Current status of Radiation Monitoring System for ISS/RS

and preliminary results of its components testing onboard Mir station.

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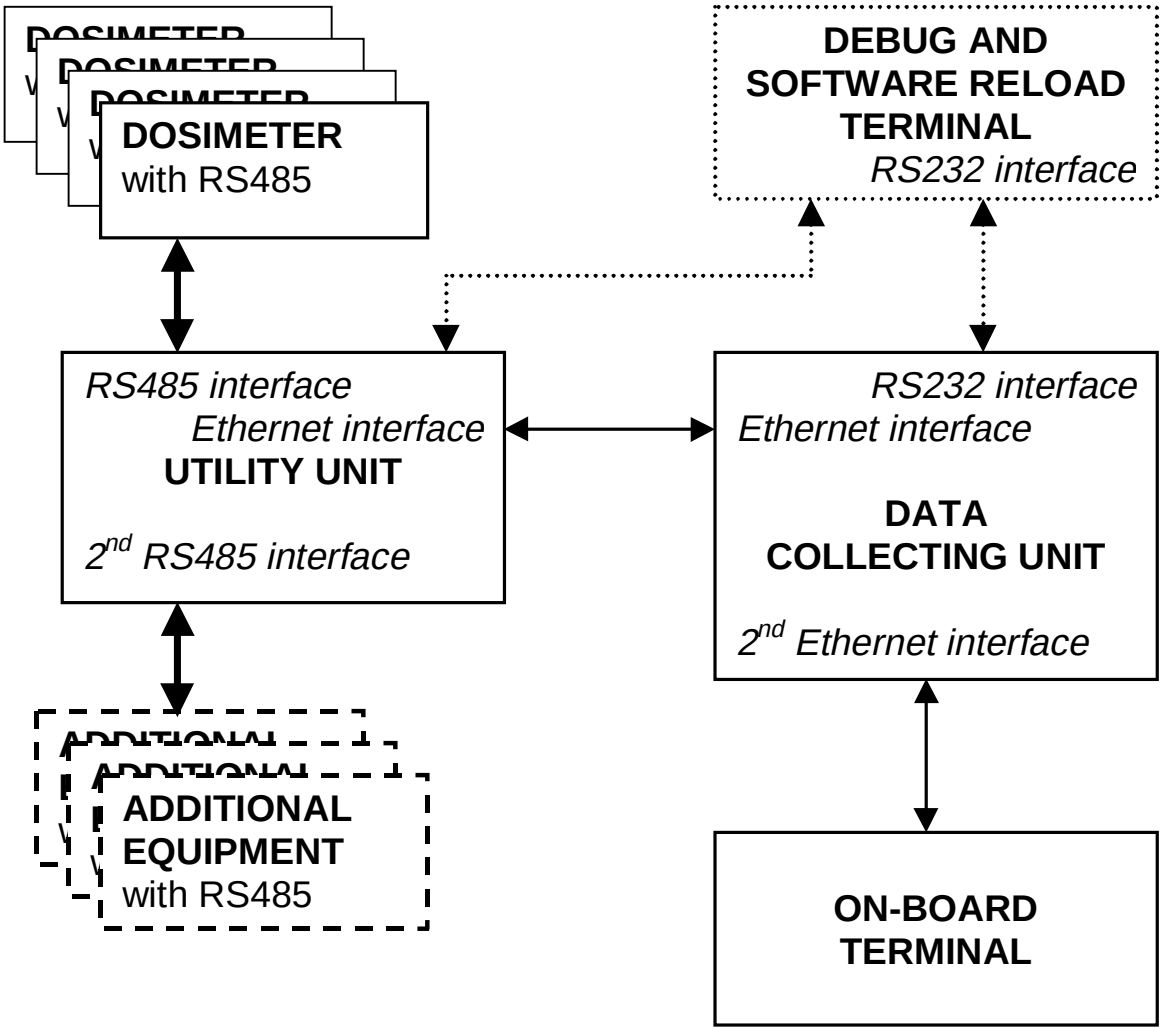
Presented by A.Akulin.

ISS Radiation Monitoring System. Cartoon illustration.

The Radiation Monitoring System has been developed at the Institute of Nuclear Physics of Moscow State University, on the order of Russian Space Agency. The main goal of the system is to protect the cosmonauts on-board of the russian segment of ISS from the space radiation influence. The brief description of the system and its components has been introduced at the WRMISS'98, in Budapest. This paper describes the current status of RMS and shows the results of testing of its components onboard MIR station.

ISS Radiation Monitoring System.

Functional scheme.



The system has a modular structure. The Utility Unit periodically accepts data from a set of dosimeters mounted in several certain places of russian segment service module. The data is transferred using RS485 interface and microcontroller-oriented exchange protocol.

At next stages of delivery RMS will also accept data from additional equipment, connected using another one RS485 interface. Additional instruments with proprietary interfaces could also be connected using special interface converter that could be developed and manufactured by the Institute, if any collaboration will need this.

The data accepted by Utility Unit is transferred via Ethernet link to a Data Collection Unit which:

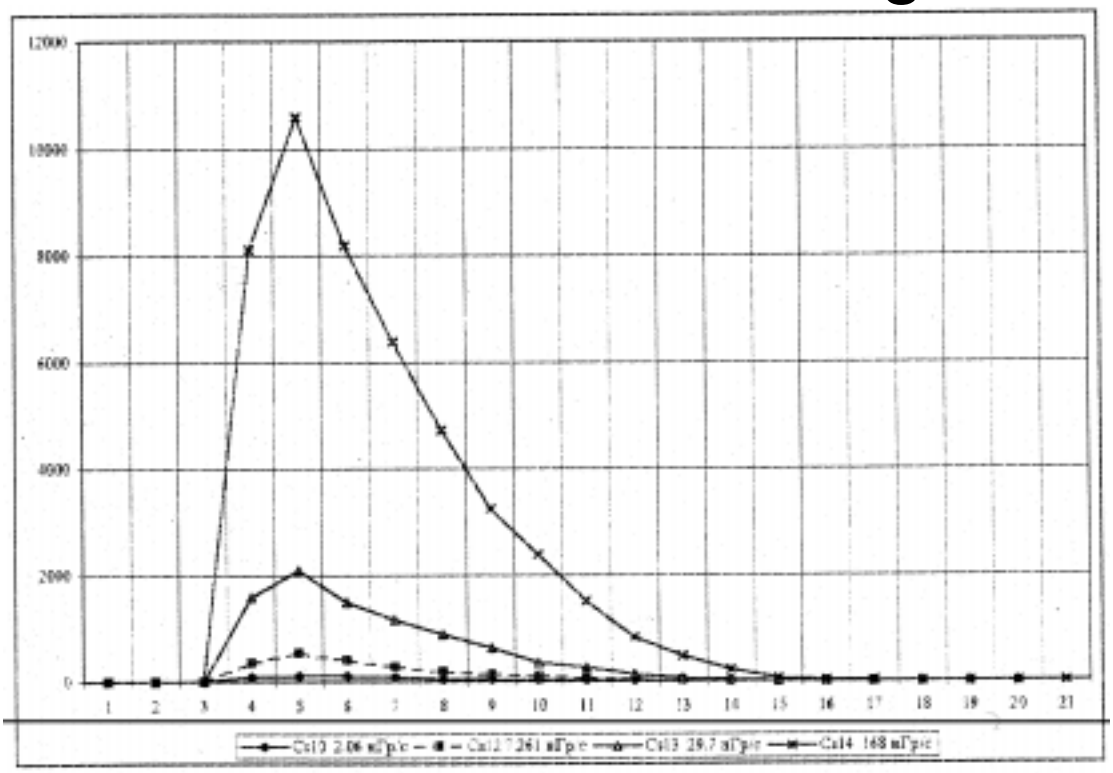
1. Periodically sends data frames to onboard telemetry interface, to transmit it down to the ground.
2. Processes the data and sends the results of processing to the on-board terminal, via Ethernet link.

Both Units software could be reloaded online using RS232 interface or via Ethernet.

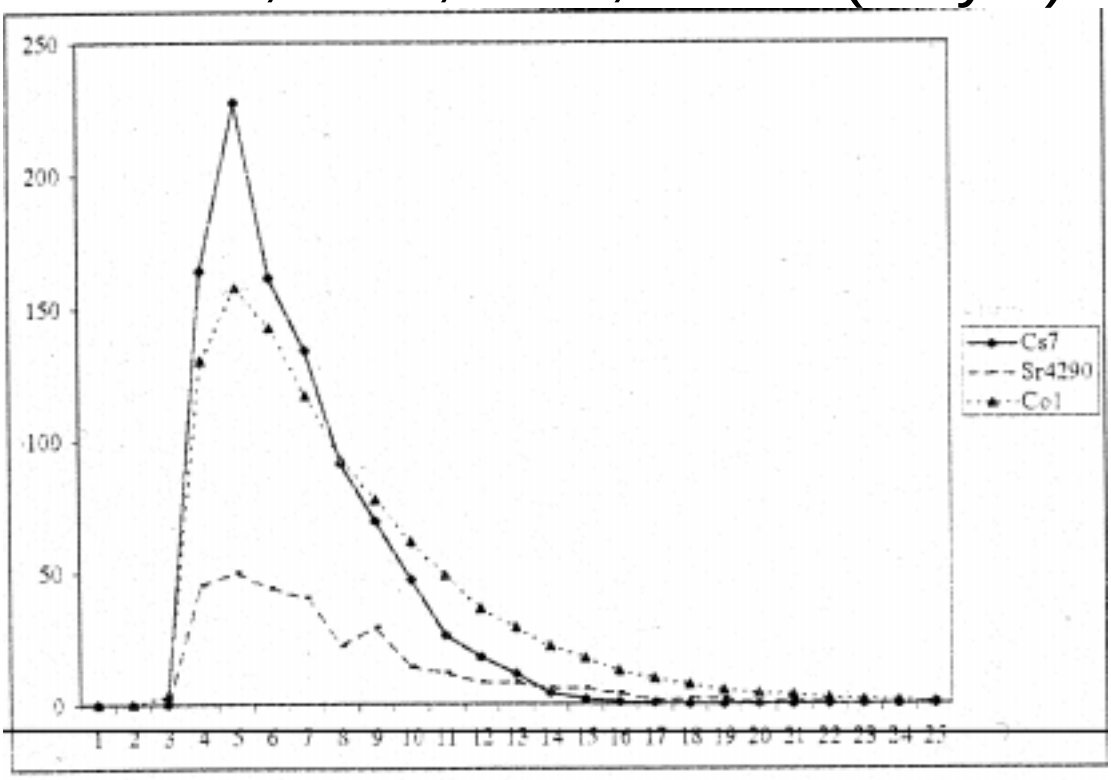
Hardware blocks were designed so that they could cover much wider area of applications than the target system. Software was developed using the high-level language, ANSI C. The industrial operating system RTEMS was used as a base of Utility Unit software.

These factors together allow to use the separate components of RMS as universal building blocks to develop new scientific systems fastly and with good quality.

METROLOGY TESTS, fig.1.



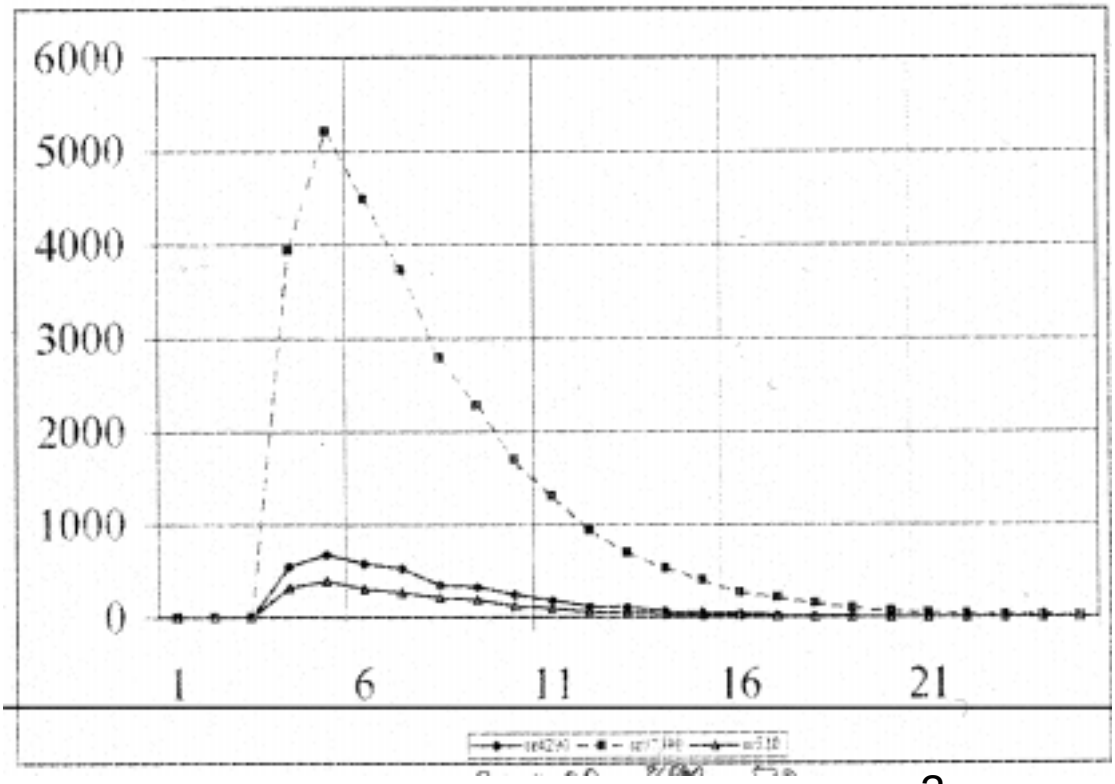
Cs: 2.06; 7.26; 29.7; 168.0 (nGy/s)



Cs: 0.661 MeV; Sr; Co: 1.25 MeV

During preparation of system, a couple of tests was made with its components, including vibration, EMC et cetera.
Some metrology results are shown for illustration. You see the plots of the particles flux for several different sources of different intensity.
X axis show the ADC channel number, Y axis is the flux value.

METROLOGY TESTS, fig.2.



Sr: 36000; 4290; 520 (p/cmm^2/min)

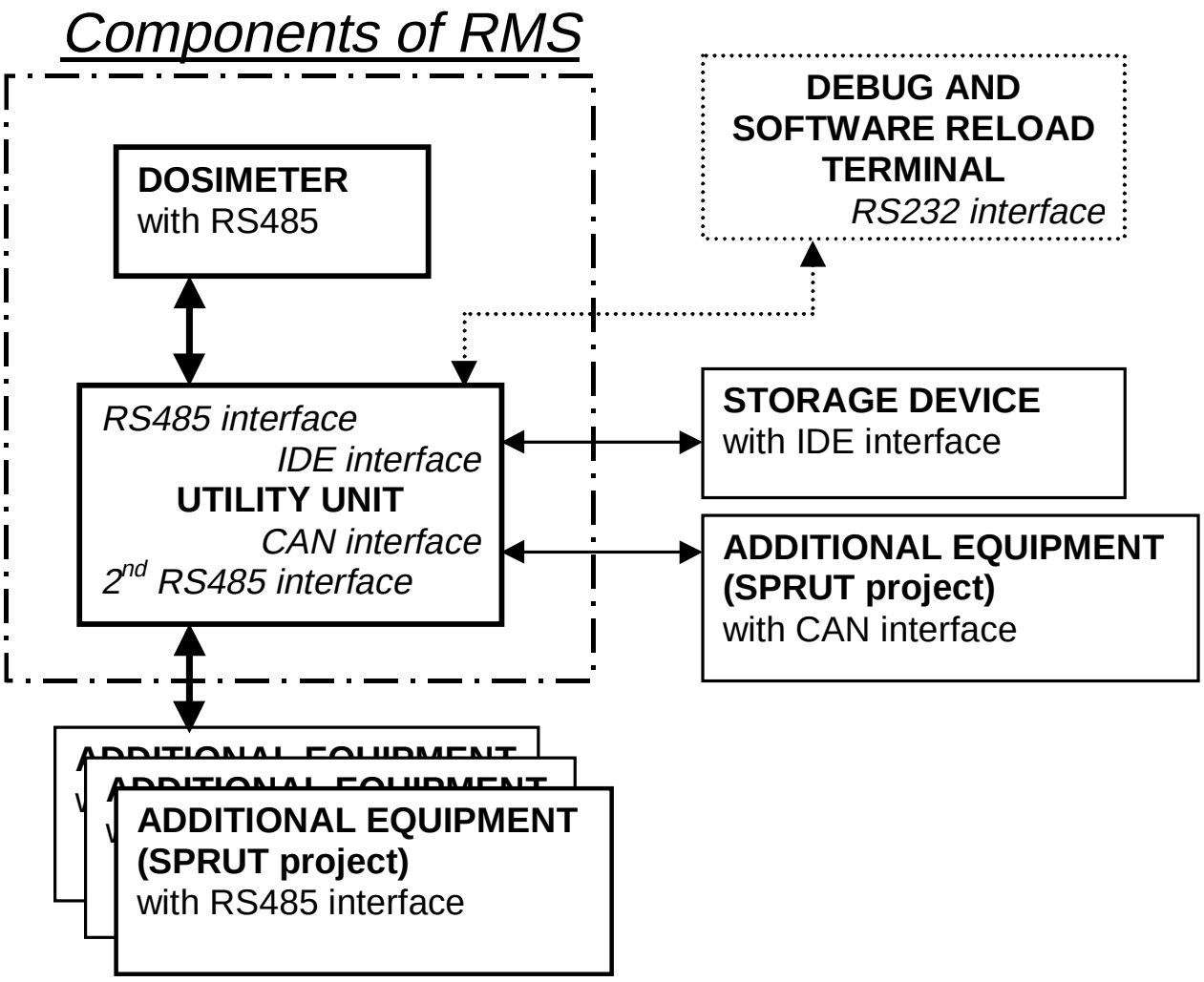
Absorbed dose measurements

Nucleide type	Absorbed dose in H_2O
Cs-137	2.57 nGy/s
Cs-137	10.4 nGy/s
Cs-137	41.6 nGy/s
Cs-137	78.2 nGy/s
Cs-137	244 nGy/s
Co-60	5.14 nGy/s

Sr of 36.000, 4.000, 500 particles per minute per square cantimeter were compared.
The summary of sources used is shown in a table.

Hardware configuration onboard MIR station.

Functional scheme.

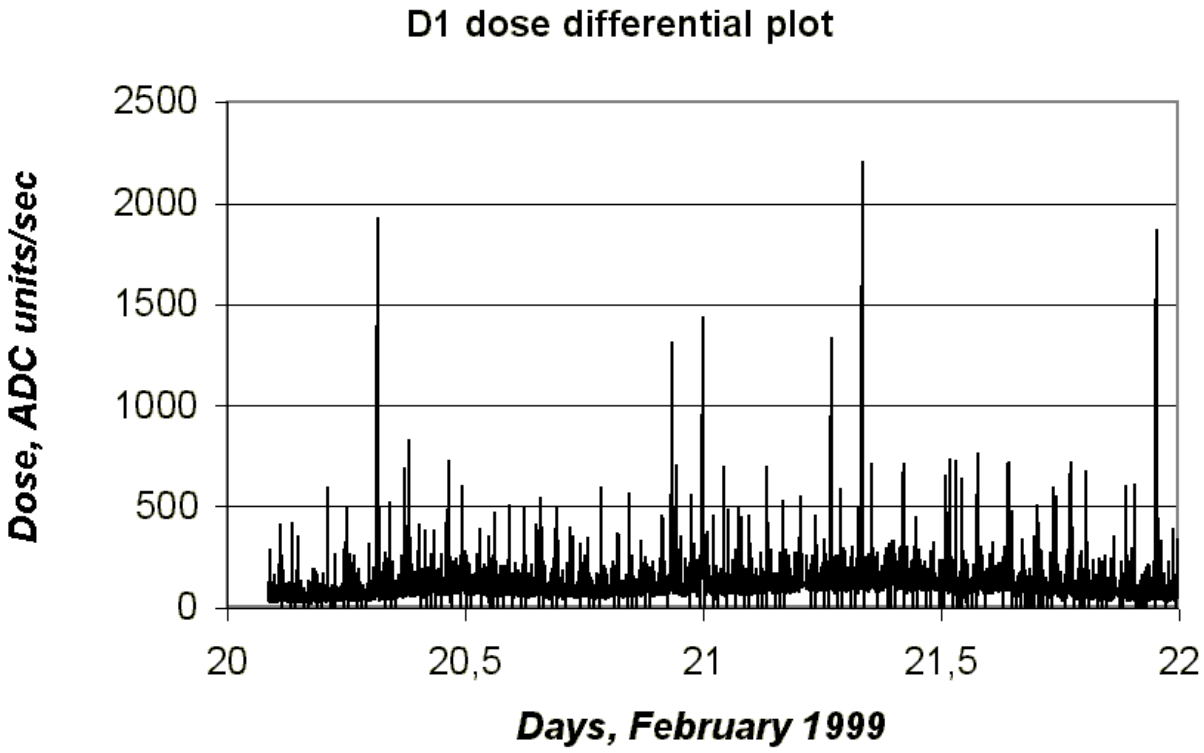


The modular structure of hardware and software made it possible to use RMS components as building blocks to fastly develop the electronics of SPRUT project for the MIR station. Many thanks to dr.Grigoryan, p.i. of the project, for this opportunity, that allowed us to test the components of RMS onboard of the spacecraft.

Hardware components of RMS were used without change, the additional interfaces and additional scientific equipment was added. The instruments and the storage device of the SPRUT were connected to the Utility Unit via RS485, CAN-bus, IDE.

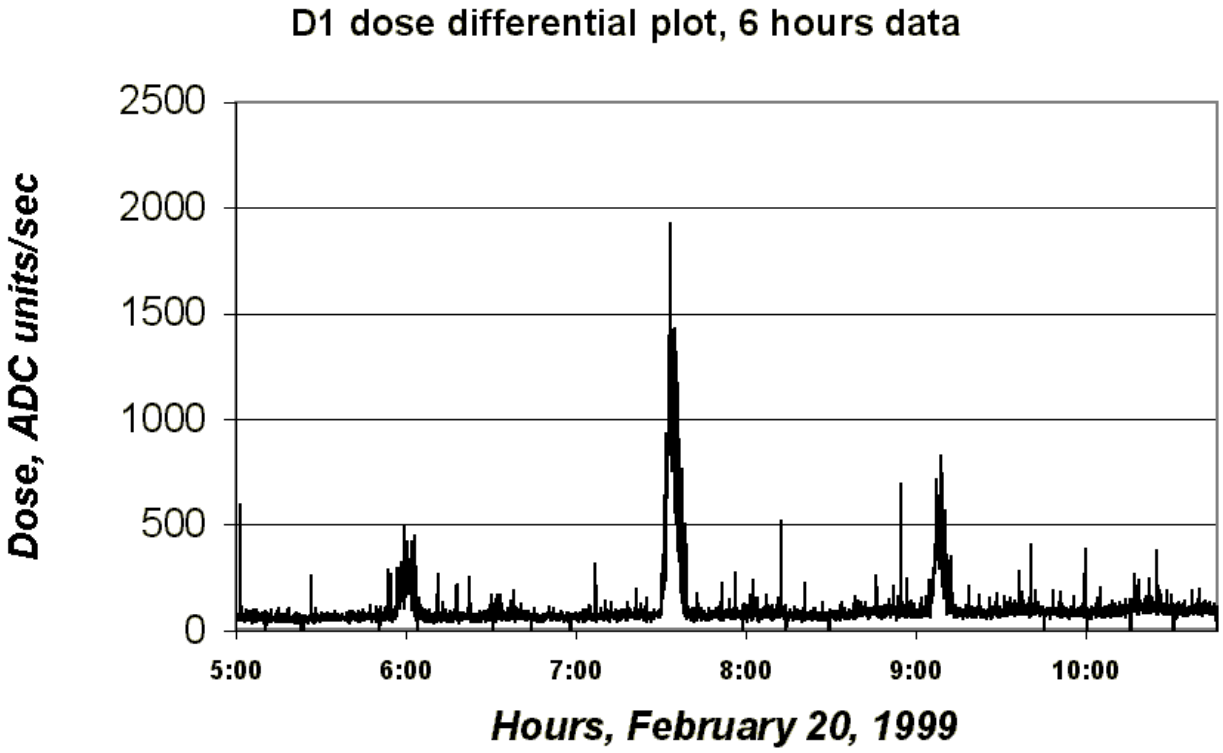
Software of the Utility Unit was reworked to meet the application requirements.

Testing results onboard MIR.



The main goal of mounting modules to the MIR station was to test the developed hardware and software in real environment, at all stages that space equipment runs, before the whole RMS will be mounted onboard ISS.
The dosimetric data from MIR/SPRUT, 1999, is now available is is to be studied on the Earth, to verify the RMS data processing algorithms and to corellate the processing results with measurements made by other instruments.
The typical dose plot is shown.

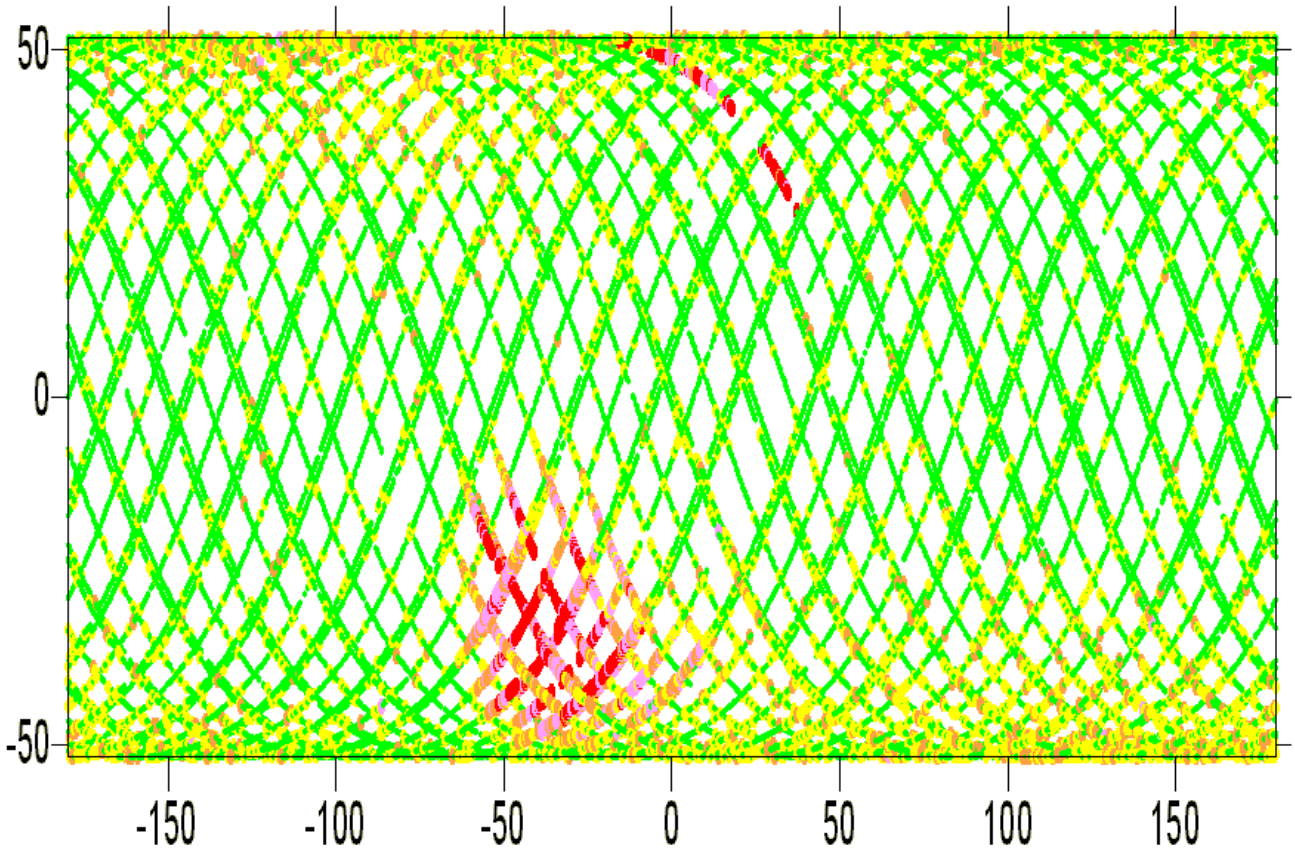
Testing results onboard MIR.



The same dose plot in higher time scale is shown. The periodical moments of passing the spacecraft through SAA are seen.

Testing results onboard MIR.

Flux, circuits scatter plot. February 20-28 1999



The flux plot of spacecraft circuits shown, for the period of about a week. Axis show longitude and latitude, in degrees. The South-Atlantic Anomaly is seen on the plot, illustrating the proper functioning of the disimetric hardware.

CONCLUSIONS

1. The RMS hardware and software was made, tested and is ready to fly onboard ISS/RS.
2. Metrology tests show the fitness of the system to the technical requirements.
3. Preliminary tests onboard MIR station show usability and reliability of RMS components.
4. Obtained results show the fittness of hardware and software to solve the promordial task - to protect the cosmonaut from space radiation influence.
5. We are open for any collaboration, both using components of RMS to build new scientific instruments, or using other instruments as a part of RMS on-board of ISS/RS. The hardware and software of RMS could be easily adopted.

Testing results onboard MIR. (black-white plot).