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Invited lecture

NEW POSSIBILITIES FOR SPACE RESEARCH IN BULGARIA[1]

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1. FIRST PERIOD – HISTORICAL REVIEW.

The organized participation of Bulgarian scientists in space research started in 1969 when the Scientific Group of Space Physics (SGSP) at the Presidium of the Bulgarian Academy of Sciences was created. Years of creative enthusiasm followed the euphoria caused by mankind's grand success in the peaceful study of space at the time. Yet with the first man flown to space and the first spacecraft landed on the moon, targeted studies began in Bulgaria in the field of probe methods for studying of space plasma.

In 1972, after launch of first Bulgarian equipment P-1, Bulgaria became the 18th in order space country.

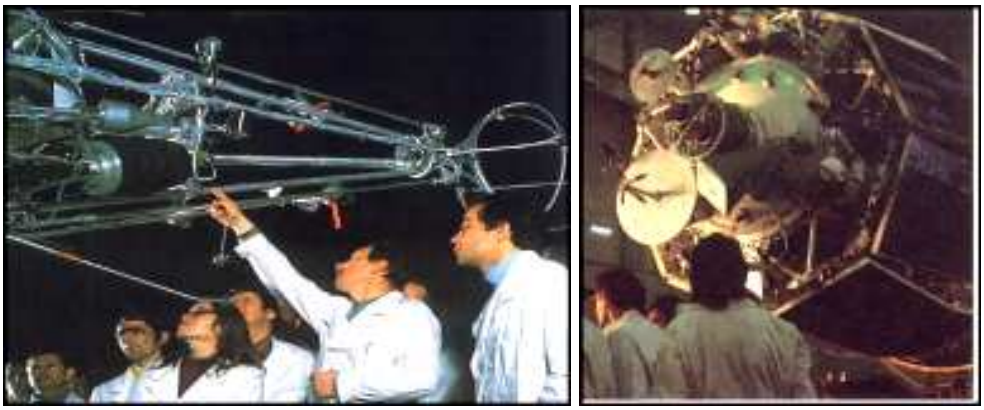

Figure 1a,b: Bulgarian scientists during the preparing of the INTERCOSMOS experiments.

[1]Lecture presented by M. Tsvetkov

In 1975, based on the SGSP, the Central Laboratory for Space Research (CLSR) was founded. Soon, Bulgarian scientists gained significant experience through their successful participation in the INTERCOSMOS Program, preparing experiments and designing equipment for the satellites INTERCOSMOS - 8 (IK - 8, 1972), IK - 12, 14, 19 and the heavy geophysical rockets VERTICAL - 3, 4, 6, 7, 10 (Fig.1a.b.).

In the years that followed, an ever growing number of Bulgarian scientists and institutes joined in the preparation and performance of space experiments. In 1979, the first Bulgarian astronaut Georgi Ivanov (Fig. 2) flew in space on board of SOYUZ - 33 Space Ship. The research program and equipment for his flight were designed entirely by the suggestions of our scientists ("Spectar-15", "Daga", "Sredets", "Vital").

In 1981, through the two satellites INTERCOSMOS "Bulgaria - 1300"(Fig.3.), furnished entirely with Bulgarian equipment, and METEOR - PRIRODA, the National Space Program "Bulgaria-1300" was implemented, aimed at studying the ionospheric-magnetospheric relationship and remote sensing of the Earth from space. These successful experiments consolidated the priority scientific and scientific-application research areas in the country - space physics, remote sensing of the Earth, and space technology.

Figure 2: Astronauts Georgi Ivanov (BG) and N. Rukavishnikov (USSR) on board of SOYUS-33.

The decision of the Government from 1987 for restructuring of the CLSR into a Space Research Institute (SRI) was a manifestation of recognition for the success of space studies and awareness of their future significance. The gained experience and scientific knowledge were the prerequisite for the development of a new research

program for the second manned flight with a Bulgarian astronaut. Under the "Shipka" Program, research teams from the Bulgarian Academy of Sciences, Sofia University, the Academy of Agriculture and other universities and institutes were engaged in the implementation of more than 48 research experiments in the field of space physics, remote sensing of the Earth from space, space biology and medicine, space material science, space equipment. The flight took place in 1988 with astronaut Alexander Alexandrov (Fig. 4). The leading research institute in the implementation of the "Shipka" project was SRI - BAS. For the implementation of this research program the Bulgarian scientists designed 15 research devices and complexes which continue to work even after the Bulgarian flight as part of the equipment on the Russian MIR Orbital Space Station. In parallel with the preparation of this flight, scientists from SRI participated successfully in the international programs VENUS-HALLEY (1985-1986), PHOBOS (1988-1989), AKTIVEN (1989), APEX (1990) (Fig.5).

Figure 3: First Bulgarian Satellite "Bulgaria 1300" lunched in 1981.

Figure 4: The second Bulgarian astronaut Alexander Alexandrov with his russian colleagues.

In the recent years, in the SRI, new programs are elaborated and a number of old programs and complexes are improved, such as: the SVET space greenhouse, the R-400 very high frequency (VHF) radiometer under the PRIRODA project, the NEUROLAB-B system for monitoring the astronauts' psychophysiological status which were flown and operated on board of the MIR orbital space station.

2. SECOND PERIOD – AFTER 1989

One of the greatest achievement of the SRI is the "Neurolab-B" system (Fig.6) which operates on board of the MIR orbital station. It is intended for complex psycho-physiological study of astronauts (electrocardiogram, miogram, electrooculogram, breathing, temperature, blood pressure, skin conductivity etc.).

In the recent years, the small-sized multichannel "Holter" system (Fig.7) was designed for recording of some physiological parameters: electrocardiogram, breathing, blood pressure, temperature etc. The system is used for clinical studies in an English clinic.

Figure 5: Space equipment made at the SRI, BAS and used during different space missions.

Figure 6: The "Neurolab-B" system.

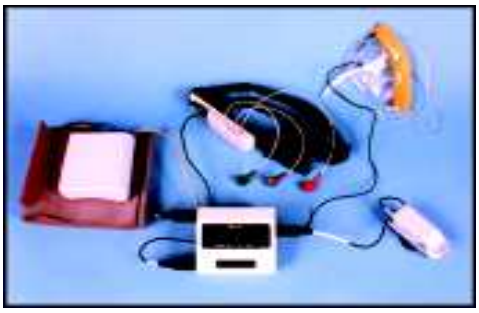

Figure 7: The "Holter" system.

Onboard of the MIR OS were carried out the experiments under the SVET SG space greenhouse project (Fig. 8) with the active participation of Russian and American astronauts during 1990-2000 are as follows: two-month experiments with radishes and Chinese cabbage - June-August 1990; three-month "Super Dwarf" wheat experiments - August-November 1995; six-month wheat experiments with two successive wheat crops – July, 1996 – January, 1997 (with the Utah State University, Logan, USA); four-month experiments with three "Brassica Rapa" generations – May - September, 1997 (with the Louisiana State University, USA); six-month experiments with two successive crops of a new wheat brand – November, 1998 - May, 1999; and three-week experiments with leaf crop - May - June, 2000 (with the IBMP, Moscow).

The project is discussed by the international scientific community which qualifies it as one of the most prestigious ones, carried out in the 1990s on the MIR OS. Plant experiments will continue in the next 21st century on the International Space Station, for which a new generation of SVET-3 SG is being designed, along with similar NASA and ESA equipment.

Figure 8: The "SVET SG" - first space greenhouse successfully tested at MIR OS.

During the project RAPIDS joint workgroup of specialist from NLR and Space Research Institute was formed. An demonstration scenario was developed and coordinated according to the proper test areas concerning schedule activities. The mobile ground receiving station RAPIDS was transported and installed near to the Space Research Institute in Sofia in 22-29 of September 2000. Bulgarian partners have organized a model of Receiving and Processing Center for remote sensing data. As result of the work were received optical (SPOT) and radar (ERS) data.

Figure 9: The mobile ground receiving station "RAPIDS".

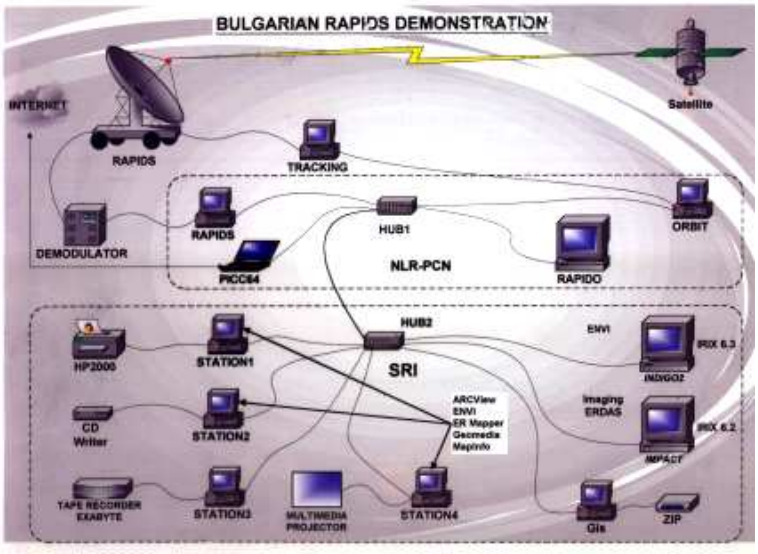

Figure 10. The pipeline structure of "RAPIDS".

SRI perform scientific and applied activity in the field of aviation and space navigation and communication systems and equipment. The team of the Laboratory of Navigation and communication is basically engaged with increasing the effectiveness of the available space or national security communication and navigation systems. Intensive work is underway to design integrated navigation-communication systems with wide practical application in the field of on-line monitoring of movable objects - transportation vehicles and aircraft. The speedy communication modules (Fig. 11) developed in the Laboratory, operating in the range of 2.4 - 5.8 GHz, are applied on a number of ground-based communication systems, using modern protocols and route-defining methods.

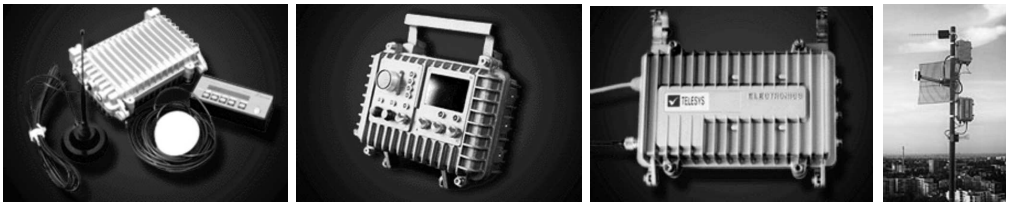

Figure 11: The components from the "RAPIDS" systems made in Space Research Institute, BAS.

3. FUTURE – INTEROPERABILITY BY COOPERATION AND INTEGRATION

The partnership between Bulgaria and a partner countries in Framework Program 6th of EU;

Looking for partners for joint participation in space programs for launching small satellites for Earth observation;

Taking a part in the International Space Station program developing systems and devices for medical and biological investigations;

Take a participation in the field of aircraft onboard systems and unmanned vehicles.