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ANALYSIS RESULTS OF ONBOARD MEASUREMENT ELEMENTS OF ONBOARD SEGMENT BY THE SPACE IONIZING RADIATION MONITORING SYSTEM

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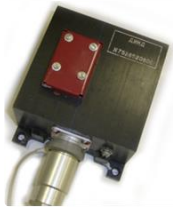
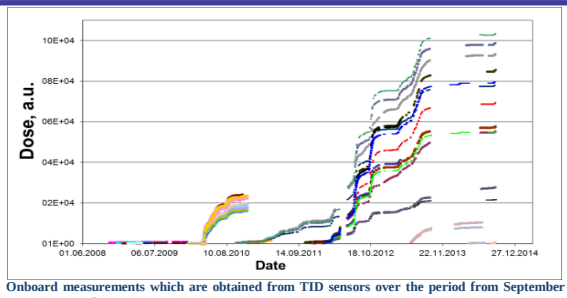
Elements of monitoring system space-borne segment



TID sensor with protecting cover

For a long time the Branch of JSC "United Rocket and Space Corporation" – "Institute of Space Device Engineering" receives the onboard TID measurements, which are obtained from dose sensors (which are based on the MOSFET – dosimetry). The data are given to Branch of JSC "URSC" – "ISDE" from JSC "Information Satellite Systems – Reshetnev Company" after the adaptation of telemetric information. The sensors are the main elements of space-borne segment of space ionizing radiation influence on the spacecraft's avionics monitoring system (ROSCOSMOS). Currently 42 TID sensors are placed onboard of 21 spacecrafts which are functioning on Middle Earth orbit (MEO) ~ 20000 km.

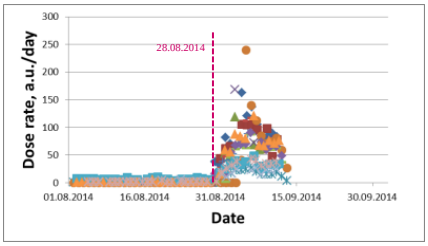
Onboard measurements



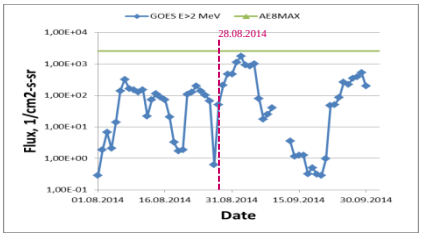
Onboard measurements which are obtained from TID sensors over the period from September 2008 to September 2014

Analysis of dose rate increase

In the end of the August 2014 TID sensors fixed the significant dose rate increase (order of magnitude greater)

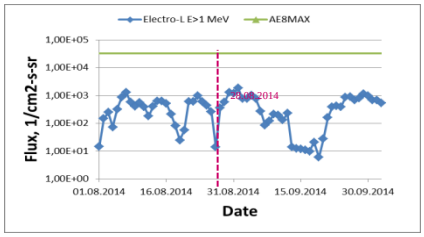


Onboard measurements which are obtained from TID sensors from August to September 2014



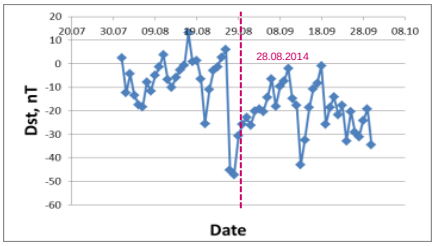
GOES data [3] of electron flux with E>2 MeV from August to September 2014 and calculated mean flux value (AE8MAX model)

The TID sensors control the charge particles flux increase (the main contribution to the increase on MEO [1] gives high-energy electrons). In 2014 year electron flux increase was followed by the strong geomagnetic storm (the electron flux increase was taking place in the storm recovery phase).

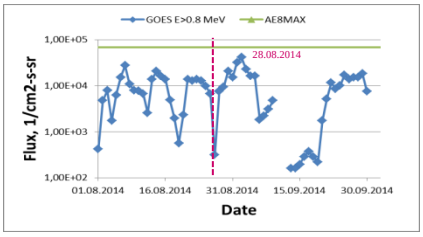


ELECTRO-L* data of electron flux with E>1 MeV from August to September 2014 and calculated mean flux value (AE8MAX model)

*The data are given from Federal State Budgetary Institution "Fedorov Institute of Applied Geophysics



Geomagnetic Dst index data [2] over the period from August to September 2014



GOES data [3] of electron flux with E>0.8 МэВ from August to September 2014 and calculated mean flux value (AE8MAX model)

Experimental and calculated radiation conditions in 2014

Spacecraft	Average flux values based on flight data 1/cm²-s-sr	Flux value based on the AE8MAX model 1/cm²-s-sr
Electro-L, E > 1 MeV	3.77E+02	3.26E+04
GOES, E > 2 MeV	1.13E+02	2.57E+03
GOES, E > 0.8 MeV	7.98E+03	6.78E+04

Comparison of space ionizing radiation characteristic in 2009 and 2014

Year	Average dose rate, a. u./ s	Average GOES flux of electrons E>2 MeV, 1/cm²-days-sr
2009	7.53E-06	6.76E+06
01-07.2014	1.63E-05	7.50E+06
01-09.2014	5.87E-05	9.53E+06

In this year the anomalous low dose rate level is observed (less then calculated level in order of magnitude) which is comparable with the 2009 year level, but in distinction from 2009 (annual average Wolf number W=3) the solar activity in 2014 year is in solar activity maximum (the Wolf number is W~80)

Conclusion

The significant dose rate increase (August 2014) is caused by the high-energy electrons influence (E> 1 MeV) as a result of geomagnetic storm. During the 2014 year the anomalous low dose rate level is observed on the MEO (10 times less then calculated value),which is comparable with the 2009 year level. Most likely the solar activity is not the main factor which influence on the dose rate level caused by the electrons impact (Wolf numbers characterizing the solar activity in 2009 and 2014 are differs on the order of magnitude from each other), consequently, there are other factors of influence on charge particles flux variations. For the definition of these factors and the character of their influence on the radiation conditions it is necessary to continue controlling the levels of space ionizing radiation and their influence on spacecraft avionics. The aim of this action is the accumulation of abnormal space ionizing radiation characteristics increasing events statistic.

[1] Anashin Vasily, Protopopov Grigory, Gaidash Sergey, Sergeecheva Nataliya, Tasenko Sergey, Shatov Pavel, Elushov Ilya "The recent anomalities of space weather characteristics fixed by the Russian Federal Space Agency monitoring system", 10 ESWW, Antwerp, Belgium, 18 - 22 November 2013
[2] http://wdc.kugi.kyoto-u.ac.jp/dstdir/index.html
[3] http://www.swpc.noaa.gov/Data/index.html