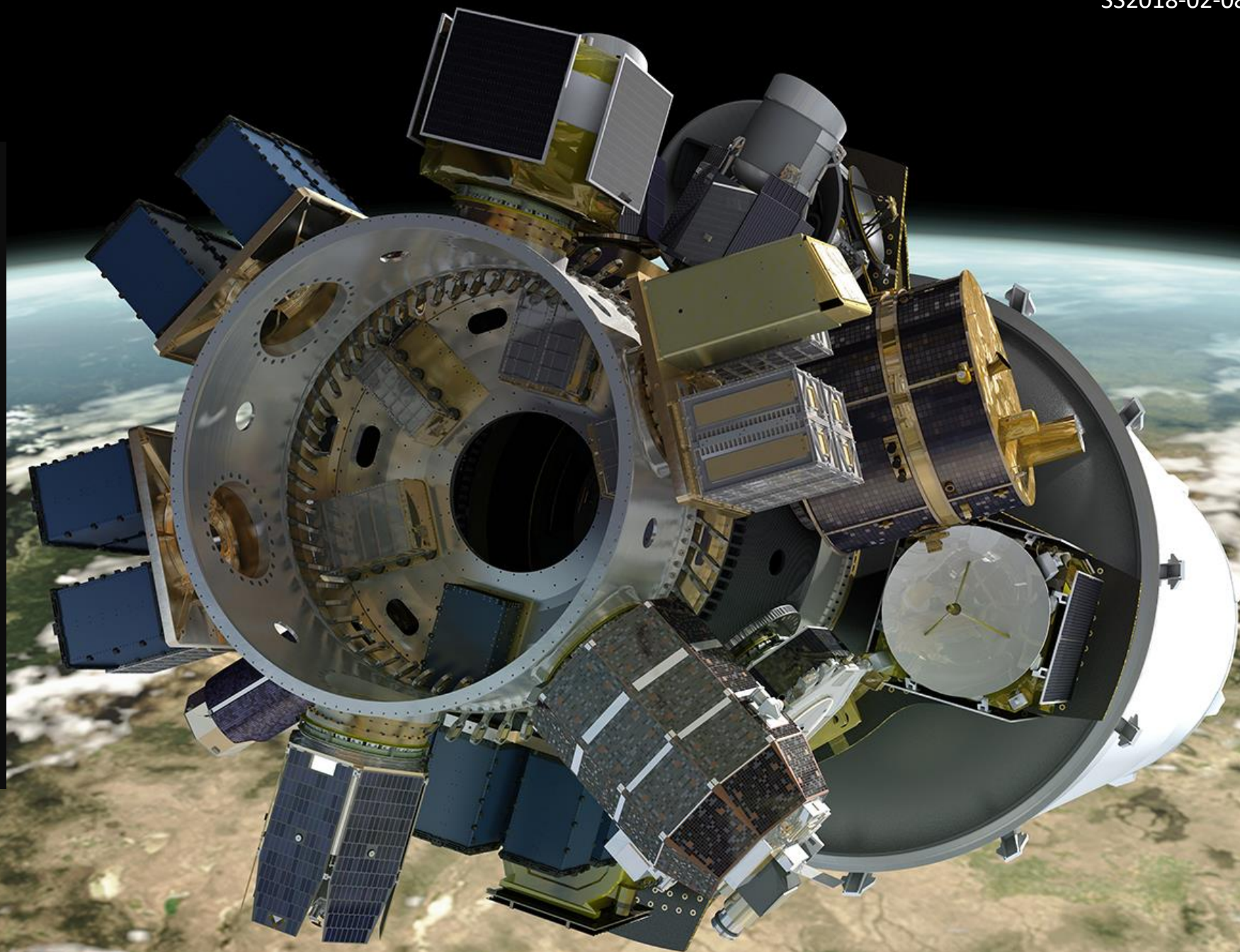


Spaceflight Update

CubeSat Workshop

23 April 2019



What's Up with Spaceflight?

- **2018 – The Year of the ‘SmallSat Express’**
 - **4 missions with 95 spacecraft deployed (79 CubeSats)**
 - 12 Jan: PSLV C40 (1-Micro, 1-6U, 11-3U, 2-1U, 4-0.25U)
 - 21 May: Cygnus OA-9 (2-3U)
 - 29 Nov: PSLV C43 (1-Micro, 1-6U, 8-3U, 1-2U, 1-1U)
 - **3 Dec: SSO-A (15-Micros, 49 CubeSats)**
- **2019 – More Missions, But Smaller Bites!**
 - **17 Missions Planned for 2019: 2 Complete, 15 to Go!**
 - *21 CubeSats so far*
 - **21 Feb: GTO-1 – First GTO and GEO Rideshare**
 - 1 April: PSLV C45 (1-3U, 20-3UXL)
 - More to come....



PSLV C40



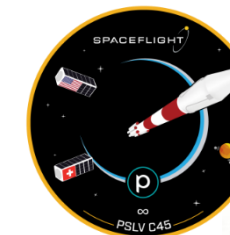
PSLV C43



F9 SSO-A



F9 GTO-1



PSLV C45

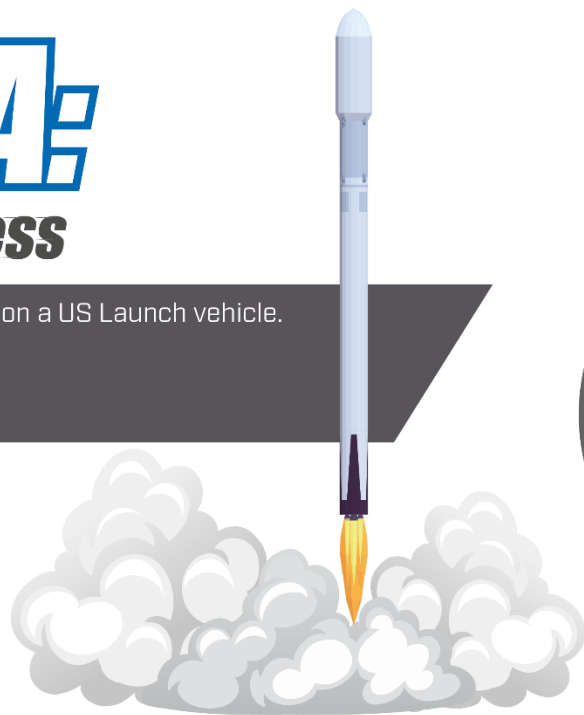


Spaceflight Totals to Date: 247 Total Spacecraft launched, 225 CubeSats

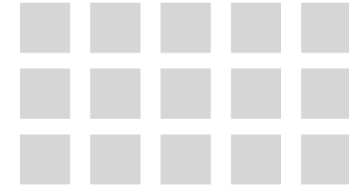
SSO-A: Smallsat Express

Single largest dedicated rideshare mission on a US Launch vehicle.

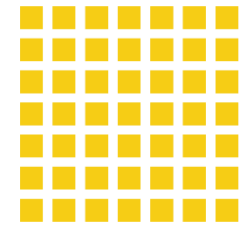
Launch Vehicle: SpaceX Falcon 9
 Launch Site: Vandenberg Air Force Base
 Destination: Sun Synchronous Lower Earth Orbit



Microsats: 15

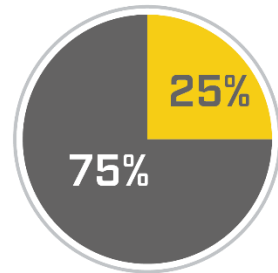


Cubes: 49

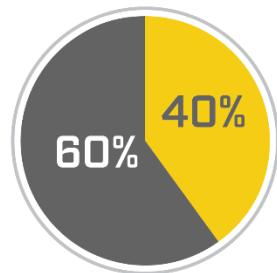


Parameter	Osculating Value at Descending Node
Perigee	584 km
Apogee	584 km
Inclination	97.75 deg
LTDN	10:30 AM

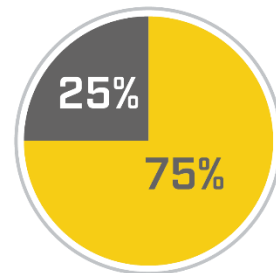
Countries represented: 17



■ First time customers ■ Return customers



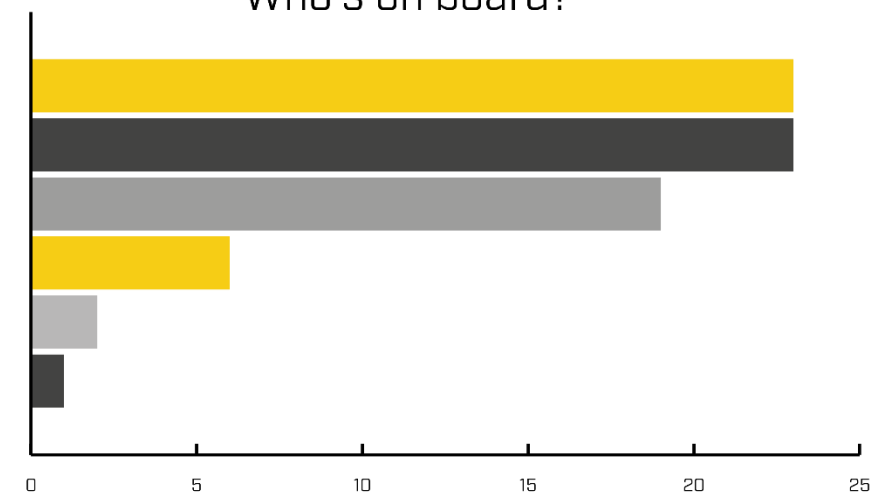
■ International ■ Domestic



■ Commercial ■ Government

- University spacecraft
- Tech demonstrations
- Imaging spacecraft
- Communication spacecraft
- Art exhibits
- High school spacecraft

Who's on board?

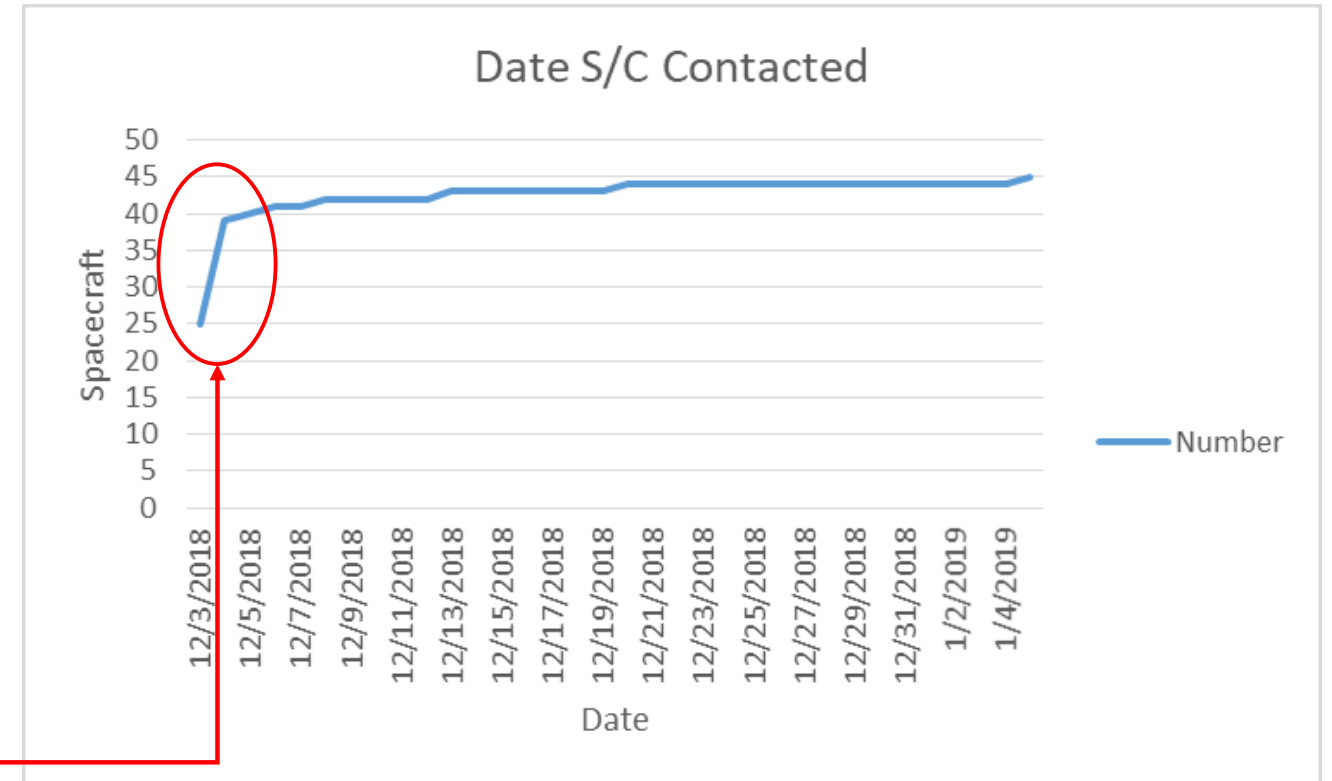


Notable Spacecraft

Spacecraft Separation and Contacts

Spacecraft Type	Number	Spacecraft not contacted by customer
Micro	15	0
Cubesats	49	4

- 94% (60 of 64) spacecraft reported contact by their owner
- 87% (56 of 64) of spacecraft reported contact within 24 hours after launch
- 100% of Objects Accounted for by CSPoC
 - 19 Spacecraft Remain Unidentified
 - 12 are non-US
 - It is contingent on spacecraft owner to coordinate with CSPoC for ID



- 100% deployment of all customers
- 94% of all spacecraft contacted
- CSPoC has Accounted for All Spacecraft

GTO-1: The First Rideshare to GTO & GEO...and beyond!

- **1st Rideshare on Commercial GEOSat**
 - Two spacecraft on top of commercial SSL GeoSat Nusantara Satu
 - SpacEL Beresheet Lunar Lander Separated into GTO orbit
 - AFRL S5 Spacecraft 'hitch-hiked' a ride to above-GEO on SSL GeoSat
- Beresheet performed orbit raising to TLI, lunar orbit capture, and landing attempt
- AFRL S5 Deployed into near-GEO prior to primary GEOSat settling into operational orbit



SpacEL Beresheet Lunar Lander

AFRL S5 Experimental Spacecraft (Enclosed in Cone Below Beresheet)

SSL Maxar Nusantara Satu GEOSat



Forecone Deployment into above GEO 'Graveyard' orbit - Exposed S5 prior to deployment



What's Coming Up for Spaceflight?

- 15 More Launches Planned for 2019
 - 3+ Rocket Lab Electrons
 - Arianespace Vega
 - More PSLVs
 - Above-ISS CubeSat deployment via SEOPS Slingshot



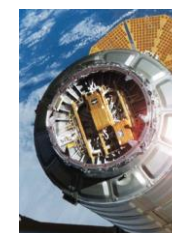
Electron



Vega



PSLV



Slingshot

- Spaceflight is working with most new launch vehicles
 - Vector
 - Virgin Orbit
 - Others....



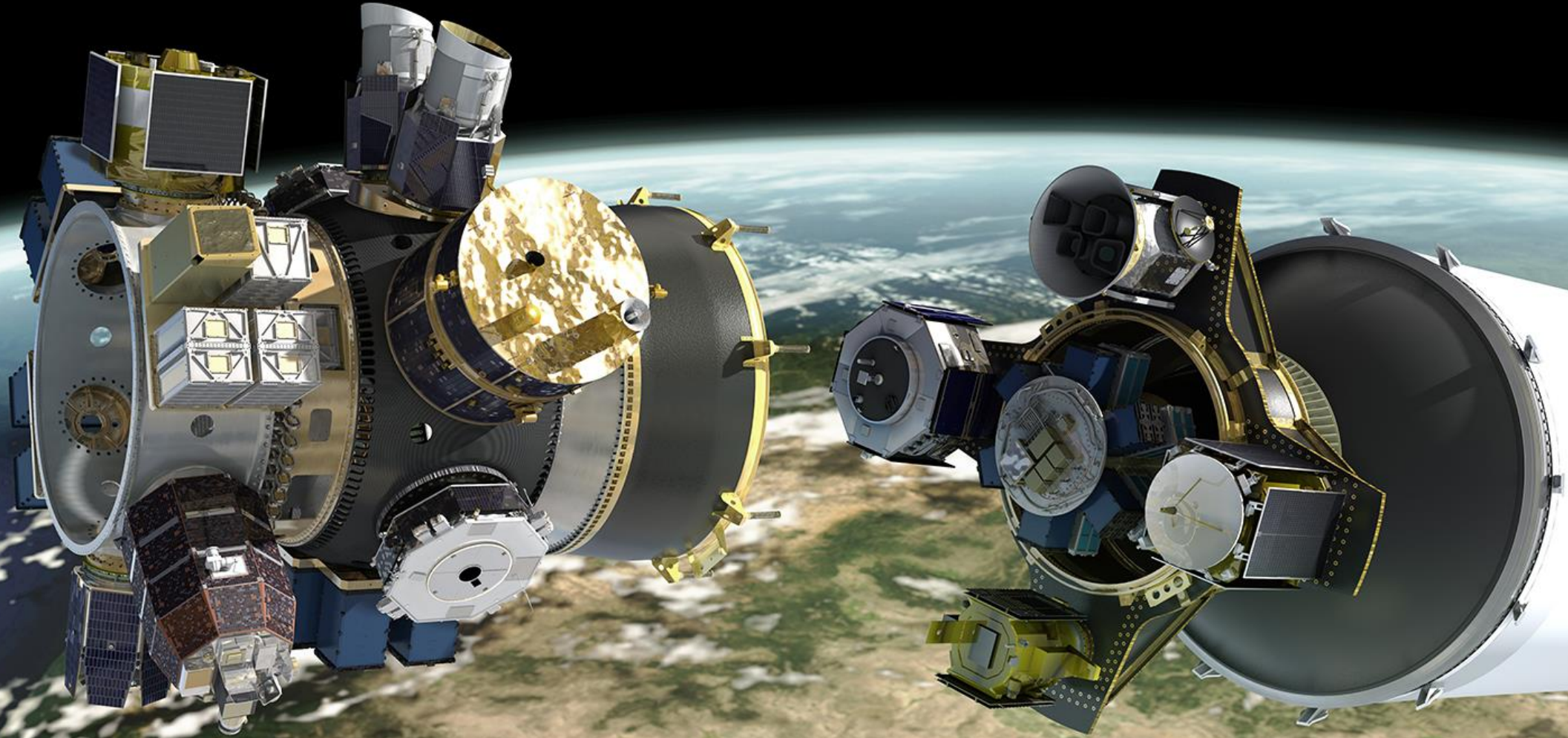
Vector R



Launcher One



TBD Space



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