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Development and testing of a modernised Programmable Ion Mobility Spectrometer

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The atmosphere is made slightly electrically conductive by cosmic rays and natural radioactivity, which generate ions. Air conductivity is a key component of the global electric circuit and influences droplet and cloud charging [1]. Further, atmospheric ions may affect the radiative balance through particle formation and infra-red absorption [2], [3]. Both considerations motivate the need for accurate atmospheric ion measurements. The Programmable Ion Mobility Spectrometer (PIMS) is a computer-controlled instrument based on the Gerdien measurement principle in which a cylindrical capacitor, across which a voltage is applied, is aspirated to sample air ions [4]. Computer control of a switchable multimode electrometer [5] offers the capability to measure ions in two modes, offering self-calibration, which removes the difficulties with providing a well-characterised environment for calibration [6]. The PIMS can independently monitor internal leakage currents which can be a significant source of thermally dependent error, especially in outdoor use. First developed in the early 2000s, the PIMS has recently been modernised with a new electrometer and advanced microcontroller, leading to significantly miniaturised electronics and opportunities for more sophisticated interfacing. The modernised PIMS was tested at Nagycenk Geophysical Observatory (47.632°N,16.718°E), Hungary in summer 2022, alongside a full range of meteorological and atmospheric electrical measurements for comparison.

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