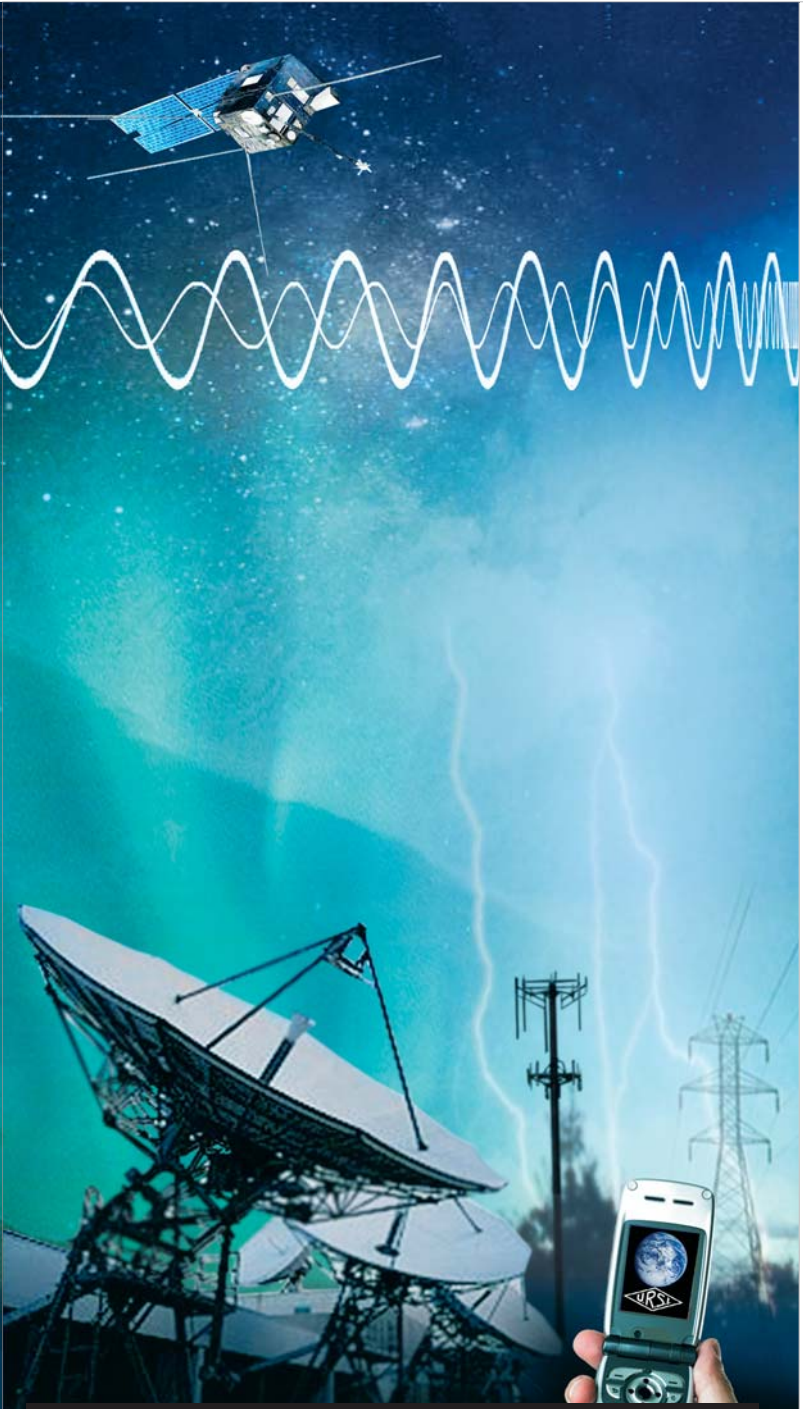


INTERNATIONAL UNION OF RADIO SCIENCE

U.R.S.I.

Presentation

At the international level, almost every branch of science functions under the auspices of, and is represented by, an organization known as a union. For the science involving the various forms of what are commonly called radio waves, the pertinent union is the **International Union of Radio Science**, commonly referred to by its acronym **URSI** (based on its name in French: Union Radio-Scientifique Internationale). URSI and other unions associated with other branches of science are, in turn, members of the International Council of Science (ICSU).

URSI was founded in the early days of radio telegraphy. Since that time radio science has matured to encompass the fields of radio, telecommunication and the electronic sciences, all of which are pervasive and have dramatically altered modern life. Radio, television, cellular telephones, computers, and the Internet all have developed from the fields of science associated with URSI.

URSI was founded in 1919 at the time that ICSU itself was constituted. Since then the basic technical area covered by URSI has expanded and proven highly important in the development of radio science. A number of Nobel prizes have been awarded to scientists actively involved in radio science.

From left to right and top to bottom:
E.V. Appleton (1947), N.G. Basov, A.M. Mokorov and C.H. Townes (1964), B.D. Josephson (1973), H. Alfven (1970), A. Hewish and M. Ryle (1974), A.A. Penzias and R.W. Wilson(1978), J.H. Taylor (1993), V.L. Ginzburg (2003).

"The history of our Union is one of steady growth and of effort to coordinate the international scientific foundations of the fantastically extending roles of radio and electronic applications. Our domain extends over the Earth, throughout the solar system, and out among the galaxies. We can be sure of one thing: when man reaches the outermost limits of the observable Universe, he will materially be assisted by means of radio for communications navigation and control using the electromagnetic waves envisaged by the genius of Maxwell a hundred years ago".

J.H. DELLINGER
1963

And, as we look to the future, even more dramatic change is promised: the development of the electromagnetic environment, the development of nanotechnology, the prospect of new modes of transportation of energy by electromagnetic waves, and the explosion of wireless communications.

URSI objectives and activities

The objective of URSI is to stimulate and to coordinate, on an international basis, studies in the fields of radio, telecommunication, and electronic sciences through scientific and technical symposia and publications and by organizing and participating in international scientific committees.

- A General Assembly of URSI is held every three years. At the General Assembly, current trends in research are reviewed, new results are presented, and plans are made for future research work, especially where international cooperation is desirable. Organizational and committee work is also carried out at the General Assembly.

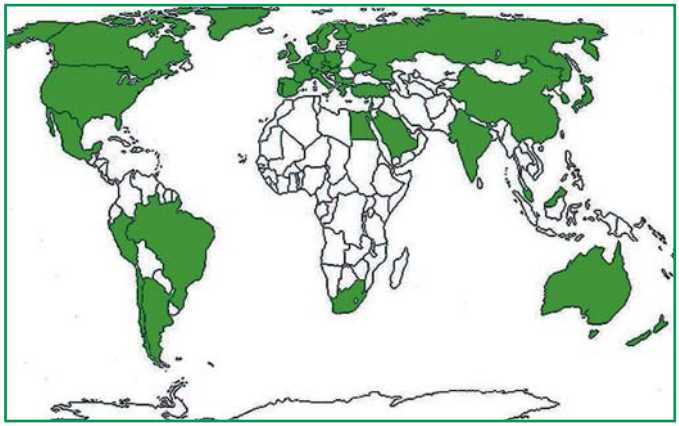
  A number of countries also hold annual technical and administrative meetings, and most of the 10 URSI Scientific Commissions hold frequent technical symposia. The triennial *Commission B Electromagnetic Theory Symposium* and the *Commission F Symposium on Microwave Remote Sensing of the Earth*, *Oceans*, *Ice*, *and Atmosphere* are two examples. In addition, there are major URSI conferences that are regional, such as the *Asia-Pacific Radio Science Conference* and the annual *North American Radio Science Meeting*.

  URSI's scientific work is carried out within and among its scientific commissions and through interaction with other scientific unions.

- URSI publishes the URSI *Radio Science Bulletin* and is closely affiliated with the journal *Radio Science,* published by the American Geophysical Union (AGU).
  The *Radio Science Bulletin* publishes scientific papers in radio science, review papers and book reviews.

- URSI issues call for nominations for a number of awards and prizes, which are presented during each General Assembly:
  - the Balthasar Van der Pol Gold Medal,
  - the John Howard Dellinger Gold Medal,
  - the Appleton Prize,
  - the Booker Gold Medal,
  - the Issac Koga Gold Medal.

- The Members of URSI are the national committees formed by the Academies of Science or equivalent organizations in the various territories that adhere to the Union. All Member Committees are represented on the Council, which is the ultimate decision-making body of URSI. URSI has a Board to manage its affairs and activities, and the officers of the Board are elected by the Council. The day-to-day management of the activities of URSI is the responsibility of the Secretary General and the Secretariat staff. URSI fosters the participation of individual scientists in its activities and affairs, and has instituted the designation URSI Radio Scientist to qualified individual participants.



Present members of URSI: *Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China (CIE), China (SRS), Czech Republic, Denmark, Egypt, Finland, France, Germany, Greece, Hungary, India, Ireland, Israel, Italy, Japan, Malaysia, Mexico, Netherlands, New Zealand, Norway, Peru, Poland, Portugal, Russia, Saudi Arabia, Slovakia, South Africa, South Korea, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, USA.*

Associate Members of URSI: *Argentina, Chile, Serbia and Montenegro.*

URSI COMMISSIONS

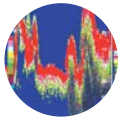
The various disciplines covered by URSI are allocated to 10 Scientific Commissions. The Commissions meet as their business requires and at the General Assemblies.

New measurement techniques based on electromagnetic principles or used for the determination of electromagnetic quantities are very important for developing industries. The ***Electromagnetic Metrology Commission*** concentrates on this research. These measurement techniques find applications in telecommunications, radio frequencies, infrared and optics as well as for the determination of the fundamental constants of nature. A major issue is, for instance, the development and the operation of atomic clocks for highly accurate time measurements.

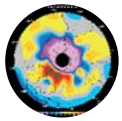
The ***Fields and Waves Commission*** studies the behavior of electromagnetic fields in a general sense. Its research focuses on analytical, numerical and measurement techniques to understand electromagnetic phenomena. For instance, practical projects are the development of antennas and antenna arrays, the propagation of waves in special materials and the application of electromagnetic fields as a non-destructive probing tool.

The demand for highly effective telecommunication systems is ever-increasing. The development of next-generation mobile phone systems, telecommunication networks and wireless broadband communication systems is thus vital. This is the topic of URSI's ***Radio-Communication Systems and Signal Processing Commission.*** It also investigates new techniques to transport information along these systems by studying new coding, modulation, signal and image processing techniques.

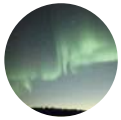
The ***Electronics and Photonics Commission*** researches the new electronic and photonic devices and systems that have become so pervasive in modern society, permitting the development, for example, of the digital computer, television and mobile communications. Examples of such devices are semiconductor lasers, optical fibers and microwave integrated circuits. In essence, these devices generate, detect, store or process electromagnetic signals of all kinds.



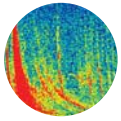
Electromagnetic noise of natural or man-made origin disturbs our communication, navigation and broadcasting. The ***Electromagnetic Noise and Interference Commission*** deals with all aspects of this noise by investigating the effects on the performance of radio, TV, phones and navigation instruments. Electromagnetic fields from a geophysical or seismic origin also reside under the umbrella of this commission.



Remote-sensing techniques to probe and monitor our environment - including air, sea, land and vegetation - play an increasing role in our world. The ***Wave Propagation and Remote Sensing Commission*** encourages research on electromagnetic wave propagation through the various layers of the geosphere and biosphere. Forest fires, crop yield and soil moisture are among the important factors to be monitored globally by corresponding satellite-born instruments.



The ionosphere is an important part of the terrestrial atmosphere. Being electrically conducting, it strongly affects electromagnetic waves passing through it. The ***Ionospheric Radio and Propagation Commission*** focuses on the propagation of electromagnetic waves in this medium and in ionized media in general. Space weather influences the ionosphere in many ways, which, in turn, have adverse effects on telecommunication and navigation. This is an emerging issue of the Commission.



The ***Waves in Plasmas Commission*** studies the generation, propagation and interactions of waves in space plasmas (solar corona, solar wind, magnetosphere, etc) as well as in man-made plasmas in laboratories. Of particular interest is the interaction of low-frequency natural and artificial electromagnetic waves with the medium (ionosphere, radiation belts, etc).

The investigation of the universe by radio waves has revealed many new insights into its physical nature and evolution. Radio emission can be detected from celestial objects and diffuse material throughout the observable universe. The ***Radio Astronomy Commission*** is concerned with the observation and interpretation of these celestial radio emissions and with the technology and techniques involved. One of its tasks is to support efforts to ensure radio observations are free from harmful man-made interference.

The ***Electromagnetics in Biology and Medicine Commission*** studies the interaction of electromagnetic fields with biological systems. The effects of and the mechanisms involved with exposure of biological systems in general, and of humans in particular, to electromagnetic waves are investigated. These effects may be harmful, e.g., the exposure to electromagnetic radiation from radar, power lines or cell phones, but also bear great potential in medical use. Bone growth after fractures and chronic pain have recently been successfully treated with electromagnetic fields

In addition to the Scientific Commissions, the Scientific Committee on Telecommunications (SCT) was formed within URSI as a liaison with the International Telecommunications Union (ITU). The ITU is responsible for the central coordination of the world's telecommunication systems. The SCT acts as a contact between the research scientists associated with URSI and the engineers in the ITU, who are mostly associated with industry.

Managing the electromagnetic environment.

In our modern society, there is a need to strengthen the understanding of - and to develop engineering solutions for - measuring, monitoring and controlling the effects of naturally occurring and man-made electromagnetic emissions related to:

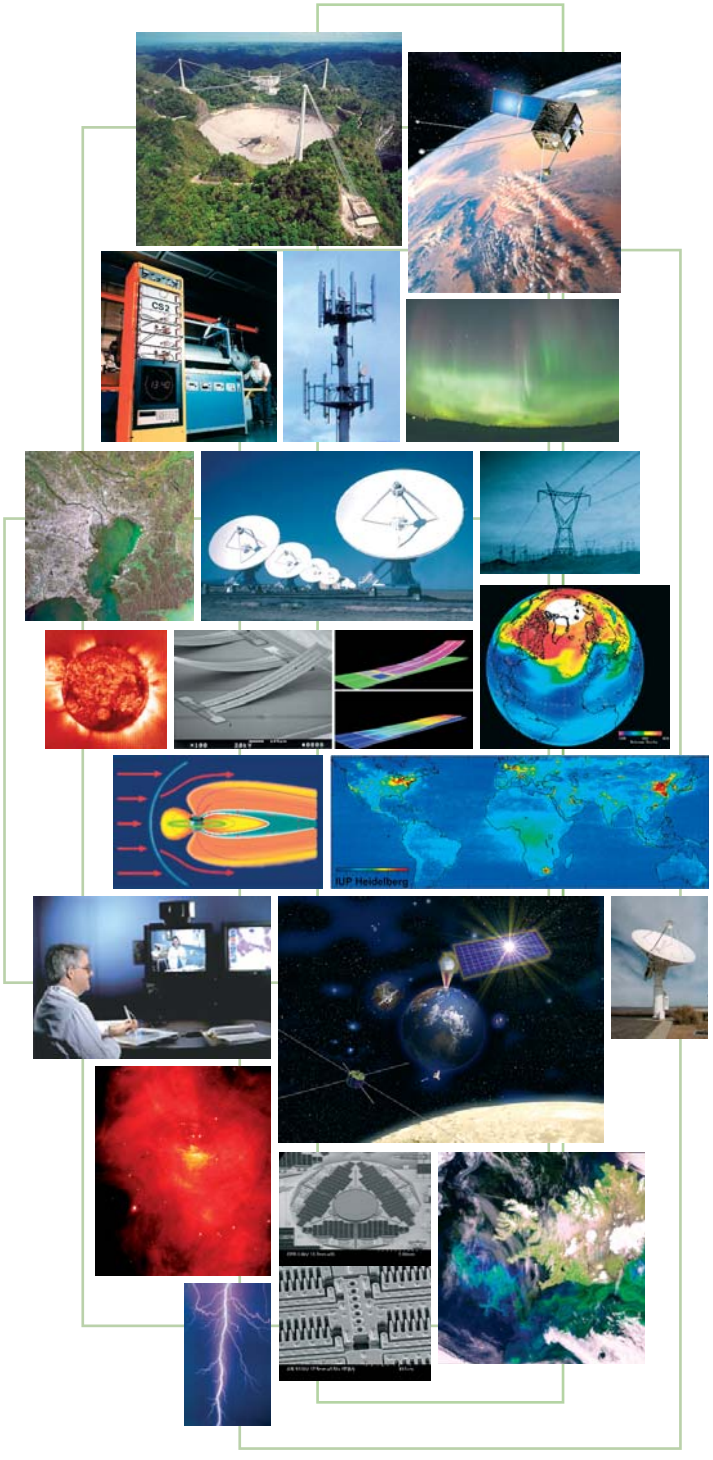
- space-based services such as telecommunications, telemedicine, medical surveillance, Earth observation (including man-made pollution in all domains and electromagnetic waves associated with seismic events), meteorology, altimetry, positioning, navigation, defence surveillance, etc.
- the Earth environment (the potential effect on the climate system),
- humans (e.g., effects of electromagnetic radiation from cellular telephony),
- the monitoring of variations in the space environment (e.g., from variations in solar activity) that may affect space-based services, and, when possible, the correction of these effects.

Investigating the transport of energy by electromagnetic waves.

A clean, renewable, and therefore sustainable method of energy production that can be substituted world-wide for nuclear as well as fossil energy resources may be provided by Space Solar Power Systems (SSPS). In these systems, solar-radiation energy is collected by huge space-based solar cells and subsequently converted to microwave energy, which is then transmitted to the Earth. Although the feasibility of such systems has been proven, a broad range of technological and environmental questions have to be answered.

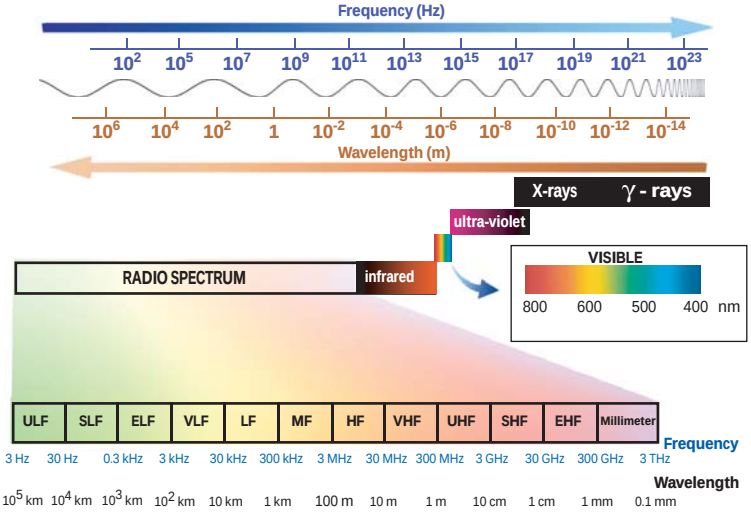
Nanotechnology.

Nanotechnology will have an enormous impact on society, the economy and on the various sciences, as well. It offers the promise of creating not only minuscule circuits, but of constructing biological molecules for medical purposes, including the possibilities of micromachining and nano-surgery. URSI will actively contribute to this field through the development of micro-electronic-mechanical systems (MEMS) and metamaterials.



The electromagnetic spectrum

Electromagnetic waves carry electromagnetic energy through space. In empty space, they propagate at the speed of light. The basic properties (defined by Maxwell's equations) are identical over all of the electromagnetic spectrum that has been investigated so far, i.e., from millihertz to 10^{24} Hz. Each decade of the electromagnetic spectrum below the millimeter-wave range of frequencies (10^{12} Hz) is divided into designated ranges, with their acronyms indicated below. The URSI domain of activities stops slightly above 10^{14} Hz (optical communications).



ULF = Ultra Low Frequency
Geophysical prospecting

SLF = Super Low Frequency
Power transmission
Submarine communication

ELF = Extremely Low Frequency
Telephone
Audio
geophysics

VLF = Very Low Frequency
Navigation
Positioning
Naval communication

LF = Low Frequency
Radiobeacons for aircraft
Standard frequency and time signal

MF = Medium Frequency
Maritime communication
Radio broadcasting (AM)
Radiobeacons for aircrafts
Amateur radio

HF = High Frequency
Maritime communication
Aeronautical communication
International short wave comm.
Amateur radio

VHF = Very High Frequency
TV boadcasting
Air traffic control communication
Radio broadcasting (FM)
Amateur radio
Mobile communication
Police communication

UHF = Ultra High Frequency
Cellular phone
Taxi radio
TV broadcasting
Mobile satellite communication
Radar

SHF = Super High Frequency
Satellite communication
Satellite broadcasting
Radar
Radio astronomy
Radio LAN

EHF = Extremely High Frequency
Radio astronomy
Satellite communication
Fixed wireless access
Radar
Remote sensing

Millimeter
Astronomy
Meteorology

IR = infrared
Heating
Night vision
Optical communication

Visible light
Optical communication

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