Making New Mexico a Space State

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Science, Technology and Telecommunications Committee (STTC)

Overview

- The global space economy is estimated to grow over 400% in the next 20 years to above $2.5T annually
- This growth is driven by innovations that dramatically lowered launch costs ($/kg to Low Earth Orbit)
- The State of New Mexico is uniquely positioned to become a leader in commercial space
- Leverage: Spaceport America, AFRL, SNL, LANL, New Space New Mexico's Unite & Ignite Space and the State's Research Universities (UNM, NMT and NMSU)

Actions

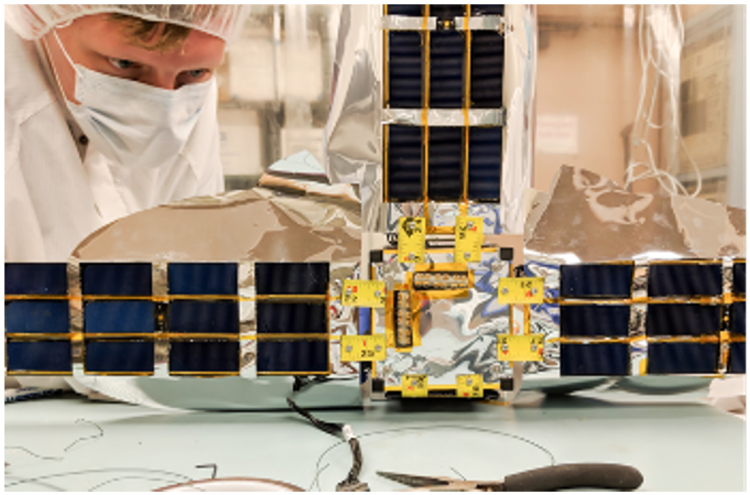
- A well-trained **workforce** is a crucial element for attracting the space industry to NM
- New Mexico must evolve from a *Test and Evaluation* center to *Research and Development* center
- Enhance Space-STEM educational pathways
- Utilize student projects to bridge the gap between classroom learning and application
- Build faculty involvement in the space innovation ecosystem
- Foster partnerships between Universities and the Commercial Space Industry

NMSU NanoSat Lab Model

The NMSU Nanosat Lab's INCA Mission has demonstrated success in workforce development for the space industry.

Fast Facts:

- AFRL – University Nanosat Program
- Collaboration with NASA/GSFC (foundation for two other program with GSFC)
- 81 Undergraduates
- 5 Masters
- 2 PhD
- 2 Companies
- Launching this Fall
- 72% of graduates are working in the space industry
- 5 student at AFRL
- 49% URM and 28% Female



Science, Technology and Telecommunications Committee (STTC)

NMSU Industry Partnership

SPiN: Simplify Space Manufacturing

- AFRL Hyperspace Challenge (Fall 2020)
- NASA MSTTR proposal
- AFRL SBIR proposal
- NSF SBIR proposal
- Office opened in NM
- Taylor Burgett (NMSU Grad Student Hired)
- Arrowhead Center - NSF I-Corps
- Highly aligned with AFRL "**plug and play**"

NMSU Industry Partnership

Northrop Grumman - Satellite Alignment System

- Mission and satellite design project
- Elements moved to senior capstone design class
- Reviews done with NGC
- **Autonomous proximity operation - docking**
- 28 students over two years

NMSU Industry Partnership

C6 Launch Systems Inc

- Canadian launch company
- Spaceport America - Rocket engine test stand
- Zac Holt
- Office in NM
- Low cost access to space

NMSU Industry Partnership

Canadian Space Mining Corporation

- Related funding from NASA - *MUREP Advancing Regolith-related Technologies & Education (MARTE)*
- Connection with NSF - *Engineering Research Center for Bio-mediated and Bio-inspired Geotechnics (CBBG)*
- Dr. Douglas Cortez (Civil Engineering)
- NASA's **Artemis** missions to the Moon.

NMSU RPSP: *Commercial Space New Mexico*

New request of $550,000

Goal: Use New Mexico State University to drive economic expansion in New Mexico by supporting the emerging commercial space sector.

Objective 1: Grow human capital at NMSU to innovate new technologies for commercial space by providing development grants to promising concepts and partnering with the space industry.

Objective 2: Train faculty, staff, and students in the commercialization process and connect researchers with potential partners in industry and at the National Laboratories.

Objective 3: Provide students with the hands-on training in the development and commercialization of technologies for space. Combined with the exceptional academic programs at NMSU, this training will address the workforce needs to attract companies to New Mexico.

Objective 4: Work with the New Mexico Space Grants Consortium to develop a robust outreach program to establish vital K-12 pathways to engage and inspire students to pursue STEM degrees linked with space fields.

SCHOOL OF ENGINEERING

School of Engineering & Economic Development In the Aerospace Industry

- Founding member of the New Space NM group
- Sponsored the STEM Boomerang initiative.
- Part of the New Mexico Small Business Assistance Program (NMSBA) run by Sandia National Laboratories.
- Received NSF grants to place students in summer internships with companies.
- Online aerospace Master's Program available to all companies at NM and beyond
- Startup companies by Faculty

SCHOOL OF ENGINEERING

COSMIAC
(UNM's Aerospace Research Center)
30,000 square foot facility

- **Provides excellent design capabilities including laboratories, offices and cleanroom space for student training and industry collaboration**
- **All COSMIAC personnel in New Mexico are US citizens with active security clearances (up to TS or Q for DOE)**
- **COSMIAC consists of approximately 60 staff, students, consultants and faculty**
- **COSMIAC manages approximately $50M in contracts**

incubator

COSMIAC Technology Consortium

A major portion of the COSMIAC's UNM charter is the acceleration of business in New Mexico.

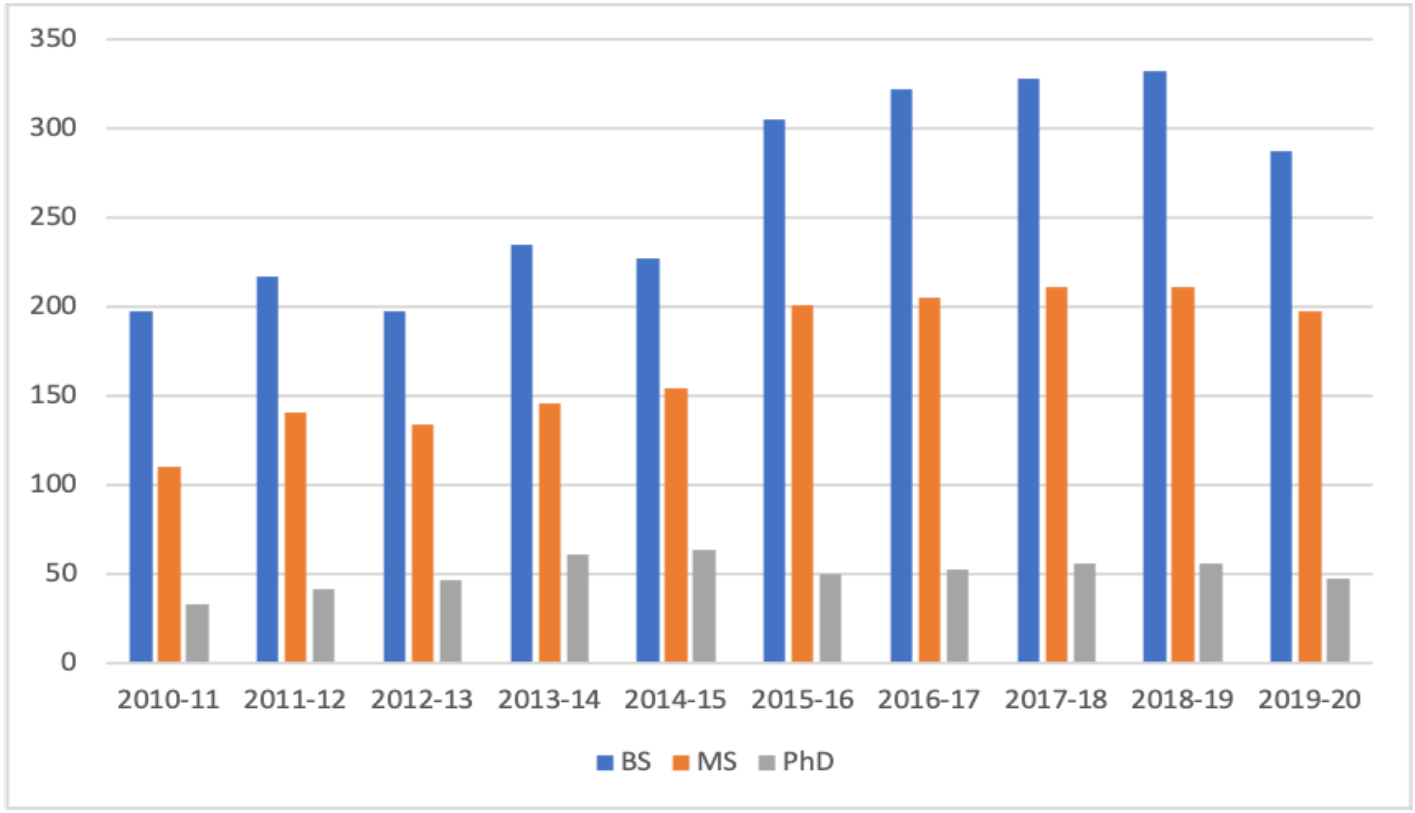
COSMIAC's hosts small businesses throughout the 30,000 square foot facility

- Acme – Expertise in Precision Acquisition, Tracking, and Pointing; Environmental emulation; Rapid prototyping; Product design; Emergent optimization algorithms; Laser and RF Communications
- Opticslah – Expertise in optical spectroscopy, femtosecond and nanosecond laser development, laser machining – tOSC and Opticlah now have joint contract together – synergism happens…
- Counter Drone – Cleared UAV capabilities
- Raven Defense – Experts in advanced RF systems and integration supporting satellite communications, directed energy, telemetry, command and control, and flight test activities
- AEgis Technologies/BlueHalo – Expertise in Modeling and Simulation
- Canyon Consulting – GNSS Systems expertise
- Prewitt Ridge – Develops engineering collaboration tools that eases inter- and intra-team friction when designing or assessing complex systems
- Sceye – High altitude persistent earth observation and communications
- emTruth – Provides secure immutable data tracking with Blockchain technology

COSMIAC

SCHOOL OF ENGINEERING

Engineering Degrees AY 2010-20



SCHOOL OF ENGINEERING

Workforce Development

Bridging the gap between academia, government and industry by having student interns work on projects driven by local organizations and COSMIAC engineers

- Projects directly related to the work of the sponsoring organization
- Removes necessary day-to-day supervision, hiring process, security clearance acquisition, etc.
- Utilizes COSMIAC laboratories, software, hardware and high bay space
- Builds the talent of people who are interested in staying in the area

Student's Assembling 3m Dish System

Spaceport America Cup

SCHOOL OF ENGINEERING

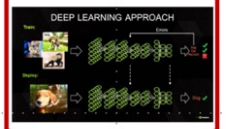
Partners

- AFRL Space Vehicles and Directed Energy Directorates
- Sandia National Laboratories
- NASA
- Millennium Engineering and Integration Company (RISE)
- Northrop Grumman
- Honeywell
- Sceye
- AEgis Technologies (under D3I HSV and SCRA ABQ)
- Engility/SAIC (under EDIS)
- Blue Halo
- Leidos
- Verus Research and other small businesses

SCHOOL OF ENGINEERING

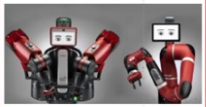
Joint AFRL/UNM Center of Excellence In Agile Manufacturing

Machine Learning
Deep Learning



Multi-material
Additive
Manufacturing

Intelligent
Robotic
Assembly

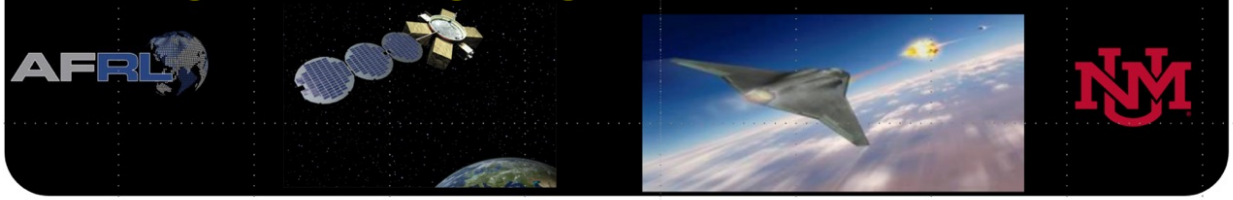


Machine Vision

Advanced
Manufacturing

BASIC RESEARCH

Agile Manufacturing for High-Value, Low-Volume Production



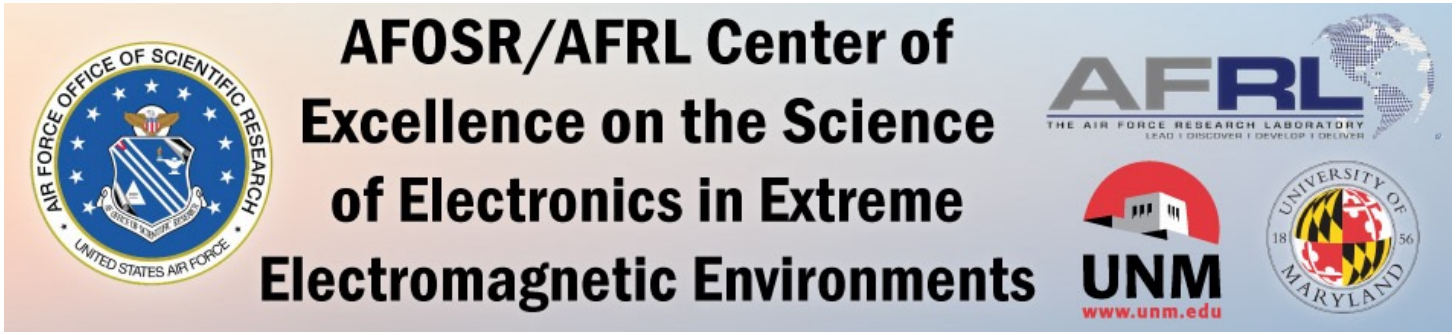
PRODUCT

Civil Engineering (CE)	Computer Science (CS)	Electrical & Computer Engineering (ECE)	Mechanical Engineering (ME)
Smart Materials and Structures	Adaptive Motion Planning Machine Learning	Computer Graphics Lab Hybrid Sys & Controls Lab MARHES Lab	Manufacturing Engineering Program ASEMlab

INFRASTRUCTURE

SCHOOL OF ENGINEERING

AFOSR/AFRL Center of Excellence
UNM



SCHOOL OF ENGINEERING

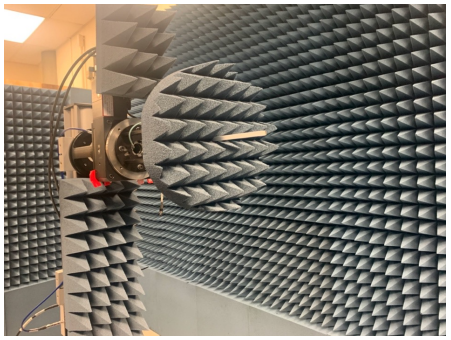
Satellite Communications

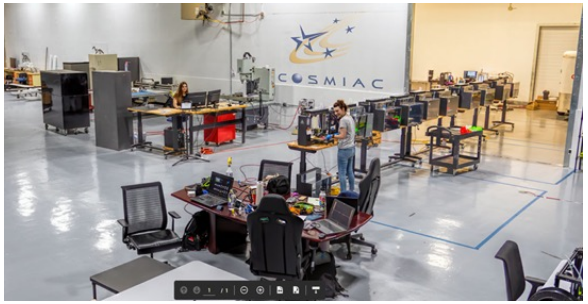
- Working closely with AFRL Communications Research Groups (FSC/WSCE)
- Three different ground stations operating 24/4
- X-band phased aperture array system

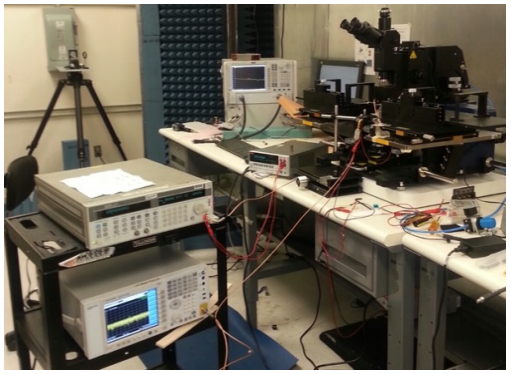
ATLAS SPACE OPERATIONS

SCHOOL OF ENGINEERING

Our Research Labs are available for usage by Industry







New Mexico Tech – NM Space State

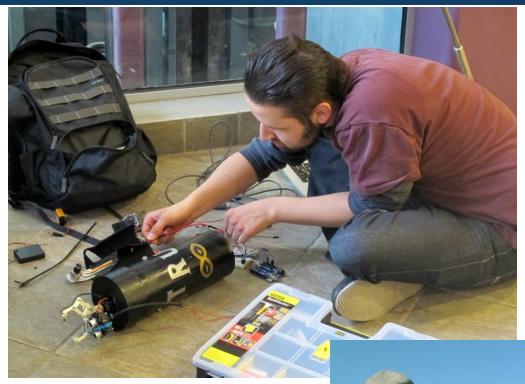
Dr. Andrei Zagrai, Professor of Mechanical Engineering
Dr. Michael Hargather, Associate Professor of Mechanical Engineering
Dr. Van Romero, Vice President for Research

NEW MEXICO TECH
SCIENCE • ENGINEERING • RESEARCH UNIVERSITY

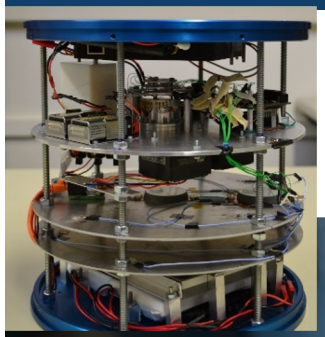
August 26, 2021

New Mexico Tech is engaging students, industry, and national agencies in development of space technology and applications

- Students are engaged in space related activities from the freshman through senior, to graduate levels
  - MENG 110 Freshman Design students build rockets and computer-program Arduino payloads to measure data during flight
  - MENG 305 Numerical Analysis students launch rockets for experimental data to use throughout the semester
  - MENG 381/382/481/482 Junior and Senior Design teams engage with industry sponsors on rocket and payload development
  - Aerodynamics and propulsion classes are taught at undergraduate and graduate levels regularly
- Additional activities are ongoing across campus in Electrical Engineering, Materials Engineering, Chemical Engineering, and other departments
- NMT activities are supported by faculty research and corporate engagement



Suborbital Rocket Launches allows testing space structures to prevent failures, save lives and reduce flight costs



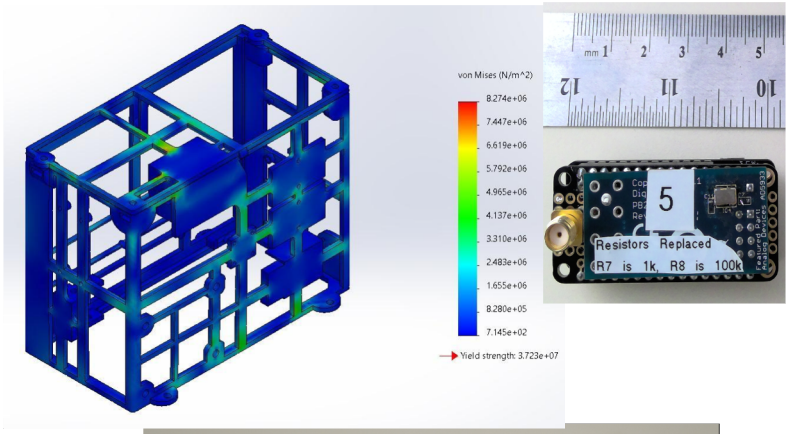
- Students designed, built and launched payloads that assess structural integrity of spaceships in real time.

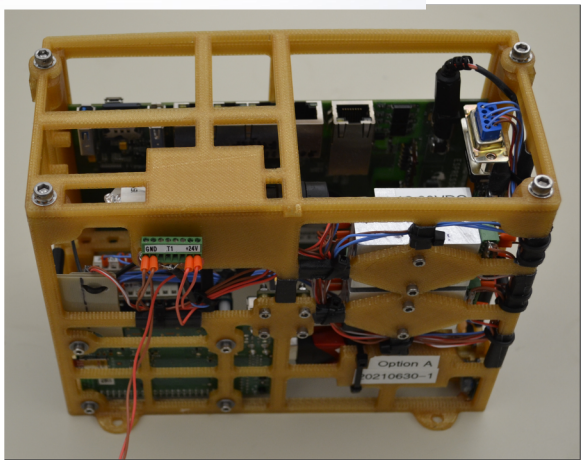
UPAerospace SpaceLoft Rocket with NMT Payload

First active ultrasonic structural test in space

NMT has an ongoing cooperation with Immortal Data Inc to develop new flight recorders for space vehicles

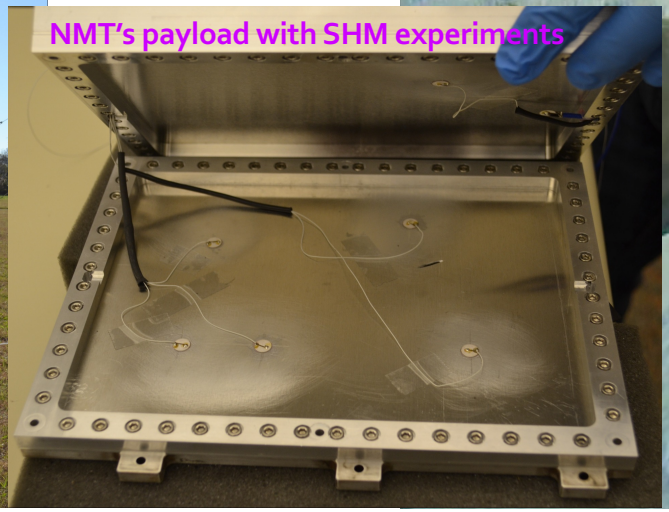
- The purpose of this cooperative efforts is to design, build, and fly the first-generation distributed blackbox with on-board SHM system.
- Undergraduate student team designed and fabricated the payload for suborbital flight. Graduate students worked on SHM experiment.
- Suborbital flight is scheduled for Nov. 2021 from Spaceport America.



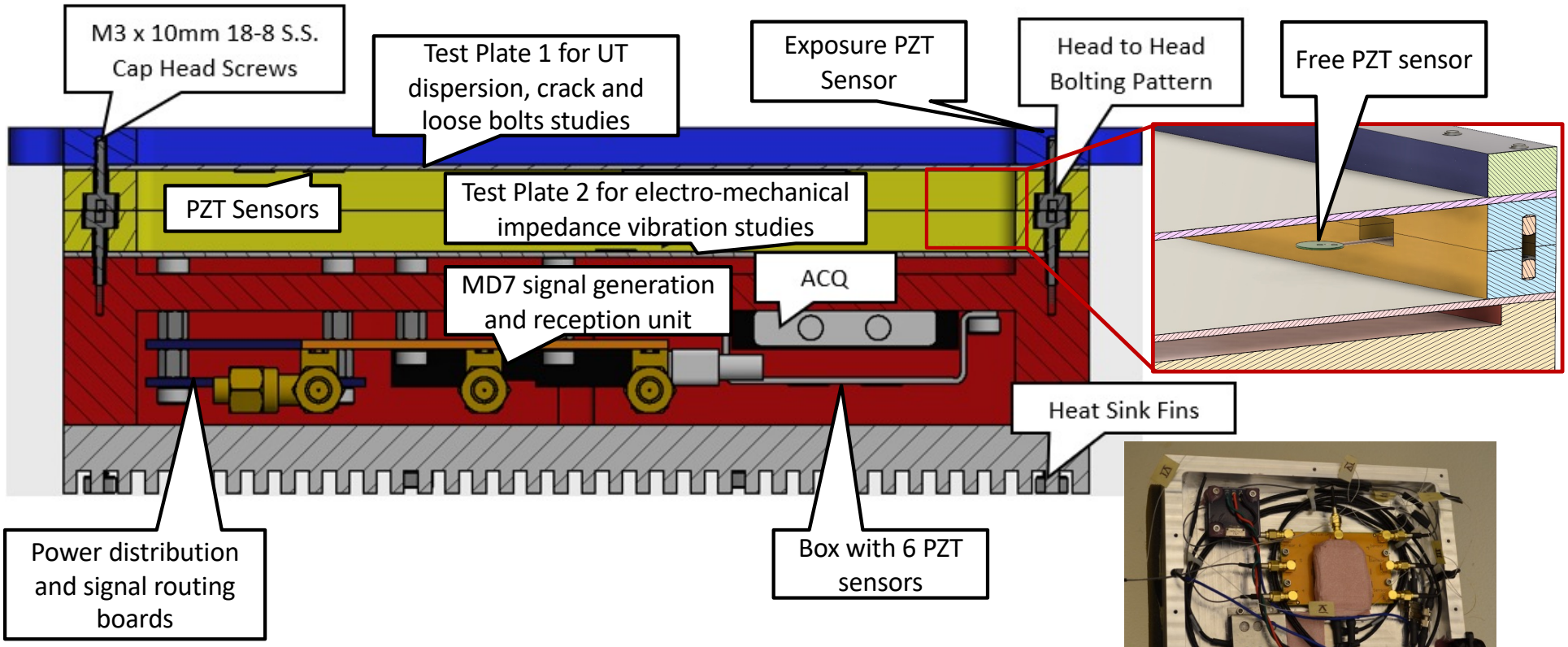


New Mexico Tech on ISS

- Previous flights from Space Port allowed New Mexico Tech to develop Structural Health Monitoring (SHM) payload for International Space Station (ISS)
- Payload was launched as a part of MISSE-12 platform on NG-12 ISS resupply mission 2 Nov 2019 and returned in Jan 2021.

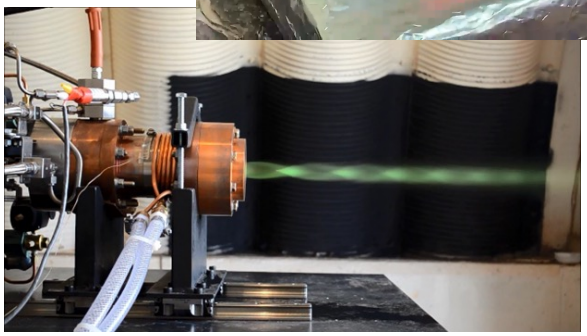


ISS SHM Payload Design



Propulsion research and development is focused on additive manufacturing of solid propellants and green liquid propellants

- 3D printing of solid rocket propellants is an ongoing collaboration with X-BOW Launch Systems
  - Started in 2018 funded via DARPA SBIR
  - X-BOW now employs over 50 individuals in the state, including 4 NMT graduates at undergrad and grad levels, offices in Albuquerque and Socorro
  - 2 NMT professors are listed as co-inventors on patents submitted by X-BOW for additive manufacturing of rocket motors
  - Work has supported ~8 students at NMT at undergrad and grad levels
- Sandia National Laboratories invested in development of green liquid propellants with nitrous oxide and ethanol
  - Laboratory-scale rocket facility built at EMRTC
- Los Alamos National Laboratory novel propellant test flights conducted by NMT Mechanical Engineering



NMT students have been launching rockets at Spaceport America for over 5 years, will compete in Spaceport America Cup this year

- NMT has partnered with White Sands Research and Developers, a small business from Las Cruces, for design teams from 2016-2020
- Currently transitioning to Spaceport America Cup competition
- Historical external funding through NM Space Grant Consortium
- Students build entire rocket, instrumentation payload, launch system
- Former design students employed by SpaceX, Blue Origin, and othe companies

Future developments and capabilities

- Ongoing partnerships with National Laboratories, AFRL, White Sands, and Spaceport America here in the state
- Expanding university research with federal agencies and industry partners
  - Faculty research laboratories
  - Energetic Materials Research and Testing Center (EMRTC) facilities for energetic materials manufacture, testing, and development
- Training of students to prepare them for jobs with Aerospace industry