Historical note

" Non-empty" gap between electron radiation belts: the first observations.

Mikhail Panasyuk, Skobeltsyn Institute of Nuclear Physics of Lomonosov Moscow State University (panasyuk@sinp.msu.ru)

Physics of electrons in the Earth's radiation belts with energy over several MeV are extremely important both for the development of our understanding of physical background of the particles' dynamics in geomagnetic trap and for the applications – influence of the particles on spacecrafts' electronics and materials. It is sufficient to note that the problems of the sources, transport mechanism and losses of these particles are still understood incompletely.

The history of discovery and primary studies of this phenomenon is very interesting. Shortly after the scientific groups of J. Van Allen from the USA and S. Vernov from the Soviet Union carried out first studies of radiation belts it became clear that in the Earth's geomagnetic trap electrons fill two splitted areas – inner and outer radiation belts. But as soon as 1964 it came to light that sometimes the gap between the belts is filled with very high-energy electrons. This phenomenon - filling of the gap between L-shells 3 and 2 with 6 MeV electrons – was discovered by the Soviet scientific team of S. Vernov from Moscow University who launched four satellites "Electron" in order to study radiation belts. Discovered "new" belt existed for ~ 1 month. Unfortunately these results were published only in Conference Proceedings[1].

Later scientific team leaded by Evgeny Gorchakov also from Moscow State University placed a Cherenkov detector with record response to relatively low flux of high-energy electrons of radiation belts on board soviet "Kosmos-900" satellite. Geometric factor of the instrument[2] (g = 7100 cm^2 sr) significantly exceeded response of the Relativistic Electron Proton Telescope (REPT) onboard new spacecrafts Van Allen Probes[3] (geometric factor g=0.2 cm^2 sr). During this experiment the MSU scientists detected electrons with energy over 15 MeV in the gap between the inner and outer electron belts for the first time. Here I adduce a figure from an article by Gorchakov, et al.[2] where one can see a belt of 15 MeV electrons (marked with an oval) during the pass of the satellite through the radiation belts in April 1977. The belt of relativistic electrons existed for several days and then disappeared. During 1977 and 1978 the same research team succeeded in registration of several similar events of appearance of high energy relativistic electrons[4]. Analysis of these results led to the conclusion, that all these events had been observed during time intervals on the recovery phase of geomagnetic storms and correlate with increasing of solar wind velocity. Nevertheless final conclusions about the character of acceleration responsible for the appearance of the observed electrons were not made.

It is a matter for regret that in virtue of seclusion of the Soviet space research from the world science this outstanding results failed to enter scientific community domain.

It is hoped that new radiation belts experiments including Van Allen probes[5] and others (for example, Russian "Lomonosov" and "RELEC", scheduled for launch in 2013 -2014) will turn over a new leaf in our understanding of background of this phenomenon .

References

1. Vernov S.N., Gorchakov E.V., Kuznetsov S.N. et al. Proceedings of 9th International Cosmic ray Conference (London), 1965, v.5, p.40.

2. Gorchakov E.V., Iozenas V.A., Ternovskaya M.V., et al. Kosmicheskie issledovaniya (in Russian). 1981, V.19, N2, p.310.

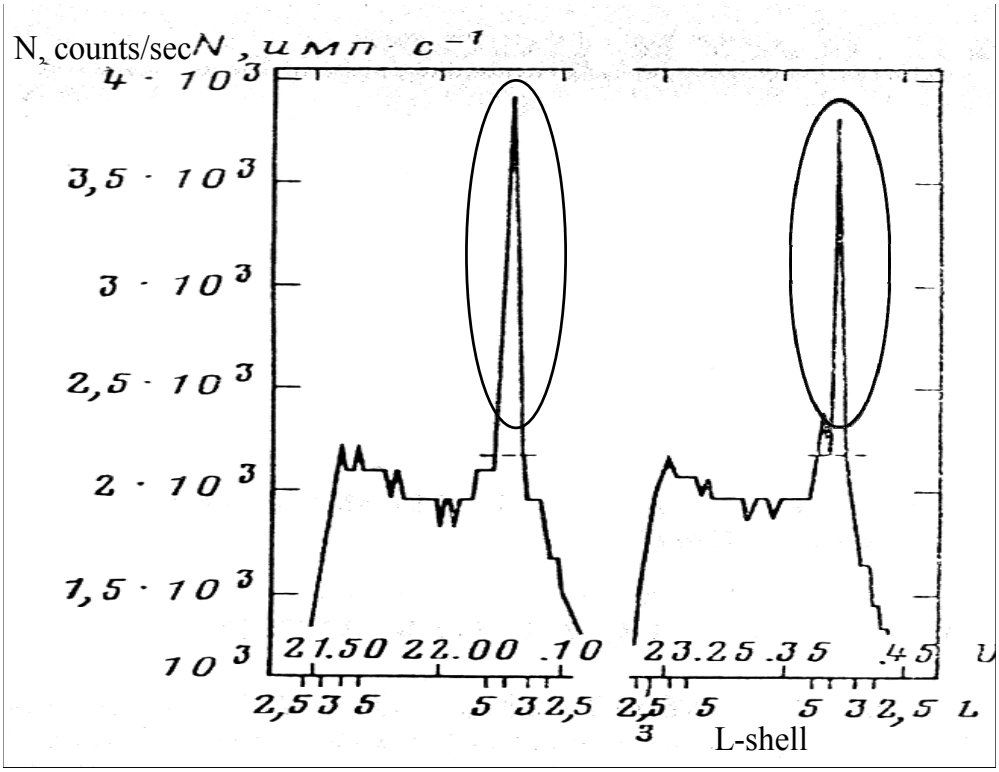
3. Baker D.N. ,S.G. Kanekal ,V.C. Hoxie etal. Space Science Reviews , December 2012. (DOI 10.1007/s11214-012-9950-9)

4. Gorchakov E.V., Iozenas V.A., Ternovskaya M.V., et al. Izvestiya akademii nauk, seriya phizicheskaya (in Russian), 1984, V.48, N11, p.2231.

5. Science. 1 March 2013,Vol. 339 no. 6123 p. 1019 (DOI: 10.1126/science.339.6123.1019-b)

Figure caption.

Relativistic electrons belt (~ 15 MeV) observed in April 1977 by scientific equipment onboard the Soviet satellite “Kosmos-900”.



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