

# Project of Lithuanian Nano-Satellite

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# INTRODUCTION

The Lithuanian Energy Institute and the Institute of Biochemistry participated in the soviet space program "Mars";

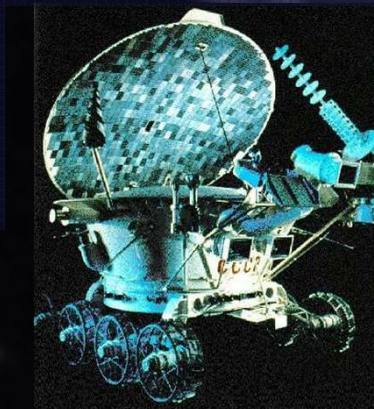
The Institute of Botany researched plant-physiology at zero gravity conditions at Salyut and Mir orbital stations;

Faculty of Semiconductor Physics of Vilnius University developed photodetector arrays of robotic vision systems for the Lunar rover "Lunokhod";

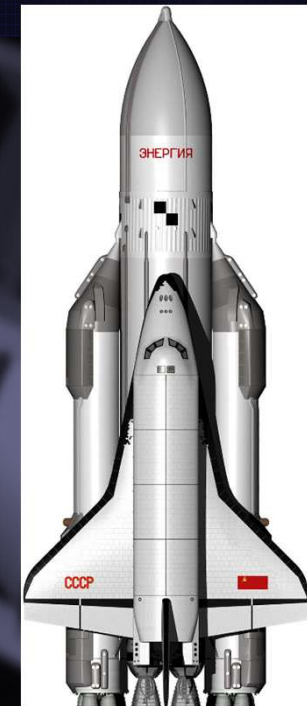
Lithuanian Textile Institute developed technology of heat insulation panels for the shuttle "Buran";

Kaunas University of Technology researched a piezoelectric control and vibrotechnics systems of liquid-fuel rocket engines;

Direct access to the space has been lost for the last 20 years;

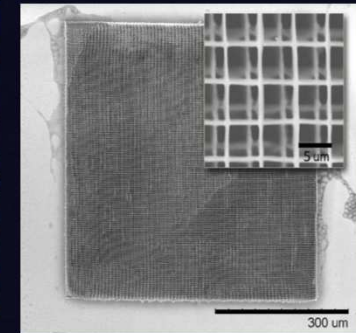


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# MAIN AREAS OF ACTIVITIES

- **Microsensors & microactuators - MEMS, MEOMS**



- **Thermoaerodynamics**

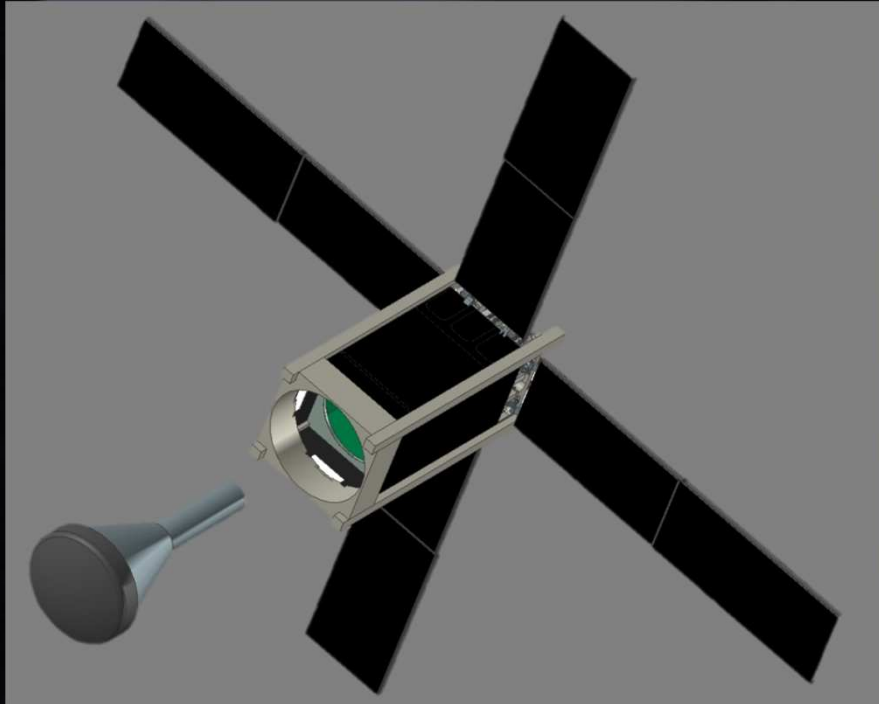


- **ICT**



- **Space science – microgravity and astrophysics**

# GENERAL IDEA OF THE PROJECT



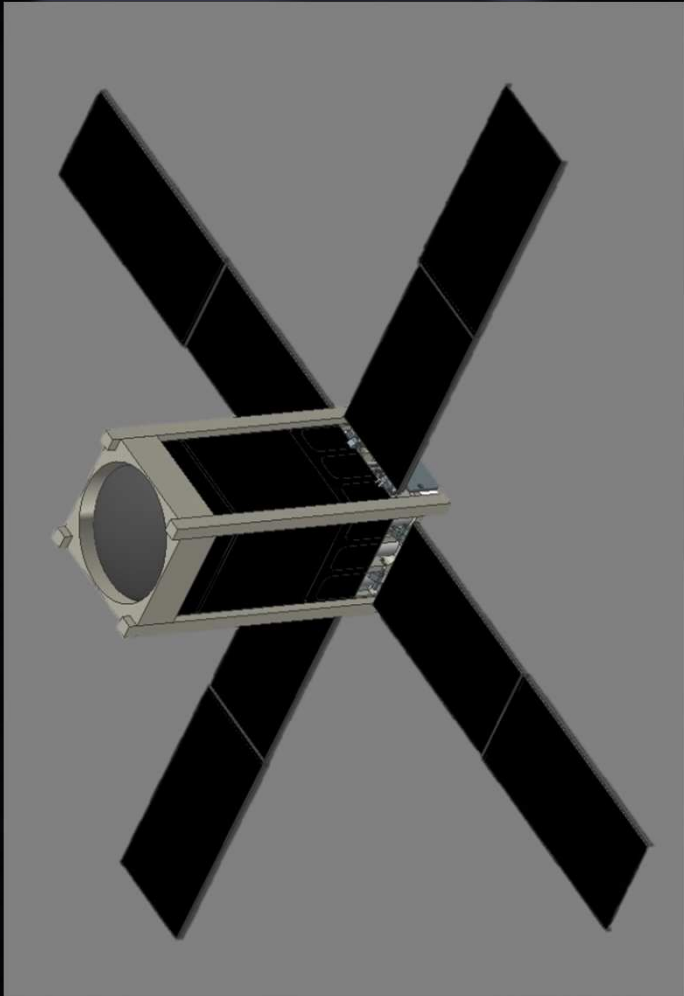
Idea of the mission should be new, interesting from scientific point of view and involve previous works;

Idea – to construct nano-satellite with a capsule capable of re-entering Earth atmosphere;

Satellite should consists of:

1. Service module;
2. Research module – re-entry capsule with 100 g of scientific payload;

# SERVICE MODULE



2U – 3U type CUBESAT;

Standard main processor with the possibility of devices control by means of the analogue signals;

Standard means of communication;

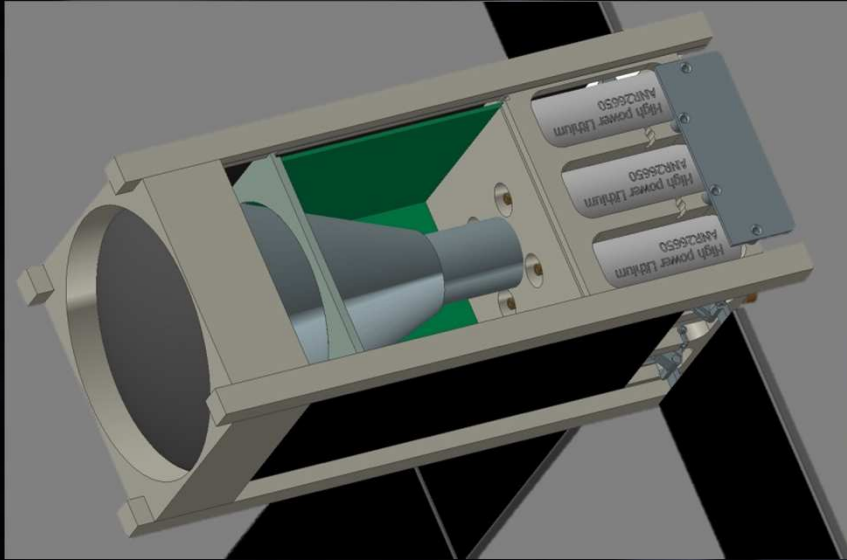
Standard means of attitude determination;

Means of active propulsion for controlled deceleration;

Some special means of attitude control;

Advanced launch container.

# SATELLITE DECELERATION

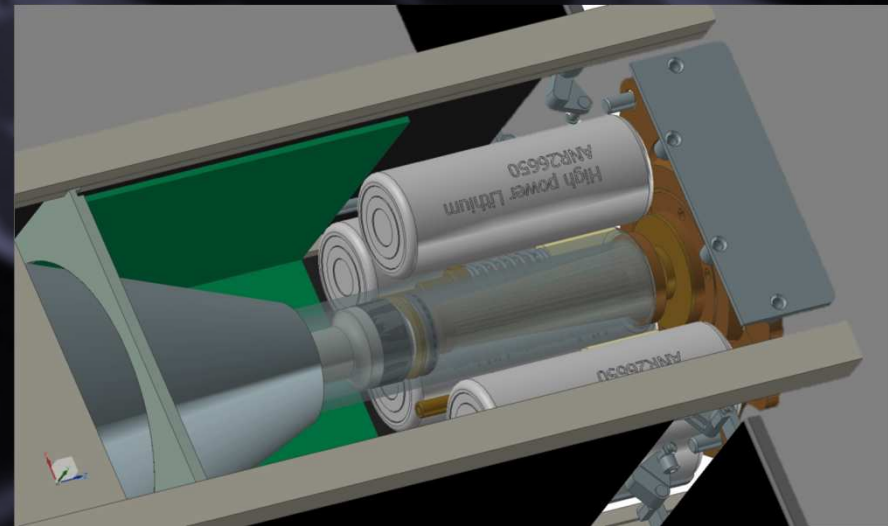


Initially an elliptical orbit of 200x800 km was considered;

Gradual self deceleration could be implemented;

For a final controlled deceleration special steam “canon” (based on the water resistor-jet principle) was developed;

Large batteries and solar cells had to provide power for a final “shot”.



# SATELLITE DECELERATION



Depending on the main payload carrier 800 km circular orbit is probable;

More reliable active propulsion must be implemented for ensuring low landing scattering;

Mono-propellant 1 N rocket thruster is planned to be implemented;

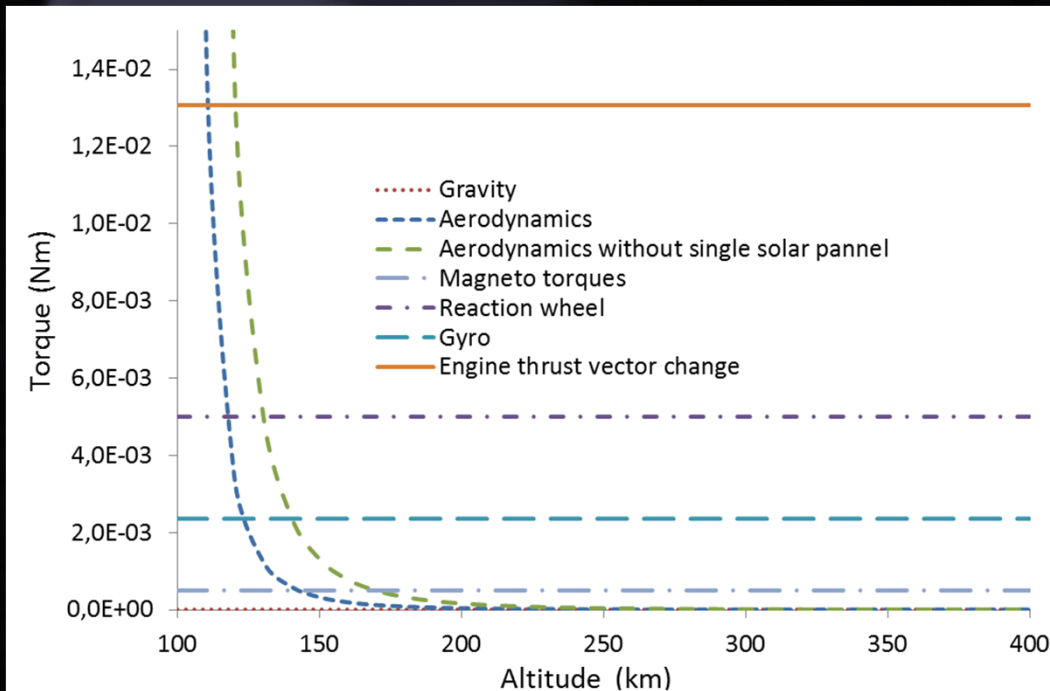
Collaboration with engines producer is established;

Thruster systems suitable for implementation on nano-sat are being developed;

“Green” rocket fuel is planned to be implemented;

Negotiations considering certification of the thruster are held.

# ATTITUDE CONTROL



For accurate landing in predefined area of the earth attitude of satellite must be precisely controlled;

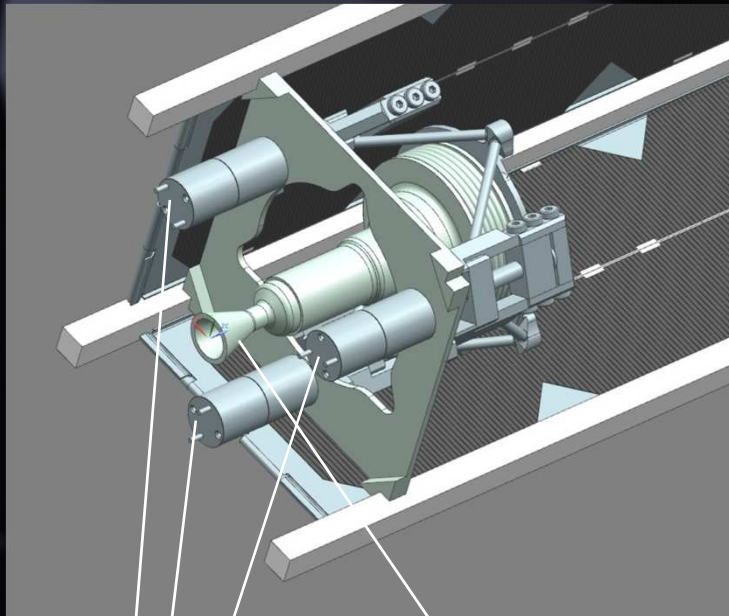
Attitude control is a serious problem during satellite deceleration;

No other mean but active thrusting could ensure reliable attitude control at low altitudes;

Special thrust vector control system suitable for nano-sat is under development.



# THRUST VECTOR CONTROL SYSTEM



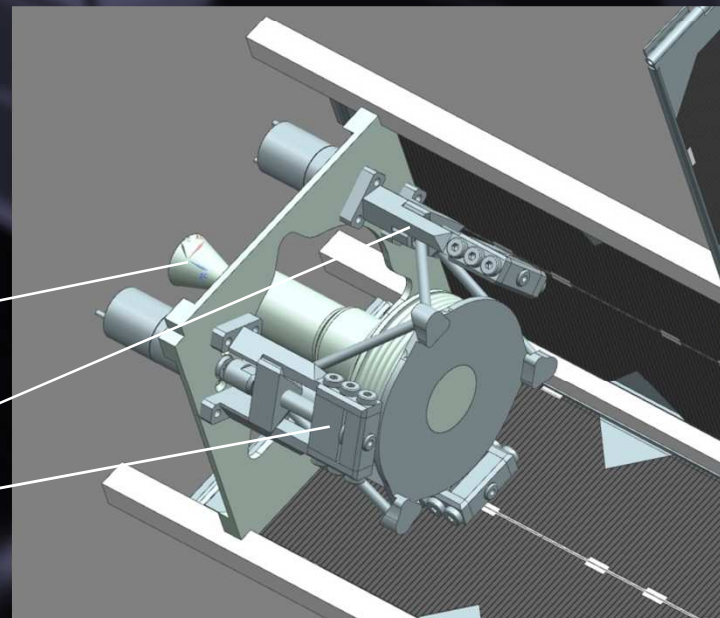
Thrust vector changing system relying on the screw-nut gear with step motors is under construction.

System ensures continuous smooth vector adjustment during the phase of deceleration.

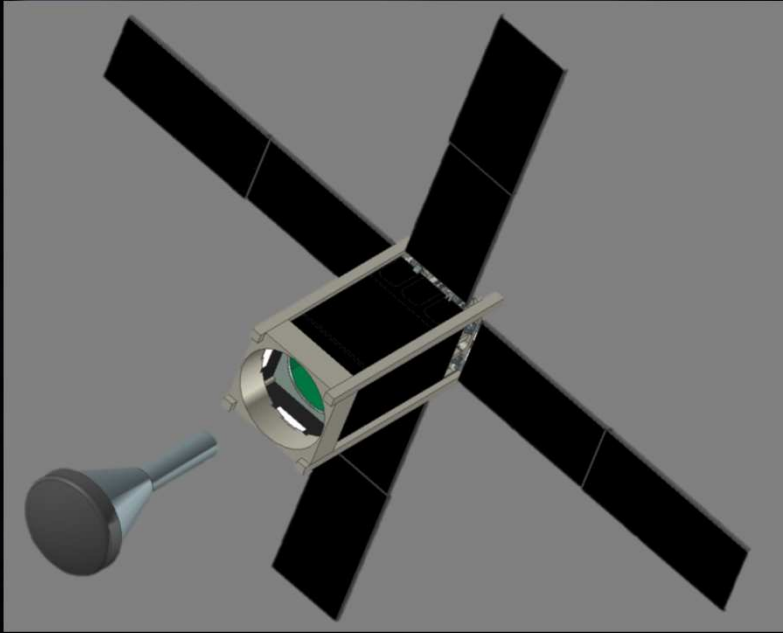
Step motors

Thruster nozzle

Screw-nut gears



# RE-ENTRY CAPSULE



800 – 1000 g re-entry capsule has to be constructed;

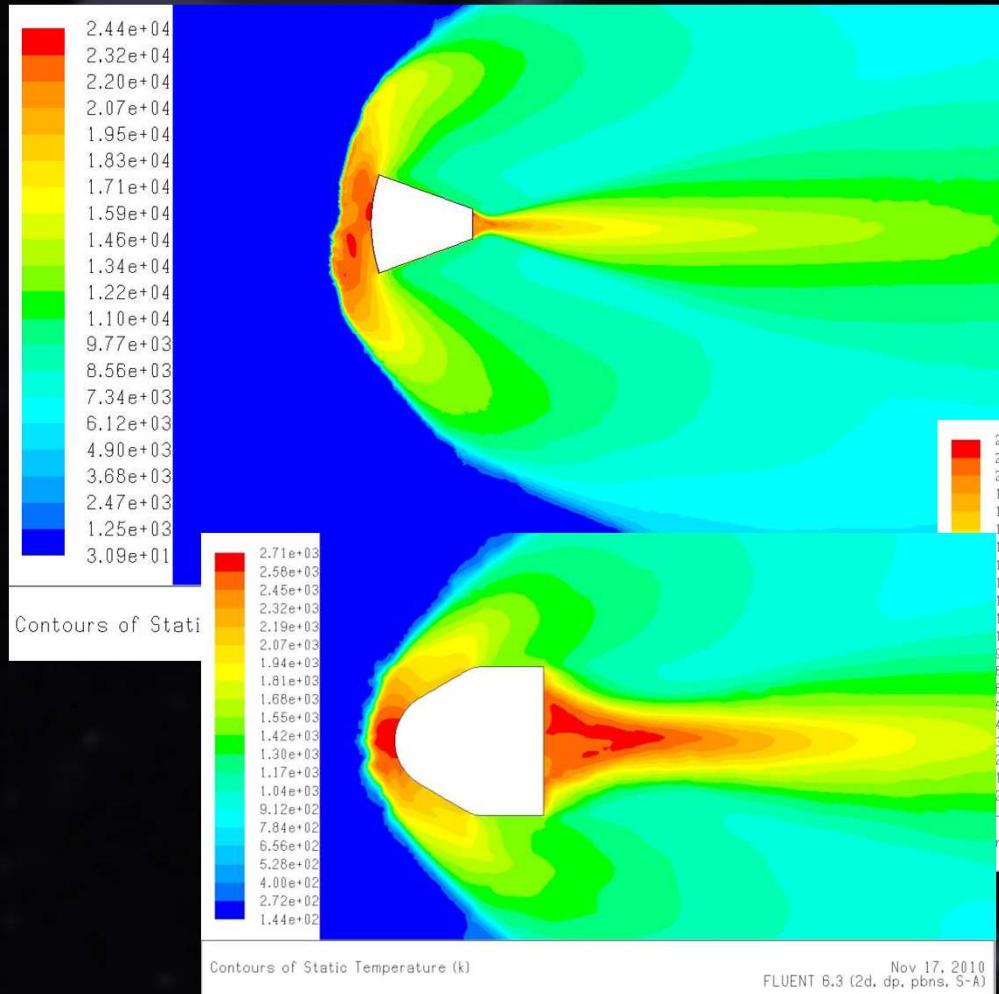
Capsule should be capable of carrying up to 100 g of scientific payload;

Capsule should separate at low altitude (approx. 100 km) and re-enter the atmosphere with a ballistic trajectory;

Heat shield must protect capsule and the payload during re-entry;

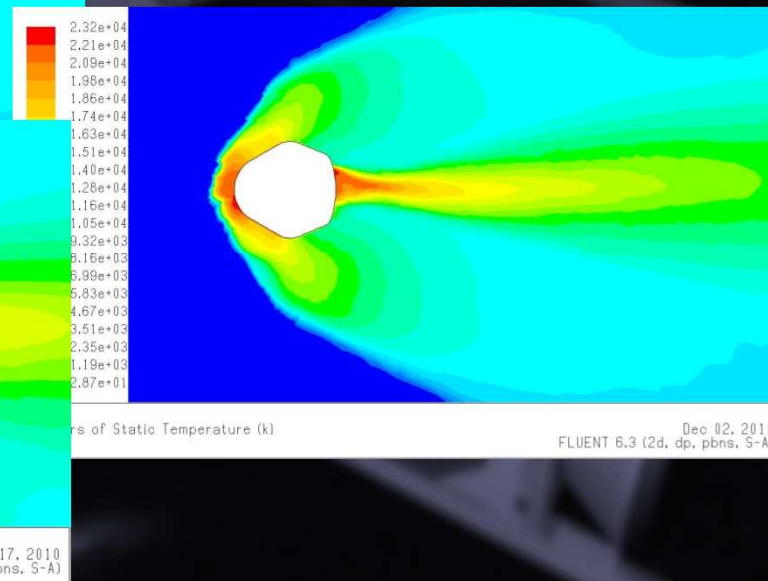
Due to the low mass of capsule rapid deceleration will occur.

# RE-ENTRY



Number of shapes of re-entry capsule were considered;

Blunt nose body shape capsule was chosen as most suitable one.

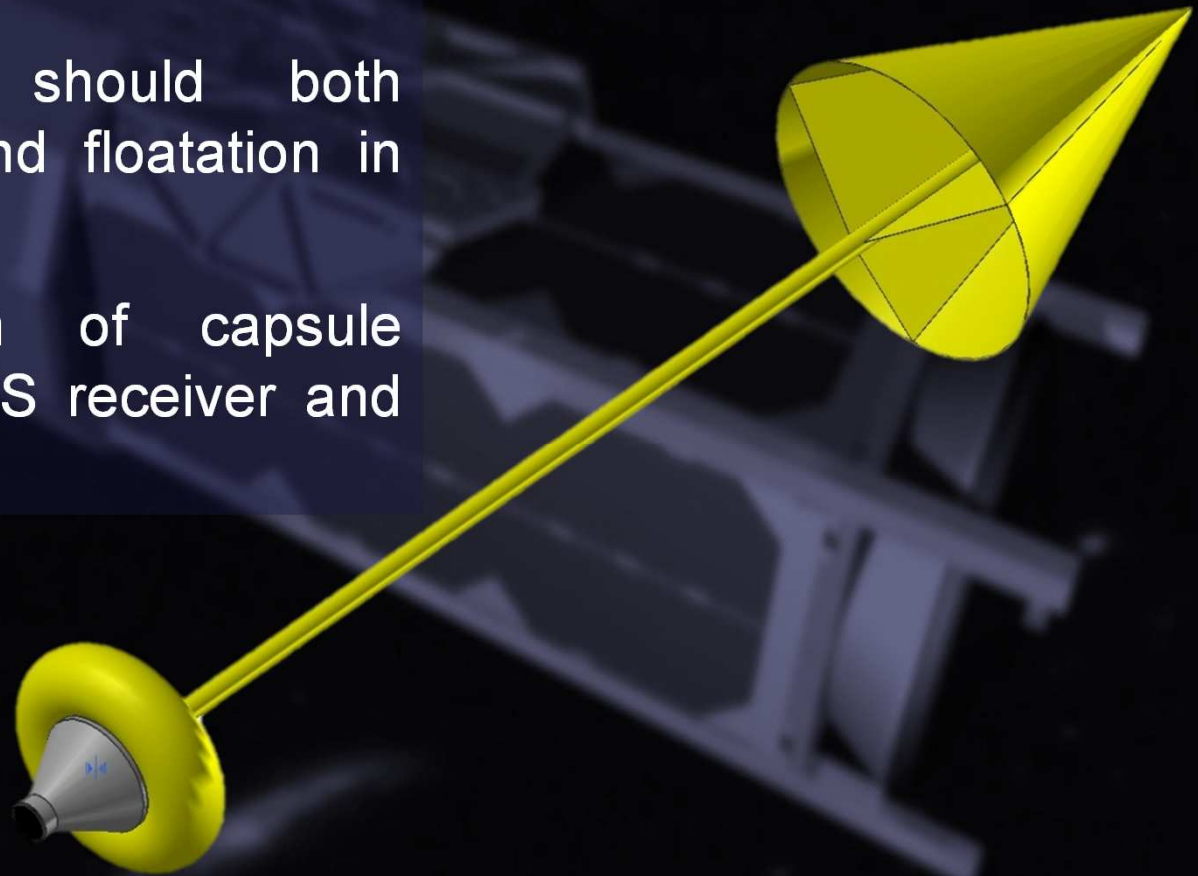


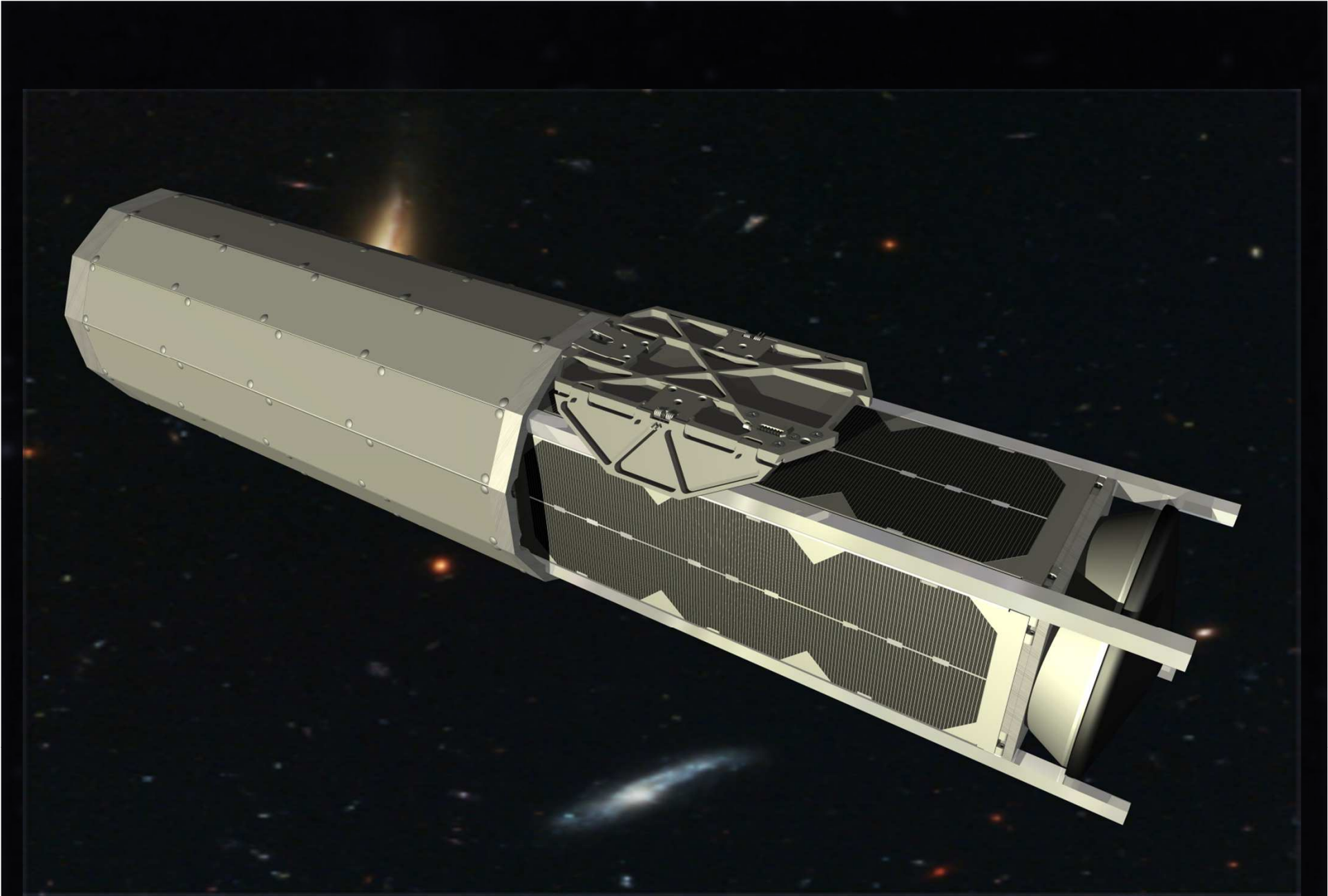
# LANDING OF RE-ENTRY CAPSULE

Soft landing by means of special parachute is planned.

Parachuting system should both provide soft landing and floatation in case of water landing.

Position determination of capsule should be done by GPS receiver and mobile satellite modem.





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# CONCLUSIONS

1. Satellite under construction should consist of two parts – service module constructed of reliable components and reentry capsule capable of safe bringing down of 100 g of payload;
2. Special heat protection materials and shapes of capsule are investigated;
3. Special high thrust active propulsion system suitable for implementation on nano-sats is being developed;
4. Soft landing and on-Earth position determination instrumentation is being prepared;
5. Approaches and technologies tested on the nano-sat under construction could later be implemented on other nano-satellites.



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THANK YOU FOR YOUR  
ATTENTION