AEGIS Propulsion Systems Integration

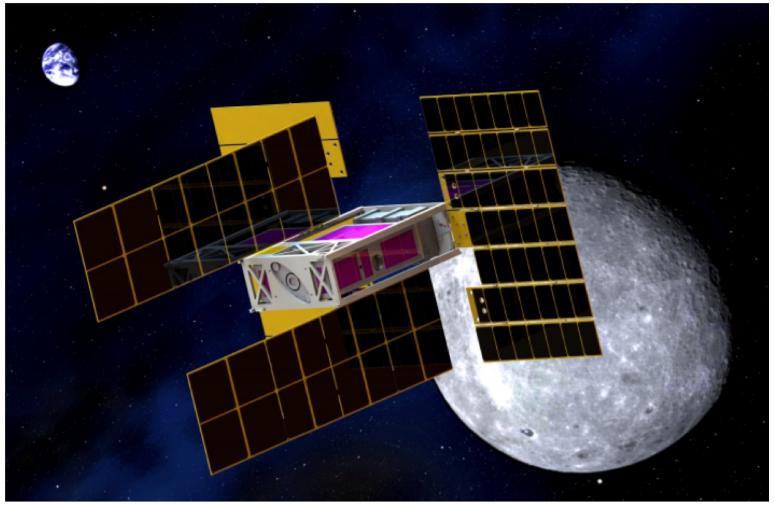
Alabama Experiment for Galactic-ray In-situ Shielding

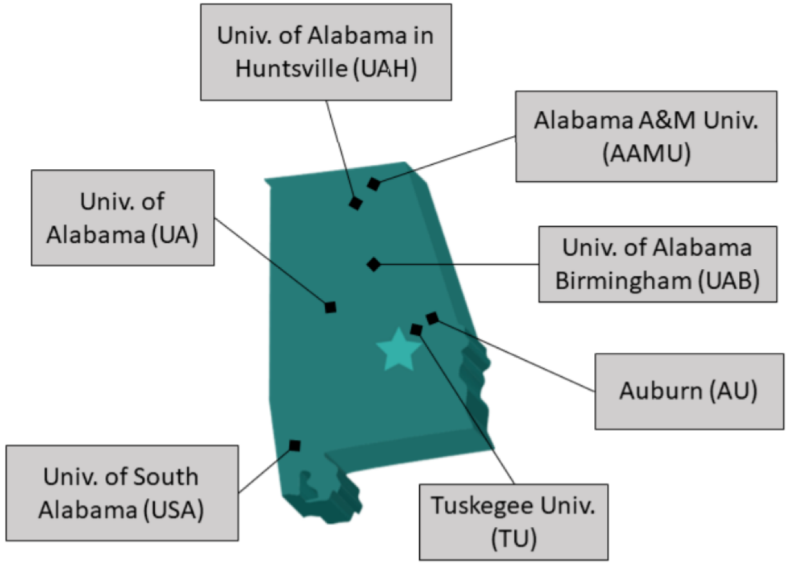
PRC Presentation – 2/28/2020

Project Presentation - Goals

6U CubeSat developed by 5 (7 in the future) Universities in Alabama sponsored by the ASGC

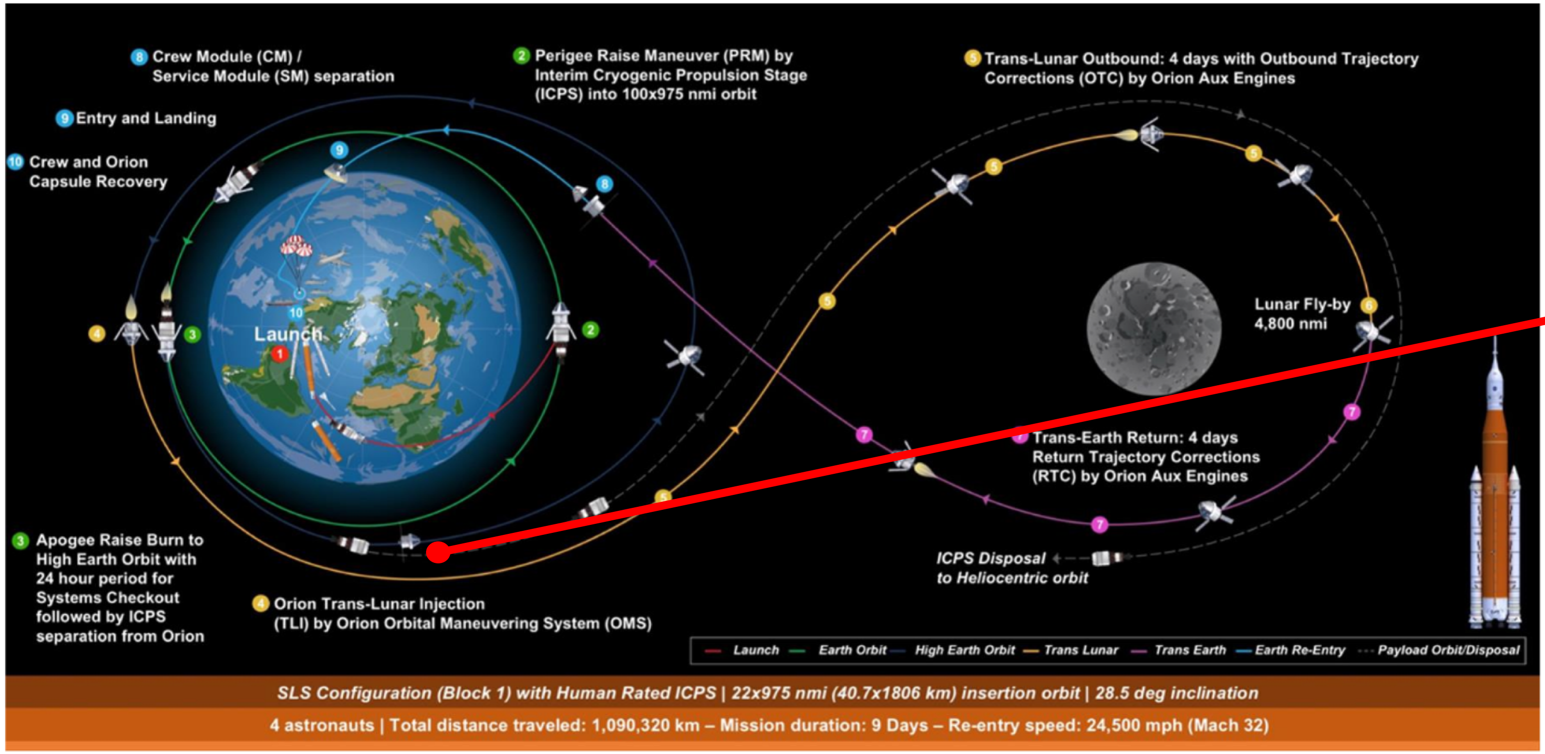
- Science Goals:
  - Measure the performance of lunar regolith-based shielding for reducing radiation.
  - Acquire data to use for validating shielding simulations.
- Educational Goals:
  - Students participate in the design and development of real aerospace system



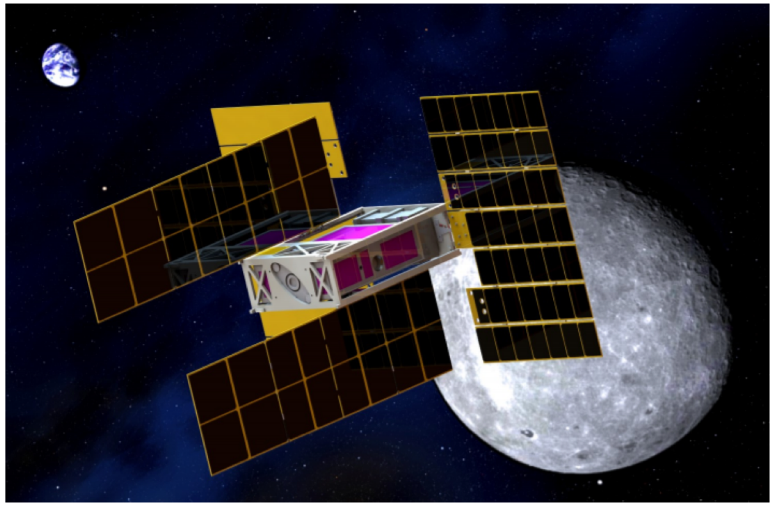


Project Presentation – Launch Vehicle

Artemis-2



Secondary Payload



6U Cubesat

Science Orbit Trade

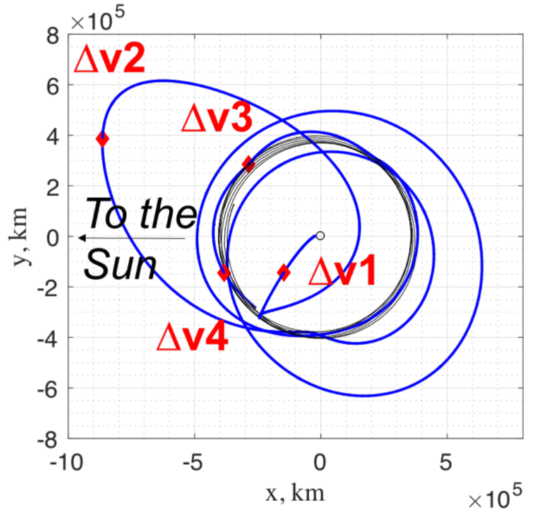
Science Requirement

- Science observational distance (from Earth): 400,000 km (+- 150k km)

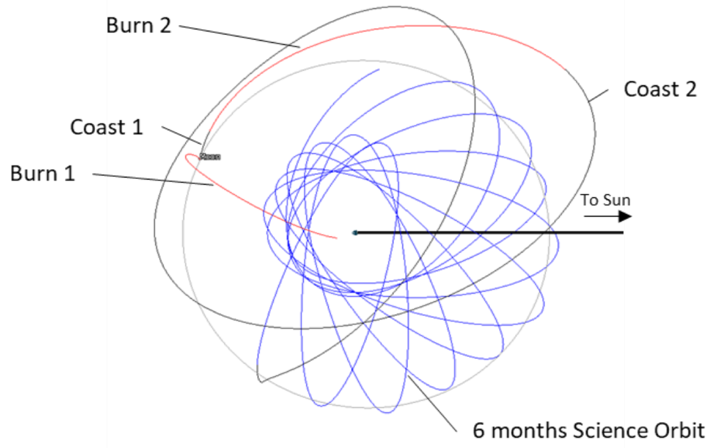
Orbit Trade

- Lunar orbit
  - Cons → ~6months transfer. Complicated trajectory highly depending on initial vector and launch date
  - Pros → Close to the moon, better science return (marginal)
- Cislunar Orbit:
  - Cons → Not close to the moon
  - Pros → Stable, science mission can start sooner.

Decision: Cislunar Orbit
→ Need to be able to impart 12 m/s ΔV before perilune



EQUULEUS trajectory in the Sun–Earth rotating frame.



AEGIS current Baseline Trajectory

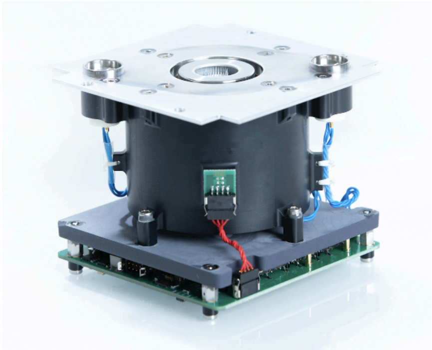
Trade Study

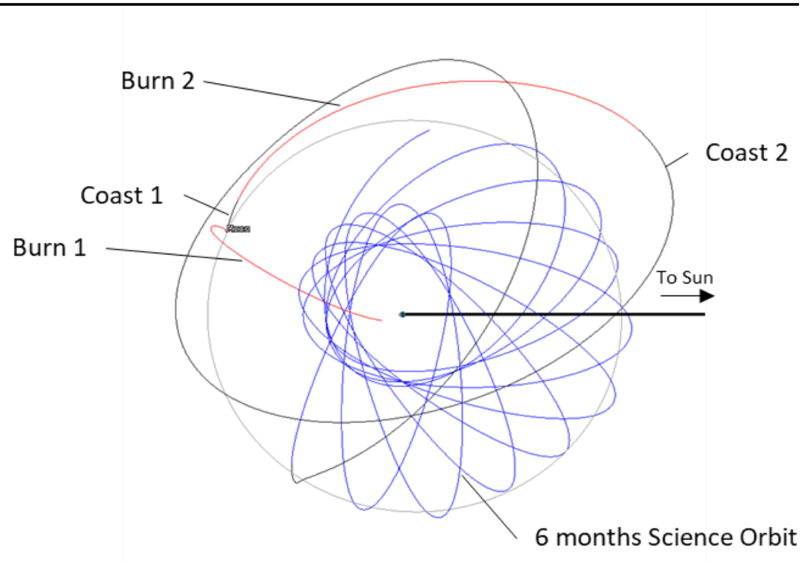
Thruster	Manufacturer	Type	Volume, [m^3]	Thrust, [N]	Thruster Mass, [kg]	I_{sp}, max, [s]	Propellant Mass, [kg]	Power, [W]	TRL
EPSS C1K	NanoAvionics	Green Propellant Thruster	0.001	0.1	0.8	200	0.92	1.9	9
BGT-X5	Busek	Green Monopropellant	0.001	0.5	0.8	225	0.82	20	5
MPS 130 Champs	Aerojet	Adaptable Modular High-Impulse Green	0.001	1.25	1.06	235	0.79	8	6
1N HPGP	Bradford ECAPS	HPGP	0.00445	1.00	0.38	231	0.80	10	9
Hydros-C	Tethers Unlimited, Inc.	Alternative (Green)	0.003321	1.2	1.87	310	0.60	20	[illegible]
BIT-3	Busek	RF Ion	0.00161568	0.00124	1.5	2640	0.11	80	[illegible]
RITu-X	Airbus	Radio Frequency Ion	1.45E-03	0.0005	0.44	3000	0.10	50	[illegible]
BmP-220	Busek	Electric	3.10E-04	0.00002	0.5	536	0.54	7.5	9
BIT-1	Busek	Inductively Coupled Plasma (ICP)	0.001	1.85E-04	0.053	1600	0.18	28	5
Nano-FEEP (IFM-Nano)	Enpulsion	Field Emission Electric Propulsion	6.60E-04	0.0002	0.64	6000	0.05	25	6

Low Volume
High ΔV
Thrust Vectoring

Current State

- IFM Nano Thruster





AEGIS current Baseline Trajectory

- 145 g of fuel remaining for disposal, or future changes to the orbit maneuvers
- Thrust vectoring allows to drop RCS system for desaturation in pitch and yaw
- Risk: Due to the low thrust depending on the actual trajectory and bus stop availability for Artemis 2 this propulsion system might not be able to provide the required ΔV before perilune

Maneuver	ΔV [m/s]	Fuel [g]
Pre-Lunar Fly-by Burn	11.92	7.67
Apoapsis Lowering Burn	36.75	23.6
Reaction Wheels Desaturation	-	53
Current Margin	-	145.73

Questions?

Backup Figures