2023 Workshop: Meteoroids and Space Debris

Long title
Meteoroids and Space Debris
Conveners
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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 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 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 Close[1], Yanlin Li[2], and Julio Urbina[2]

[1]Stanford University

[2]The 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 Oppenheim*[1]**

[1]Boston University

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

***Paul A. Bernhardt*[1]**, *Lauchie Scott*[2], *Andrew Howarth*[3], *and Eliana Nossa*[4]

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

[2]*DRDC Ottawa Research Centre, Ottawa, Canada,*

[3]*University of Calgary, Calgary, Canada,*

[4]*Aerospace 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. Stober*[3], *J.D. Carrillo-Sanchez*[1,2], *D. Janches*[1,2], *R. Weryk*[4], *J.L. Hormaechea*[5,6], *J.S. Bruzzone*[7], *and J.M.C. Plane*[8].

[1]*ITM Physics Laboratory, NASA/Goddard Space 5 Flight Center, Code 675, 8800 Greenbelt Rd., Greenbelt MD 20771, USA*

[2]*Department of Physics, Catholic University of America, 620 Michigan Ave., N.E. Washington, DC 20064, USA*

[3]*Institute of Applied Physics & Oeschger Center for Climate Change Research, Microwave Physics, University of Bern, Bern, Switzerland*

[4]*Physics and Astronomy, The University of Western Ontario, 1151 Richmond Street, London, ON, N6A 3K7, Canada*

[5]*Facultad de Ciencias Astronomicas y Geofisicas, Universidad Nacional de La Plata, Argentina*

[6]*Estacion Astronomica Rio Grande, Rio Grande, Tierra del Fuego, Argentina*

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

[8]*School 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 Friedel*[1]**, *Jesse Woodroffe[1], J.-C. Liou[2], Lauri Newman[1], Matt Hejduck[3], Jim Spann[1], and Paul Bernhardt[4]*

[1]*NASA Headquarters,*

[2]*Johnson Space Center,*

[3]*The Aerospace Corporation,*

[4]*University 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. Chau*[1]**, *M. Clahsen[1], O. Wucknitz[1], K. S. Obenberger[1], T. D. Carozzi[1], M. Pozoga[1], C. Vocks[1], J. Künsemöller[1], M. Höft[1], and G. Baumgarten[1]*

[1]*Leibniz 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 Li*[1]**, *Freddy Galindo[1], Julio Urbina[1], Qihou Zhou[2], Tai-Yin Huang[1,3]*

[1]*The Pennsylvania State University*

[2]*Miami University*

[3]*National 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 Terra*[1]*, Christiano Brum*[1]*, Julio Urbina*[2]*, and Flaviane Venditti*[1]

[1]*University of Central Florida*

[2]*The 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 Chu*[1]*, Zhibin Yu*[2]*, and Yingfei Chen*[1]

[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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