Paper ID: 88954
student

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IP)

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BIOLUMINESCENT LIGHTING FOR SUSTAINABLE ILLUMINATION IN FUTURE LUNAR UNDERGROUND COLONIES

Abstract

Exploration of lava tubes, underground caves formed by volcanic activity, has unveiled their potential as human habitats for space exploration. These natural structures offer protected living quarters, shielded from cosmic and solar radiation as well as micrometeorite impacts. Moreover, the stable environment within lava tubes, buffered from temperature fluctuations, presents a promising option for a long term sustained human habitation. Leveraging biological solutions for sustainable space missions, particularly microbial systems, has emerged as a promising avenue for space exploration. This research delves into the integration of bioluminescent microbes as a sustainable lighting solution tailored for underground habitats in future lunar colonies. In addressing the unique challenges of subterranean lunar environments, such as limited sunlight and resource constraints, bioluminescent lighting offers an energy-efficient and environmentally sustainable alternative. By evaluating the feasibility and effectiveness of bioluminescent lighting systems within lava tubes on the Moon, researchers can be informed of the energy efficiency, sustainability, psychological impact on inhabitants, and practical applications of microbial bioluminescence in lunar subterranean architecture. This research zeroes in on a football-field-sized lunar lava tube as a model to shed the light on the efficacy of microbial bioluminescent lighting systems for future lunar settlers.