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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Relativistic electron beams above thunderclouds" *by* M. Füllekrug et al.

Anonymous Referee #2

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In my opinion this paper presents a highly original and clever piece of work which definitely is worthy of publication. It is a paper which has important implications for future studies in this exciting area of research. It would be beneficial if, before publication in final form, the authors would:

1. estimate the size of the current mentioned in lines 9 and 105,
2. explain in outline how the current mentioned in line 53 is found, and
3. estimate the probability that a cosmic ray will be in the right place at the right time to produce the seed electrons, as discussed on line 100 of the paper.

My remaining comments are relatively minor; they are aimed at making the paper clearer and even more readily understandable. My suggestions for improvements are

as follows:

Abstract, lines 1, 2. Non-luminous relativistic electron beams above thunderclouds have been detected by the radio signals of low frequency (∼40 to 400 kHz) which they radiate.

Line 4. Large positive lightning discharges ...

Line 5. Delete occurrence

Line 6. . . . independently of sprites.

Line 7. beams of electrons . . .

Line 8, line 105. ∼ - 10 mC upwards (i.e. please specify sign of charge)

Introduction, line 15. . . . continuous electrical breakdown . . .

Line 30. . . . even though transient narrow beams . . .

Section 2, line 48. . . . temperatures as low as . . .

Line 69. . . . the lightning discharge. They do not . . .

Line 72. radiation burst follows the sprite luminosity after ∼4 ms. Both . . .

Section 3, line 76, 80, 95. . . . sprite-producing . . .

Line 120, 121. Please give a reference.

Line 132. . . . velocity of ∼7000 km/s (0.23c) through the . . .

Section 5, line 164, 165. . . . body of sprites and the electron beams . . .

Caption to Figure 4, line 1. The average spectra of radiation from electron beams . . .

Line 2. . . . The average spectrum of radiation produced by several . . .

Line 6, 7. The radiation from the simulated electron beam is relatively . . .

ACPD

11, C4599–C4601, 2011

Line 11. . . . radio transmitters, the strongest of which here is the BBC Radio 4 transmitter at 198 kHz, which exhibit . . .

Caption to Table 1. Please state the full range of times over which observations were made using all techniques in this campaign.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 15551, 2011.