ABSTRACT

Previous expeditions to Mars have successfully measured background levels and small spikes of methane, but none have been able to localize any sources or sinks. Localization of methane detections would contribute towards addressing questions about potential current Martian life and disprove any notions that previous methane observations were errors. This would help discriminate between biological and abiotic methane formation hypotheses as methane can be linked to microbial activity and geochemical/geophysical processes.

Our proposed Mars Areostationary Trace Gas Localizer (ATGL) mission aims to identify and track methane plumes over 3 Martian years, with a spacecraft cost under $300M. Located in an areostationary orbit, ATGL's ultra-high miniaturized spectrometer would be capable of capturing methane variations in a predetermined area with multiple degrees of fidelity: a coarse observation mode for large scale localization and fine observation mode for Regions of Interest (ROIs). With a nominal on-orbit mass of 300 kg, the spacecraft is a low-mass, low-cost system to answer an important question.

Proposed to launch on an Atlas V in 2024, ATGL could be integrated as a secondary payload on an ESPA Grande platform. This levied some difficulties with the integration of a complex system but these were addressed via extensive analysis in mechanical, power, propulsion, command and data handling, and thermal systems. For example, with AGI's Systems Tool Kit, we have designed a propulsion system using a configuration of RIT 10 EVO electric propulsion thrusters for delivering the satellite from a geostationary transfer orbit to an areostationary orbit. A spacecraft bus has been designed to fit its subsystems within its volume constraints (0.85m X 0.94m X 0.77m) while delivering enough power to the spacecraft via deployable solar panels. Further, a communications architecture using 0.78m X-Band antenna has been chosen for direct-to-Earth communication capabilities. This design has the potential to lead to small robust satellites that enable a focused, yet compelling set of science goals aligned with high-priority questions in planetary sciences.