Disdrometer, Optical Rain Gauge, GNSS-NavIC receiver, Automatic Weather Station apart from regular launching of the GPS Radiosonde.

For more details, please visit: <https://www.narl.gov.in/>

- National Centre for Radio Astrophysics (NCRA), Pune

NCRA is a research institution in the field of radio astronomy is located in the Pune University Campus, is part of the Tata Institute of Fundamental Research (TIFR), Mumbai, India. NCRA has an active research program in many areas of Astronomy and Astrophysics, which includes studies of the Sun, Interplanetary scintillations, pulsars, the Interstellar medium, Active galaxies and cosmology and particularly in the specialized field of Radio Astronomy and Radio instrumentation. NCRA has set up a unique facility for radio astronomical research using the metre wavelengths range of the radio spectrum, known as the Giant Metrewave Radio Telescope (GMRT), it is located at a site about 80 km north of Pune. GMRT consists of 30 fully steerable gigantic parabolic dishes of 45m diameter each spread over distances of upto 25 km. GMRT is one of the most challenging experimental programmes in basic sciences undertaken by Indian scientists and engineers.

The Radio Astronomy Centre (RAC) is part of the NCRA which provides stimulating environment for the front-line research in radio astronomy and astrophysics. The Ooty Radio Telescope (ORT, as it is known) is a cylindrical paraboloid of reflecting surface, 530 m long and 30 m wide, placed on a hill whose slope of about 11 degree in the north-south direction which is the same as the latitude of the location of ORT. This makes it possible to track celestial objects for about 10 hours continuously from their rising in east to their setting in the west by simply rotating the antenna mechanically along its long axis.

The Square Kilometre Array (SKA), the next generation radio telescope, is a truly international telescope, with India being one of the member countries in the SKA Organisation and hence involved in the design and operation of SKA-I. The SKA will be roughly contemporaneous with other international facilities like Large Synoptic Survey Telescope (LSST), Thirty Meter Telescope (TMT) etc. in optical/IR bands.

For more information, please visit: <http://www.ncra.tifr.res.in/ncra/main>

- V International Scientific and Technical Conference "Metrology of Physical and chemical measurements", September 14-16, 2021
- XII All-Russian Scientific and Technical Conference "Metrology in Radio Electronics", September 21-23, 2021



- X International Symposium "Metrology of Time and Space", October 6-8, 2021
- 8th International Conference on Advances in Metrology (AdMet-2022) was held at CSIR-NPL during 22-25 August 2022 (included talks on Comm A areas)
- National University of Sciences and Technology (NUST), Islamabad, Pakistan

The National University of Sciences & Technology (NUST) is number one science and technology university in Pakistan. Following Com. A related activities were conducted at NUST, Islamabad:

- Workshop on Electromagnetic Compatibility and Interference (EMC/I): NUST School of Electrical Engineering and Computer Science (SEECs) has organized a one-day workshop on electromagnetic compatibility and interference (EMC/I) on 21st September 2022 at NUST H-12 Campus, Islamabad, Pakistan.
- Student Workshop on Doherty Power Amplifier Design: A two days student workshop on power amplifier design was held at NUST H-12 Campus, Islamabad on 27-28 Dec 2021. The focus of the talk was to highlight the design concepts of power amplifier used in wireless communication systems.
- 1st International Conference on Microwave, Antennas & Circuits (ICMAC 2021): The First International Conference on Microwave, Antennas & Circuits (ICMAC 2021) was held at NUST, Islamabad on Dec 21-22, 2021.

1. Publications made by Members of Commission A

1. 12.09.2022 Poster by Dr. Kamil Staszek (Vicechair-Junior of Commission A – Electromagnetic Metrology of URSI-Poland); "Calibration of a Six-Port-Based CW Radar Using Unknown Positions of a Target".
2. 13.09.2022 Poster by Agnieszka Szyplowska, Arkadiusz Lewandowski, Marcin Kafarski, Andrzej Wilczek, Jacek Majcher, Wojciech Skierucha; „Measurement of Soil Dielectric Permittivity Spectra at Various Temperatures”.
3. Book published on Metrology – T. H. Loh (Editor), Metrology for 5G and Emerging Wireless Technologies, The Institution of Engineering and Technology, 17 Dec. 2021.
4. N. Poudel, T. Bhardwaj, P. Arora, A. Gupta and D. K. Aswal, "Indian Standard Time dissemination over internet via indigenously designed devices and applications", MAPAN-Journal of Met. Soc. of India, 36 (4), 711 (2021)
5. A. Acharya, P. Arora, S. Yadav and A. Sen Gupta, "Detection, Acquisition and Processing of Fluorescence from Cold atoms in Cesium Fountain Primary Frequency Standard at NPL, India", MAPAN-Journal of Metrology Society of India 35(4), 521 (2020)
6. Bharath Vattikonda, Manoj Das, Trilok Bhardwaj, Subhasis Panja, Poonam Arora, Anurag Gupta and D.



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- K. Aswal, "Part 1 - Time & Frequency Metrology: Realization and Dissemination of Indian Standard Time", Metrology for Inclusive Growth of India, Ed. D. K. Aswal, Springer Nature, ISBN 978-981-15-8871-6 (2020)
7. Bharath Vattikonda, Manoj Das, Trilok Bhardwaj, Subhasis Panja, Poonam Arora, Anurag Gupta and D. K. Aswal, "Part 2 - Time & Frequency Metrology: Realization and Dissemination of Indian Standard Time", Metrology for Inclusive Growth of India, Ed. D. K. Aswal, Springer Nature, ISBN 978-981-15-8871-6 (2020)
8. Poonam Arora and Amitava Sen Gupta, "Time & Frequency Metrology", Handbook of Metrology and Applications, Ed. D. K. Aswal et. al., Springer Nature, DOI: <https://doi.org/10.1007/978-981-19-1550-5> (2023)
9. Poonam Arora and Amitava Sen Gupta, "Atomic Frequency Standards", Handbook of Metrology and Applications, Ed. D. K. Aswal et. al., Springer Nature, DOI: <https://doi.org/10.1007/978-981-19-1550-5> (2023)
10. Koudelny A.V., Malay I.M., Matveev A.I., Perepelkin V.A., Chirkov I.P. Development of a complex of equipment for measuring the power of electromagnetic oscillations of the highest accuracy in the frequency range from 78.33 to 11.10 GHz // Almanac of modern Metrology. 2021. No. 2 (26). pp. 25-36
11. Chirkov I.P. Promising developments in the field of electromagnetic vibration power measurements // Metrology in radio electronics. Materials of the XII All-Russian Scientific and Technical Conference, Mendeleevo, September 21-23, 2021, pp. 49-51
12. Koudelny A.V., Malay I.M., Perepelkin V.A., Chirkov I.P. Investigation of a waveguide microcalorimetric comparator for the frequency range 75.0 - 118.1 GHz // Metrology in radio electronics. Materials of the XII All-Russian Scientific and Technical Conference, Mendeleevo, September 21-23, 2021, pp. 181-186
13. Koudelny A.V., Malay I.M., Perepelkin V.A., Chirkov I.P. Bolometric semiconductor microwave power converters of millimeter wavelength range // Metrology in radio electronics. Materials of the XII All-Russian Scientific and Technical Conference, Mendeleevo, September 21-23, 2021, pp. 187 -192
14. Matveev A.I., Perepelkin V.A., Chirkov I.P. Investigation of waveguide multi-probe wattmeters of terminal type in the frequency range from 16.70 to 37.5 GHz // Metrology in radio electronics. Materials of the XII All-Russian Scientific and Technical Conference, Mendeleevo, September 21-23, 2021, pp. 213-222
15. V. Koudelny, I.M. Malay, A.I. Matveev, V.A. Perepelkin, I.P. Chirkov. The state primary standard of the unit of power of electromagnetic oscillations in the frequency range 37.5-118.1 GHz GET 167-2021 // Measuring equipment. 2022. No. 6. pp. 3-8
16. Chirkov I.P., Borovkov A.S., Semenov V.A. Computer program "Determination of the measurement error of the module of the effective reflection coefficient of the output of a flow-through wattmeter"// Registration number (certificate): 2022663096. Registration date: 11.07.2022
17. Russer, J.A., Baev, A., Haider, M., Kuznetsov, Y., Russer, P. Identification of Cycle Frequencies for Correlation Analysis of Cyclostationary Noisy EM Fields // 2021 15th International Conference on Advanced Technologies, Systems and Services in



Telecommunications, TELSIKS 2021 – Proceedings. - P. 163-166. DOI:
10.1109/TELSIKS52058.2021.9606412

18. Balzovsky E.V., Buyanov Yu. I. and Koshelev V.I. Ultrawideband antenna arrays based on planar combined antennas for the frequency of 3.1–10.6 GHz // Journal of Physics: Conference Series. – 2021. – V. 1843. – P. 012003. DOI: 10.1088/1742-6596/1843/1/012003

19. Key CCEM comparison.RF-K27.W of radio frequency power from 50 to 75 GHz in a rectangular waveguide/ Electromagnetic Wave Metrology Group // January 2023 - Metrologia 60(1A):01001 -DOI: 10.1088/0026-1394/60/ 1A/01001

20. Anyutin, N.V. Electromagnetic Field Transformation from a Surface Closed Around the Antenna to its Aperture. Meas Tech 64, 51–59 (2021). <https://doi.org/10.1007/s11018-021-01895-4>

21. M. A. Zenchenko, A. M. Kaverin and A. V. Kleopin, "Simulation and Generation of Navigation Signals with Normalized Distortions," 2021 IEEE East-West Design & Test Symposium (EWDTS), 2021, pp. 1-4, doi: 10.1109/EWDTS52692.2021.9581043

22. Lukyanov, V.I., Vasilyeva, M.V. Accounting for Nonuniformity of the Electromagnetic Field when Calibrating Thin Dipole and Loop Antennas in Four-Wire Sources. Meas Tech 64, 238–243 (2021). <https://doi.org/10.1007/s11018-021-01924-2>

23. Djigan V.I. Low complexity RLS adaptive filters // Proceedings of the 23-th International Conference on Digital Signal Processing and its Applications (DSPA-2022). Russian Academy of Science: The Institute of Control Problems, Moscow, Russia, March 30 – April 1, 2022. – Moscow, Russia. – 5 p.

24. Get 166-2020 State Primary Standard for the Frequency Deviation Unit

25. O. V. Kaminsky, A. V. Mylnikov, I. V. Mogilev & V. A. Tishenko // Measurement Techniques, 2022, Vol. 65, № 4, July, 2022, <https://link.springer.com/article/10.1007/s11018-022-02073-w>

26. Zenchenko M.A., Kleopin A.V., Makarov V.V., Selin L.N. A Coplanar Waveguide with a Gallium Arsenide Substrate for an Electro-Optic Sampling System with a Bandwidth over 110 GHz // Measurement Techniques, Vol. 65, No. 1, April, 2022, P. 70 -76, <https://doi.org/10.1007/s11018-022-02050-3>

27. Kleopin A.V., Zenchenko M.A. Tikhonov Regularization in Pulse Signal Processing for Oscilloscope Measurements// В сборнике: 2022 24th International Conference on Digital Signal Processing and its Applications, DSPA 2022. 24. <https://doi.org/10.1109/DSPA53304.2022.9790777>

28. Parinov S. T., Klezovich O. A., Smirnov A. A. GET 158-2029 State primary standard for the electric field strength unit within frequency range 0–20 kHz // Measurement Techniques, 2022, Vol. 65, № 4, July, 2022, <https://DOI 10.1007/s11018-022-02074-9>

29. Ozerov M.A., Titarenko A.V. Multidimensional Spatial Filtration for Improving Measurement Accuracy of Electrodynamics Characteristics of Antenna Radiation // Measurement Techniques, 2022, Vol. 64, No. 11, p. 912-921, <https://doi.org/10.1007/s11018-022-02021-8>

30. Kuznetsov, Y., Baev, A., Konovalyuk, M., Gorbunova A., Russer, J.A. Independent Component Analysis



of the Cyclostationary Signals in the Transmission Line // IEEE International Symposium on Electromagnetic Compatibility 2022-September, P. 96-101 DOI: 10.1109/EMCEurope51680.2022.9901014

31. Denisov, A., Kuznetsov, Y., Baev, A., Konovalyuk, M., Gorbunova A. WLAN Adjacent Channel Interference Suppression Using Cyclic Wiener Filter // 2022 24th International Conference on Digital Signal Processing and its Applications, DSPA 2022 DOI: 10.1109/DSPA53304.2022.9790769

2. Proposals of resolutions

URSI is a liaison organization, and the chair of commission A is always invited and many colleagues participating in the CCTF are also URSI members of commission A.

A special issue of Metrologia was prepared from CCTF. It can be found here:

https://iopscience.iop.org/collections/0026-1394_challenges-in-time-and-frequency-metrology

At the general conference of weights and measures CGPM in 2022, important decisions on these topics have been achieved. Please have a look on resolution 4 and 5 here

<https://www.bipm.org/en/cgpm-2022>

Resolution 4 on continuous UTC follows the actions taken by many organizations, as URSI, in recommending UTC without discontinuities.

See URSI resolution at GASS 2021 in Rome and the related Radio Science Letter

<https://www.ursi.org/Publications/RadioScienceLetters/Volume3/RSL21-0047-final.pdf>

3. Technical Advisory Committee

Technical Advisory Committee of Commission A was established in 2015 after the AT-RASC2015 meeting and the membership of the committee was refreshed after the GASS2017. Following is the list of members of the Technical Advisory Committee for the period from 2021 to 2023.

- Felicitas Arias, France
- Chen Kunfeng, The 41st Institute of CETC, China
- Demetrios Matsakis, USA
- Amitava Sen Gupta, The NorthCap University, India
- Emmanuel Van Lil, KU Leuven, Belgium
- Steven Weiss, The Johns Hopkins School for Professionals, USA
- Patrizia Tavella, BIPM, France
- Dominique Schreurs, KU Leuven, Belgium
- Tian Hong Loh, National Physical Laboratory, UK
- Rowayda A. Sadek, Helwan University, Egypt
- Parmeswar Banerjee, Amity University, India
- Noshewan Shoaib, National University of Sciences and Technology, Pakistan (ECR)
- Pedro Miguel Cruz, Bosch Security Systems SA, Portugal (ECR)



- Nuno Borges Carvalho, Instituto de Telecomunicacoes, Universidade de Aveiro, Portugal (Vice Chair)
- Yasuhiro Koyama, NICT, Japan (Chair)

The committee was consulted for coordination of Commission A’s sessions for AT-RASC2018, AP-RASC2019, and GASS2021. Various ideas were proposed by the committee members, many of whom volunteered to become conveners of these flagship meetings.

4. Working Group for Education and Training

At the time of commission business meeting during the GASS2014, it was proposed to establish a new working group focusing on the education and training for Electromagnetic Metrology. There are many institutes providing such education and training, and it was thought to be very helpful if we could share valuable materials and resources. Since the formal establishment of the new working group will require detailed Terms of Reference and a list of membership, it was proposed to start from ad-hoc group with the task of collecting the information on training organized by the various institutes and sharing the information. Dr. Demetrios Matsakis of United States Naval Observatory volunteered to become the Chair of the WG and the initial members have been defined as the list below.

- Ashish Agarwal, National Physical Laboratory, India
- Charles F. Bunting, Oklahoma State University, USA
- William A. Davis, Professor Emeritus, Virginia Tech, USA
- Yashiro Koyama, NICT, Japan
- Tian Hong Loh, National Physical Laboratory, UK
- Demetrios Matsakis (WG Chair)
- Alireza Motevasselian, LEAX Arkivator Telecom, Sweden
- Patrizia Tavella, BIPM, France
- Congsi Wang, Key Laboratory of Electronic Equipment Structure, China

There will be a dedicated session for the Education and Training in Electromagnetic Metrology at the GASS2017 and information about available resources and experiences will be shared among the community of Commission A.

5. Sponsored meetings

During the period from GASS2021 to GASS2023, the following meetings and conferences have been technically supported by Commission A.

Type meeting	Month Year	Continent	Place	Dates	Name of meeting
1A	August 2025	Oceania	Sydney, Australia	1-Aug-25	AP-RASC 2025



3B	November 2023	Europe	Genoa, Italy	15-17 November 2023	2023 IEEE CAMA - Conference on Antenna Measurements and Applications
3B	October 2023	Asia	Kuala Lumpur, Malaysia	30 October - 2 November 2023	ISAP 2023
1A	August 2023	Asia	Sapporo, Hokkaido, Japan	19 - 26 August 2023	URSI GASS 2023
3B	October 2022	Oceania	Sydney, Australia	31 October - 3 November 2022	ISAP 2022
3B	September 2022	Europe	Gothenburg, Sweden	5-8 September 2022	EMC Europe 2022

6. AT-RASC2022

Atlantic Radio Science Conference 2022 (AT-AP-RASC2022) was held at Expo Meloneras, Gran Canaria in 2022. Commission A organized the following 14 sessions including joint sessions with other commissions and 51 papers were presented in total.

Session Topics at AT_AP-RASC 2021

- o Session A01-1: Antenna and Propagation Measurement Techniques (Part 1)
- o Session A01-2: Antenna and Propagation Measurement Techniques (Part 2)
- o Session A02: Measurements in Advanced Communication Systems
- o Session A03-1: Characterization of Electromagnetic Properties of Materials (Part 1)
- o Session A03-2: Characterization of Electromagnetic Properties of Materials (Part 2)
- o Session A06-1: Realization & Dissemination of Time Scales & Standard Frequenc. (Part 1)
- o Session A06-2: Realization & Dissemination of Time Scales & Standard Frequenc. (Part 2)
- o Session A08: Measurements for Health Diagnostics, Apps and Biotechnology, incl Bio-sensing
- o Session A09: Space Metrology
- o Session A10: Calibration, Traceability, and Inter Comparisons of Instruments and Measurements
- o Session A12: Smart City as a measurement hub
- o Session A14: Quantum Metrology
- o Session A15: Precision Metrology - Practice, Education and Prospects
- o Session A16: Microwave and Optical Frequency Standards



- o Session A17-1: Time and Frequency Metrology (Part 1)
- o Session A17-2: Time and Frequency Metrology (Part 2)
- o Session A18-1: Adv. Time& Freq. Transfer Techn.& Precision Geolocation (Part 1)
- o Session A18-2: Adv. Time& Freq. Transfer Techn.& Precision Geolocation (Part 2)

8. GASS2023

The 35th URSI General Assembly and Scientific Symposium (GASS2023) will be held at the in Sapporo, Japan from in August, 2023. Commission A is organizing 17 sessions including joint sessions with other commissions, an received a total of 52 papers. The sessions are:

- A01 : Antenna and Propagation Measurement Techniques (Tian Loh, Pedro Pinho)
- A01 : Antenna and Propagation Measurement Techniques (Tian Loh, Pedro Pinho)
- Commission A Tutorial
- A01 : Antenna and Propagation Measurement Techniques (Tian Loh, Pedro Pinho)
- A02 : Measurements in Telecommunications and Advanced Communication Systems (Tian Loh, Nuno Carvalho)
- A03 : Metrological Analysis and Characterization of Material Properties (Nosherwan Shoaib, Imran Shoaib, Takashi Shimizu)
- A07 : Measurements for Health Diagnostics, Applications and Biotechnology, including Bio-sensing (Nuno Carvalho)
- A10 : Space Metrology (Liu Min)
- A13 : Microwave and Optical Frequency Standards (Ekkehard Peik, Amitava Sen Gupta)
- A14 : Realization and Dissemination of Time Scales and Standard Frequencies (Demetrios Matsakis, Jose Mauricio Lopez, Ashish Agarwal, Dirk Piester)
- A09 : Calibration, Traceability, and Inter Comparisons of Instruments and Measurements (Demetrios Matsakis)
- A15 : Time and Frequency Metrology (Amitava Sen Gupta, Architi Hati)

A tutorial lecture will be given by Prof. Nuno Borges Carvalho on Smart City Measurement.

Chair : Nuno Borges Carvalho

E-mail : nbcarvalho@ua.pt

Vice Chair : Amitava Sen Gupta

E-mail: sengupta53@yahoo.com

Early Career Representative : Nosherwan Shoaib

E-mail : nosherwan.shoaib@seecs.edu.pk

Early Career Representative : Giovanna Signorile

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