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19th IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Technologies (2B)

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COST EFFICIENT DESIGN FOR A FARADAY CUP TO DETECT METEOR SMOKE PARTICLES ON BOARD A SOUNDING ROCKET

Abstract

Meteor Smoke Particles or MSPs are the product of the burnt meteors which again condense to form tiny particles whose size range in the order of microns. Meteor ablation happens in the mesosphere which is situated approximately 70km from the Earth's surface. Also, these Meteor Smoke Particles are involved in a lot of atmospherical phenomenon. This makes it imperative to acquire more knowledge on these Particles. Hence, Sounding Rockets with an apogee of about 70-100km can be employed to help in the detection of these particles.

Remote Optical Sensing cannot be employed to detect these particles as their sizes are too low, even for sophisticated equipments. The method most commonly employed is the in-situ method. The mesospheric ice particles acquire a net charge in the D-region of the Ionosphere. The D-region being the lowest region in the Ionosphere is also the place where the probability of finding the MSPs are the highest. The fact that these particles acquire a charge when in the Ionosphere's D-region due to the loss of electrons by the intensive recombination with O2+ ions to produce O2 is put to use. The most successful device employed to detect these Meteor Smoke Particles is called a Faraday Cup. Designed by Michael Faraday, who theorized the presence of ions in 1830, this equipment is basically a metal cup which is designed to catch charged particles in vacuum by means of generating an electric current. The resulting current can be measured and then deduced to find out the number of ions hitting the cup. It is a shielded insulated block thick enough to stop a charge beam. The accumulated charge is then measured and then can be effectively used to count the number of protons too.

Usually the classical Faraday cup, consists of a negatively biased grid and then a positively biased grid. A collector grid is placed at the payload potential too. As opposed to free electrons and ions, MSPs are heavy enough to pass the potential grids and reach the collector resulting in a measurable current. But the assumption is that each particle consists of a single charge and considerable size. The authors through this paper propose a cheaper way of rigging up a faraday cup with better efficiency using brass as the block and a sheet of polyethylene. These design modifications will inspire Sounding Rockets to employ their own FC in their endeavours.