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Atmospheric Measurement Techniques Discussions

Interactive comment on "A novel rocket borne ion mass spectrometer with large mass range: instrument description and first flight results" *by* Joan Stude et al.

Anonymous Referee #2

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This paper describes what seems to be a very exciting instrument for detecting heavy charged ions in the Earth's mesosphere and lower thermosphere. It is essentially a resurrected mass spectrometer which is now run in a mode for rapid scanning up to 2000 amu, including an estimate of the numbers of even heavier ions, and measures in both positive and negative ion modes. The detector is a channel electron multiplier coated with MgO to improve sensitivity to heavy ions. Results from the inaugural flight in northern Norway are reported.

The instrument has been designed to detect meteoric smoke particles, which are the nm-sized particles which form from the condensation of the metallic vapors produced

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Discussion paper

by meteoric ablation. One of the goals of the flight was to determine the possible role of these particles in radar echoes that are seen during polar winter in the mesosphere. The science that has come out of the measurements is largely left for future papers, and this paper focuses on the instrumental description and performance.

Promising results are obtained. These seem to be in accord with previous measurements and models which have shown that smoke particles should mostly be negatively charged below about 90 km. My only substantive question is around charge balance. The positive ion spectrum at 69 km in Figure 6 shows a much lower integrated count rate than the negative ion spectrum at 70 km in Figure 7. Do these counts needs to be scaled in some way to compare them directly? The total positive ions should essentially equal the total negative ions, since electrons should almost all be attached to molecules or particles at this height, even during the day.

The paper is well written and appropriately illustrated. Some minor points for correction are listed below. One final point: the data availability needs to be specified – location and electronic address.

Minor points:

line 5: major

line 20: there are some more recent references (from the Leeds group) which might be appropriate here:

Frankland, V. L.; James, A. D.; Feng. W.; Plane, J. M. C. (2015): The uptake of HNO3 on meteoric smoke analogues, Journal of Atmospheric and Solar-Terrestrial Physics, 127, 150-160, 127, 150-160.

James A. D., J. S. A. Brooke, T. P. Mangan, T. F. Whale, J. M. C. Plane, and B. J. Murray (2018), Nucleation of nitric acid hydrates in polar stratospheric clouds by meteoric material, Atmospheric Chemistry and Physics, 18, 4519-4531.

line 59: presumably the payload detaches from the rocket motor at some point before

measurements commence? This should be made clear here, since it sounds as though the motor is attached throughout flight.

line 59 and elsewhere: supersonic is usually written as a single word

line 65: the end of this sentence reads a little strangely. Perhaps rewrite to something like "... cryopump also provides structural support."

line 67: "on the ground..."

line 68: "...transmission, independent bias potentials can be applied to the intake cone, lens and quadrupole"

Figure 2 caption: what is "Bat." – presumably battery, but this should be spelled out.

line 111: "..). For the inline..."

line 118: "...the ram direction"

line 120: "...of a standard ..."

line 121: "...atmosphere with a composition..."

line 170: "...operate up to 49"

line 172: "Thus ions enter the instrument"

line 173: "In constrast to 70 km,"

line 182: "In constrast to the calibration"

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