Using Space Solar Power Satellites to Aid in Planetary Science Discovery and Exploration. Corey Bergsrud[1] and Jeremy Straub [2], [1]Department of Electrical Engineering, Upson Hall II Room 160, 243 Centennial Drive Stop 7165, Grand Forks, ND, 58202-7165, corey.bergsrud@my.und.edu, [2]Department of Computer Science, 3950 Campus Road Stop 9015, Grand Forks, ND, 58202-9015, jeremy.straub@my.und.edu.

Introduction: Planetary scientists have identified numerous targets of exploration within the solar system in the Decadal Survey [1] and other venues. Space Solar Power Satellites (SSPSs) represent a possible solution to providing power to numerous missions to these multiple locations within the solar system. By reducing the mass and volume that is committed to power generation, missions can benefit from lower mass and volume leading to lower cost and, potentially, increased mission frequency.

This paper presents an overview of the SSPS technology, previously discussed in [2-8] and its application to planetary science missions. It details how SSPS use can drive lower costs and discusses prospective cost savings in the context of two example missions.

SSPS Benefit: Many planetary missions, such as those presented in the Decadal Survey may benefit from the use of a SSPS. A SSPS system generates power using solar panels and supplies power wirelessly to target device (e.g., a satellite, rover, blimp) that is equipment with a microwave wireless power receiving rectifying antenna (rectenna). Due to the significantly higher concentration of the power in the microwave beam, the rectenna can be significantly smaller than the solar panel system required to generate a similar level of power. This receiving unit converts the wireless power into direct current which can be utilized to power the craft's subsystems.

Two Types of Systems: Two types of SSPS use may benefit various planetary science missions. First, for inner-planetary missions, a SSPS space grid infrastructure could be established to convey power from higher-density collection areas via high-density microwave beams to the outer areas of the solar system. These units could be utilized to power craft in orbit of planets and asteroids; they also could serve as a network of power stations to power craft with electric propulsion systems in-route. Second, for missions to the outer planets, a SSPS with a very large solar array (and/or an internal nuclear generation capability) could be sent with the mission craft to its destination. The SSPS/nuclear power unit could then transmit power wirelessly via microwave radiation to craft in orbit and on the surface of the target being explored.

In both cases the use of a SSPS system reduces the mass, volume and complexity of the science mission vehicles, prospectively allowing more (smaller) vehicles to be included to increase exploration potential or to incorporate more experiments on a vehicle of a given size. By incorporating a mechanism to replace SSPSs (or the solar panels onboard these craft), mission longevity can be increased (as solar cell decay limits power generation, eventually resulting in reduced spacecraft capabilities).

Conclusions: SSPS use can benefit the planetary science community in multiple ways. It can enable new mission concepts based on utilizing numerous small craft on missions to the outer planets (where each craft would be unable to house a solar panel sufficiently large to power its own operations). Benefits also include reduction of the amount of craft mass and volume devoted to power generation, allowing more scientific instruments to be placed on the craft and increase mission longevity.

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