2023 Workshop: Meteoroids and Space Debris

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

As meteoroids enter the Earth's atmosphere, their momentum turns into heat, generating high-temperature plasma surrounding their body. These plasmas, referred to as meteors, have been studied for well over a century, yet many outstanding guestions 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 guestions 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 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 methods. We also welcome presentations that use AI and machine learning techniques to study all types of meteor echoes and space debris.

Agenda

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

Sigrid Close¹, Yanlin Li², and Julio Urbina²

¹Stanford University

²The Pennsylvania State University

10:06- 10:25 LT Evolution of meteors from picoseconds to minutes and the observational Consequences (17 min talk + Q&A and discussion)

Meers Oppenheim¹

¹Boston University

10:26 - 10:40 LT Plasma Waves generated by Space Debris (12 min talk + Q&A and discussion)

Paul A. Bernhardt¹, Lauchie Scott², Andrew Howarth³, and Eliana Nossa⁴

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

²DRDC Ottawa Research Centre, Ottawa, Canada,

³University of Calgary, Calgary, Canada,

⁴Aerospace Corporation, El Segundo, CA, USA

10:41- 10:55 LT A Novel Methodology to Estimate Pre-atmospheric Dynamical Conditions of

Small Meteoroids (12 min talk + Q&A and discussion)

E.C.M. Dawkins,^{1,2}, G. Stober³, J.D. Carrillo-Sanchez^{1,2}, D. Janches^{1,2}, R. Weryk⁴, J.L. Hormaechea^{5,6}, J.S. Bruzzone⁷, and J.M.C. Plane⁸.

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⁷*Facultad de Ciencias, Universidad de la Republica, Igua 4225 Montevideo, Uruguay*

⁸School of Chemistry, University of Leeds, Leeds, U.K.

10:56 - 11:10 LT **Orbital Debris, Space Domain Awareness and Space Traffic Management: Research and Operational Needs** (12 min talk + Q&A and discussion)

Reinhard Friedel¹, Jesse Woodroffe¹, J.-C. Liou², Lauri Newman¹, Matt Hejduck³, Jim Spann¹, and Paul Bernhardt⁴

¹NASA Headquarters,

²Johnson Space Center,

³The Aerospace Corporation,

⁴University of Alaska Fairbank

11:11 – 11:25 LT Radar, Radio and Optical Observations of Long-duration Meteors Over Northern Germany (12 min talk + Q&A and discussion)

J. L. Chau¹, M. Clahsen¹, O. Wucknitz¹, K. S. Obenberger¹, T. D. Carozzi¹, M. Pozoga ¹, C. Vocks¹, J. Künsemöller¹, M. Höft¹, and G. Baumgarten¹

¹Leibniz Institute for Atmospheric Physics

11:26 – 11:36 LT Patterns of the Meteor Head-echoes Observed by the Jicamarca High-Power Large-Aperature Radar (10 min talk + Q&A and discussion)

Yanlin Li¹, Freddy Galindo¹, Julio Urbina¹, Qihou Zhou², Tai-Yin Huang^{1,3}

¹The Pennsylvania State University

²Miami University

³National Science Foundation

11:37 – 11:48 LT Puerto Rican Initiative for Studies using Meteor Radar (PRISMA): An Overview and Preliminary Results (10 min talk + Q&A and discussion)

Pedrina Terra¹, Christiano Brum¹, Julio Urbina², and Flaviane Venditti¹

¹University of Central Florida

²The Pennsylvania State University

11:49 – 11:59 LT Meteoric Thermosphere-Ionosphere Metal (TIMt) Layers Observed by Lidars in Antarctica and from Midlatitudes: Intermittency vs. Regularity (10 min talk + Q&A and discussion)

Xinzhao Chu¹, *Zhibin Yu²*, and *Yingfei Chen¹*

¹ University of Colorado Boulder

² Harbin Institute of Technology Shenzhen

12:00 LT Adjourn

We are grateful for your participation and look forward to learning together during the upcoming workshop!

Justification

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. Several recent network of multi-static meteor radars, a regional network of radar systems, and regional optical instruments have recently been funded. In addition, there are new efforts worldwide in developing lower cost radar systems that can enable new research and discovery, broadening the participation of underrepresented communities. Additionally, the utilization of AI and machine learning to conduct meteor and space debris research can open new frontiers or research in space science.

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