Mesospheric Aerosol Sampling Spectrometer

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The Mesospheric Aerosol Sampling Spectrometer (MASS) instrument has been launched on two sounding rockets in August, 2007 from Andoya, Norway to detect charged sub-visible aerosol particles in the polar mesosphere. These launches coincided with measurements by the Aeronomy of Ice in the Mesosphere (AIM) satellite and the German/Norwegian Existence and Charge state Of Meteoric dust grains in the middle Atmosphere (ECOMA) rocket campaign. The MASS instrument is designed to collect charged aerosols, cluster ions, and electrons on four pairs of graphite electrodes, three of which are biased with increasing voltage. The design of the MASS instrument was complicated by the short mean free path in the mesosphere. The opening to MASS was deliberately built to increase the mean free path and to reduce the shock wave within the instrument. The design procedure began with aerodynamics simulations of the flow through the instrument using Direct Simulation Monte Carlo (DSMC) in 2-D and later in 3-D. The electric fields within the instrument were calculated using a Laplace solver in 3-D. With the aerodynamics simulations and the electric field calculations an algorithm was created to find the trajectories of charged aerosols within MASS including collisions. Using this algorithm the collection efficiencies for each electrode was calculated as a function of the charge to mass ratio of the incoming particle. The simulation results have been confirmed experimentally using an Argon RF ion beam. The data from the August launches have been analyzed and the initial results show the MASS instrument operated as expected. Additional studies are underway to determine if there were effects from payload charging or spurious charge generation within the instrument. This project is supported by NASA.