2024 Workshop: Meteoroids and Space Debris

Long title
Meteoroids and Space Debris
Conveners
Sigrid Close
Julio Urbina
Nicholas Holl
jvu1@psu.edu
Description

As meteoroids enter the Earth’s atmosphere, their kinetic energy converts into intense heat, generating a blazing plasma enveloping their form. These plasmas, commonly referred to as meteors, have captivated scientific inquiry for well over a century, yet numerous enigmas persist. Concurrently, the proliferation of space debris—also denoted as orbital debris, space junk, or space waste—comprises defunct human-made objects encircling Earth devoid of utility. These synthetic meteors and debris, alongside their celestial counterparts, pose enduring hazards to satellite infrastructure, augmenting the influx of macroscopic particles into Earth's atmospheric. 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. Emphasis is placed on presentations exploring engineering methodologies for observing and characterizing the meteoroid and debris populace, encompassing various observational techniques such as lidar, radar, satellite, and optical methods, as well as modeling approaches. We also welcome presentations that use emerging AI and machine learning techniques to study all types of meteor echoes and space debris.

Agenda

10-10:05 ***Welcome, Introductions, Overview of Session, and Motivation, Including Some Announcements***

10:05 - 10:25 **New Meteor Observations and the Questions They Can Answer** (15 min talk + Q&A and

discussion)

Meers Oppenheim[1] , Yakov Dimant[1], Alex Green[1], and Trevor Douglas-Hedges[1]

[1]Boston University, MA, USA

10:25 - 10:45 **Vector Sensor Tracking of Satellite Generated Waves to Locate Space Debris Passing**

Through the Space Plasma Environment (15 min talk + Q&A and discussion)

Paul A. Bernhardt[1]; Bengt Eliasson[2], and Andrew Howarth[3]

[1]Geophysical Institute, University of Alaska, Fairbanks AK, USA

[2]Department of Physics, SUPA, University of Strathclyde, Glasgow, UK

[3]University of Calgary, Calgary, Canada

10:45 - 11:05 **Meteor Persistent Trains and Their Connection to Ozone** (15 min talk + Q&A and

discussion)

Logan Cordonnier[1], K. S. Obenberger[2], J.M Holmes[2], G.B. Taylor[1], D. Vida[3]

[1]University of New Mexico,

[2]Air Force Research Laboratory,

[3]University of Western Ontario

11:05 - 11:25 **Coherent and Incoherent MIMO radar observations of meteor echoes** (15 min talk + Q&A and discussion)
J. L. Chau, M. Clahsen, J. M. Urco, O. Wucknitz, K. Obenberger, C. Vocks

J. L. Chau[1], M. Clahsen[1], J. M. Urco[1], O. Wucknitz[1], K. Obenberger[2], and C. Vocks[1]

[1]Leibniz Institute for Physics

[2]Air Force Research Laboratory

11: 25 - 11:40 **The first anniversary of the PRISMA meteor radar operation at CCORE: A Climatology of the Mesospheric Solar Tide Modes** (12 min talk + Q&A and discussion)

Pedrina Terra[1], Christiano Brum[1], Nicholas Holl[2], Julio Urbina[2]

[1]University of Central Florida

[2]The Pennsylvania State University

11:40 - 11:55 **A Meteor Radar and Optical Instrument Network in South America** (12 min talk + Q&A and discussion)

Alan Liu[1] et al.

[1]Embry-Riddle Aeronautical University

11:55 – 12:00 **Discussion & Adjourn**

Justification

These plasmas, commonly referred to as meteors, have been studied for well over a century, yet many outstanding questions remain. Additionally, space debris, also known as orbital debris, space junk, and space waste, constitutes the collection of objects orbiting Earth that were created by humans but no longer serve any useful purpose. These artificial meteors/debris and meteoroids of astronomical origin pose a long-standing threat to satellites, contributing to the influx of macroscopic particles into Earth's atmosphere. Several recent networks of multi-static meteor radars, regional radar systems, and optical instruments have recently received funding. Moreover, there are ongoing efforts worldwide to develop lower-cost radar systems, which can facilitate new research and discovery, thereby broadening the participation of underrepresented communities. Furthermore, the utilization of AI and machine learning to conduct meteor and space debris research can open new frontiers in space science research.

Related to CEDAR Science Thrusts:
Explore processes related to geospace evolution
Develop observational and instrumentation strategies for geospace system studies
Workshop format
Short Presentations
Panel Discussion
Keywords
meteors, satellite, modelling, AI
View PDF