5 Years of Lessons via MDSGC Payloads at Capitol

Capitol Technology University

Marcus Bailey

Lening Rivera

Angela Walters

Alex “Sandy” Antunes

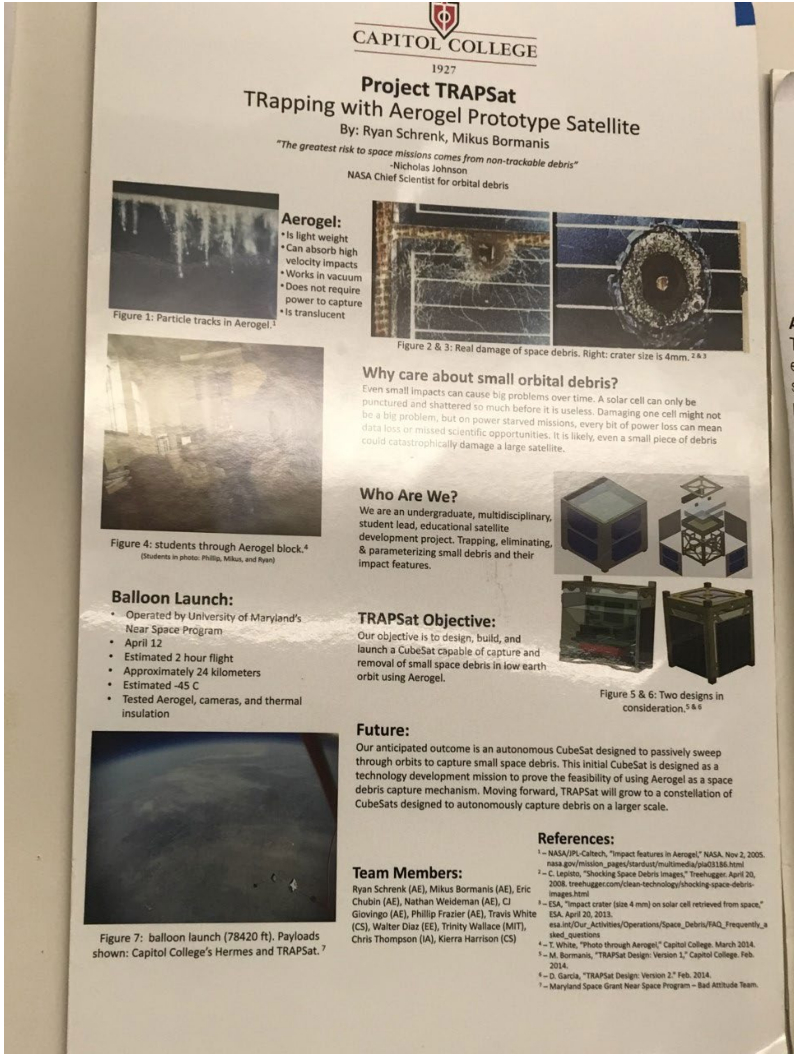
Crawl

- **Presenting a problem or challenge**
- The birth of an idea
- The inspiration behind the idea
- Developing a mission
- Establishing goals and objectives

Walk

- Model and Test
- Identify and integrate
- Validation
- Present findings to the science community and peers

HAB with University of Maryland (UMD) courtesy of the MDSGC



CAPITOL COLLEGE

1927

Project TRAPSat

TRapping with Aerogel Prototype Satellite

By: Ryan Schrenk, Mikus Bormanis

"The greatest risk to space missions comes from non-trackable debris"

-Nicholas Johnson

NASA Chief Scientist for orbital debris

Figure 1: Particle tracks in Aerogel.[1]

Aerogel:

- Is light weight
- Can absorb high velocity impacts
- Works in vacuum
- Does not require power to capture
- Is translucent

Figure 2 & 3: Real damage of space debris. Right: crater size is 4mm.[2&3]

Figure 4: students through Aerogel block.[4]

(Students in photo: Phillip, Mikus, and Ryan)

Why care about small orbital debris?

Even small impacts can cause big problems over time. A solar cell can only be punctured and shattered so much before it is useless. Damaging one cell might not be a big problem, but on power starved missions, every bit of power loss can mean data loss or missed scientific opportunities. It is likely, even a small piece of debris could catastrophically damage a large satellite.

Who Are We?

We are an undergraduate, multidisciplinary, student lead, educational satellite development project. Trapping, eliminating, & parameterizing small debris and their impact features.

Balloon Launch:

- Operated by University of Maryland's Near Space Program
- April 12
- Estimated 2 hour flight
- Approximately 24 kilometers
- Estimated -45 C
- Tested Aerogel, cameras, and thermal insulation

TRAPSat Objective:

Our objective is to design, build, and launch a CubeSat capable of capture and removal of small space debris in low earth orbit using Aerogel.

Figure 5 & 6: Two designs in consideration.[5&6]

Figure 7: balloon launch (78420 ft). Payloads shown: Capitol College's Hermes and TRAPSat.[7]

Future:

Our anticipated outcome is an autonomous CubeSat designed to passively sweep through orbits to capture small space debris. This initial CubeSat is designed as a technology development mission to prove the feasibility of using Aerogel as a space debris capture mechanism. Moving forward, TRAPSat will grow to a constellation of CubeSats designed to autonomously capture debris on a larger scale.

Team Members:

Ryan Schrenk (AE), Mikus Bormanis (AE), Eric Chubin (AE), Nathan Weideman (AE), CJ Giovingo (AE), Phillip Frazier (AE), Travis White (CS), Walter Diaz (EE), Trinity Wallace (MIT), Chris Thompson (IA), Kierra Harrison (CS)

References:

1 – NASA/JPL-Caltech, "Impact features in Aerogel," NASA. Nov 2, 2005. nasa.gov/mission_pages/stardust/multimedia/pia03186.html

2 – C. Lepisto, "Shocking Space Debris Images," Treehugger. April 20, 2008. treehugger.com/clean-technology/shocking-space-debris-images.html

3 – ESA, "Impact crater (size 4 mm) on solar cell retrieved from space," ESA. April 20, 2013. esa.int/Our_Activities/Operations/Space_Debris/FAQ_Frequently_asked_questions

4 – T. White, "Photo through Aerogel," Capitol College. March 2014.

5 – M. Bormanis, "TRAPSat Design: Version 1," Capitol College. Feb. 2014.

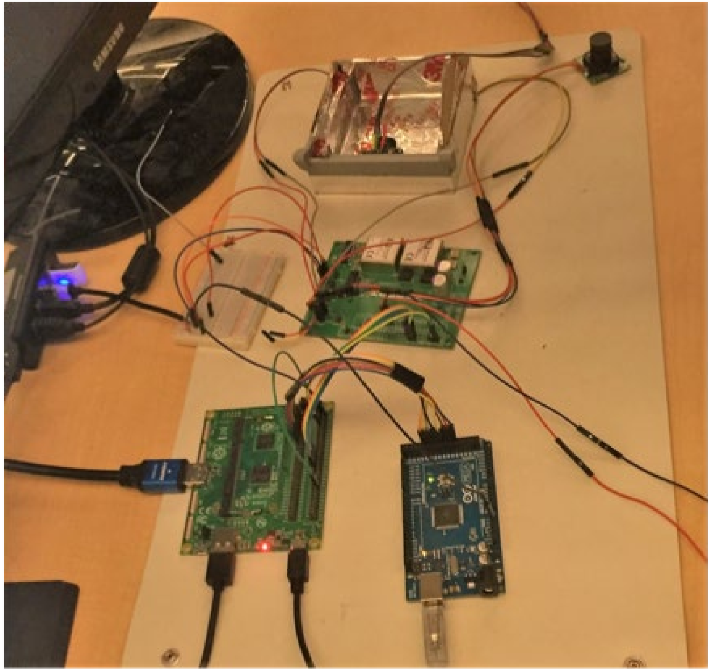
6 – D. Garcia, "TRAPSat Design: Version 2." Feb. 2014.

7 – Maryland Space Grant Near Space Program – Bad Attitude Team.

TRAPSat flying at 80,000 ft courtesy of UMD and the MD Space Grant

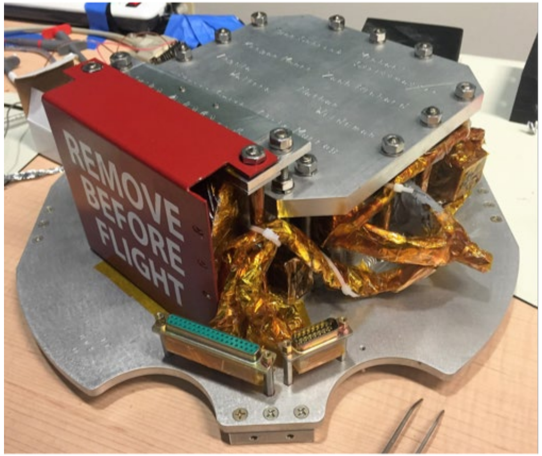
Run

- Industry equipment
- Industry methods
- Gaining TRL (Technology Readiness Level)
- Mission Testing



Fly

- Standardized engineering process
- Provides real world STEM application
- Completion
- Taking the idea to the final test



TRAPSat ROCKSAT-X payload
- top

Sounding rocket launch 8/17/16
- bottom

Student Benefits

- Job Ready
- Class equivalent
- Comprehensive STEM student education
- Maintaining industry relations which will lead to stronger networks
- Work on multidisciplinary team

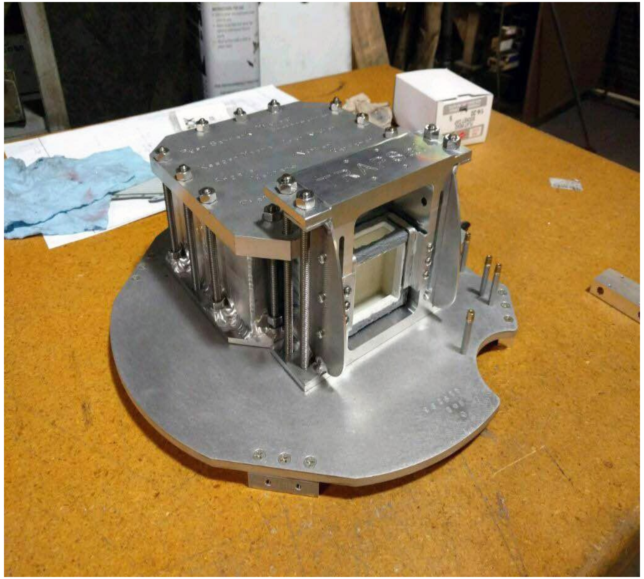
Right : Mike Strittmatter
Left : Chris Murray

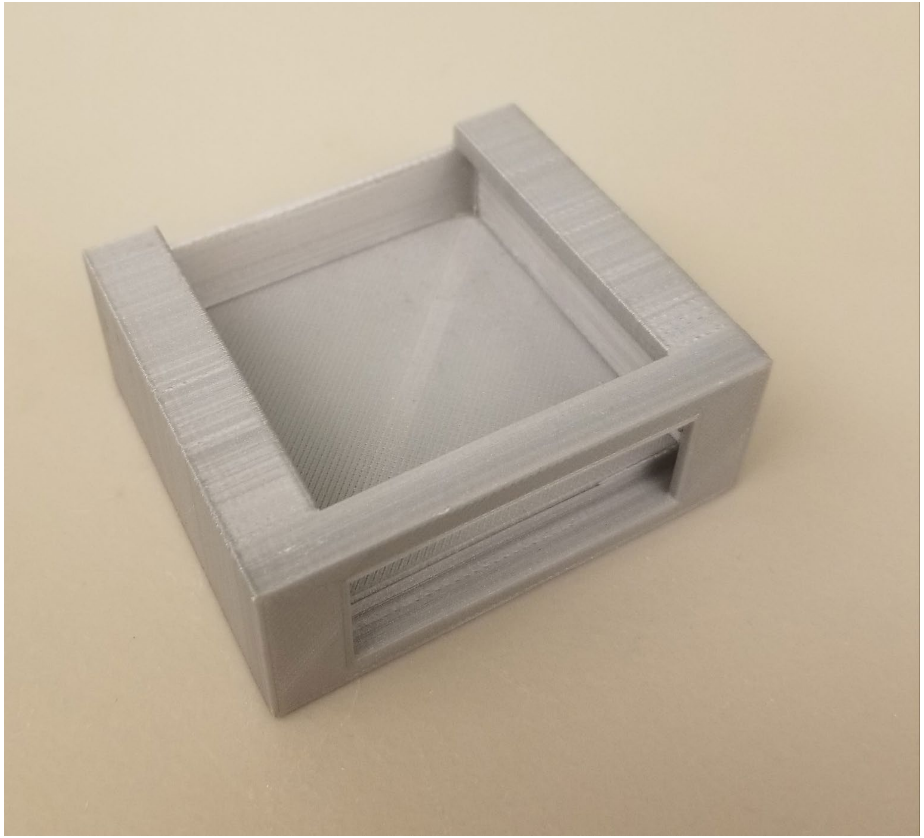
Payload	Date	Purpose
NS-45 (TrapSat)	Nov 8 2014	Captured debris in LEO
NS-45 (APRS)	Nov 8 2014	Use APRS to send info
NS-46 (Hermes)	Apr 2015	Use Iridium to triangulate
NS-46 (TrapSat)	Apr 2015	Captured debris in LEO
NS-46 (Pi in the Sky)	Apr 2015	A balloon launch with a Raspberry Pi and a camera
NS-47 (TrapSat)	Apr 18, 2015	Captured debris in LEO
NS-47 (Hermes)	Apr 18, 2015	Use Iridium to triangulate
NS-56 (Cloud 360)	July 23, 2016	Using 360 degree video to test clouds
NS-56 (HABScope)	July 23, 2016	Doing infrared Astronomy
NS-58 (Cloud 360)	Sept 2016	Using 360 degree video to test clouds
NS-60 (Hermes)	Nov 13, 2016	Use Iridium to triangulate
NS-63 (TrapSat Burn)	Apr 15, 2017	Testing nichrome wire
NS-64 (CTU PR)	May 7, 2017	A PR flight by CTU to take pictures of the atmosphere
NS-76 (Aether)	Apr 13, 2018	Testing for the sounding rocket


CLEAR SPRING ELEMENTARY SCHOOL

TrapSat

- Took pictures and captured small debris in LEO
- Aerogel was used to capture particles
- Take an image of the debris
- This helped determine location of debris





Removable Aerogel Support Container (RASC)

Removable Aerogel Support Container (RASC) from camera

APRS (Automated Positioning Reporting System)

- Use APRS to use reserved frequency to send information

- Process data into packets

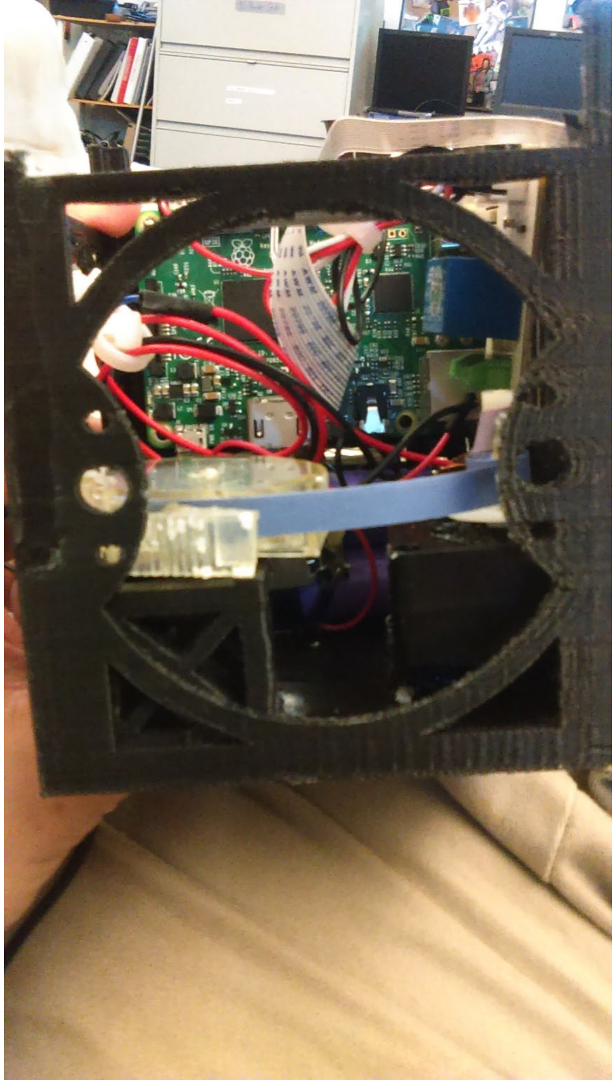
- Send through the antenna

HABScope

- Used infrared cameras to do infrared Astronomy
- First Capitol Project to use attitude Stabilization
- Could not fly for RockSat mission as it was too heavy

Cloud 360

- Was a mission that was created for the Capitol Brazil program
- Took PH readings and 360 degree video for the entire flight
- Correlate the PH data to the specific cloud



Hermes

- The purpose was to use triangulation to locate the payload.

- GPS at high altitudes is not allowed

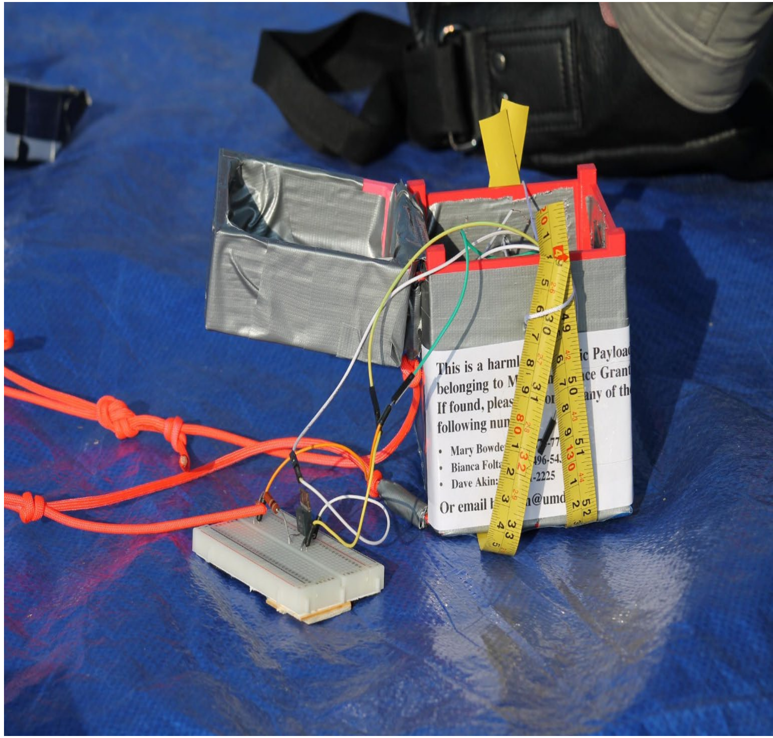
- Iridium module was used instead

TrapSat Burn

- Wanted to test burning nichrome wire to expose aerogel

- Flight was successful

- Programmed with 10-15 minute delay before the burn



Why it Matters?

- Builds technical skills
- Establishes career skills
- Builds confidence

Technical Skills

- It’s a hands on experience
- Helps to learn about payload requirements
- Working across majors
- Can evolve your project into a sounding rocket
- HAB skills translate to NASA projects

Carl Hansen with APRS

Career skills

- Working on a multi-disciplinary team
- It helps with networking
- It improves your people skills
- Dealing with deadlines
- Working across institutions

MDSGC Vice President (Dr, Terry Teas), President (Dick Henry) and Dr. Mary Bowden

Acknowledgements

- Thank you to the Maryland Space Grant Consortium (MDSGC) for making our projects and ideas possible

Special Thanks to Advisors including:

- Allison Evans
- Cinnamon Wright
- Dr. Mary Bowden
- Dr. Terry Teas

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