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

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  - KREM Senior Design Team
  - KRUPS Comm. Senior Design Team
  - KRUPS TPS Senior Design Team

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Student Involvement

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**

March 2018
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
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)
Capsule powers on and data collection begins ~T+194 sec

Iridium and radio power on, begin transmission ~T+197 sec

Capsule ejection ~T+200 sec

Iridium modem attempts to transmit data >T+197 sec

Iridium establishes consistent connection~T+700 sec

Splash down ~T+800 sec

Stable connection altitude ~30 km

Rocket apogee ~150 km

Iridium satellites ~483 km

Transmission complete and power off ~T+900 sec
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
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](image)
Questions?