

National Aeronautics and Space Administration



Cube Quest Challenge

Objective

Sponsored by NASA's Space Technology Mission Directorate Centennial Challenges program, university and private developer teams will compete for prizes by building 6U-sized CubeSats and demonstrating superior performance while in lunar orbit (the "Lunar Derby") or at a range of four million km from Earth (the "Deep Space Derby"). Within those two arenas, competitors attempt to achieve any or all of the contest goals including: highest data communications rate, transmission of the largest volume of data within a limited timed interval, data transmission from the farthest range beyond four million km, and/or longest survival in the deep space environment. There is also a prize for achieving a specified lunar orbit. To be eligible for prizes, each achievement must meet or exceed a specified minimum value. NASA believes that CubeSats with these kinds of capabilities will contribute to new and more affordable missions to explore the Moon and beyond.

Prize Purse

The total prize purse for the competition is \$5 million. An already-completed competition element offered three free launch opportunities on NASA's EM-1, the first un-crewed lunar flyby mission of Orion, launched atop NASA's Space Launch System (SLS) rocket. EM-1 is currently scheduled to launch in late 2019.

Ground Tournaments

During a series of four already completed Ground Tournaments (GTs), \$460,000 in prizes were awarded for CubeSat designs judged as meeting or exceeding benchmarks for excellence. At GT-4, the final Ground Tournament, the Centennial Challenges program announced the names



of three top scoring teams each awarded \$20,000 and offered free integration and launch aboard NASA's EM-1 mission.

The Cube Quest rules allow any qualified U.S.-based team to obtain their own launch in order to compete with their 6U-sized CubeSat for prizes in the Lunar Derby or Deep Space Derby. Teams have 365 days after their own launch for verified achievements eligible for prizes; however, the entire competition ends 365 days after EM-1 launch (currently scheduled in late 2019).

The three EM-1 launch winners are: Cislunar Explorers, CU-E3, and Team Miles.



Cislunar Explorers 6U-sized CubeSat splits into two; each uses water for its propellant.

NASAfacts

Cislunar Explorers

Cornell University (Ithaca, NY)

Goals: Achieve Lunar Orbit, Space Longevity

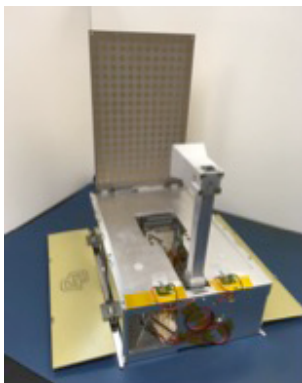
Notable Technologies: Cornell-designed water electrolysis propulsion systems utilizing a 3D-printed Titanium nozzle that burns hydrogen and oxygen safely stored as water. The 6U CubeSat splits into two 3U units that each generate sufficient power for electrolysis of the water propellant, and that spin for stability and to separate liquid water from the gases. Cornell has also developed their own CO₂ cold-gas thrusters for attitude control, and a UHF RF amplifier for communications at lunar distances. They use off-the-shelf cameras for optical navigation.

CU-E3

University of Colorado, Boulder (Boulder, CO)

Goal: Best Burst Data Rate, Highest Data Volume, Farthest Communications Distance, Spacecraft Longevity

Notable Technologies: CU intends to win the communications distance, data rate and data volume prizes by using their novel CU-designed deployable reflect-array antenna with a deployable feed horn driven by their own X-band transmitter. CU has partnered with Atlas Space Operations for ground station services.



CU-E3 plans to win using their own X-band transmitter (above) that drives their unique deployable reflect-array antenna.



Team Miles propels their CubeSat with 12 iodine-fueled plasma thrusters, controlled by a custom radiation-tolerant computer.

Team Miles

Fluid & Reason (Tampa, FL)

Goal: Farthest Communications Distance

Notable Technologies: Team Miles will use an array of 12 of their own ConstantQ plasma thrusters, iodine-fueled electric propulsion, canted to allow 3-axis pointing control as well as speed them beyond 4 million km range. The team has radiation-tested their custom Resilient Affordable CubeSat Process flight computer and other electronics to determine survival over the duration expected to reach their goal of 7.7 million km range.

Team Miles are “citizen inventors” who came together from the Maker community to compete in Cube Quest. Since then, they have decided to commercialize their novel technologies.

More on the Cube Quest Challenge

The Cube Quest is part of NASA’s Centennial Challenges program, based at the agency’s Marshall Space Flight Center in Huntsville, Alabama. Centennial Challenges is a part of the agency’s Space Technology Mission Directorate. The challenge competition is managed at NASA’s Ames Research Center in California’s Silicon Valley.

For more information about the Cube Quest Challenge, visit: <http://www.nasa.gov/cubequest>

For more information about the Centennial Challenges program, visit: <http://www.nasa.gov/winit>

National Aeronautics and Space Administration

Ames Research Center

Sillicon Valley, California 94035

www.nasa.gov/centers/ames