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Interactive comment on "Using paraxial approximation to describe the optical setup of a typical EARLINET lidar system" *by* Panagiotis Kokkalis

Anonymous Referee #1

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Panagiotis Kokkalis derives in his manuscript analytical formulas to calculate the overlap of a lidar system by using paraxial approximation. These are useful information for anyone who is interested in designing a lidar system, although he stated that a 3D ray tracing simulation is still necessary. The polarization effects of the optical elements cannot be described by paraxial approximation, additional literature is necessary. To assess the focal lengths and the diameters of the lenses and the acceptance angles of the interference filters, these calculations are helpful in lidar design. To study the planetary boundary layer it is desired to have a lidar system with a low distance of full overlap, which can be achieved by the presented formula. Therefore this manuscript is suitable for publication in AMT with some improvements.

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The major remarks:

A comparison of the theoretical overlap calculations with the signals of a real EARLINET lidar system would be of great value. Does a lidar system with a given set of parameters (focal lengths, FOVs, ...) reach the calculated overlap? In the current version it is only compared to ZEEMAX simulations.

The minor remarks:

- Fig 1: The DFO should start where the laser emits the beam, not at the back of the laser housing. L4 is not mentioned in the text. “with a free aperture diameter of Dobj, located at distance Z1 from L1 under an incident angle AIFF” -> it is L2 (as shown in the figure)

- Fig 2: Too much information, too less description text to explain it, not even subdivided in a, b, c. Achieve a better relation to eq. 9-13.

- Fig 3: Important figure. The acceptance angles (2.9° and 1.15°) for different BW are not explained in the description text.

- Fig 4: missing a) and b) in the picture Are the ZEEMAX calculations really from 2008? Someone may wonder, why it is such an old figure. What is fig 4a supposed to tell the reader? What exactly is shown in the 5 fields?

- Fig 6: missing space “DFO relative”

- Tab 2: indices should not be written in italic, but as normal text.

- p3, l3 “a decreased bandwidth”

- p5, l2 “Fcol”; indices should not be written in italic, but as normal text.

- p6, l3 (TFOV x EX)ˆ-1 or TFOV x EXˆ-1 ?

- p8, l12 “In addition, an advantage of using ... makes the detection surface”, something is missing

- p9, l9 “The IFF allows for incident angles lower than AIFFmax” , incomplete sentence

- p10, l11 Why do you use 252 m for the near field in the ZEEMAX calculations? The DFO is 257 m.

- p10, l19 “the slightly different parameters of lenses used from ZEMAX database” Why do you not create lenses in ZEEMAX with the same parameters as used for the paraxial approximation to exclude this source of deviations and to better assess the other effects?

- p11, l11 “The real performance of a lidar system”

- p11, l13 “However, with paraxial approximation it is feasible to estimate the diaphragms size and its location on the optical axis.”

- p11, l17 “transmitted to the left, the collected light travels to the right”, usually light does not travel just to the left or the right, you should make clear that you are referring to figure 7.

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