Development of the thermal interface between the Dragonfly Mass Spectrometer and the DrACO Sample Delivery Carousel

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NASA Goddard Space Flight Center

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Titan, Saturn’s largest moon

Dense, cryogenic nitrogen atmosphere

Methane clouds, rain, & seas

Titan's Surface:

Complex organic soil

Water-ice crust

Subsurface water ocean

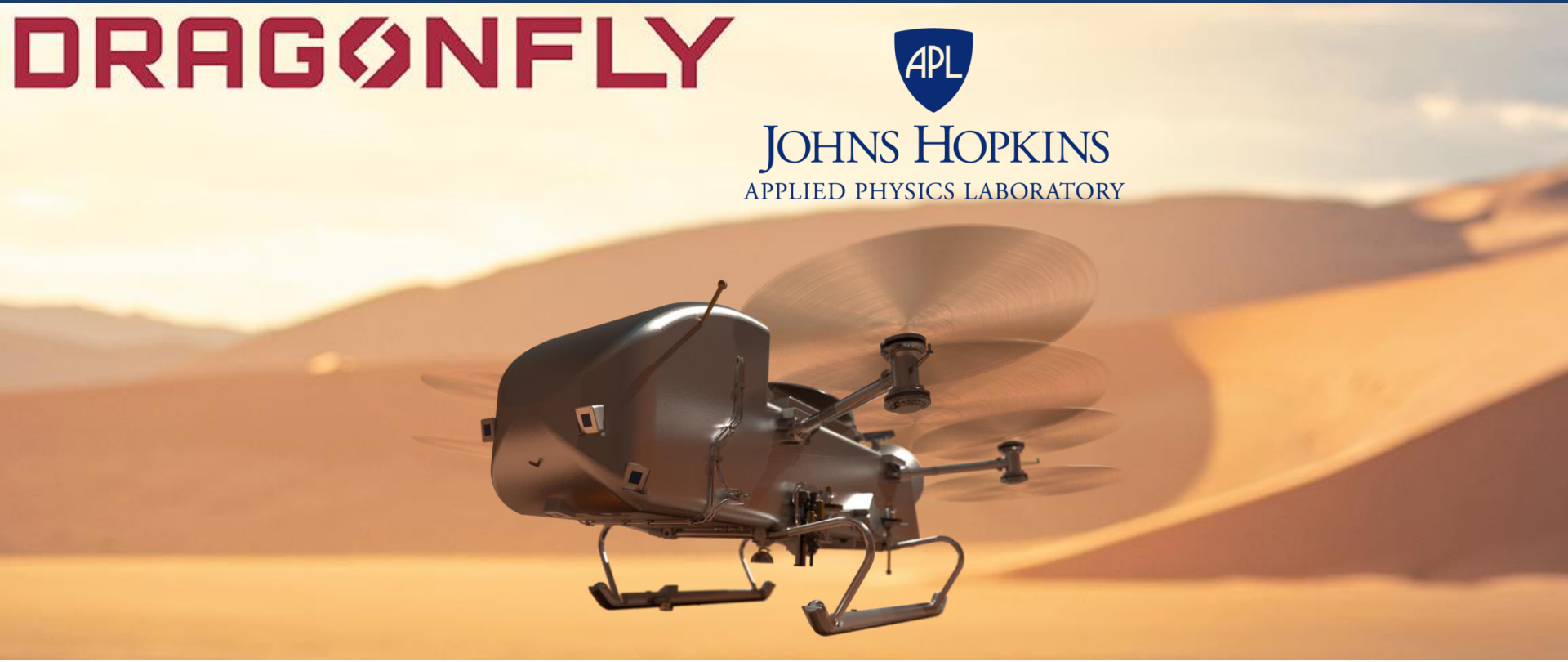
Possible pre-biotic chemistry!

Huygens Probe

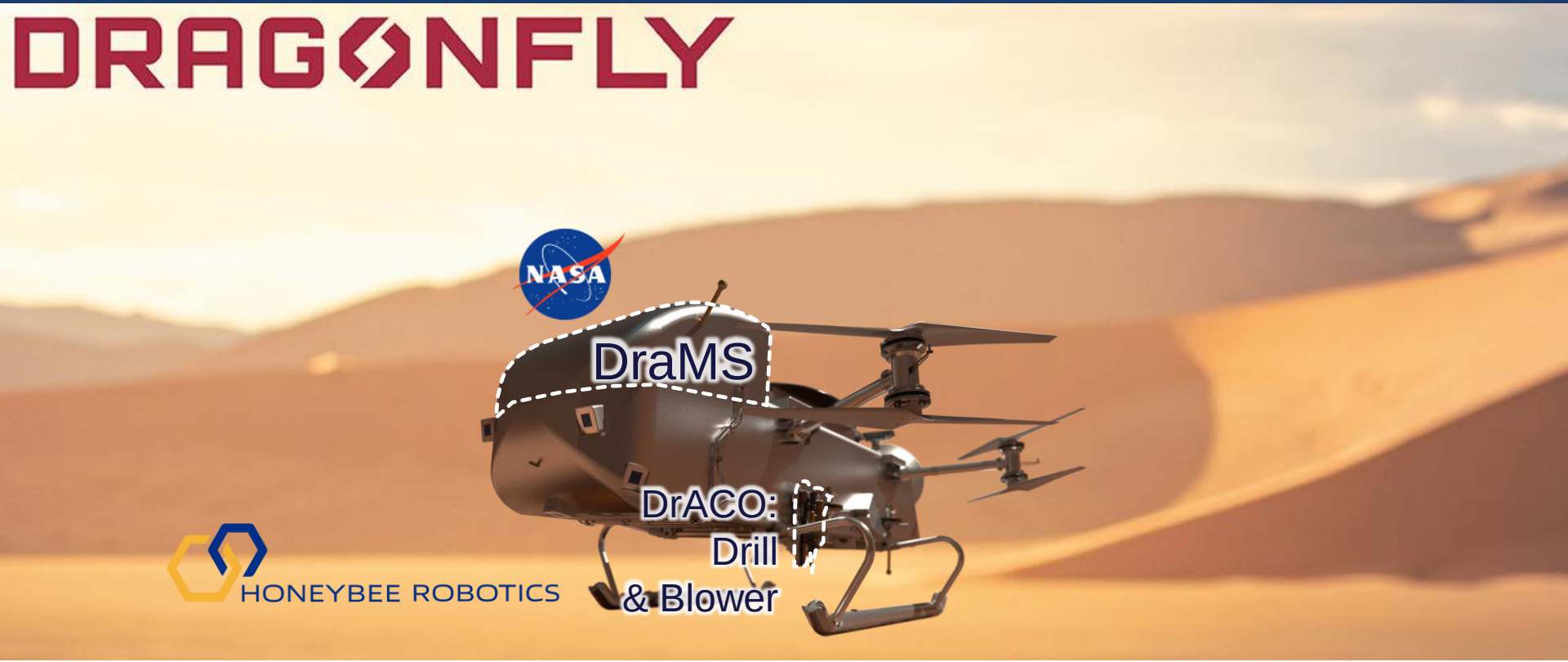
DRAGONFLY

APL

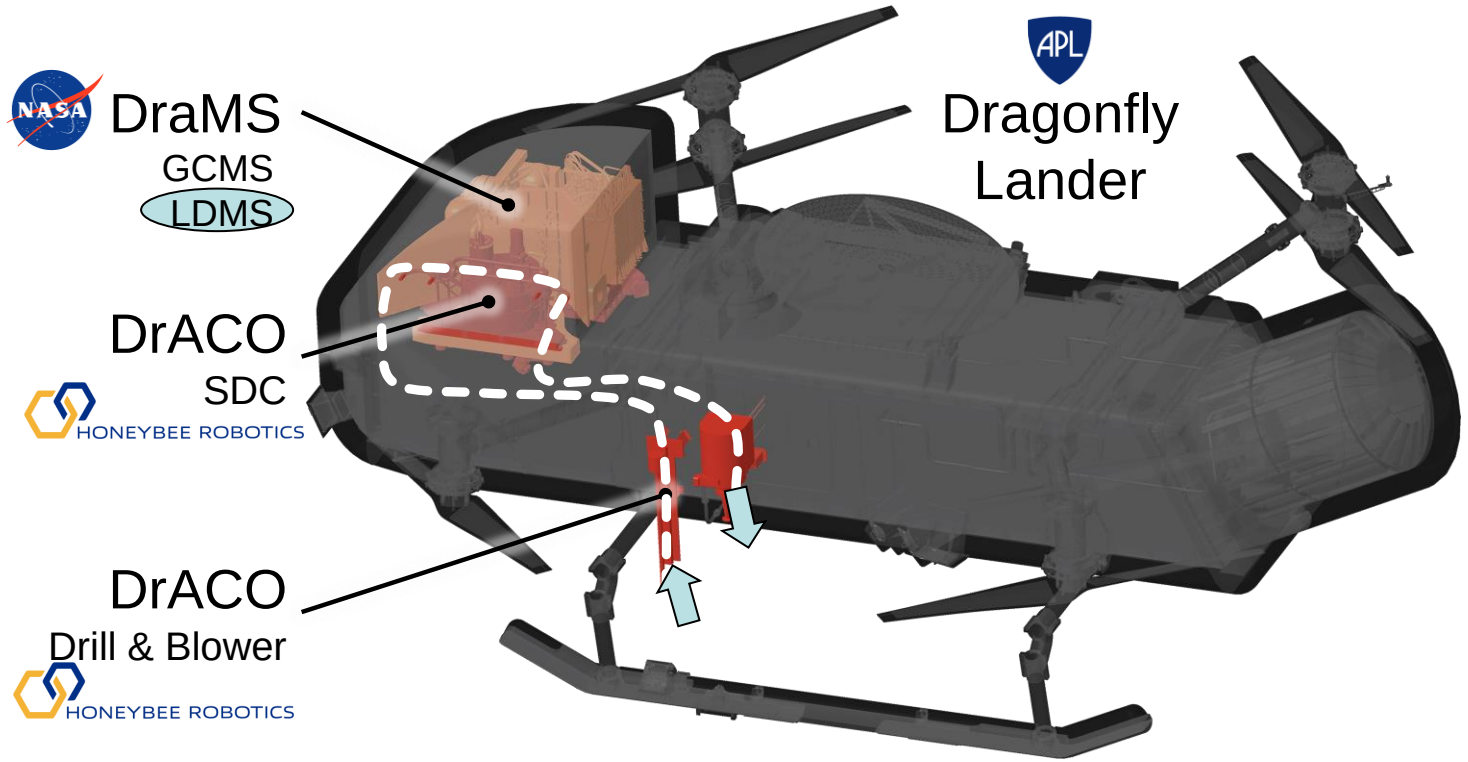
JOHNS HOPKINS
APPLIED PHYSICS LABORATORY



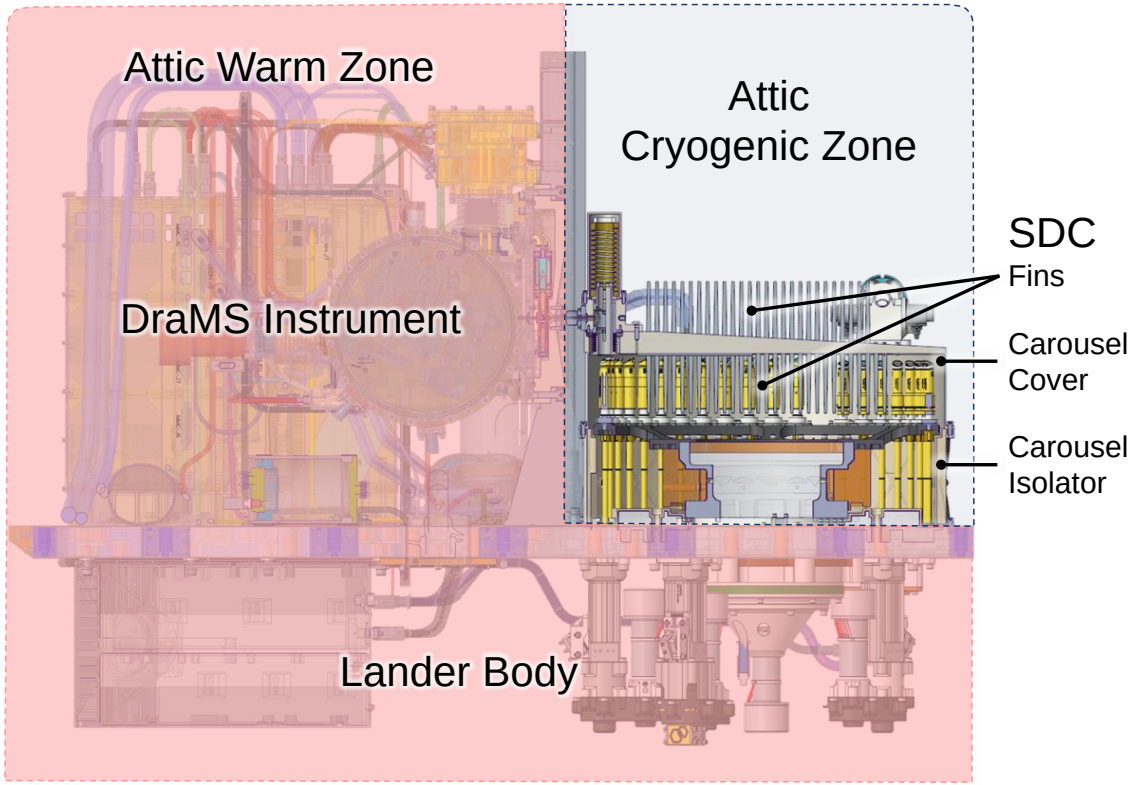
DRAGONFLY



Lander Architecture: Two Instruments Meet

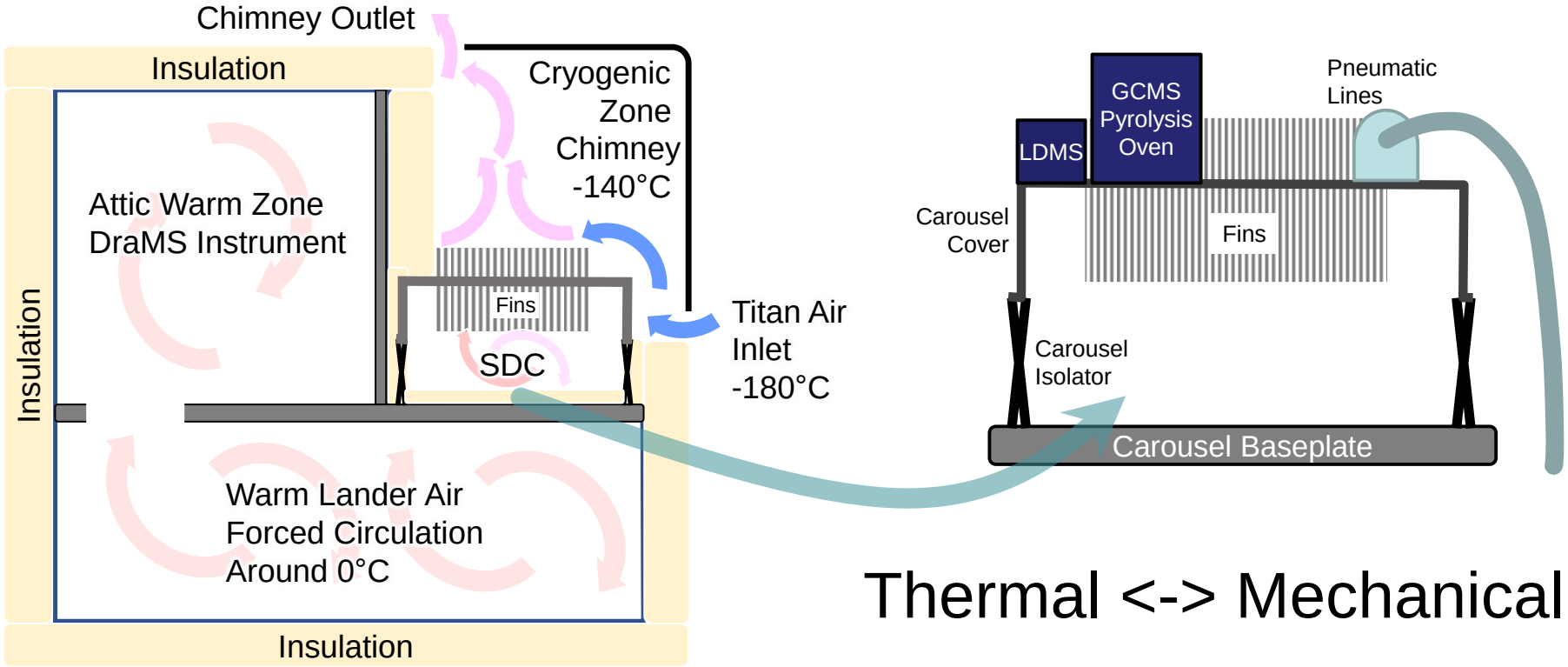


Thermal Zones



<160 K
<(-113 Celsius)
Cup maximum T

Thermal-Mechanical Design

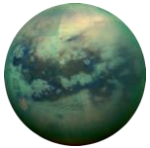


Thermal <-> Mechanical

“Titan-Equivalence” on Earth

Test as you fly:

≠



g = 9.81 m/s^2 1.35 m/s^2

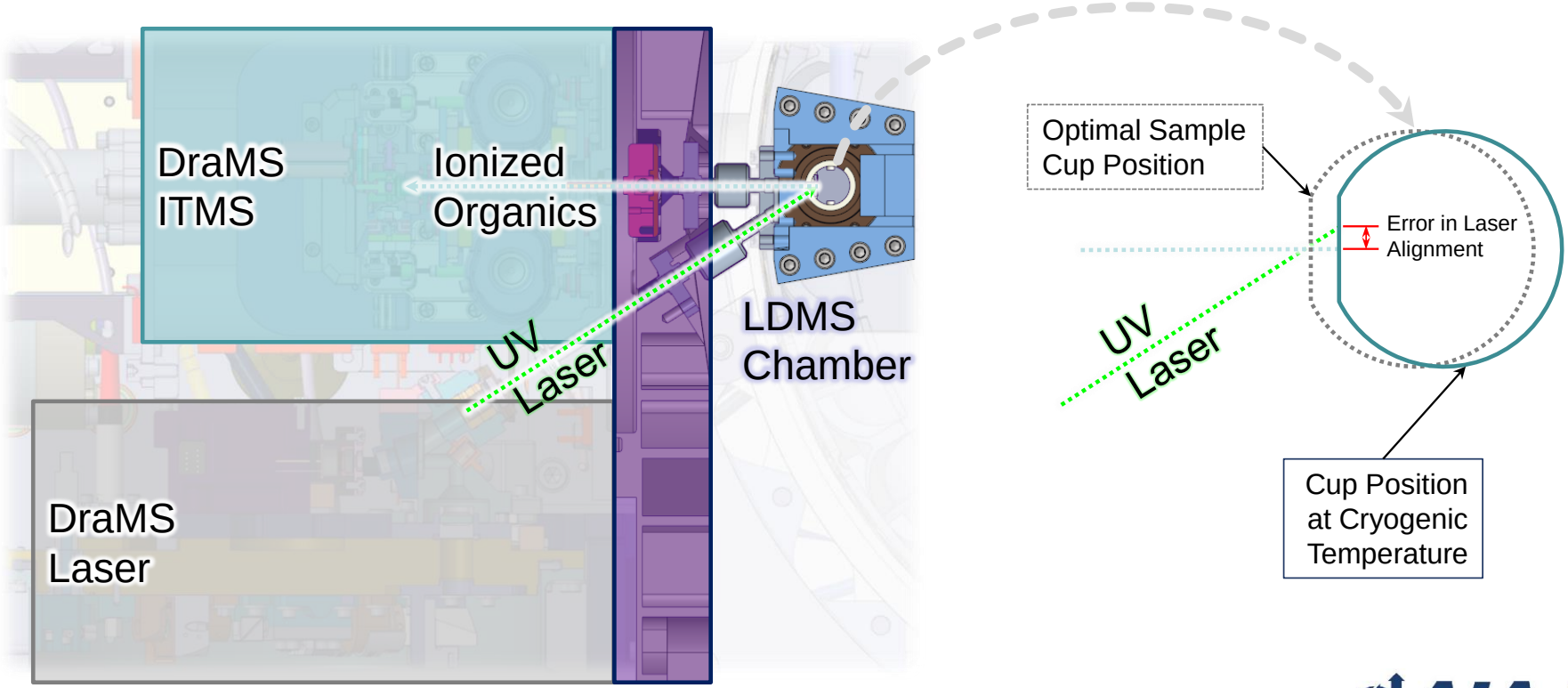
Dimensionless Rayleigh **R**a number describes free convection

$$\mathrm{R}a = \frac{\rho \beta \Delta T l^3 g}{\eta \alpha}$$

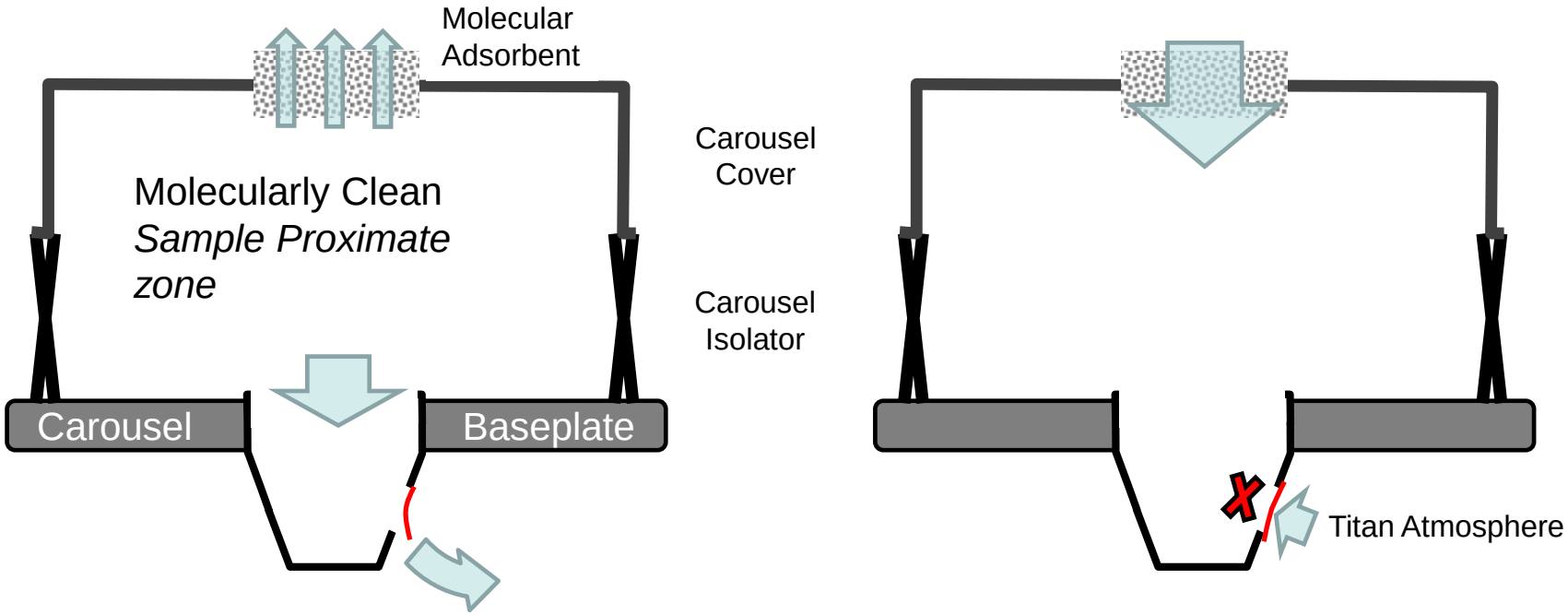
Adjust density ρ

$\mathrm{Ra}_{\mathrm{Earth}} = \mathrm{Ra}_{\mathrm{Titan}}$

Alignment


DraMS
ITMS
Ionized
Organics
UV
Laser
LDMS
Chamber
DraMS
Laser
Optimal Sample
Cup Position
Error in Laser
Alignment
UV
Laser
Cup Position
at Cryogenic
Temperature

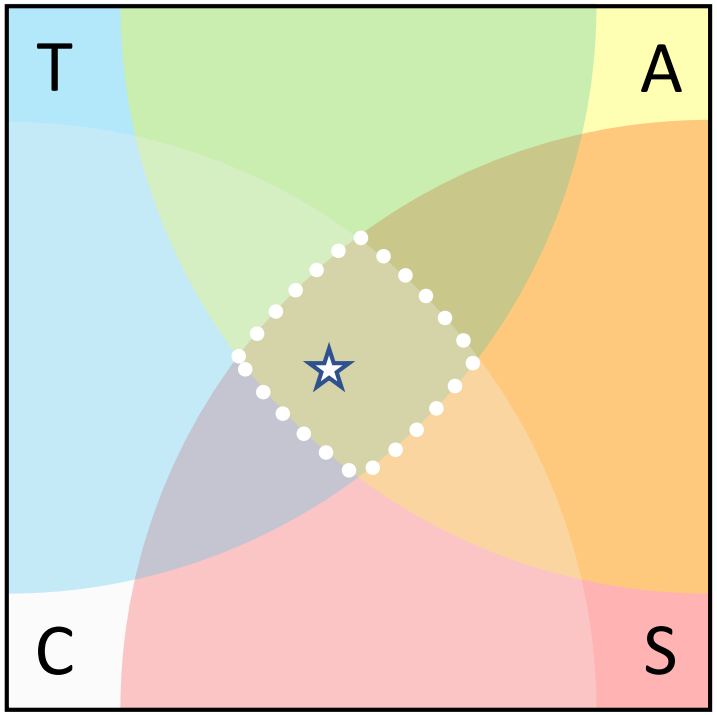
Contamination Control

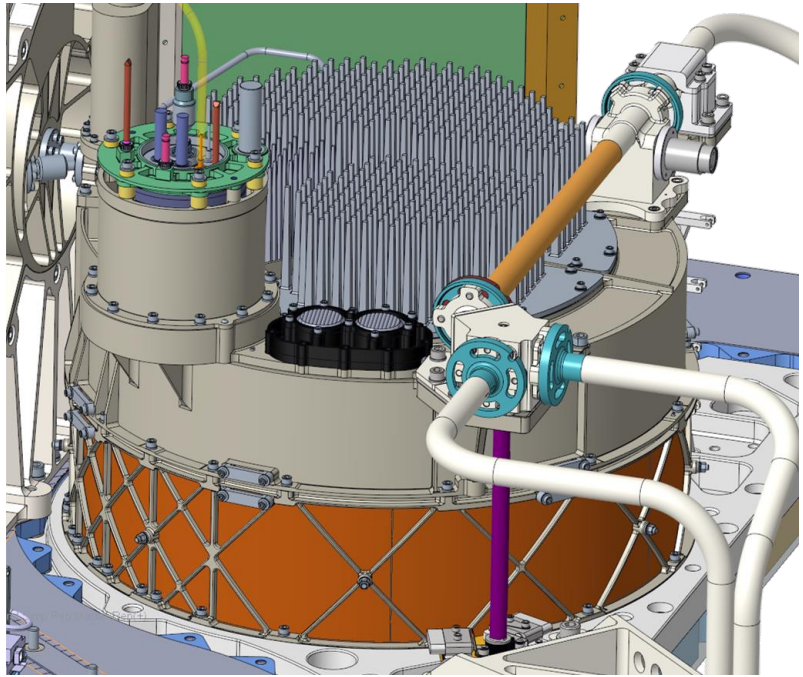


Launch venting

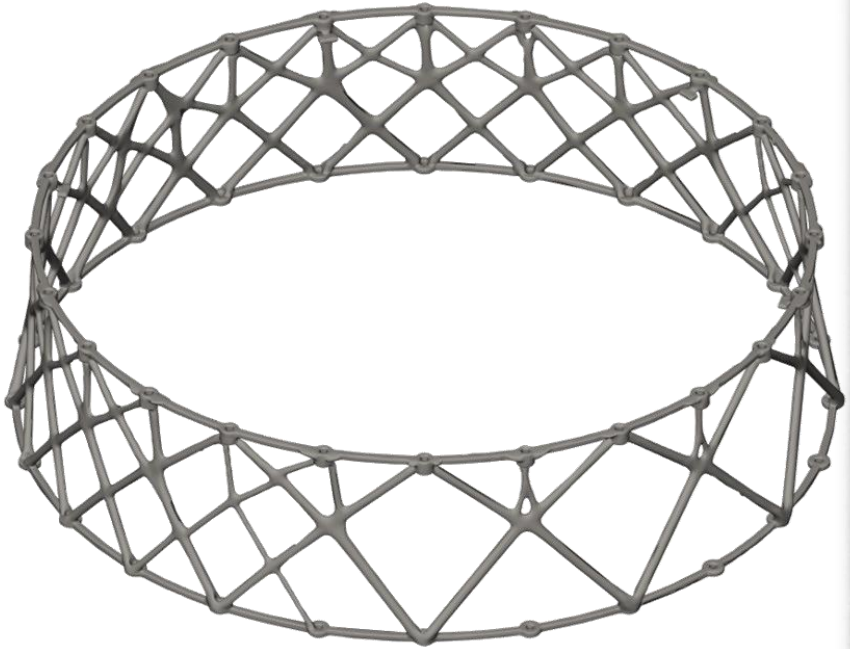
EDL Pressurizing

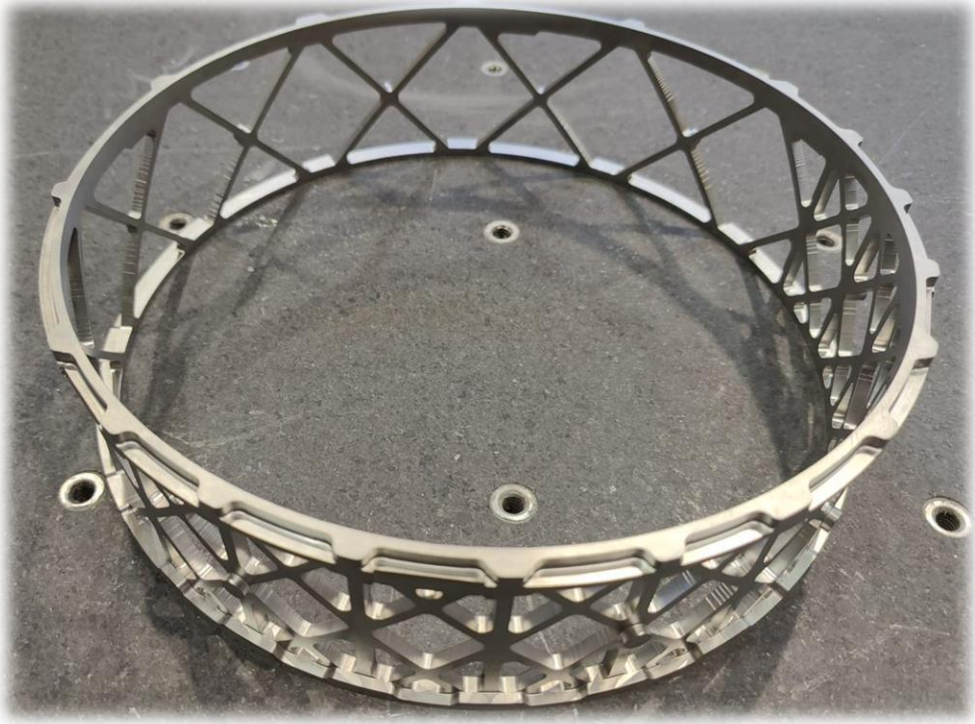
Design Space & Solution



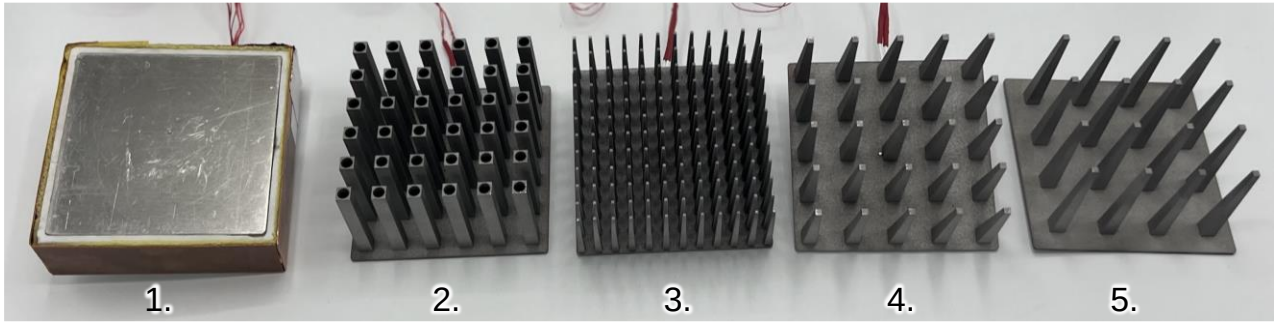


Generative Structure Design: Isolator

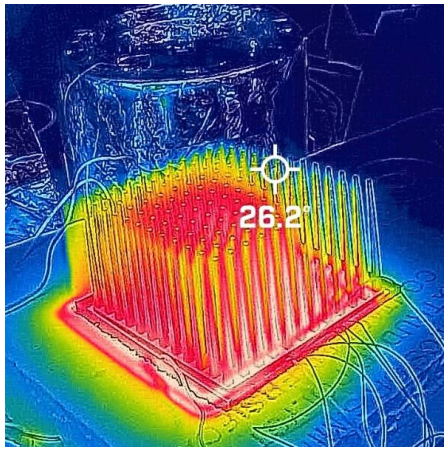


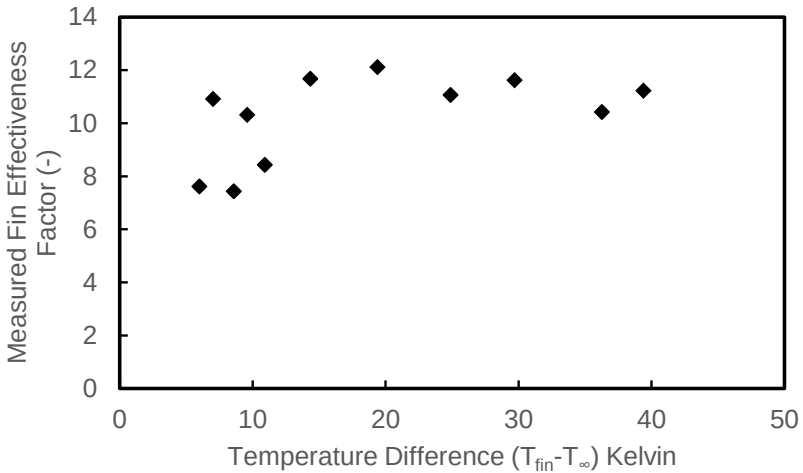


Fins & Insulation

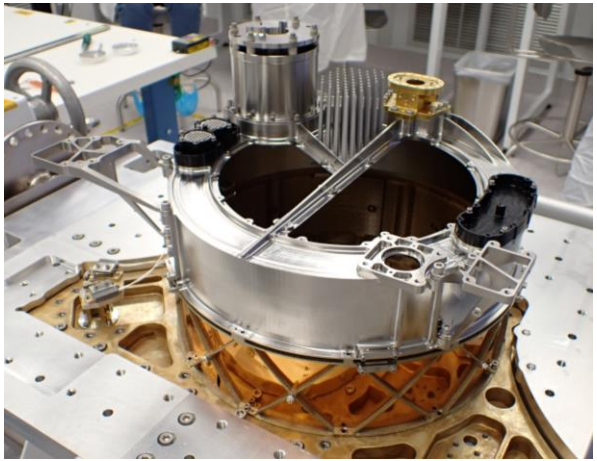


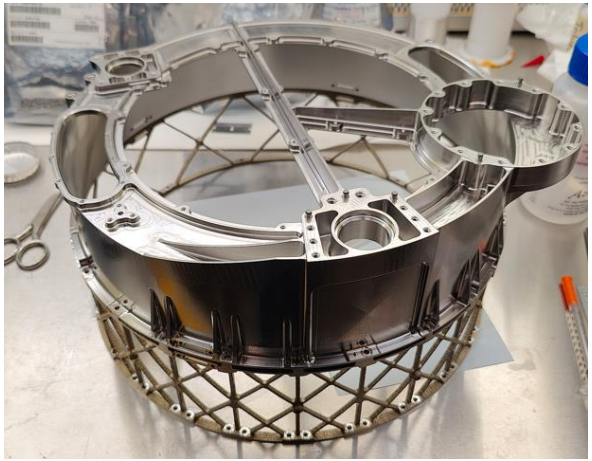
Additive Manufacturing: Fins & PEEK insulation

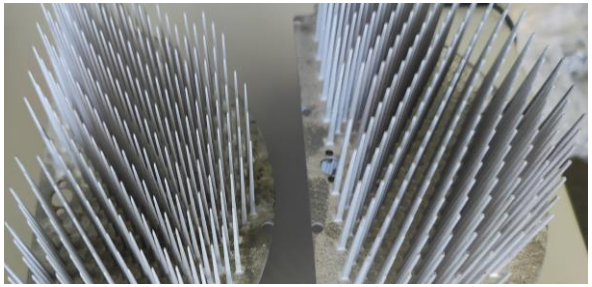




Engineering Model Build

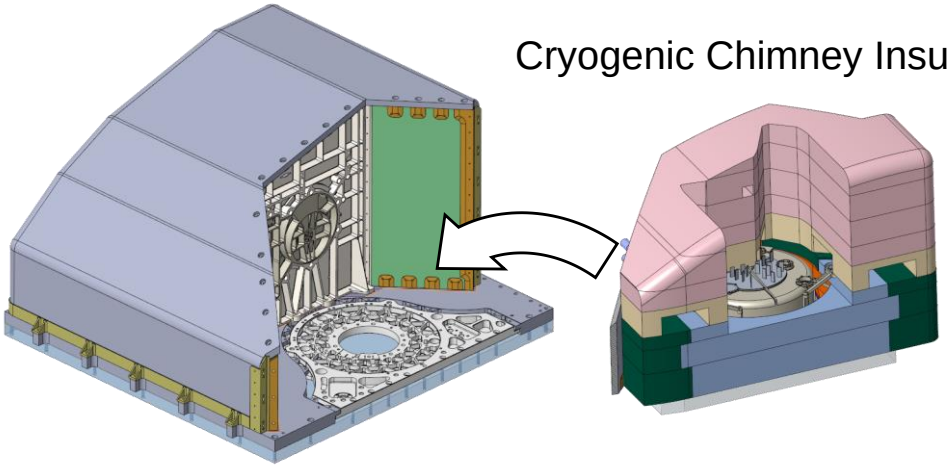




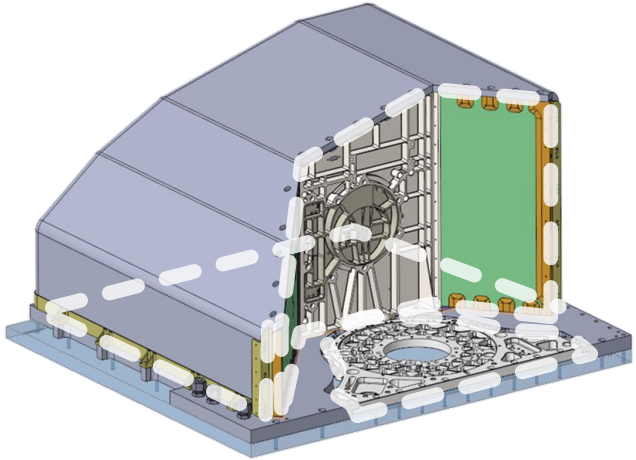



Ongoing EM Development

Cryogenic Chimney Insulation



Sealing-Test Mock-up

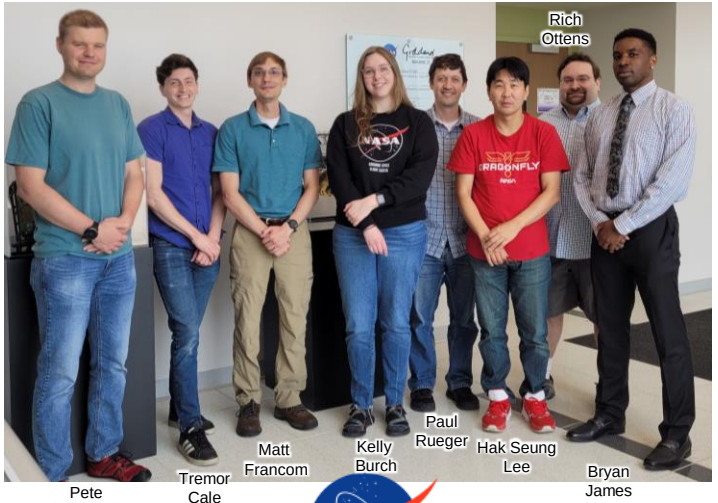


EM T-Titan Test

1. Thermal Balance
2. Validate insulation effectiveness
3. Validate Alignment @ Titan ambient

Conclusion

- Engineering Model design ready for CDR!
- Looking forward to DraMS/DrACO in relevant environment



Thank You!