



*Bauman Moscow State Technical University  
(BMSTU)*



## **“Baumanets” student micro-satellite**

**Presentation at UNIVERSAT 2006 International Symposium**

**June 28, 2006 Moscow, Russia**

**Victoria Mayorova**

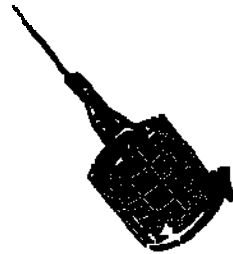
**Director of Youth Space Center of Bauman Moscow State Technical University  
Moscow, Russia**



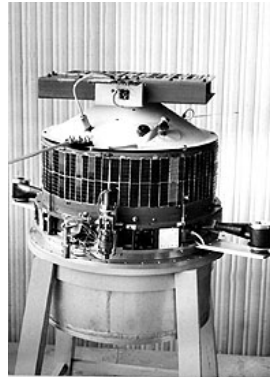
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## *Educational micro-satellites of Russia (USSR)*



**“RS-1”, “RS-2”**  
**1978**  
Mass: 40 kg



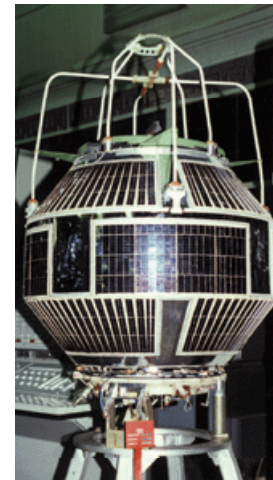
**“Iskra” (series)**  
**1981**  
Mass: 28 kg



**“Pion” (series)**  
**1989**  
Mass: 78 kg



**“Kolibri”**  
**2001**  
Mass: 20 kg



**“Mozhaetz” (series)**  
**2002**  
Mass: 67 kg



**“Tatyana”**  
**January 2005**  
Mass: 31 kg



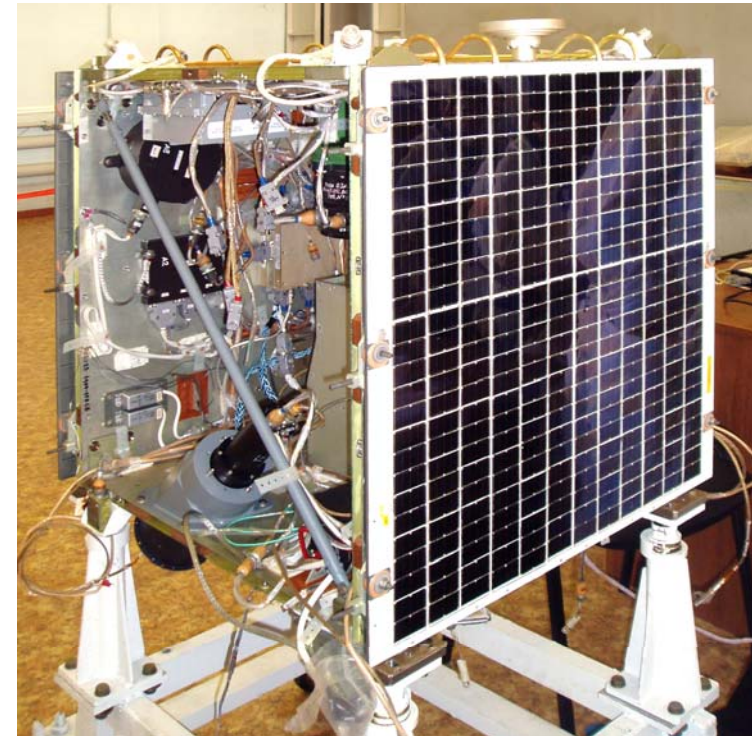
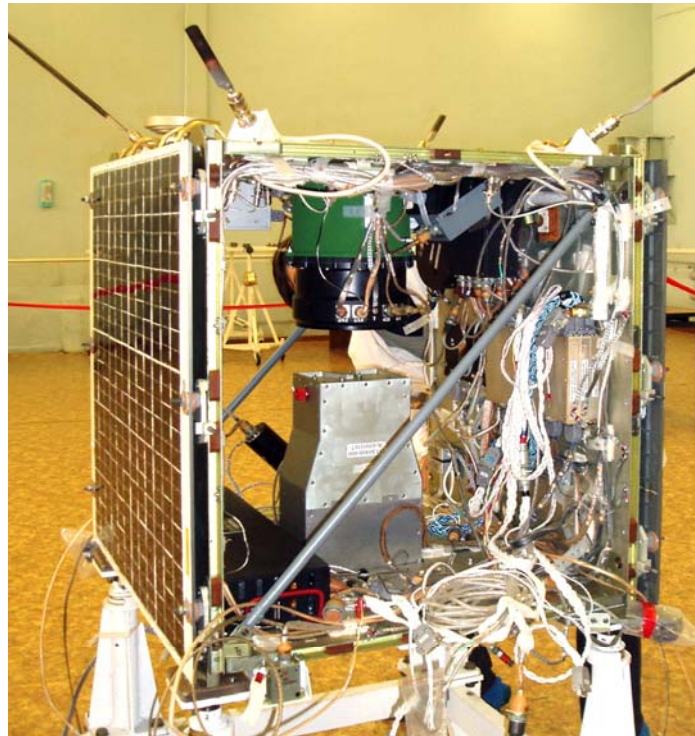




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## *"Baumanets" microsatellite*



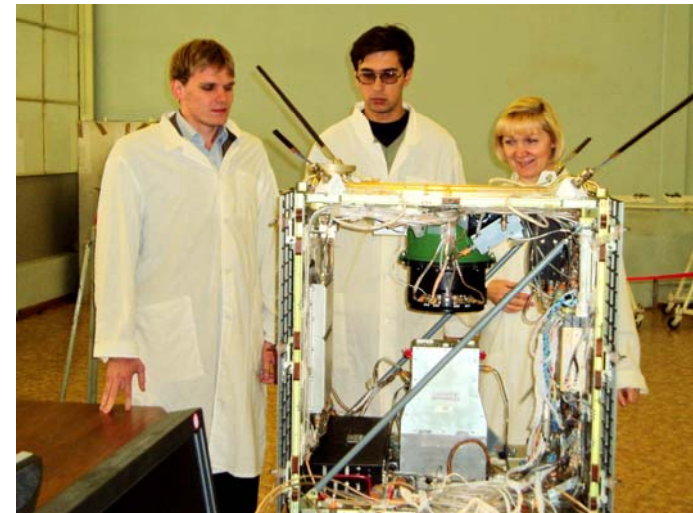




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## *Students work groups*





# Bauman Moscow State Technical University (BMSTU)



## Cooperation during "Baumanets" development

### BAUMANETS Project Cooperation



**Bauman Moscow  
State Technical University**

*Science and educational  
program, scientific hardware,  
mission control*



**"Mashinostroenie"  
Production Association**

*Main integrator of the project*



**"LEPTON"**

*Science and Production  
Association  
Optoelectronic hardware  
for Earth remote sensing*

**"SAIT"**

*Science and Production Enterprise  
Onboard radio link for remote  
sensing data transmission*



**Science and Research  
Laboratory for Aerospace  
Technology**

*Radio-communication system*



**ISC  
"KOSMOTRAS"**

*Installation and launch  
of Baumanets microsatellite  
on Dnepr LV*

*Research Centre for  
Earth operative monitoring  
Ground segment  
for data acquisition  
and processing*



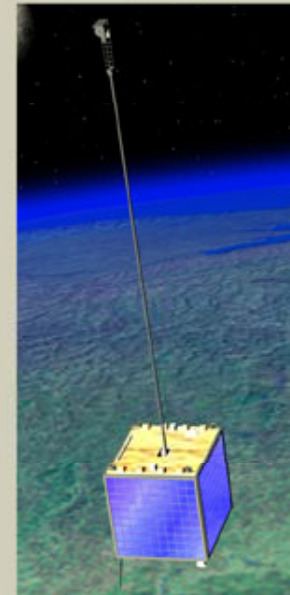
**Mission Control Centre**

*Mission control*



**Central Research  
Institute for Machine Building**

*Scientific expertise*



**"POLYOT"**

*Production Corporation  
Attitude control and  
determination system*



**"KVANT"**

*State Scientific  
and Production Enterprise  
Photovoltaic cells*



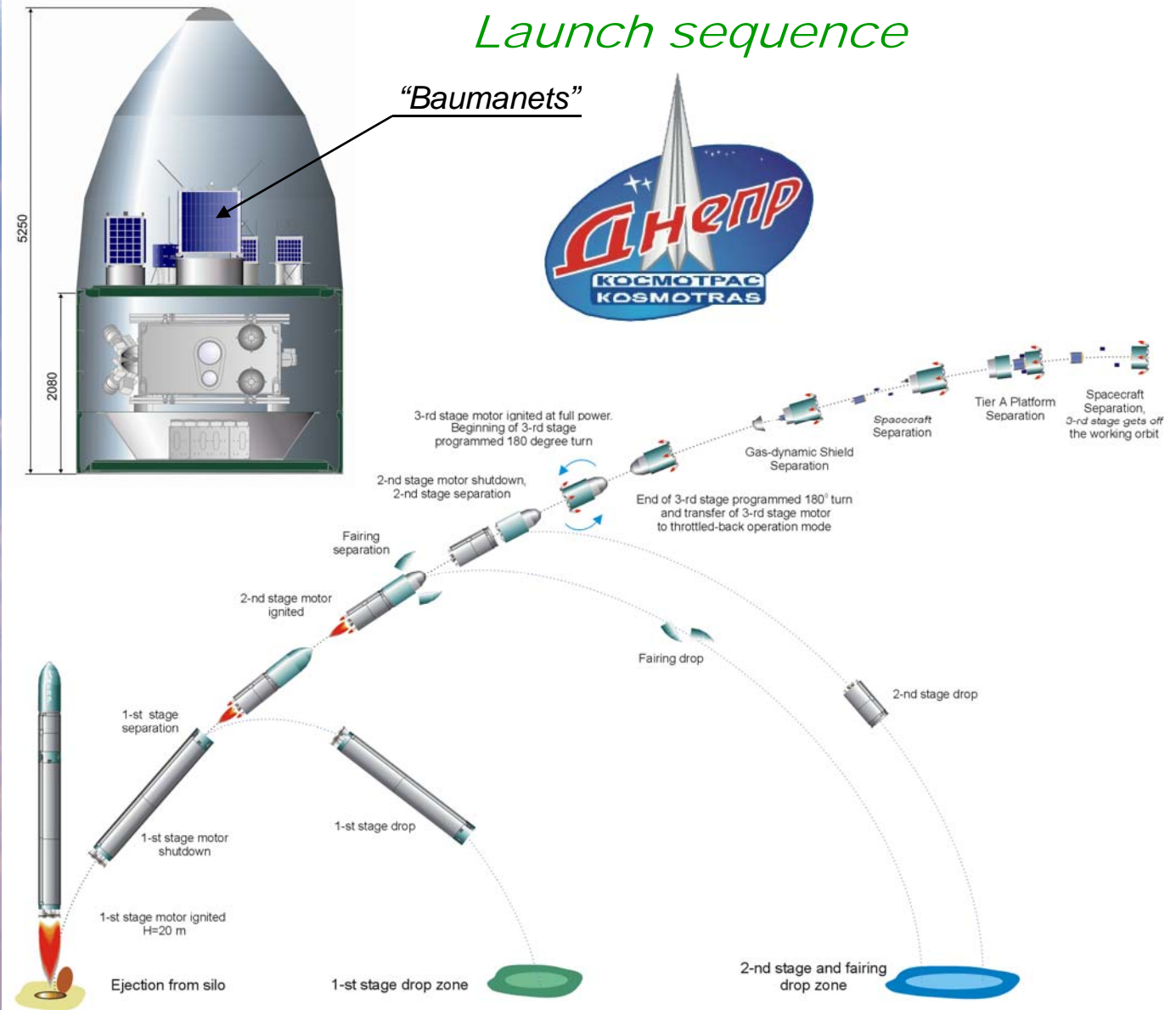
**"ISTOCHNIK"**

*Science and Research Institute  
for rechargeable batteries  
Rechargeable battery*





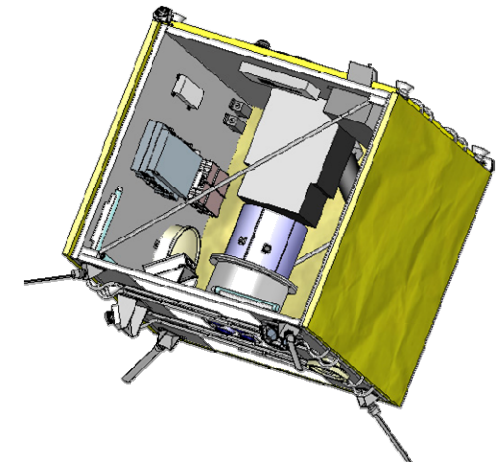
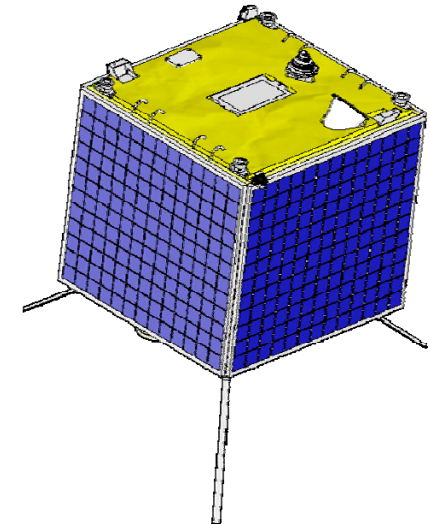
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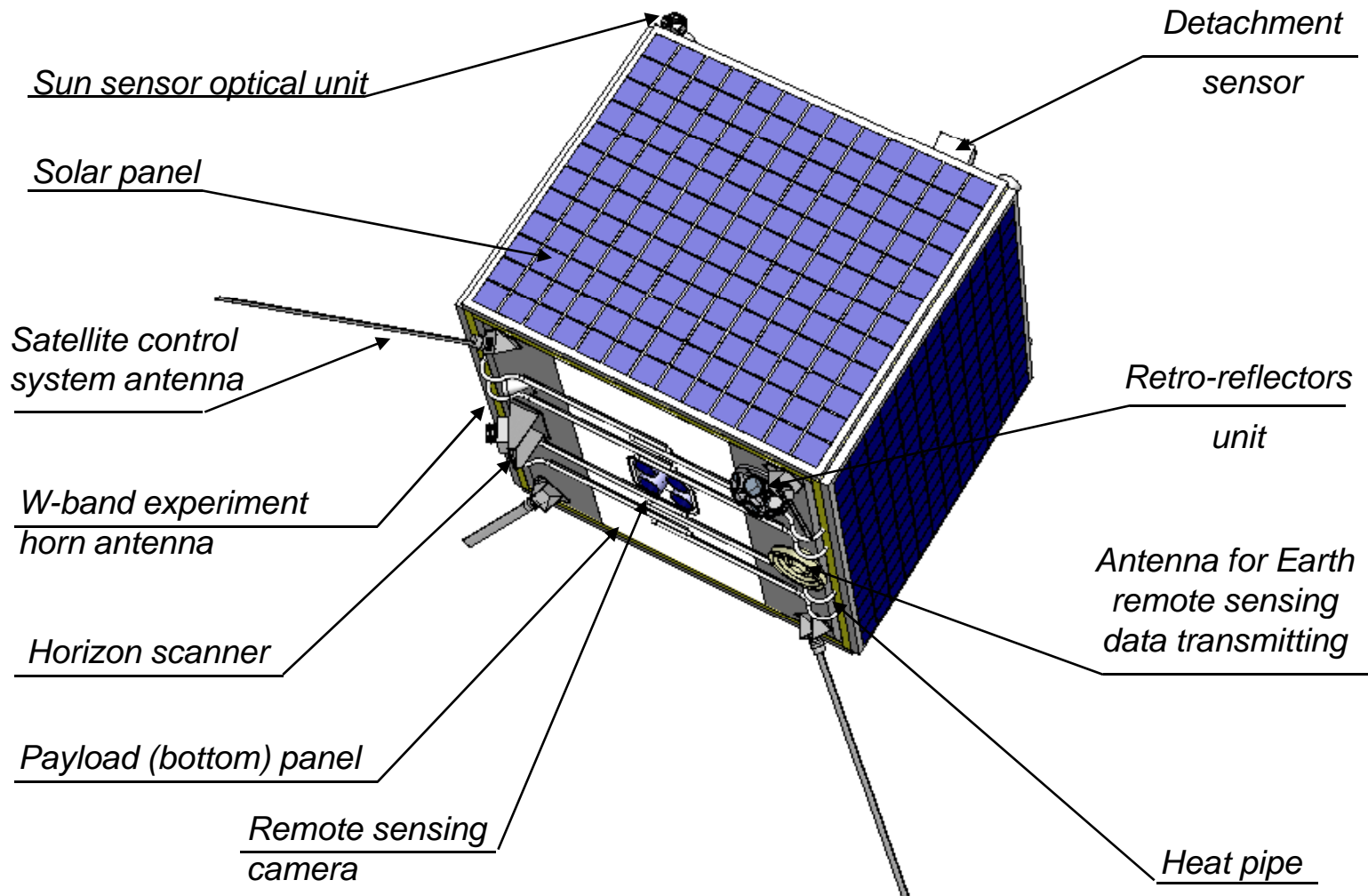
## *"Baumanets" characteristics*

Orbit altitude, km	490 - 510
Orbit inclination, degrees	~97,4° (sun-synchronous)
Mass, kg	97
Size, mm	700x700x700
Average energy usage, watts	22
Peak energy capability, watts	97
Positioning accuracy, degrees	< 2
Stabilization accuracy, degrees/sec	< 0,01
Data line width, Mbits/sec	27
Remote sensing data frequency, MHz	8192





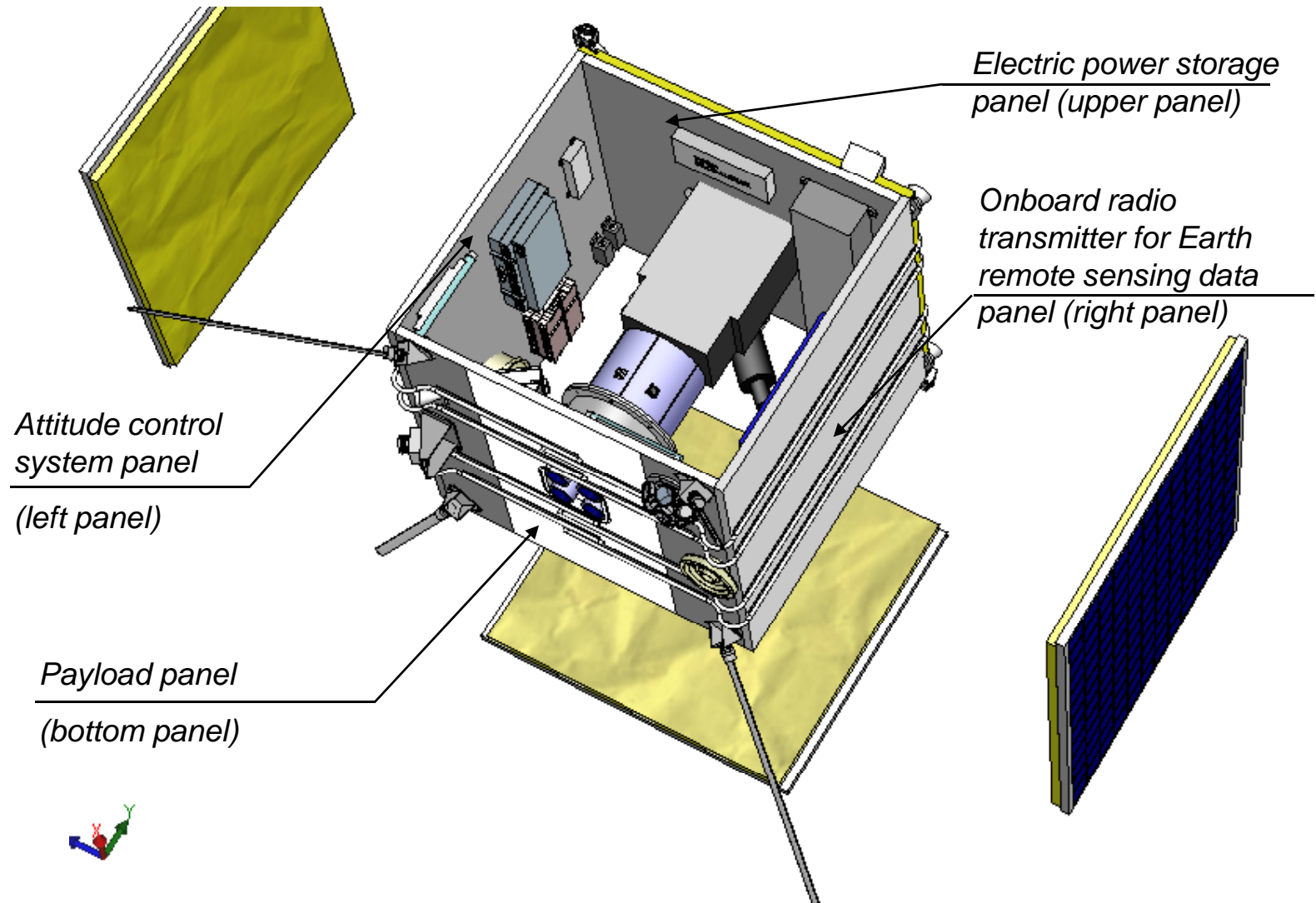
*"Baumanets" general arrangements*







*"Baumanets" general arrangements*

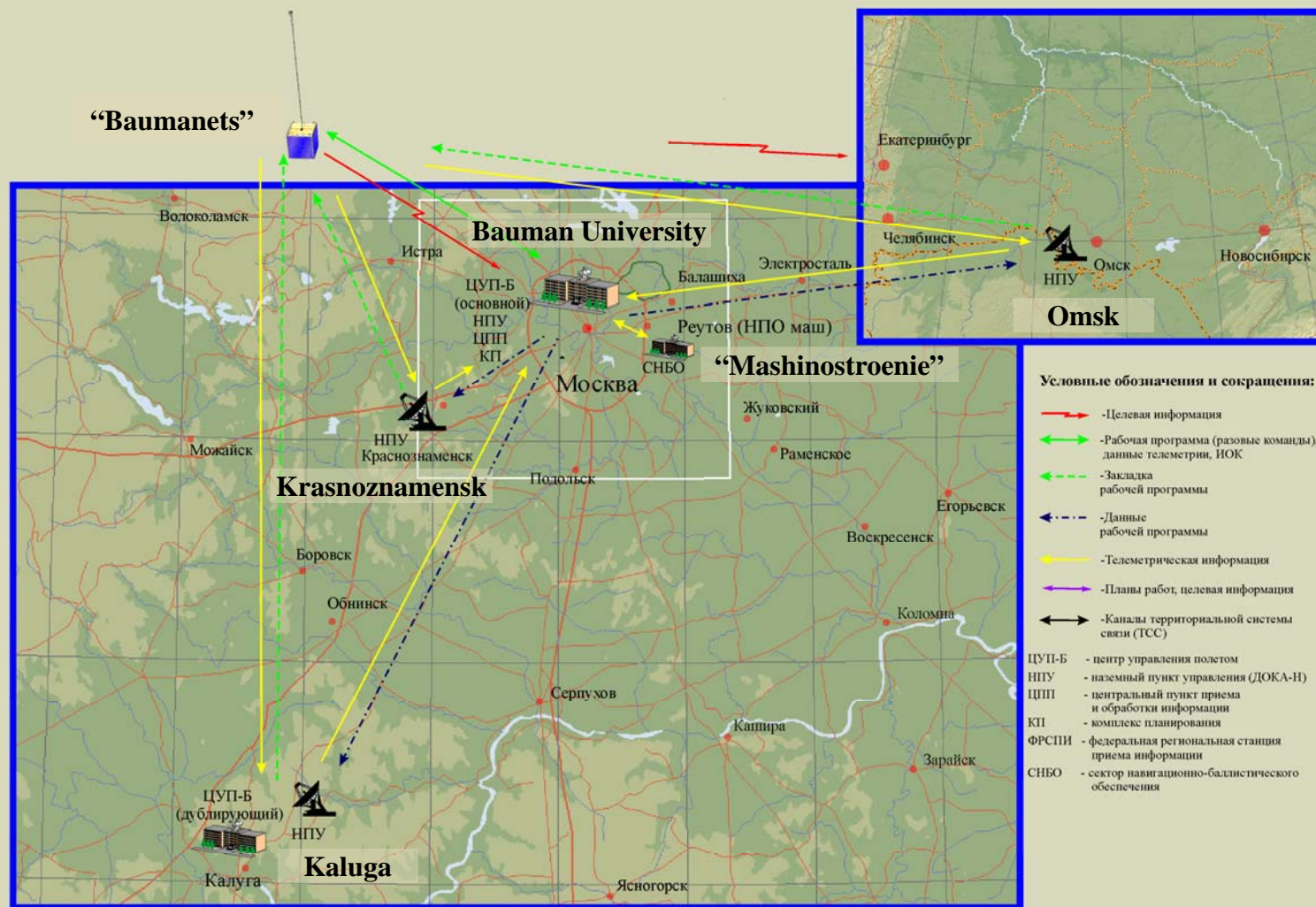




# Bauman Moscow State Technical University (BMSTU)



## "Baumanets" control network







*Bauman Moscow State Technical University  
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*Educational programs:  
preparing skilled workforce for space industry*

## **Educational program based on “Baumanets” satellite project**

**Scientific  
experiments on  
board of  
“Baumanets”**

**Creation of Mission  
Control Center**

**Creation of Remote  
Sensing Data  
Processing Center**

**Creation of “Satellite  
Technologies”  
laboratory**

**Development of  
“Small Satellite  
Design”  
academic course**

**Development of  
practical laboratory  
courses**

**International Cooperation**



*Educational scientific experiments*

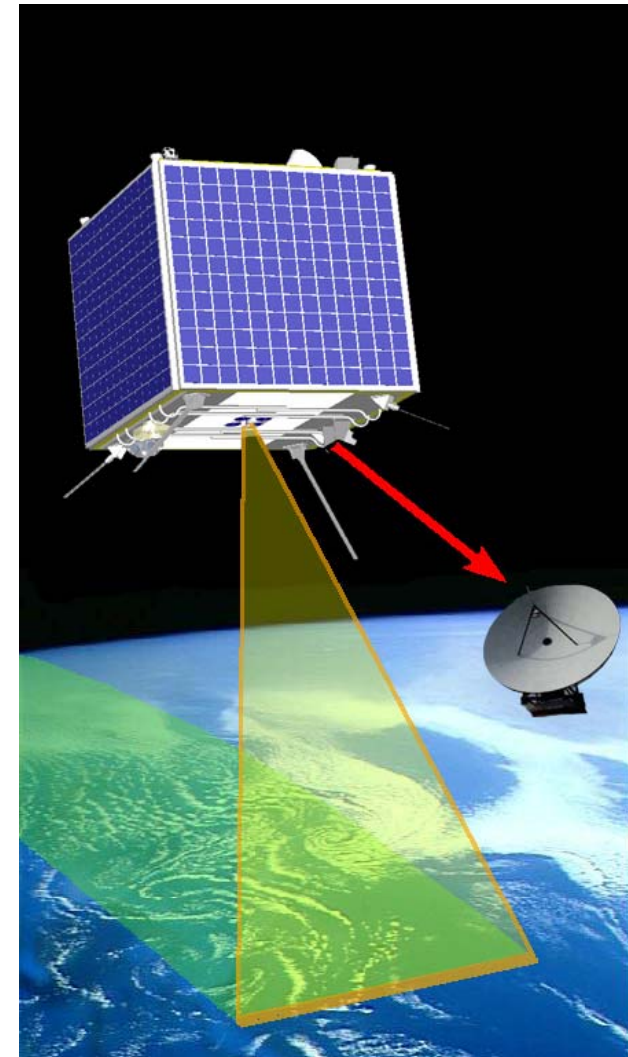
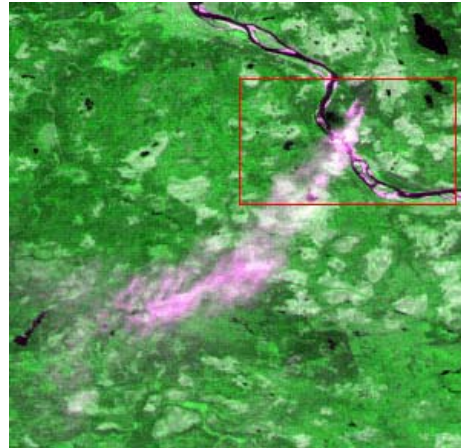
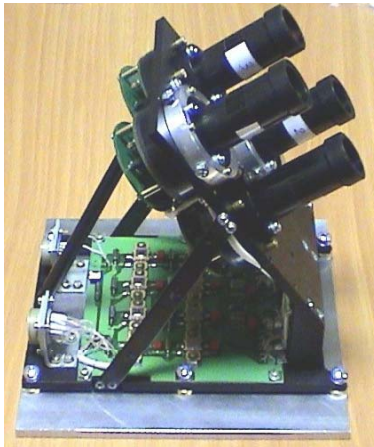
1. **Earth remote sensing**
2. **Orbit parameters definition with retro-reflectors**
3. **Measuring signal attenuation in millimeter wavelengths at low receiving angles**
4. **“GlobalStar” terminal experiment**
5. **Development and testing of on-board computer**







## *1. Earth remote sensing*





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## 1. Earth remote sensing

### SkanEx stations network

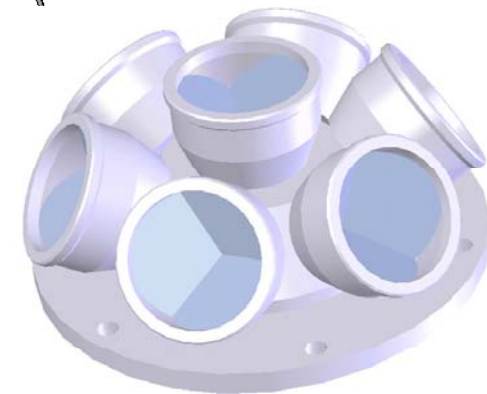
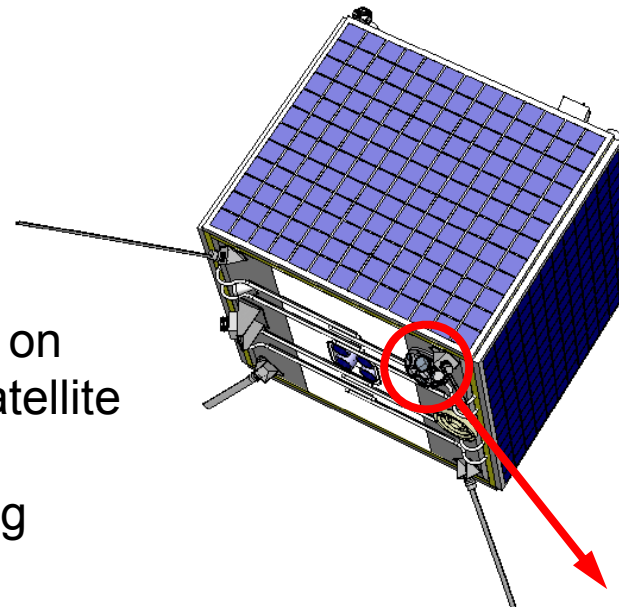






## *2. Orbit parameters definition with retro-reflectors*

- Precise information on Baumanets microsatellite orbit parameters is necessary for testing onboard systems
- Research of Earth gravitational field model



**Laser retro-reflectors unit**





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## 2. Orbit parameters definition with retro-reflectors International network of laser location stations





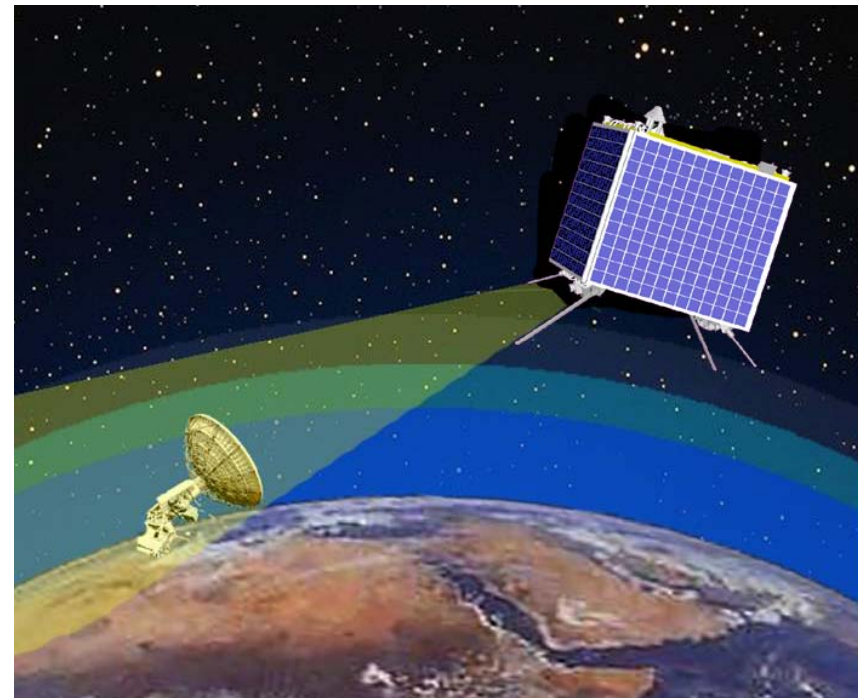


### *3. Measuring signal attenuation in millimeter wavelengths at low receiving angles*

Measuring signal attenuation at 94 GHz wavelength communication during Satellite – Earth data transmitting.

Study influence of factors:

- Receiving angle
- Atmospheric conditions





### *3. Measuring signal attenuation in millimeter wavelengths at low receiving angles*

#### **Ground segment**

#### **Two radio-telescopes**

Bauman University facility,  
Dmitrov region

#### **Telescope characteristics:**

- Antenna diameter 7.75 m
- Focal distance 3250 mm
- Working wavelength 1-8 mm
- Structural mass 30 tonnes
- Maximum angular tracking speed
  - Azimuth 200 ang. sec/sec
  - Bearing 300 ang. sec/sec



**Eastern telescope**







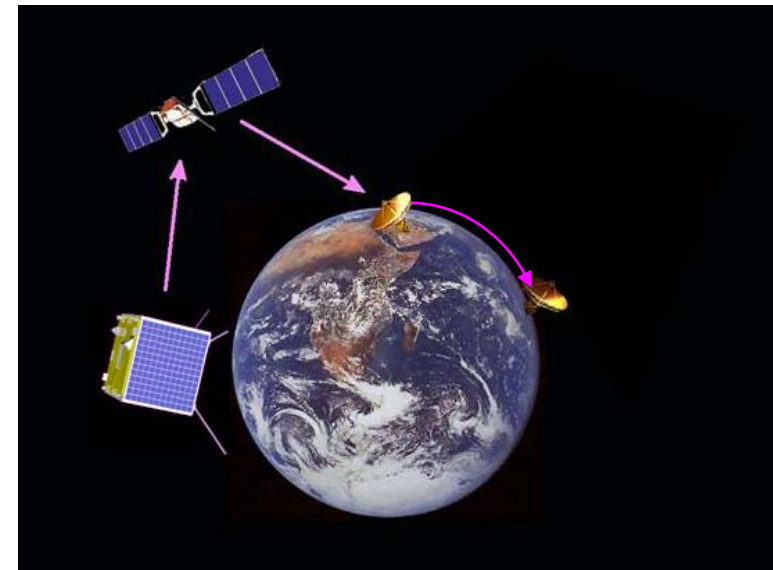
#### *4. "GlobalStar" terminal experiment*

Possibility to transfer telemetry and scientific data from satellite to ground stations via "Globalstar" network

Possibility to send satellite control signals from ground stations via "Globalstar" network

Possibility to define satellite's position with the help of "Globalstar" network

Define zones of stable connection with satellites on orbit within "Globalstar" network



**Signal transfer**



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## 4. "GlobalStar" terminal experiment

### GlobalStar coverage

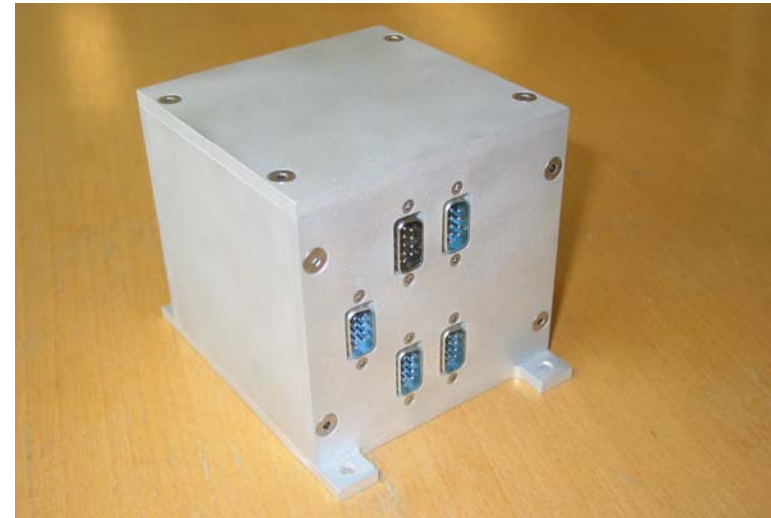






## *5. Development and testing of on-board computer*

- commercial “of the shelf” components
- size: 100x100x130 mm
- energy consumption: 0.5 watt
- non-pressurized container
- mass: < 1 kg
- ARM7DTMI processor @ 40 MHz
- 32-digit address bus
- 2MB PSRAM (pseudo static RAM)
- 2MB EPROM
- 4MB FLASH
- RS232, CAN2B interface
- 16 input/output channels
- ECOS 2.0 operating system
- “C” programming language





## *International cooperation*

- Access to remote sensing information directly from satellite
- Joint analysis of images received from the satellites
- Laser location using retro-reflectors
- Partnership in satellite developing
- New experiments on board
- Share experience in satellite design







*Bauman Moscow State Technical University  
(BMSTU)*



## *Contact data*

*Youth Space Center:*

***<http://ysc.sm.bmstu.ru>***

***[ysc@bmstu.ru](mailto:ysc@bmstu.ru)***

*Tel:*

***+7-095-263-6994***

*"Baumanets" micro satellite:*

***<http://microsat.sm.bmstu.ru>***





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*Thank You!*