



A rocket-borne mass spectrometer for detection of heavy ions in the atmosphere – instrument description and first results

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We built a compact quadrupole ion mass spectrometer to detect ambient heavy ions in the atmosphere during a sounding rocket flight. Based on previous instruments from Max-Planck-Institute for Nuclear Physics (MPIK, Heidelberg), the instrument is using a cryogenic pump to maintain high vacuum. This allows the operation of the instrument at atmospheric pressures above the requirements for the quadrupole and the channel electron multiplier detector. To improve sensitivity compared to earlier designs from MPIK, a quadrupole lens was placed between inlet orifice and quadrupole. The quadrupole mass analyser is driven by internal, battery powered electronics. A measurement mode optimized for mass resolution or mass range can be electronically selected during flight.

The first flight was successfully accomplished during noon in April 2018 from Andøya, Norway. The instrument was part of the PMWE campaign led by Leibniz-Institute of Atmospheric Physics (IAP, Kühlungsborn) to study polar mesospheric winter echoes. The instrument's mass range was adjusted to provide mass resolution up to 2000 u/q and detect the presence of heavier ions. Measurements started at an altitude of 55 km by jettisoning a sealing cap. The flight with an apogee of 120 km was accompanied by electron density measurements and radar observations. We detected positive ions with masses up to 100 u/q forming distinct layers and negative ions with masses heavier than 2000 u/q throughout most of the ascent.