# On the Efficiency of Rocket-borne Particle Detection in the Mesosphere

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The detection of nanometer-sized meteoric smoke particles in the mesosphere/lower thermosphere region of the Earth's atmosphere is difficult. They are too small for optical detection and their momentum is not sufficient to produce electrical impulses upon impact. One way is direct sampling with the MAGIC particle samplers, another way is to study the charged fraction of the particles that is detectable e.g. with a Faraday Cup detector. Sounding rockets are important tools for this kind of *in-situ* studies of the middle and upper atmosphere. However, aerodynamic perturbations in the measurement volume make these studies far from trivial. Nanometer-sized particles tend to follow the gas flow around the payload and not reach the detector if the aerodynamic design of the instrument has not been considered carefully. The measurements are further complicated by the fact that the payload moves from continuum flow conditions to free molecular flow conditions in the altitude range of interest. Therefore, aerodynamic simulations are of critical importance.

Before particle impact can be simulated the flow field of the background gas needs to be quantified and this is done with a Direct Simulation Monte Carlo model. A model has been developed at MISU to introduce smoke particles in the gas flow and determine their trajectories. This model is based on the Brownian motion of the particles due to the thermal motion of the molecules in the gas. The result from this is a detection efficiency for the various detectors at different altitudes and particle sizes. In this paper, we apply these ideas to the recent rocket experiments MAGIC and ECOMA, aiming at a better understanding of meteoric material in the middle atmosphere.

There are a number of other open questions to be addressed about rocket-borne particle detection: Will the dust particle stay intact or fragment as it impacts the detector surface, will there be charge production on the detector surface, what fraction of the dust particles are charged with what sign and what fraction of these particles do we detect?