LVIV CENTER OF INSTITUTE FOR SPACE RESEARCH

NATIONAL ACADEMY OF SCIENCES OF UKRAINE

NATIONAL SPACE AGENCY OF UKRAINE

LVIV UKRAINE

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The Center has 106 specialists including: 1 member of the International Academy of Astronautics, 2 Doctors of Sciences and 10 Candidates of Sciences (PhD).

LC ISR includes 3 scientific departments and 1 laboratory, and performs fundamental and applied researches in the following interdisciplinary scientific directions:

- Fundamental study of acousto-electromagnetic interactions in atmosphere and ionosphere
- Propagation theory and experimental study of electromagnetic fields in conducting media (space plasma, ground, sea water)
- Development of advanced sensors and systems for measuring the parameters of physical fields and data collection and processing for space industry and geophysical applications.

This research is supported from numerous national and international sources, including STCU, INTAS and NATO grants.

FOCUS AND EXPERTISE

The Center with its engineering divisions has made significant contribution to the solution of large-scale fundamental and applied scientific problems, including:

- The development of theoretical substantiation of lithosphere-ionosphere coupling through the acoustic and atmospheric gravity waves with the aim to clarify the mechanism of ionospheric earthquakes precursors formation;
- The development of the method mechanism of earthquakes electromagnetic precursors recognition in the focal area and creation of the specialized instrumentation for these precursors detection;
- The study of interaction process in the electronic circuits with the aim to provide as low as possible sensitivity threshold of measuring devices for space, ground and sea bed applications;
- The development and adoption of new methodology to provide the electromagnetic cleanliness of autonomous objects and to realize their calibration without interruption of the operation process;
- The adoption of space instrumentation development technology for the manufacturing of the advanced geophysical systems for scientific research and raw materials prospecting (oil, gas etc.).

The development and production of flux-gate magnetometers (FGM) and induction magnetometers (IM) with highest possible level of their parameters is one of the main activity areas of LC ISR. To reach a world level, the reduction of weight, energy loss and noise level can be placed among main lines of FGM and IM development.

The advanced geophysical instrumentation produced in LC ISR is generally recognized at world market: Indeed more than 25 countries have imported magnetometers, electrometers and magnetotelluric stations.

PARTNERSHIP OPPORTUNITIES

The Institute is open for collaboration with interested institutions in the development of both low noise, wide band and super-low power, light-weight FGMs and IMs for different applications. The international collaboration is realized in frames of direct contacts and Agreements of Collaboration. The Center adheres to the international standards, including ISO.

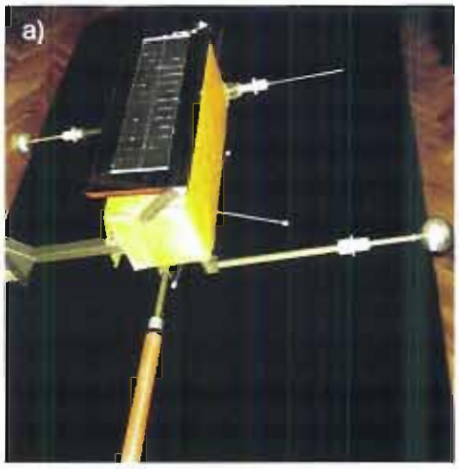
ADVANCED GEOPHYSICAL INSTRUMENTATION

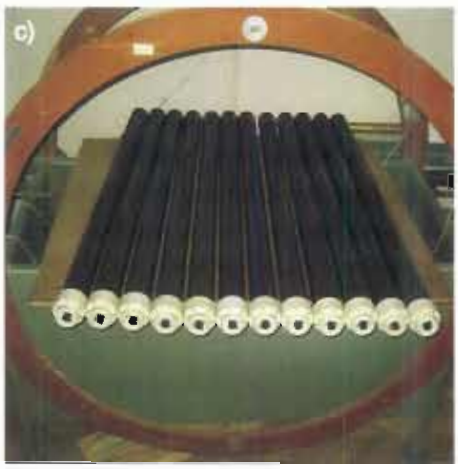
The top of the world list of the geophysical instrumentation, used for deep sounding of the Earth's interior, is occupied by the produced with our FGMs magnetotelluric stations LEMI-417 (see right, b), which are widely used in Ukraine and exported to about 20 countries in the world. Numerous inventions and know-hows promoted this. Table summarizes the parameters of advanced FGMs produced by LC ISR.

Parameters	LEMI-011	LEMI-018	LEMI-019	LEMI-020
Measurement range, nT	± 50000	± 65 000	± 60 000	± 65 000
Noise level, pT/√Hz	< 100	< 7	< 5	< 20
Temperature drift, nT/°C	< 5	< 0.1	< 0.5	< 0.1
Component orthogonality error, min of arc	± 20	< 30	-	< 30
Power consumption, mW	5-25	< 600	≤ 30	< 20
Total weight, kg	0.065	3	0.1	0.025

NEW MANUFACTURING TECHNOLOGY

The implementation of the space technology in the geophysical instrumentation stimulated also the development of new methodology of IM design and manufacturing. As the result, the produced by LC ISR induction magnetometers found considerable market interest because of the highest ratio quality/price. The photo (right, c) shows a batch of LEMI-120 magnetometers before their delivery for trans-continental geophysical monitoring network to Australia. The main parameters of the most widespread LC ISR's IMs are given in the following table.





a) Nanosatellite with advanced scientific instrumentation

b) FGM based magnetotelluric stations LEMI-417

c) Induction magnetometers LEMI-120

Parameters	LEMI-030	LEMI-118	LEMI-120	LEMI-123
Frequency range, Hz	0.001-30	1-100000	0.0001-1000	1-1000
Noise, pT/sqrt (Hz)	at 0.1 Hz- <2 at 1 Hz- <0.2 at 30 Hz-<0.04	at 1 Hz - ≤ 5 at 10 Hz - ≤ 0.2 at 50 kHz - ≤0.01	at 0.001 Hz - <100 at 100 Hz - <0.01 at 1000 Hz - <0.01	at 1 Hz - < 8 at 100Hz-<0.05 at 1 kHz- <0.02
Power consumption, mW	≤ 240	≤ 240	< 240	< 160
Weight, kg	5.7	< 1.7	< 6.7	0.71
Length, mm	870	850	1350	300

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The Lviv Center of Institute for Space Research (LC ISR) of the National Academy of Sciences (NASU) and National Space Agency of Ukraine (NSAU) was organized in 1996 as a scientific experimental division of the Institute for Space Research. The institute's main objectives are: the development, testing and implementation of the advanced instrumentation for space research.

PRIMARY SCIENTIFIC DIRECTIONS

- fundamental investigations of acoustic-electromagnetic interactions in atmosphere and ionosphere
- investigation of the lithosphere-ionosphere and Sun-Earth connections
- propagation theory and experimental study of electromagnetic fields in conducting media (space plasma, ground, sea water)
- development and manufacturing of high class sensors and systems for measuring the parameters of electric and magnetic fields and for data collection and processing for space and ground geophysics
- preparation and realization of space experiments.

DISTINCTIVE COMPETENCIES

LC ISR has a unique technological resource for the development, manufacturing and calibration of flux-gate and induction magnetometers. This allows creating the space and ground-based instrumentation with the highest for today level of metrological parameters.

Some examples of LC ISR production are presented on the figures. The specific advantage of LC ISR technology is the tailoring of the developed instrumentation to the customer's requirements and all what is theoretically possible within existing physical restrictions may be realized at the highest level.

Some examples of the technological achievements of the institute

More than 10 spatial experiments were carried out with the participation of LC ISR specialists. The first scientific space physics experiment "Variant" on board the remote sensing satellite "Sich-1M" with international scientific payload (launched 24.12.2004) enabled for the first time direct measurements of the spatial current density in space plasma.

The effect of solar bursts on atmospheric infrasound was revealed and the concept of the interaction model of solar activity and atmospheric infrasound was developed for the first time;

A generalized approach to the recognition of the electromagnetic precursory signals of earthquakes preparation process when structural changes and anomalies occur in the Earth crust was proposed.

A new physical effect – gamma – magnetic normalization of alloys with high magnetic permeability – was discovered and experimentally confirmed.

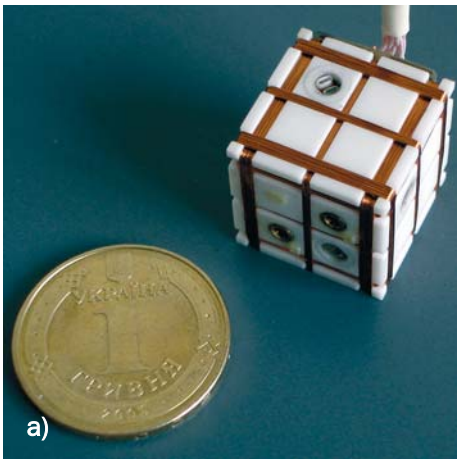
LC ISR is one of the leading organizations in the world in the branch of development and manufacturing of field electromagnetic geophysical instrumentation, as well as of methodology and practice of electromagnetic measurements. A set of high-class geophysical devices both for space, on-ground and marine applications were developed and commercialized.

These devices have international recognition and are used both in Ukraine and abroad (USA, Canada, European Community, Japan, Italy, Hungary etc., about 25 countries altogether). The success of the achieved sustainability is in great deal based on LC ISR–STCU collaboration in regular and partnership projects.

PARTNERING OPPORTUNITIES

LC ISR has close relations with Alberta University and several private companies in Canada. The institute is looking for collaboration with interested institutions and companies (in Canada, the EU and the USA) in the development of both low noise and super-low power light-weight flux-gate and induction coil magnetometers for different applications – space and field geophysics.

LC ISR is also looking for the partnership in the development of new advanced electromagnetic instrumentation for geophysical prospecting, especially for new applications, such as cable and autonomous systems for oil/gas prospecting at sea bed, in the harsh environment as mountaineer or polar areas etc.


a)


b)


c)


d)

a) The lightest and smallest flux-gate sensor with high resolution (better than 10 pT)

b) Low noise electric sensors for DC and AC variations LEMI-501, LEMI-502

c) Wide-band three-component induction magnetometer LEMI-106i

d) The best in its class attitude control magnetometer for precise satellite orientation LEMI-016