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# *Interactive comment on* "Earth's radiation belts ions: Patterns of the spatial-energy structure and its solar-cyclic variations" *by* Alexander S. Kovtyukh

**Anonymous Referee #1**

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## Comments for the manuscript: "Earth's radiation belts ions: Patterns of the spatial-energy structure and its solar-cyclic variations" by A. S. Kovtyukh

Thank you very much or the corrections! I think that the manuscript now is much linear



and easy to read. I have just a few more corrections though, mostly concerning the fluency of the text and no more technical questions. The list is reported below.

l p12cm

| Line | Comment |
|---|---|
| 12 | "[...] in the inner regions of the ERB, fluxes [...] |
| 24-25 | "The ERB consist mainly of electrons and protons, but there are also helium nuclei and other [...] " |
| 33 | "[...] geomagnetic trap, drift conserving [...] and populate [...] " |
| 34-35 | "This layer is called the drift shell. " |
| 37 | "For the dipole magnetic field, L is [...] " |
| 42 | "[...] along a certain magnetic field line [...] " |
| 43-44 | "This dependence is described [...] " |
| 45 | "[...] the same magnetic field line, respectively [...] " |
| 48-49 | "[...] of radial diffusion of ions towards [...] " |
| 53 | "The inner belt (L $<$ 2.5) of protons with E $>$ 10 MeV is formed by [...] " |
| 55 | "For protons with E $<$ 10 MeV, this mechanism [...] " |
| 56 | "The inner belt of ions with Z $>$ 4 is formed [...] " |
| 58-59 | "In the intermediate region (2.5 $<$ L $<$ 3.5), the mechanism of a ion capture from the Solar Cosmic Rays takes place during strong magnetic storms [...] " |
| 62 | "However, for a comprehensive verification [...] " |
| 76-77 | "[...] the possibility to create sufficiently complete and reliable empirical models [...] " |
| 79-83 | "In the following sections, the spatial-energy structure of the ERB in the {E, L} space for protons, helium and CNO group ions are considered (Sect. 2), together with possible physical mechanisms of formation of these structures and their solar-cyclic variations (Sect. 3). Finally, the main conclusions of this work are given (Sect. 4). " |
| 89 | "According to this criterion and to the theory of [...] " |

91 “[...] represents this very boundary [...] "

93-94 “A significant number of these discrepancies can be connected to the [...] "

107-108 “[...] to separate fluxes of ions by their charge. Moreover, for the ions [...] "

114-115 “[...] the results of every experiment can be compared to the others [...] "

119 “Figures 1–6 show the spatial-energy distributions [...] "

120 I suggest removing entirely the quote “hese figures united in pairs: " and just leave the part describing odd and even Figures

123-124 “The markers are connected by lines of equal intensity [...] "

132 I suggest removing the quote “In this place, it is need to say a few words about the method of constructing these figures.[...] "

147 “[...] corresponding set of experimental points (icons); then it was transferred [...] "

185 “Figure N sums up results from [...] "

188-189 “21$^{st}$ / 22$^{nd}$ / 23$^{rd}$ [...] "

190 See line 185

198 See lines 188-189

205 “From a comparison of Figs. 1 and 2, one can see [...] "

210 “[...] (2016a,b), which have been constructed from Figs. 1 and 2 confirm [...] "

214 “[...] J $\propto$ E$^{-\gamma}$, where the index $\gamma$ = [...] "

219 I would remove the “of the magnetic field" part here, magnetic field lines already describe everything

223 “Segments of iso-lines, that are parallel to the red line, also correspond to [...] "

227 “at L = 3–6, $\gamma$ = 4.8 $\pm$ 0.5. [...] "

228 “between these iso-lines increase with L [...] "

239 “[...] helium ion fluxes, averaged for quiet periods (Kp $<$ 2), are presented [...] "

240 See line 185

244-245 See lines 188-189

246 See line 185



250 See lines 188-189

251 “with Figs. 3–4, one can see that [...] "

253-254 “[...] E $>$ 1 MeV practically do not change, and [...] "

255 “Figures 3 and 4 show the same patterns [...] "

258 “[...] because there are no experimental data for helium ions in these regions. [...] "

266 “For helium spectra [...] "

270 “[...] the red line (i.e. in the region of power-law spectra) substantially deviate from [...] "

278 “[...] CNO group ions fluxes, averaged for quiet periods (Kp $<$ 2), are [...] "

280 See line 185

283-284 See lines 188-189

285 See line 185

286-287 “[...] period of activity [...] "

289 “[...] nd its configuration differ [...] "

291 “[...] Figs. 5–6 one can see that, for ions of CNO group, the [...] "

297 “[...] This means that, for ions of the CNO group, the ionization [...] "

300 “[...] have not been obtained by the experiments collected in [...] "

304 “[...] especially large at the peak of solar activity (Fig. 6): during these times, the slope of iso-lines [...] "

306 “At the same time, at L $>$ 4 in Fig. 5 and at L $>$ 3 in Fig. 6, the iso-lines [...] "

316 “[...] at the minimum of solar activity [...] "

319 “[...] following the results obtained [...] "

324 “[...] and are reduced rapidly with [...] "

328 “[...] have not been considered in these works [...] "

329 “In quiet periods, only the mechanism of ionization loss is significant [...] "

330 “[...] trapped in small L [...] "

331 “[...] the ERB protons are determined, in this mechanism, by the density [...] "

336 “[...] the proton supply rates to the inner belt, under the action of the CRAND mechanism, remain [...] "

338 “[...] with decreasing solar activity [...] "

341 “A proton lifetime on [...] "

352 “[...] this was noted in sections [...] "

357 “[...] where L* corresponds to the L shell of protons of the same energy [...] "

362 “[...] remains unchanged [...] "

363-364 “[...] in fact, these protons form mainly under the action [...] "

369 “[...] of radial diffuson of ions during the [...] "

377 “[...] values of L, these fluxes begin [...] "

384 “[...] highly turbulized region, but [...] "

387 “[...] must be generated in the outer [...] "

389 “The high-energy part of the ion [...] "

390 “[...] has a power-law shape and the exponents [...] "

394-395 “[...] along logarithmic axes E and J in a J(E) plane [...] "

424 “[...] decreases rapidly with [...] "

426 “Then, the lower boundary [...] "

429 “Using $B_s$ [...] "

434-435 “[...] as a result of their interactions with the current layer [...] "

439 “It has been found that in the outer belt [...] "

438-439 “[...] in the near equatorial plane [...] "

443 “[...] radial diffusion which conserves $\mu$ [...] "

448 “This kind of dependence of the amplitude [...] "

461 “[...] the extensive gaps in $Z \geq 2$ ion data do not allow [...] "



640-644 For what concerns all the Figures, the captions are very similar, so I suggest a modification in the first one (Figure 1) that should be repeated for all the others: “[...] J, which is given in units of $(cm^2$ s ster MeV$)^{-1}$, is the differential flux of protons [...] ". Also “associated with " and “[...] the power-law tail of the proton spectra, while green line corresponds to [...] "