**PROJECT: LUNASONDE**

**FLIGHT PLAN**
The LunaSonde satellite will ride as a secondary payload to Geosynchronous Transfer Orbit (GTO) and will use an ion thruster to gradually orbit the Earth's gravitational force lower Lunar Orbit (LOL). If this LOL is achieved, it will use integrated (meaning directly embedded on electronic devices) attitude thrusters to maintain a lunar orbit consistently above the LMO per challenge requirements. After this point, the ion thrusters can be fired and the spacecraft will spin-out from LLO into an interplanetary orbit. This fulfills the maximum distance and longevity parts of the Lunar Cube Quest Challenge.

**PROPULSION & NAVIGATION**
LunaSonde uses ion thrusters to sustain spin-out from Geosynchronous Transfer Orbit (GTO). In a manner similar to the European Space Agency's SMART-2 Mission, LunaSonde gradually ``spins-out'' from GTO to insertion into LMO Lunar Orbit (LLD). This trajectory coupled with an adaptive navigation system means reliance on satellite-earth communications and increased on-board data handling. This degree of autonomy above the atmosphere allows the spacecraft to operate even during intermittent communication.

**MAXIMUM TRANSMISSION DISTANCE**
The satellite implements a novel magnetic navigation system to ensure proper alignment of the communication sub-system. The satellite uses small, dedicated telemetry networks.

**MAXIMUM TRANSMISSION RATE**
LunaSonde applies laser communication to transmit data rates an order of magnitude greater than current radiotelemetry methods.

**MAXIMUM ENDURANCE**
An open-source flight computer based on the popular Arduino and Raspberry Pi coupled with the use of radiation hardened microelectronics leads to a very durable computer. By managing the adverse effects of the hostile environment of space, the spacecraft demonstrates the ability to survive in cis-lunar space and beyond.

**OPTICAL COMMUNICATION**
Efficiency transmits of data by taking advantage of cutting edge photonic innovations. Photonics Integrated Circuits (PICs) streamline the encoding process and a monolithically integrated system allows micro-fluids compatible with the CubeSat form factor with a much lower power requirement than the system used on NASA's LADEE mission.

**MAGNETORECEPTION ORIENTATION SYSTEM**
A biomimetic `quantum compass` uses the extreme sensitivity of several key molecules in order for the spacecraft to navigate in cis-lunar space. This eliminates the need for sun/star trackers and imaging processing load.

**ADAPTIVE MANUFACTURED SHELL**
Carbon fiber 3D printer filament creates an exterior printed around the electronics and sensor subsystems. This simplifies construction with a ``Paper-to-Printer'' approach, so spacecraft can be constructed from designs in 24 hours.

**NEURAL NETWORK NAVIGATION**
Improves autonomous capabilities, by adaptively adjusting the `weights` on specific parameters, such as mass distribution and instrument error, providing a machine-learning approach to trajectory planning. This builds upon previous work using neural networks to track orbital debris but reversed to map the correct trajectory of the spacecraft.

**RAD-HARD NEXT GENERATION FLIGHT COMPUTER**
Improves the longevity of the planned mission. The custom-designed prototype utilizes advancements in the fields of fault-tolerant computing and signal/noise to protect hardware and memory respectively. By retooling pre-existing open-source architectures with these advances, the costs of developing an entirely new flight computer.