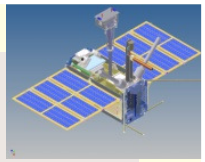
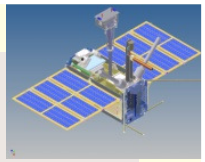


On-orbit microsatellite "Chibis-M" testing of the trigger from high-altitude atmosphere lightning discharges.

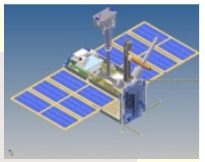
Klimov S.I.[1)], L.M. Zelenyi[1)], V.M. Gotlib[1)], V.N.Karedin[1)], I.V. Kozlov[1)], S.I. Svertilov[2)], G.K.Garipov[2)], V.V. Bogomolov[2)], V.N.Nazarov[1)], V.N.Angarov[1)].

1) Space Research Institute of the RAS, Moscow;
2) Scientific Research Institute of Nuclear Physics MSU, Moscow.

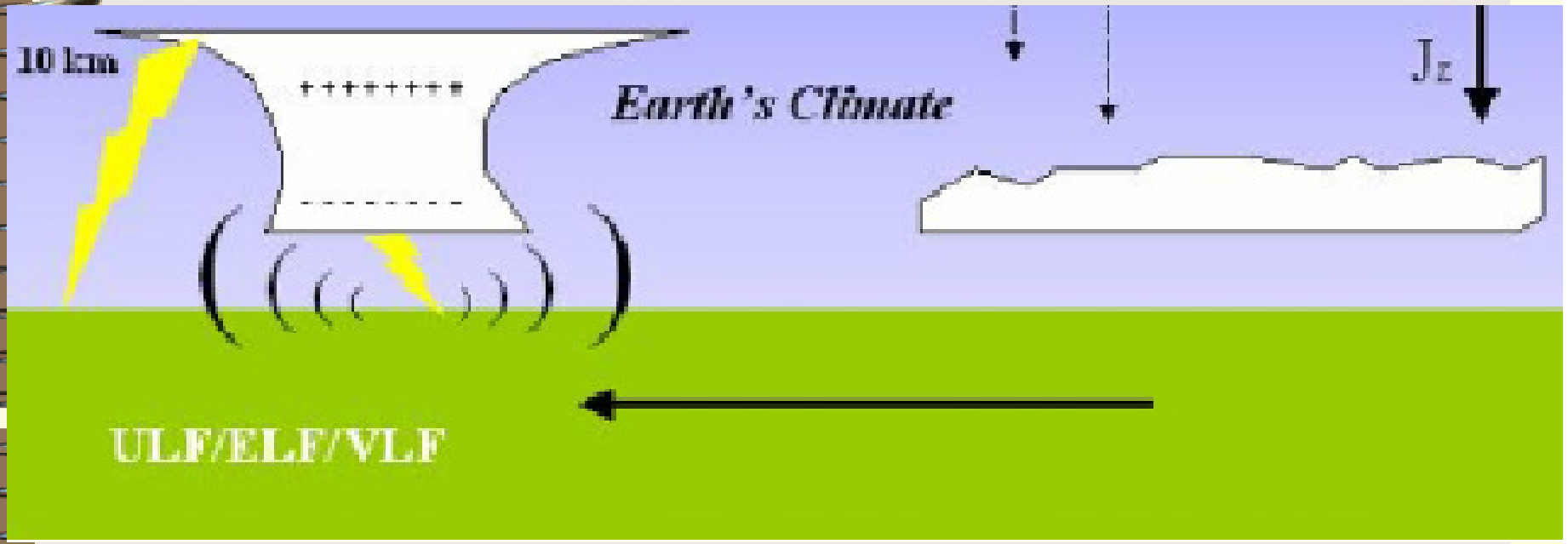


The theoretical model of high-altitude lightning stepped leader was elaborated. The model is in the agreement with the available experimental data. Basing on the calculations requirements for the further studying of high-altitude discharges was formulated. The main requirement is the following. Simultaneous observations of radio and gamma emission in sub microsecond time range should be done.

The optimal instrument set of micro-satellite platform and its auxiliary systems was formed. The methods of high-speed processing of data simultaneously receiving from several sensors were developed. The main micro-satellite parameters were elaborated. Its total weight is 40 kg, useful load for measuring equipment is 10-12 kg, and duration of stay on the low circum-terrestrial orbit is not less than 3 years.

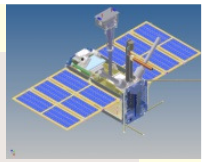


We are oriented [1] to the study of the processes, proceeding at the heights to 10 - 20 km, with the aid of the micro-satellite, which is found on the height ~500 km,



and ground-based observatories.

[1] Klimov, S.I., V.G.Rodin, L.M.Zelenyi, V.N.Angarov. Development of the Method of the Creation of Micro-Satellite (~ 50 kg) Platforms for the Fundamental and Applied Research of the Earth and Near-Earth Outer Space. R Sandau, H-P. Roeser, A. Valenzuela (Eds.) ***Small Satellites for Earth Observation. Springer Science+Busines Media B.V. p. 333-343, 2008.***

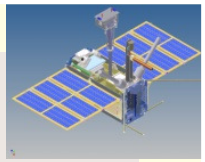


Space Research Institute of RAS, Moscow

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 Spase Research Institute of NANU-NKAU, Lviv, Ukraine;
- Etvosh University, Budapest, Hungary.

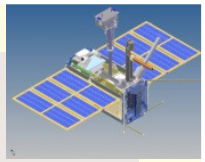
developed the complex of the scientific instruments KNA “Groza” (total mass 10.8 kg)



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 – Magnetc - wave complex (0.1-40 kHz);
- BND – Scientific data (SD) collector;
- PRD2.2 – Transmitter of SD

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 510 km.

Orientation systems:

- types: the electromechanical (electroflywheels), magnetodynamic (electromagnets), gravitational (boom);

- accuracy of the determination of orientation from the solar sensors, fluxgate magnetometr 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

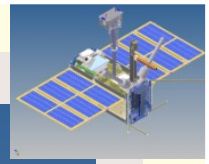
The radio frequency of telemetrie link (2W) 2200 MHz, 1Mbit/s.

- the capacity of onboard storage - 0.5 Gbytes

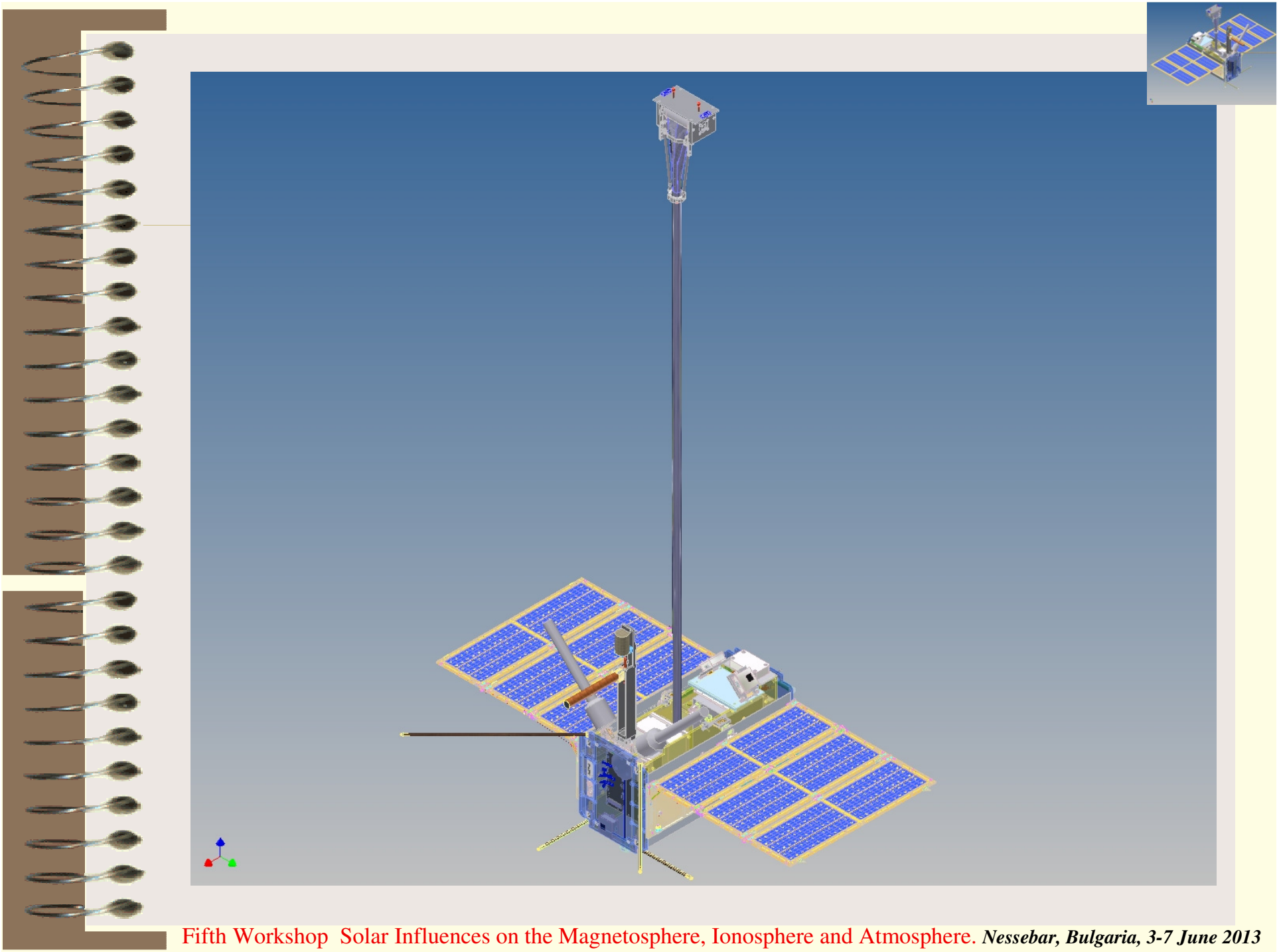
- the volume of the adopted from the board information - ~ 0.02 Gbayt/day

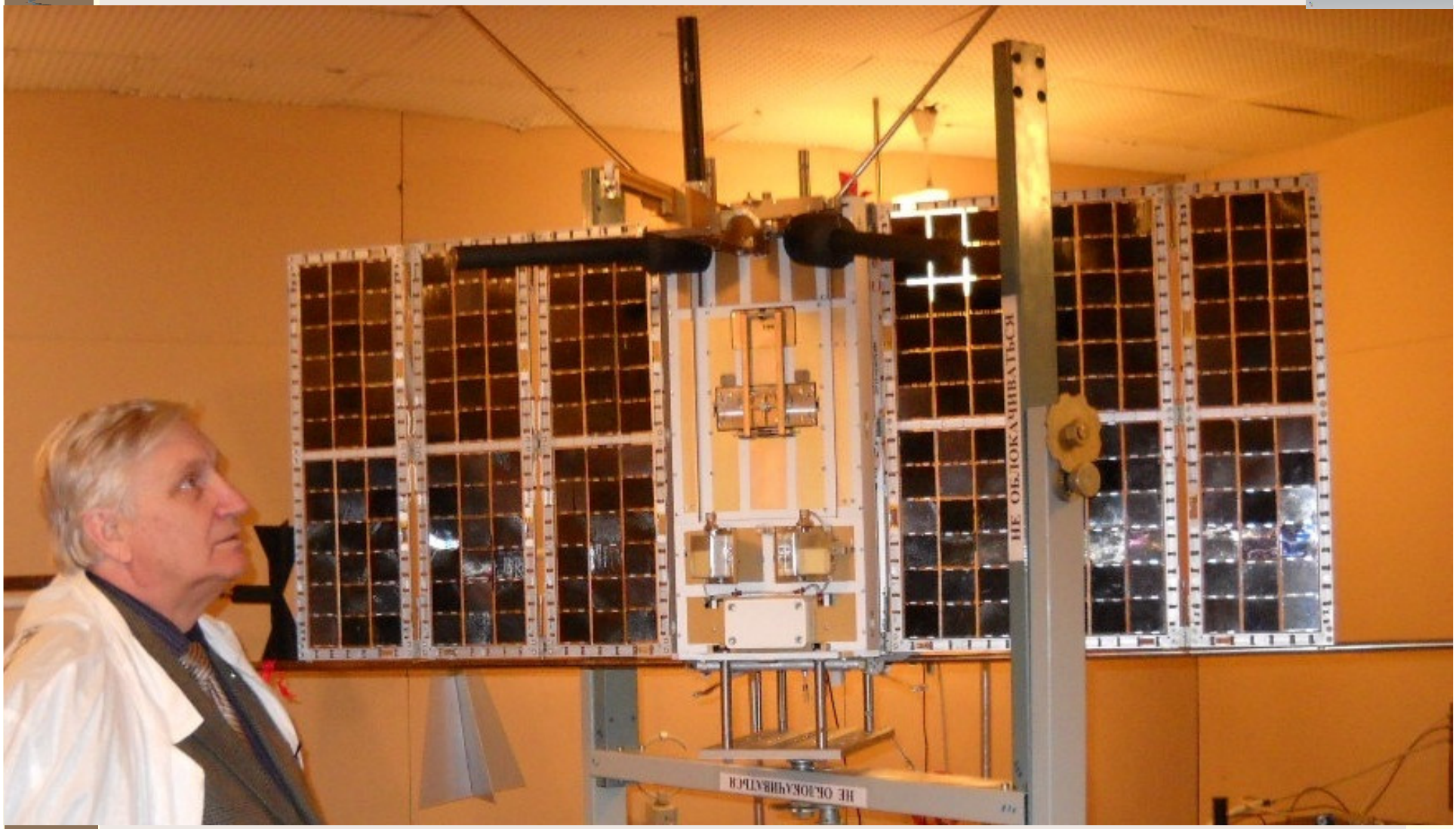
The system of onboard power supply 50 W:

Basic parameters of the “Chibis-M”

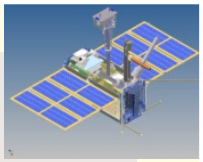


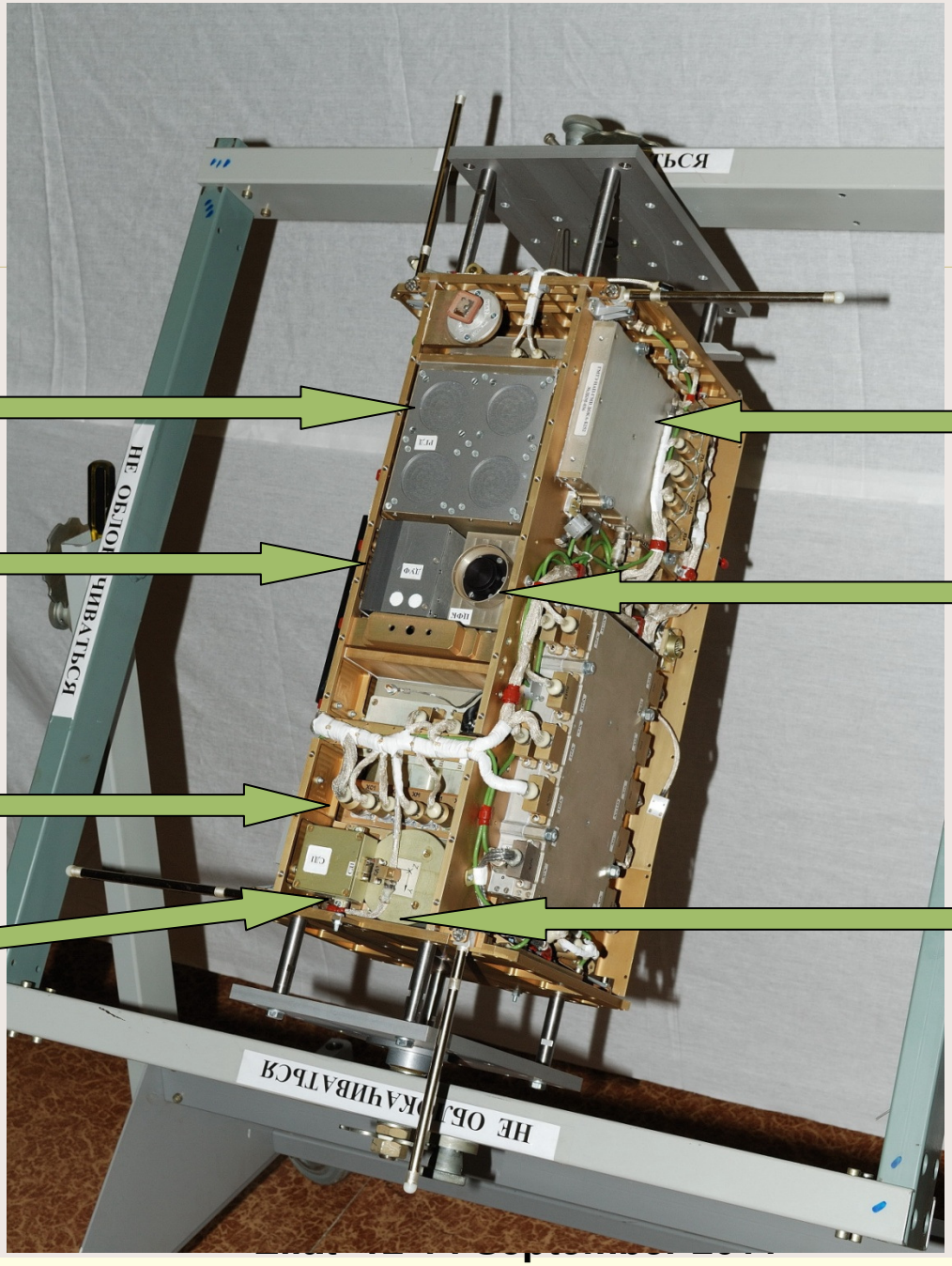
Total mass – 40 kg

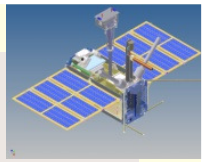




"Chibis-M" flight model. EMC test 30.03.11.

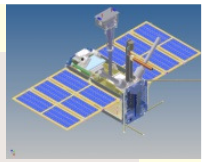



RGD
DUV
BND
solar
sensor №3
GPS
DFC
antenna
2.2 GHz



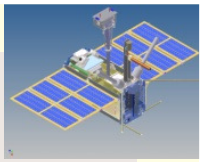
Ring memory (RM) in each instrument has the fixed size by several events. The overall size of the memory of instrument is determined by the maximum duration of the event of this instrument, which the producers of experiment assign. The duration of event can be regulated upon commands. Example: [RFA]-1s, [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.

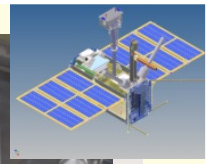


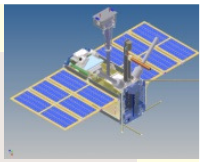
Each instrument autonomously produces the record of event in RM with its time resolution. A quantity of events of those recorded for one session of the work of instrument it is limited by approximately several Gbyte. For the selected values of productivity (RChA) this will be about 10 events. To additionally increase the storage capacities of RM are deprived limitations on the transmission of telemetry data (1 Mbit/s) to the Earth.

Priority on the production of the trigger not given to any instrument, each instrument produce sign.



PROJECT REALIZATION

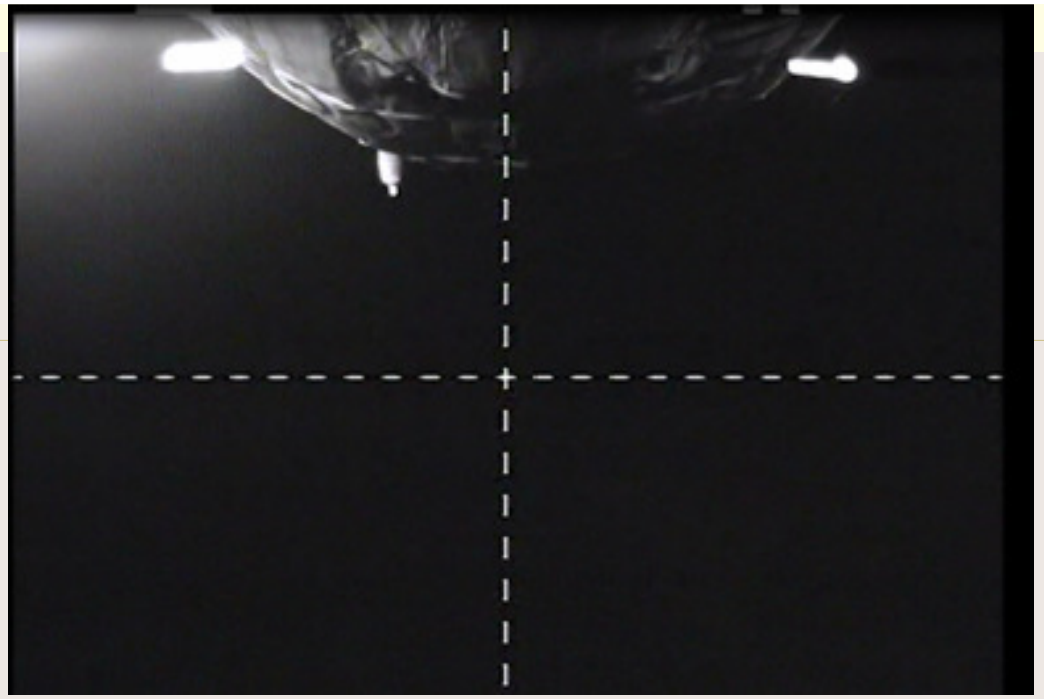


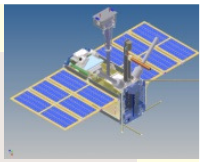


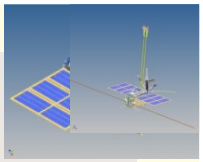

NASA HD

Progres M-13M

TV

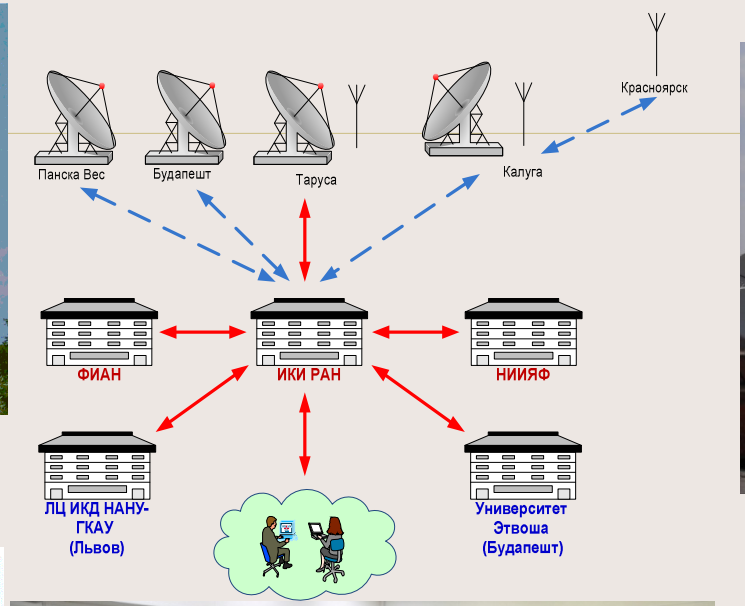






Management during on orbit flight

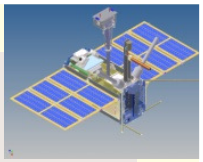
Tarusa, Russia



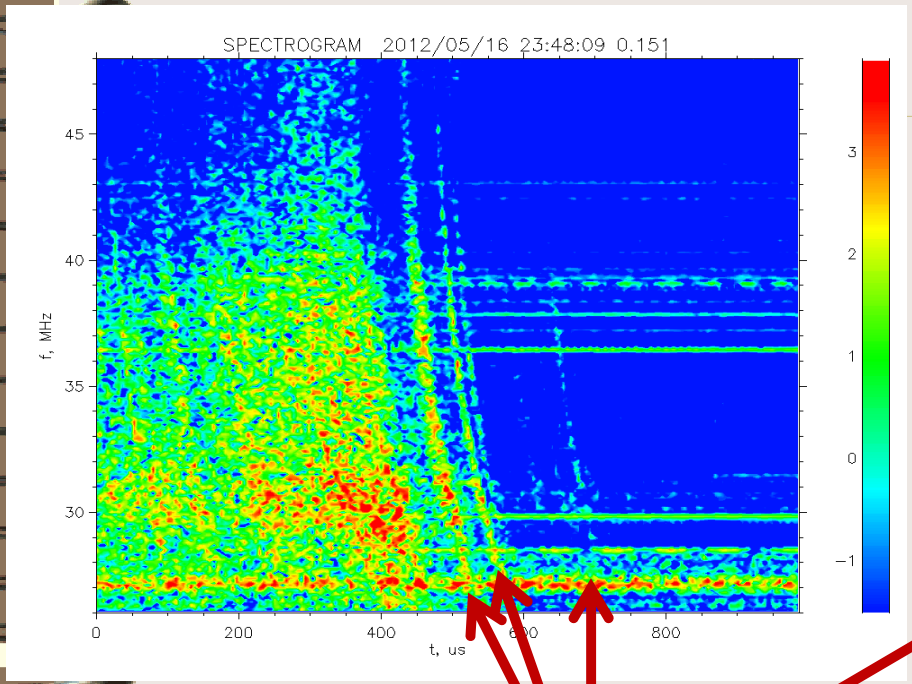
Kaluga, Russia

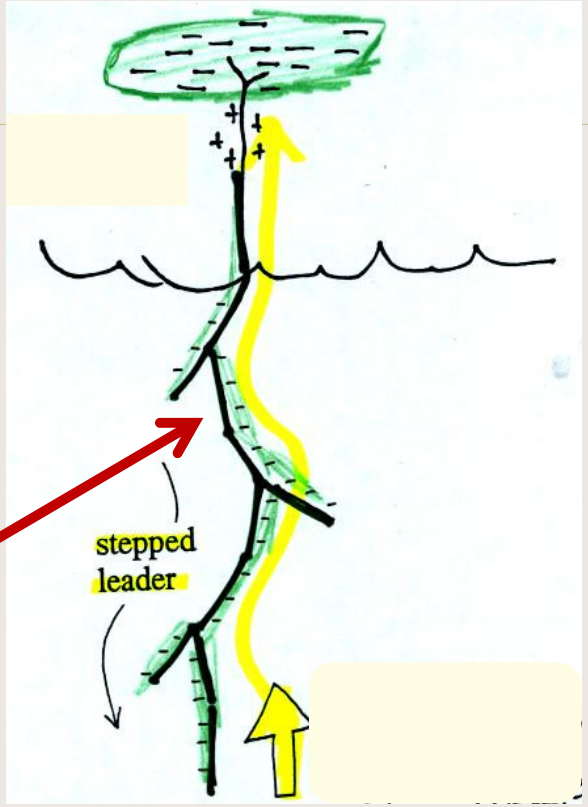
Budapest, Hungary

Panska Ves, Czech

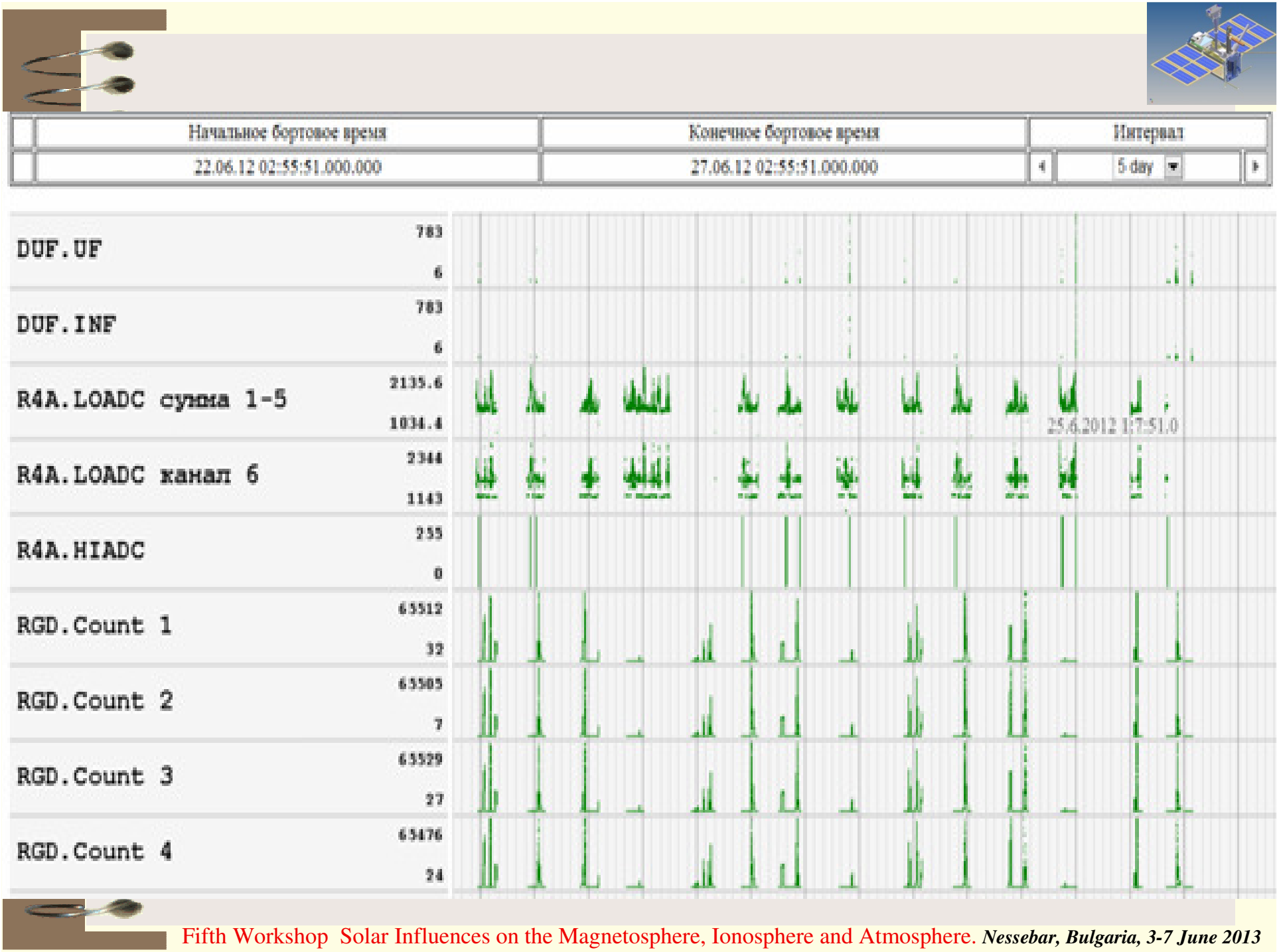


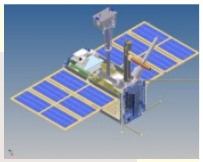
Step leader registration.





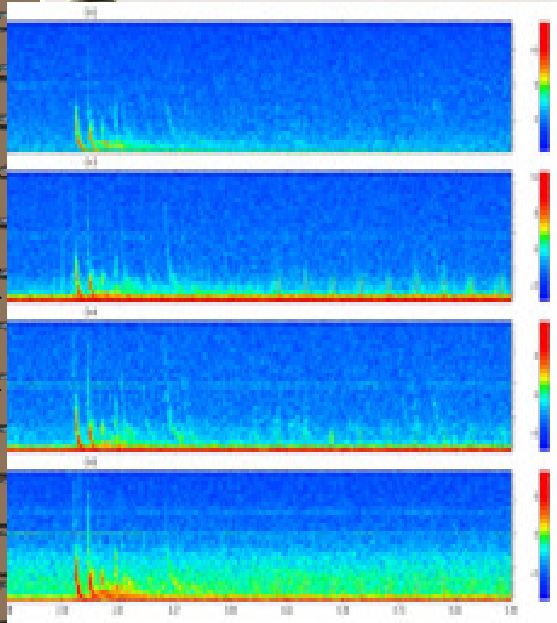
Multiple short level, with the interval of 50...100 mks within approximately 1 mks (step leader)

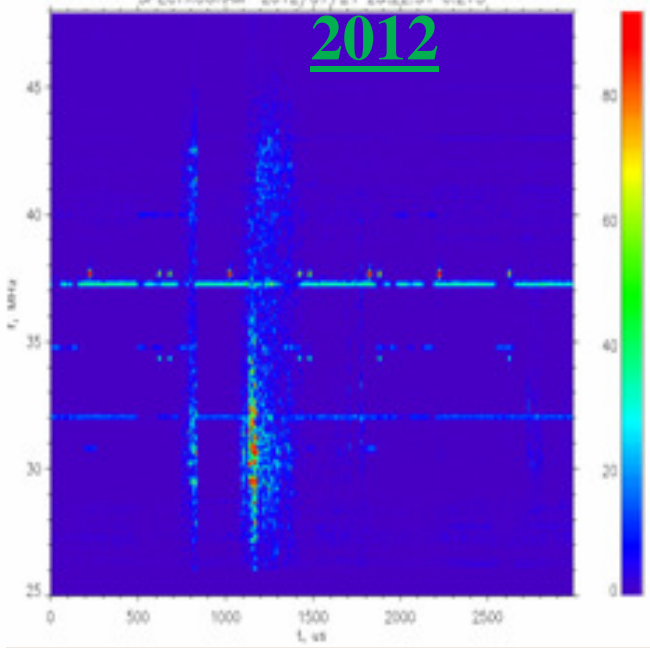

Начальное бортовое время
22.06.12 02:55:51.000.000
Конечное бортовое время
27.06.12 02:55:51.000.000
Интервал
5 day
DUF.UF
783
6
DUF.INF
783
6
R4A.LOADC сумма 1-5
2135.6
1034.4
25.6.2012 1:7:51.0
R4A.LOADC канал 6
2344
1143
R4A.HIADC
255
0
RGD.Count 1
65512
32
RGD.Count 2
65505
7
RGD.Count 3
65529
27
RGD.Count 4
65476
24



RChA, DUV, MWC 21 July 2012

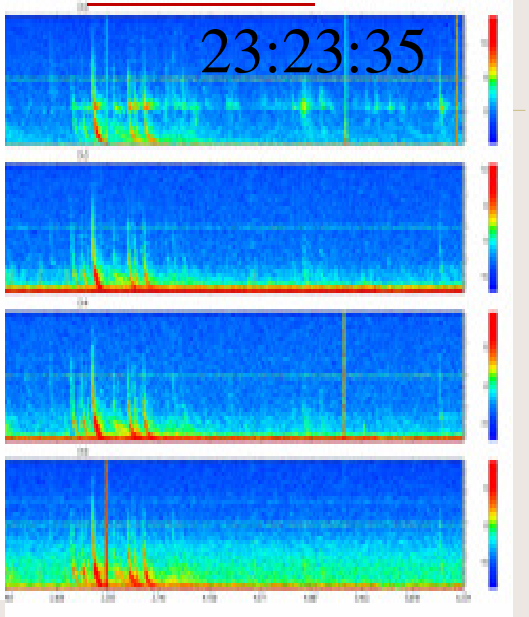
23:22:20 + 31s =





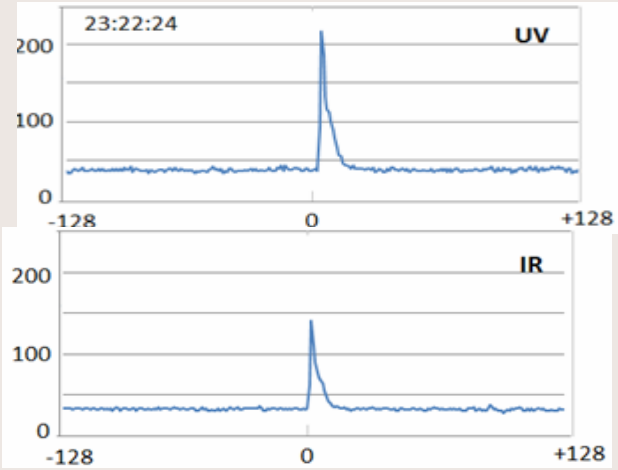
23:22:20 + 75s =

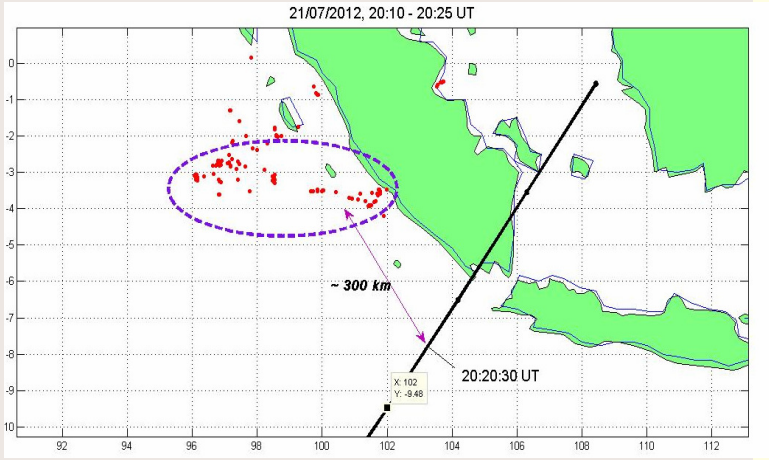
23:23:35

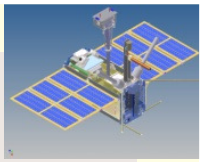


23:22:20 + 4s =

23:22:24

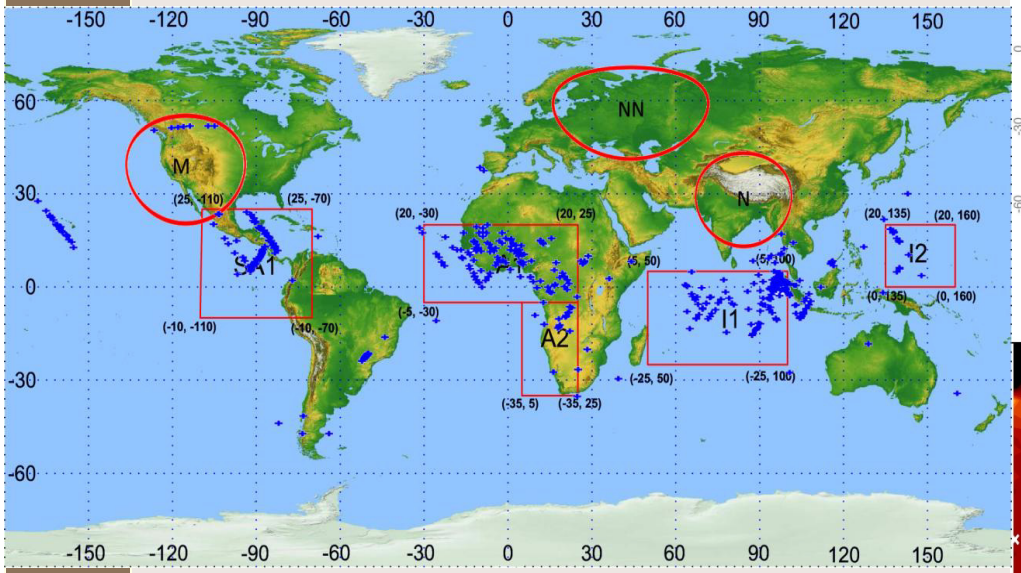


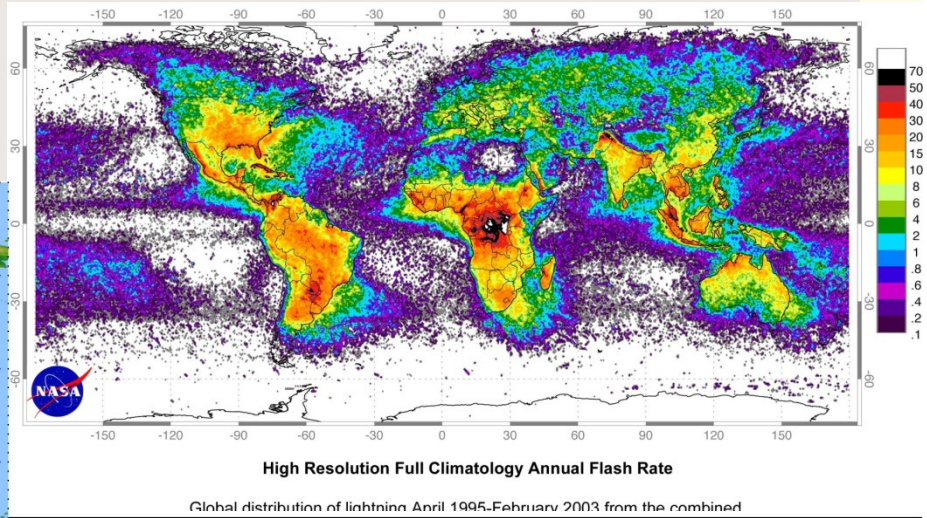




Preliminary results

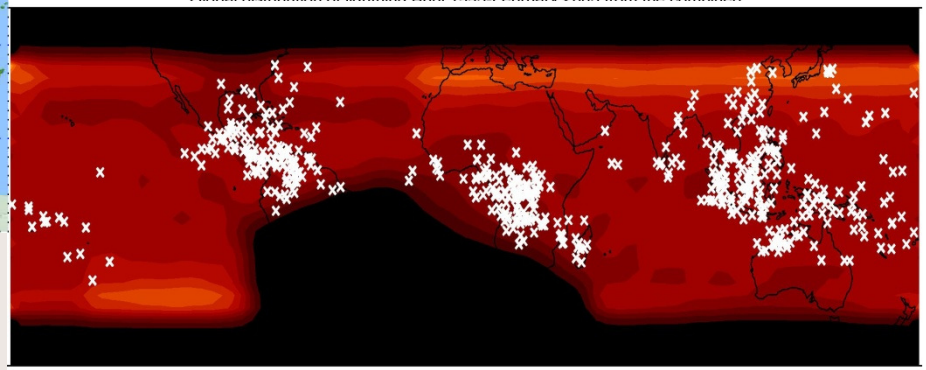
During its work «Chibis-M» were identified on the Earth zone of the most intensive man-caused interference and the zone of the most promising for the registration of lightning activity.

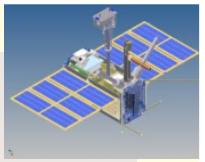




High Resolution Full Climatology Annual Flash Rate

Global distribution of lightning April 1995-February 2003 from the combined

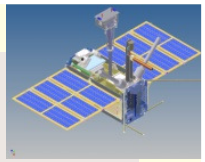




COOPERATION.

Coordinated with "Chibis-M"

ground observation

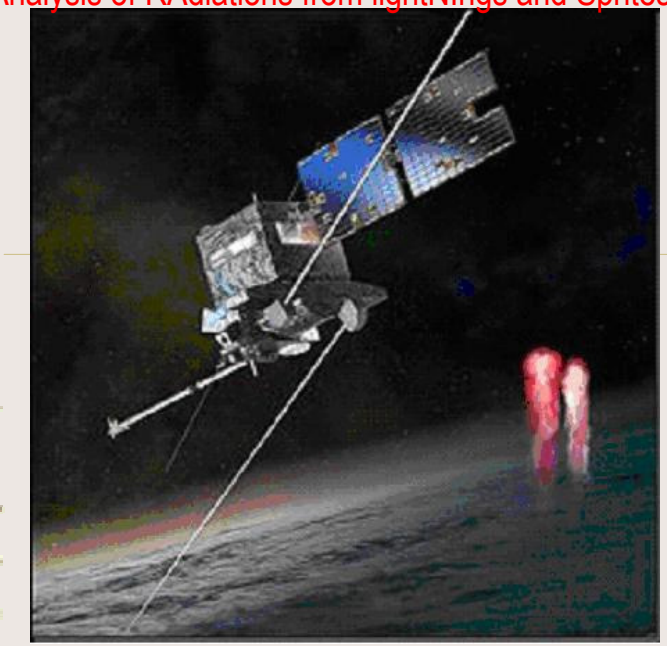


We is oriented for the measurements TGF and NBP at the height of the micro-satellite ~ of 500 km. Is certain, emission from the lightning, born at the height 5-20 km and propageted to the height 500 km, they interact with the ambient atmosphere and the ionosphere and change. We are interested in the contacts with the specialists, who study these interactions.

We should know the conditions, under which occur the discharges at the height of 5-20 km. For this are, in the first place, necessary the coordinated ground observations, especially in the equatorial regions.

TARANIS

(Tool for the Analysis of RAdiations from lightNIngs and Sprites)



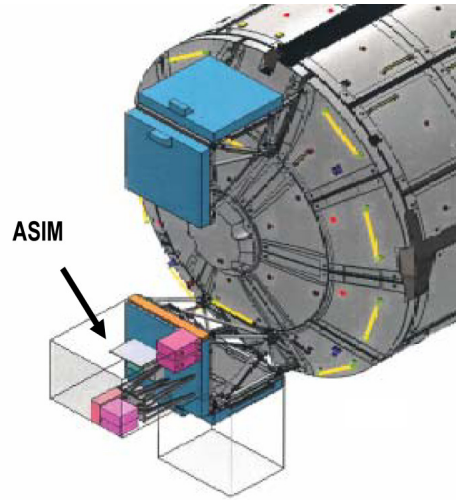
French micro-satellite project managed by the Laboratoire de Physique et Chimie de l'Environnement and Centre National d'Etudes Spatiales (Orleans)

The polar orbit at 650 km altitude

Payload includes:

2 cameras and 3 photometers (from IR to UV), X- and γ-ray detectors (20 kev - 10 Mev), energetic electron detectors (70 kev - 4 Mev), and electric- and magnetic sensors in a wide range (1 Hz - 30 MHz).

Launch is scheduled for 2015.



ASIM

(Atmosphere-Space Interactions Monitor)

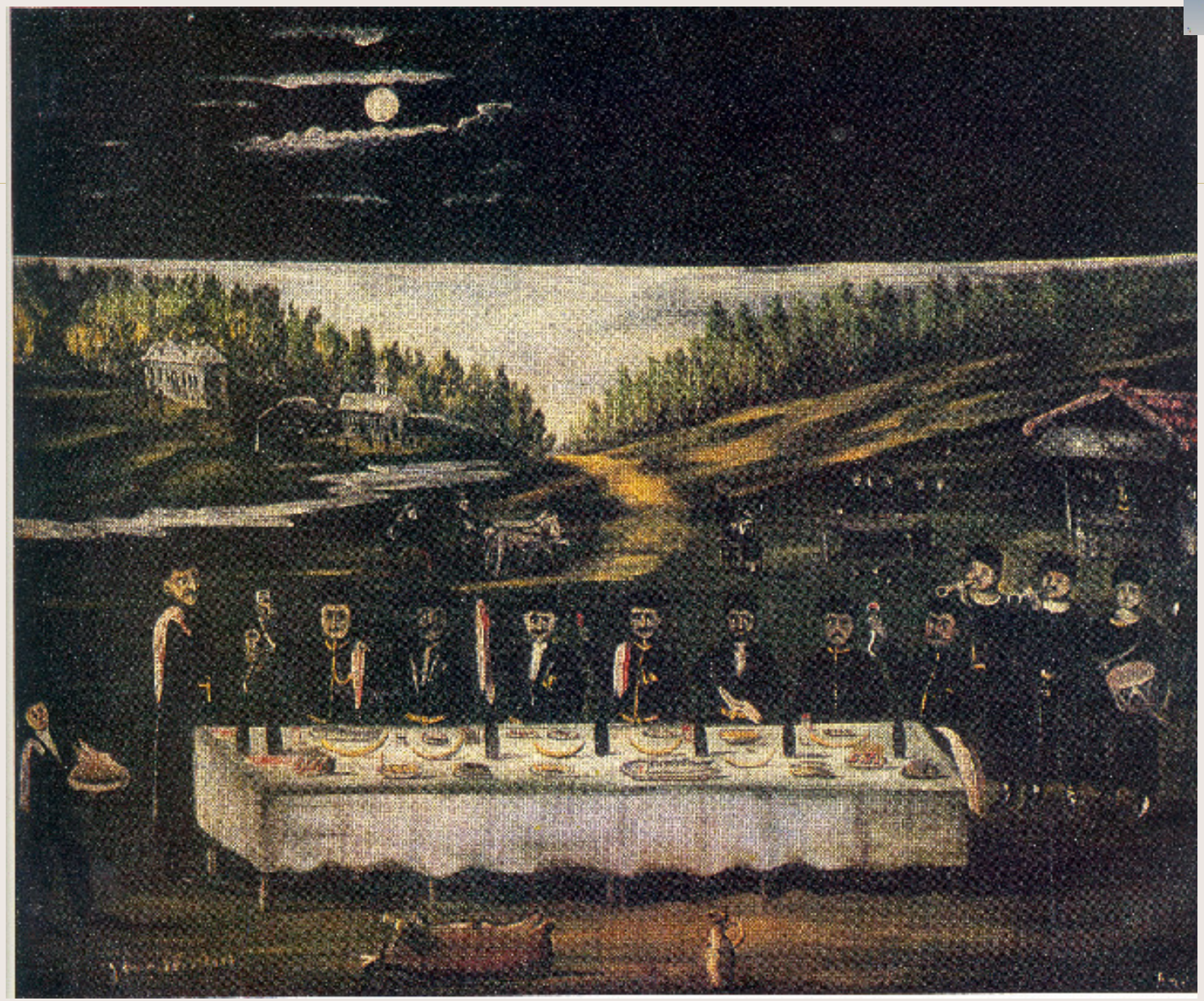
Scientific management - by the National Space Institute, Denmark.

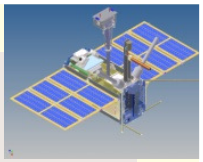
Mounted on the ISS external module Columbus, ASIM will study giant electrical discharges at high altitudes above thunderstorms.

The package of instruments includes 6 specially designed cameras, 6 photometers, and X- and γ-ray detectors.

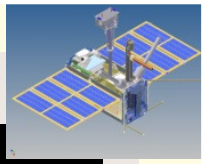
Expected to be launched in 2013, duration ~2 years.

Ancient method of the night observations






25.01.2012 02:09



Thanks for the attention

Distinguished Colleagues