2021 Workshop: Meteoroids and Space Debris

Long title

Meteoroids and Space Debris

Conveners

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Description

A meteoroid is defined as a small, solid extraterrestrial object. Upon entry into a planet’s atmosphere, it heats and ablates off particles that then collide with the background neutrals, forming a dense plasma that extends around the meteoroid as well as behind it. These plasmas, referred to as meteors, have been studied for well over a century, yet many outstanding questions remain. In addition, space debris, also known as orbital debris, space junk, and space waste, is the collection of objects in orbit around Earth that were created by humans but no longer serve any useful purpose. These artificial meteors/Debris and meteoroids of astronomic origin are a long-standing threat to satellites, and both contribute to the flux of macroscopic particles into Earth's atmosphere. To address the outstanding questions currently under investigation in the field of meteor, meteoroid and debris science and engineering, we invite presentations on the physics of meteoroid and debris particles and their impacts effects on the atmosphere, ionosphere, and satellites. We also encourage presentations that address the engineering techniques for observing and characterizing the meteoroid and debris population, including any observational (i.e. lidar, radar, satellite and optical) or modeling method.

Agenda

Meteor Evolution from femtoseconds to minutes (Meers Oppenheim)

High-resolution optical imaging of meteors (Peter Brown)

Estimating 4-D MLT wind fields using Gaussian process regression on multi-static specular meteor radar observations (Ryan Volz)

Meteoroid Orbit Determination from HPLA Radar Data (Jared Blanchard)

High-Resolution Simulation of Plasma Formation Around a Small Ablating Meteoroid (Trevor Hedges)

A Computer Vision Take on Meteor Detection (Yanli Li)

Fast-Repeat Ionosonde Observations of Meteors (John Mathews)

Justification

Viewing Earth-Atmosphere-Geospace coupling and interactions as a complete and interactive system, meteors contribute across a wide range of spatial and temporal scales as both a driver and catalyst of significance to microphysics and phenomena. Meteors are routinely observed using a wide array of observational techniques in both the neutral and plasma environment and can be used as a tracer to study background parameters such as neutral winds, temperatures and tides. Many open questions exist in the meteor field. These range from gaps in fundamental understanding such as: what is the scatter process that results in radar observed meteor head echoes? and what is the mass loading of the upper atmosphere by meteor ablation and why do estimates very so drastically? to more nuanced questions about the relationship between meteor properties defined by the meteor input function and atmospheric phenomena tied to meteors. As with any study that uses the tools of system dynamics and system science one must first define the system (i.e. defining the boundaries, inputs and outputs in a thermodynamic system) and then make the simplifying assumptions that yield the relevant physics to the problem at hand. For meteor related studies, this system definition has often been implicit and related to boundaries defined by meteor ablation heights. But, as our measurement capability and knowledge increases regarding the Sporadic Meteoroid Complex (SMC), we continue to push these traditional boundaries to uncover new insight into the processes, drivers, and feedbacks related to meteors within the Earth-Atmosphere-Geospace system allowing us to learn more about the coupling and interactions that can be uncovered using meteor science.

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