Authors´ response to Referee #2 comments

We would like to thank Referee #2 for the constructive comments that helped us to improve the manuscript. In this post, we will provide our response to the Referee's comments. In our replies, we provide original comment from the Referee and our response followed by the changes made to the manuscript.

(1) Lines 34-35, The sentence ". . .did not change the size distribution or the chemistry of the ambient aerosol particles." is too strong. The results do suggest there are some minor changes to the particle chemical composition (due to the composition dependence of concentration factor).

> **Response and author's changes in manuscript:** sentence is now …did not significantly change the size distribution…

(2) Please add diagrams illustrating the setup of the laboratory and field tests (at least in the supplementary information).

> **Response and author's changes in manuscript:** Set-ups for the laboratory and fields test have been added to Supplemental information (Fig. S2).

(3) Please clarify what a "multiplex chopper" is.

> **Response and author's changes in manuscript:** multiplex chopper is an efficient Particle time of Flight (ePToF) chopper that is based on a multiplexed particle beam chopper system with 50% particle throughput providing significantly improved signal-to-noise for the particle size measurement (compared to standard 1–2% throughput). We added to the text: …"(efficient Particle Time of Flight, ePToF, chopper) with 50% particle throughput."

(4) Line 270: how was CF measured? Fig. S2a-b shows the CF was 6.8 instead of 5.7.

> **Response and author's changes in manuscript:** The CF of 5.7 was an average of the CFs calculated separately to each data point (n=652) while the CF based on the regression slope was 6.8. We think that the average of the CFs is a better representation of the data since the regression slope can be biased by the large values. In addition, it gives a more realistic uncertainty. We have changed the text to read:
>
> **"**For the lower flow regime data (Fig. S3a–b), the average CF, calculated as the ratio of the number concentration in the output flow to that in the sample flow, was 5.7 ± 0.4 with a theoretical CF of 7.5. Linear regression of that data yielded a correlation coefficient (R^2) of 0.984. In the higher flow regime (Fig. S3c–d), the measured CF was 9.0 ± 0.7, with a theoretical CF of 13.6."

(5) Figure S2c-d, the values of regression slope listed in Figures S2c and S2d are different (9.7 and 10.4).

> **Response and author's changes in manuscript:** The correct regression slope in Fig. S2c (now Fig. S3c) is 10.4. The figure has been changed.

(6) Line 302, how frequently was the sampling alternated between ADIc and the bypass line?

> **Response and author's changes in manuscript:** The SP-AM was switching between the bypass line and the ADIc every 30 minutes. Switching period has been added to the text.

(7) Lines 368-369: The low particle transmission efficiency through the lens is unlikely the only cause for the low CF. Figure S3c shows that in the lower size range (e.g., 400- 600 nm), the CF was about 5, substantially

below the theoretical value. How do the measurements of Q-AMS with ADIc bypassed compare with HR-AMS data for different species?

Response and author's changes in manuscript: The referee is right that the CF for organics and m/z 57 (~6 and ~4, respectively) was much lower than the theoretical CF (10.5) at the size range of 400–600 nm. Unfortunately the bypass period was rather short and the Q-AMS size distribution data was too noisy to be compared with the size distributions from the HR-AMS during the bypass.

However, in Table 3 we present the ratio of Q-AMS to HR-AMS mass loadings (without size distribution information) for the chemical species during the bypass period. The mass concentrations from the Q-AMS and HR-AMS in bypass agreed for sulfate and nitrate while ammonium had larger concentrations from the Q-AMS in bypass (for ammonium see comment (8) for Referee #1). In terms of organics, the mass loadings measured by the Q-AMS were smaller than those from the HR-AMS in bypass (ratio=0.7). This suggests that the low CF for organics can be partly due to the fact that the two instruments did not agree well for organics even when the Q-AMS was bypassing the ADIc. To investigate this difference, the mass spectra of organics from the Q-AMS with the ADIc and in bypass was compared to the mass spectra from the HR-AMS (in bypass) in the unit mass resolution mode (see Figure below). It is clear that m/z 44 agrees pretty well for the two instruments but the HR-AMS has more signal at most m/z's, especially at higher m/z's. It's possible that there was more fragmentation in the Q-AMS, but it's also possible that there was always road paving aerosol in the air and the lens cutoff affected the mass spectra even during bypass.

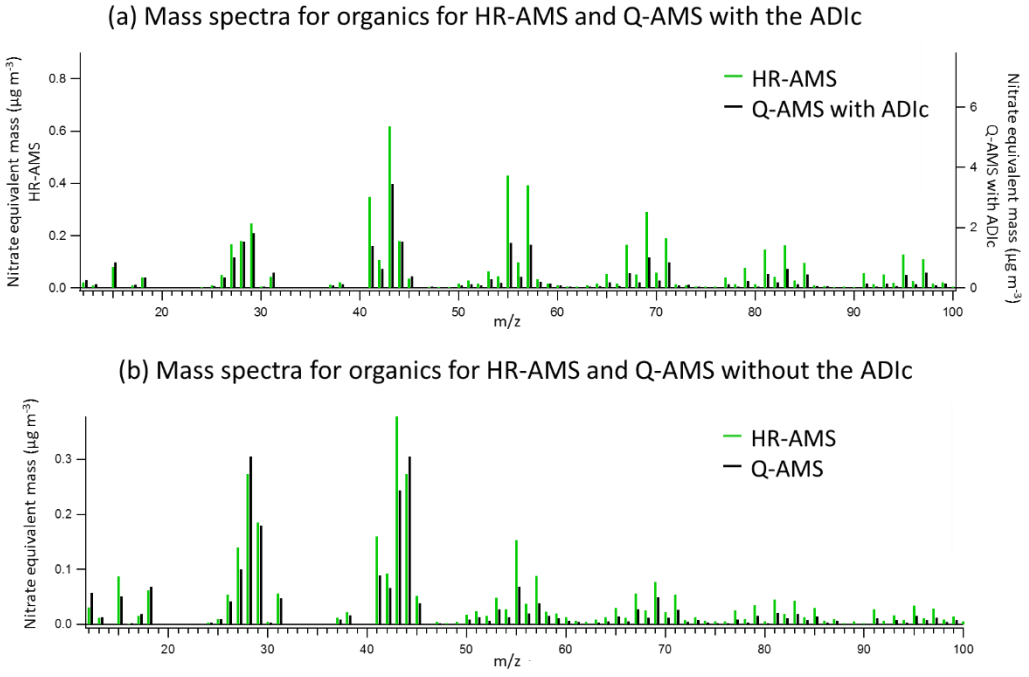

Fig. R1. Mass spectra for organics measured with the Q-AMS with the ADIc and HR-AMS in bypass (without the ADIc) (a), and the Q-AMS and HR-AMS without the ADIc (b).

Nevertheless, it can't be ruled out totally, that the concentration process was less effective for hydrocarbon-like organics than for e.g. sulfate during the field test at ARI. However, during the measurements in Helsinki, just the opposite was found. At SMEAR III hydrocarbon-like organics had higher CF than highly oxygenated organics (Fig. 4).

We added to manuscript: “Besides the lens cut-off, it is possible that the CF was smaller for hydrocarbon-like organics than for oxygenated organics during the measurements at ARI. However, that is just the opposite of what was found at SMEAR III in Helsinki where hydrocarbon-like fragment ions had higher CF than highly oxygenated fragment ions (Fig. 4).”

We added two sentences about the agreement between the two instruments during bypass:

”Average values of CF are presented in Table 3, along with the ratio of the mass loadings during bypass periods.” in the first paragraph of Section 3.2.3 and ”The agreement between the two instruments during bypass periods was excellent for nitrate and sulfate (Table 3).” in the second paragraph.

Figure S5a has been changed because it contained incorrect data.

Also, “the average mass loadings” have been removed from the caption for Table 3 because the mass loadings were not presented in Table 3.