Institute for Biomedical Problems Russian Academy of Sciences ongoing FP-7 activities and perspectives

Ilyin Viacheslav

Russian Federation State Scientific Center – Institute for Biomedical Problems

COSMOS FP7 Space Information Day
19th July 2011, Riga, Latvia

Draft Call Topics that we are interested in

Space-based applications at the service of European Society (GMES)

Strengthening the foundations of Space science and technology (SSF)

- ***Research to support space science and exploration***
  - Exploitation of space science and exploration data
- ***Research to support space transportation and key technologies***
  - Key technologies for in-space activities

Structure of the Institute for Biomedical Problems

Department of clinic-physiology researches and expertise

Dep. Operative Medical Support Management of Spaceflights

Dep. Psychophysiology and optimizing of operators activity

Dep. Physiology homeostasis regulations

Dep. Sensomotor physiology and prophylaxis

Dep. Physiology of cardiorespiratory system in modified environment

Dep. Barophysiology and diving medicine

Dep. Radiation safety of piloted spaceflights

Dep. Sanitary-hygiene safety

Dep. Life support systems

Dep. Experimental biology

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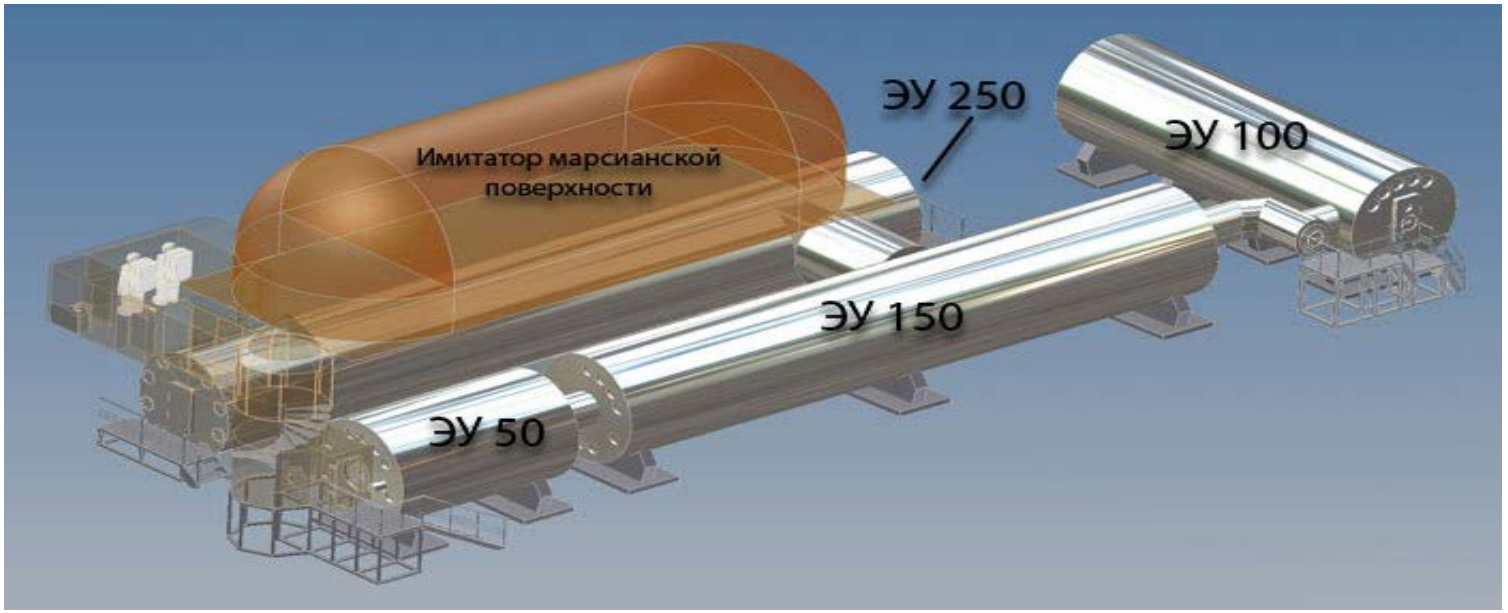
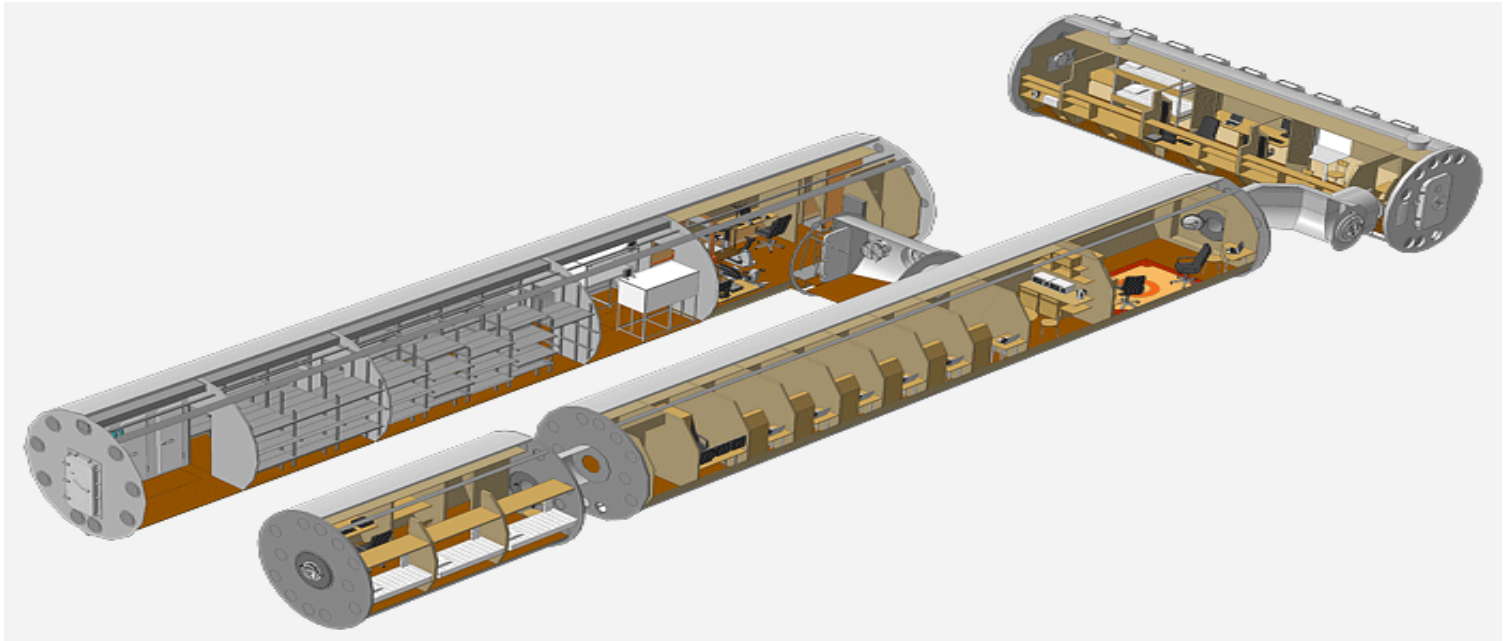
List of competencies on the basis of the recent work programme

1. Space
2. Biomedical problems and safety of spaceflights;
3. Space, Ecology, Aviation, Extreme and Sport physiology and medicine;
4. Hyperbaric physiology and diving medicine;
5. Psychology. Psychology of small groups. Engineering psychology and ergonomics ;
6. Gravitational biology;
7. Space radiational biology;
8. Physiology of humans and animals;
9. Cell biology and biotechnology;
10. Hygiene, microbiology and epidemiology of confined habitats;
11. Complex systems of human life support systems;
12. Physiology and medicine of healthy human and dangerous occupations;
13. Physiology and medicine of high altitudes;
14. Electromagnetophysiology;
15. Innovations.

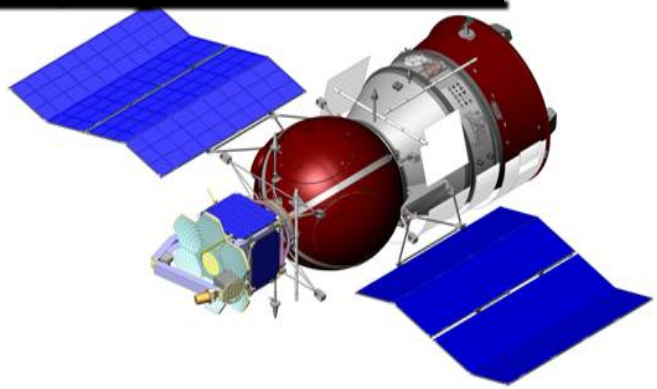
Relevant experiments: Experiment Mars-500





Relevant experiments

Bion-M# (1,2,3), Photon-M#4, spacecrafts



Date of lunch – 2012, 201?, 201?
Orbit parameters: with the height up 575 km
Inclination – 64,9°
Duration of flights – 30-45 days
Total weigh of spacecraft – 6480 kg
Hardware weight – 650 kg inside
- 250 kg outside
Weight of recovery module – 2300 kg
Temperature at outside space in orbital flight from -150 up to 125 °C
Daily energy supply for hardware 550 w
Rocket – Souz 2
Launching side – Byikonur
Touchdown area – near Orenburg city, RF

Objects: Snails, lizards, plants, cell cultures, geckos, microorganisms, biosamples, seeds, seedlings

Areas of research:

Ontogenesis in microgravity
Cell physiology
Biotechnology
Exobiology experiments
Radiobiology

Short history of the organisation and / or working group

Working group is formed by labs of IBMP Dep. Sanitary and Hygiene Safety, which was maintained in 1964. It is dealing with control and prophylaxis of infections of humans in confined habitats, environmental microbial protection and astrobiology.

Now the group is involved onto one FP-7 Project, devoted to microbial ecology in confined habitat and one project is under preparation, devoted to elaboration of probiotics for antiinfectional safetyof the crew.

We also want to claim for the astrobiological project purposed to study possibility for microbial transportation by space dust.

Experience with the EU Framework Programme

- **Since June 2011 the research team participare in FP-7 Project BIOSMHARS "BIOcontamination Specific Modelling in HAbitats Related to Space“**
- 1. Coordinator MEDES-IMPS Institute of Space Physiology and Medicine, France
- 2. SCK•CEN Belgian Nuclear Research Centre, Belgium
- 3. Institute of BioPhysics, Russia
- 4. Institute for BioMedical Problems, Russia
- 5. Technical Research Centre of Finland
- 6. University of Eastern Finland

Experience with the EU Framework Programme

- **Nowadays under elaboration: Nutraceuticals for long distance space flight PROBIOSPACE**
- Coordinator: **BioLog, company for Biotechnology and Research Ltd.**
- **Ulica Mosa Pijade 20, 2000 Maribor, Slovenia, Tel.: + 386 31 644 712**
- The sub-contractor(s) participating to the activity are:
- ***1.*University Of Maribor, Faculty Of Medicine, Department of Biochemistry and Nutrition, Slomskov trg 15, 2000 Maribor, Slovenia**
- **2.** Institute for BioMedical Problems, Russia
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Proposed new projects: Stardust

- ***Experiments relating to the capture of micrometeroids using Aerogel***
- *A*t the 6km/s speed of the Stardust mission, the particles capture in aerogel were severely ablated and fragmented. In the proposed experiments speeds relating to impact may range as low as 3km/s (11-8, where 11 is escape speed of a particle orbiting close to the Earth's 30km/s; 8 is typical LEO speed); most impacts however, would be more energetic. Despite the inevitable fragmentation, we hope to see traces of biofossil fragments and not merely the silicate grains recovered by the Stardust mission.
- Aerogel has been deployed on several space missions, having pore diameter ~10 nm, ie. 100 times smaller than micron-sized meteoroids, Track lengths for carbonaceous particles at 6km/s into 0.005g/cm3 aerogel are ~10 mm, so 60mm deep aerogel should be sufficient for all but the fastest meteoroids. The flight time of 30-45 days and limited collection aperture implies that several aerogel-filled cells should be used. For extraction and analysis of particles from aerogel, we would collaborate with the OU PSSRI group who have specialist micro-instrumentation which they used on Stardust aerogel samples.
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Proposed new projects: Stardust

Experiments aimed at isolating microorganisms (living or dead) from space

- The aim of these experiments will be to determine if microbes exist in space outside the orbiter. Sterile tubes containing sterile aerogel will be left on the outside exposed to space during the spacecraft's travel. These will be closed in space and returned to Earth for microbial sampling. In order to reduce the possibility of contamination the lid closures should possess a subaseal, or similar structure, to allow samples to be sterilely accessed from within the tube. Microbial growth experiments will be done in suitable clean rooms.

Proposed new project: Stardust
Experiments relating to the exposure of organisms to the space environment

- We propose that the cells to be used for experimental exposure of microbes in space should be of the dimensions:68mm deep and 30mm across, with lids 15mm diameter. These would be mounted on the exterior of the spacecraft where they would be subjected to high fluctuations in temperature (approx -150 to +125^{o}C depending on albedo) around orbits of duration ~90 minutes. The warm period is sufficiently long to revive our specimens and facilitate some metabolism between periods of freezing during passage through the Earth's shadow. Samples deeper in the cell will be subjected to smaller fluctuations, as occurs in practice below the surface crusts on solar system bodies. This serves in particular as an analogue for microbial bioprocesses in near-surface Cometary crusts, although in this case, the heated/freezing cycle is longer at ~10-30 hours. The series of Bion and Foton flights would allow trials of various substrates with nutrients. We intend including specimens in a separate insulated compartment in the lower 30mm of the cell, which can serve as controls.

The following organism will be exposed

- a) Diatoms. These are the most abundant life-forms in antarctic ice and are may exist in comets and Mars polar ice. For the spacecraft exposure, we shall select a more stable substrate than ice, from a range of organic polymers.
- b) Viruses: the tobacco mosaic virus and the common cold virus, to assess change of viability after exposure to space conditions
- c) Red Rain cells-these have extraordinarily strong cell walls, and are highly resistant to high temperature and radiation. Experiments at Cardiff show they are DNA-based prokaryotes. Samples will be provided within nutrients on trays, the lower ones receiving successively less light and lower thermal fluctuations.
- d) Multi-resistant *Staphylococcus aureus* will be exposed to determine how exposure to space conditions influences the ability of this bacterium to resist antibiotics.

Proposed coordinator

- Address data of the person to contact
- Prof. Chandra Wickramasinghe, MA, PhD, ScD

  Director, Cardiff Centre for Astrobiology
  Cardiff, UK

- Relevant links / references
- http://journalofcosmology.com/About.html
  Astrobiology website: http://www.astrobiology.cf.ac.uk