Development Status of NASA's Long-Lived Solar System Explorer (LLISSE)

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Introduction: Exploration of the surface and interior of Venus possess unique challenges to scientists and spacecraft designers. The cloud layers and dense atmosphere make standard remote sensing practices difficult and surface conditions are extremely challenging for landers. NASA has been tackling these challenges through projects such as LLISSE [1], which stands for Long-Lived Insitu Solar System Explorer. This briefing will discuss recent progress on the development of components, subsystems and systems that target extended (months) operations on the Venus surface.

Technology Developments: Recent developments by NASA, and others, are making progress toward overcoming the noted challenges. For example, high temperature sensors have been demonstrated to function in Venus conditions. Wide band gap, silicon carbide (SiC) based electronics have been demonstrated to function successfully for extended periods of time at over 500C and in the reactive chemistry of the Venus atmosphere [2]. Several other subsystems are in development including power in the form of high temperature batteries and power management devices, communications including antennas, transmitters [3] and other components, materials [4], and structures and mechanisms.

Some examples and recent progress: the world's first demonstration of stable operation of integrated circuits (ICs) for 60 days in simulated Venus conditions. Four chemical species sensors have shown operation for 60 days in Venus conditions. Transistors associated with lower frequency communications have been demonstrated and work continues on antenna design and fabrication. Further, electronic circuits with the capability to provide operability for LLISSE have been designed and are being fabricated. Multi-cell batteries have demonstrated life well beyond the 60-day life under simulated LLISSE loads.

With the ongoing developments, one can envision near-term applications on the Venus surface that will help us understand the mysteries about the complex Venus atmosphere and climate. And, if augmented by a high-temperature seismometer, they could enable the capture of data that reveals the seismicity of Venus and allows our first glimpses into the interior.

Summary and Conclusions: Progress continues to be made toward a complete lander system that can operate in the harsh Venus surface conditions and be ready for missions launching in the late 2020's.

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