LightSail Program Status: On Track for Two Launches

Rex Ridenoure, CEO
Ecliptic Enterprises Corporation
Pasadena, CA
… and the LightSail Team

Spring CubeSat Workshop
San Luis Obispo, CA
2015 Apr 22-24
LightSail Program Scope

- Privately funded by members of The Planetary Society

- Principal objectives
  - Demonstrate feasibility of solar sailing from 3U CubeSat in Earth orbit
  - Serve as pathfinder for future solar sail missions

- Mission plans
  - LightSail A (2015 launch on Atlas 5)
  - LightSail B (2016 launch on Falcon Heavy)
  - Mission-control ground segments in California and Georgia
LightSail Team

- Overall program direction; funding; outreach
- Program management
- Lead system contractor; system I&T
- Mission management; system analyses; mission ops
- Launch integration; environmental test; mission ops
- Systems engineering; ACS; flight software
- Systems engineering; system I&T support
- CubeSat design; initial construction; I&T support
LightSail History

- Follow-on to previous solar sail mission attempt by TPS
  - Cosmos 1 (2005)

- 3U CubeSat concept defined 2009-2011
  - Two spacecraft constructed by end of 2011 (one partly tested)

- ~18-month program pause 2012-2013

- Program resumed late 2013
  - Two launch opportunities secured (LightSail-A and LightSail-B)
  - New program and technical management team

- LightSail-A I&T completed late 2014

- LightSail-B I&T to be completed late 2015
LightSail Spacecraft

LightSail A: 4.93 kg
LightSail-A Spacecraft
(Mostly stowed)
LightSail-A Spacecraft
(Fully deployed)

Sail area = 32 m$^2$
Four 4-m booms
5.6 m on a side
LightSail Cameras

PSCAM
LightSail Launches

• **LightSail-A**
  - Atlas 5 / AFSPC-5 payload; from CCAFS; 2015
  - NASA ELaNa slot on ULTRASat (NPS CuL Lite)
  - Low elliptical orbit
  - 2015 ~May 20

• **LightSail-B**
  - Falcon Heavy / STP payloads; from CCAFS
  - Embedded target for Prox-1 spacecraft
  - ~720-km LEO orbit
  - 2016 2Q-3Q
LightSail Mission Objectives

• LightSail-A objective
  – Successfully deploy solar sail from 3U CubeSat in Earth orbit and demonstrate key spacecraft functions (i.e., show design is sound)

• LightSail-B objectives
  – Successfully deploy solar sail
  – Successfully control attitude before and after sail deployment
  – Observably change orbit parameters (e.g., inclination)
  – Capture engineering and CONOPS data relevant to future CubeSat-class solar sail missions

• Mission collaborations
  – NEO Scout
  – Lunar Flashlight

• Plus other program objectives of TPS …
LightSail-A Mission Operations

• LightSail-A
  – ~Launch+1 hr: Eject from ULTRASat
  – Eject+15 sec: Boot-up complete; ACS ON
  – Eject+55 min: RF antenna deploy; start beacon TLM
  – Eject+4 days: Gyros and camera checkout
  – Eject+28 days: Deploy solar panels, solar sails; image sail deployment and download images
  – Sail deploy+2 to 10 days: Enter atmosphere
Prox-1 / LightSail-B CONOPS

LV Separation & Detumble (2 hours)

Initial Acquisition & System Checkout (1 week)

CubeSat Deployment & Orbit Determination (2 weeks)

Rendezvous (1 week)

Proximity Operations (1 week)

Sail Deployment & Inspection (1 week)
LightSail-A Issues Resolved
(Partial List)

• **Hardware**
  – Re-design payload interface board (re-spin)
  – Upgrade and mod flight computer board
  – Upgrade and mod radio board
  – Replace blown radios
  – Re-tune/match and replace RF antenna
  – Fix camera housing interference
  – Stiffen solar panels

• **Software**
  – Major re-do of ACS CONOPS and software
  – Resolve various telemetry issues

• **Test**
  – Fix vibe failures of burn wire assembly
  – Deployment table facility

• **Ops**
  – Lower duty cycle of motor drive

  – Wire staking
  – Fastener staking
  – Mod burn wire install
  – Mod spectraline routing
  – Re-grease motor
  – Fix cracked cells
  – Fix solar panel switch
  – Work mode transitions
  – Fix motor drive counter
  – Breakout board issues
  – Ground tracking

2015 Apr 22
Spring CubeSat Workshop -- Cal Poly SLO
LightSail Schedule
(Since program pause in late 2011)

• 2012 Aug  Program resumption assessment
• 2013 Aug  Preliminary program review
• 2013 Dec  Program review – and resumption
• 2014 Jan-Aug LS-A build-up, mods, functional testing
• 2014 Sep   LS-A day-in-the-life test
• 2014 Oct-Nov LS-A system environmental testing
• 2014 Dec   LS-A Mission Readiness Review
• 2015 Jan   LS-A P-POD/ULTRASat integration; ship to Cape
• 2015 Apr   LS-A ORT-1 and ORT-2
• 2015 May   LS-A launch (expected)
• 2015 Jun   LS-A mission ops
• 2015 Jan-Dec LS-B I&T
• Mid-2016   LS-B launch (expected) and mission ops
LightSail-A Ready for Launch!

LightSail A: 4.93 kg
LightSail Information

• Intro
  – http://sail.planetary.org/

• Solar sail deployment (PSCAM view)
  – planet.ly/unfurl

• TPS updates by Jason Davis

• And talk to us at the Ecliptic booth!
  – Rex Ridenoure
  – Barbara Plante (Boreal Space)
  – Alex Diaz (Half Band Technologies)
  – Justin Foley (Cal Poly)
  – SWAG -- !