

Interactive comment on “Optimizing the detection, ablation and ion extraction efficiency of a single particle laser ablation mass spectrometer for application in environments with low aerosol particle concentrations” by Hans-Christian Clemen et al.

Anonymous Referee #2

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General comments:

This is a well-written and extremely thorough paper about improvements to the AL-ABAMA laser ablation aerosol mass spectrometer that greatly improve the detectable size range and the detection efficiency. Bravo.

Specific minor comments:

C1

- 1) The CPI is discussed first, so the CPI should be Figure 3 and the air diffuser and lens should be Figure 4.
- 2) For the angle of the air diffuser, the text says 5.6 degrees, but the figure says 6 degrees. Maybe use the same value in both places.
- 3) Pg 8, lines 165-6: What does the acronym ODD stand for? Outer diameter diffuser, maybe? I think it would make more sense to mention the ID at the end of the diffuser which looks like 31.2 mm.
- 4) Pg 9, line 182-186: What you are calling outer diameter lens (ODL) is not an outer diameter. It is the inner diameter of the lens. I think it would be better to use subscripts to distinguish between the ID of the lens and the ID of the orifice, rather than calling one an OD.
- 5) Figure 7: I'm confused by the timing. The DIE trigger is shown 50 ns after the Q-switch out. Then it takes 50 + 5 ns for the voltages to turn on. Wouldn't the voltages be on 35 ns after the laser pulse, not 70 ns as indicated in the figure? Shouldn't the expected DIE (line 272) be 35 ns? What DIE did you determine from the high voltage signals? The 70 ns time is mentioned again on page 35, line 725.
- 6) You should refer to Figure 10 in Section 4.1.3 about the INP measurements. There is currently no reference to Figure 10 in the text.
- 7) Pg 17, lines 353 – 361: Is this section about PSLs for which the size is known? If not, it is not clear how summing over large size ranges in the OPC will give you the correct concentration to compare with the number detected. Please clarify.
- 8) Figure 12: I would add a legend with the results from the fit for σ_p and r_{DL} .
- 9) Pg 21, lines 455 –6: I don't understand the source of this statement. The results in Kollner (2020) show DE at 2.5 hPa for lab experiments and DE at 3.2 hPa for field measurements which are actually higher, though the size is not indicated. Pg 22, lines 457-8: Please summarize the reasons for the much lower DE in Kollner (2020) vs

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Brands et al. (2011) for 200 to 600 nm particles. A PhD Thesis is not the easiest source to find this information.

10) Figure 13 caption: I think you mean the detection efficiency is “relative to”, not “related to”

11) Figure 14: What is the physical distance between the exit of the lens and the first detection laser? A particle beam width < 20 um seems really small. Is this consistent with your CFD calculations?

12) Figure 17: I understand why you ordered the x-axis in Figure 17b the way you did, but it makes it very hard to compare with 17a. I would use the same order for the x-axis in both 17a and 17b. You can draw the same conclusions in the text.

13) pg 31, lines 646-7. What does the statement that “a voltage of 1100 was assumed” mean? Was the voltage not actually set to 1100V? Or you think the effective voltage at the electrode is different than the setting?

14) Figure 19: Why are the curves for 308 nm, DIE(on) asymmetric?

15) Pg 35, lines 703-4. It’s not clear what “the offset between the two curves” is referring to. The difference between cation and anion curves, which anticorrelate? Or the difference between the DIE(on) and DIE(off+) curves which are slightly offset.

Supplement

16) Figures in the Supplement should be called S1, S2, etc. Same with the equations. And sections. This will make it less confusing when you refer to something in the main paper.

17) Figure S2. The calculated particle beam diameters are orders of magnitude larger than the measured particle beam widths in Figure 14 in the paper. Do you have an explanation?

18) Figure S8 and S9: It is hard to compare these figures to Figure 21 in the main

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paper because the panels are in a different order. Please put the cations in Figure S8 and the anions in Figure S9. Also put the sum in the top panel and the number in the bottom panel.

19) Pg 13, lines 203-4: Superscripts with m/z’s seem like an odd notation for these ions. Normally, the superscript would be charge. Or, in the case of isotopes, the superscript would precede the symbol. Maybe put the sign and the m/z in parentheses instead.

Technical corrections:

Pg 1, line 14: insert “than” before “500”

Pg 1, line 19: “ALABMA” misspelled

Pg 1, line 19-20: use “an” before “up” in two places

Pg 2, line 41: use “an” before SPMS

Pg 5, line 96: “a sufficiently light scattering signal” is missing the word “large”

Pg 10, Figure 5 caption: should be “Schematic” not “Schematical”

Pg 16, line 337: Please group the minus sign with the temperature value.

Pg 21, line 438: should be “a detectable” not “an detectable”

Pg 21, line 454: word missing between “this” and “not”

Figure 13 caption: I think you mean the detection efficiency is “relative to”, not “related to”

Pg 24, line 502: word missing between “likely” and “to”

Pg 30, line 624: should be “a reduced” not “an reduced”

Pg 31, line 655: “new installed DIE result” should be “newly installed DIE results”

Pg 33, line 676: “mass spectra” should be “mass spectrum”

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Figure 21 caption: “Dependence of mass spectral information on particle beam position. . .” is better English than “Mass spectral information in dependence of. . .”

Pg 34, line 692: “switched” instead of “dwitched” and “a reduced” instead of “an reduced”

Pg 34, line 694: “significantly” instead of “significant”

Pg 40, line 838: Presumably, something should go here besides “TEXT”

Supplement

Pg 1, line 2: Presumably, something should go here besides “TEXT”

Pg 9, line 140: delete “can”

Pg 10, 161: “cumulated” is not commonly used in English. Maybe used “summed” instead.

Pg 13, line 195: “randomly” instead of “random”

Pg 13, line 196: “spectrum” instead of “spectra”

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