Samara State Aerospace University

The project of the scientific - educational small satellite for research of Earth upper atmosphere density

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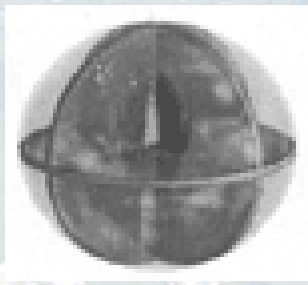
Some history : small satellite PION



Mass – 50 kg
Diameter – 0,35m

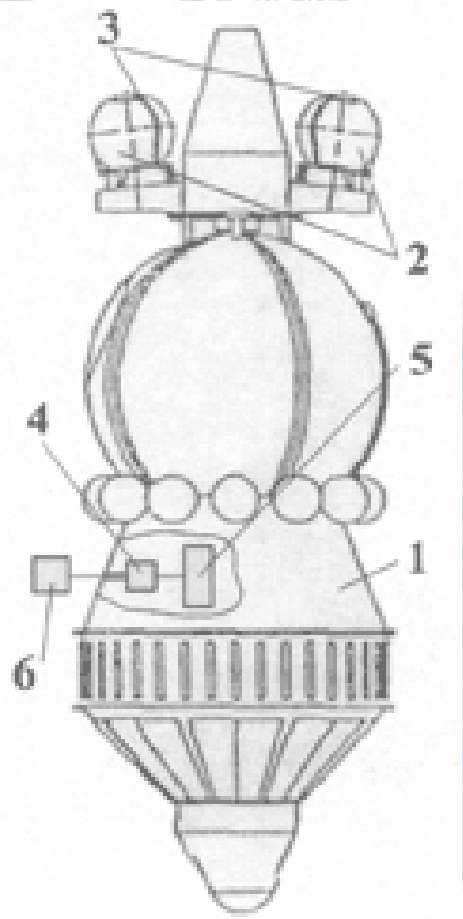
Were launched six satellites from 1989-1992

Some history : small satellite PION

The tasks were solved by small satellites PION:

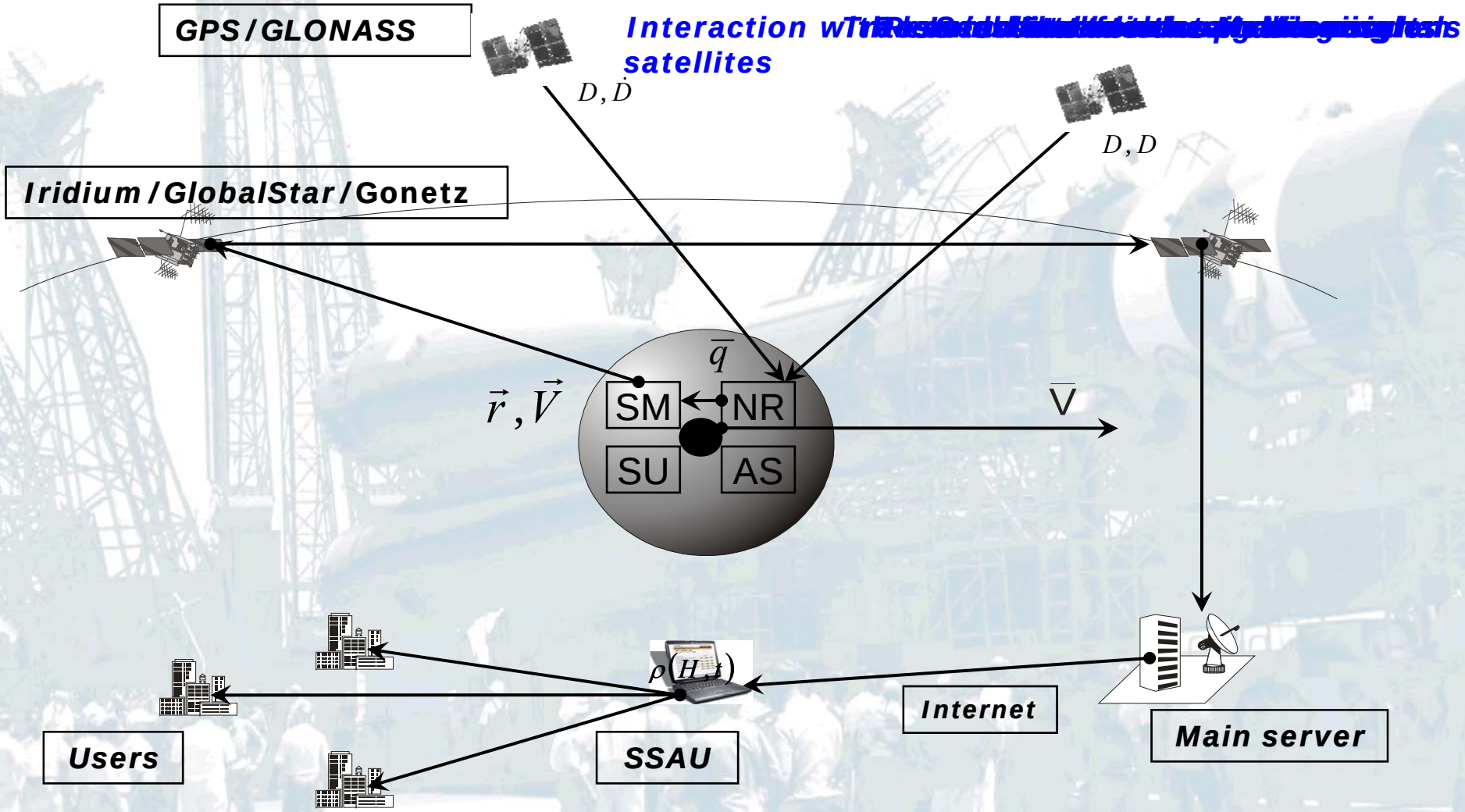
- ***Operative refinement of characteristics of the upper atmosphere density model***
- ***Refinement of aerodynamic characteristics for the space objects making flight in the same altitude interval, as PION***
- ***Improvement of methods and means of the radar control of space and tracking point targets***
- ***Perfection of methodical and program ballistic maintenance of flight space experiments***

Some history : small satellite PION



1. ***Resurs/Foton space vehicle***
2. ***Small satellites PION***
3. ***Ejection systems***
4. ***Control system***
5. ***Autonomous supply unit***
6. ***Ground testing unit***

Concept of scientific-educational small satellite "EoI"



NR – navigating receiver, SM – satellite modem, AS - auxiliary systems, SU – supply unit

The tasks for scientific-educational small satellite "Eol"

The main applied applications of the project "Eol" are:

- Research of changes of the Earth upper atmosphere density, including its short-period variations
-Improvement of the existing model of Earth upper atmosphere density
- Improvement of the technology of usage of navigation receivers for operating definition of Earth upper atmosphere with a minimum time lag;
- Improvement of the technology of support of constant access to onboard satellite systems and transmission of scientific data from the satellite to customers with usage of low-altitude communications satellites networks (Global Star, Orbcomm, …) and a global INTERNET network (without usage of existing ground control centers);
- Improvement of the perspective damping system of satellite

The tasks for scientific-educational small satellite “Eol”

- The educational tasks decided by the project:
- - Improvement of educational technologies of the remote training using direct access to the process of measurements in orbit;
- - Increase of quality of student space education

  on the basis of possibility of involvement in designing and manufacture of the small satellite,

  on the basis of access to the process of direct measurement of motion parameters, receiving and processing of the measuring information;
- - Created in support of the project available information resource in the INTERNET will advocate reaching of cosmonautics especially among youth.

The navigating ballistic substantiation of project parameters

Initial orbit parameters satellite “Eol” (the same like space vehicle “Foton”): height in apogee - 320 km, height in perigee – 280 km

Ballistic coefficient c_x :

$$\sigma = \frac{C_X S}{2m},$$

where C_X - coefficient of aerodynamic drag (for sphere is about 2,15)

m -”Eol” mass,

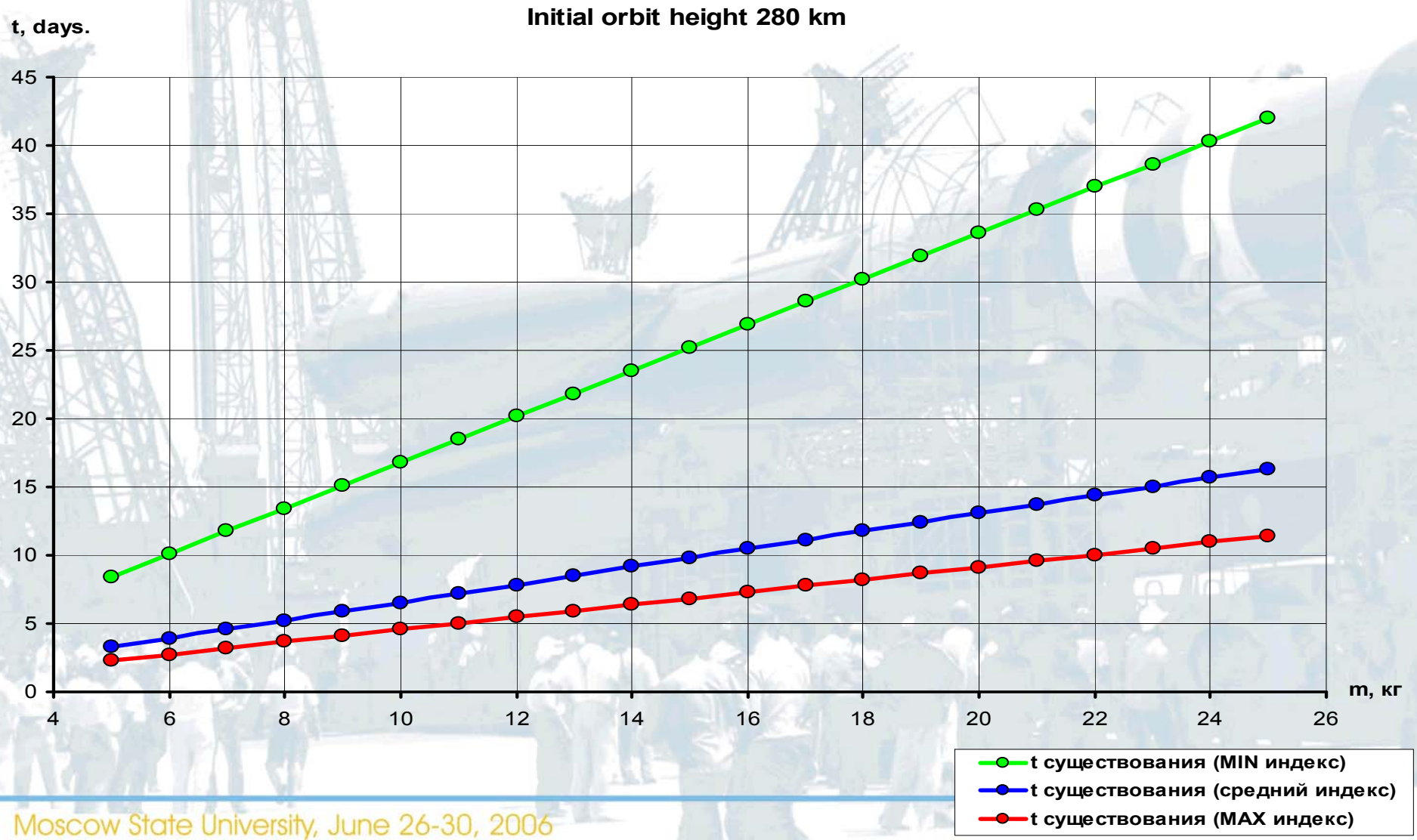
S - “Eol” maximum cross-section area

Changing of trajectory parameters for the turn:

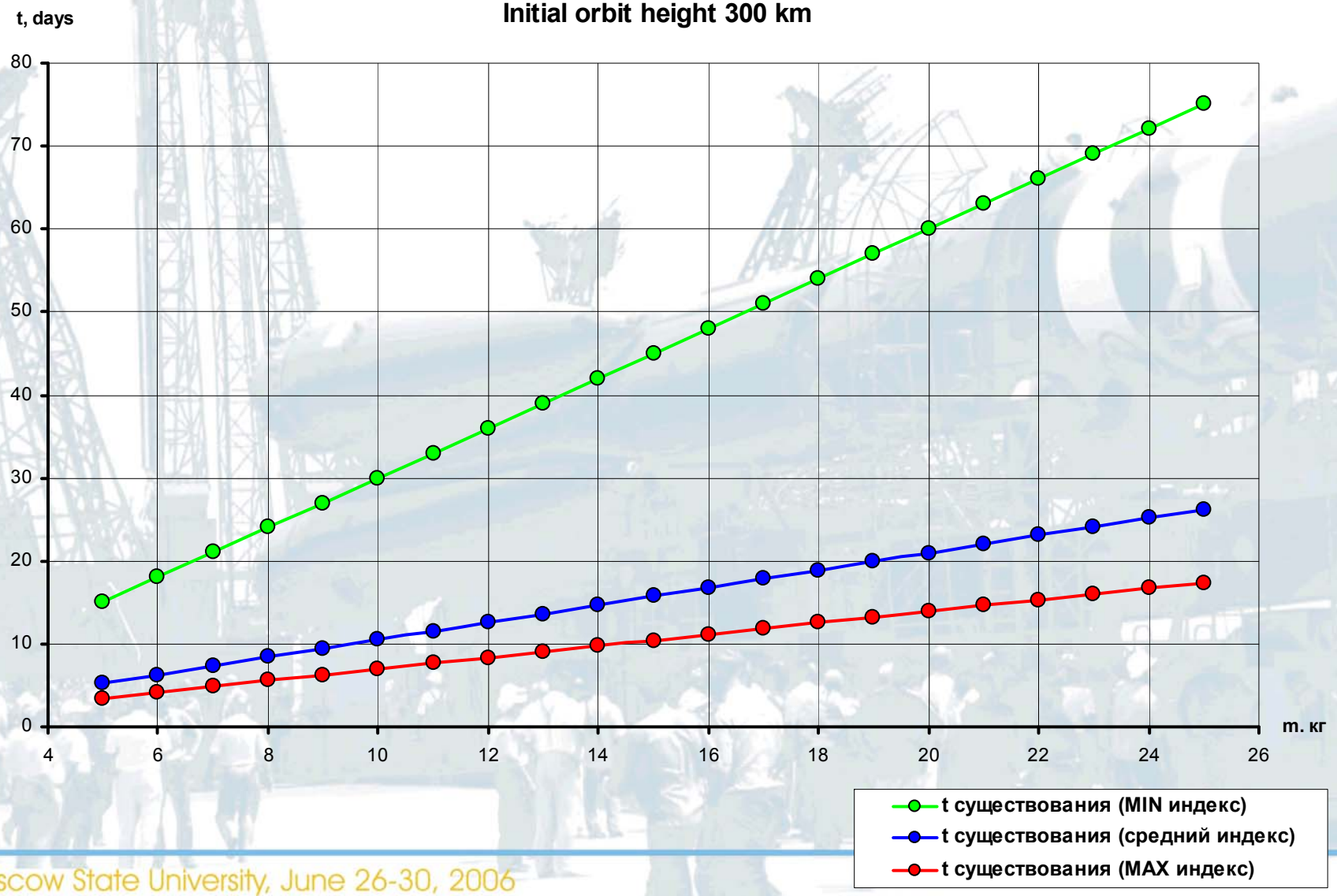
- module of radius - vector $\delta r = -4\pi\sigma\rho r^2$

- displacement along orbit $\delta l = 12\pi^2\sigma\rho r^2$

The navigating ballistic substantiation of project parameters



The navigating ballistic substantiation of project parameters



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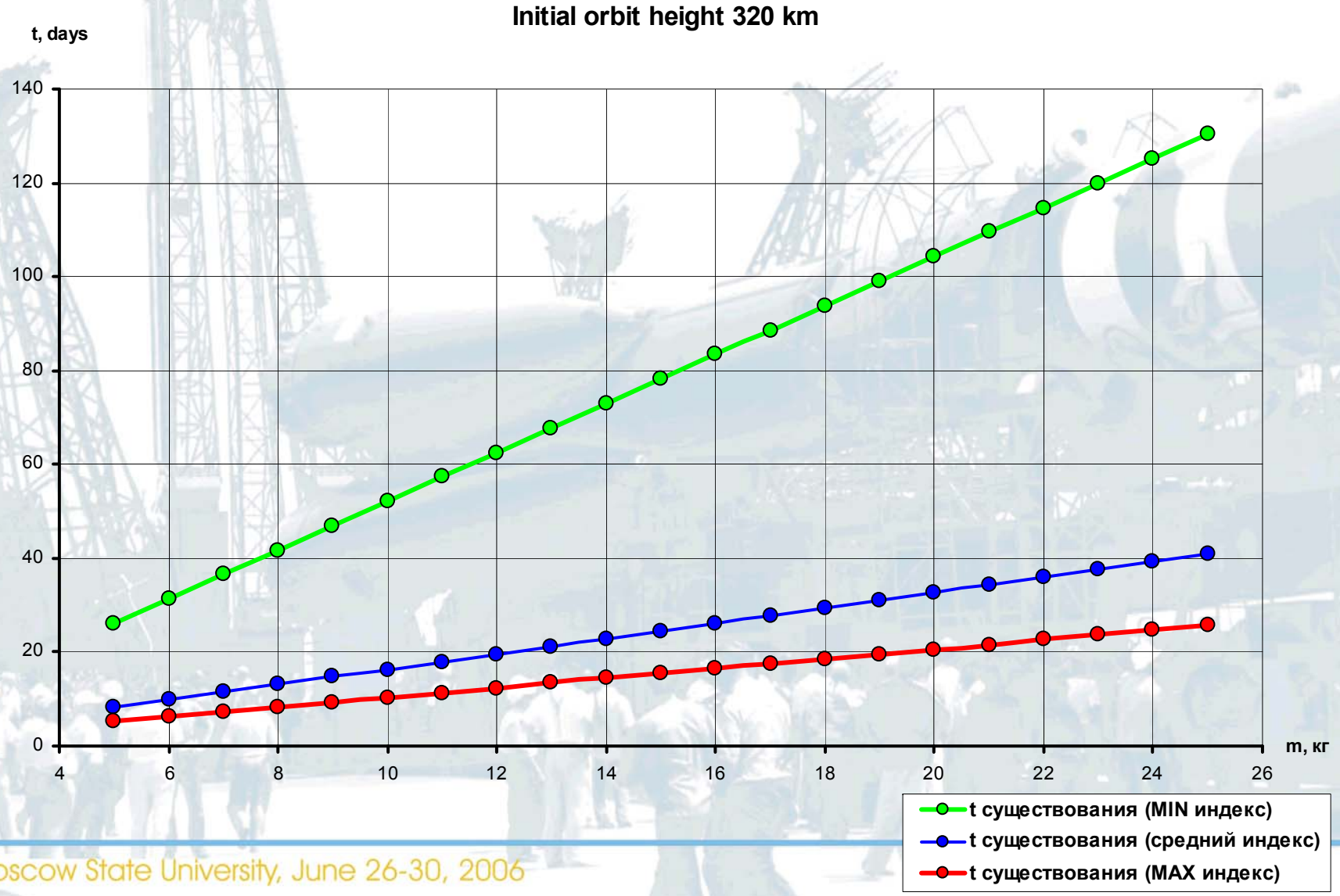

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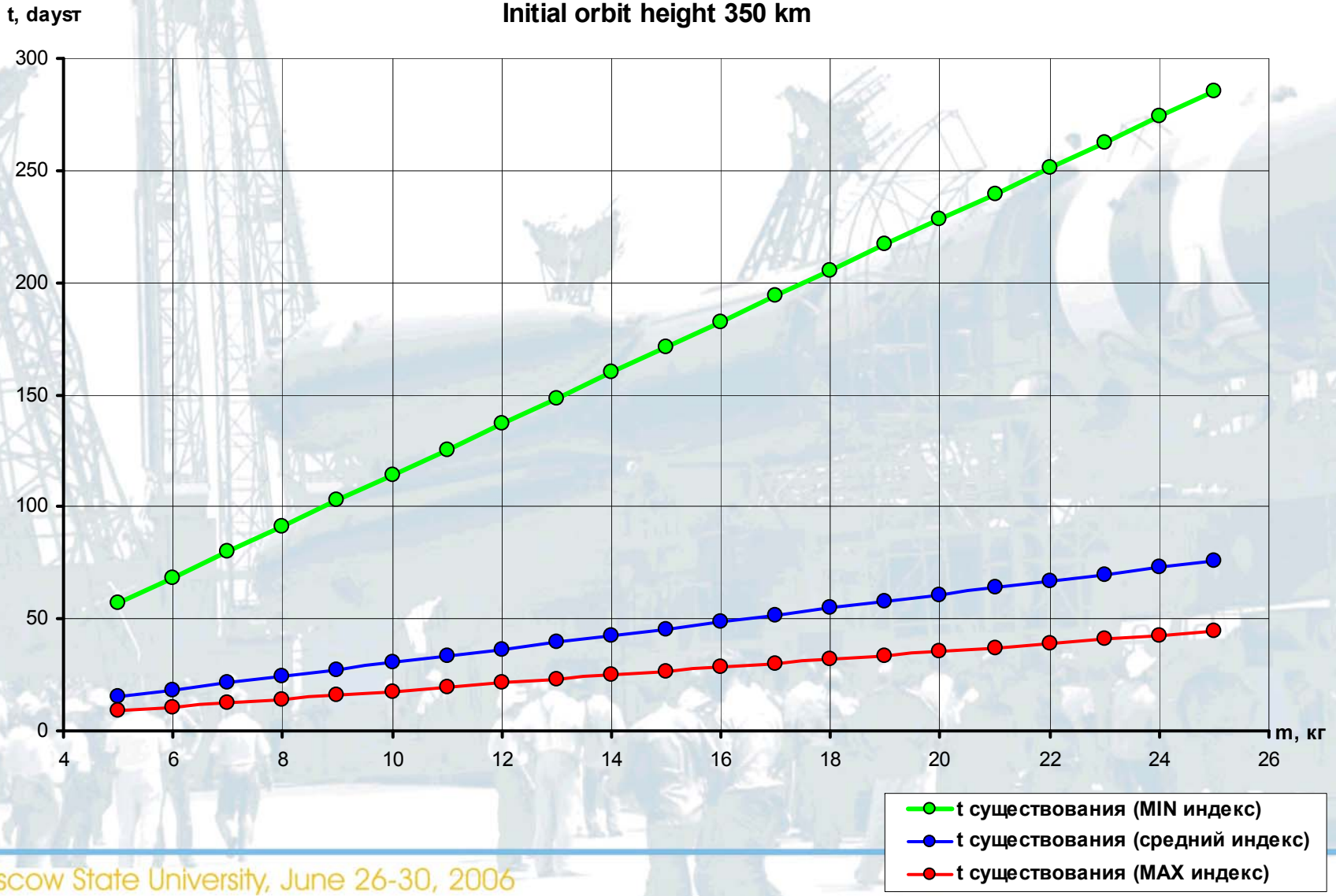
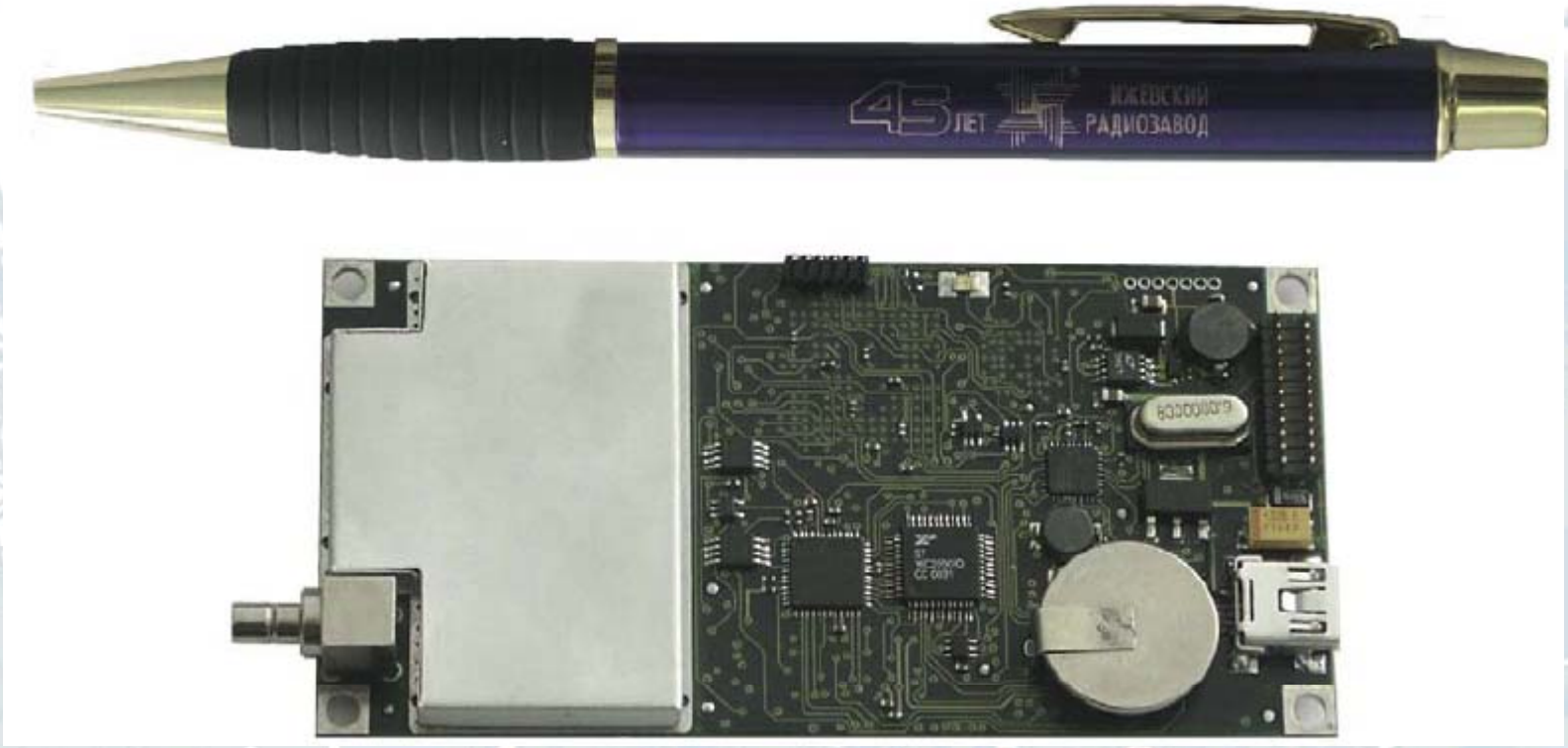


The device of attachment and ejection of satellite “Eol”

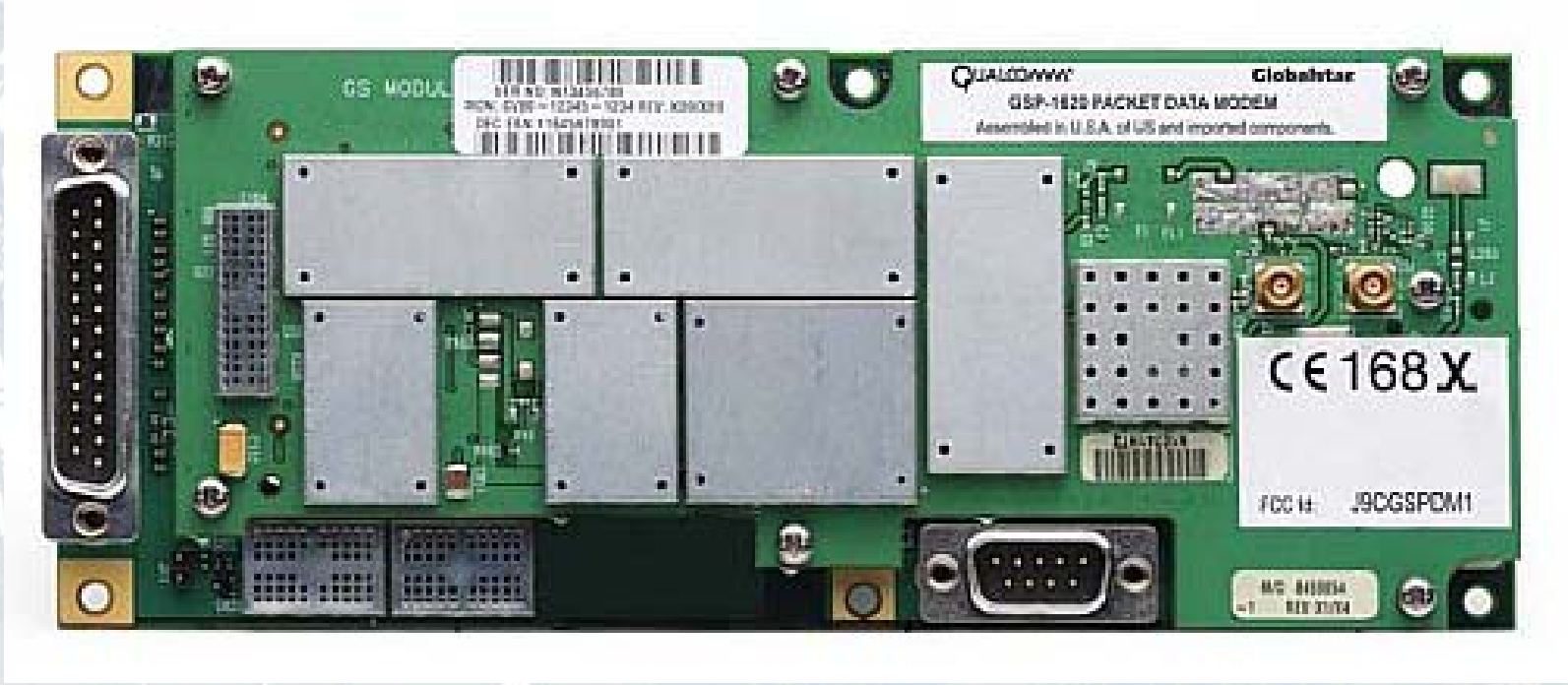
Ejection device is spring type:
after command supply on separations knifes work, coupling tapes are exempted, and due to energy of a spring there is a pushing away of a satellite to speed about 2 m/s.

Navigating GPS/GLONASS receiver (Izhevsk Radio Plant)



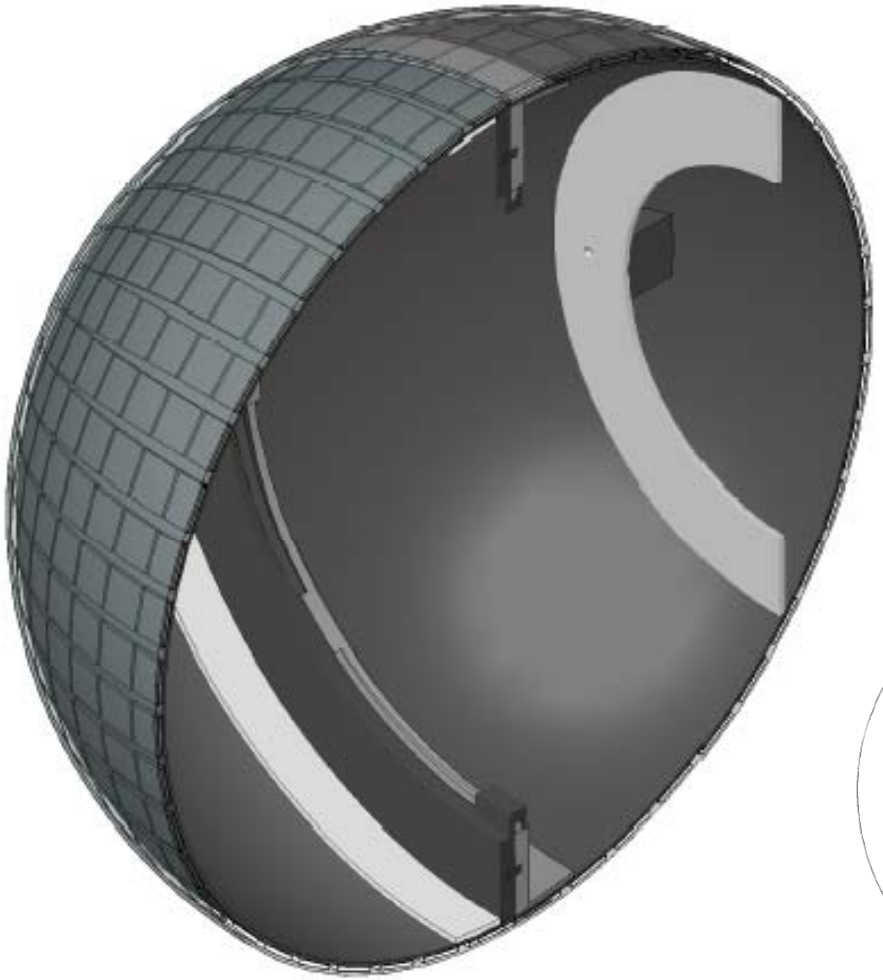
Dimensions - 90 mm x 45 mm x 9 mm; power supply - < 1,7 W; mass - 25 g ; number of canals - 16

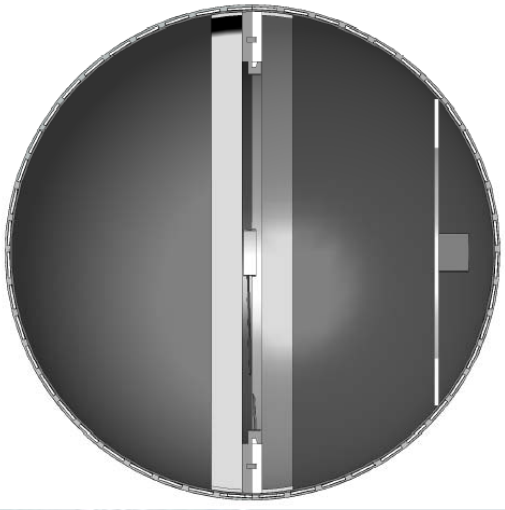
Satellite modem

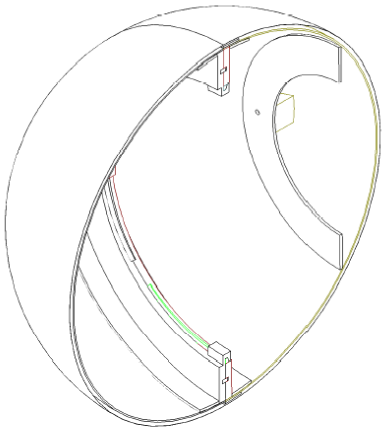


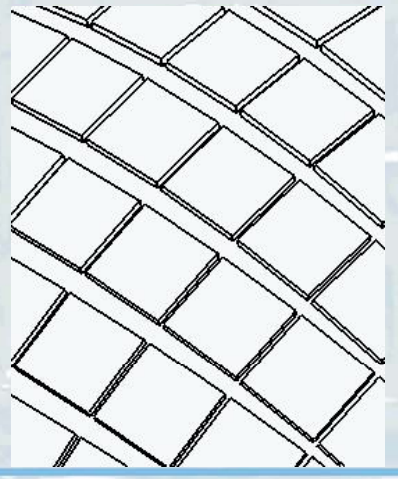
Dimensions – 190 mm x 75 mm x 17 mm;
mass - 180 g.

Preliminary construction of satellite “Eol”









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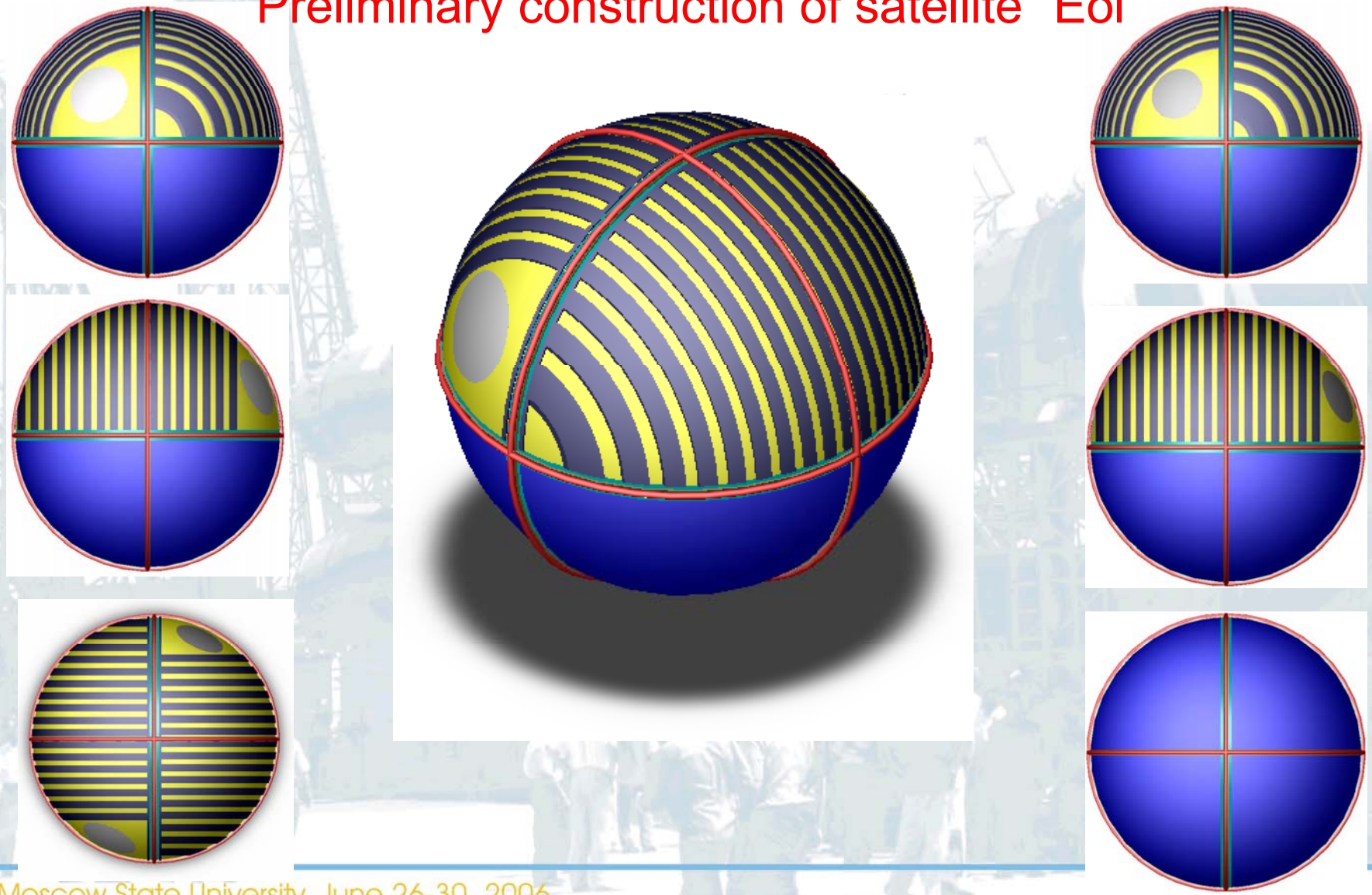

Thank you very much for attention

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