ION GAP LOCATIONS: INTERBALL/TAIL OBSERVATIONS

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Ion distributions in the inner magnetosphere measured with the CORALL ion energy spectrometer on the INTERBALL/Tail Probe are analysed for time interval of 1995-1998 years. In contrast with low-apogee spacecraft our observations show that the ion gap are observed at a distance of (2-10)R_E from the Earth. These events are projected into the region of invariant latitudes (ILAT) 60-80^o at different magnetic local time (MLT) with exception of sector (18.5 - 22.0) h. The distributions measured have some features that have earlier been observed by other spacecraft.

1. Introduction. In the literature, there are separate experimental data about the decrease (gap) of energy spectra in the range from a few hundred to several thousand electronvolts for ion fluxes in the inner (2-7)R_E near-equatorial magnetosphere [1 - 4, 6]. However, these observations are rather scare and the most part of them were made at low- and middle-apogee spacecraft (geosynchronous, AMPTE, Akebono, and INTERBALL/Auroral Probe, respectively). Therefore, observations of these phenomenon by the high-apogee satellite INTERBALL/Tail Probe with an apogee of $\sim$30 R_E would allow this effect to be observed at larger distances from the Earth. Preliminary results of ion gap measurements on Tail Probe have been published by Yermolaev [6].

The Tail Probe of the INTERBALL project was launched on August 3, 1995 into an orbit with the following parameters: H_a = 184000 km, initial $H_p \sim$ 900 km, inclination $\sim 65^o$, and period $\sim$ 92 h. After launch, the height of perigee (it is located in the Earth's Souther hemisphere) was steadily increasing and reached a maximum of $\sim 4R_E$ in the beginning of 1998, and after that, it began to decrease. Thus, the orbit allows measurements of the inner magnetosphere parameters to be made starting at least from altitude of $\sim 4R_E$ (from $\sim 2R_E$ during the first year of satellite operation) and above.

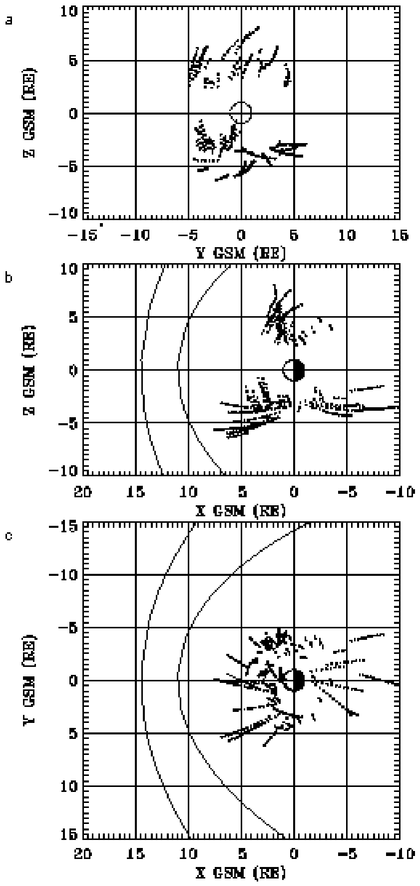

Fig.1. Location of ion gap observations in GSM frame

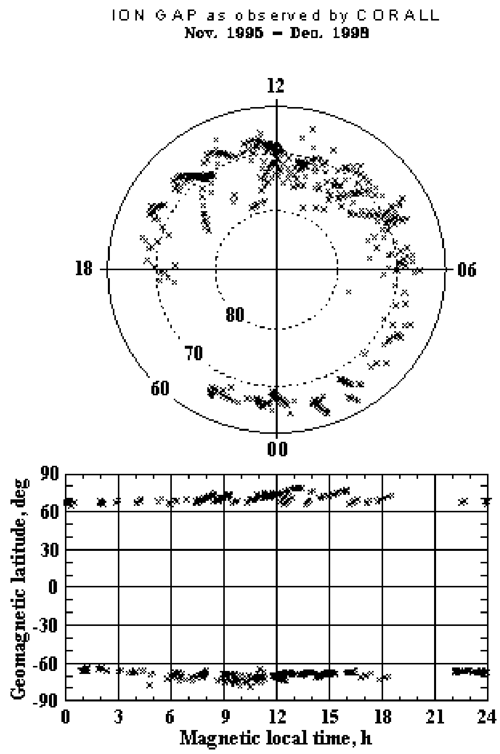

Fig.2. Location of ion gap observations in ILAT-MLT frame

Basically, our analysis utilized the data of the energy-angle ion spectrometer CORALL [5, 6]. For a period of 4 s, the CORALL instrument measures energy spectra of ions in the energy range of 30 eV - 25 keV in 5 directions lying in a plane that contains the satellite spin axis. For a time of satellite revolution about its spin axis (2 min) the instrument scans a complite 3-D distribution function (DF) of ions.

The CORALL instrument is mounted immediately at the outer side of instrument compartment of the satellite and has no sufficiently reliable protection against penetration radiation. Therefore, at the *a priori* dangerous time intervals when, according to model calculations, the satellite should be located in the most hazardous (for instrument) parts of the radiation belt, CORALL was switched off to avoid failures due to radiation damage. Therefore, near the perigee the data always have gaps of a duration of about 3 h.

2. Observations. More 300 satellite's passages through the perigee region ($\sqrt{X^2+Y^2+Z^2} \leq 12\ R_E$) have been analyzed for period September 1995 – December 1998. The statistics of these observations, in which DFs with gaps were observed, is presented in Figure 1 in the form of three projections of satellite trajectory in the orthogonal GSM reference frame. The same set of trajectories projected along the model magnetic field into MLT-ILAT reference frame is shown in Figure 2. One can see that all these events are located at distances of 2 – 10 R_E from the Earth, mainly lower and higher than the geomagnetic equator plane $Z \sim 0R_E$ (this is due to a constraint imposed by the orbit type), and they are observed at wide region of MLT with the exception of 18.5 –22.00 h interval. It is important to note that all events are projected into a sufficiently narrow interval of ILAT $\sim 60-80^o$.

3. Discussion and conclusions. Analyzing the results of observations (the period September 1995 – December 1998) of plasma and magnetic field on the INTERBALL/Tail Probe satellite in the inner magnetosphere at distance 2–12 R_E from the Earth, one can make the following conclusions:

- the ion gaps are observed at distances of 2–10 R_E and are projected to invariant latitude ILAT 60-80^o at all values of local magnetic time MLT with exception of 18.5 – 22.0 h region;

- the features observed in ion energy spectra and the position of ion gaps on them are close in their characteristics to those observed earlier at lesser distances of 2–7 R_E on other spacecraft [1-4];

- qualitatively, the results of our observations coincide with predictions of some model calculations for the dynamics of ion populations as a function of ion energy, the place of injection, and magnetospheric conditions (see, for instance, [1-4] and references therein). However, futher quantitative examination is needed, especially as far as explanation of simultaneous observation of several ion gaps and populations in the DFs and their shape [6] is concerned. The shape of distributions can give additional arguments in favor of one or other physical mechanisms responsible for ion dynamics in the inner magnetosphere.

The results obtained are preliminary in nature, and will be checked using a larger statistics of observations both on the INTERBALL/Tail Probe satellite and on other spacecraft, primarily, INTERBALL/Auroral Probe. Simultaneous observations by several spacecraft allow one to investigate in detail the geometry and dynamics of the described class of phenomena.

Acknowledgments The work is supported in part by the INTAS 97-1612 Grant. The author is grateful to S.I.Klimov, S.A.Romanov, A.A.Skalsky, and M.N.Nozdrachev for their results of magnetic field measurements; to A.O.Fedorov for his assistance in processing the CORALL data; to L.M.Zelenyi, R.A.Kovrazhkin, Yu.I.Galperin, J.-A.Sauvaud, and N.Yu.Buzulukova for useful discussions of the measurement results; and to V.I.Prokhorenko for calculations of the INTERBALL/Tail Probe orbits and help in figure preparation.

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