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HARNESSING THE SUN FOR THE MOON: THERMO-OPTICAL ANALYSIS AND ORBITAL SIMULATION OF A LUNAR SOLAR POWER SATELLITE FOR FUTURE LUNAR EXPLORATION

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ABSTRACT

This study explores the application of an innovative Lunar Solar Power Satellite (LSPS) configuration in a lunar environment to provide a sustainable base load energy supply for future human settlements on the Moon. Inspired by advanced Space-Based Solar Power (SBSP) architectures, this analysis proposes a satellite system strategically positioned to orbit the Moon.
The proposed satellites capture uninterrupted solar energy from the sun, transmitting it to designated lunar surface stations via wireless power transmission methods such as microwave or laser beaming. This approach ensures a reliable base load power supply for sustaining critical operations, from life support systems to industrial activities in lunar habitats.
The system leverages advanced materials optimized for thermal resistance and energy conversion efficiency, minimizing power losses while maximizing operational durability. Additionally, precision control systems manage satellite alignment and energy transmission, addressing the unique orbital dynamics of a lunar deployment.
A comprehensive implemented model is presented from a physical and mathematical standpoint, capable of simulating the thermal, optical and orbital behavior of the presented satellite within a lunar scenario. This mathematical model

is enhanced through the results of simulations carried out by Ansys, in order to validate the results and make the model more robust and reliable.
This approach demonstrates the potential for LSPS technology to establish a continuous and reliable energy infrastructure, enabling human exploration and habitation on the Moon. By bridging the gap between current terrestrial power solutions and future extraterrestrial needs, this innovative concept marks a critical step toward sustainable off-Earth settlements.