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Propulsion Integration

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Cal Poly CubeSat Workshop 2019

AD's Propulsion Experiences

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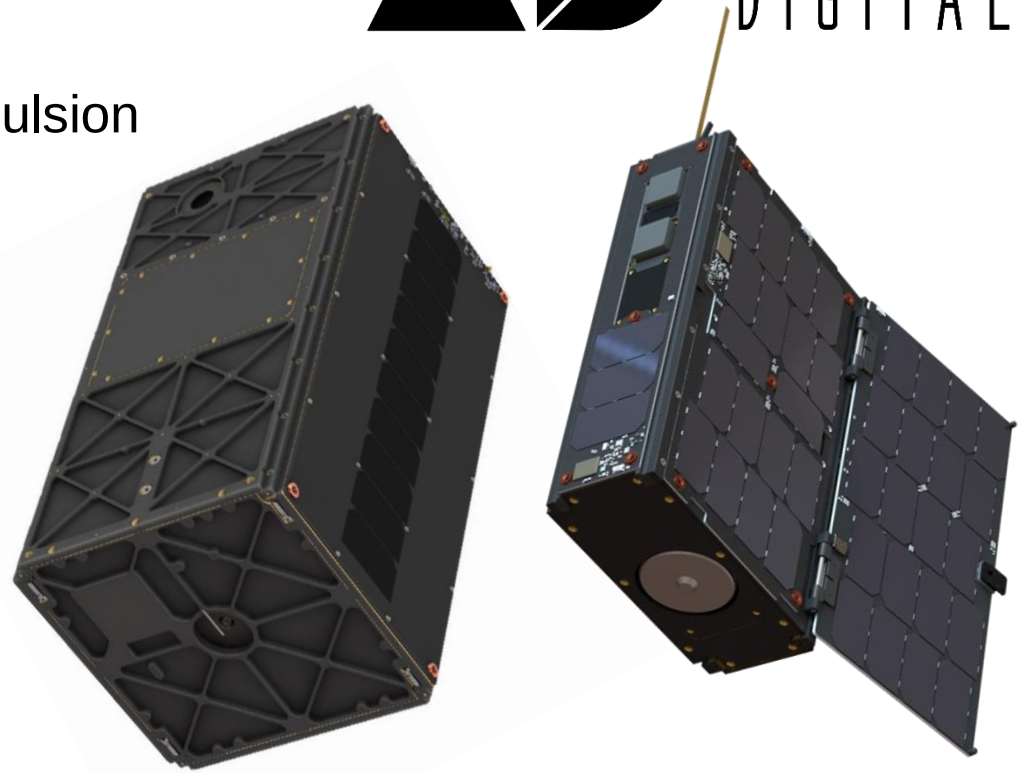
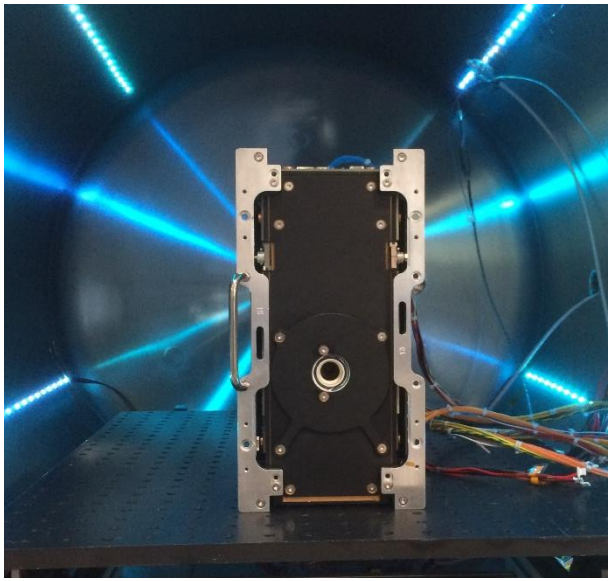
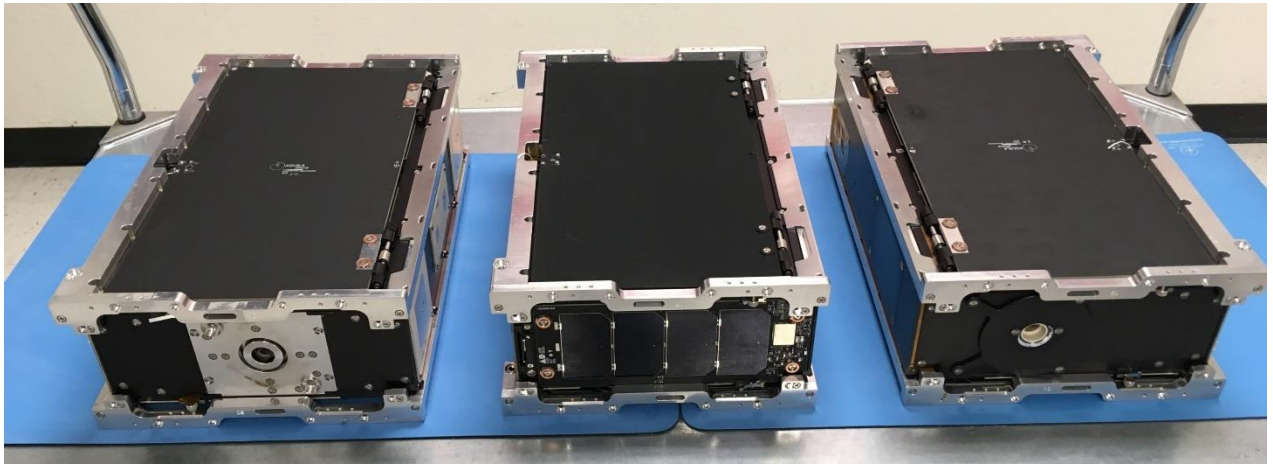
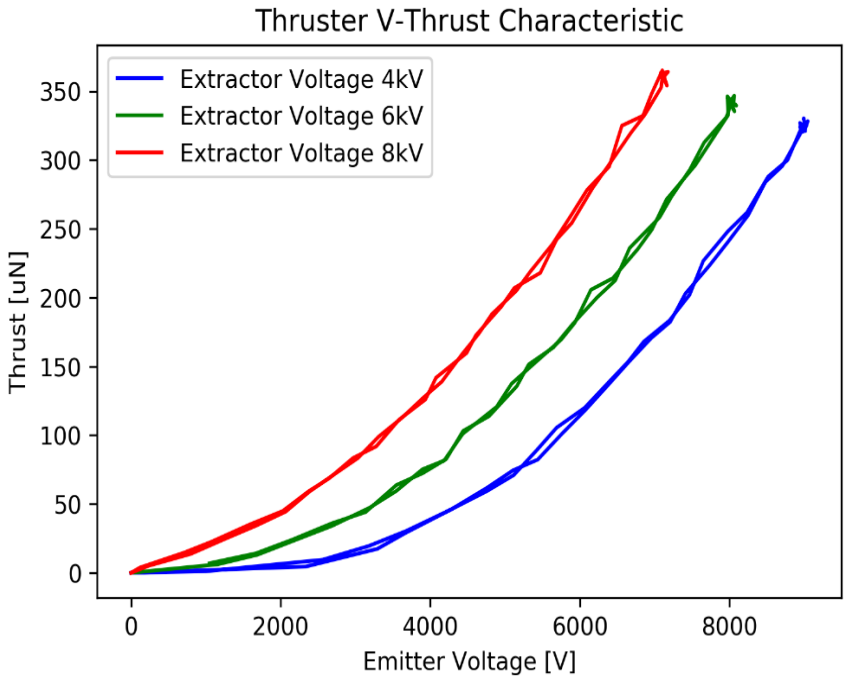
- Field Emission Electric Propulsion (FEEP)
- Hall Effect Thruster
- Microwave Water Thruster
- RF Plasma Thruster

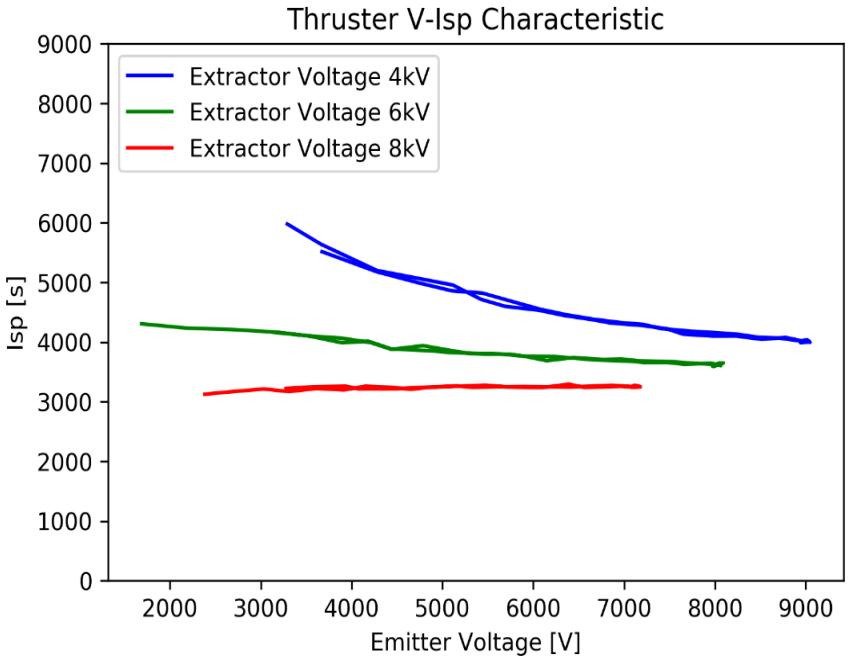






FEEP Thrust Data





- Thrust and specific impulse vs emitter voltage
- Enpulsion-equipped spacecraft is the first on-orbit for AD

Momentum Management

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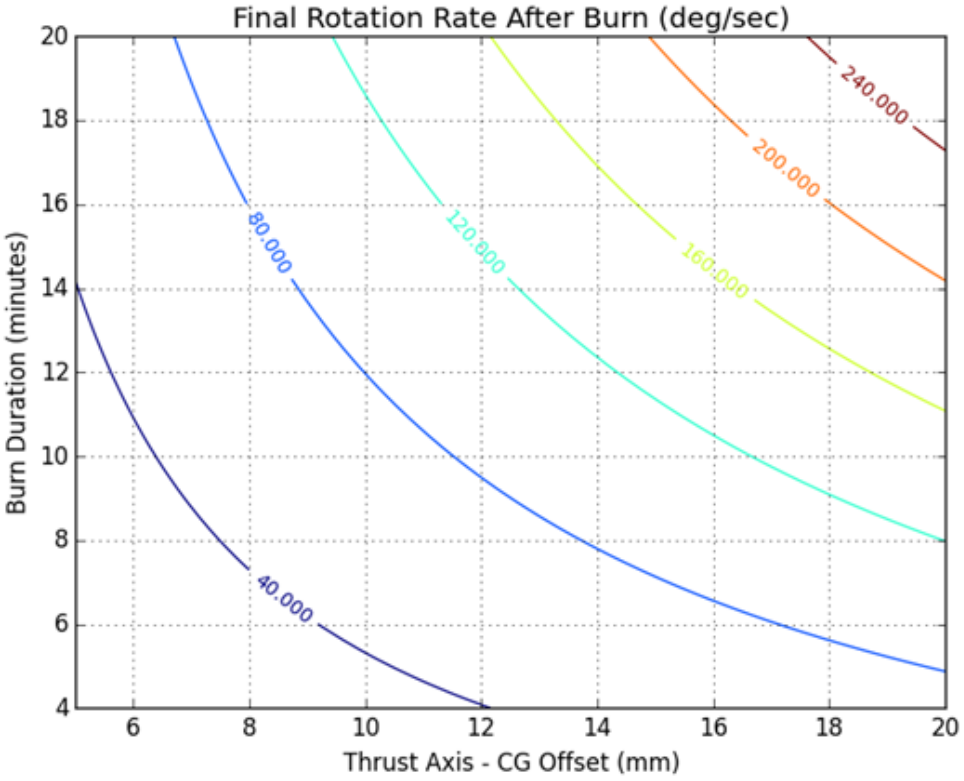
- Off-axis thrusting torque can quickly saturate CubeSat momentum systems
- Mitigation Options:
  - Align thrust axis with CG (still have thrust angle offset issues)
  - Shorter firings followed by desaturation
  - Include RCS thrusters
  - Thrust vectoring



Permanent Magnets

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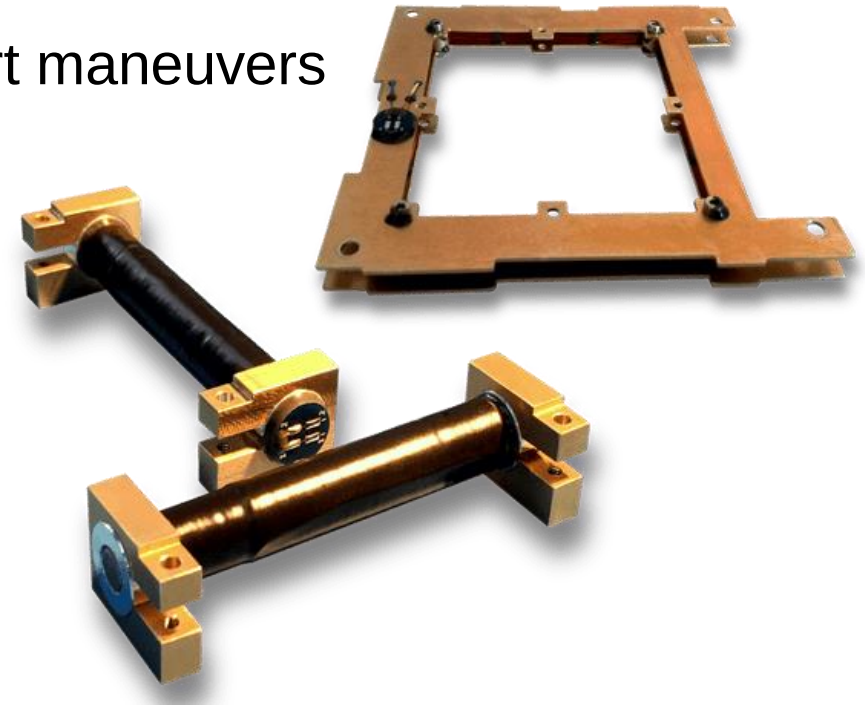
- Corvus bus 3-axis counteract capability:
  - 0.02 Am^2 standard
  - 0.4 Am^2 with supplemental torquers
- Mitigation options:
  - 100% 3 axis control
  - Magnetic clocking
  - Magnetic pointing with short maneuvers
  - Magnetic lock



Peak Power

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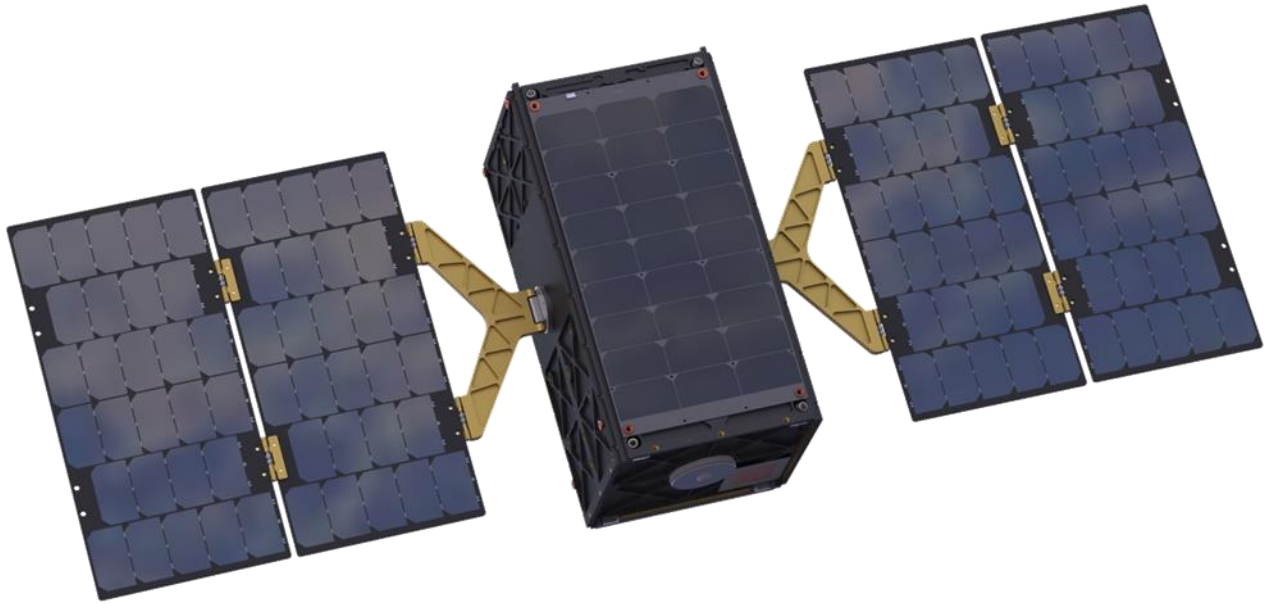
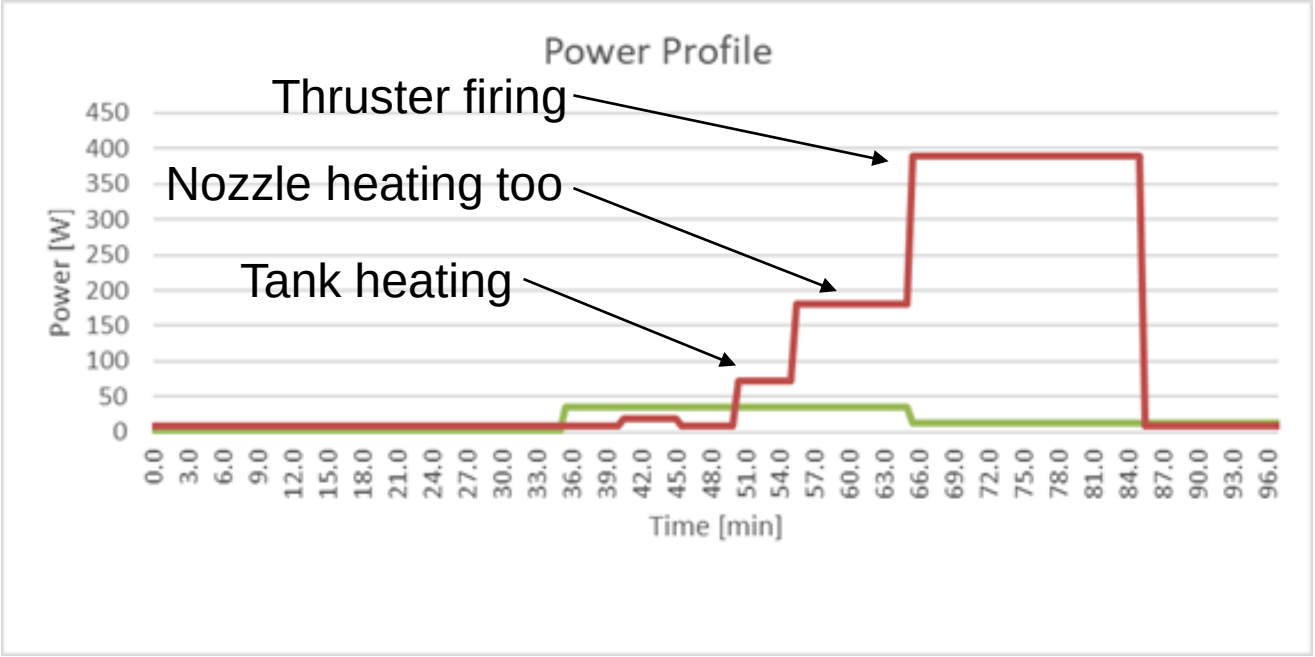
- High power and voltage challenges
  - > 36 volts and 400 watts at high end
- Mitigation options:
  - Separate high voltage thruster battery
  - Direct power supply (off solar arrays)
  - Thick copper from 3.7V bus to high power converter



Orbit Average Power

- With EP, more power = faster maneuvers
- System integrator fallacy: Look at thrusting power consumption → derive thrust/watt → make a design choice
- But all propulsion systems have some form of "pre-heat"!



Trajectories

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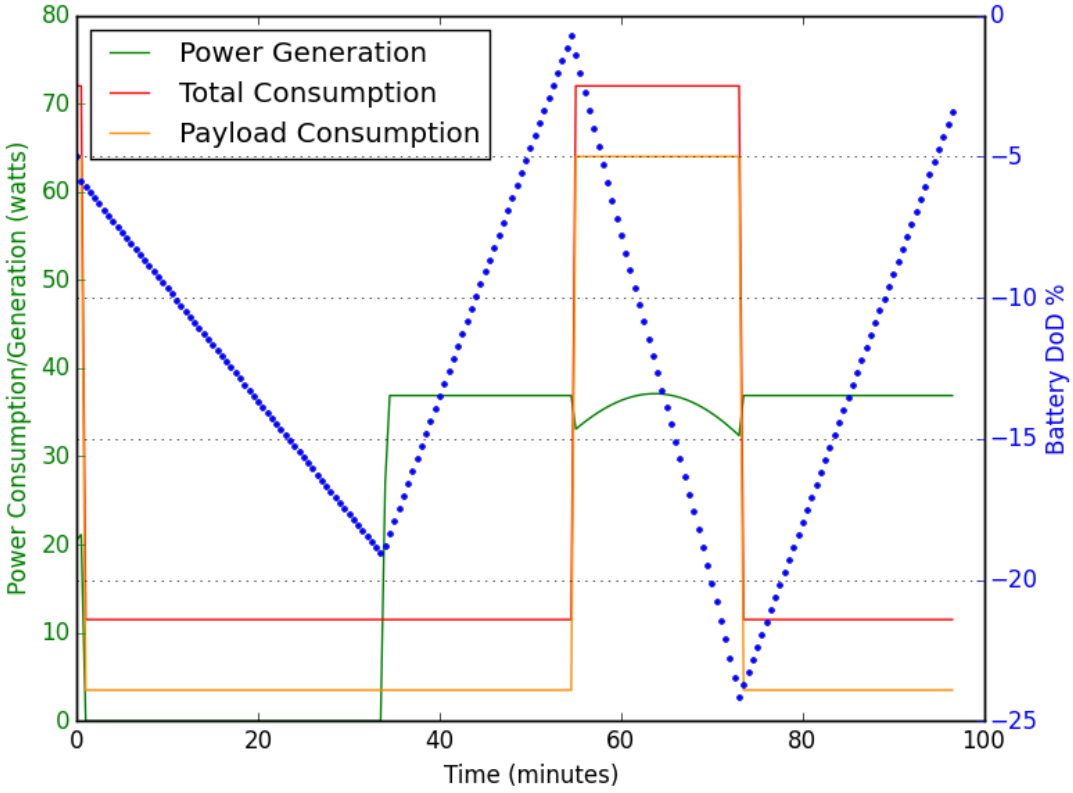
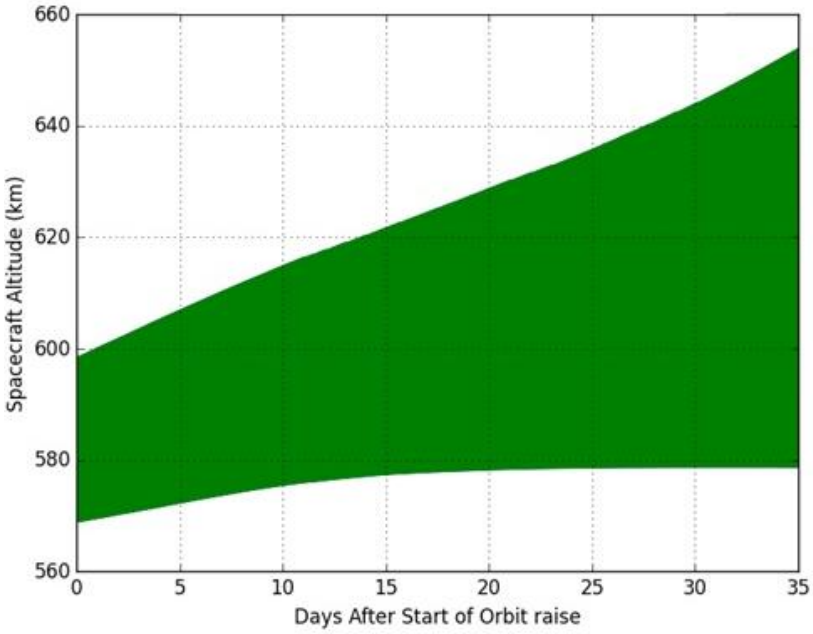
- “Low Thrust” or 100’s of Hohmanns
- Apogee Precession
- Maximize sun exposure + Minimize battery use





Maneuver Planning with CSpOC

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- Help CSpOC help you!
- Provide Maneuver Notifications through API
- All info in the Spaceflight Safety Handbook for Operators
  - https://www.space-track.org/documentation/#faq

Pretty Pictures from Corvus-BC

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- Not what you came for
- so sorry
- I want to show off anyways