

Status of technology demonstration for a Drag-free CubeSat

10TH ANNUAL SUMMER CUBESAT DEVELOPERS' WORKSHOP –
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مدينة الملك عبدالعزيز
للعلوم والتقنية KACST



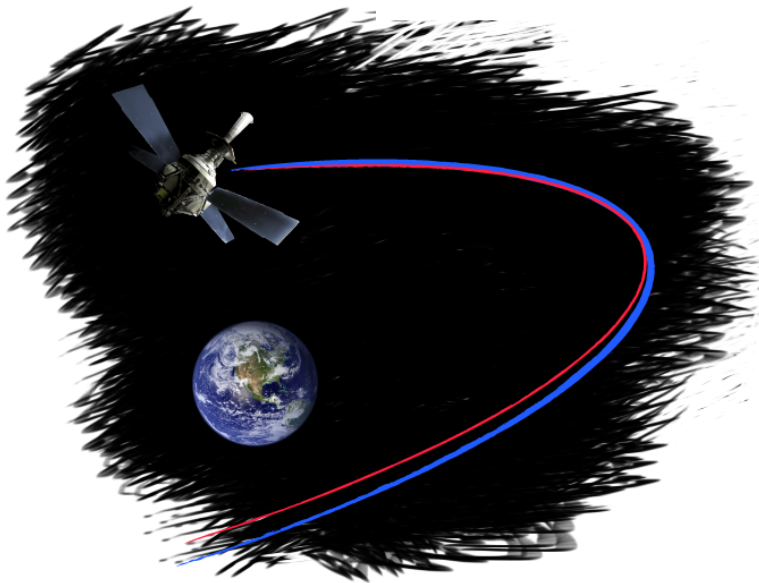
UF | UNIVERSITY of
FLORIDA

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Physics Laboratory

Drag-free Satellite

GOAL

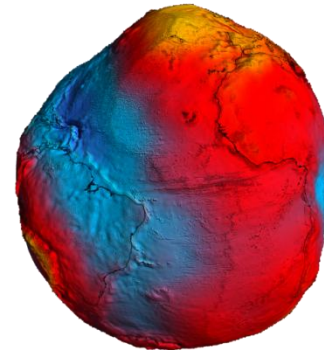
- Cancel deviation from geodetic orbit



APPLICATIONS

- Geodesy
- Aeronomy
- Autonomous orbit determination
- Fundamental Physics

See also talk by
John Conklin at 4:45pm

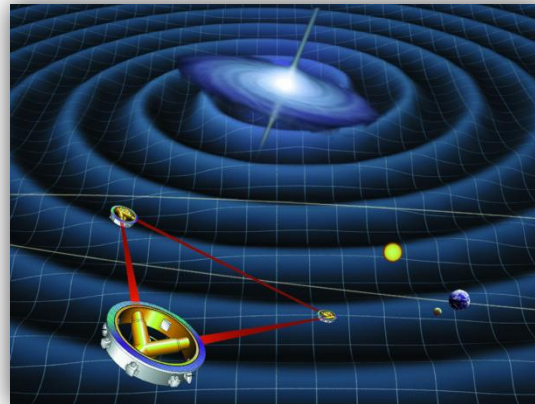
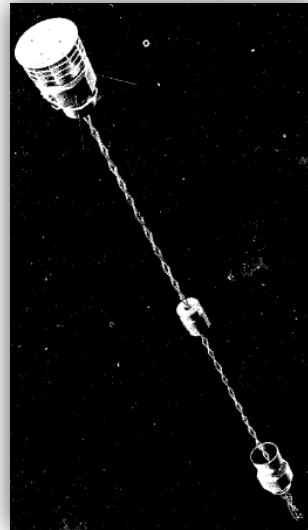


Drag-free History

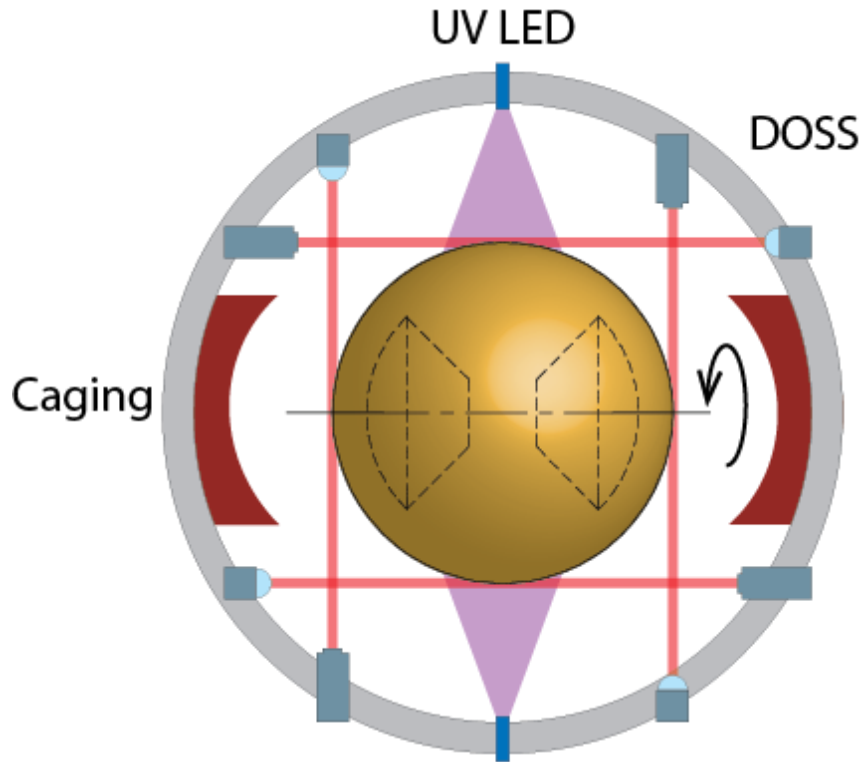
- TRIAD I (1972)
- GRACE (2002)*
- Gravity Probe B (2004)
- GOCE (2009)

- Planned:
 - LISA Pathfinder
 - LISA

* Accelerometer only



Modular Gravitational Reference Sensor



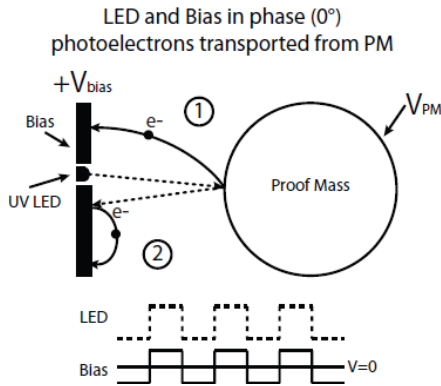
- Differential Optical Shadow Sensor (DOSS) to sense external disturbances
- UV LED for Charge Management to compensate internal disturbance
- Caging Mechanism designed for 200N holding force
- Spinning sphere for spectral shift of disturbances

UV LED

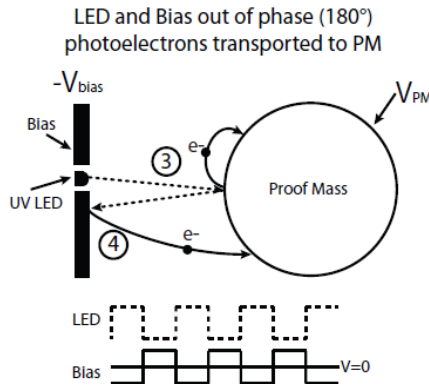


UV LED Charge Management

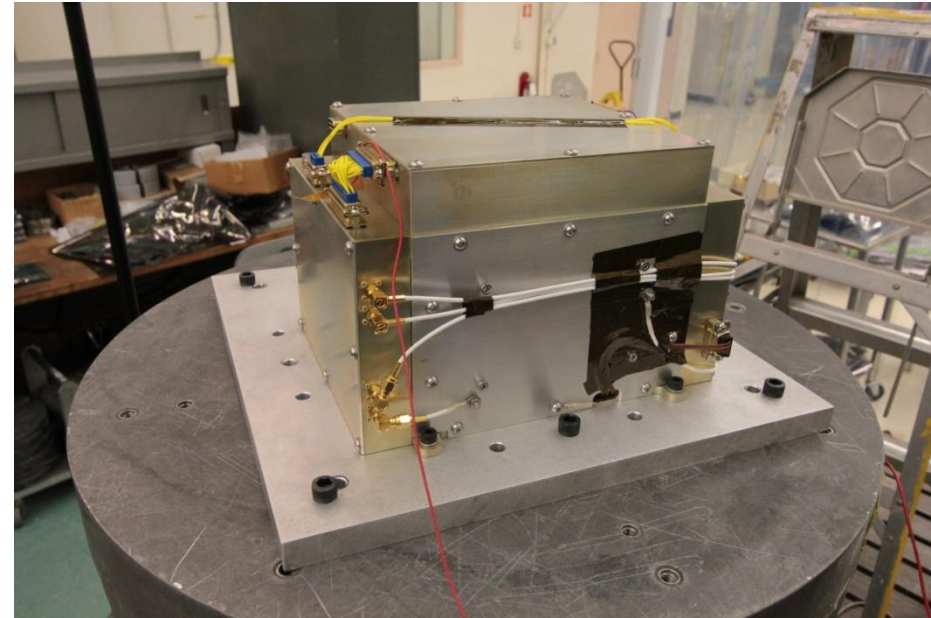
- To be launched March 2014 on Saudi Sat
- Flight System is in build right now
- Shown is engineering model on vibration table

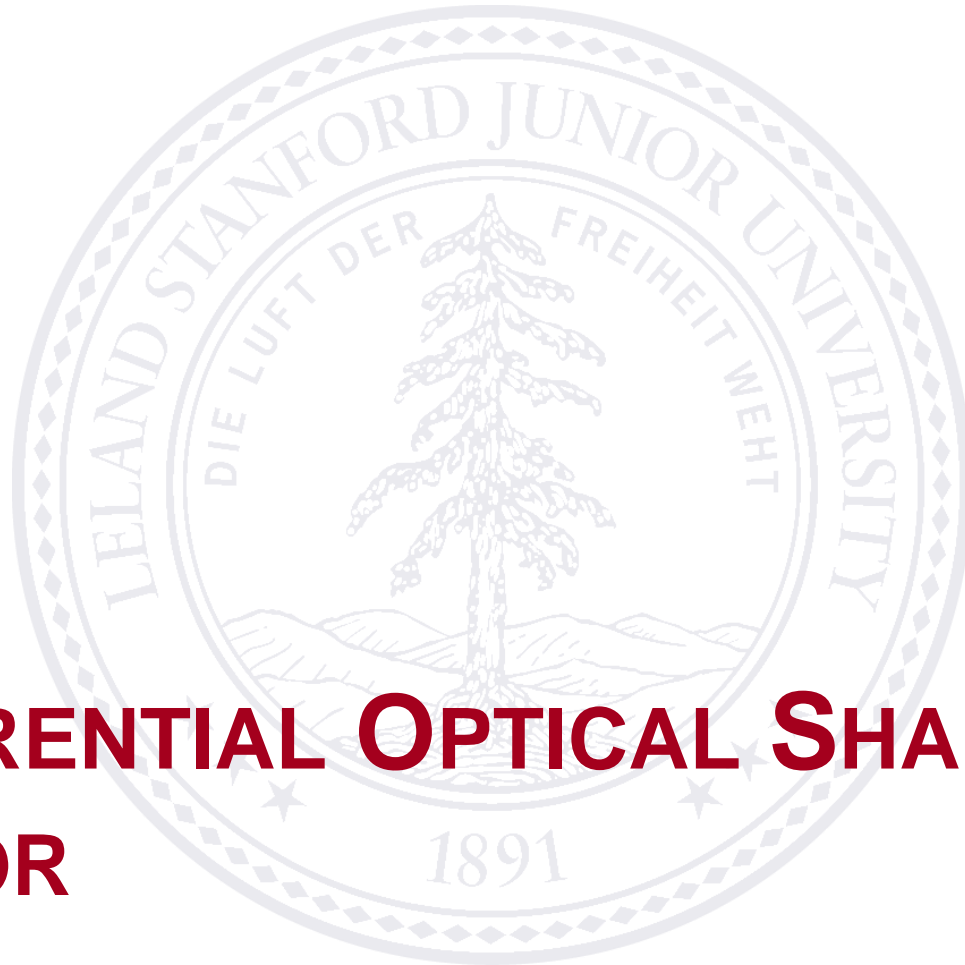


“Positive
Charge
Transfer”



“Negative
Charge
Transfer”

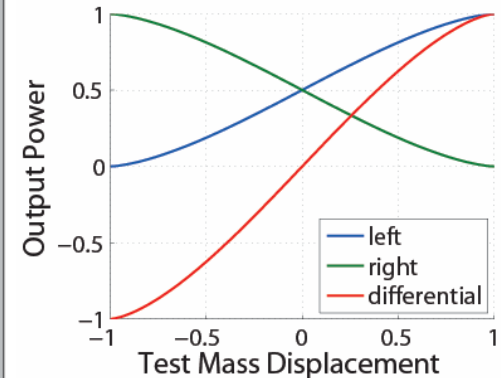
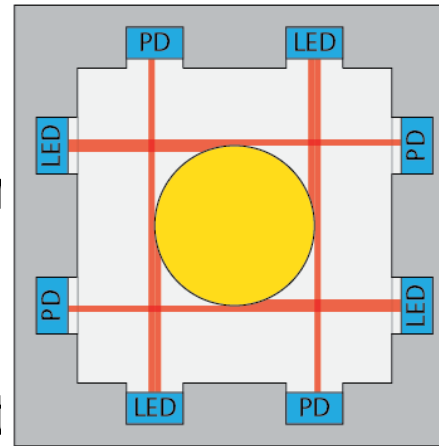




DIFFERENTIAL OPTICAL SHADOW SENSOR

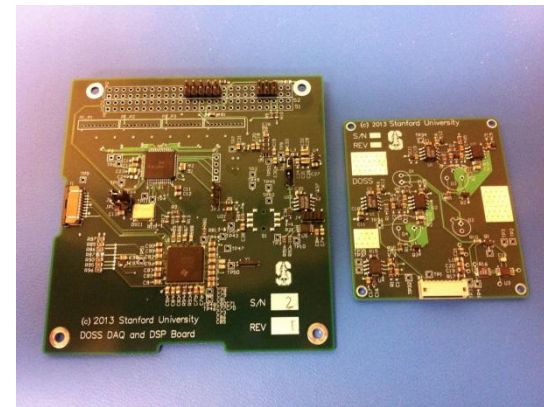
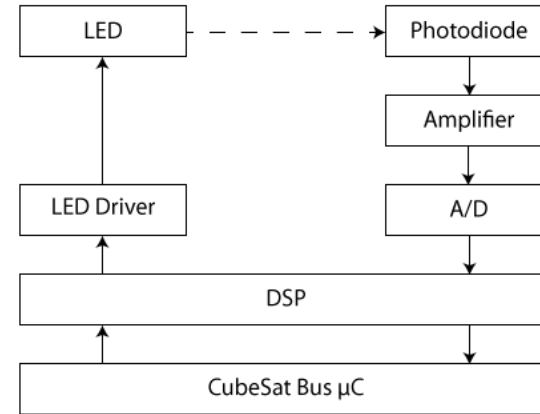
Differential Optical Shadow Sensor (DOSS)

- Precision displacement measurement
- Designed for 1nm resolution at 10mHz-1Hz
- 8 balanced beams for redundant 3D measurement

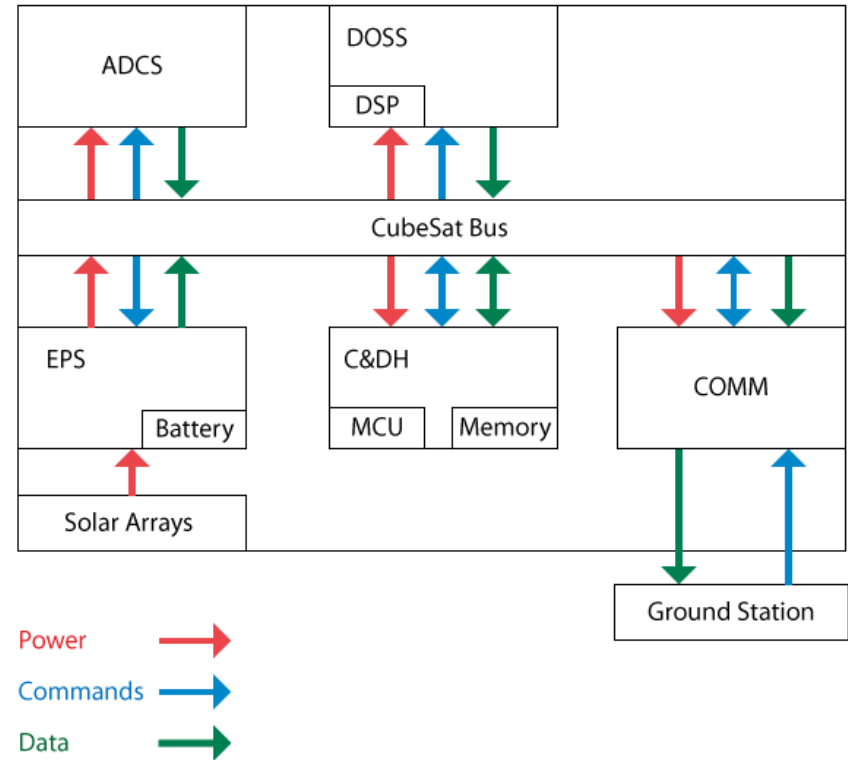
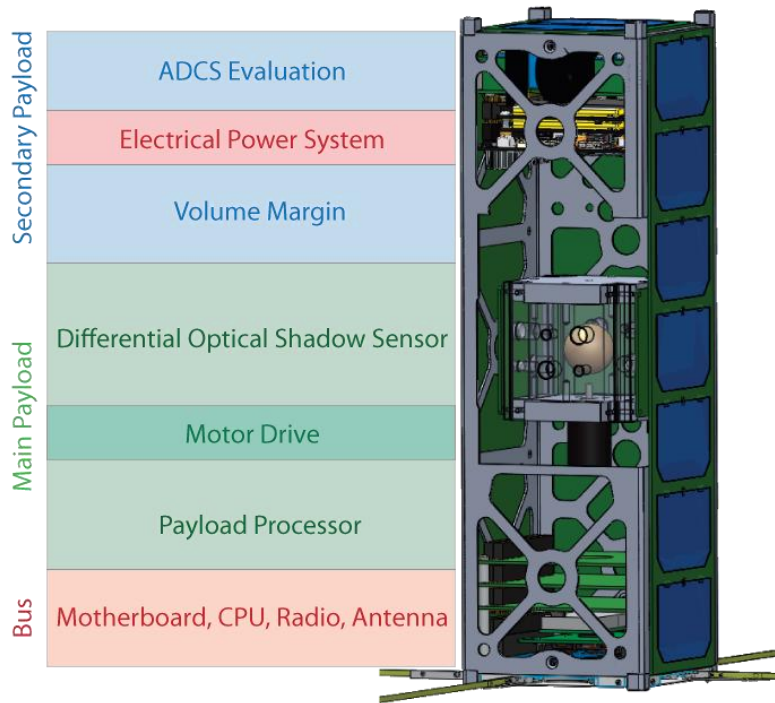


DOSS Electronics

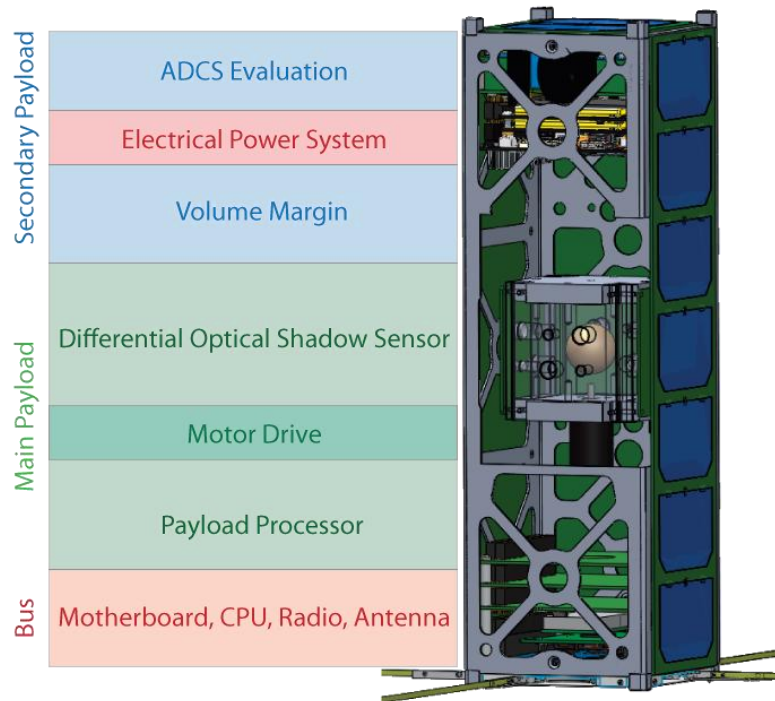
- Low noise amplifier
- 8 channel 24 bit ADC
- DSP payload computer
- Digital lock-in amplification
- Low power design



DOSS Technology Demonstration Satellite



DOSS Technology Demonstration Satellite



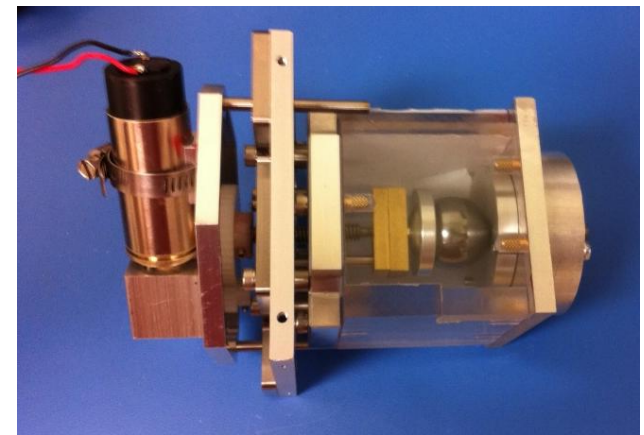
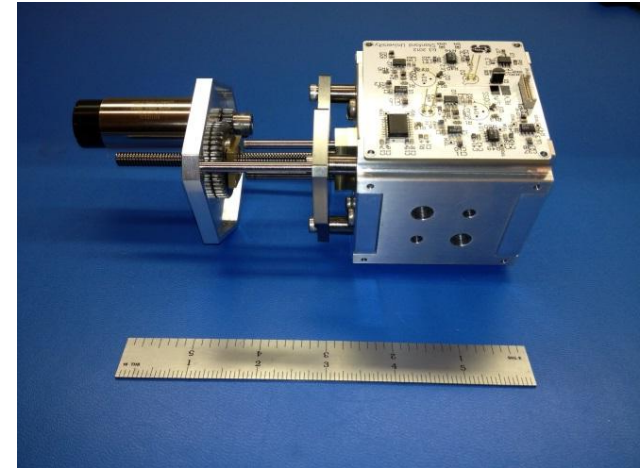
- 3U CubeSat
- Designed for 1nm resolution at 10mHz-1Hz
- Raise Technology Readiness Level (TRL)
- Test Attitude Control Algorithms
- Educate graduate and undergraduate students
- Completion: 2014
- Selected for ELaNa



CAGING MECHANISM

Caging Mechanism

- Lock Test Mass during launch
- Release in orbit with low relative velocity
- Housing for thermal and magnetic isolation

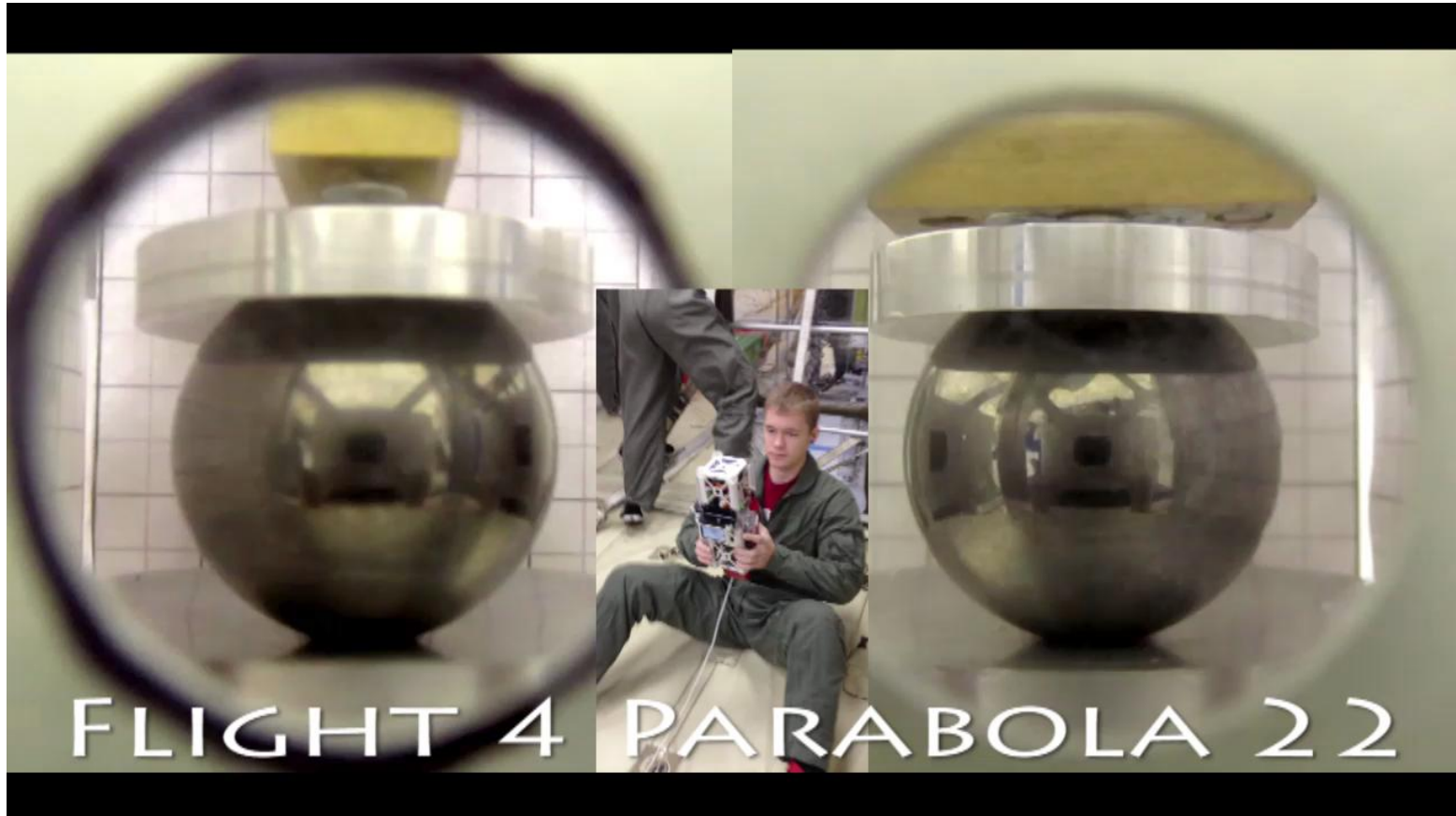


Microgravity test on Parabolic Flight

- August 2012: Learned about NASA Flight Opportunities program at SmallSat Conference
- September 2012: Proposal submitted
- January 2013: Proposal selected
- April 2013: Experiment flown



Test Mass Uncaging Experiment

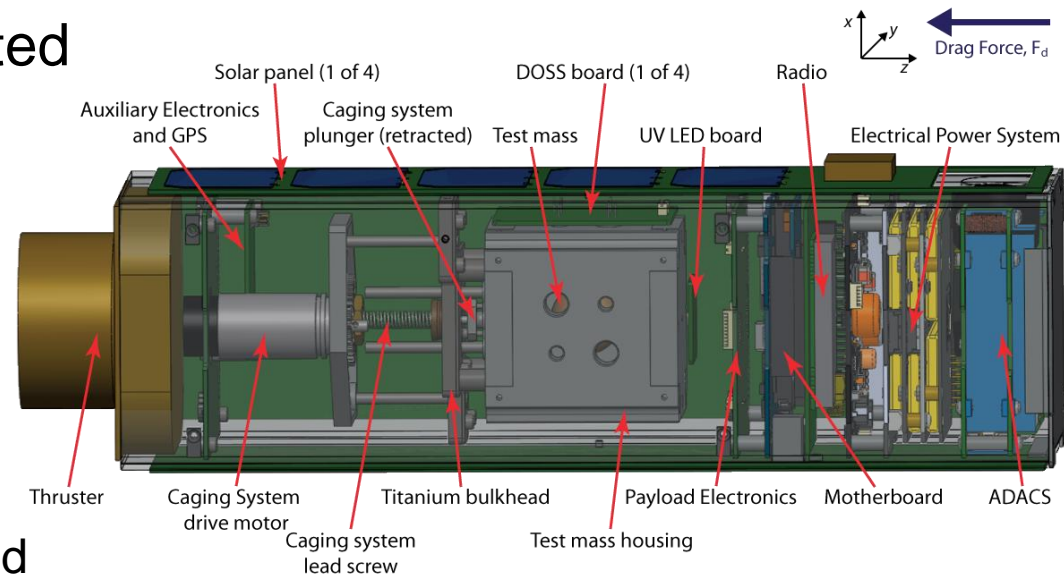




THE DRAG-FREE CUBESAT

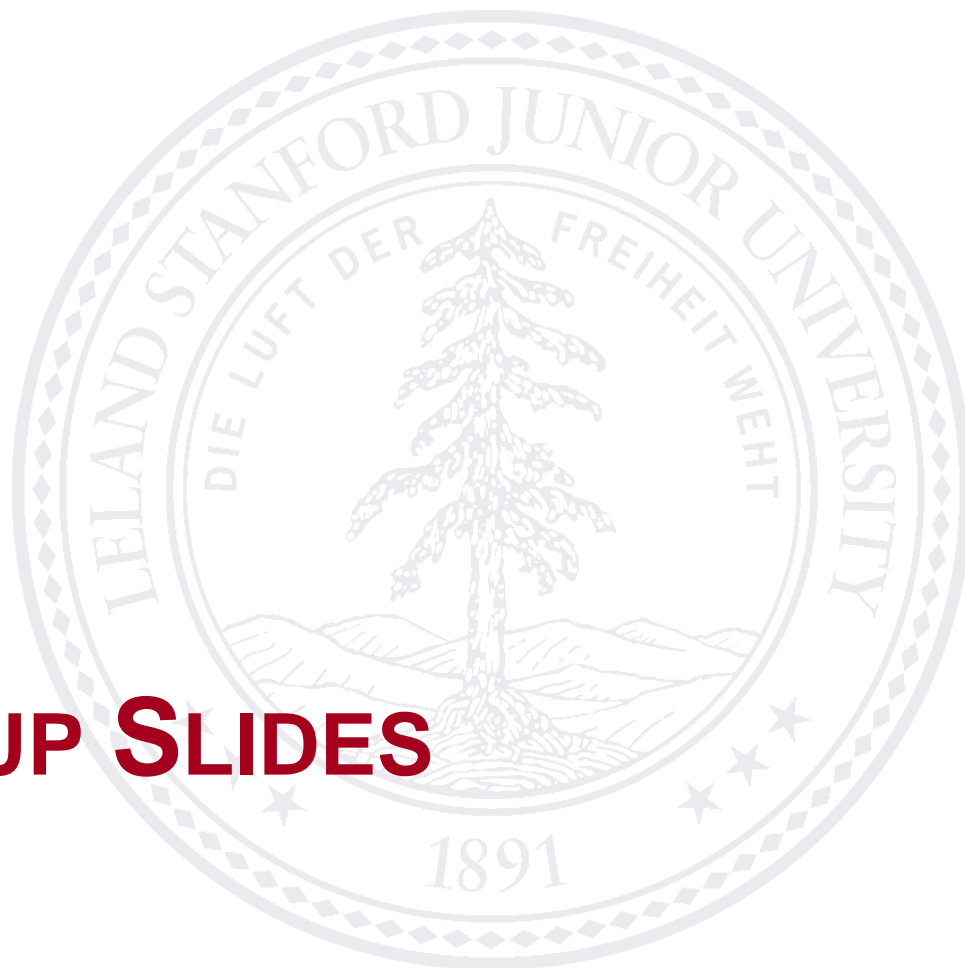
The Drag-free CubeSat

- 3U CubeSat
- Demonstrate fully integrated MGRS
- 2y development time
- Areas of research:
 - Drag-free control algorithm
 - In-orbit performance evaluation
 - Environmental modeling and optimization (thermal, electromagnetic)



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BACKUP SLIDES

Zero G Flight

