

# CSU Department of Defense (DoD) Awardees

Moderated by:

Dr. Frank A. Gomez  
Executive Director, STEM-NET  
Office of the Chancellor



<https://www2.calstate.edu/impact-of-the-csu/research/stem-net>

## Speakers

**Reginald Williams, Department of Defense**

Department of the Navy's (DoN ) Historically Black Colleges Universities and Minority Institutions (HBCU/MI)Program

**Abraham Wolcott, San José State University**

Diamond Surface Science, Synchrotron Radiation and the Transition Edge Sensor Detector

**Scott Hauswirth, California State University, Northridge**

Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

**Daniel Fernandez, California State University, Monterey Bay**

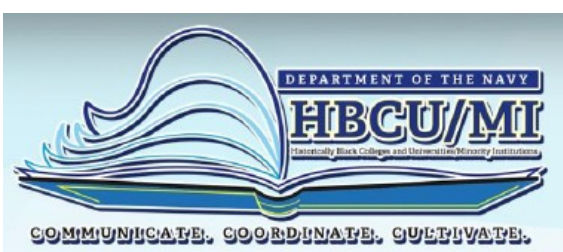
An Infusion of DoD Equipment Funding to Help Advance an Existing Fog Research Program: My Experience

**Joseph Kalman, California State University, Long Beach**

DoD Funded Solid Propulsion and Combustion Research at CSULB

**Akm Newaz, San Francisco State University**

Electrical and Optoelectrical Properties of Natural Van der Waals Heterostructures



## Department of the Navy's (DoN ) Historically Black Colleges Universities and Minority Institutions (HBCU/MI)Program

# Department of the Navy's (DoN ) Historically Black Colleges Universities and Minority Institutions (HBCU/MI)Program

*Reginald Williams – Department of Defense*

***Keynote Speaker***

**Reginald Williams**, Program Officer

Office of Naval Research

[reginald.g.williams@navy.mil](mailto:reginald.g.williams@navy.mil)

**Diamond Surface Science, Synchrotron Radiation and the  
Transition Edge Sensor Detector**

*Abraham Wolcott – San José State University*

**Reginald Williams**, Program Officer

Office of Naval Research

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# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

## Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

*Scott Hauswirth – CSU Northridge*

*Collaborators (if any):*

***Priya Ganguli, Jennifer Cotton, Eileen Evans, Robinson Cecil,  
Joshua Schwartz, and Julian Lozos***

**Scott Hauswirth**, Assistant Professor

CSU Northridge, Department of Geological Sciences

[scott.hauswirth@csun.edu](mailto:scott.hauswirth@csun.edu)

# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

## Project Overview

- DoD Program: *“Research and Education Program for Historically Black Colleges and Universities and Minority-Serving Institutions Equipment/Instrumentation Grant”*
- A possibly different approach to a DoD instrumentation proposals
  - Geology and environmental science at DoD?
  - Multiple instruments for disparate research focuses?
  - All PIs first-time DoD grant proposers
- Lots of questions on our end:
  - Is there DoD interest?
  - Is it cohesive?
  - What angle for this proposal?

**Scott Hauswirth**

CSUN/Geological Sciences

[scott.hauswirth@csun.edu](mailto:scott.hauswirth@csun.edu)

# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

## Project Overview

- Aimed to create a GeoAnalytical Center within CSUN Dept. of Geological Sciences (DGS) with some degree of cohesion that will:
  - Provide structured, centralized facilities to advance the department's research capabilities
  - Expand research opportunities for graduate and undergraduate students
  - Promote integration of laboratory and computational methods into both upper and lower division courses
  - Promote use of equipment for community outreach

# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

## Project Overview

- Includes purchase of **six** instruments/pieces of equipment supporting **all five junior faculty** in the department plus 2 others
- Suite of instrumentation highlights interdisciplinary nature of research in dept.:
  - “traditional” geology
  - environmental science
  - paleobiology/climatology
  - geophysics/seismology
- And there is DoD interest in these areas!



# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

## Project Overview

- Equipment adds new capabilities and expands capabilities of existing facilities.
- Instruments:
  - Isotope ratio mass spectrometer (IRMS+EA +TC/EA +GC+Gas bench) (Cotton, Hauswirth, Ganguli)
    - Measuring stable isotope ratios for C, H, N, O, S (potentially others) in:
      - Soil, water, solids (rocks, biological materials, etc.)
  - Inductively couple plasma mass spectrometer (ICP-MS) (Cecil, Schwartz, Hauswirth, Ganguli)
    - Measuring metals concentrations (and isotope ratios) in rocks/minerals, soil, and water
    - Will be connected to existing hi-res ICP-MS with laser ablation system to allow simultaneous measurement of Pb/U (for age-dating rocks) and trace metals

# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

## Project Overview

- Other equipment:
  - Ion chromatograph (IC) (Hauswirth, Ganguli)
    - Measures concentrations of ions (chloride, sulfate, nitrate, etc.) in water
  - Ground penetrating radar (GPR) (Evans, Hauswirth, Ganguli)
    - Allows detection of subsurface structures (human-made or natural)
  - Electrical resistivity system (Evans, Ganguli, Hauswirth)
    - Measures subsurface electrical resistivity for identifying subsurface structures, fresh/saltwater interface
  - Computing node to expand seismological modeling capabilities (Lozos)

# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

## Activities

- So far: purchasing + installing equipment!
  - IC operational since Fall 2019, ICP-MS installed Winter 2020-21, IRMS system installed April 2021
  - Other equipment coming soon



IRMS  
System

**Scott Hauswirth**

CSUN/Geological Sciences

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# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

## Activities

- Example projects:
- Effects of wildfires on water quality – ongoing project investigating Malibu Creek watershed after Woolsey fire.
  - Polycyclic aromatic hydrocarbons (PAHs) – toxic/carcinogenic, released during fire.
    - What are concentrations in watershed? How long do they persist?
    - What is the source? (Also from exhaust, petroleum, etc.) → measure C, H isotopes of individual PAH compounds with **IRMS** system to differentiate source
  - Ions released during fire → measure with **IC**
  - Metals released + increase transport due to increased sediment → measure with **ICP-MS**

# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

## Activities

- Contaminant cycling in coastal lagoons
  - Nutrients, metals, other contaminants transported to coastal lagoons → affect geochemistry, ecosystems
  - Mercury can be converted to toxic, bioaccumulative methylmercury in lagoons
- Nutrients → measure with **IC**, Metals → measure with **ICP-MS**
- Need to know surface + groundwater fluxes into/out of lagoons
  - Identify buried channels with **GPR**
  - Identify saltwater/freshwater boundary, measure flux with **ER**

# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

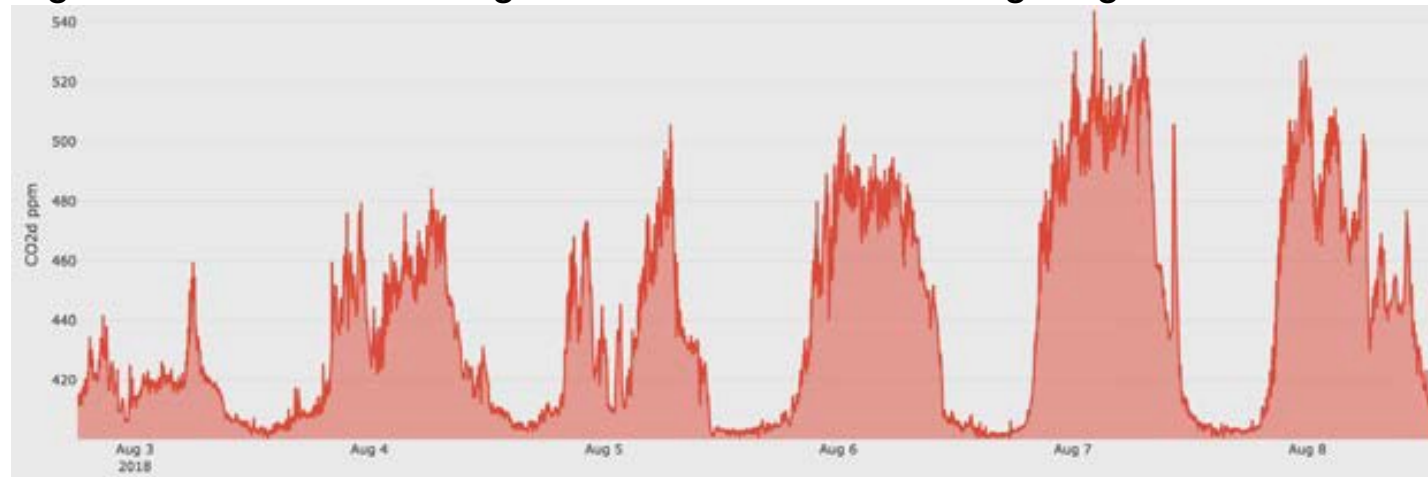
## Activities

- Integration into education
  - Large underserved population in department
  - Development of new BA Environmental Science major (currently in review)
  - Hydrogeology, Env. Hydrogeology (new), Env. Field Sampling+Analysis (new), Env. Geochemistry, Applied Geophysics courses will all include project-based components using instrumentation
  - Focus on hands-on, research-oriented education, including in lower courses, aims to expand interest in department and attract high quality undergrad and grad students

# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

## Activities

- Integration into outreach
  - IRMS frees up an existing CO<sub>2</sub>, H<sub>2</sub>O, and C-isotope analyzer → will be plumbed to roof of building + will collect real-time measurements
  - Combined with O<sub>3</sub> and PM meters → San Fernando Valley (SFV) Air Quality monitoring station
  - Will develop high school modules using the real time data + arrange high school tours



**Scott Hauswirth**

CSUN/Geological Sciences

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# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

## Lessons Learned

- Without reviews, difficult to assess what was reviewed positively. Our thoughts:
  - Strong emphasis on integration of education and outreach to traditionally underserved populations
  - Identified links with multiple DoD agencies (Earth Sciences, Littoral Geosciences, Modeling Complex Systems) + emphasized not only research, but training of students on fundamental science relevant to those divisions
  - Letter of support from researcher within DoD
  - Incorporation of junior faculty and focus on growth and new directions of department



# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

## Next Steps/Long-Term Plans

- Remaining items will be purchased + installed this summer
- Actual analyses starting soon
- Implementation into courses starting in 2021/2022 (probably Spring).

# Development of a CSUN GeoAnalytical Center for Research, Teaching, and Outreach in Earth Systems Science

## Summary

**Scott Hauswirth**

*CSUN/Geological Sciences*

*scott.hauswirth@csun.edu*



California State University  
**MONTEREY BAY**

**An Infusion of DoD Equipment Funding to Help  
Advance an Existing Fog Research Program: My  
Experience**

# **An Infusion of DoD Equipment Funding to Help Advance an Existing Fog Research Program: My Experience**

*Daniel Fernandez– California State University, Monterey Bay*

**Daniel Fernandez**, Professor

California State University, Monterey Bay, Department of Applied Environmental Science

[dfernandez@csumb.edu](mailto:dfernandez@csumb.edu)



## **An Infusion of DoD Equipment Funding to Help Advance an Existing Fog Research Program: My Experience**

### **Outline**

- A bit about me.
- Fog research.
- A hook to DoD research.
- My grant specifics.
- Suggestions for you if you choose to apply for this opportunity.
- A short time-lapse video of the FM-120 deployment.



## About Me



# An Infusion of DoD Equipment Funding to Help Advance an Existing Fog Research Program: My Experience

Daniel M. Fernandez

CSUMB Professor since 1996.  
I teach classes in Physics and  
Environmental Studies.

Since 2005, I have been involved  
in fog research, specifically,  
collection of water from fog.

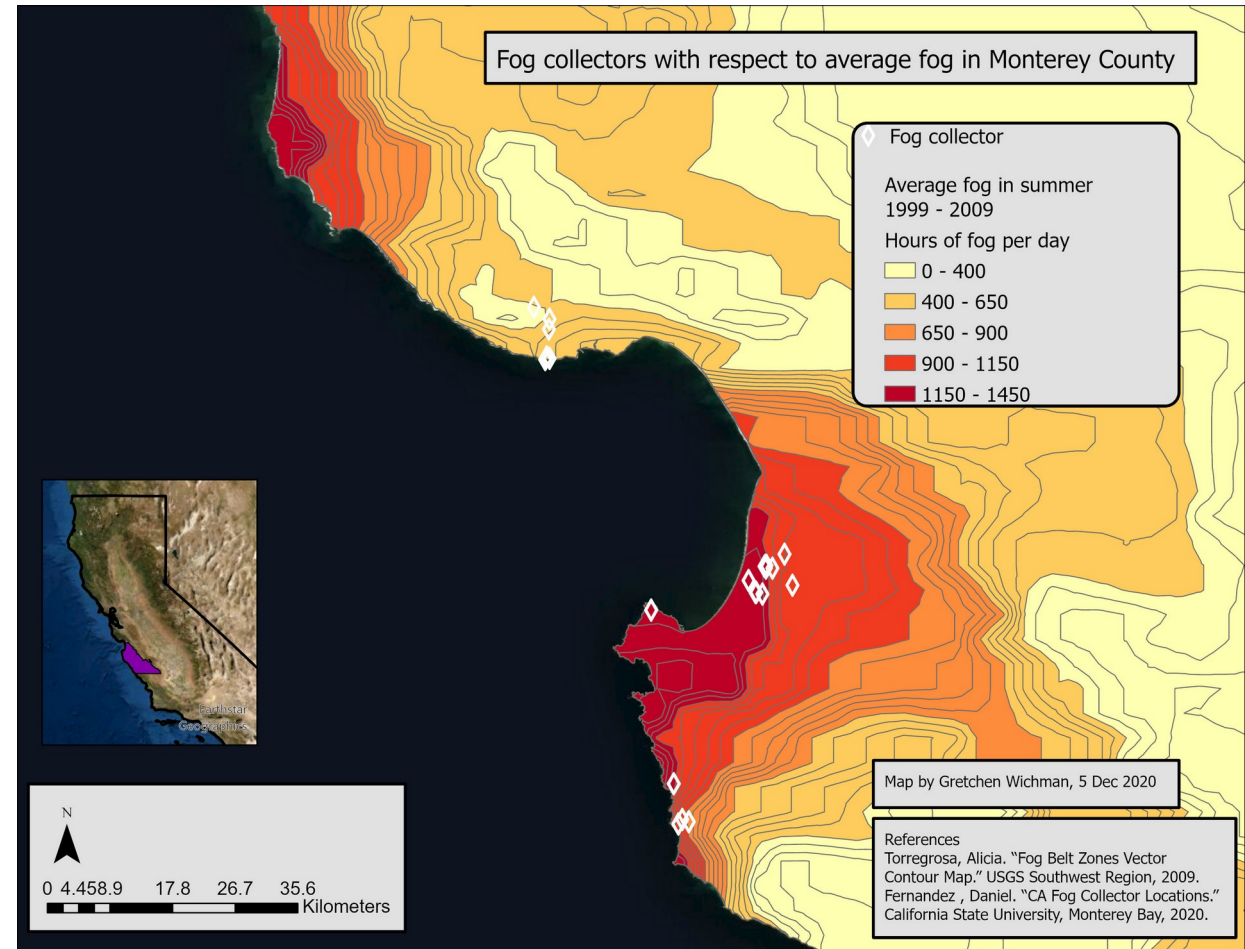
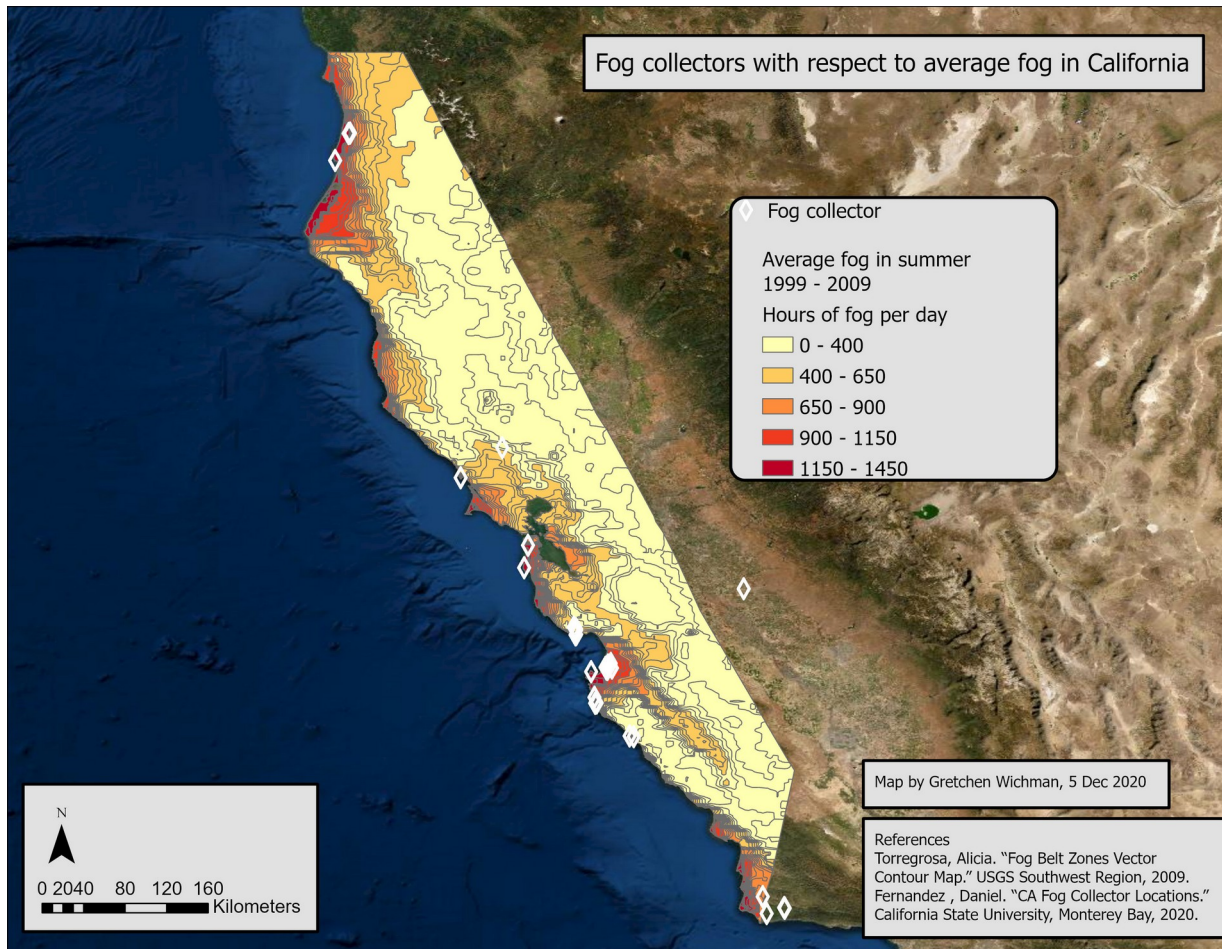




# An Infusion of DoD Equipment Funding to Help Advance an Existing Fog Research Program: My Experience

## Fog Research

- Deploys “standard fog collectors” statewide to collect and measure volumes of water from fog.







# An Infusion of DoD Equipment Funding to Help Advance an Existing Fog Research Program: My Experience

## Examples of DoD Interest

Visibility and operations in foggy environments.







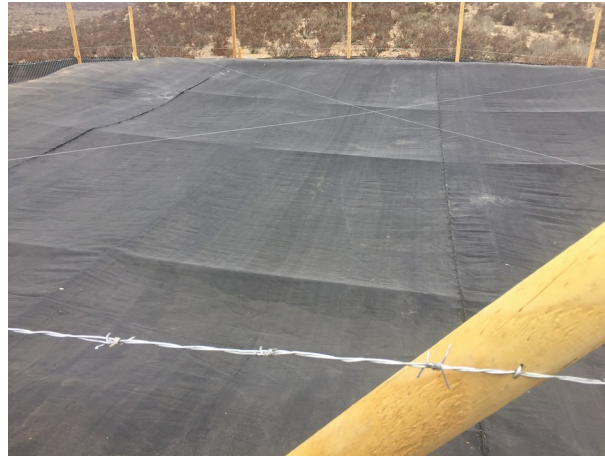
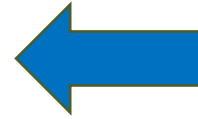
## An Infusion of DoD Equipment Funding to Help Advance an Existing Fog Research Program: My Experience

### Example of DoD Interests, ct'd

Potential for collection of usable water.





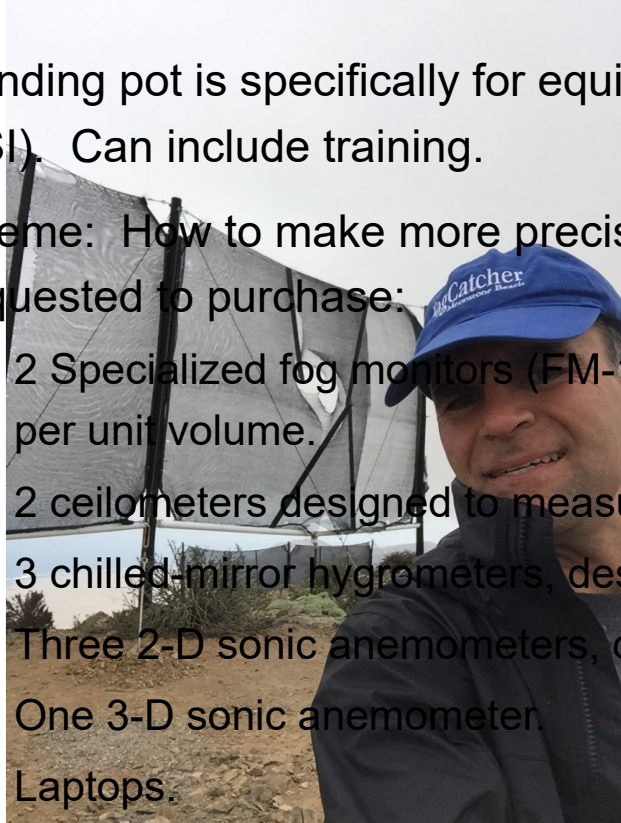




## An Infusion of DoD Equipment Funding to Help Advance an Existing Fog Research Program: My Experience

### Grant Specifics

- Funding pot is specifically for equipment (particular emphasis on HIS and on engaging students from HSI). Can include training.
- Theme: How to make more precise and exacting measurements of fog characteristics. Equipment requested to purchase:
  - 2 Specialized fog monitors (FM-120) designed to measure the sizes of and count the number of fog droplets per unit volume.
  - 2 ceilometers designed to measure the cloud ceiling height.
  - 3 chilled-mirror hygrometers, designed to measure very accurately the relative humidity.
  - Three 2-D sonic anemometers, designed to measure the wind speed and wind direction.
  - One 3-D sonic anemometer.
  - Laptops.

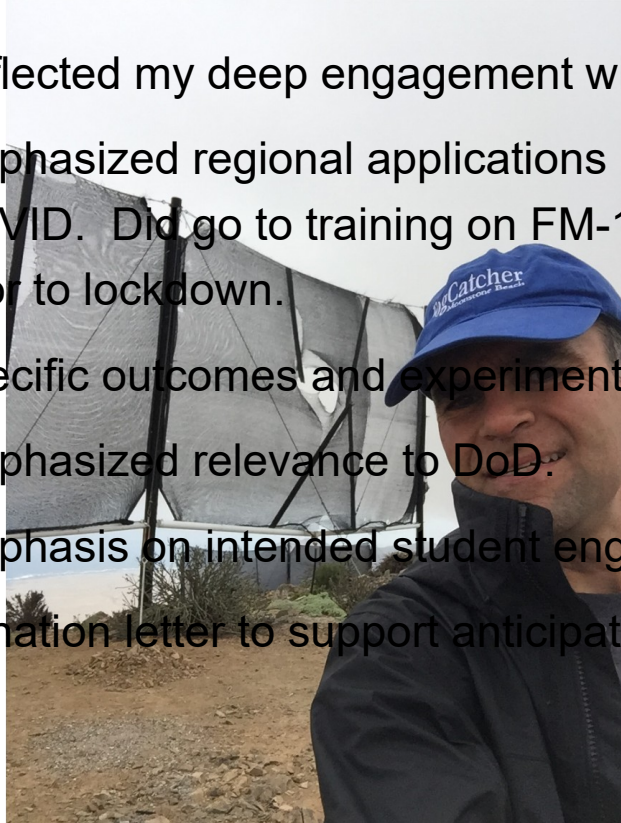




## An Infusion of DoD Equipment Funding to Help Advance an Existing Fog Research Program: My Experience

### Grant Features

- Reflected my deep engagement with this research to date.
- Emphasized regional applications (no \$ for travel included, but don't need it!). This worked out well given COVID. Did go to training on FM-120 in Colorado (right before lockdown!!). All equipment also received prior to lockdown.
- Specific outcomes and experiments anticipated.
- Emphasized relevance to DoD.
- Emphasis on intended student engagement and prior student engagement.
- Donation letter to support anticipated yearly calibration costs.







## An Infusion of DoD Equipment Funding to Help Advance an Existing Fog Research Program: My Experience

### Work thus far

- [Video of regional FM-120 deployment.](#)
- Course-based Undergraduate Research Experience (CURE) in 2<sup>nd</sup> semester physics class.



# DoD Funded Solid Propulsion and Combustion Research at CSULB

*Joe Kalman, California State University, Long Beach (CSULB)*

**Joe Kalman**, Assistant Professor

CSULB, Department of Mechanical and Aerospace Engineering (MAE)

Joseph.Kalman@csulb.edu

## Project Overview

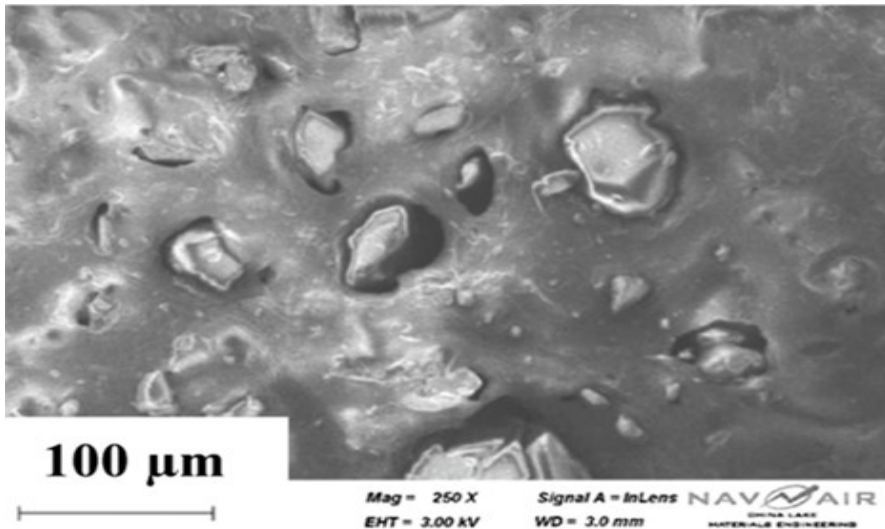
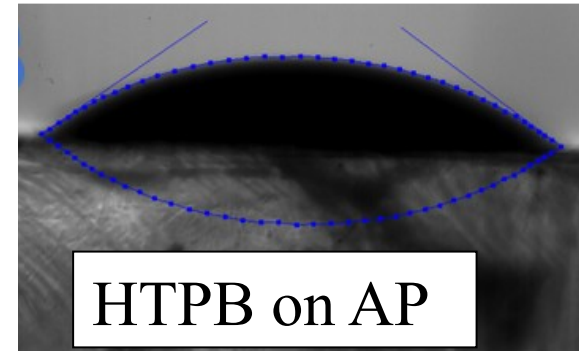
- Office of Naval Research
  - Development of High Pressure and X-ray based Diagnostics for Solid Propulsion (Advanced Energetic Materials, current)
  - Interfacial Properties towards Additive Manufacturing of Solid Propellants (HBCU/MI, current)
  - Solid Propulsion Mix and Characterization for Research in Propulsion Technologies (DURIP—equipment only, ends this year)
- Air Force Research Laboratory
  - Interfacial Physics of Propellants (ends this year)
  - Strain Measurements and Damage in Propellant Microstructures (ended)

## Project Overview

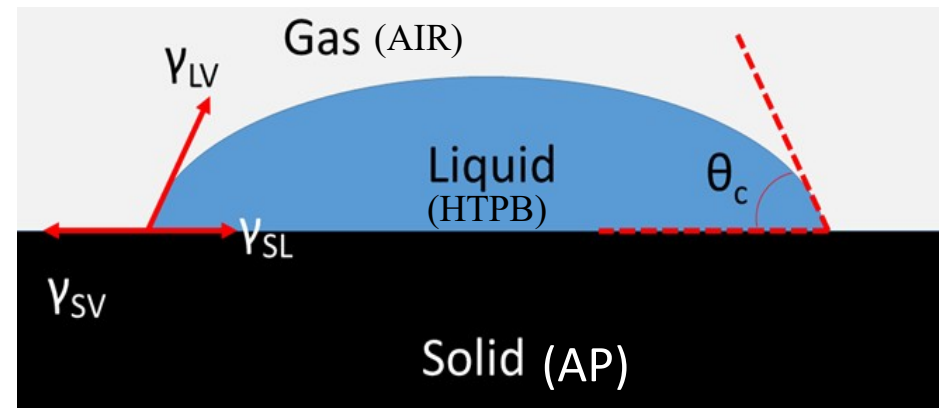
- Office of Naval Research
  - Development of High Pressure and X-ray based Diagnostics for Solid Propulsion (Advanced Energetic Materials, current)
  - **Interfacial Properties towards Additive Manufacturing of Solid Propellants (HBCU/MI, current)**
  - Solid Propulsion Mix and Characterization for Research in Propulsion Technologies (DURIP—equipment only, ends this year)
- Air Force Research Laboratory
  - **Interfacial Physics of Propellants (ends this year)**
  - Strain Measurements and Damage in Propellant Microstructures (ended)

## Motivation

- Particle-Binder Dewetting
  - Reduces mechanical strength
  - Pores for convective combustion



Joe Kalman



Kalman, J., and Essel, J. "Influence of Particle Size on the Combustion of CL-20/HTPB Propellants." Propellants, Explosives, Pyrotechnics, Vol. 42, No. 11, 2017, pp. 1261–1267. doi:10.1002/prop.201700137.

CSULB/MAE

joseph.Kalman@csulb.edu



## Results

- Static Contact angles
  - Polymer structure influence
  - Solvent effects on surface

Solvent	Average (deg)	Std. Dev. (deg)
Toluene	41.35	3.92
Hexanes	34.04	0.71
Ethyl Acetate	22.61	2.86
Ethyl Methyl Ketone	27.62	5.26
Methanol	33.83	2.80
Distilled Water	35.92	1.24

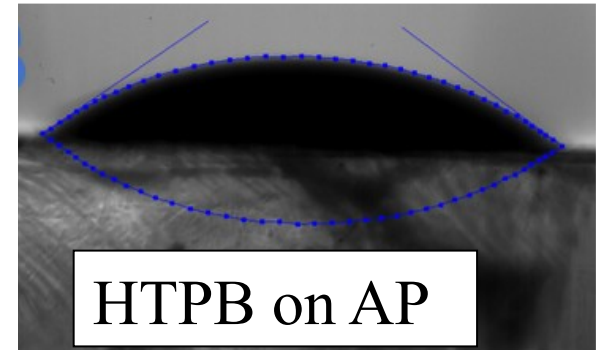
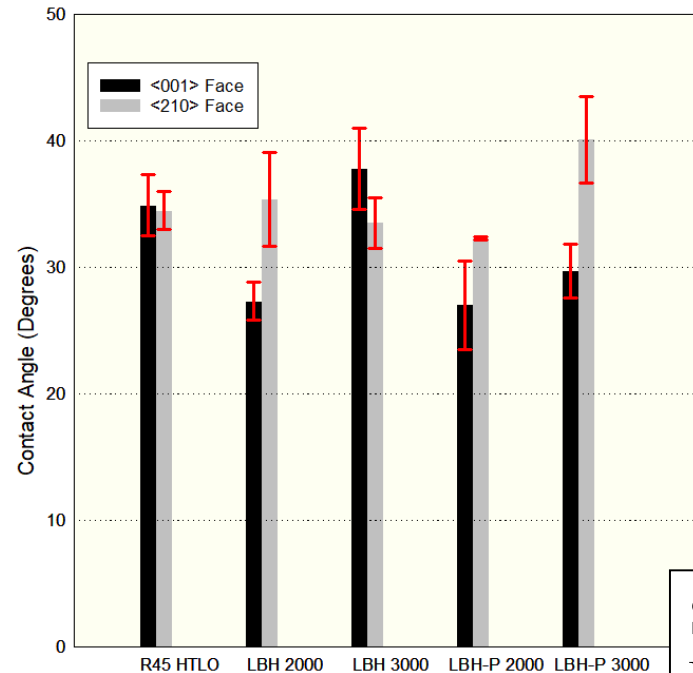
Student: Aaren Cortes  
Current MSAE Student

*Joe Kalman*

CSULB/MAE

*joseph.Kalman@csulb.edu*

Ramirez and Kalman. "Influence of HTPB Variants on the Wettability of Ammonium Perchlorate." AIAA Scitech 2020 Forum. 2020.



Student: David Ramirez  
Undergraduate Honors thesis  
DoD SMART Scholar

## Results

- Simulate interaction (shear rate) in mixer
- HTPB/Toluene mixtures on AP
  - Spreading ratio decrease with polymer content
  - Evaporation of toluene during spreading

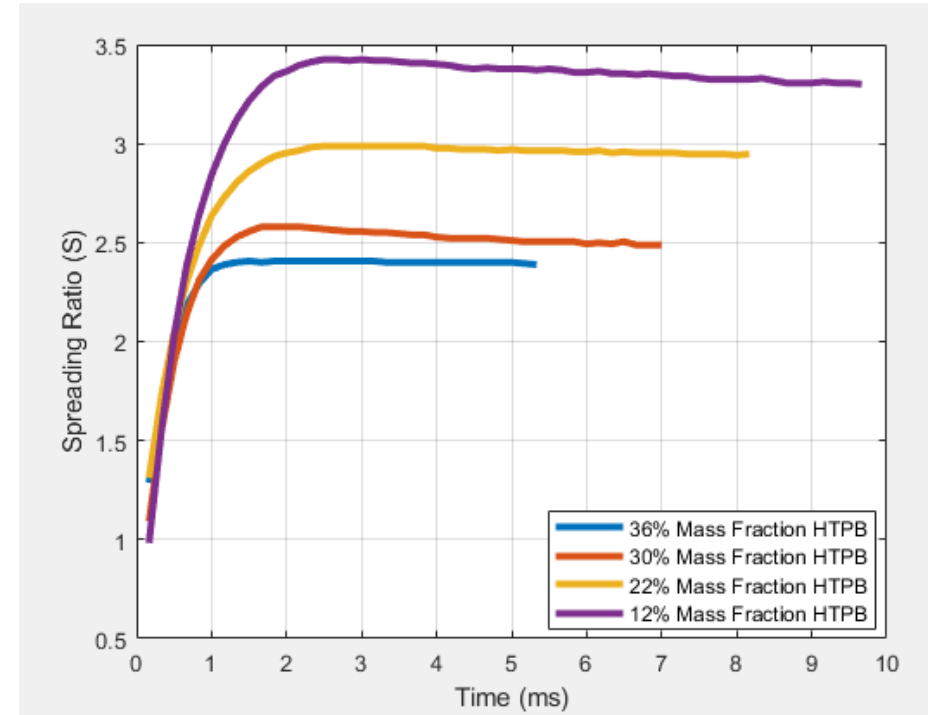


*Joe Kalman*

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Student: Sahson Raissi  
Current MSME Student



Raissi and Kalman. "Investigation of Hydroxyl-terminated Polybutadiene Droplets Impacting Ammonium Perchlorate and Polytetrafluoroethylene Surfaces." *AIAA Region VI 2021*.

**Best Presentation-Masters Category**

## Lessons Learned (and tips)

- Know (or find out) problems DoD is interested in solving
- Partner or collaborate with DoD researchers
- Propose ideas that :
  - do not require too much infrastructure/experimental development
  - Are easily broken down to 'simple' problems
- Be prepared for administrative work
  - Plan for course release
  - Lots of time teaching students
  - New research can 'scare' campus administration/safety, limitations at a CSU

*Joe Kalman*

*CSULB/MAE*

*joseph.Kalman@csulb.edu*

## Questions

- Thank you!
- Please feel free to reach out for questions, collaborations, etc.

*Joe Kalman*

*CSULB/MAE*

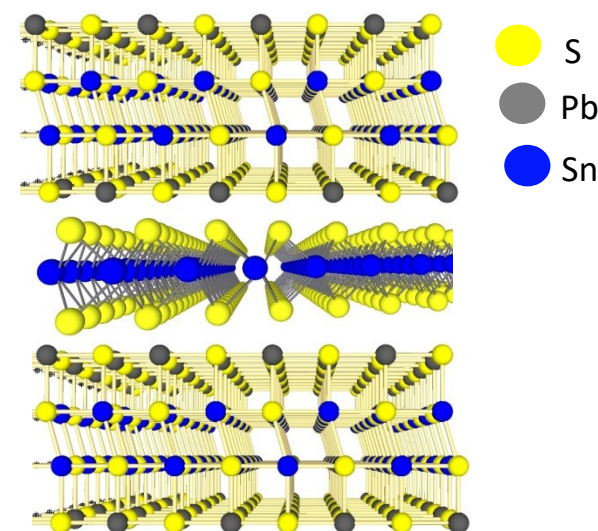
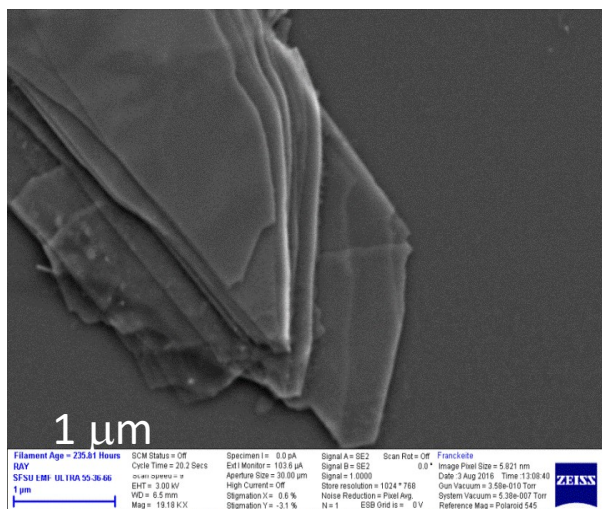
*joseph.Kalman@csulb.edu*



# Optoelectronics of a Natural van der Waals Heterostructures

## Optoelectronics of a Natural van der Waals Heterostructures

Akm Newaz– San Francisco State University



Franckeite

Akm Newaz, Associate Professor

Quantum Materials and Nanodevice Laboratory  
Department of Physics and Astronomy, SFSU

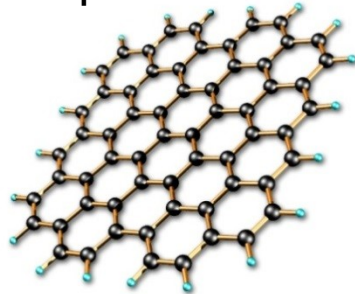


# 2D layered atomic crystals

Graphite



Graphene

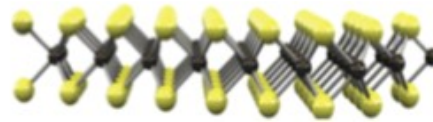


- massless Dirac fermions
- Strongest-ever
- Highest T-cond
- Record mobility
- ....

Molybdenite



Mono-MoS<sub>2</sub>

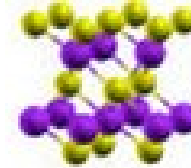


- Semiconductor
- Strong Spin-orbit Int.

Bi<sub>2</sub>Te<sub>3</sub>



B<sub>2</sub>Te<sub>3</sub>

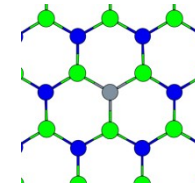


- Topological insulator

Boron Nitride



Mono-hBN



- Insulator
- Lattice matched to graphene

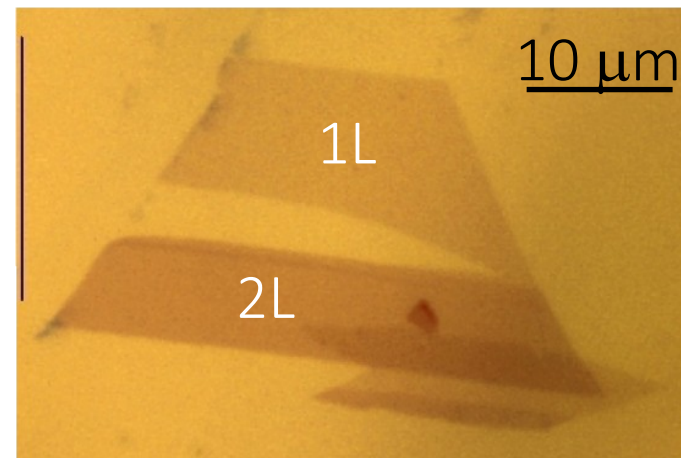
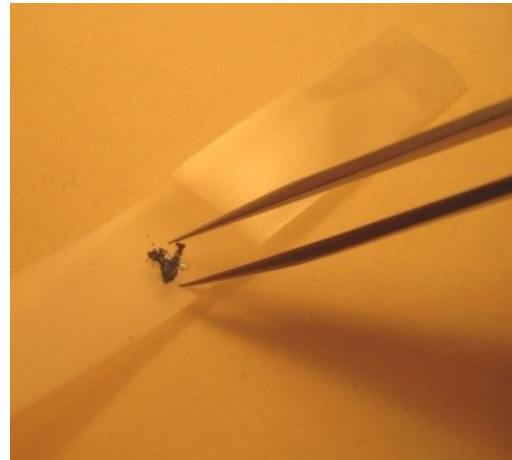
- ❑ Complex-metallic compounds : TaSe<sub>2</sub>, TaS<sub>2</sub>, ...
- ❑ Magnetic materials: FeSe<sub>2</sub>, CoSe<sub>2</sub>, ...
- ❑ Superconducting: NbSe<sub>2</sub>, Bi<sub>2</sub>Sr<sub>2</sub>CaCu<sub>2</sub>O<sub>8-x</sub>, ZrNCl, ...
- ❑ Hundreds more!!!



# Optoelectronics of a Natural van der Waals Heterostructures

## Making 2D Atomic Crystal

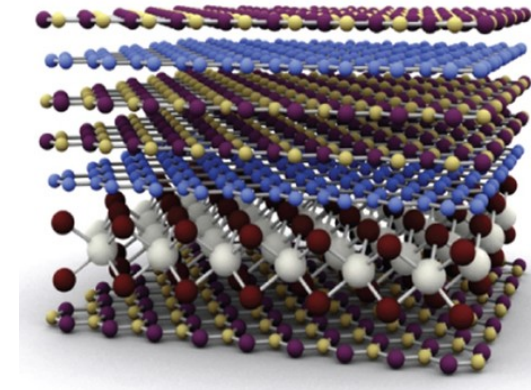
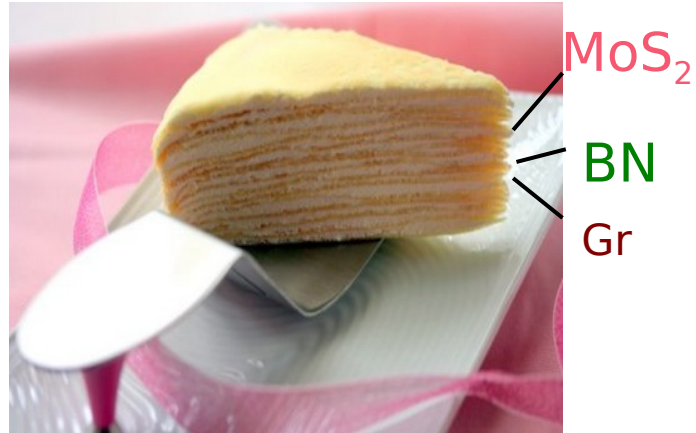
### *Mechanical Exfoliation*



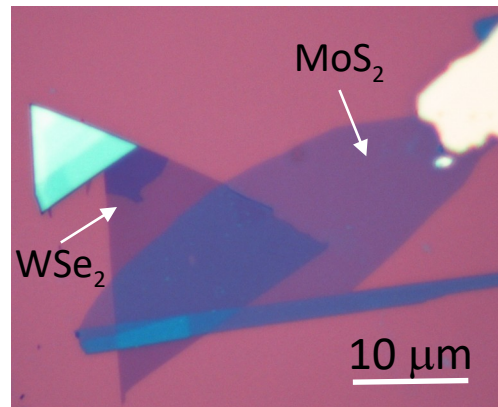


# Van der Waals Heterostructures (vdWH)

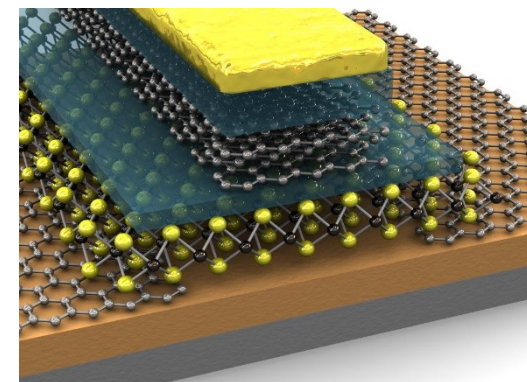
Artificial



Novoselov, Nature (2012)



WSe<sub>2</sub>/MoS<sub>2</sub> Heterostructure



vdWH devices





# Optoelectronics of a Natural van der Waals Heterostructures

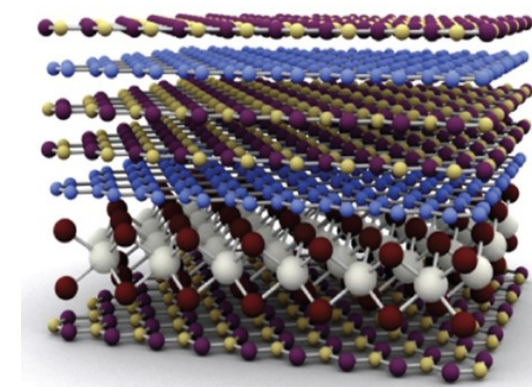
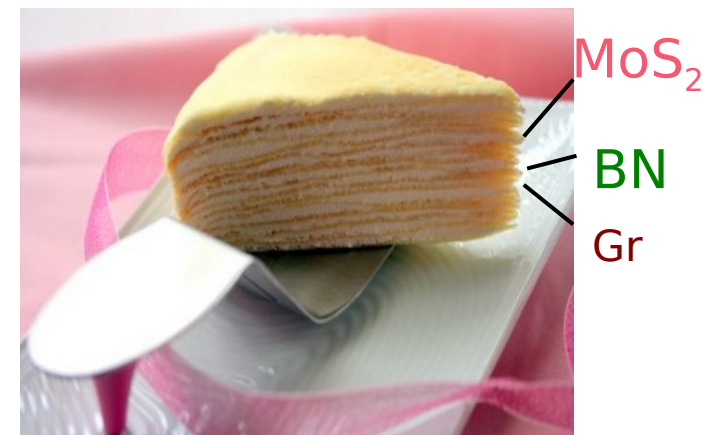
## Van der Waals Heterostructures (vdWH)

- Designer materials at atom levels.
- Attractive for novel functional devices.

Problems:

- 1) Poor control on crystal orientation.
- 2) Impurities, such as air bubbles or adsorbates can sit at the interface.

Artificial



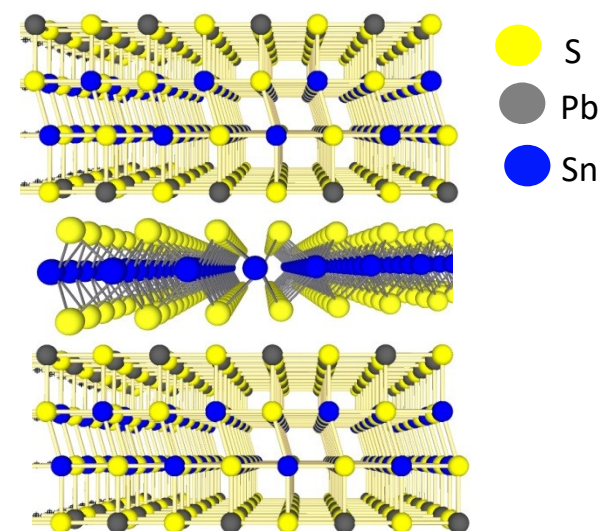
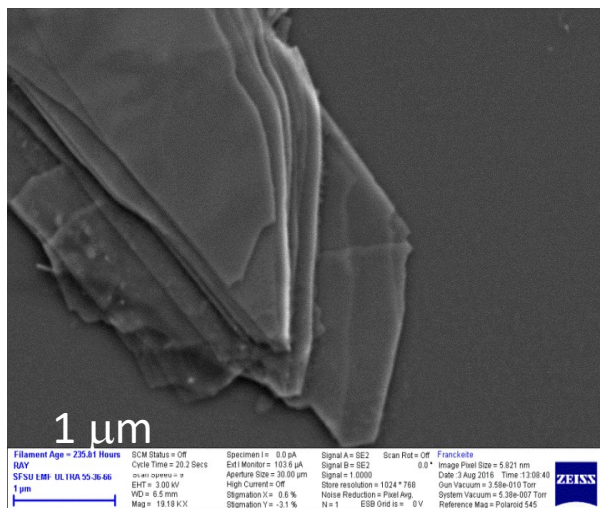
Novoselov, Nature (2012)



# Optoelectronics of a Natural van der Waals Heterostructures

## Van der Waals Heterostructures (vdWH)

What if mother nature get involved in preparing vdWHs ?

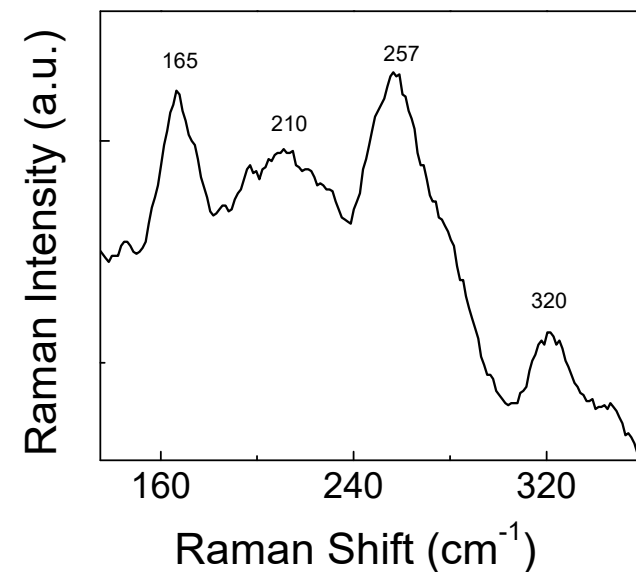
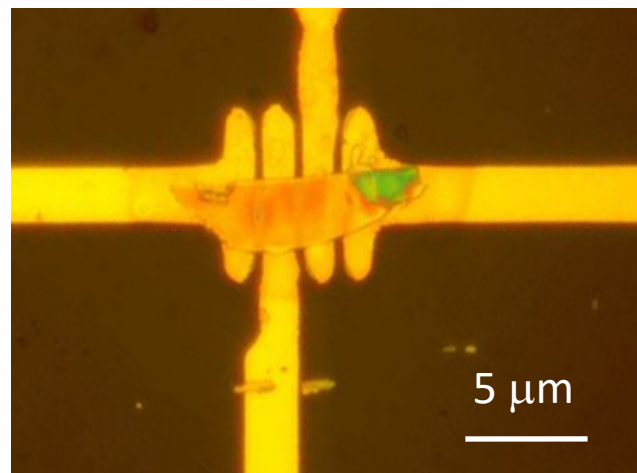
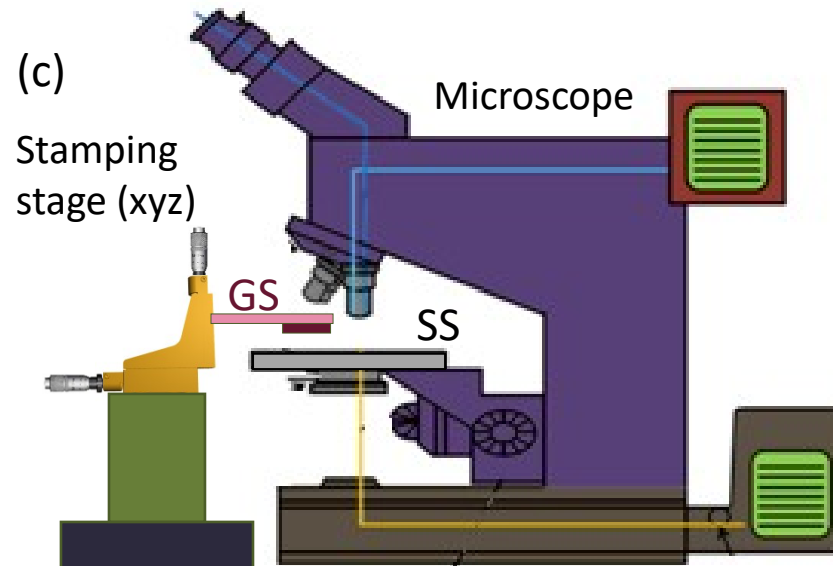
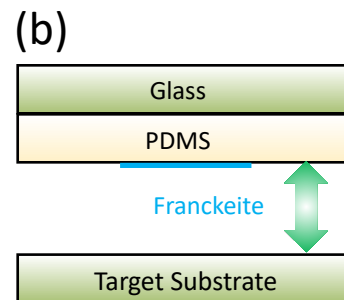
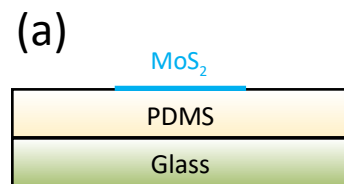


Franckeite

- Perfect crystal orientation!
- New functionality may appear



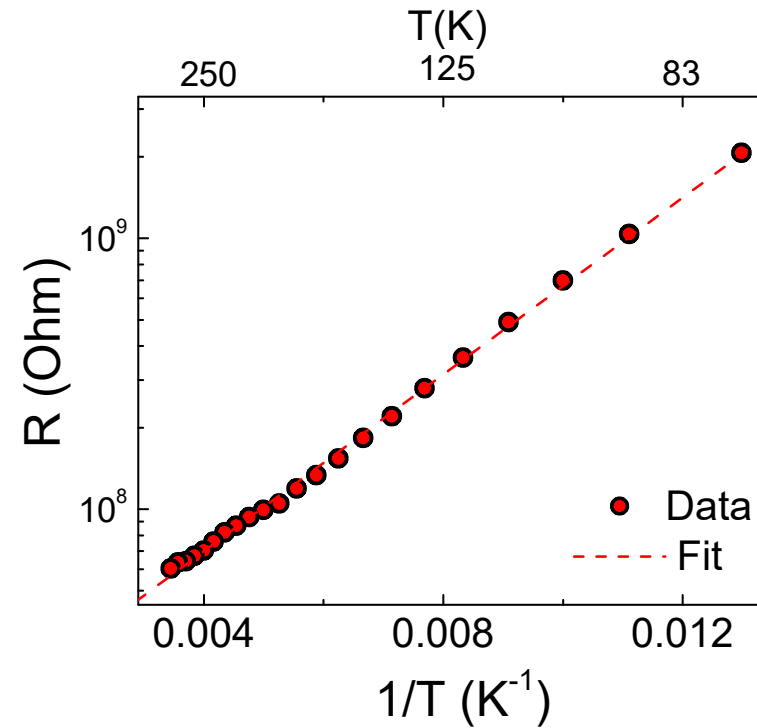
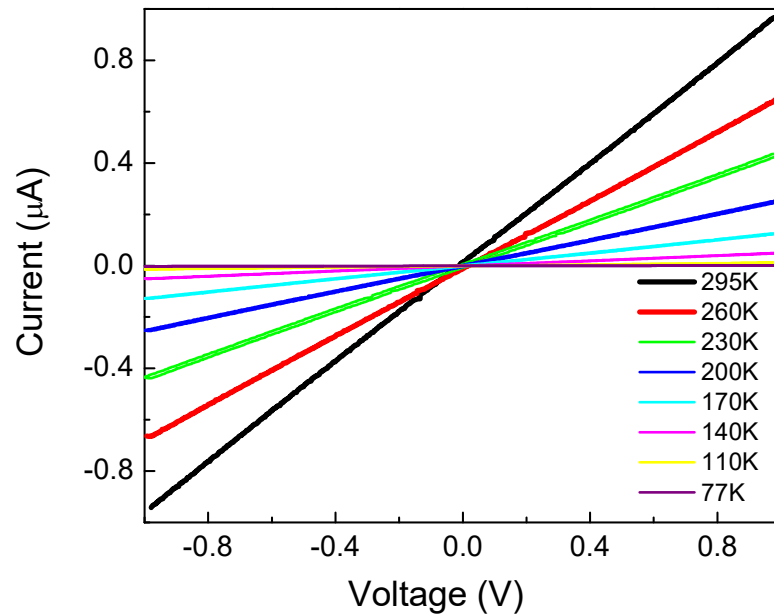
# Sample Fabrication





# Optoelectronics of a Natural van der Waals Heterostructures

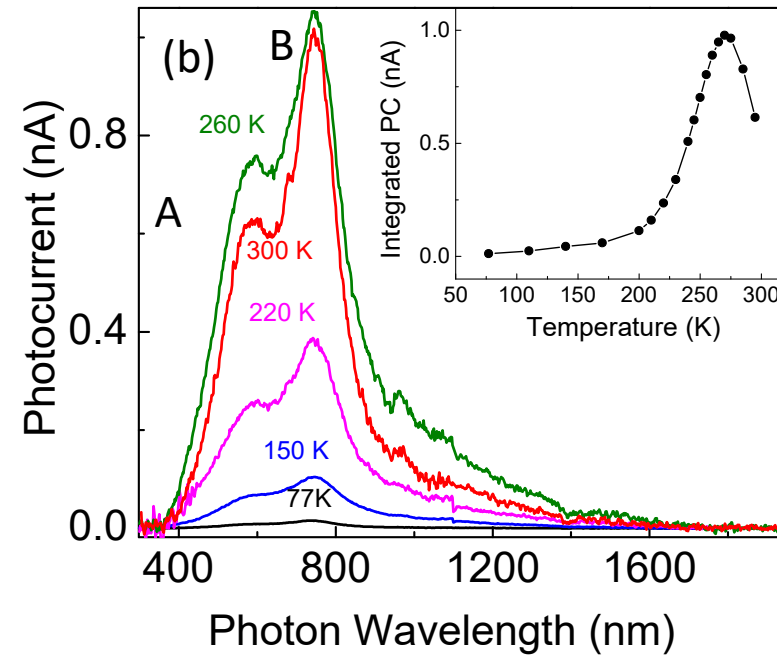
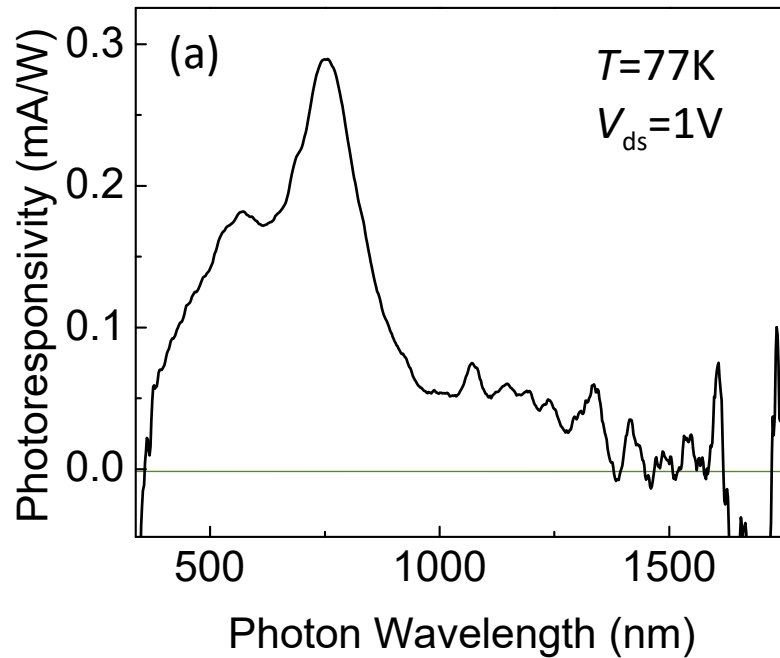
## Electrical Transport Properties





# Optoelectronics of a Natural van der Waals Heterostructures

## Opto-electronics of Natural vdWH

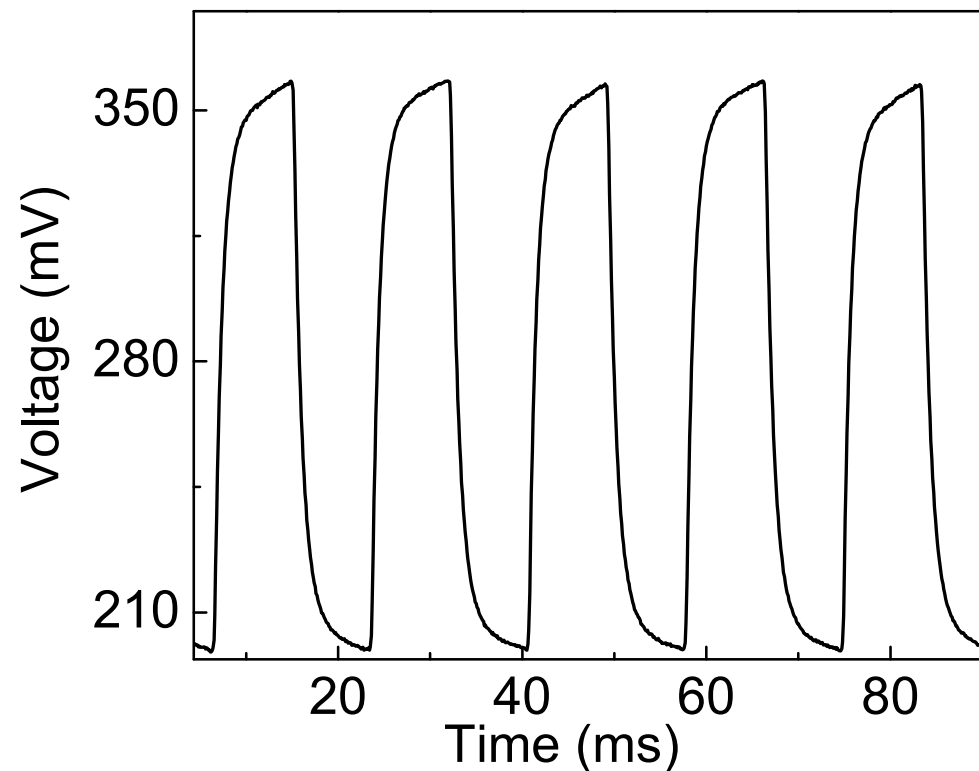






## Optoelectronics of a Natural van der Waals Heterostructures

### Time response of Photocurrent

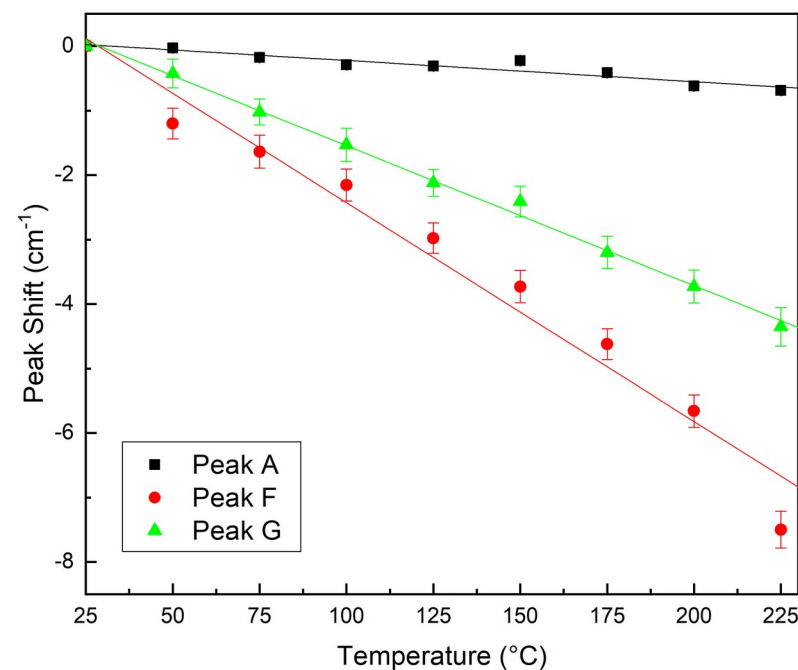
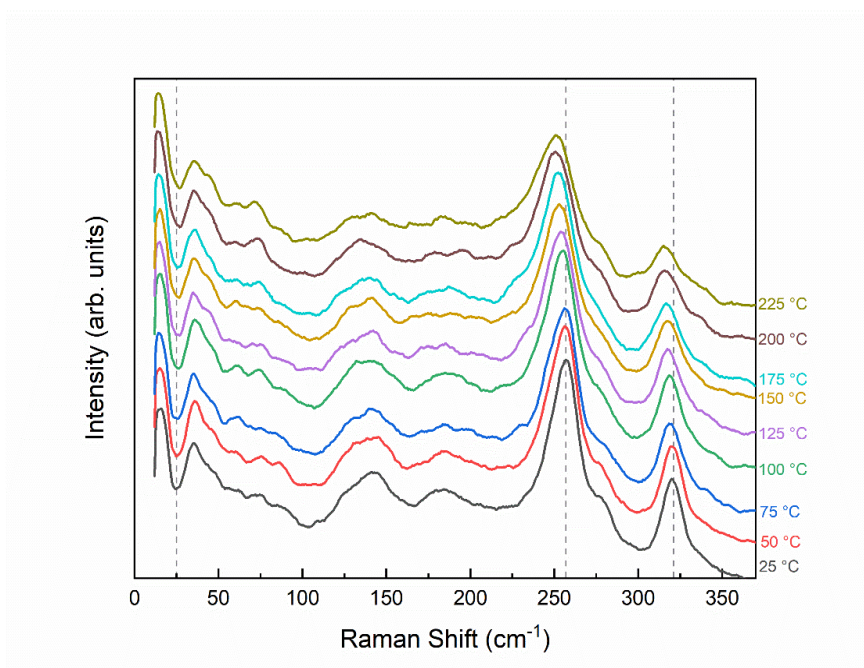


- Rise time and fall time 0.5 mS so the frequency is  $\sim 2$  KHz.
- A potential candidate for broadband nanoscale photodetector



# Optoelectronics of a Natural van der Waals Heterostructures

## Thermal Properties of Natural vdWHs



- 1) We determined the crystal structure and all possible phonon vibrations
- 2) We have found several low vibrations mode.
- 3) The Raman modes behave differently with respect to temperatures



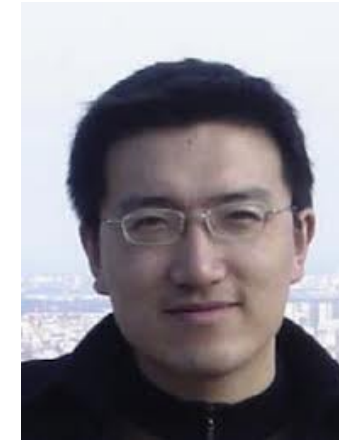
# Optoelectronics of a Natural van der Waals Heterostructures

## Acknowledgements

SFSU group



University of Oklahoma group



Stanford group (Prof. E. Pop)



Prof. E. Pop



K. Smithe



# Optoelectronics of a Natural van der Waals Heterostructures

## HBCU/MI grant: REP and Instrumentation Grant



**DEPARTMENT OF DEFENSE**  
Research and Education Program  
for  
Historically Black Colleges and Universities and  
Minority-Serving Institutions (HBCU/MI)

Fiscal Year 2018

Funding Opportunity Announcement  
W911NF-17-S-0010



Issued by the U.S. Army Contracting Command-Aberdeen Proving Ground  
Research Triangle Park Division on behalf of the Army Research Office (ARO)

and the

Assistant Secretary of Defense for Research and Engineering  
(Research Directorate/Basic Research Office)

Deadline is usually second week of August



# Optoelectronics of a Natural van der Waals Heterostructures

## Tips

- 1) Find and contact the program manager in your field
- 2) Project Relevance to the interest of XXXXXX and the potential contributions to the DoD mission
- 3) Total length 25 pages long including the facilities and References



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## **Next Steps/Closing Remarks**

Dr. Frank A. Gomez  
Executive Director, STEM-NET  
Office of the Chancellor

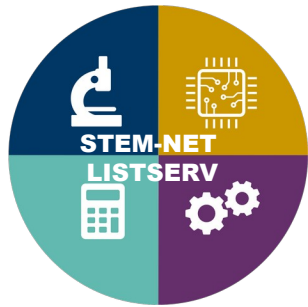


<https://www2.calstate.edu/impact-of-the-csu/research/stem-net>



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### Save the Dates

## STEM-NET Virtual Research Café 10.0

- May 26, 2021  
Registration Link: TBA

## STEM-NET June Webcast

- CSU NSF RUI Exemplars  
Registration Link: TBA