



Ministry of Education of Republic of Belarus,
Belarusian State University
Minsk, Belarus

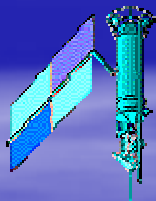
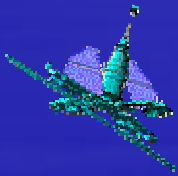
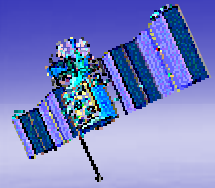


Aerospace Education in the Republic of Belarus

S.V. Ablameyko, V.V. Ponariadov, V.A. Saetchnikov, A.I. Zhuk

United Nations/Belarus International Workshop
on Space Technology Applications for Socio-Economic Benefits
11-15 November, Minsk

Belarusian State University - the leading educational center in Belarus, founded in October 30, 1921



BSU today

- 20 faculties and educational institutes
- lyceum
- college
- 3 scientific-experimental stations
- 3 museums
- 4 scientific-research institutes
- 115 scientific-research laboratories
- 25 scientific centers
- 10 unitary enterprises



BSU today

University staff:

7398 (8680) staff members, including:

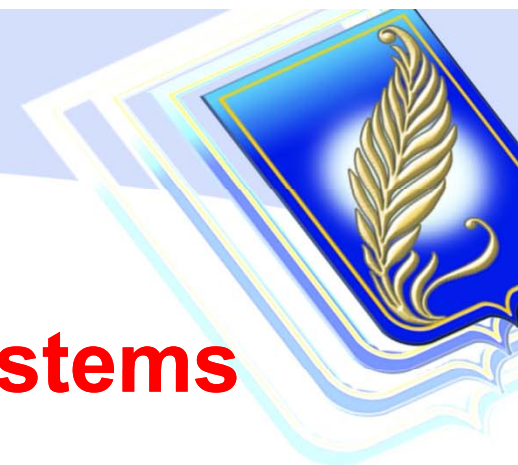
- 2477 lecturers
- 1900 researchers and research engineers

Lecturers:

- 6 academicians of the National Academy of Science of Belarus
- 7 corresponding member of the National Academy of Science of Belarus
- 291 doctors of science
- 1350 candidates of science



BSU in international ranking systems



Webometrics

QS

Scimago

University Ranking
by Academic
Performance
(URAP)

4 international
Colleges &
Universities (4icu)

BSU ranking



BSU dynamics in
«Webometrics»



BSU ranking

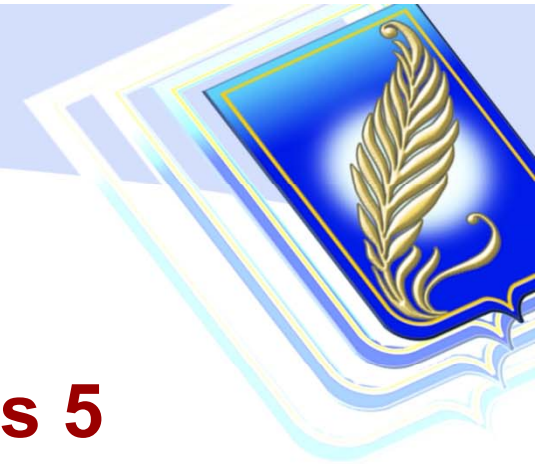


BSU in QS World University Rankings

QS	Place
2011	500–550
2012	500–550

In 2012 BSU remained among 550 best universities of the world, and among universities of CIS countries moved from 10 to 9 place.

BSU ranking



According to Webometrics BSU takes 5 place among universities of CIS countries.

Ahead of us only:

- Lomonosov Moscow State University
- Saint Petersburg State University
- Tomsk State University
- National Technical University of Ukraine “Kyiv Polytechnic institute”

In all ranking systems BSU is among 10 best universities of CIS countries.

Faculties and Educational Institutes

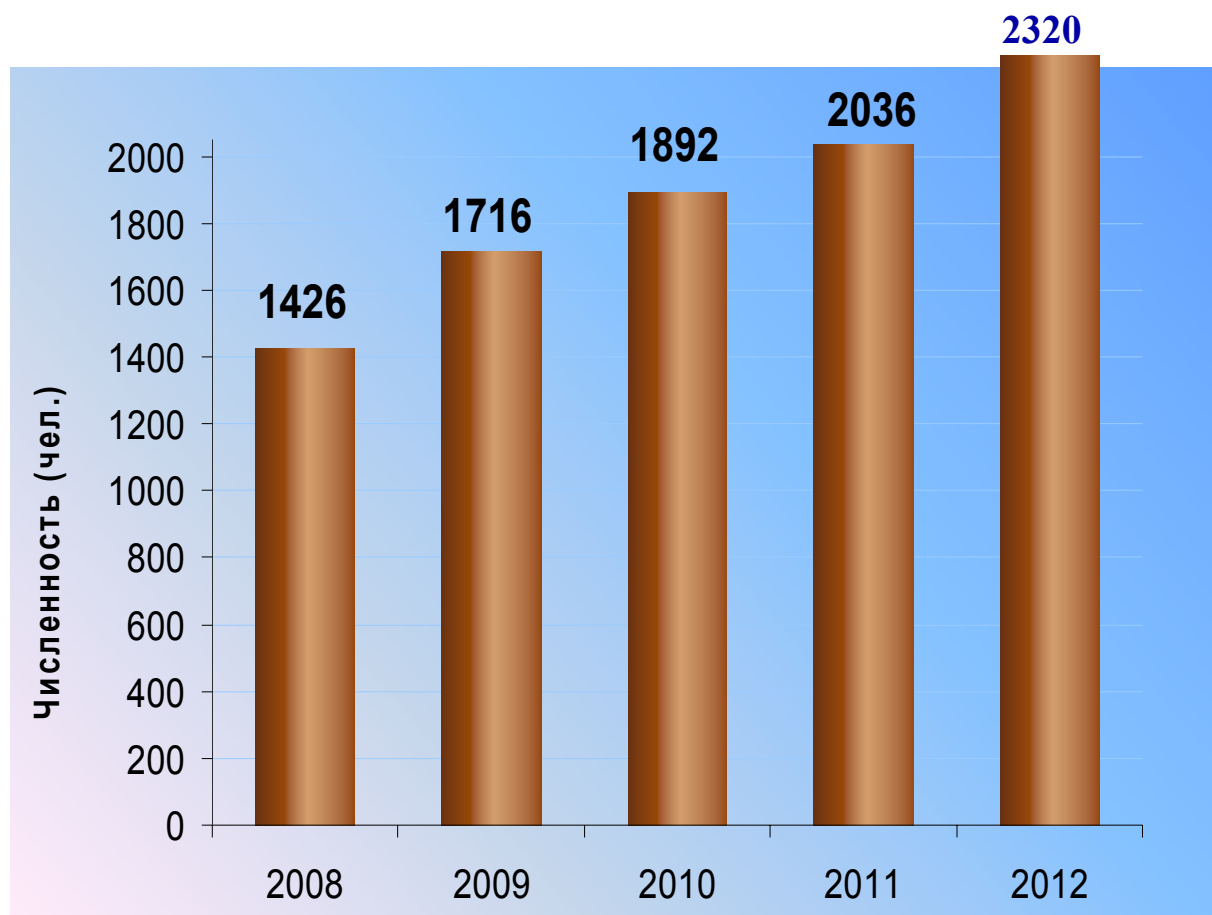


- Mechanics and Mathematics
- Applied Mathematics and Computer Science
- Radiophysics and Computer Technologies
- Physics
- Chemistry
- Biology
- Geography
- Economics
- Military
- History
- Philosophy and Social Science
- Law
- International Relations
- Pre-University Education

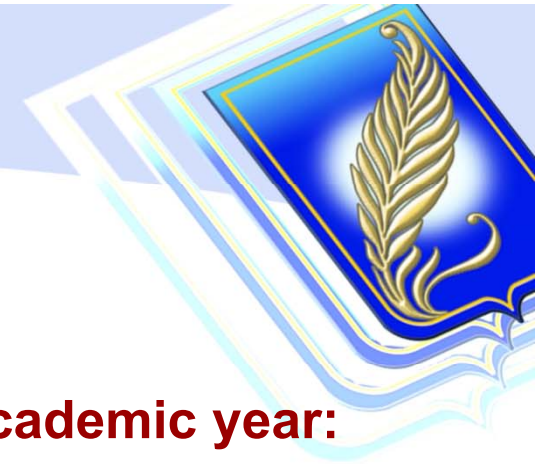


- Journalism
- Philology
- Liberal Arts
- Business and Management of Technologies
- Management and Social Technologies
- Theology

International students



International students



In 2012/2013 academic year:

**2 320 international students from
53 countries of the world.**

Among them:

China – 900,

Russia – 239,

Turkmenistan – 702,

Turkey – 58,

Vietnam – 51,

Azerbaijan – 40.

International Contacts



More than 300 partner bilateral agreements:

CIS
Europe
Asia
Africa
North and South America

Membership in international associations:

Eurasian University Association
European University Association
Baltic University
International Association of Teachers of Russian language as a Foreign Language
CEI University Network
CIRCEOS
IAESTE
ICRANet



International centers at the university:

EU Informational Center
Council of Europe InfoPoint
Center for UN study
Confucius Institute

Academic mobility



More than 1000 staff members are sent abroad for study and research visits per annum

About 240 students take part in conferences and seminars abroad annually

About 150 incoming and 180 outgoing exchange students per year

30% of outgoing exchanges students carry out long term study visits (more than 6 months)



Top 7 countries outgoing exchange students:

1. Russia
2. Germany
3. Poland
4. China
5. Czech
6. Italy
7. France

Top 7 countries incoming exchange students:

1. Germany
2. Poland
3. Finland
4. Ukraine
5. Czech
6. China
7. Lithuania

Academic mobility



Programs of academic mobility in the BSU

1. ERASMUS-MUNDUS. Annually over 50 BSU staff and students conduct their studies and research in European universities. 8-10 European students come to BSU each year in the frame work of the Program

2. DAAD. Every year approx. 15-20 students and researches are being selected for scholarships to study in Germany.

3. IAESTE. Since 2002 more than 30 BSU students took part in the program.

4. VISEGRAD FUND. 10-15 BSU students and graduates receive funding to study in HIEs in Czech Republic, Poland, Hungary and Slovakia

BSU students and staff participate in many other programs of study and research abroad, such as Fulbright, GFPS, Copernicus, Visby as well as national scholarship programs of different counties.



International projects



There are more than 40 international projects implemented funded by INTAS, FP7, ISTC, NATO, CEI, CERN, VISBY, SIDA, UNO, UCPD, FPB-Belarus, different EU funding instruments and etc.

Since 1994 the BSU has participated in 12 Tempus projects

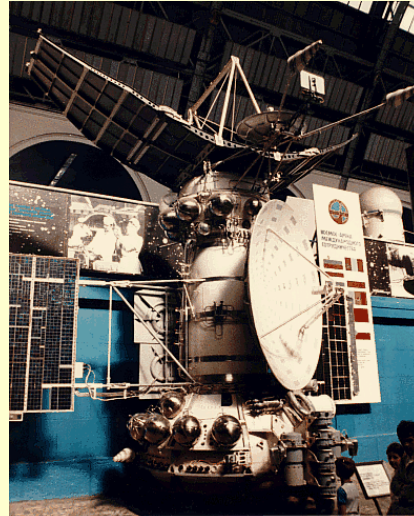
Approximate amount of personal grants BSU teaching staff and researchers receive is about 200000 Euro per year



Participation of BSU in USSR, Russia and international space programs



Mir project (USSR)



Venera project (USSR)



Buran-Energia project (USSR)

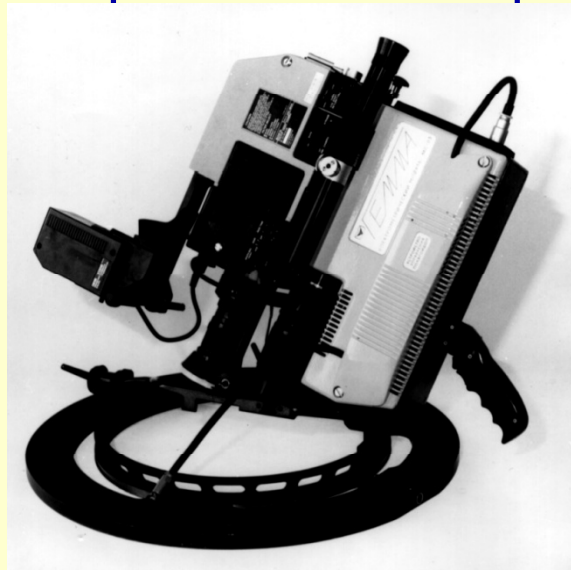


International Space Station



Space Remote Sensing Systems, 1988 (Mir)

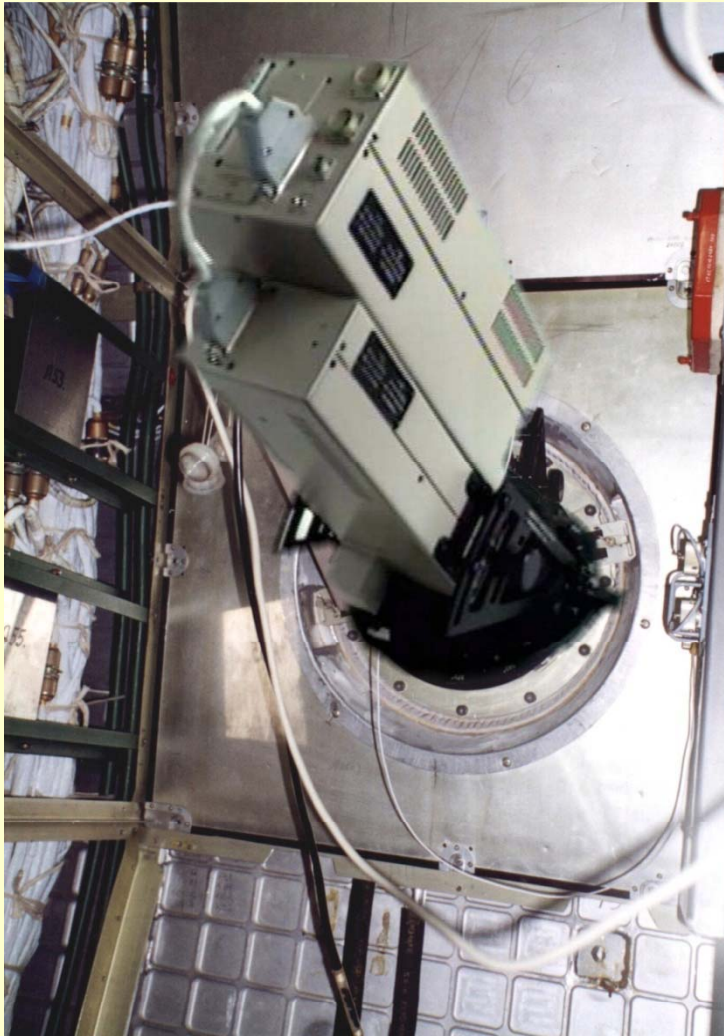
- Since 1985 BSU has been developing optical methods and equipment for Earth remote sensing. As a result different space remote sensing systems have been designed.
- BSU specialists have participated in many international projects: FIFE-89 (USA), Curecs - 86, - 88, -91. They have developed scientific equipment for aircraft laboratories.



Interactive microprocessor-based video-spectrometric system «Gemma 2- video» (functioned on board «Kvant» module «Mir» station, geocological experiment, 1988).



Board video-photometric system «VFS-3M», 2000 - 2002 (ISS)



- Designed to an automatical remote registration of optical emission at atmosphere.
- Able to register Red Sprites and Blue Jets.
- Used in experiment «Atmosphere and Magnetosphere Electromagnetic Interaction» on board International Space Station (ISS) in 2000.



Photospectral system «ФСС», 2000 – today (ISS)

Designed to research reflected emission spectrum from underlying terrain and to obtain visible photographic image on board ISS -1 - ISS -24 (experiment «Storm»).



ФОТОСПЕКТРАЛЬНАЯ СИСТЕМА ФСС

(создана НИИПФП им. А.Н.Севченко БГУ по контракту с РКК «Энергия»)



предназначена для проведения измерений спектров отраженного излучения подстилающих поверхностей в диапазоне длин волн от 350 до 1050 нм

и фотоизображений в видимом диапазоне длин волн на Российском сегменте Международной космической станции в космическом эксперименте «Ураган-МКС» (экспериментальная обработка наземно-

космической системы мониторинга и прогноза развития природных и техногенных катастроф)

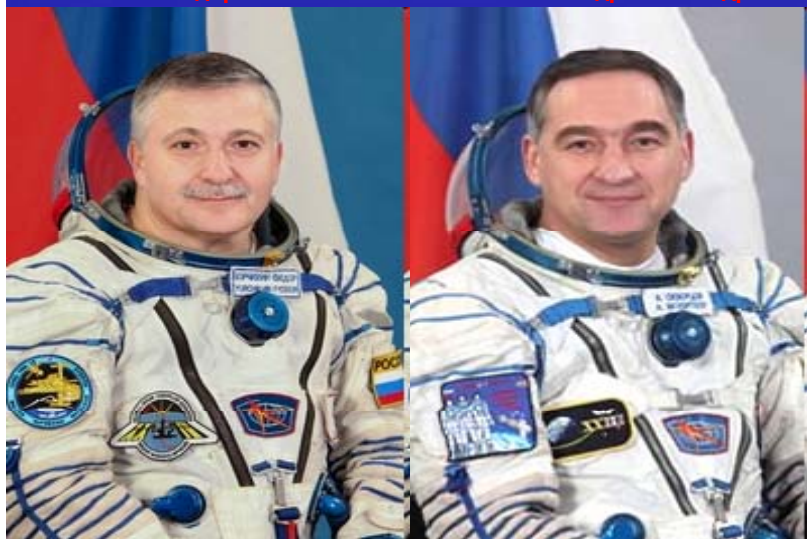
В июле, августе ОАО РКК «Энергия» были проведены летно-космические испытания ФСС. Целью этих испытаний была проверка работоспособности ФСС и отработка различных режимов съемки космонавтом в рамках космического эксперимента «Ураган».

В июле 2010 г. система ФСС была доставлена грузовым кораблем «Прогресс-М-06М» на борт РС МКС.



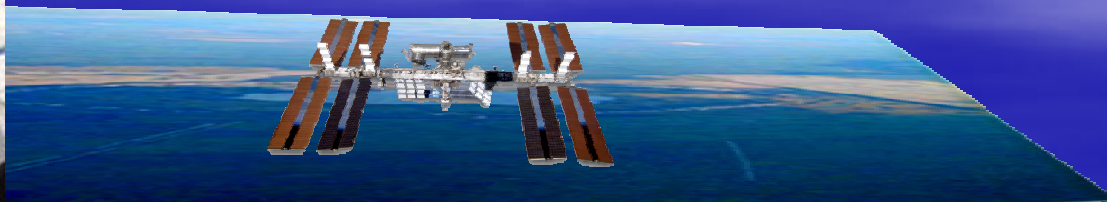
ЮРЧИХИН
Федор Николаевич

СКВОРЦОВ
Александр Александрович



С борта РС МКС космонавтами А.А. Скворцовым и Ф.Н. Юрчихиным в ходе первых включений научной аппаратуры ФСС получены первые результаты съемок земной поверхности. На основании полученных результатов проведен анализ работы аппаратуры ФСС в различных режимах.

14 июля 2010 г. был проведен трехуровневый подспутниковый эксперимент по съемкам объекта «Кольцевая структура» (обвалованное песчаным кольцом озеро в Гомельской области, РБ).

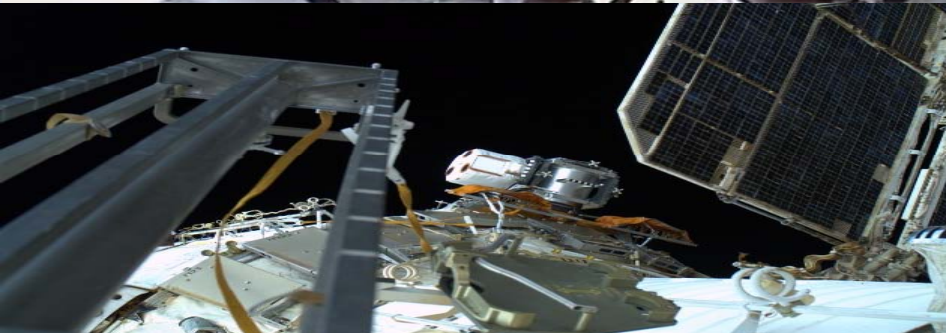


БЛОК ВНЕШНИХ ДАТЧИКОВ БВД научной аппаратуры "Фотон- Гамма"



Транспортным кораблем «Прогресс» БВД в октябре 2010 г. доставлен на борт РС МКС.

16 февраля 2011 г. российские космонавты Дмитрий Кондратьев и Олег Скрипочка во время выхода в открытый космос установили БВД на внешней поверхности модуля «Звезда» российского сегмента Международной космической станции.



Spectrometers and spectroradiometers (today)



MS-08



MS -09



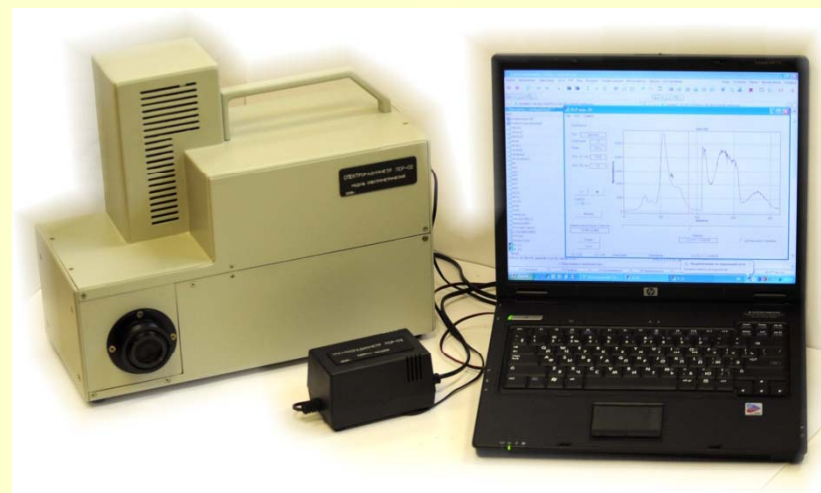
MS -10

MS -12

Spectroradiometers series MC (radiation brightness and rapid analysis of radiation, scattering, transmission, absorption and luminescence characteristics of various objects)



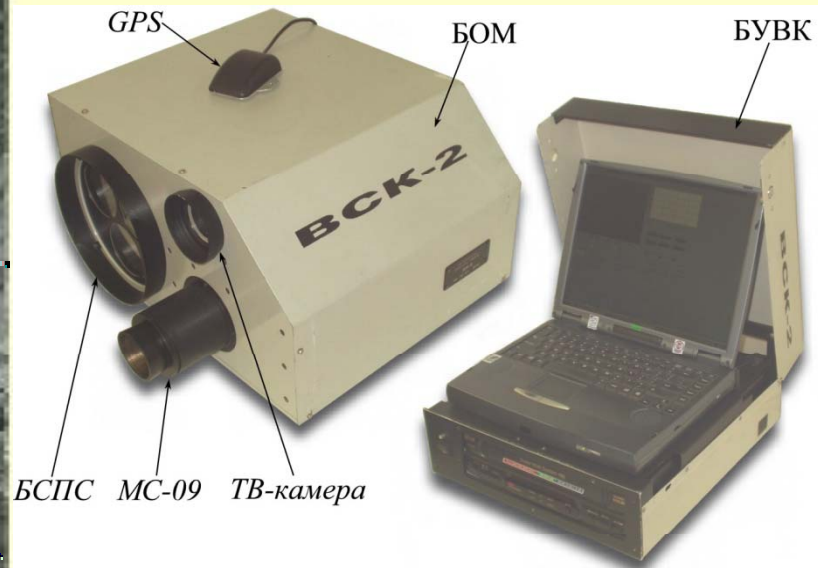
Spectrometer PVS-02
(the emission, reflection and absorption spectra)



Spectroradiometer PSR-02 (spectral density of energy brightness and the polarization characteristics of radiation)



Aircraft Control System (today)



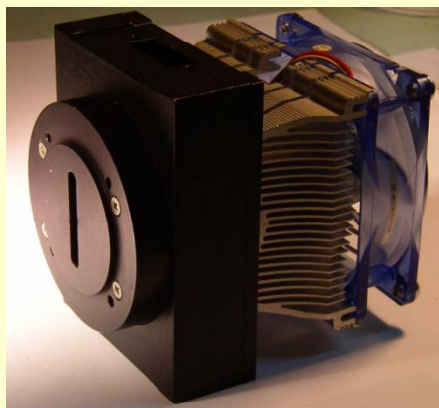
Aircraft An-2

Aircraft videospectral system «VSS-2»
(Designed to forest remote control)



Aircraft emergency situation control system

Compact spectrometers



- Voltage - 5 V.
- Power < 0,2 W - detector based on a CCD matrix
- Power < 10 W - detector based on InGaAs.

CCD spectrometer S10420-1006	Multi Element detector based on InGaAs photodiode array
Vacuum UV spectrometer	IR spectrometer
Spectral range of the detector based on CCD - 160 nm – 320 nm. Spectral resolution - 0,08 nm/pixel	Spectral range of detector based on InGaAs photodiode array - 1,3 – 2,8 μm . Spectral resolution - 3 nm/pixel

Spectrometer equipped with a mirror, lens and fiber optic lighting system entrance slit. The LVDS interface used to connect to Control and Data Acquisition System.



Control and Data Acquisition System

The system is designed to control the actuators optoelectronic and mechanical systems, collecting and gathering data from various sensors, including multielement photodetectors.



- Processor Size - 60 mm x 44 mm with 240-pin; Expansion Module Size - 100 mm x 64 mm with 240-pin;
- Voltage – 3V; Power – 3,5 W;
- 32-bit Processor ARM9 c MMU @ 200 MHz;
- SDRAM Memory 16MB – 256MB;
- NAND Flash Memory 32MB – 256MB;
- 4 serial RS232 interface;
- USB interface, compatible with USB2.0;
- 10/100Mb Ethernet interface;
- I²C interface, 100KHz and 400KHz;
- SPI interface; JTAG interface; External Memory Interface – 4GB;
- 2-channel DMA; LVDS interface Expansion Module;





2004 – National project: **Development of the national remote sensing system (NRSS)** including satellites, ground station infrastructure and national bank of remote sensing data for state and commercial users.

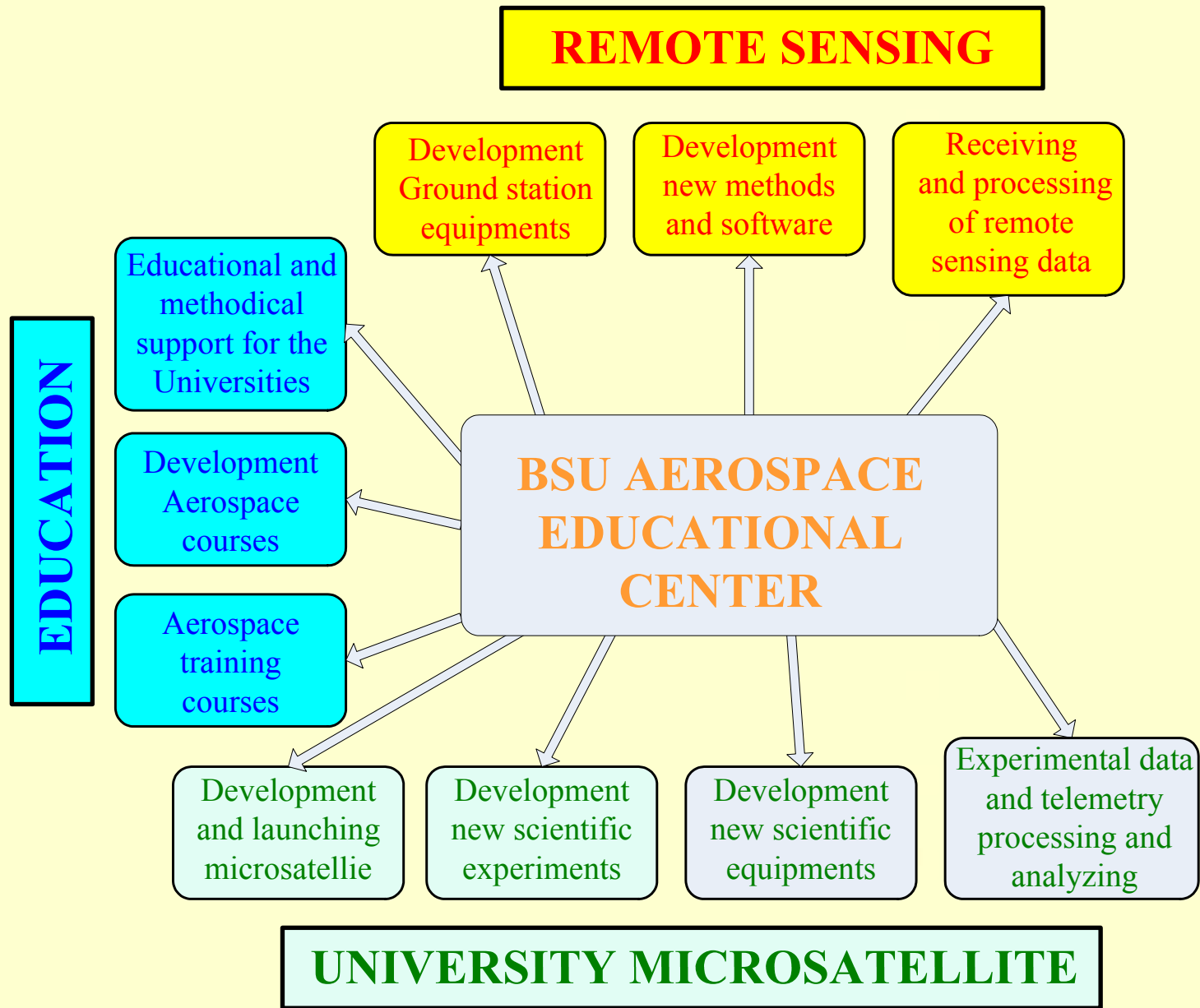
Educational segment of NRSS was provided by BSU.

2008 – **National space program** which consists of 12 subprograms including **educational program**:

Some aims of the educational program:

- Development of student space research including development of university satellites and using experimental data from its for education.
- Modernization of the education system (new and updated educational trade, branched).
- International cooperation.
- Разработка и реализация международных молодежных проектов по реализации научно-образовательных космических экспериментов.
- Development of Internet and distant education technologies.

To coordinate these activities Aerospace educational center has been organized.



Aerospace Education in BSU

2008 г. – BSU aerospace educational center was founded.

2009 – new educational branch “Satellite information systems and technologies” was opened.

2010 – new educational trade “Aerospace radio electronics and information systems and technologies” with branches:

- «Global navigation and telecommunication systems».
- «Radio electronics systems for data transmission and data processing».
- «Onboard and ground information systems».



BSU Aerospace Educational Center website

Центр аэрокосмического образования БГУ - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.aec.bsu.by/ScientificWork.aspx

Most Visited Getting Started Latest Headlines

Центр аэрокосмического образов... x

Центр аэрокосмического образования БГУ

О Центре Новости Научная деятельность Обучение Информационные ресурсы Контакты Наши партнёры Login

- Национальная программа по использованию космического пространства в мирных целях
- Программа Союзного Государства «Космос НТ»
- Обеспечение деятельности и развитие БКСДЗ

Национальная программа по использованию космического пространства в мирных целях

Подпрограмма: Кадровое обеспечение космической деятельности в Республике Беларусь

Цель подпрограммы:

- Создание системы профессионального аэрокосмического образования.
- Формирование кадрового потенциала аэрокосмической отрасли.

Основные направления выполнения подпрограммы:

- Развитие студенческой науки по космическим исследованиям, в том числе созданию университетских малых космических аппаратов.
- Разработка и реализация международных молодежных проектов по реализации научно-образовательных космических экспериментов.
- Развитие образовательной деятельности посредством интернет – технологий на основе использования экспериментальных данных с космических аппаратов и информационных космических технологий.
- Создание (возможно в структуре Национального космического агентства) научно-методического центра аэрокосмического образования, обеспечивающего:
 - координацию деятельности учреждений образования и взаимодействие с отраслями по вопросам подготовки, переподготовки и повышения квалификации кадров для работы в области исследования и использования космического пространства,
 - согласование предложений по открытию новых специальностей и квалификаций и внесению изменений в Общегосударственный классификатор Республики Беларусь ОКРБ 011-2001 «Специальности и квалификации».

Программа Союзного Государства «Космос НТ»

Цель программы:

- Создание технических и научно-методических центров для обеспечения системы обучения (в том числе и дистанционного), а также подготовки высококвалифицированных национальных научных и производственных кадров по современным космическим технологиям в интересах объединения научно-технического и информационного пространств России и Беларуси.

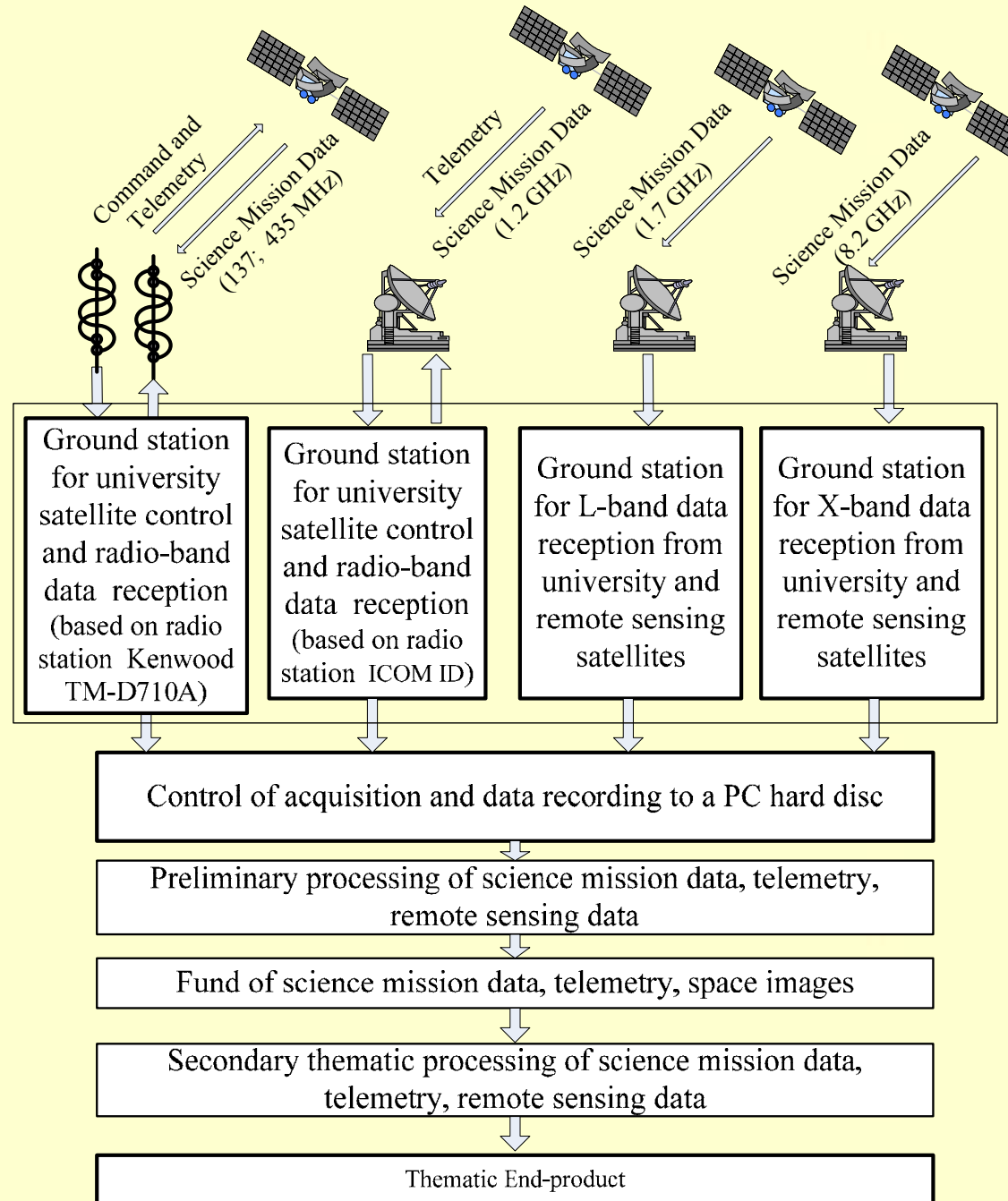
Основные направления выполнения программы:

- Создание инфраструктуры Научно-методического Центра аэрокосмического образования БГУ и Центра космических технологий и образования МГУ.
- Совершенствование и унификация правового, информационного и научно-методического обеспечения системы подготовки кадров по современным космическим

Done

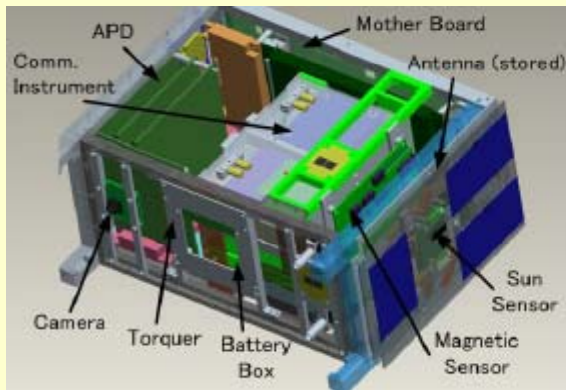
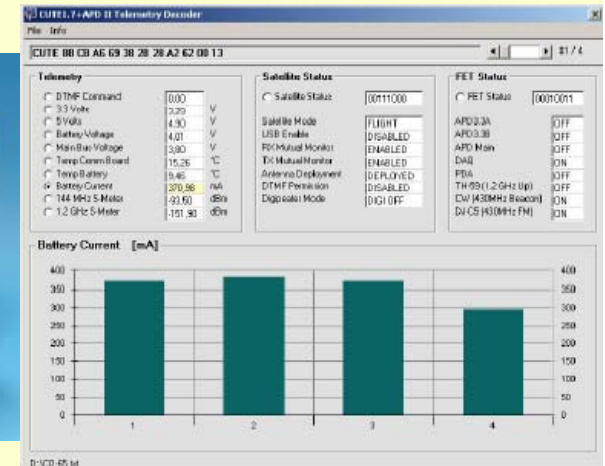
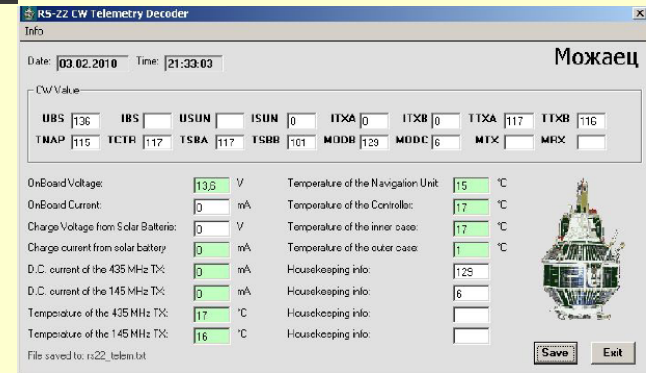
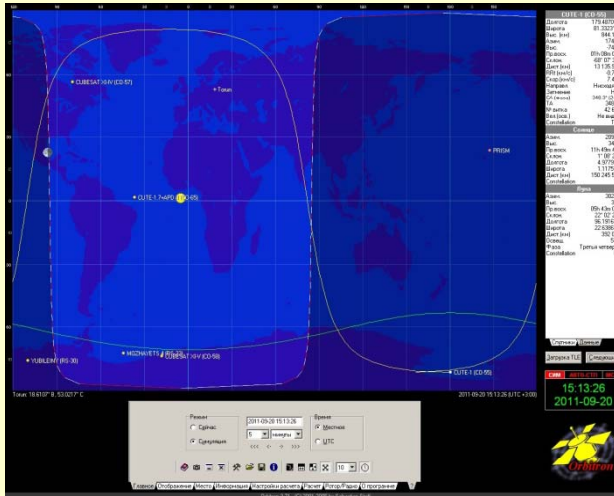
www.aec.bsu.by

Ground station

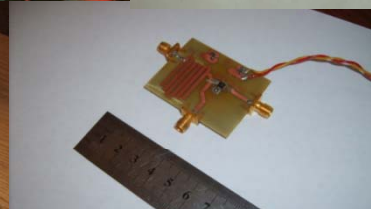
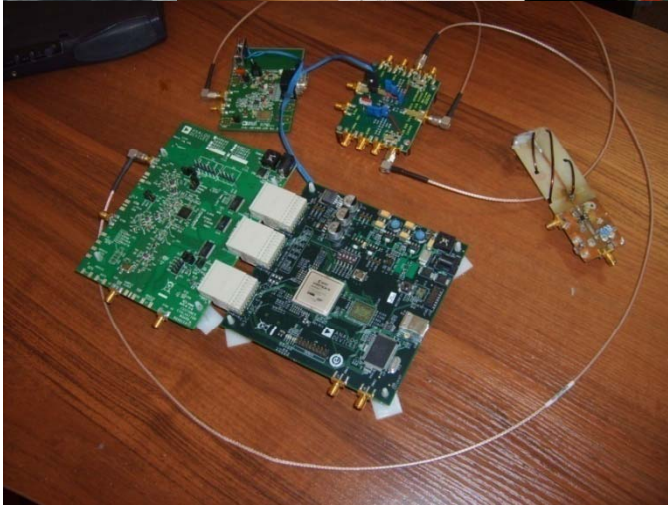
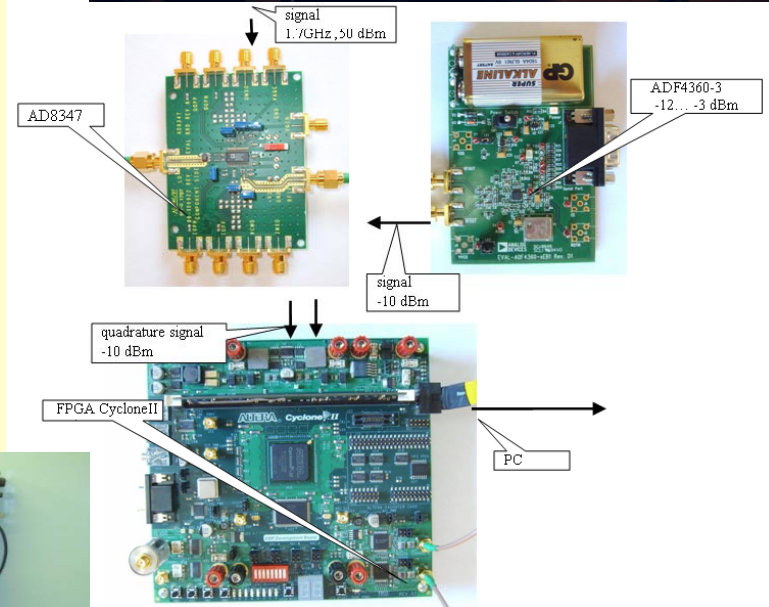
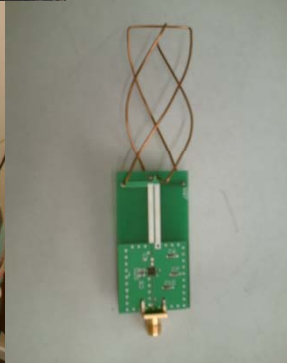


Radio amateur range

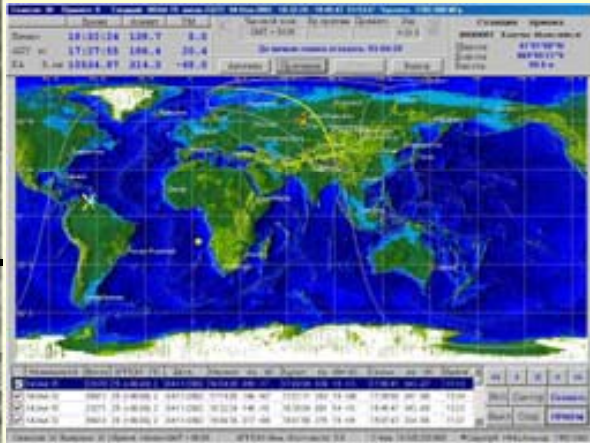
Satellite	Frequency, MHz
HO-68	435,7900
ITUpSAT1	437,3250
PRISM	437,2500
KKS-1	437,3850
CO-66	437,4850
CO-55	436,8375
CO-65	437,2750
CO-58	437,4650
CO-57	436,8475
RS-22	435,3520
VO-52	145,8600



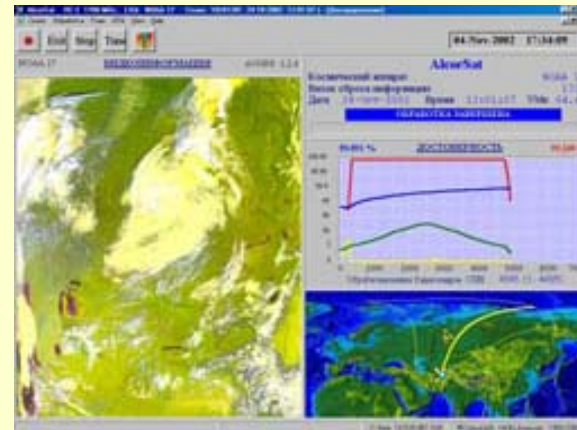
L-band range for remote sensing satellites



Ground station for L-band data reception from university and remote sensing satellites (processing data)



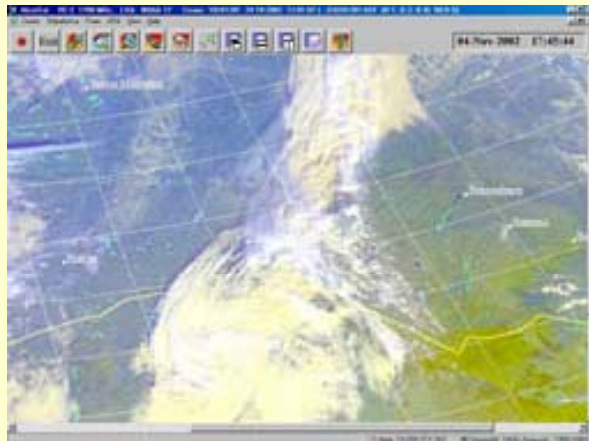
Control of acquisition



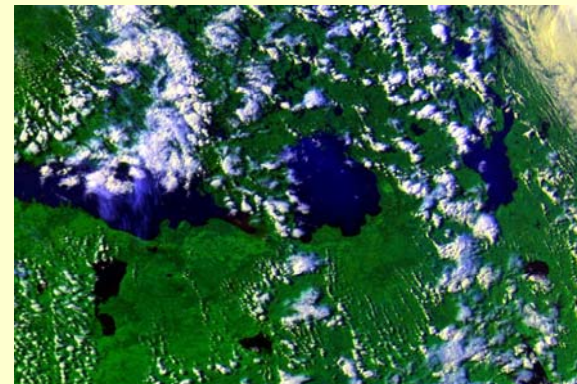
Decoding information



AVHRR image from NOAA-19



Visualisation and preliminary processing



FengYun-1D image, CHRPT format

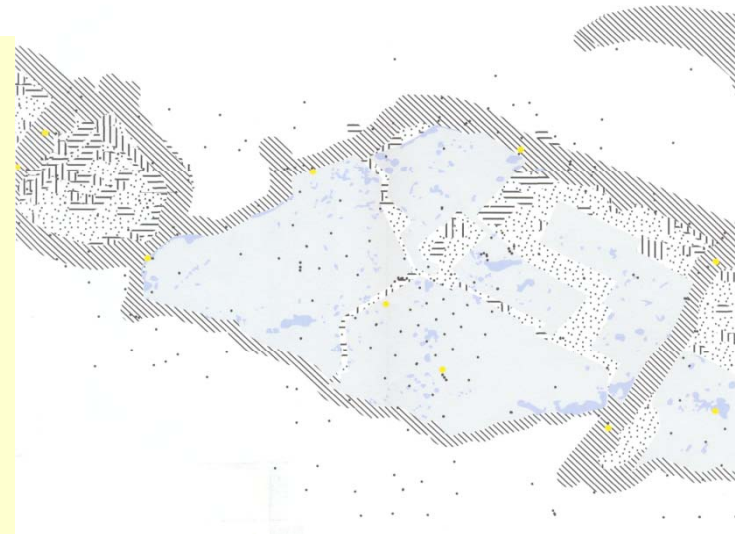
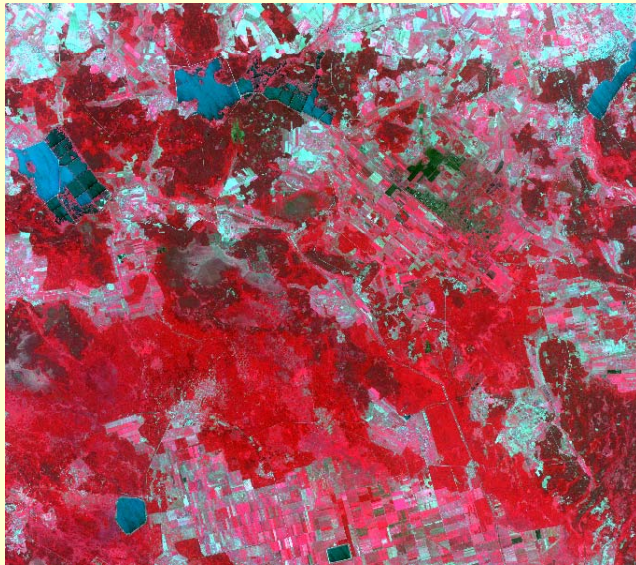


Lecture courses for “Satellite information systems and technologies”

- Small sized satellites ;
- Global navigation satellite system;
- Statistical theory of radiotechnical systems of remote sensing, radar and navigation;
- Communications satellites;
- Image processing and remote sensing;
- Databases;
- The object-oriented approach and programming;
- Optical and radar-based observations;
- Spacecraft system design;
- Electronics in space;
- Space Technique and instrumentation.



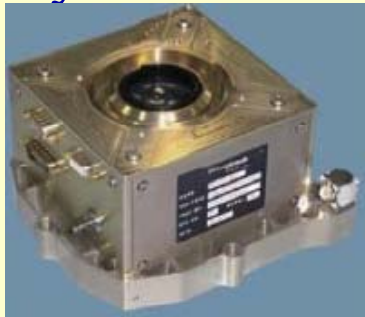
Remote sensing data processing



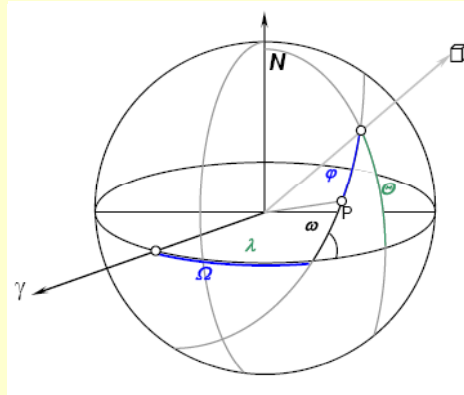
Starobinsk deposit of potash salts and predictive model.

Course “Small satellites” (Lectures)

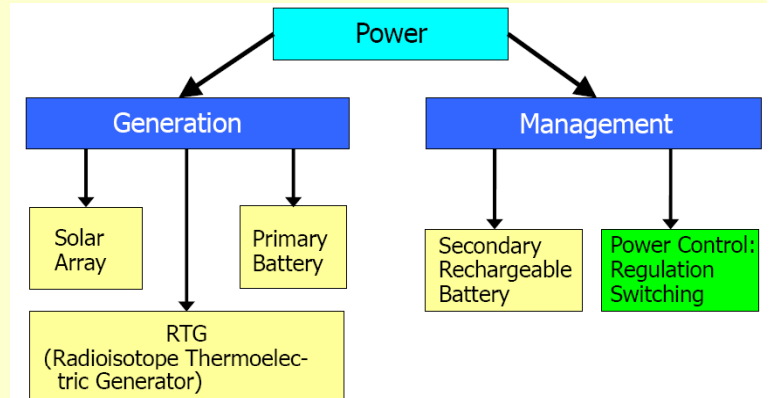
Lectures presented on the origins of spacecraft flight dynamics and control ; spacecraft system; spacecraft and mission design ; spacecraft system engineering ; propulsion systems.



Control System
(Active Pixel Sensor)



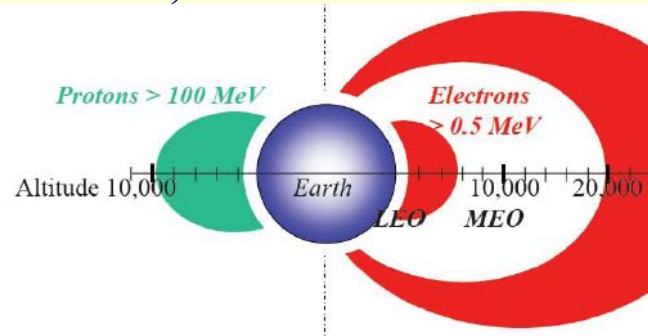
Satellite Dynamics



Power System Design



Control System
(GNSS/GPS Receiver)

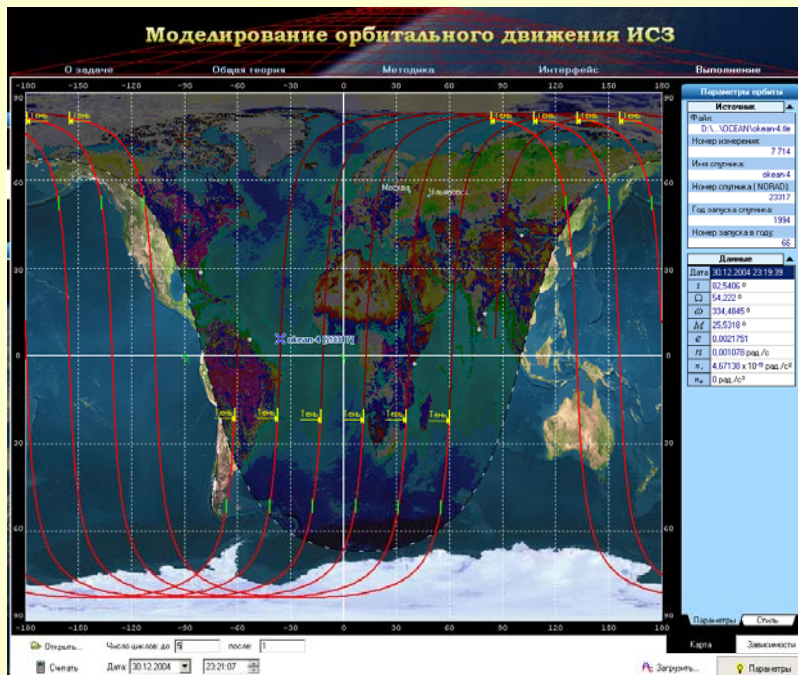


Space Environment

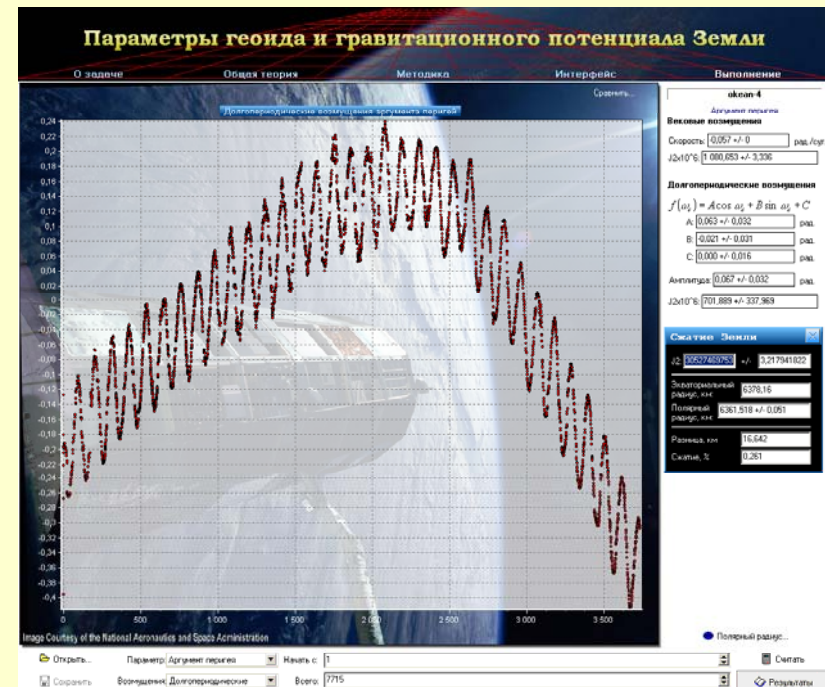


Course “Small satellites”(Practice)

The purpose of the lab exercises is to introduce the students to the methods of the measurements, to the modern conception of near-Earth space structure and the physical processes and phenomena occurred in it. It's also intended to the teaching of the basic methods of experimental data processing and analyzing.



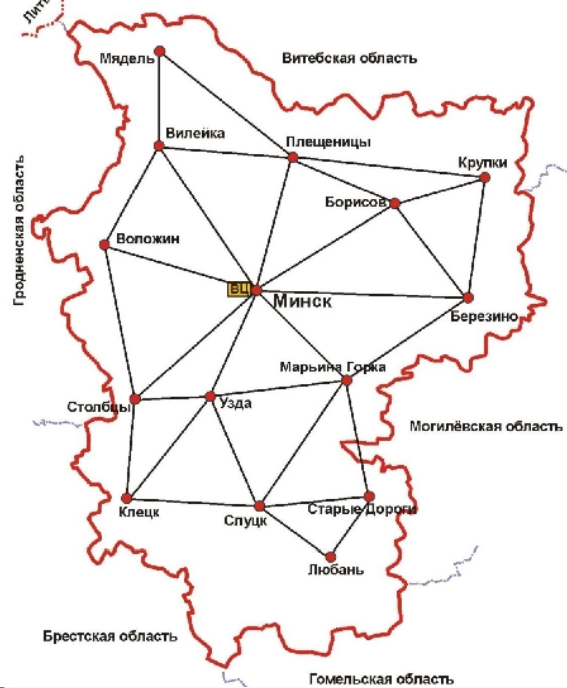
Satellite Dynamics
(satellite's orbit)



Calculation of the second zonal harmonics
of the Earth's gravitational field

Applied Space Technology

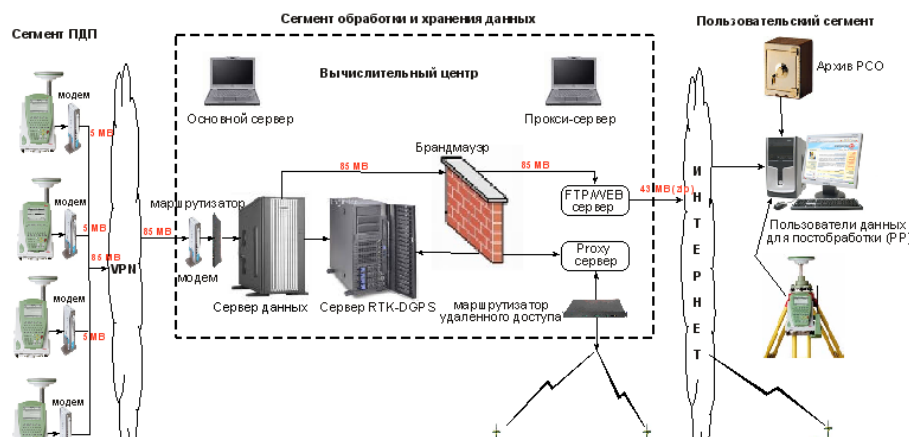
ПЕРВАЯ В РЕСПУБЛИКЕ БЕЛАРУШЬ СПУТНИКОВАЯ СИСТЕМА ТОЧНОГО ПОЗИЦИОНИРОВАНИЯ (ССТП)



Transport monitoring

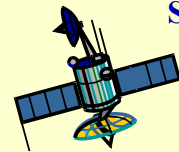
Precise positioning system of the Minsk region

Схема движения информации в Спутниковой сети точного позиционирования (сетевой режим POST)



Distance education

Spacecraft promising multifunctional space system
of the Union State of Russia and Belarus



Satellite
Communications
(VSAT)

The Republic of Belarus

Russian Federation

GROUP terminal complex Distance education

GROUP terminal complex Distance education

Belarusian National
Technical University



Belarusian State
University of
Informatics and
Radioelectronics



Minsk State
Higher
Radioengineering
College



Universities and
college



BSU
Main Techcenter
DE RB

Moscow State Institute of
Radio-engineering
Electronics and Automation



Russian State
University of Tourism
and Service



Moscow Aviation
Institute



Moscow State
Technical University
n.a. N.E. Bauman



Moscow Institute of
Geodesy and
Cartography



Khrunichev Space Center
Main Techcenter
DE RF

Terrestrial
Communications Network
(Internet, цифровая передача данных)



Personal
Terminals



Universities and
college

Aerospace training courses, seminars, conferences



Professor BMSTU (Russia) Vlasov I.B. and members of seminar **“Global navigation satellite system”**



Creators University satellite Tatiana-2 (Russia) and members of seminar **“Small satellites”**



“Education and Space” (IV Belarusian Space Congress)



BSU University microsatellite (Project)

Objectives - BSU University microsatellite is intended for applied, scientific and educational issues as well as training students of BSU and other belarusian universities in control methods of spacecrafts and data processing out of space.

Collaboration - The project will be developed in cooperation with Universities and Research Institutes of Russia and International.

Aim - The main purpose of the experiment is study of interaction of the atmosphere, ionosphere and magnetosphere of the Earth by means of the orbital detectors.



BSU – SWSU educational nanosatellite

Problems

Research:

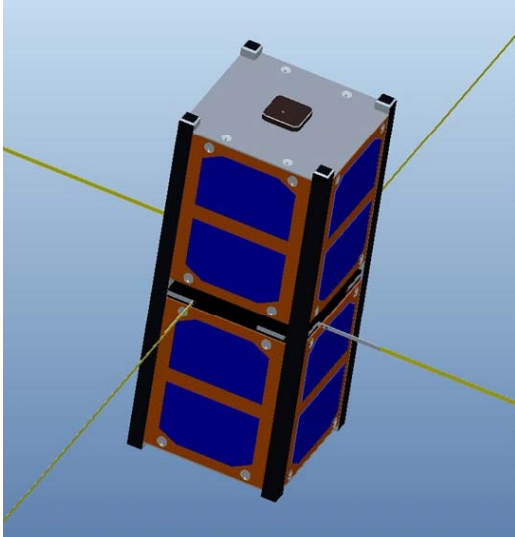
- Study the atmosphere, ionosphere and magnetosphere of the Earth by orbital detectors.
- Material study under zero gravity and radiation.

Technological:

- Development and studying the technology of image transfer through channels of satellite communication.
- Development and studying orientation and stabilization systems of the nanosatellite.
- Development and studying radio engineering and optical methods for ballistic measurements of the nanosatellite.

Educational:

- Development of a new approach for education of students, training of technical and engineer staff in the field of space technologies.
- Development and carrying out international university space scientific experiments.



5.11.2012 in BGU
competition was
declared

On competition of
the best project of
space experiment
15 works were given
also it is offered to
the 23rd name of
the university
nanosatellite



Белорусский государственный университет
начал собственную программу по разработке,
запуску и эксплуатации университетского
наноспутника.

15.11.2012-15.02.2013

*Отправь
свою идею в космос!*



Объявляется конкурс!

- На лучшее ИМЯ для университетского наноспутника
- На лучший проект космического эксперимента для университетского наноспутника

Open competition "Send your idea to the space"

Nomination - best project of space experiment

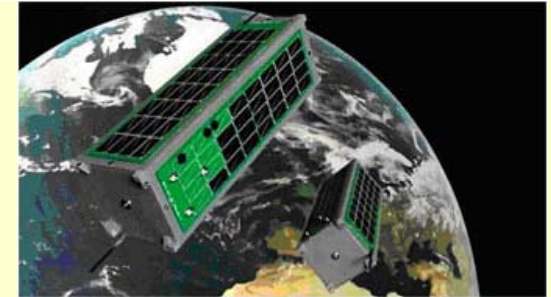
The 1st place – "Phase transitions under zero gravity and space radiation", the author the Krot Yury, the graduate student of the physics faculty.

The 2nd place – "Electromagnetic field pollution from a radio emission", author - Martinov Anton, the student of the 4th course of the faculty of radio physics and computer technologies.

The 3rd place – "An ionospheric harbinger" (research of ionospheric indignations during preparation of seismic events), author Reznikov Yury, the student of the 5th course of the faculty of radio physics and computer technologies.

Nomination – the best NAME for the university nanosatellite

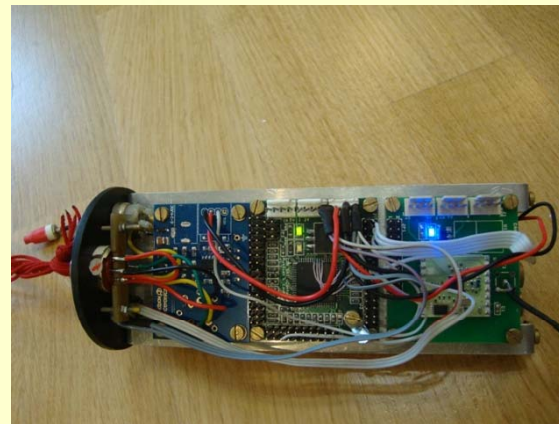
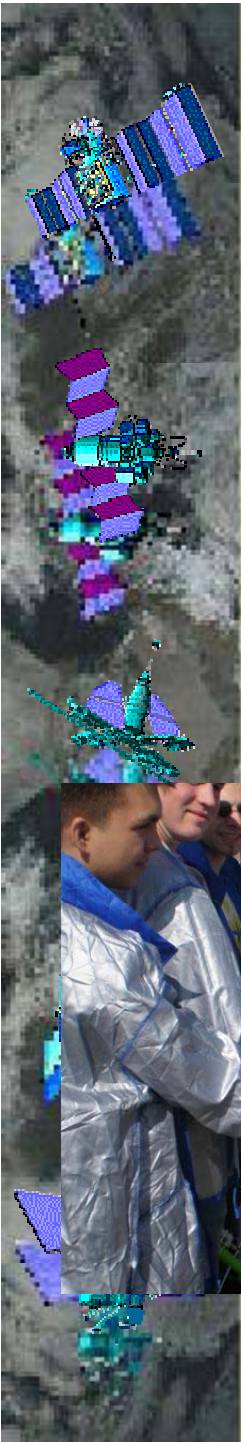
BEKASS the author the Peter Lopuh, the head of the department of the general physical geography and hydrometeorology of geographical faculty.



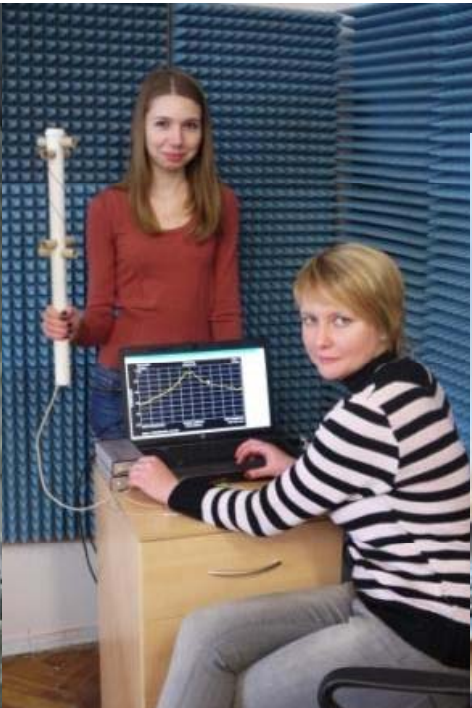
Pico satellite «BelSat»

•May, 4 2012 the BGU lyceum team, under the leadership of students of faculty of radio physics and computer technologies started an educational picosatellite of own development "BelSat" on height of 2 km near the city of Kaluga (Grabtsevo's airfield) within the first CanSat championship in Russia. Through 213 seconds the satellite successfully landed on a parachute of own development. Descent all the time from the satellite the telemetry from various sensors, and also from the GPS receiver came to reception station which also is own development.

•To the BelSat team the 2nd place among 17 teams was awarded, and also the cup on the nomination "For Development of the Best Scientific Task" is handed over.

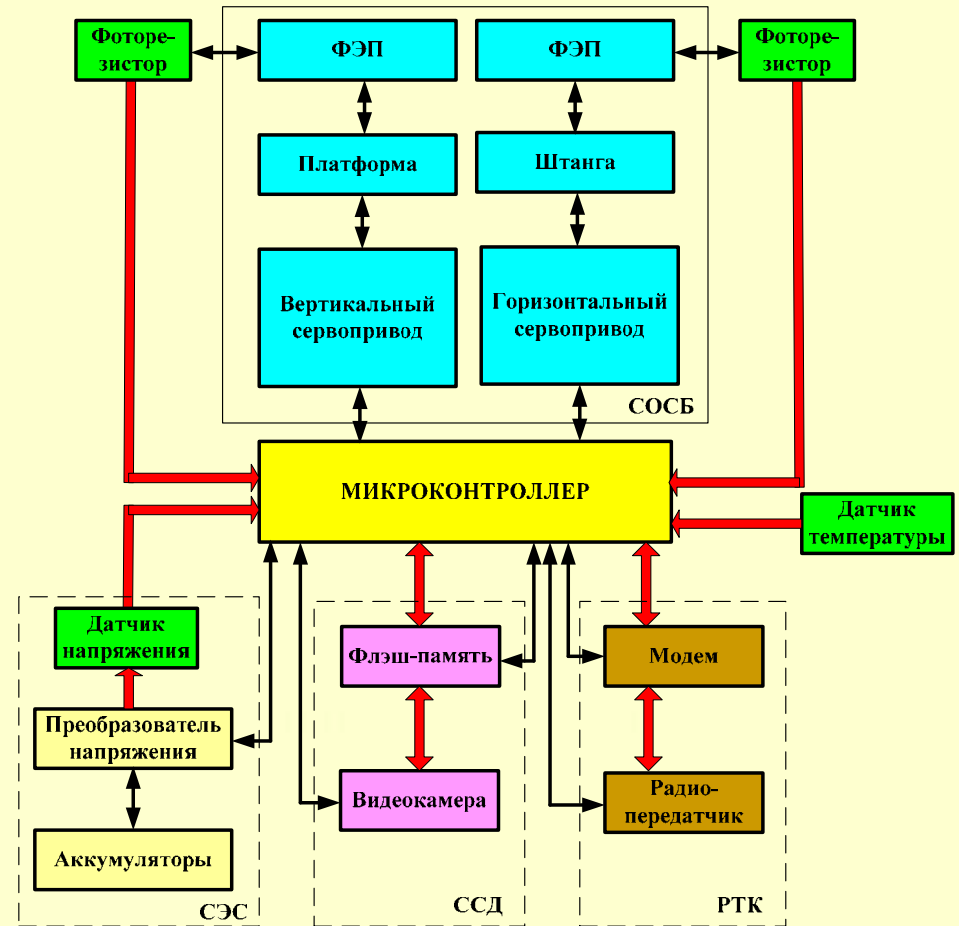
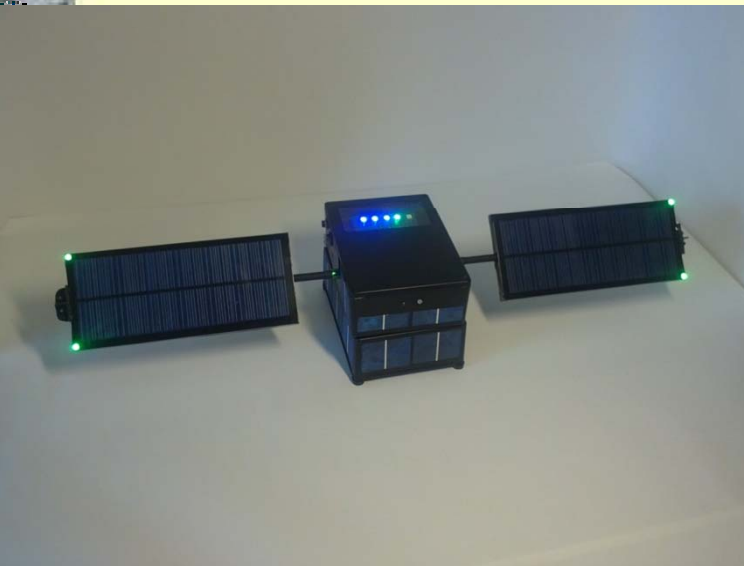
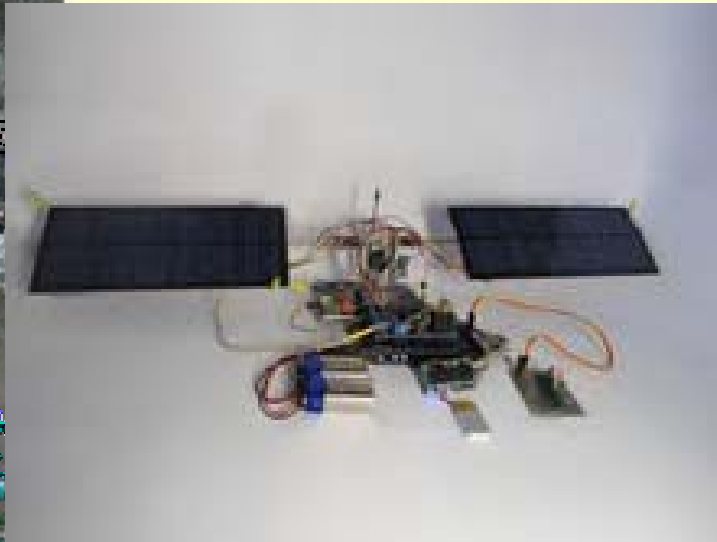


The students participating in development

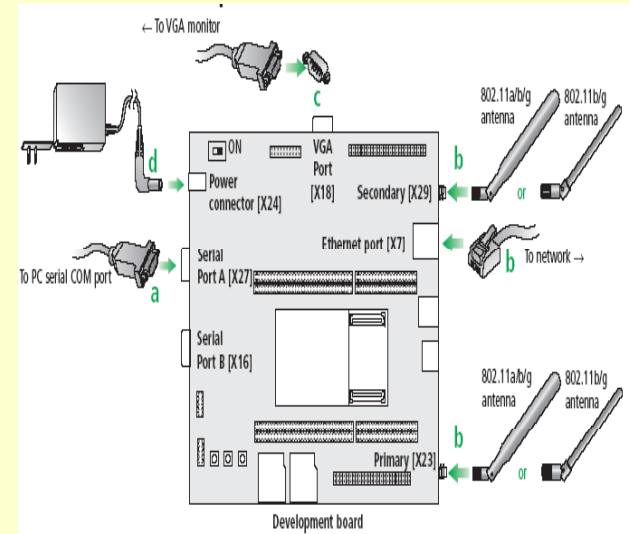
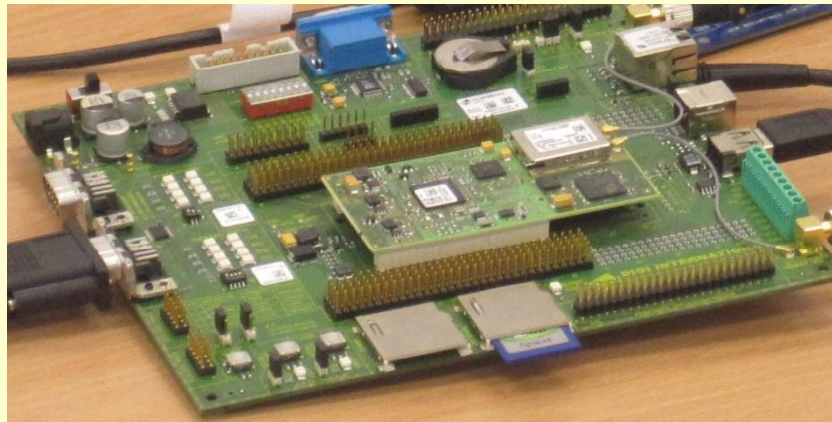


Nanosatellite model

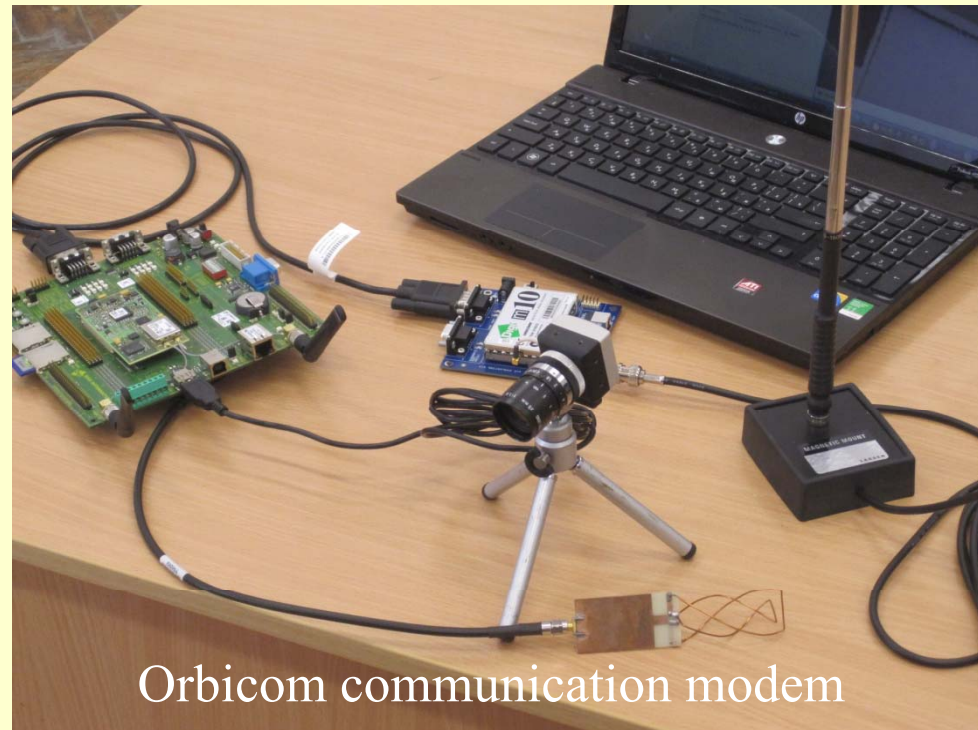
Within performance of an academic year project by students of the 4th year of specialization "Satellite information systems and technologies" the training model of the nanosatellite had been developed. This model is applied for modeling of reliability and operability of onboard systems and separate modules.



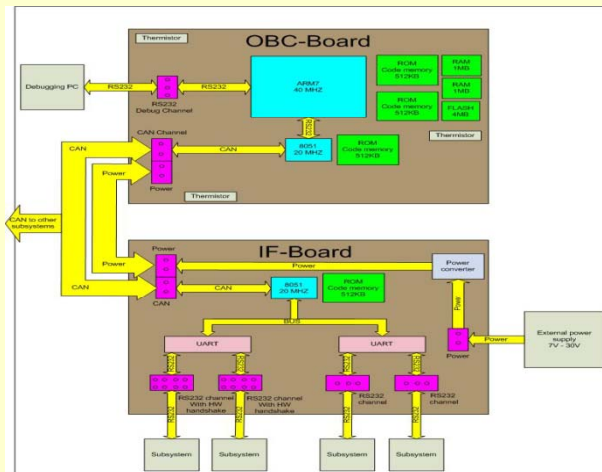
The space vehicle simulator



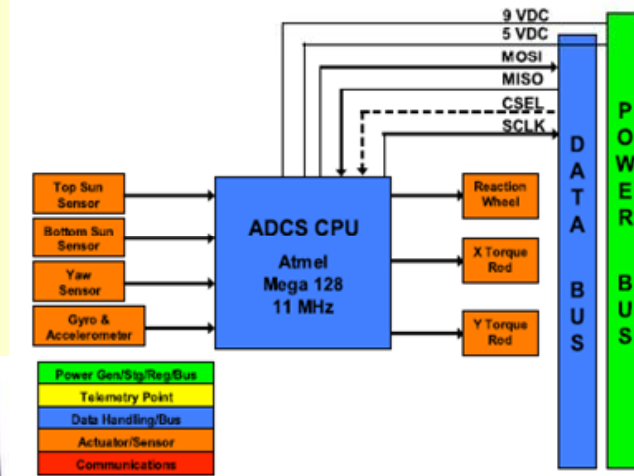
- ARM920T 400/533 MHz
- 16 Kb cash
- tire speed 133 MГц;
- NAND flash till 1Gb
- DDR SDRAM 256 Mb
- expected 4 Krad



Orbicom communication modem

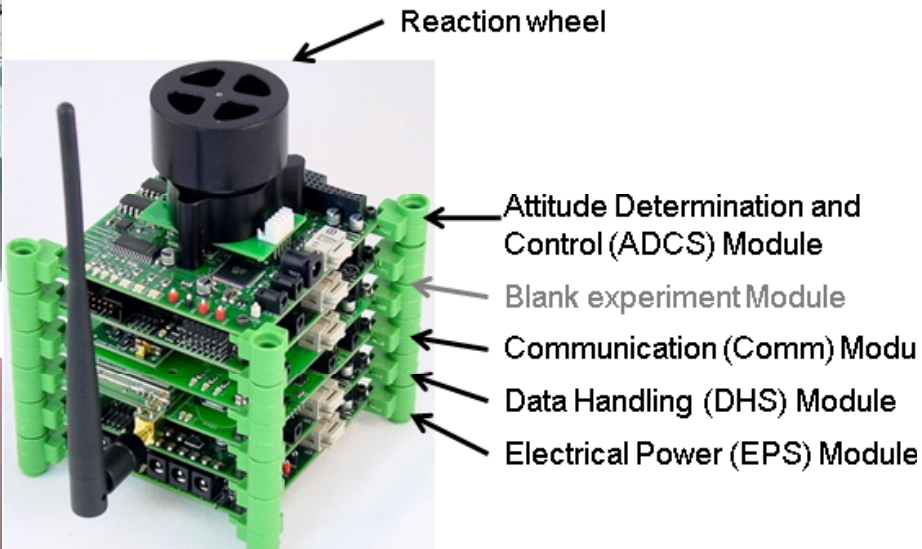
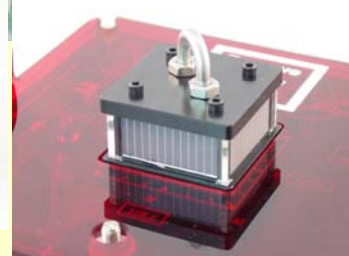
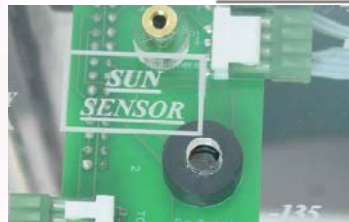
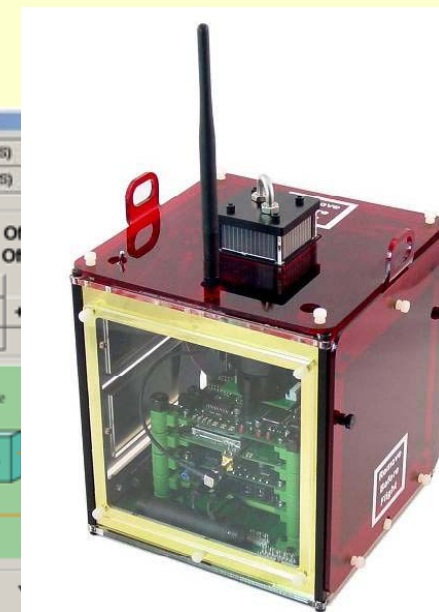
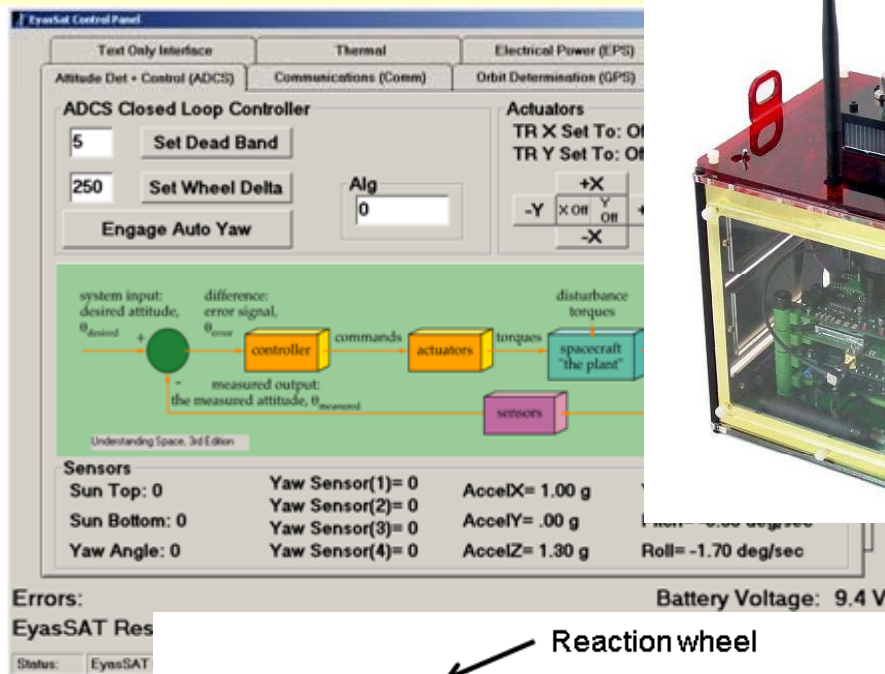
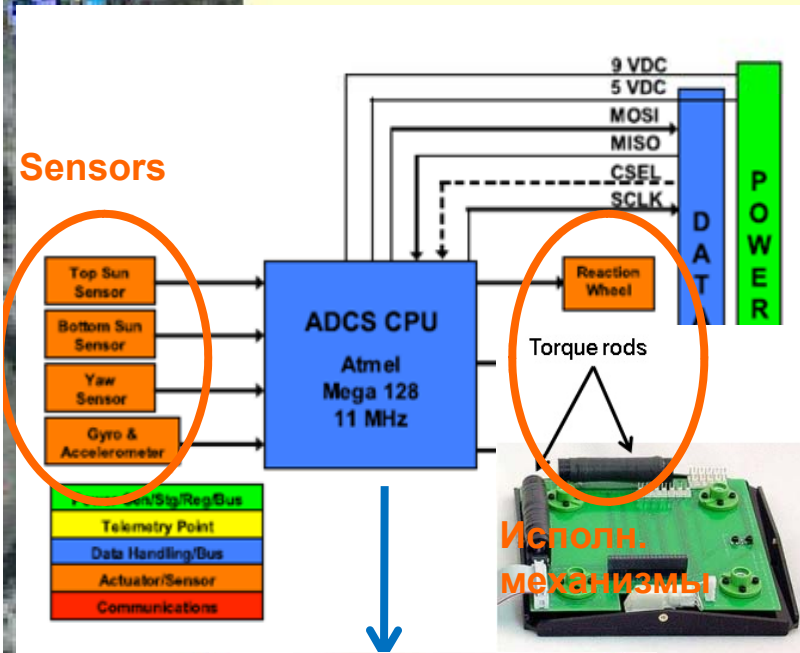


CubSat nanosatellite exercise machine





Laboratory exercise machine of the CubeSat format

Orientation and stabilization system



Our Partners



Universities of Russian Federation: South-West State University, Kursk. Lomonosov Moscow State University, Bauman Moscow State Technical University, Siberian State Aerospace University (Krasnoyarsk), Samara State Aerospace University

Universities of Ukraine: Dnepropetrovsk National University, National Technical University of Ukraine (Kiev), National Aerospace University (Kharkov)

Universities of Kazakhstan: Karaganda State Technical University, Gumilyov Eurasian National University(Astana)

Universities of Europe: Technical University of Berlin (Germany), ECM-Office (Germany), Fontys University of Applied Sciences (Netherlands), Institute for Business and Management (Netherlands), Lessius University, Department of Industrial Sciences (Engineering) (Belgium), the Institute of Aeronautics and Astronautics (ILR) (Germany)



Thank you!