Academic microsatellite "Chibis-M". Testing of the algorithm output characteristic of high altitude atmospheric lightning.


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4) BL-Electronics; Solymar, **Hungary**
5) Space Research Group of Eötvös University, Budapest **Hungary**
«Lightning» consists of a sequence of several fast phenomena.

In what direction is the lightning: up or down? In both!

Step 1:
- Stepped leader
- Return stroke
- Upward discharge

Step 2:
- Radio
- Infrared
- Visible light
- Ultraviolet
- X-ray
- Gamma

Wavelength: 5,000,000,000
Energy: 0.000000248
1 cm = 10,000,000 nanometers
Space Research Institute of RAS, Moscow

with the participation by

- Scientific Research Institute of Nuclear Physics MSU, Moscow;
- Physics Institute im. P.N. Lebedev of the RAS, Moscow;
- Lviv Centre of Space Research Institute of NANU-NKAU, Lviv, Ukraine;
- Etvosh University, Budapest, Hungary.

developed the complex of the scientific instruments KNA “Groza” (total mass 10.8 kg).
KNA “Groza”:
- RGD - Roentgen - gamma detector (range of X-ray and gamma emissions – 50-1000 keV);
- DUF - Ultraviolet detector (range of ultraviolet radiations - 180-400 nm, 650-800 nm);
- RFA - Radio-frequency analyzer (26-48 MHz);
- TsFK - Camera of optical range (spatial resolution 300 m);
- MWC – Magnetic - wave complex (0.1-40 kHz);
- BND – Scientific data (SD) collector;
- PRD2.2 – Transmitter of SD
The principal goal of the mission is to receive data for development of theory explaining lightning phenomena in higher atmosphere in all band of radiation.
The image shows a satellite component with various labeled parts:

- **RGD**
- **DUV**
- **BND**
- **GPS**
- **DFC**
- **solar sensor №3**
- **antenna 2.2 GHz**

These components are typical for satellite systems, with specific functions such as GPS (Global Positioning System) for navigation, DFC (Data Format Converter) for signal processing, and solar sensors for power generation.

The image is from the 9th IAA Symposium on Small Satellites for Earth Observation, held in Berlin, Germany, from April 8 – 12, 2013.
Basic parameters of the “Chibis-M”

Mass
- 40 kg.

Scientific instruments
- 10.8 kg.

Service system
- 18.2 kg.

Construction and temperature control system
- 9.3 kg.

Orbit
- circular with the height ~ of 500 km.

Orientation systems:
- types: the electromechanical (electroflywheels), magnetodynamic (electromagnets), gravitational (boom);
- accuracy of the determination of orientation from the solar sensors, fluxgate magnetometer and systems GPS - GLONASS - to 2- angl. deg.
- accuracy of guidance +/- 3 - 15 angl. deg.

Data-transmission system:
The radio frequency of command and service links 145, 435 MHz.

- S/C-Earth - 128 kbit/s

The radio frequency of telemetric link (2W) 2200 MHz, 1Mbit/s.

- the capacity of onboard storage - 0.5 Gbytes

- the volume of the adopted from the board information - ~ 0.02 Gbyte/day

The system of onboard power supply 50 W
PROJECT REALIZATION
9th IAA Symposium on Small Satellites for Earth Observation, April 8 – 12, 2013, Berlin, Germany
Stages of project implementation

Transpotr-launch container is installed on “top cover” of the Progress M-13

Progress M-13M undocked from the ISS
Chibis microsatellite: lesson learned during first phase of operations.

IAA-B9- 0902


Session 9: Results & Lessons Learned
Wednesday, April 10, 2013, 10:50 - 12:10
Management during on orbit flight

Tarusa, Russia

Kaluga, Russia

Budapest, Hungary

Panska Ves, Czech
Ground segment and operations for microsatellite - "Chibis M":
Learned lessons, current status and prospective evolutions.

IAA-B9-0802

Session 8: Ground Segment
Wednesday, April 10, 2013, 09:00 - 10:30
Ring memory (RM) in each instrument has the fixed size by several events. The overall size of the memory of instrument is determined by the maximum duration of the event of this instrument, which the producers of experiment assign. The duration of event can be regulated upon commands. Example: [RFA]-1s, [RGD]-20 ms, [DUF]-100 ms.

By commands it can be assigned and other parameters of the numbering of the event: the period of numbering (sampling), criterion “event occurred” (trigger), size “before” and “after” event.
Strobes coincided, but events were not recorded. RChA and RGD are coincided. RChA cannot write down event - it means necessary information in FIFO [RCHA] to retain in the period of strobe RChA.

Strobes did not coincide, events were not recorded. Write time in RM after trigger t 1g. Write time in RM before the trigger t 1g. Write time in RM to the trigger t 1r = 1 ms.

RGD

DUF

RFA

BND

Strobes RChA and RGD are coincided. RChA cannot write down event - it means necessary information in FIFO [RCHA] to retain to the period of strobe RChA. Strobes coincided, but events were not recorded. BDC gave $T_c$ for recording of information in the instruments.

Example of production of the trigger complex $T_c$ by the BND instrument.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DUF.UF</td>
<td>783</td>
</tr>
<tr>
<td>DUF.INF</td>
<td>783</td>
</tr>
<tr>
<td>R4A.LOADC сума 1-5</td>
<td>2135.6</td>
</tr>
<tr>
<td>R4A.LOADC канал 6</td>
<td>2344</td>
</tr>
<tr>
<td>R4A.HIADC</td>
<td>235</td>
</tr>
<tr>
<td>RGD.Count 1</td>
<td>65512</td>
</tr>
<tr>
<td>RGD.Count 2</td>
<td>65505</td>
</tr>
<tr>
<td>RGD.Count 3</td>
<td>65529</td>
</tr>
<tr>
<td>RGD.Count 4</td>
<td>65476</td>
</tr>
</tbody>
</table>

**Time intervals:**
- Initial on-board time: 22.06.12 02:55:51.000.000
- Final on-board time: 27.06.12 02:55:51.000.000
- Interval: 5 days

*9th IAA Symposium on Small Satellites for Earth Observation, April 8 – 12, 2013, Berlin, Germany*
Multiple short level, with the interval of 50...100 mks within approximately 1 mks (step leader)
Preliminary results

During its work «Chibis-M» were identified on the Earth zone of the most intensive man-caused interference and the zone of the most promising for the registration of lightning activity.
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Thanks for the attention

Distinguished Colleagues
Радиоизлучение разряда молнии

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