Laser Ranging to Measure LightSail 2 Orbit Raising

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LightSail 2 Mission Overview

- The LightSail 2 project will demonstrate controlled solar sailing in Earth orbit from a 3U CubeSat platform
  - First mission to change orbital energy via solar sailing
- Scheduled for launch no earlier than Nov. 30, 2018 as part of the Space Test Program-2 payload on the SpaceX Falcon Heavy launch vehicle
  - Injected into a 720 km, 24 deg inclination orbit
  - Deployed by Prox-1 microsatellite 7 days after launch
- Through controlling sail orientation relative to the sun, the orbit apogee will be raised ~600 m/day for one month following sail deployment

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LightSail 2 CONOPS

LS2 Deployment from Prox-1
LS2 Initial Acquisition & Checkout
(L+7 days)

Solar Panel Deployment
(L+12 days)

Solar Sail Deployment
(L+13 days, Duration 2.5 min)

Sail Control: Apogee Raise
(L+13 – L+43 days)

Flight Ops Sequence of Events

Days Past Launch	Event	Notes
L+7	P-POD deployment	Prox-1 timer is set to deploy LS2 7 days after launch vehicle injection. The 7 days will allow separation of the 11 spacecraft deployed into the 720 km orbit so that they can be individually identified.
L+7 – L+12	On-orbit checkout and orbit determination	Evaluation of LS2 engineering subsystems and cameras. Orbit determined by the 18th Space Control Squadron located at Vandenberg Air Force Base, California (TLEs) and the International Laser Ranging Service.
L+12	Deploy solar panels	Panel deployment will be commanded following completion of on-orbit checkout
L+13	Deploy solar sail	Sail deployment will be commanded after verification that EPS performance with panels deployed is as expected. Sail deployment takes about 2.5 minutes. Downlink images.

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Flight Ops Sequence of Events (Cont.)

Days Past Launch	Event	Notes
L+13 – L+43	Controlled solar sailing	90 deg sail rotations every half orbit, controlled via momentum wheel and torque rods. Apogee raise of ~700 m per day expected.
L+43 – L+57	Extended mission phase	Possible evaluation of alternate solar sail control strategies
L+57 – L+180	Deorbit phase	Continued downlink of stored images and telemetry. Possible additional imaging, and characterization of uncontrolled sail orientation.
> L+180	Reentry and End-of-Mission	Timing of reentry is very uncertain. Reentry could occur from 6 months to 3 years past launch.

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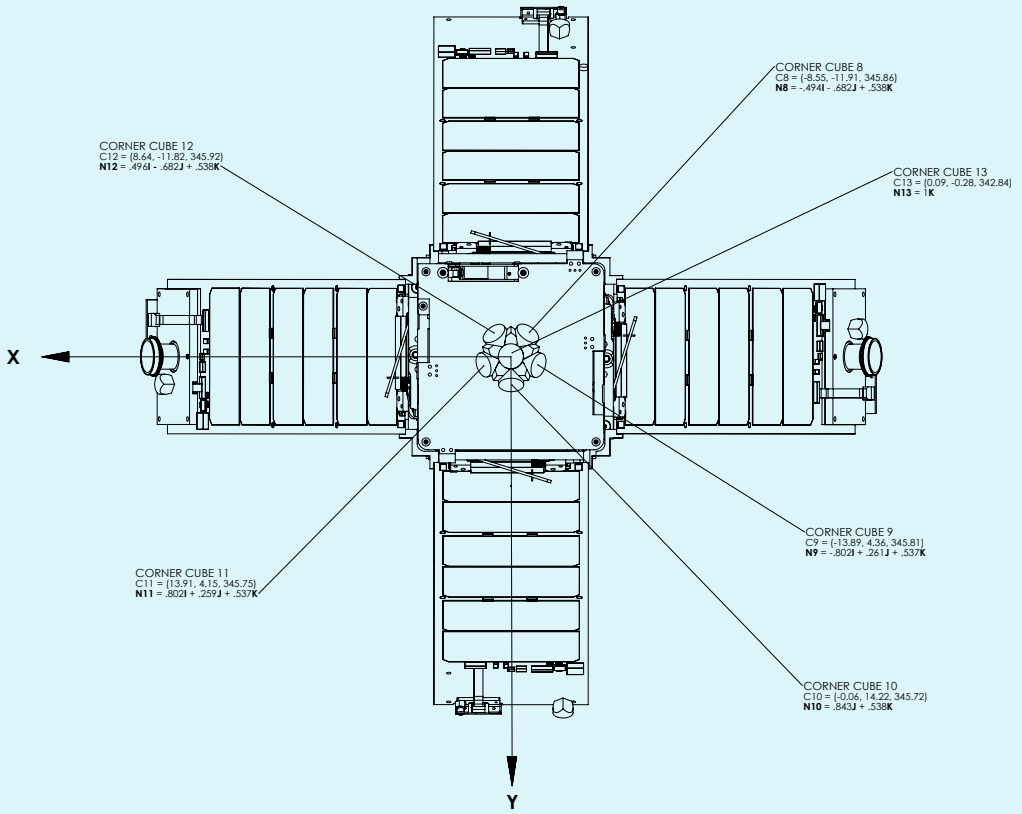
LightSail 2 Laser Ranging Corner Cube Placement

- LS2 includes 13 corner cubes for laser ranging
  - One mounted on each of the deployed solar panels (4 total)
  - One mounted on each of the +X, -X, -Y faces (3 total)
  - Six mounted as an array on the +Z face
- Only +Z array visible prior to panel deployment



Laser Ranging Plan

- Laser ranging is planned for precise orbit determination both before and after sail deployment
- Only stations within ±30° of equator can observe LS2
- Will request TLE updates twice per day once sail is deployed
- Laser ranging will be challenging, due to the changing orbit
  - Attempts to track LightSail 1 (summer 2015) were unsuccessful
  - Corner cube array on spacecraft +Z axis added for LightSail 2
- The LightSail 2 team greatly appreciates the efforts of the laser ranging community in helping the project to determine solar sailing performance.

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