Technology Development for the Kentucky Re-entry Universal Payload System (KRUPS)

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  - Chris Meek
  - KRUPS Core Team
  - KREM Senior Design Team
  - KRUPS Comm. Senior Design Team
  - KRUPS TPS Senior Design Team
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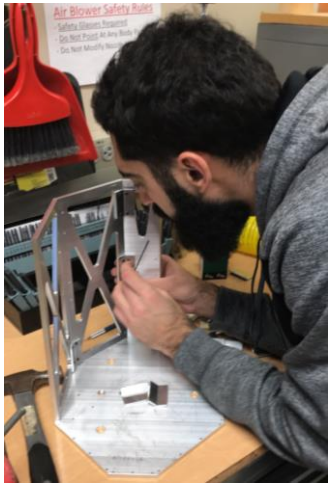
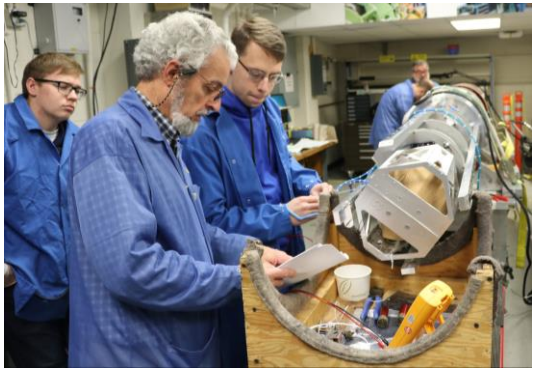
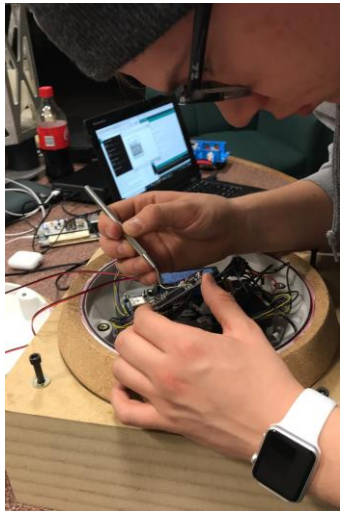
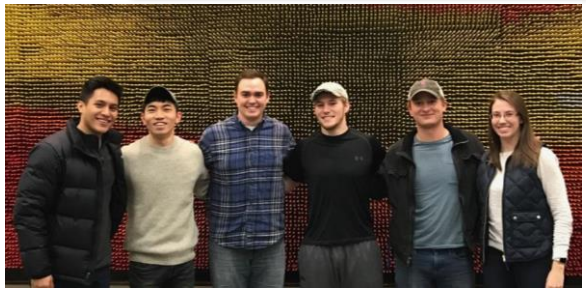
Student Involvement

WORKFORCE









Students involved in:

- RockOn! where we learned rocket science thanks to the Colorado, Virginia, and National Space Grant programs
- Two Sounding Rocket projects:
  - KUDOS: Kentucky Space Grant Team Fellowship with Aug 2017 launch via RockSat-X
  - KOREVET: Space Grant USIP with upcoming March 2018 launch via USIP

Students gained hands-on and multidisciplinary experience designing and building space experiments

46 students from UK are involved in both projects

Objectives and Motivation

- Provide an affordable and proven technology testbed for re-entry experiments
  - Geometry based off of Deep Space 2
- Provide thermal response data from thermal protection system
  - Flight data is needed:
    - Validation of computational models
    - Ground testing cannot always be extrapolated to real flight

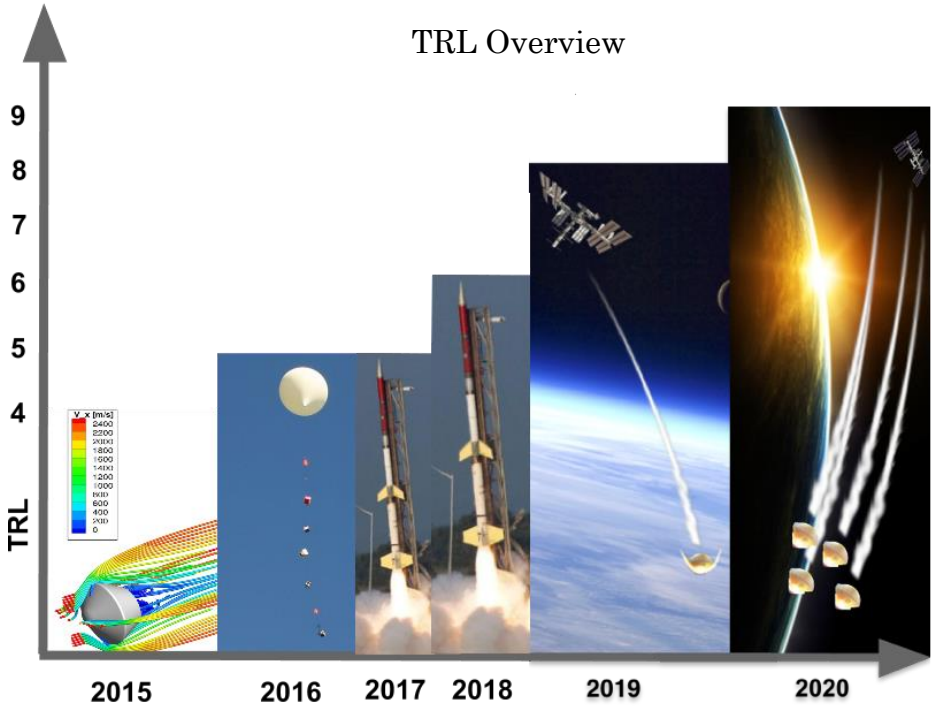
Deep Space 2

KRUPS Prototype

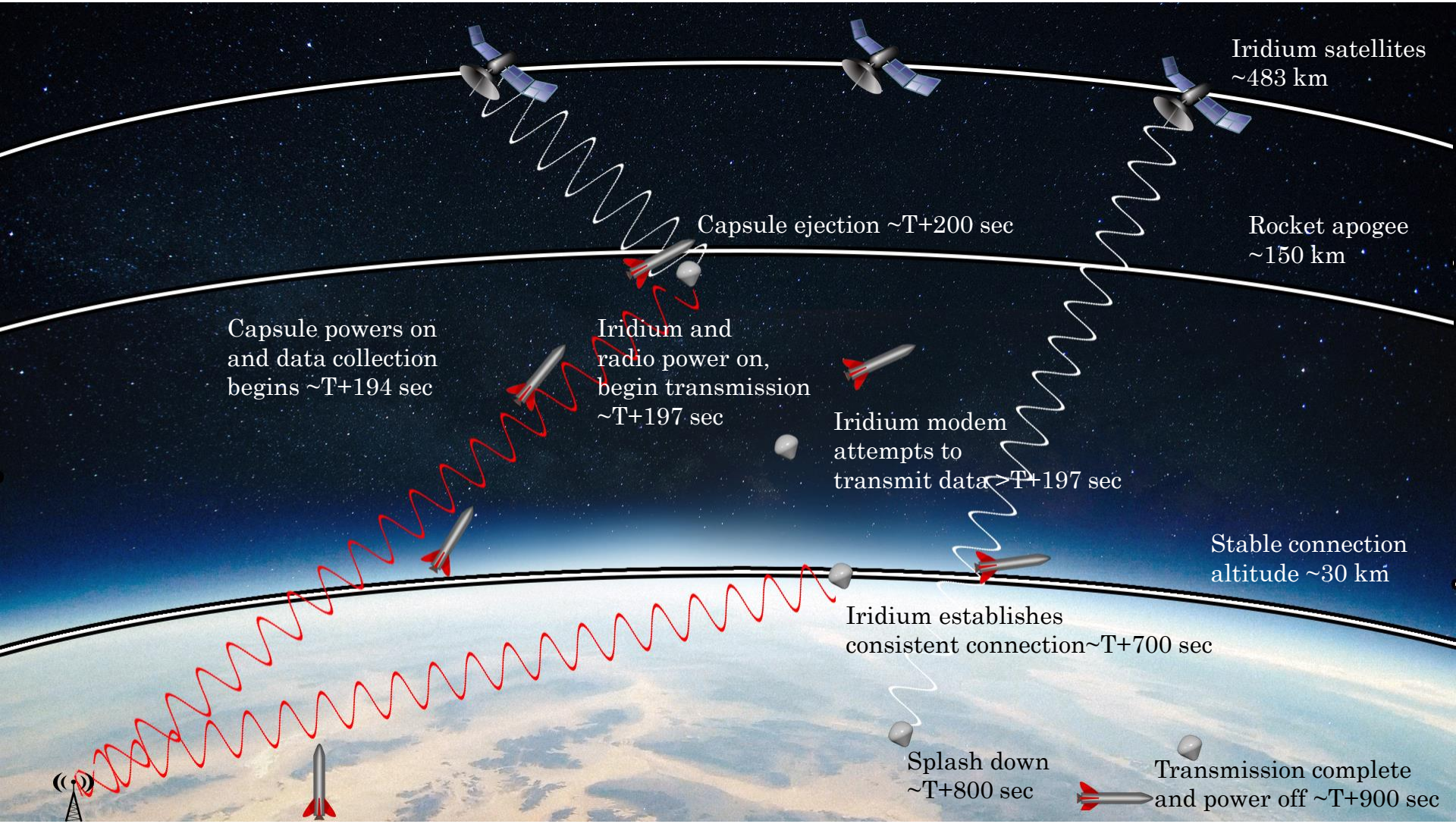
Project Overview

- **Overall Goal**: Launch multiple 11-inch diameter Kentucky Re-entry Universal Payload System (KRUPS) from the ISS
  - Numerous on-board experiments
- Two sounding rocket launches for modular and full system testing
  - KUDOS (Aug 2017)
    - Scaled Prototype (7.5-inch)
  - KOREVET (March 2018)
    - Full scale Prototype (11-inch)

TRL Overview



Sounding Rocket Concept of Operations



KUDOS Launch

What worked?

- Capsule did not rotate during launch
- Capsule powered on
- Capsule ejected without damage
- Connected with Iridium Satellites
- GoPros captured ejection

What did not work?

- Door opening caused capsule to shift in KREM
- Capsule hit the inside of KREM during ejection
- No data packets received

Front camera

Back camera

KUDOS Launch

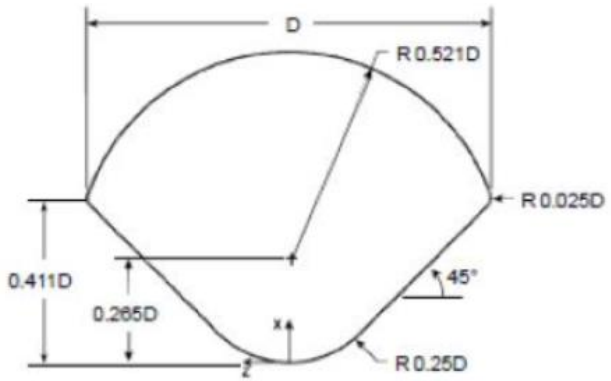
Why were no data packets received?

- Center of Gravity may have been too close to Center of Pressure
- Higher spin-rate caused by the impact
- Stable connection was never achieved
- Water leaks after splash-down
- Impact survival

Subsystem Comparison

Thermal Protection System

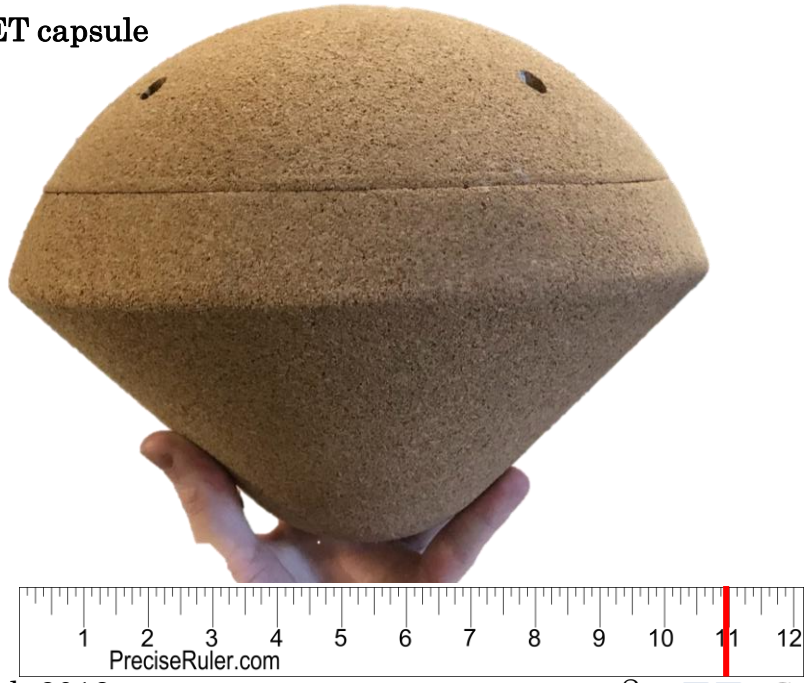
- High density cork decoy blocks
- 45 degree angled fore-shell



KRUPS capsule geometry

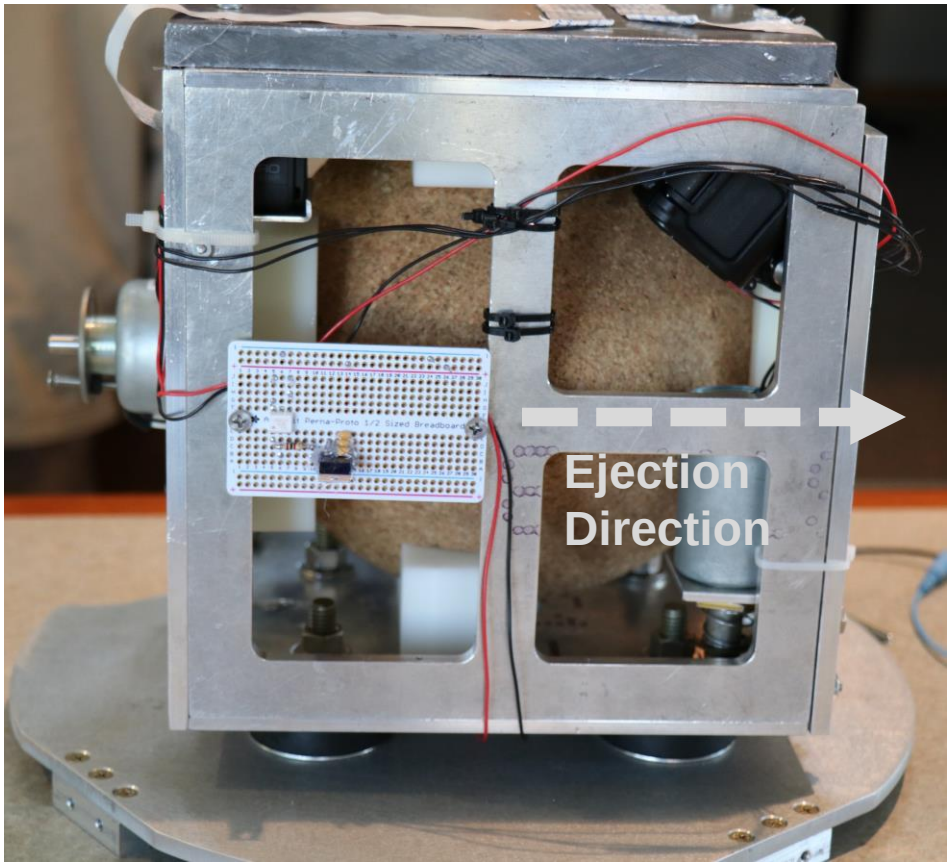
KUDOS capsule

KOREVET capsule



Subsystem Comparison

KRUPS Rocket Ejection Mechanism (KREM)



KUDOS KREM

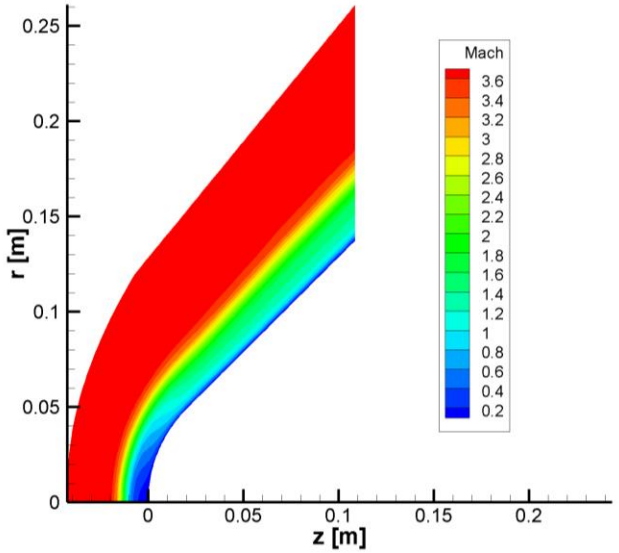
KOREVET KREM

Future Plans

KOREVET Launch

- Launch scheduled for March 22, 2018
- Recover data packets and compare to CFD models at the University of Kentucky for model validation

NASA EPSCoR ISS Proposal?



CFD results for KOREVET, provided by Christen Setters

Questions?