

# A DEMONSTRATION EXPERIMENT FOR MICROWAVE POWER TRANSMISSION FROM SPACE TO GROUND

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Verification of the microwave power transmission from space to ground is the most important and urgent subject in the SPS research. The technology demonstration should include; 1) high-power microwave power transmission more than several hundreds of kW, 2) suppression of unnecessary power radiation interfering with other microwave utilities, 3) microwave beam control from the large transmitting antenna dynamically moving in orbit, and 4) no serious interaction of the high-power microwave beam with the ionosphere.

We have made a conceptual design for a demonstration experiment in which a microwave power beam at 100-400 kW is transmitted from a satellite in the low earth orbit to a rectenna on ground. The microwave beam is transmitted for about 1 min while the rectenna site transmits a pilot signal to the satellite. The satellite consists of a deployable flat board (10m × 10m ~ 20m × 20m, 7 ton) and a satellite bus (1 ton). The satellite bus is either directly connected to the flat board or separated with a mast or 4 tether wires. If we use the mast or tether wires of 50 m long, the satellite is automatically stabilized by the gravity gradient force. The flat board consists of a number of panels of several meters size in 5-20 cm thick. The panel has several electrical modules of 1 m × 1 m size, which has a solar cell array on one side and phased array antennas on the other side. Each module contains a battery and a microwave power system. The solar array on each module generates 50 W on average and the module transmits a 1 kW microwave beam at 5.8 GHz for about 1min.

We have investigated the technologies applicable to the demonstration experiment. For the deployment of the large flat board, a lot of folded panels are to be developed in two dimensions and latched to keep the flat shape. New technologies, such as shape-memory alloys, are desirable in the actuators and latch mechanism for better reliability and weight reduction. The microwave power transmission is the most critical technology in the demonstration experiment. A combination of the Phase-controlled Magnetron (PCM) and Active Integrated Antenna (AIA) is a potential candidate for the demonstration experiment. The AIA is an integrated circuit consisting of planar microwave circuits and planar antenna. The retrodirective control system in each module requires a phase-synchronized oscillator. Since the panel can move slightly to each other, the phase-synchronization of the clock is necessary between all panels. If we can transmit a 400 kW power from the 370 km altitude, the power density on ground amounts to 0.3 W/m<sup>2</sup>. In this case, it will be possible to get an electrical power if we collect the microwave power by using a parabola antenna.

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