



# The University of New Mexico Research Center COSMIAC

Federal EIN No: 85-6000642

NAICS ID(s): 611310

UEI No: F6XLTRUQJEN4

Cage Code: 6T086

SIC Code: 82,822



# Introduction and Overview



- COSMIAC is a Research Center under the School of Engineering at the University of New Mexico. UNM is a minority serving academic institution
- COSMIAC's Mission Statement - To provide a dynamic work environment where faculty and students find fulfillment and enjoyment in providing technical engineering solutions for our clients that correlate to ever-changing technologies
- COSMIAC's 30,000 square foot facility provides excellent design capabilities including laboratories, high bay, offices and cleanroom space
- 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 and holds approximately 95% of all of UNM's security clearances



# COSMIAC Differentiators

- Local and experienced - Headquartered in Albuquerque, COSMIAC knows what it takes to run a highly successful research center in New Mexico. We bring 15 years of engineering experience
- Only one organization in Albuquerque produces cleared new college graduate engineers
- Extensive reach back to the largest research university in New Mexico
- Ability to go from concept design to deliverable product in an efficient and affordable fashion.
- Agile group of cleared engineers in a wide variety of different specializations



# Services and Focus Areas

- Telecommunications
- Positioning, Navigation and Timing
- Targeted Research and Development services to meet the needs of our customers
- Facilitation and oversight of technical collaborations
- Satellite development, demonstration and flight opportunities
- Rapid Prototyping with additive and subtractive manufacturing
- Services and support for radiation analysis and testing
- VR/AR, machine learning and GPU processing
- Signal Processing and Remote Sensing Artificial Intelligence
- C-sUAS Drone building and government testing



# Current Projects: Radiation

## Radiation Testing – Government

- Perform Total Ionizing Dose and Single Event Effects testing and analysis
- Modeling and Simulation of space effects
- Working for DTRA to develop Mil-Std for radiation hardening of spacecraft and missiles

## Radiation Testing – Private Industry

- Performed parts radiation testing for Blue Origin, SEAKR and other commercial and government organizations
- CRADA in place to support corporate testing at Kirtland Air Force Base

## Travel to Test

- Capabilities for TID, FXR, LINAC and other sources within NM to avoid company complexities with COVID



Testing Solar Panels



Flash X-ray Testing



Heavy Ion Testing



Students Reviewing Radiation Test Data



# Current Projects: SATCOM

## Satellite Communications

- Two different ground stations operating 24/7 supporting government missions
- MC3 ground station supporting NPS/NRO distributed ground station architecture - decoding packets daily
- 3m dish for USB operations



Mobile CubeSat Command & Control



3 Meter Dish



COSMIAC Facility with SATCOM Equipment

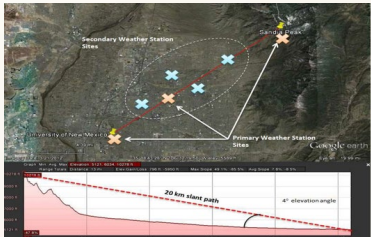


SATCOM Room



# Current Projects: W/V Band

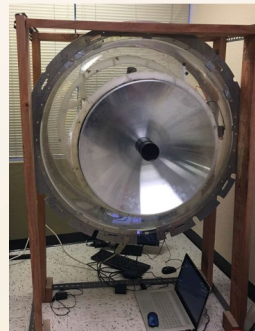
- W/V-Band Atmospheric Prorogation Research – joint activity with AFRL and NASA GRC. The W/V-band Terrestrial Link Experiment (WTLE) has been operational since October 2015 supporting AFRL flight experiment (WSCE-B)
  - 24km link used to characterize rain attenuation, depolarization, scintillation, and gaseous absorption effects of the atmosphere in the W and V-bands



24 Km Test Range



Long Range Testbed



V-Band Antenna Testing



Communications Control System



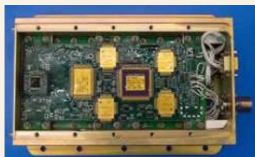
# Current Projects: RHEME

## RHEME: UNM's First ISS Experiment

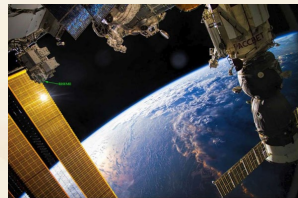
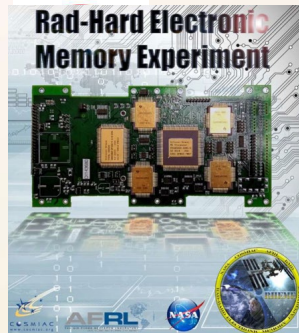
- Working with NASA and AFRL to measure radiation in space and its effects over memory ICs.
- FPGA (Virtex 5) at the core of the system for control and communications with the ISS
- Testing SEU mitigation schemes at the architecture and system levels
- RHEME was launched on STP-H5 (Currently on the ISS), RHEME-II STPSat-5 (LEO-Polar – on orbit), and RHEME-III STP6-M18 (GEO – launched Dec 21)



System Component



Rad-Hard Electronics in Practice



RHEME on ISS





# Current Projects: Machine Learning

**Machine learning improves software-based decision making**

**Nvidia GPUs accelerate development of neural networks**

- COSMIAC has a dual NVidia Titan platform with a total of 9216 Cuda enabled cores and 48 GB of GPU RAM
- Amazon Web Services allows for on demand acceleration
- AWS.GOV provides pathway for secure processing/documentation

**Deep Learning:**

- Taking advantage of the above platforms, COSMIAC can create large neural networks that can be deployed to embedded platforms
- Enable remote platforms to decide what to do with big data
- To transmit or not to transmit – efficient use of bandwidth
- Publications at various conferences

*We study machine learning to provide intelligent solutions to engineering challenges*



Frame Segmentation (Tramway/ Montgomery)



Image Recognition



Object Detection (NanoRacks ISS)



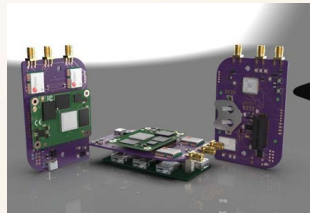


# Current Projects: SatNavTA

**Current activities for SatNav Technology Area (SatNavTA) involve:**

- Specializing in Software Defined Transmitter (e.g. ORDWG) and Software Define Receiver embedded systems and software
- Developing SDR technology to receive and measure the effectiveness of advanced signals
- Drone countermeasures
- Developing, training, testing, and deploying Machine Learning Algorithms for threat detection, prediction, and mitigation
- Developing a distributable machine learning toolset with a diverse set of model deployment options (FPGA, GPU, ARM, TPU, VPU, etc)
  - Custom Ubuntu Linux build called MLTos
- Creating a standard database of GNSS signals to serve as a benchmark for future machine learning development

**Supporting the AFRL SatNav Technology area (SatNavTA) Program and the Joint Navigation Warfare Center (JNWC)**



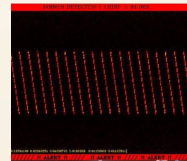
Sensor Board for ML Research



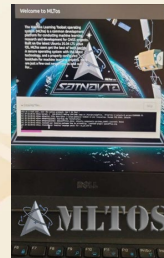
MLTos Reference Design



Hardware Platform for Ref. Design



Threat Detection using MLTos



Machine Learning Operating System



# Current Projects: Rapid Manufacturing and Testing

## 24-Hour Manufacturing Facility

- Went from Authorization to Proceed to full production in eight days producing 500+ face masks and 500+ face shields per week for COVID relief
- Full array of additive and subtractive manufacturing capability to include 3D Printing of high temperature materials for aerospace and defense applications
- Class 1000 cleanroom
- Designed to support field testing at a moments notice
- US only facility
- Creating prototypes for Other Government Agencies

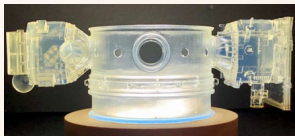


Class 1000 Cleanroom

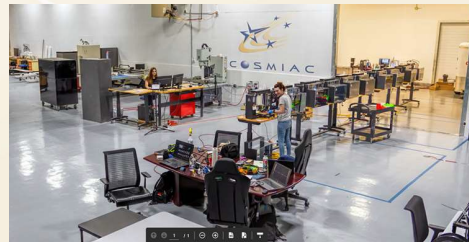


Bell Jar Vacuum Chamber

3D Printed Satellites



Launchpad Subtractive Manufacturing



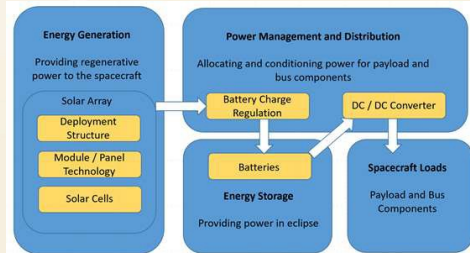
Launchpad High Bay



# Current Projects: Advanced Space Power Prototyping

## Program created in May 2021

- Wide Band Gap Semiconductors for improved power density and efficiency
  - more power for less heat and weight
- Digital control for versatility and reusability
  - same control board can be used in different converters, just change the code to add MPPT or your favorite battery charge algorithm
  - software can be ported to different CPUs and FPGAs for Rad-hardening or to alleviate supply issues
- Modular Design for reliability and reconfigurability
  - N+1 redundancy, and the ability to configure several different power systems from a few modules/building blocks





# Current Projects: SSPIDR

## Space Solar Power Incremental Demonstrations and Research

- Creating prototypes to allow for testing and academic outreach
  - 1000+ middle and high school students attended outreach
- Supporting bus development
- Providing administrative support for team operations



Students Working with Beam Box



Space to Space Power Beaming Demonstration



- A LEctenna is a rectifying antenna (rectenna) with a light emitting diode (LED)
- Space Solar Power, also known as Space-Based Solar Power, moves the solar panels from the Earth's surface to orbit. In space, there is less atmosphere and clouds to get in the way of the sun's rays. This means that the solar panels can collect much more energy than on Earth's surface

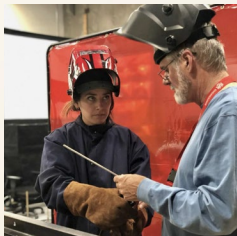


# COSMIAC Workforce Development

**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 local area

Student's Assembling  
3m Dish System



Learning to  
Weld



Student Incubator



# Contact Information

- Director  
Mr. Brian Zufelt  
– 505.314.3756 /  
[brian.zufelt@cosmiac.org](mailto:brian.zufelt@cosmiac.org)
- NASA Lead  
Ms. Samantha Korfe  
– 505.250.5289 /  
[samantha.korfe@cosmiac.org](mailto:samantha.korfe@cosmiac.org)
- Chief Engineer  
Dr. Andrew Cochrane  
– 505.876.7420 /  
[andrew.cochrane@cosmiac.org](mailto:andrew.cochrane@cosmiac.org)
- Deputy Director  
Mr. Craig Kief  
– 505.934.1861 /  
[craig.kief@cosmiac.org](mailto:craig.kief@cosmiac.org)
- Office Manager  
Ms. Maria Daw  
– 505.414.7825 /  
[maria.daw@cosmiac.org](mailto:maria.daw@cosmiac.org)
- Office of Sponsored Projects  
Ms. Denise Vigil  
– 505.277.4642 /  
[cdvigil4@unm.edu](mailto:cdvigil4@unm.edu)