

Interactive comment on “Earth’s radiation belts ions: Patterns of the spatial-energy structure and its solar-cyclic variations” by Alexander S. Kovtyukh

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Reply to Interactive comment by Anonymous Referee #1 from 29 November 2019 on the manuscript “Earth’s radiation belts ions: patterns of the spatial-energy structure and its solar-cyclic variations” by Alexander S. Kovtyukh

Thank you very much for 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.

Line Comment 12 “[...] in the inner regions of the ERB, fluxes [...] AC: I agree. Text

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corrected.

24-25 "The ERB consist mainly of electrons and protons, but there are also helium nuclei and other [...]" AC: I agree. Text corrected.

33 "[...] geomagnetic trap, drift conserving [...] and populate [...]" AC: I agree. Text corrected.

34-35 "This layer is called the drift shell." AC: I agree. Text corrected.

37 "For the dipole magnetic field, L is [...]" AC: I agree. Text corrected.

42 "[...] along a certain magnetic field line [...]" AC: I agree. Text corrected.

43-44 "This dependence is described [...]" AC: I agree. Text corrected.

45 "[...] the same magnetic field line, respectively [...]" AC: I agree. Text corrected.

48-49 "[...] of radial diffusion of ions towards [...]" AC: I agree. Text corrected.

53 "The inner belt ($L < 2.5$) of protons with $E > 10$ MeV is formed by [...]" AC: I agree. Text corrected.

55 "For protons with $E < 10$ MeV, this mechanism [...]" AC: I agree. Text corrected.

56 "The inner belt of ions with $Z > 4$ is formed [...]" AC: I agree. Text corrected.

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 [...]" AC: I agree. Text corrected.

62 "However, for a comprehensive verification [...]" AC: I agree. Text corrected.

76-77 "[...] the possibility to create sufficiently complete and reliable empirical models [...]" AC: I agree. Text corrected.

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

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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). " AC: I agree. Text corrected.

89 "According to this criterion and to the theory of [...]" AC: I agree. Text corrected.

91 "[...] represents this very boundary [...]" AC: I agree. Text corrected.

93-94 "A significant number of these discrepancies can be connected to the [...]" AC: I agree. Text corrected.

107-108 "[...] to separate fluxes of ions by their charge. Moreover, for the ions [...]" AC: I agree. Text corrected.

114-115 "[...] the results of every experiment can be compared to the others [...]" AC: I agree. Text corrected.

119 "Figures 1–6 show the spatial-energy distributions [...]" AC: I agree. Text corrected.

120 I suggest removing entirely the quote "hese figures united in pairs: " and just leave the part describing odd and even Figures AC: I agree. Text corrected.

123-124 "The markers are connected by lines of equal intensity [...]" AC: I agree. Text corrected.

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

147 "[...] corresponding set of experimental points (icons); then it was transferred [...]" AC: I agree. Text corrected.

185 "Figure N sums up results from [...]" AC: I agree. Text corrected.

188-189 "21st / 22nd / 23rd [...]" AC: I agree. Text corrected. (?)

190 See line 185 AC: I agree. Text corrected.

198 See lines 188-189 AC: I agree. Text corrected. (?)

205 "From a comparison of Figs. 1 and 2, one can see [...]" AC: I agree. Text corrected.

210 "[...] (2016a,b), which have been constructed from Figs. 1 and 2 confirm [...]" AC: I agree. Text corrected.

214 "[...] J / E-, where the index = [...]" AC: I agree. Text corrected.

219 I would remove the "of the magnetic field" part here, magnetic field lines already describe everything AC: I agree. Text corrected.

223 "Segments of iso-lines, that are parallel to the red line, also correspond to [...]" AC: I agree. Text corrected.

227 "at $L = 3-6$, $= 4.8 \pm 0.5$. [...]" AC: I agree. Text corrected.

228 "between these iso-lines increase with L [...]" AC: I agree. Text corrected.

239 "[...] helium ion fluxes, averaged for quiet periods ($Kp < 2$), are presented [...]" AC: I agree. Text corrected.

240 See line 185 AC: I agree. Text corrected.

244-245 See lines 188-189 AC: I agree. Text corrected. (?)

246 See line 185 AC: I agree. Text corrected.

250 See lines 188-189 AC: I agree. Text corrected. (?)

251 "with Figs. 3-4, one can see that [...]" AC: I agree. Text corrected.

253-254 "[...] $E > 1$ MeV practically do not change, and [...]" AC: I agree. Text corrected.

255 "Figures 3 and 4 show the same patterns [...]" AC: I agree. Text corrected.

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

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AC: I agree. Text corrected.

266 "For helium spectra [...]" AC: I agree. Text corrected.

270 "[...] the red line (i.e. in the region of power-law spectra) substantially deviate from [...]" AC: I agree. Text corrected.

278 "[...] CNO group ions fluxes, averaged for quiet periods ($K_p < 2$), are [...]" AC: I agree. Text corrected.

280 See line 185 AC: I agree. Text corrected.

283-284 See lines 188-189 AC: I agree. Text corrected. (?)

285 See line 185 AC: I agree. Text corrected.

286-287 "[...] period of activity [...]" AC: I agree. Text corrected. (?)

289 "[...] nd its configuration differ [...]" AC: (?)

291 "[...] Figs. 5–6 one can see that, for ions of CNO group, the [...]" AC: I agree. Text corrected.

297 "[...] This means that, for ions of the CNO group, the ionization [...]" AC: I agree. Text corrected.

300 "[...] have not been obtained by the experiments collected in [...]" AC: I agree. Text corrected.

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

306 "At the same time, at $L > 4$ in Fig. 5 and at $L > 3$ in Fig. 6, the iso-lines [...]" AC: I agree. Text corrected.

316 "[...] at the minimum of solar activity [...]" AC: I agree. Text corrected.

319 "[...] following the results obtained [...]" AC: I agree. Text corrected.

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- 324 “[...] and are reduced rapidly with [...] ” AC: I agree. Text corrected.
- 328 “[...] have not been considered in these works [...] ” AC: I agree. Text corrected.
- 329 “In quiet periods, only the mechanism of ionization loss is significant [...] ” AC: I agree. Text corrected.
- 330 “[...] trapped in small L [...] ” AC: I agree. Text corrected.
- 331 “[...] the ERB protons are determined, in this mechanism, by the density [...] ” AC: I agree. Text corrected.
- 336 “[...] the proton supply rates to the inner belt, under the action of the GRAND mechanism, remain [...] ” AC: I agree. Text corrected.
- 338 “[...] with decreasing solar activity [...] ” AC: I agree. Text corrected.
- 341 “A proton lifetime on [...] ” AC: I agree. Text corrected.
- 352 “[...] this was noted in sections [...] ” AC: I agree. Text corrected.
- 357 “[...] where L? corresponds to the L shell of protons of the same energy [...] ” AC: I agree. Text corrected.
- 362 “[...] remains unchanged [...] ” AC: I agree. Text corrected.
- 363-364 “[...] in fact, these protons form mainly “under the action [...] ” AC: I agree. Text corrected.
- 369 “[...] of radial diffusion of ions during the [...] ” AC: I agree. Text corrected.
- 377 “[...] values of L, these fluxes begin [...] ” AC: I agree. Text corrected.
- 384 “[...] highly turbulized region, but [...] ” AC: I agree. Text corrected.
- 387 “[...] must be generated in the outer [...] ” AC: I agree. Text corrected.
- 389 “The high-energy part of the ion [...] ” AC: I agree. Text corrected.

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390 “[...] has a power-law shape and the exponents [...] ” AC: I agree. Text corrected.

394-395 “[...] along logarithmic axes E and J in a J(E) plane [...] ” AC: I agree. Text corrected.

424 “[...] decreases rapidly with [...] ” AC: I agree. Text corrected.

426 “Then, the lower boundary [...] ” AC: I agree. Text corrected.

429 “Using Bs [...] ” AC: I agree. Text corrected.

434-435 “[...] as a result of their interactions with the current layer [...] ” AC: I agree. Text corrected.

438-439 “[...] in the near equatorial plane [...] ” AC: I agree. Text corrected.

439 “It has been found that in the outer belt [...] ” AC: I agree. Text corrected.

443 “[...] radial diffusion which conserves μ [...] ” AC: I agree. Text corrected.

448 “This kind of dependence of the amplitude [...] ” AC: I agree. Text corrected.

461 “[...] the extensive gaps in $Z_{\geq 2}$ ion data do not allow [...] ” AC: I agree. Text corrected.

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 $(\text{cm}^2 \text{ s ster MeV})^{-1}$, is the differential flux of protons [...] ”. Also “associated with ” and “[...] the power-law tail of the proton spectra, while green line corresponds to [...] ” AC: I agree. Text corrected.

Deeply respected Referee #1, I am very grateful to you for such an exclusively generous and thorough review. All these comments are very helpful for me and it is taken into account in the manuscript.

With grand regard, Alexander S. Kovtyukh

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Please also note the supplement to this comment:

<https://www.ann-geophys-discuss.net/angeo-2019-152/angeo-2019-152-AC2-supplement.pdf>

Interactive comment on Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2019-152>, 2019.

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