EGUsphere, referee comment RC1
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Comment on egusphere-2022-33

Anonymous Referee #1

Referee comment on "The realization of autonomous, aircraft-based, real-time aerosol mass spectrometry in the upper troposphere and lower stratosphere" by Antonis Dragoneas et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-33-RC1, 2022

Review of Dragoneas et al.

This manuscript describes the design and operation of a new mass spectrometer for aerosol analysis aboard a high-altitude aircraft. It combines a single-particle laser ionization instrument with a thermal desorption/electron impact method. The manuscript is largely clear and appropriate for publication. This is a novel instrument and a paper describing it is worth publishing.

Mostly I have minor comments below. In thinking about an instrument description manuscript it is important to consider not only if what is presented is correct but also what might be missing from the manuscript. A few things should be added:

1) For both the single particle and thermal desorption mass spectrometers, please list some dimensions and voltages. The energy of the ions is especially important since it affects detection at the MCP. The electric field across the ion source is also important for understanding the ionization processes. Simply calling it an Ionwerks spectrometer is not sufficient.

2) In a bipolar mass spectrometer, one or both detectors must be floating at high voltage. Please describe in detail how the signals are coupled to ground and what preamplifiers are used.

3) Describe the spot size for the ionization laser. A 10 mJ pulse has very different implications depending on how tightly it is focused.

4) What fraction of laser shots in the single particle instrument result in spectra? Is this a function of particle size?

5) It might be helpful to show an isotope ratio plot as a diagnostic of the linearity of the single particle spectrometer. 41K versus 39K, 54 and 56Fe, or 32 and 34S would be possibilities. There are other contributions to the peaks but a scatter plot will show a locus of points along the isotope ratio.

6) What detection limits were achieved for the thermal desorption (AMS) spectrometer?

Technical comments:

Line 61: The strong statement about quantitation is not true. SPMS instruments can be quantitative both for types of particles and components within particles:

Cornwell et al., Direct Online Mass Spectrometry Measurements of Ice Nucleating Particles at a California Coastal Site, JGR, 2019.

Cziczo, et al., Ablation, Flux, and Atmospheric Implications of Meteors Inferred from Stratospheric Aerosol, Science 291, 1772 (2001);

Froyd et al., A new method to quantify mineral dust and other aerosol species from aircraft platforms using single-particle mass spectrometry, Atmos. Meas. Tech., 12, 6209–6239, 2019

Qin et al., Comparison of Two Methods for Obtaining Quantitative Mass Concentrations from Aerosol Time-of-Flight Mass Spectrometry Measurements, Anal. Chem. 2006, 78, 6169-6178

Line 72: It is worthwhile to mention that a bipolar SPMS has been flown at lower altitudes: Pratt et al., Anal. Chem. 2009, 81, 1792–1800, Development and Characterization of an Aircraft Aerosol Time-of-Flight Mass Spectrometer

Line 105: Please mention the model of the PMT.

Line 131. Having the motor outside is potentially much cleaner than the motor inside the vacuum. Is the organic background in the AMS region lower than in a stock Aerodyne AMS?

Line 145. An AMS has previously been flown on a stratospheric balloon. Although not built by Aerodyne, it was an AMS: it included an aerodynamic lens, vaporizer, shutter for the particle beam, and a mass spectrometer. Schreiner et al., A mass spectrometer system for analysis of polar stratospheric aerosols, Review of Scientific Instruments 73, 446 (2002); https://doi.org/10.1063/1.1430732.

Line 178: I found the discussion of changing pressure confusing – the instrument is in a pressure vessel, only talked about later. Readers will think the electronics are exposed to changing pressure.

Line 203: interesting point about fire safety

Circa line 220: Given the radiative cooling, it is surprising that the instrument couldn't just stay fairly indefinitely in low power mode with a modest external fan blowing on the pressure chamber rather than a dedicated air conditioning unit. Radiative cooling with a 10 to 20C temperature difference is hundreds of watts.

Circa line 300: I appreciate the detailed and readable description of the inlet.

Line 530: Just as a side note, it is interesting the Geophysica allowed you to have your own transmitter on the plane.

Line 665: I am convinced the gold is from contamination; you don't need to mention space debris.

Section 4.4 first paragraph: You can probably reduce the number of times the same references are cited in successive sentences.

Figure 4: I think Figure 4 belongs in supplemental.

What supplemental material is there is appropriate and appreciated. One could also consider a digital file of the spectra shown in the figures in the manuscript.