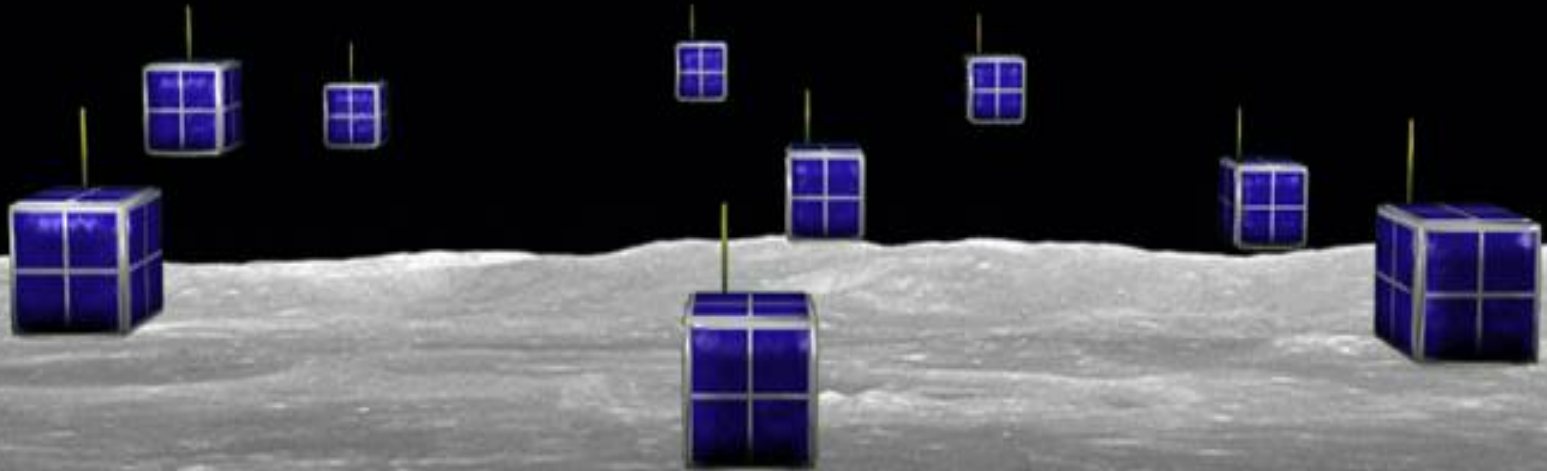# Stanford Lunar Analysis Mission: SLAM

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Stanford Amateur Radio Club

What is SLAM?

☐ Feasibility & preliminary design study

☐ Can we send CubeSats to the Moon?

Keypoints

- ☐ We *can* send CubeSats to the Moon
- ☐ Space Systems Development Lab (SSDL) future mission
- ☐ Low power CubeSats and high power, high gain carrier
- ☐ Hierarchical communication network

Motivation and Goals

Stanford on the Moon

- ☐ Stanford alumni organization
- ☐ Customer Goals
  - ◼ Multidisciplinary mission in next decade
  - ◼ Expand Stanford capabilities in space
  - ◼ Stanford initiative
  - ◼ Garner attention and fundraising for SOM future missions to establish Stanford presence on Moon

Lunar Mission Goals

- Satellite mission to Moon in next five years
- Collect data to further human missions
- Broadcast back to Earth
  - Beat Cal!
- Stanford science & engineering involvement

Images courtesy of Stanford Magazine

Lunar Mission Statement

- ☐ To design lunar satellite missions that can be carried out in large part by the Stanford community

- ☐ Determine existing Stanford infrastructure and capabilities

Image courtesy of www.stanford.edu

Why Do It?

- ☐ Educational opportunity
- ☐ Extend university capabilities in space
- ☐ Gather data about the moon
- ☐ Outreach tool
- ☐ PR opportunity for Stanford
- ☐ Increase public interest in space
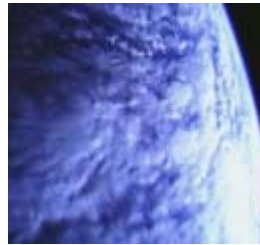- ☐ Competition
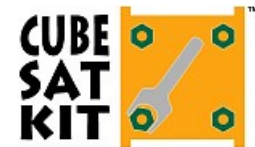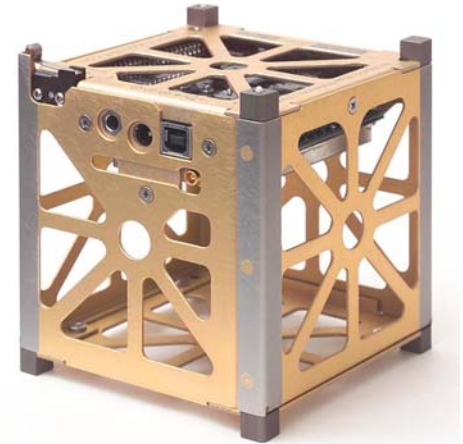- ☐ To have FUN!!

Lunar Mission

Lunar Mission

- ☐ 6 CubeSats
- ☐ Carrier
  - ■ Hybrid Engine
- ☐ Launch Vehicle
  - ■ Δv ~ 7.7km/s
- ☐ Swing-by Mission
  - ■ Δv ~ 3.1km/s
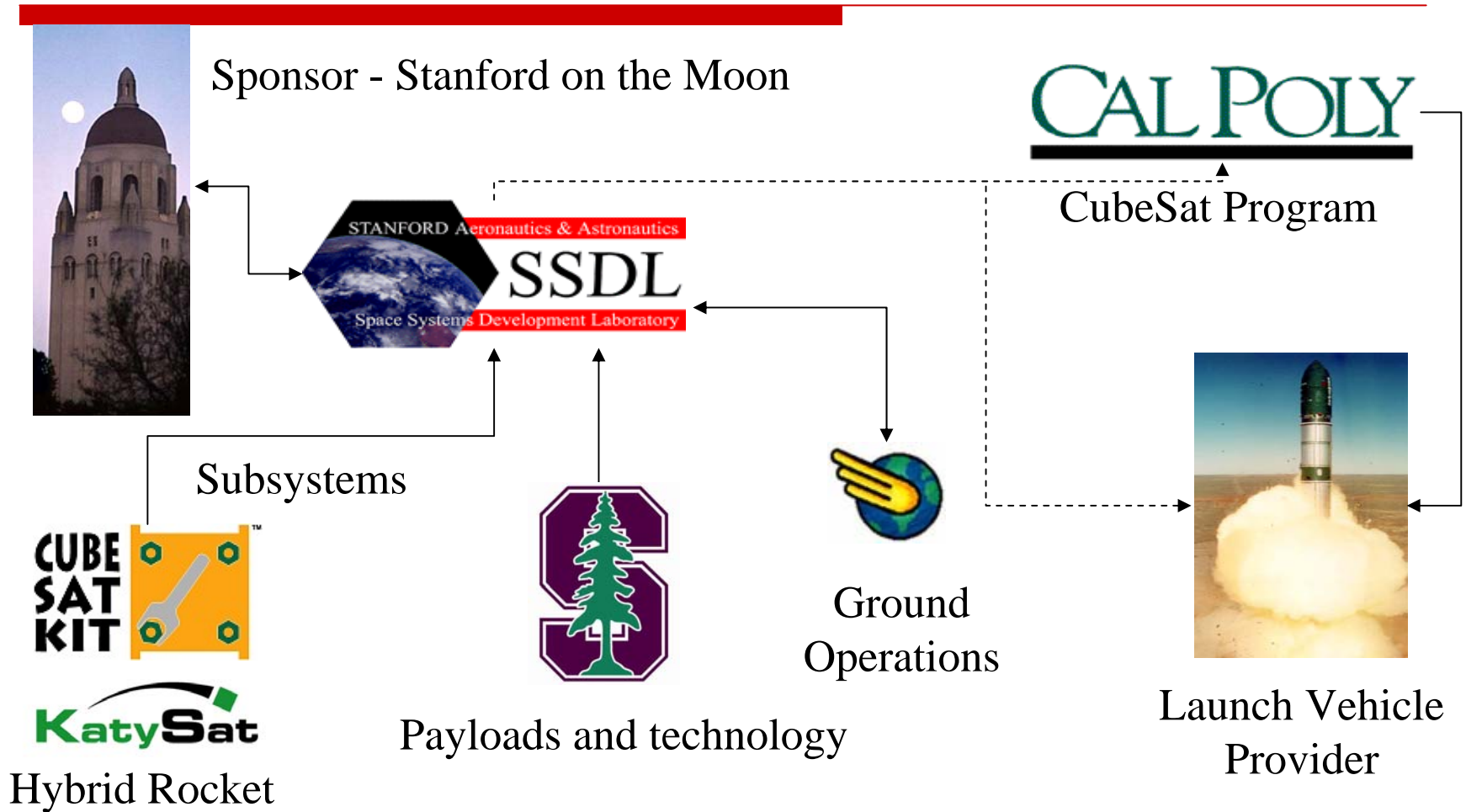- ☐ Cost
  - ■ ~$2 million

Courtesy of www.asi.org
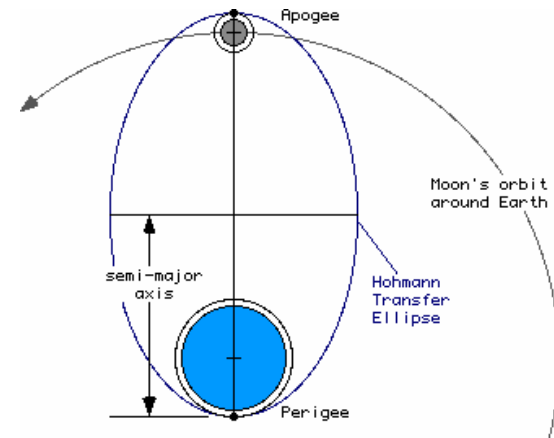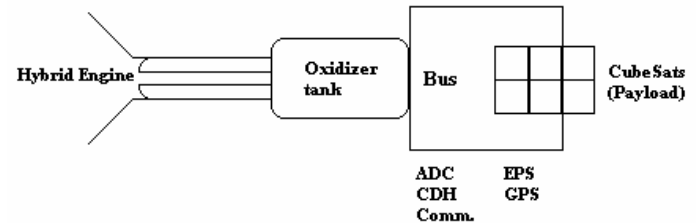
CubeSats

- Volume: 10 x 10 x 10 cm^3
- Mass ~ 1 kg
- Power ~ 1 W
- CubeSat Kit
- Advantages:
  - Lost cost (KISS)
  - Fast turnaround
  - COTS
- Prevalence: 70 universities worldwide
  - Successes: ~10 launches

Mission Organization

Sponsor - Stanford on the Moon

CAL POLY

CubeSat Program

SSDL
STANFORD Aeronautics & Astronautics
Space Systems Development Laboratory

Subsystems

CUBE SAT KIT

KatySat

Hybrid Rocket

Payloads and technology

Ground Operations
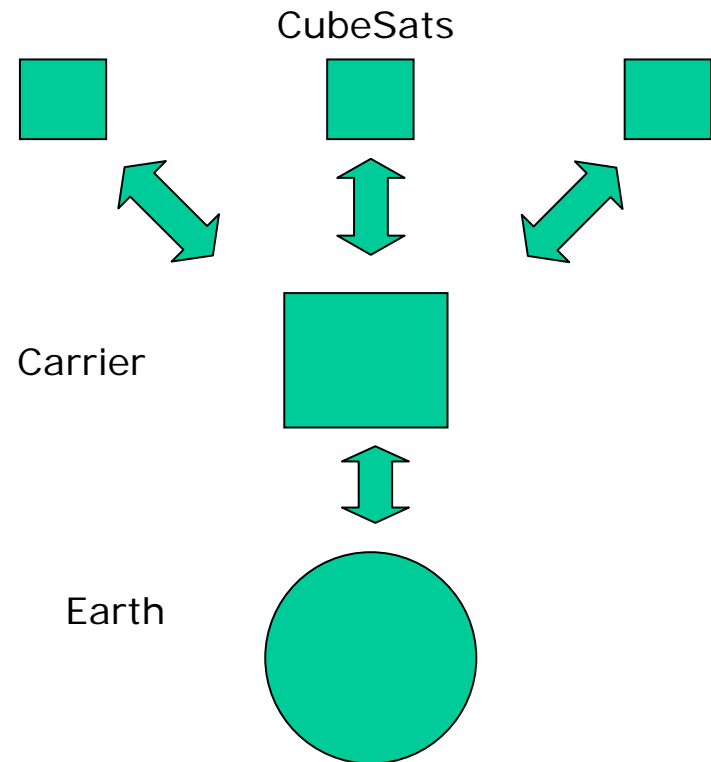
Launch Vehicle Provider

Adapted from KatySat.org

Communication

- ☐ Architecture
  - ■ Earth-Moon distance ~ 384,000km
  - ■ Carrier-Earth
    - ☐ High power, high gain carrier
    - ☐ Attitude control
  - ■ Local to Moon
    - ☐ Low power CubeSats and carrier

CubeSats

Carrier

Earth

Communication

- ☐ Sat ➡ Carrier ➡ Ground
    - ■ Routine reporting in cyclic order
    - ■ Local IP networking
    - ■ FIFO queuing of messages
    - ■ Message flagging
    - ■ Carrier onboard processing/direction
- ☐ Ground station networks
    - ■ Mercury network
    - ■ Purchase time
- ☐ Memory issues
    - ■ Orbit vs. quick flyby storage requirements

Summary

- ☐ Feasible lunar CubeSat mission
- ☐ Preliminary mission design
- ☐ Hierarchical communication network

- ☐ *Let's get to work!*

Thank you!

Questions?

For more info
            http://ssdl.stanford.edu
        http://www.stanford.edu/~kldavis/SLAM