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CONCEPTUAL DESIGN OF A LUNAR POLE SURFACE EXPLORATION SYSTEM BETWEEN HIGHLY ILLUMINATED REGION AND PERMANENTLY SHADOWED REGION

Abstract

Distances between highly illuminated regions (HIRs) and permanently shadowed regions (PSRs) that exist in the lunar poles might be short to hundreds of meters in some extreme terrains. Temperatures of PSRs fluctuate gently as PSRs were not exposed to the intensive solar radiation directly. If abundant solar energy in HIR was focalized and projected to, or converted into electricity and transferred to, or converted into microwave and transferred to an adjacent site in PSR, then a lightful, warm and low-intensity radiation environment can be created in PSR, where may be fitting for the survive of life with additional provision of water and air. One Crater Shackleton rim site and another shadowed depression site nearby were chosen as the instances to build the lunar pole surface exploration system between HIR and PSR (SESHP), and its thermodynamic model was constructed by the systematically analyzing of factors such as characteristics of solar energy conversion, thermodynamic characteristics of lunar regolith and topography parameters of Crater Shackleton, et al. After numerical simulation and optimization, a small, warm (+5 degrees) and low-intensity radiation environment was created in PSR, and equipments there can receive light from HIR for 90% of a year. Based on above discussion, a conceptual scheme of SESHP near the lunar south pole was proposed, including a revolving solar power generator, a revolving solar concentrator in HIR and a small science laboratory mounted on a location platform in an adjacent PSR. Sunlight of any azimuth in HIR can be concentrated and projected to the predefined site in PSR by the revolving solar concentrator. The location platform in HIR moves down the abrupt slopes to the predefined site in PSR with the help of a strengthened cable that provides both elcetrictiy energy and addtional brake drug. And the small science laboratory can be used to validate the adaptability of life (such as algae, seed, animalcule and cockroach) or explore the water ice beneath the surface in the artificial warm and low-intensity radiation site in PSR.