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Contents

Authors

Numbers in the index correspond to the last two digits of the six-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first four digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

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1 Planetary Defense I
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2 Space Environment Applications I
Gary B. Hughes, California Polytechnic State Univ., San Luis Obispo (United States)

3 Space Environment Applications II
Ronald G. Pirich, Northrop Grumman Aerospace Systems (Retired) (United States)

Planetary Defense and Space Environment Applications I

This volume contains papers presented at the SPIE Optics+Photonics conference, *Planetary Defense and Space Environment Applications*. This conference was formed as a natural extension of the *Nanophotonics and Macrophotonics for Space Environments* conference series, which was chaired by Edward W. Taylor and David A. Cardimona. In recent years, the emerging field of planetary defense, protecting Earth from bombardment by asteroids and comets, has begun to explore the use of directed energy technology. Transitioning ground-based, directed-energy systems for use in space environments presents many challenges, including robust design for survivability and reliability of components and systems operating in the extreme environmental conditions of space.

The focus of the *Planetary Defense and Space Environment Applications* conference is emerging and advanced optical and photonic technologies appropriate for use in space environments, including applications such as planetary defense missions and systems for solar system exploration. In the space environment, the effects of ionizing radiation, temperature ranging, and environmental effects such as atomic oxygen (AO), vacuum, and ultraviolet (UV) radiation can degrade space sensors, systems, and related components. Papers presented at the conference describe satellite architectures, including payloads which require micro-component optical or photonic systems such as Micro Electro-Mechanical Systems (MEMS) devices, integrated monolithic photonics and innovative, miniaturized, cost-effective, reliable and radiation-resistant sensor and communications technologies. This conference also incorporates papers dealing with specific missions that rely on optical and photonic technologies, such as directed-energy planetary defense, directed-energy spacecraft propulsion, active target illumination, orbital debris mitigation, spectrometry and other missions. Missions that seek to explore the surfaces of solar system bodies, by remote sensing or landing missions are included in this conference, as these missions occur in unique and challenging environments requiring specialized hardware to explore. For example, one might consider the range of unusual considerations that arise if trying to explore Venus. Conditions at most altitudes are inhospitable to present technology, especially on the surface. Similarly intriguing and challenging environments are considered, such as those of Titan, Enceladus, and Europa. Emerging and improved photonics technology can facilitate implementation of future small sat systems, as well as significantly improve related dual-use commercial and military terrestrial system applications where reduced size, reliability, and resistance to temperature and ionizing radiations are major issues. Topics dealing with research and development in these areas, and especially technologies expected to operate in adverse UV and AO environments such as

near-Earth orbits or locations such as interplanetary space that are exposed to galactic cosmic rays, are discussed.

As chair of the inaugural *Planetary Defense and Space Environment Applications* conference, I wish to thank Ron Pirich, who served as conference Co-chair, and the entire Program Committee for generously offering their time and effort in support of this conference. I am very grateful to all of the authors for their efforts and willingness to present their incredible research at this conference. I especially appreciate all of the SPIE staff members who work tirelessly to organize and execute this conference, which is truly among the best conference experiences in any field.

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