Research by Ukraine of the near Earth space
50th session of STSC COPUOS
Vienna
11-22 Feb 2013
Heritage of Yuzhnoye SDO in the development of ionosphere monitoring space systems.
PROJECTS “VARIANT” and “POTENTIAL”

SICH-1M
Launched 24 December 2004
Decay 15 April 2006

SICH-2
17 August 2011

SDO YUZHNOYE’S PROPERTY.
PROJECT CONCEPT “VARIANT” OF SPACE SYSTEM «SICH-1M» (2004)

Research of influence terrestrial effects to the ionosphere

Ground-space experiment on research of acoustic channel of litospheric-ionospheric links

- Sich-1M
- On-board registration
- Ionosphere
- Disturbed area
- Acoustic waves
- Reflected signals
- Ground registration
- Electromagnetic wave
- Earth-quakes
- Volcanic eruption
- Magnetometer
- Acoustic disturbance
- Acoustic radiator
- Acoustic response to acoustic disturbance
- Magnetometer
- Ground registration
IONOSAT project main tasks

• scientific and methodological substantiation of the efficiency of the LEO satellites use for SW monitoring, corresponding technological realization development and tests.

• multi-point global monitoring of dynamical processes in the ionosphere – study of the ionospheric disturbances created by the influences “from above” (from the Sun and open space) and “from below” (caused by natural and man-made high-energy impacts, such as earthquakes, hurricanes, explosions, starts of heavy rockets, etc.)

• Synchronous operation with the existing sub-satellite electromagnetic and meteorological polygons.

• Calibration of modern prognostic models of quiet and disturbed ionosphere.
IONOSAT PROJECT IMPLEMENTATION

STAGE 1 – SINGLE SATELLITE

STAGE 2 – SINGLE CLUSTER

STAGE 3 – CONSTELLATION of CLUSTERS

SDO YUZHNOYE’S PROPERTY.
Purpose - observation of dynamic processes in the ionosphere of the Earth as well as implementation of technological experiments in space

**Main characteristics:**

Satellite mass

~ 185 kg

Orbit:
- type
- altitude
- inclination
- local mean solar time in descending node

circular sun-synchronous
from 620 km to 710 km
from 97.9 to 98.2 deg
from 10 to 14 hours

Orientation:
- type
- orientation error in orbital coordinate system
- error in angular stabilization velocity
- error in orientation determination

three-axis active
no worse than 5 deg
no worse than 0.01 deg/sec
no worse than 3 deg

Power supply subsystem:
- type of solar array cells
- type of battery cells

GaAs
NiCd

Propulsion subsystem:
- nominal thrust of one thruster
- total thrust pulse

0.05 N
~ 10 000 N*sec

Active lifetime

3 years

Launch-vehicle

Cyclone-4
## IONOSAT-MICRO onboard scientific complex

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Measurements</th>
<th>Institution and Location</th>
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</thead>
<tbody>
<tr>
<td>1. Wave probes WP (3 pieces)</td>
<td>Electric current density $J$: Frequency range 0.1 Hz - 40 kHz, Noise $10^{-12}$ A/cm² Hz$^{1/2}$ Magnetic field $B$: Frequency range 0.1 Hz - 40 kHz, Noise $10^{-14}$ T Hz$^{1/2}$ Electric potential $\phi$: Frequency range 0.1 Hz - 40 kHz, Noise $10^{-6}$ V Hz$^{1/2}$</td>
<td>Lviv Centre of Institute for Space Research (LCISR), Ukraine</td>
</tr>
<tr>
<td>2. Electric probe EP</td>
<td>Electric potential: Frequency range DC - 200 kHz, Noise $10^{-6}$ V Hz$^{1/2}$</td>
<td>LCISR, Ukraine</td>
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<tr>
<td>3. Radiofrequency analyzer RFA</td>
<td>High frequency variations, electric component. Frequency range 0.1 - 15 MHz</td>
<td>Space Research Centre, Poland</td>
</tr>
<tr>
<td>4. Sensor of neutral and charged particles DN-DE</td>
<td>Density and temperature neutral prtcl. Nn: $10^5 - 10^{12}$ cm$^{-3}$ charged prtcl. Ni: $10^3 - 10^{11}$ cm$^{-3}$ electron temp. 0.1 - 1.5 keV</td>
<td>Institute of Technical Mechanics, Ukraine</td>
</tr>
<tr>
<td>5. DC flux-gate magnetometer FGM</td>
<td>Frequency range DC - 1 Hz, Resolution 0.01 nT</td>
<td>LCISR, Ukraine</td>
</tr>
<tr>
<td>6. TEC meter</td>
<td>Frequency $L_1 = 1217 - 1265$ MHz, $L_2 = 1565 - 1615$ MHz, 20 channels</td>
<td>IZMIRAN, Russia</td>
</tr>
<tr>
<td>7. DPU</td>
<td>Input information rate, Mb/c, 100 Output information rate, Mb/c, 64 Onboard memory, up to 28 GB</td>
<td>LCISR, Ukraine</td>
</tr>
</tbody>
</table>
- Capability to accommodate payload of various purposes
- Capability to use onboard supporting complex instrumentation of various configurations
- Platform weight: up to 100 kg
- Payload weight: up to 100 kg
- Platform active three-axis attitude
- Attitude accuracy during payload operation: 0.2 deg
- Stabilization angular velocity: 0.005 deg/sec
- Daily average power for payload: up to 50 W
- Comfortable thermal conditions creation
- Required orbit parameters maintenance
- Active operation life: not less than 5 years
Payload instrumentation
Mass: up to 100 kg
Volume available: Inside -70 dm³ Outside - 50 dm³
UKRANIAN GRUOND SUPPORT FACILITIES
for seismo-ionospheric experiments

Radio-telescope URT-2

Data Main centre of the seismic control
THANK YOU FOR YOUR ATTENTION
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