Regional Report – Bulgaria

at the 7th UNISEC-Global Meeting

National Space Program in Bulgaria (2020-2025)

"Space Research, Technology & Applications"

UNISEC Bulgaria

Plamen Dankov, PoC

UNISEC Bulgaria

Established in *2016* (before 2016 in the frame of UNISEC Europe)

- *Participated in MIC in 2012, 2016, and 2019*
- *Attended UNISEC-Global Meeting in 2013, 2016, 2017, 2018 and 2019*
- *Organized MIC Seminars, Workshops, etc. (2012, 2013, 2016, 2018)*
- *Participated in HEPTASat Training program in Sofia 2017, in Strasbourg 2018*
- *Held CanSat Training Competition in 2019*

New Opportunities for Bulgaria in the Area of Aerospace Engineering and Communications

1st UNISEC-Global Meeting, 23-24 Nov., Tokyo, Japan

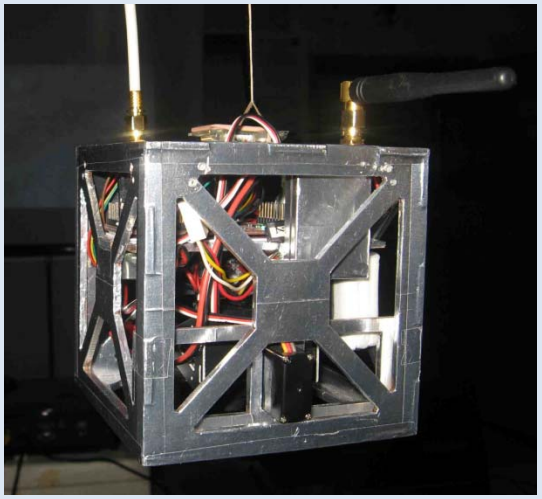
Our presentation on the
1st UNISEC Global Meeting,
23-24 Nov. 2013

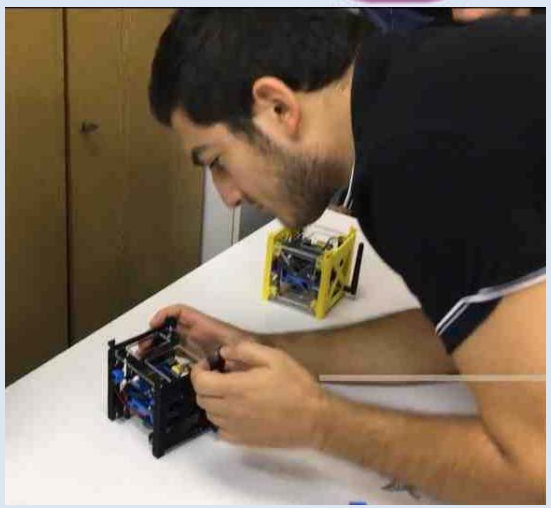
Bulgaria is a relatively old Space State

If you don't know, Bulgaria is a relatively old space country and has a serious experience in the space research since 1972:

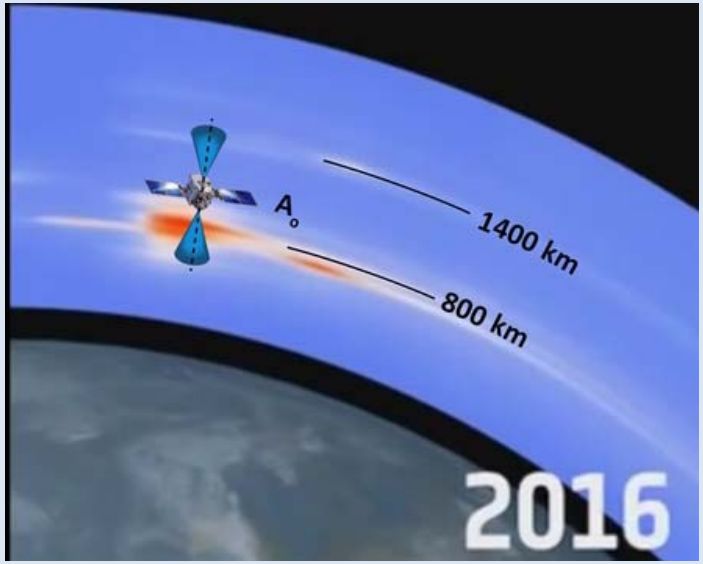
- Two Bulgarian cosmonauts;
- Bulgarian big satellites – "Bulgaria-1300";
- Bulgarian space food;
- Bulgarian space gardens, etc.

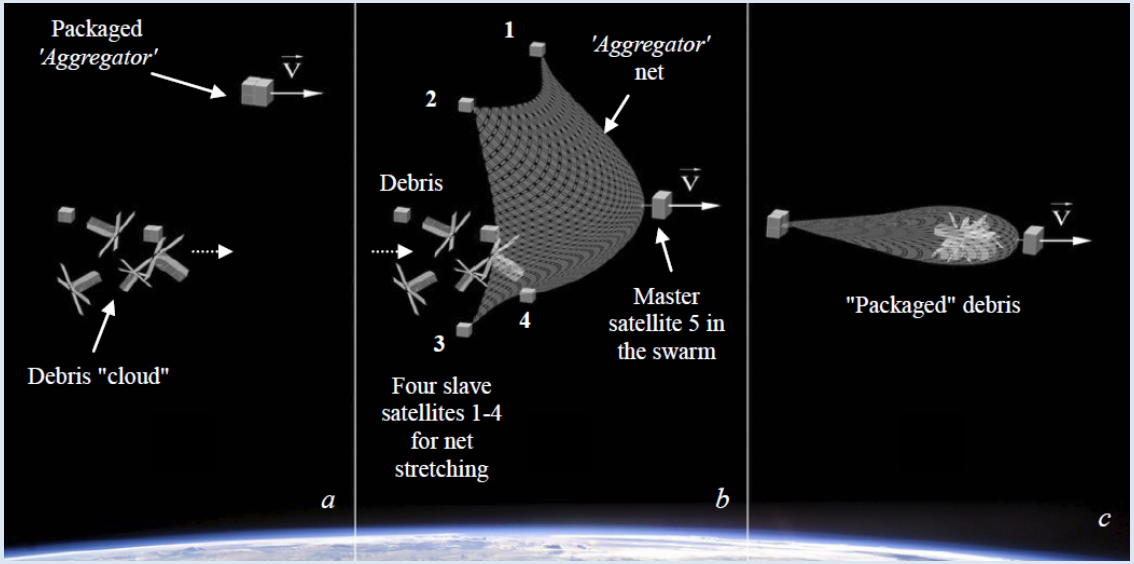
Activities in construction of 1U CubeSats and CanSats for educational purposes

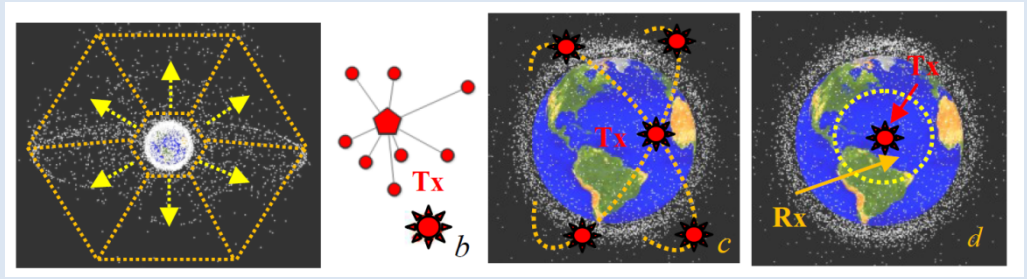


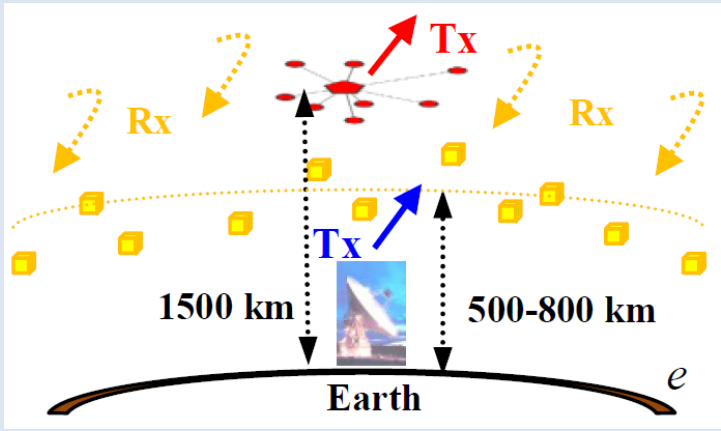


Ideas for Space Debris Identification, Classification and Aggregation by Optimized Flexible Satellite Swarms

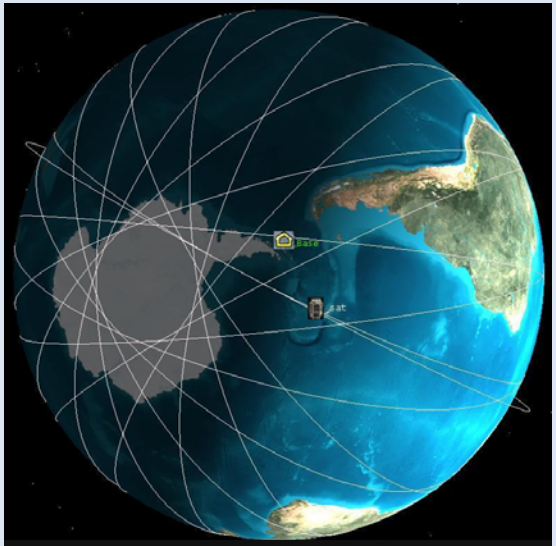


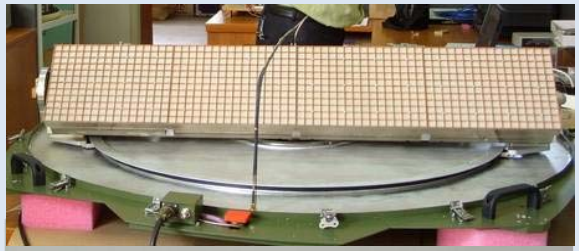


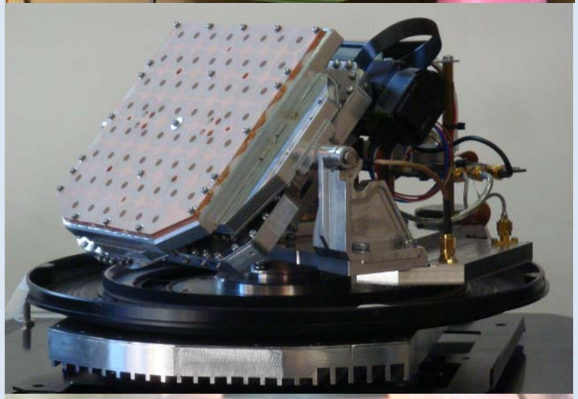


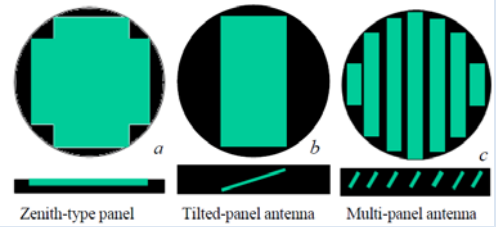


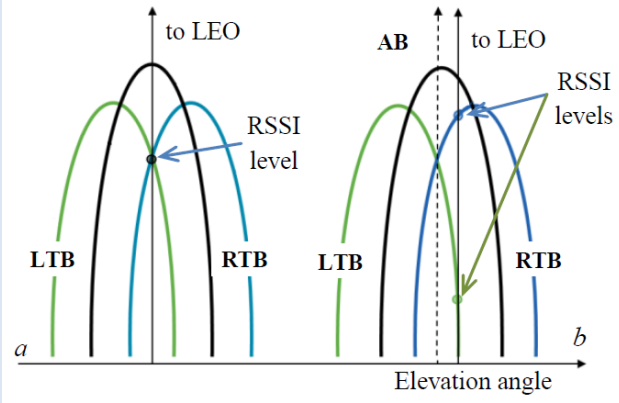
Ground stations, Antennas and Satellite Communications by LEO



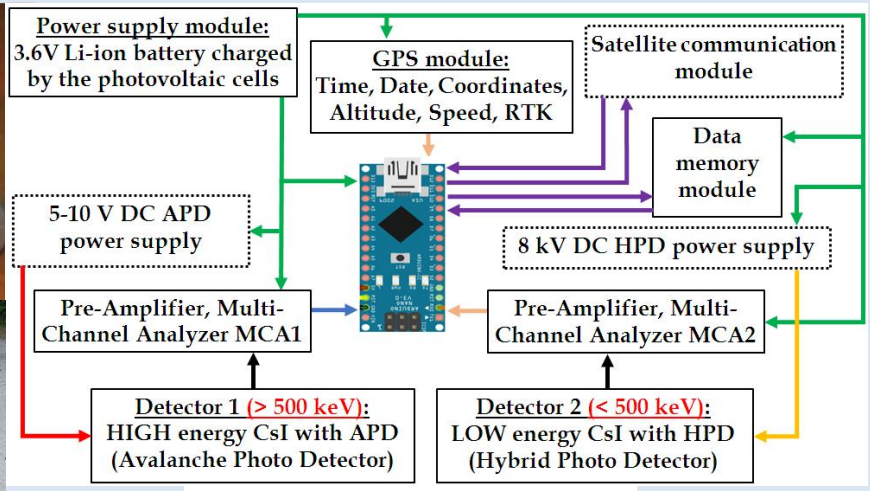


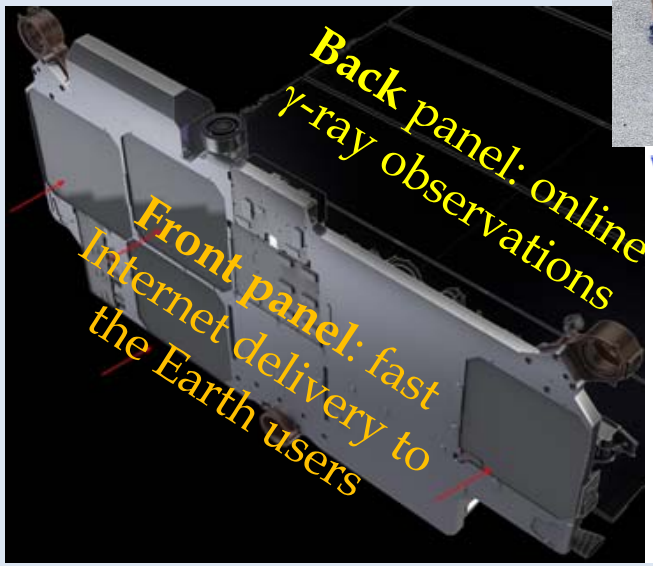


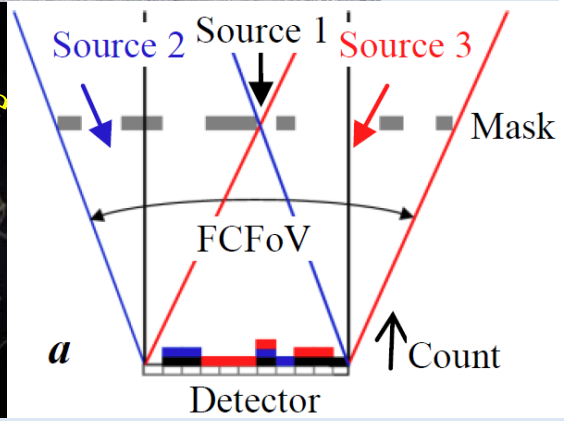


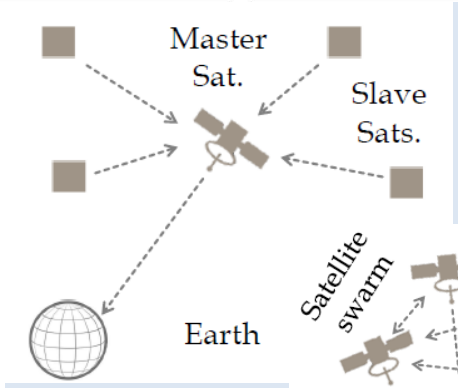


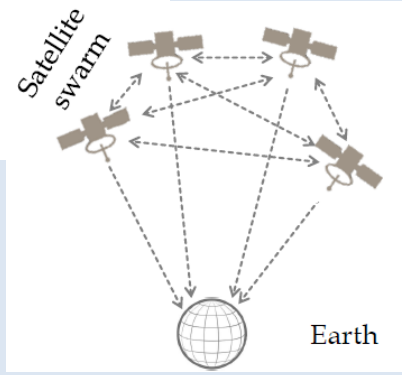
Gamma-Ray Astronomy Observations by LEO Communication Satellite Swarms for 5G Broadband Internet Delivery









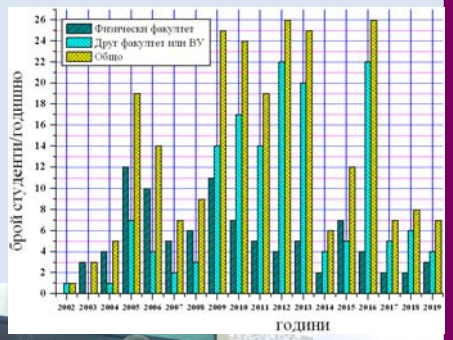


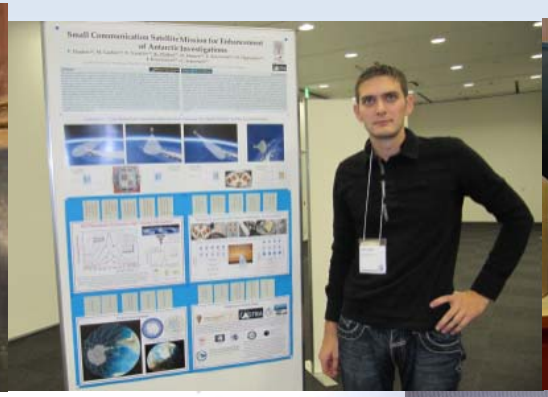
Master Program “Aerospace Engineering and Communications” in Faculty of Physics, Sofia University

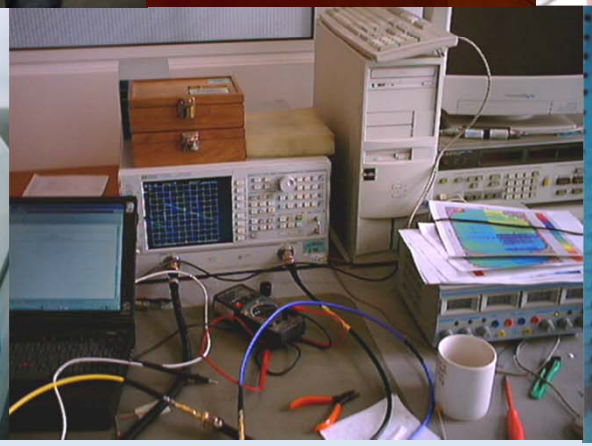
СОФИЙСКИ УНИВЕРСИТЕТ

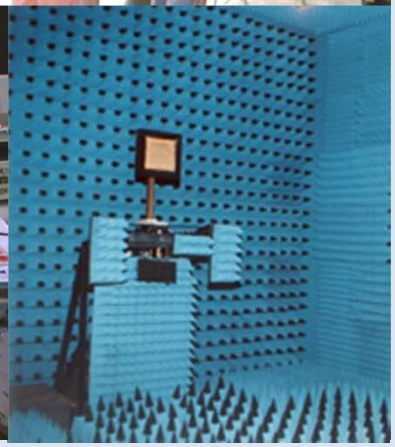
„СВ. КЛИМЕНТ ОХРИДСКИ“

ОСНОВАН 1888 Г.









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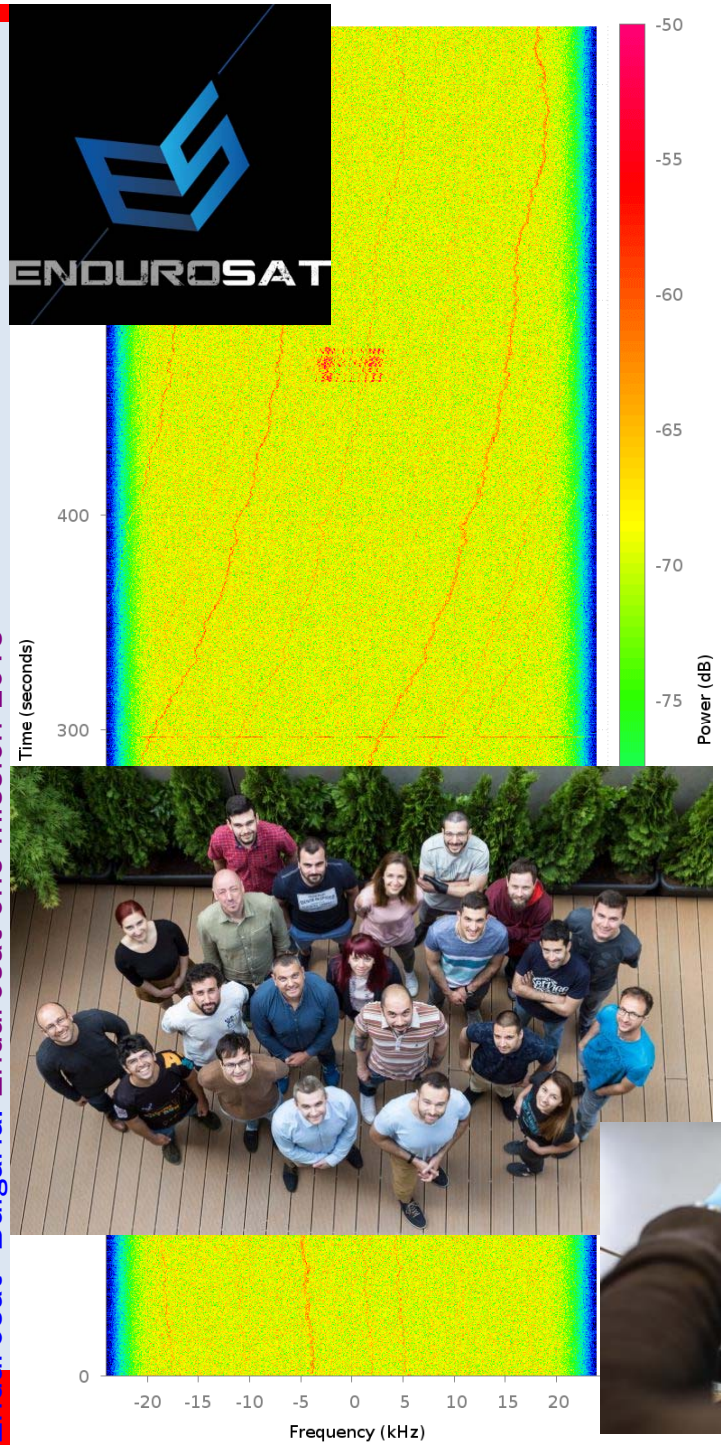
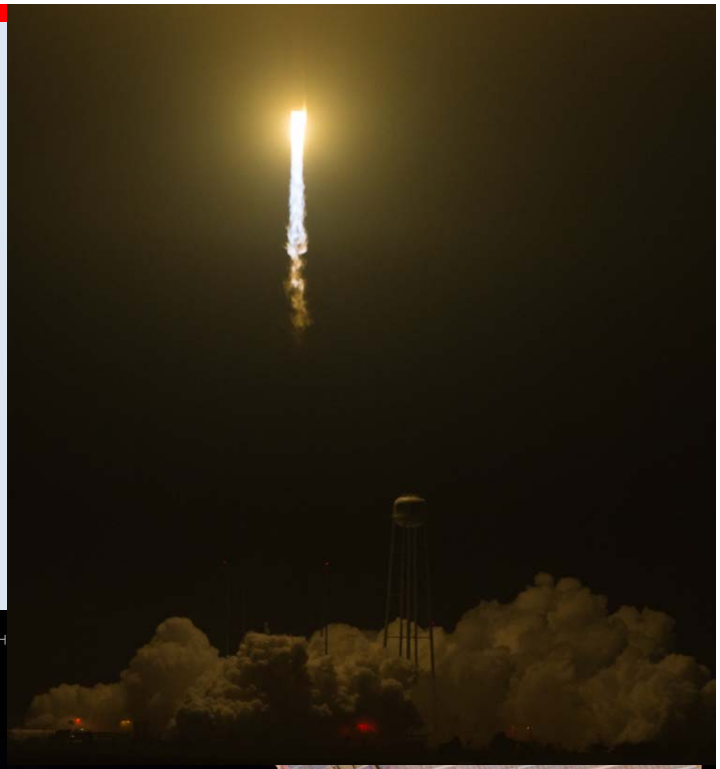
Endurosat Bulgaria: Endurosat one mission 2018

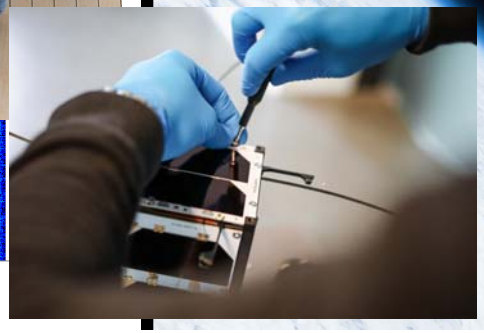
EnduroSat One

Mission from ISS; May 2018

The first Bulgarian nanosatellte in Space launched by a private company EnduroSat. Next year two more…







Five-year science program to advance space science and technology in Bulgaria (2020-2025)

The National Space Program, officially "***Space Research, Technology & Applications National Science Program***" is focused five-year R&D efforts funded by the Bulgarian government (~ € 3 500 000 for 5 years)

- The purpose is to *concentrate financial and human resources* in a particular field of research in/for Space.
- To *generate Bulgarian solutions* to major outstanding social, technological and scientific problems, local and global, connected with
- To prioritize the engagement of *young researchers*, providing more opportunities for them to stay and work in Bulgaria.

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The proposed program includes four main modules:

Space research

Space technology

Applied space research

Popularization

The activities span 5 years and cover a broad array of problems

Module 1:
Fundamental space research

WP1: Space physics
WP2: Space events affecting Earth
WP3: Space biology & medicine
WP4: Remote sensing – Earth & planetary

Space physics studies encompass gravitational lensing caused by massive space objects, neutron stars and their properties, and neutrino oscillation. The work package also involves experimental studies of cosmic rays and modeling of galactic cosmic radiation during Solar cycle variations.

Solar-terrestrial interactions, the effects of cosmic rays on gasses in the atmosphere, and the effects of coronal mass ejections on Earth will be studied in WP2. In particular, space weather will be examined as the effects of solar winds and cosmic radiation on human health or equipment can be extensive and damaging.

Space biology & medicine studies will focus on survivability of extremophile organisms in conditions simulating outer space.

Fundamental principles of flight in planets of the Solar system must be studied. WP4 will develop concepts for flying vehicles in the atmospheres of other planets for remote sensing missions.

Module 2:
Space technology

WP1: Navigation, communication & control systems
WP2: Space science instruments & systems
WP3: Space materials

Space science instruments will be developed to observe deep space phenomena, such as gamma ray bursts and other high-energy events of interest to astronomers.

New materials for use in the space industry will be developed as part of WP3, along with methods to model their properties in the space environment.

Plasma generating devices like this one at the Faculty of Physics of Sofia University will be used in the development of small satellite thrusters in WP2.

Key satellite systems will also be developed under WP2. These include small satellite propulsion systems (both electric and chemical); power management modules; near-Earth communication systems, studies of geostationary orbital slot optimization and utilization of the radio spectrum; laser technologies including a ground-based laser communication terminal and satellite-based LIDAR for remote sensing; navigation and tracking systems, and more.

Module 3:
Applied space research

WP: Remote sensing applications

Earth Observation (EO) applications will include satellite data processing related to air pollution, water pollution and seismic risk assessments. Combining satellite EO data with unmanned aerial vehicle (UAV) imaging will be used to improve relief efforts during natural disasters and industrial incidents. Imaging data from other sources will be used to study surface features on the Moon and other planets, or identify potentially hazardous asteroids.

Use case: Air pollution analytics

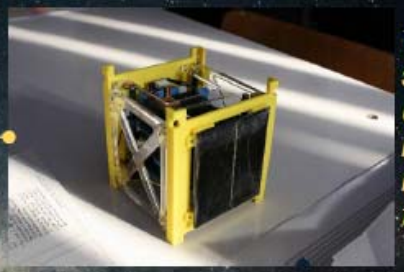
Satellite data can be used to track pollution with harmful gases like NO_2 and their levels in the atmosphere over time. The data can then be analyzed to assess the impact of pollution on human health, particularly health costs. The applications of such analyses are far-reaching.

Use case: Lunar feature identification

Extensive imagery databases of the Moon, Mars and other celestial bodies are freely available. With appropriate analytics and methods, areas with potential for future landing sites or bases can be identified.

Module 4: Popularization

WP1: Experimentarium
WP2: Outreach
WP3: Support for schools



This CubeSat was used for a hands-on small satellite assembly training at Sofia University in 2017. The Experimentarium is to conduct such trainings regularly, introducing young engineers to satellite technology in an accessible way.

A hands-on training space (Experimentarium) will be set up specifically to disseminate the knowledge obtained across the various work packages of the Program. It will focus on integration of CubeSat-class training satellites, building an uplink-downlink ground station, and set up a flight simulator for basic introduction to aircraft piloting and control.

Another important aspect of this module is outreach, consisting of consortium conferences, as well as events popularizing the results of the Program across various demographics. Additionally, technology transfer channels for businesses will be set up.

To maximize the benefits of the Program, results will be used to produce teaching materials for specialized courses. A new course for PhDs, space physics courses for secondary schools, and textbooks will be developed.

Tech sector cooperation opportunities

The following key table can be used to identify work packages compatible with business-related applications. General research areas are also listed, allowing the identification of potential cooperation areas between National Space Program consortium members and third parties, like supercomputing centers or testing laboratories. The program offers ample space for the development of experimental equipment with commercial applications

	Fundamental space research	Space technology	Applied space research	Popularization
WP1	● ●	● ● ● ● ● ● ● ● ●	● ● ●	● ● ● ● ●
WP2	● ● ● ●	● ● ● ● ● ●		
WP3	● ●	● ● ●		
WP4	● ●			

Relevant Industries

- Structures, fixtures
- PCBs
- Sensor technology
- Microchips
- Comms hardware
- Materials
- Optics, optical elements
- Software
- Batteries, power supply
- Supercomputing
- Rapid prototyping
- Clean room assembly
- Data centers
- Biomedical testing

Anticipated benefits

A number of R&D areas will benefit directly from the Program. The improvements will significantly improve Bulgaria's standing on the global map of space activities, and will give a significant boost to the local aerospace industry (as well as related high-tech industries). The following are just a handful of benefits that the National Space Program will generate.

The development of nano (lean) satellites has been includes particularly (~30 %) in Module 2 (WP1), Module 3 and Module 4 (WP1)

Significant improvement in space sciences; improved access to international space research projects, including interplanetary missions.

Establishment of local capabilities in small satellite system design & assembly. Improved space electronics & comms hardware capacity.

Setting up the stage for full integration into the European Space Agency, which in turn will generate enormous industry benefits.

Major improvement in space data acquisition and analysis for the national economy. Benefits for agriculture, biotech & others.

Thank you for your attention!

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