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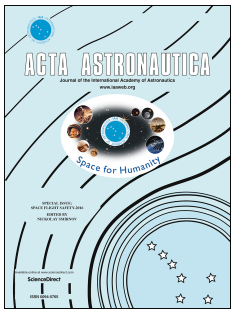

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Thermal Design, Analysis and Comparison on Three Concepts of Space Solar Power Satellite

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Abstract: Space solar power satellites (SSPS) have been widely studied as systems for collecting solar energy in space and transmitting it wirelessly to earth. A previously designed planar SSPS concept collects solar power in two huge arrays and then transmits it through one side of the power-conduction joint to the antenna. However, the system's one group of power-conduction joints may induce a single point of failure. As an SSPS concept, the module symmetrical concentrator (MSC) architecture has many advantages. This architecture can help avoid the need for a large, potentially failure-prone conductive rotating joint and limit wiring mass. However, the thermal control system has severely restricted the rapid development of MSC, especially in the sandwich module. Because of the synchronous existence of five suns concentration and solar external heat flux, the sandwich module will have a very high temperature, which will surpass the permissible temperature of the solar cells. Recently, an alternate multi-rotary joints (MR) SSPS concept was designed by the China Academy of Space Technology (CAST). This system has multiple joints to avoid the problem of a single point of failure. Meanwhile, this concept has another advantage for reducing the high power and heat removal in joints. It is well known to us that, because of the huge external flux in SSPS, the thermal management sub-system is an important component that cannot be neglected. Based on the three SSPS concepts, this study investigated the thermal design and analysis of a one-kilometer, gigawatt-level transmitting antenna in SSPS. This study compares the thermal management sub-systems of power-conduction joints in planar and MR SSPS. Moreover, the study considers three classic thermal control architectures of the MSC's sandwich module: tile, step, and separation. The study also presents an elaborate parameter design, analysis and discussion of step architecture. Finally, the results show the thermal

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