NSF CAREER 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

Frank A. Gomez *CSU Office of the Chancellor* *fgomez@calstate.edu*

The California State University
OFFICE OF THE CHANCELLOR

NSF CAREER Awardees

Speakers

Chantal Stieber, Cal Poly Pomona
Building a Research Program to Target Pollutant Reduction: From Small Internal Grants to an NSF CAREER Award and a Brighter Future

Cheryl Van Buskirk, CSUN
A CURE for Disordered Sleep

Kimberly Blisniuk, San Jose State University
A Geologic Perspective on Assessing Seismic Risk in California, and How my CAREER Grant Relates to it

Blake Riggs, San Francisco State University
Asymmetric ER Partitioning as a Pathway for Cell Fate Specification

Geoffrey Lovelace, Cal State Fullerton
Computational Gravitational-Wave Physics and Astronomy at California State University, Fullerton

Matthew Povich, Cal Poly Pomona
BUILD: Bringing the Universe to Inland Empire and Los Angeles Districts

Nina Robson, Cal State Fullerton
Research Highlights Since Receipt of the NSF CAREER Award

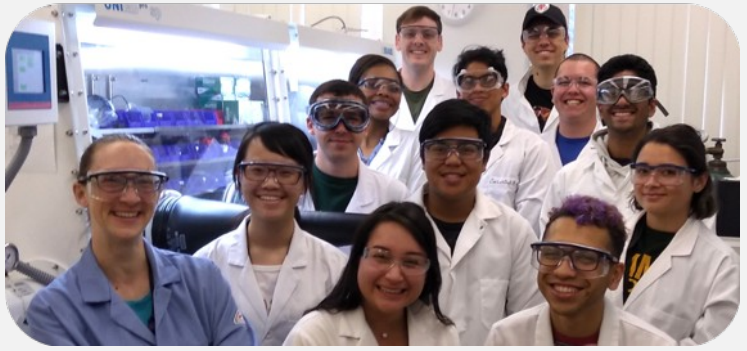
Frank A. Gomez *CSU Office of the Chancellor* *fgomez@calstate.edu*

CalPolyPomona

CAREER: Quantifying Nitrogen-Oxide (NO) Activation and Coordination Modes through Synthesis, Spectroscopy and Computations

Building a Research Program to Target Pollutant Reduction: From Small Internal Grants to an NSF CAREER Award and a Brighter Future

S. Chantal E. Stieber – Cal Poly Pomona



S. Chantal E. Stieber, Associate Professor

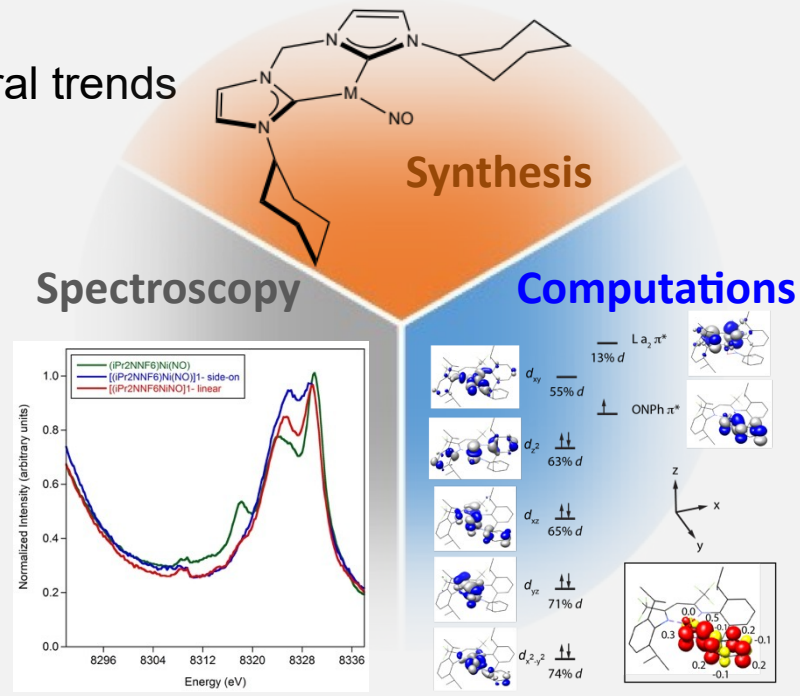
Cal Poly Pomona, Department of Chemistry & Biochemistry

sestieber@cpp.edu

CAREER: Quantifying Nitrogen-Oxide (NO) Activation and Coordination Modes through Synthesis, Spectroscopy and Computations

Project Overview

- **Aim 1.** Develop X-ray emission spectroscopy (XES) to characterize metal-NO_x species
- **Aim 2.** Advance knowledge of XES through computational methods
- **Aim 3.** Synthesize new metal complexes bound to NO_x to establish spectral trends
- **Aim 4.** Introduce computational inorganic research in the classroom
- **Aim 5.** Implement hands-on crystallography in education



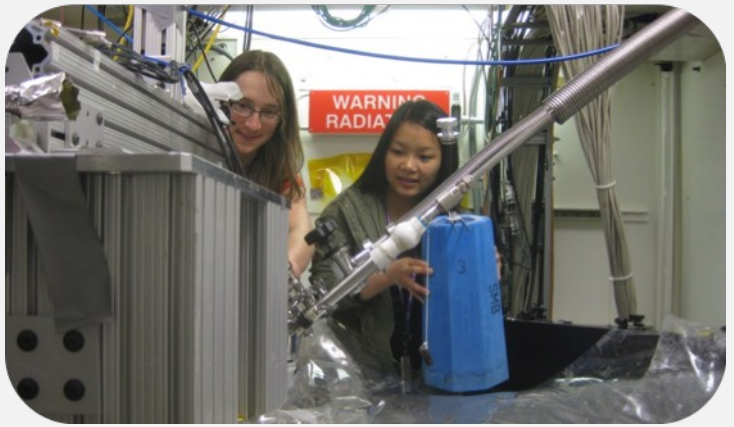
S. Chantal E. Stieber *Cal Poly Pomona/Chemistry & Biochemistry* *sestieber@cpp.edu*

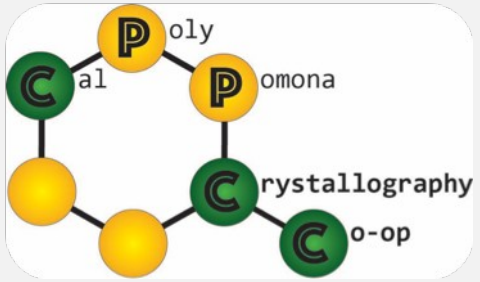
CalPolyPomona

CAREER: Quantifying Nitrogen-Oxide (NO) Activation and Coordination Modes through Synthesis, Spectroscopy and Computations

Leveraging Grants

- Many internal funding opportunities
  - RSCA, SPICE, Teacher-Scholar, Exceptional Service, student fellowships
- CSU-level funding
  - CSUPERB
- External funding
  - Off-site experiments at Stanford Synchrotron Radiation Lightsource
  - NSF XSEDE computational resources
  - Applied to NSF RUI, NSF CAREER, ACS PRF
  - Received DoD instrumentation grant for single crystal X-ray diffractometer, $600,000





S. Chantal E. Stieber *Cal Poly Pomona/Chemistry & Biochemistry* *sestieber@cpp.edu*

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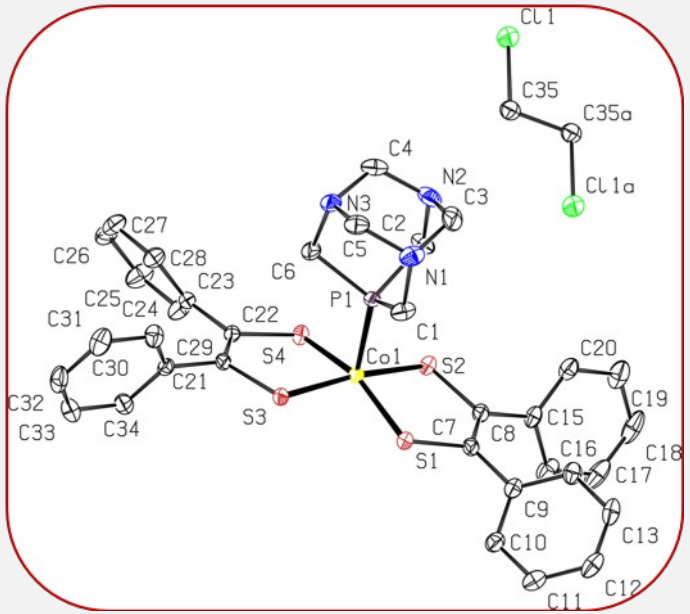
CAREER: Quantifying Nitrogen-Oxide (NO) Activation and Coordination Modes through Synthesis, Spectroscopy and Computations

Year 1 Progress

- Trained 15 undergraduates and 3 Master's students
- Publications
  - *J. Am. Chem. Soc.* **2020**, 142, 8514-8521.
  - *Acta Crystallogr. E* **2020**, 76, 736-741.
  - 3rd publication submitted-has since been accepted
- Created new course in crystallography, 3 videos
- Data collection at Stanford Synchrotron Radiation Lightsource
- 17 presentations by students at 3 conferences



S. Chantal E. Stieber *Cal Poly Pomona/Chemistry & Biochemistry* *sestieber@cpp.edu*

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CAREER: Quantifying Nitrogen-Oxide (NO) Activation and Coordination Modes through Synthesis, Spectroscopy and Computations

Serving on CAREER panel

- Most proposals are excellent!
- Pretty and easy to read/view proposals fare better
- Figures help
- Reiterate important components
- Be specific
- Preliminary results are key!
- Well thought out teaching plan/broader impacts
- Established collaborations
- Really focus on feasibility for PUIs

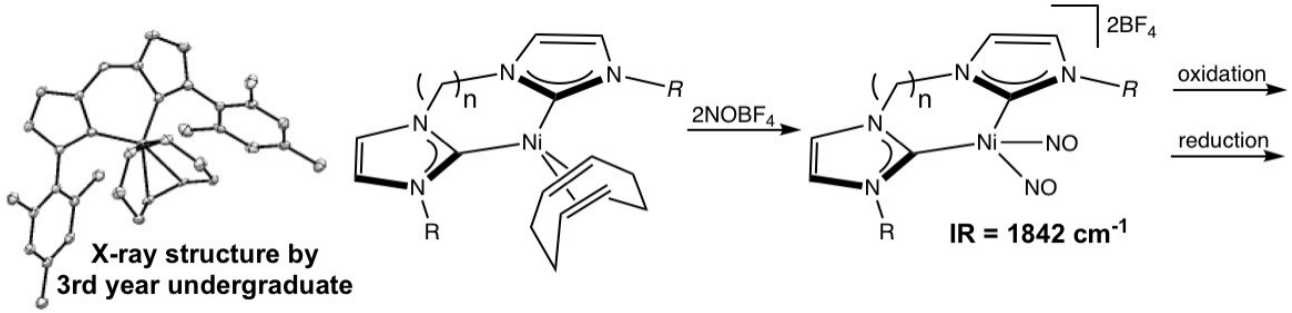


Figure 10: In-house crystal structure by 3rd year UG and synthesis of Ni-NO complex.

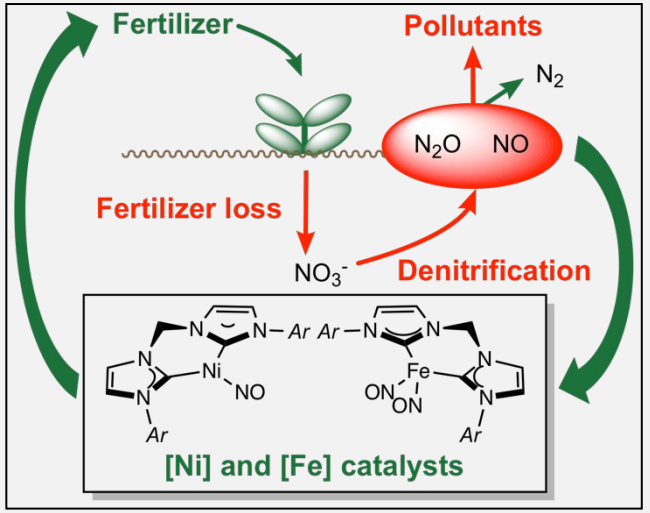
S. Chantal E. Stieber *Cal Poly Pomona/Chemistry & Biochemistry* *sestieber@cpp.edu*

CalPolyPomona

CAREER: Quantifying Nitrogen-Oxide (NO) Activation and Coordination Modes through Synthesis, Spectroscopy and Computations

Building a CAREER

- Funding begets more funding
  - Matching funds for internal opportunities
    - ARI grant: "*Iron and nickel catalysts for mitigating denitrification and agricultural pollution*" $83,452
- Center grant
- Instrumentation grants
- International collaborations and sabbatical
  - Master's student DAAD funding to do research in Germany



S. Chantal E. Stieber *Cal Poly Pomona/Chemistry & Biochemistry* *sestieber@cpp.edu*

CAREER: Quantifying Nitrogen-Oxide (NO) Activation and Coordination Modes through Synthesis, Spectroscopy and Computations

Summary

- Preliminary results are key!
- Reiterate important components
- Really focus on feasibility for PUIs
- Build collaborations

@Stieberlab

https://www.cpp.edu/~sestieber

S. Chantal E. Stieber *Cal Poly Pomona/Chemistry & Biochemistry* *sestieber@cpp.edu*

A CURE for disordered sleep

***Cheryl Van Buskirk**, California State University Northridge*

and

*Students of BIOL447/L **FIRE**: **F**ull **I**mmersion **R**esearch **E**xperience*

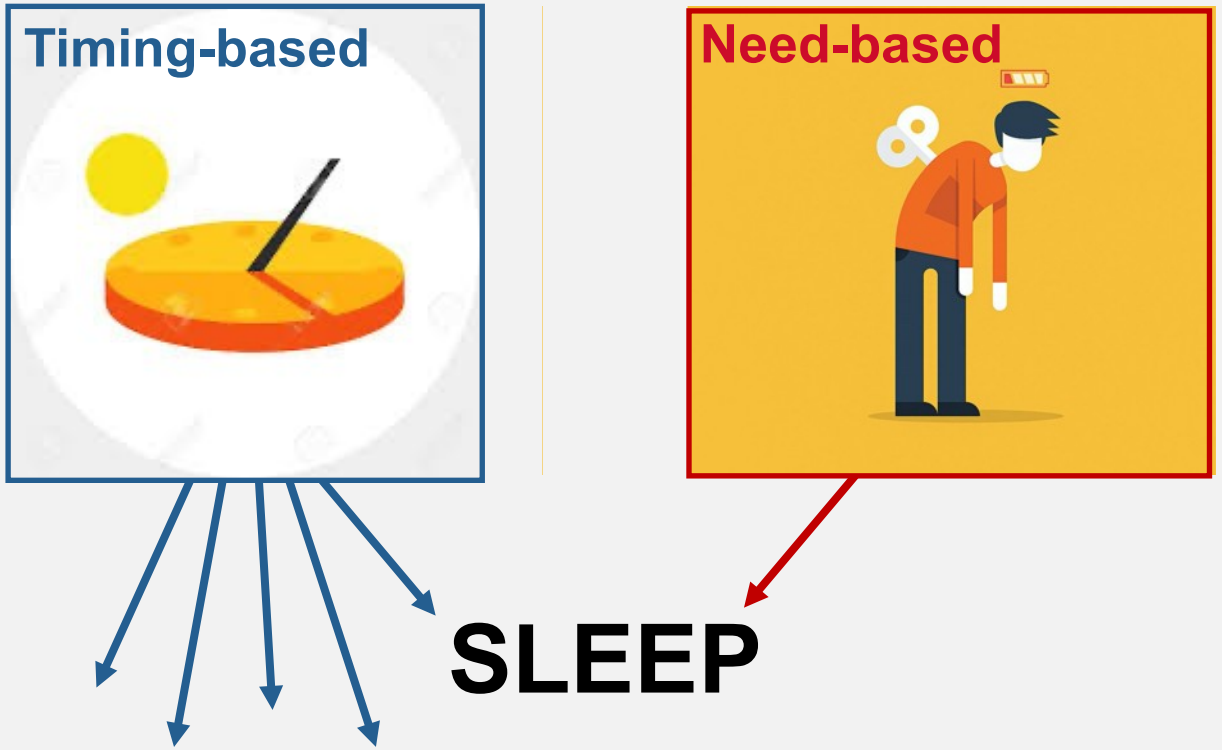
Cheryl Van Buskirk, Associate Professor

CSUN, Department of Biology

cheryl.vanbuskirk@csun.edu

Project Overview

- There is STILL debate about the core function of sleep
- Sleep is regulated by two main inputs, circadian & homeostatic
- To better understand sleep need, remove influence of circadian regulation!



Cheryl Van Buskirk *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

Project Overview

C. elegans sleeps…

1. during development
2. following cellular stress

(not just hurt - sleeping!)

Goal: identify genetic components of stress-induced sleep (SIS)

Cheryl Van Buskirk *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

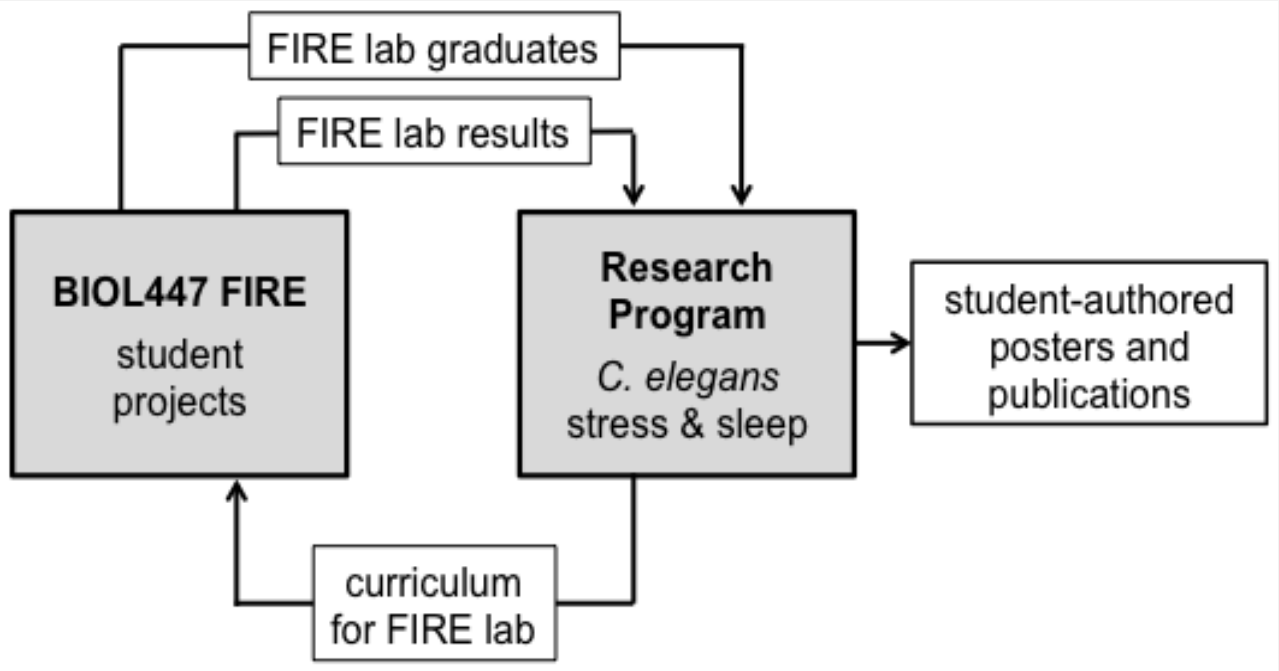
NSF-CAREER: *Integrate* Research & Education

The proposal:

2/3 research component
-includes references to educational component

1/3 education component
-includes assessment plan

Both components have preliminary data



Full Immersion Research Experience

Cheryl Van Buskirk *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

FIRE graduates present at the CSUNposium

FIRE Lab

Cheryl Van Buskirk *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

CSUN

… and contribute to publications

The authors thank the laboratories of Kaveh Ashrafi, Dennis Kim, and Susan Mango for generously providing several of the strains used in this study. We are grateful to the students of the Fall 2015 BIOL447/L Full Immersion Research Experience laboratory for their investigation of sleep responses among dauer-defective mutants and to Andrew J. Hill for comments on the manuscript. This work was

The authors thank the *Caenorhabditis* Genetics Center (CGC) and Ikue Mori for strains. Special thanks to Alex Hernandez of BIOL447/L for observing that wounding could trigger ALA-dependent sleep. This article is dedicated to Sydney Brenner.

We are grateful to David Raizen for critical input on this manuscript and to Cori Bargmann and Joshua Kaplan for sharing strains. Many thanks to the students of the CSUN BIOL447/L Full Immersion Research Experience (FIRE) course for their help screening for SIS-defective mutants and to FIRE student Kristina Roxas for identification of *npr-1*(*csn7*). This work was supported by an NSF-CAREER award IOS 1553673 to C.V.B. Some strains were provided by the Caenorhabditis Genetics Center, which is funded by NIH Office of Research Infrastructure Programs (P40 OD010440).

Cheryl Van Buskirk *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

A CURE for Disordered Sleep

…and micropublications

μP microPublication
get your data out, be cited

- NIH-supported
- single–figure, peer-reviewed, rapid
- data-curated, indexed in PubMed
- data that is not part of a larger story

microPublication BIOLOGY

8/19/2019 - *Open Access*

aptf-1 mutants are primarily defective in head movement quiescence during _C. elegans_ sleep

Bryan Robinson[1], Desiree L Goetting[1], Janine Cisneros Desir[1] and Cheryl Van Buskirk[1§]

[1]Department of Biology, California State University Northridge, Northridge CA USA 91330

[§]To whom correspondence should be addressed: cheryl.vanbuskirk@csun.edu

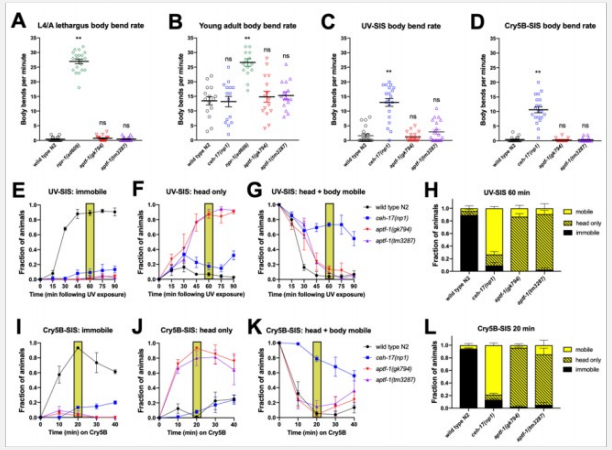


Figure 1 The RIS interneuron promotes head movement quiescence but not locomotor quiescence during lethargus and stress-induced sleep. (A-D) Locomotor rate assessed by body bends per minute among animals during the L4-to-adult lethargus (A), during the young adult stage (B), and during stress-induced sleep at the young adult stage following exposure to ultraviolet light (C) or Cry5B pore-forming toxin (D). Animals were examined on thin even lawns of *E. coli* OP50 and examined for the number of sinusoidal body bends (peak-to-peak movement of any body part) in one minute. To select mid-lethargus animals, late-L4 larvae were identified based on vulval morphology, screened one hour later for cessation of pharyngeal pumping as an indicator of lethargus entry, and scored 30 min later for bend rates. For UV-SIS, worm plates were placed lid-down on a 302nm 60mW UV light box for 50 sec and examined 60 min later. For Cry5B-SIS, animals were exposed to Cry5B-expressing bacteria for 5 min, transferred to a thin even lawn of OP50, and examined 10-15 min later. For all bend rate analyses, plates were gently moved to the stereomicroscope field of view and allowed to sit for 1 min prior to examination. Each animal was examined for 1 min and a body bend was defined as a peak-to-peak unit of sinusoidal motion. **P<0.0001 vs. N2, one-way ANOVA with Dunnett's multiple comparisons test. N=15-20, experimenter blind to genotype. (E-L) Categorization of movement during SIS following UV exposure (E-H) and during exposure to Cry5B (I-L). Each animal was examined for 5 sec and characterized as completely immobile (E and I), head mobile but body immobile (F and J), or head mobile plus body movement of at least 1/10 body-length (G and K). Two-way repeated measures (RM) ANOVA with time as the repeated factor and Sidak's multiple comparisons test reveals that more *ceh-17(lf)* than *aptf-1(lf)* animals are completely immobile under certain SIS conditions (Panel I, *ceh-17* vs. each *aptf-1* mutant, P<0.05 at 40 min). However, *aptf-1* mutants are impaired for head movement quiescence (N2 vs. *aptf-1* mutants P<0.05 at multiple time points during UV-SIS and Cry5B-SIS), and not significantly impaired for body movement with the exception of the 30 min time point of UV-SIS, for which *aptf-1(tm3287)* is different from wild type N2 (P<0.05). H and L show stacked categories of behavior for the time points indicated by shaded boxes within the time courses. Three trials of 25 animals were performed and the experimenter was blind to genotype.

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Corrections

Corrections to this article were made. These corrections were recorded in an Erratum published on Aug 23, 2019.

Description

Behavioral quiescence during sleep states can be measured by a variety of methods, each with advantages and limitations (Nagy et al., 2014). Centroid tracking gives information about locomotion (place-to-place movement) but may not register small head movements or other changes in body posture that do not change centroid position. Frame subtraction methods, based on analysis of pixel intensity changes between successive frames, register any movement as non-quiescent, but do not categorize the nature of movement. Counting body bends is a close proxy to locomotion (Karbowski et al., 2006) but can be time-consuming if done manually. Last, while nose tip movement has been observed to approximate body movement during *C. elegans* sleep (Bringmann, 2011), this approximation may not apply to mutants defective in only one of these behaviors. Here we provide an example of such a case.

C. elegans undergoes robust developmentally-timed sleep (DTS), also known as lethargus, prior to each larval molt (Raizen et al., 2008). RIS interneuron-defective *aptf-1(loss-of-function)* mutants have been found to be impaired for movement quiescence during DTS based on tracking the speed of the worm's nose tip (Turek et al., 2013). To determine whether this nose movement reflects locomotor activity, we quantified the locomotor rate of these animals, while blinded to genotype, by counting the number of sinusoidal body bends per minute. We compared lethargus (A) and post-lethargus (B) movement of two *aptf-1(lf)* strains to wild type (N2) and to lethargus-defective *npr-1(lf)* animals (Choi et al., 2013). We found that unlike *npr-1(lf)*, which showed a high frequency of body bends during and outside of lethargus, *aptf-1(lf)* mutants greatly reduced their frequency of body bends during lethargus to a level similar to that of N2 controls. However, we noted that these RIS-defective animals were strikingly defective in head movement quiescence and also showed rocking movements: alternating backward and forward body movements, each resulting in less than a half-body translation of the worm's position and virtually no net movement in either direction.

In addition to developmental sleep, *C. elegans* engages in sleep following exposure to conditions that cause cellular stress (Hill et al., 2014; Nelson et al., 2014; DeBardeleben et al., 2017). This stress-induced sleep (SIS) is dependent on the peptidergic ALA interneuron and the action of several neuropeptides that collectively promote a state of coordinated behavioral quiescence (Nath et al., 2016). Because the RIS neuron has recently been implicated in regulating SIS based on frame subtraction methods (Grubbs et al., 2019; Konietzka et al., 2019), we examined the behavior of *aptf-1(lf)* animals during SIS triggered by ultraviolet light (C) and by ingestion of pore-forming Cry5B toxin (D). We compared the behavior of *aptf-1(lf)* mutants to N2 and to SIS-defective *ceh-17(lf)* animals that are impaired for ALA neuron function (Van Buskirk and Sternberg, 2010). In contrast to ALA-defective animals, *aptf-1(lf)* mutants showed wild type body-bend quiescence during SIS. As in lethargus, RIS-defective animals showed head movement, but they did not rock back and forth as they did during lethargus. In an independent assay, we examined each animal (again, blinded to genotype) for five seconds every 10-15 min following exposure to a SIS trigger and categorized their movement during that time as "fully immobile", "body immobile but head mobile", where head mobility was defined as any discernible movement, or "head and body mobile", where body mobility was defined as a translation of the body position by at least 1/10 body length. Most *aptf-1(lf)* animals moved only their heads and did not translate their body position (F and J); SIS body movement quiescence in *aptf-1(lf)* was similar to wild type, but took longer to set in in the case of UV-SIS (G). These data indicate that the RIS neuron plays a major role in controlling head movement quiescence, with a relatively minor impact on body movement quiescence, at least when examined on standard NGM plates. It will be of interest to determine whether the impact on body movement quiescence is a secondary consequence of head movement. Though head movement is often referred to as foraging behavior, we did not observe any feeding (pharyngeal pumping) in *aptf-1* mutants in these assays. Our results have implications regarding the circuits regulated (head-only versus head and body) by RIS and ALA activity. This analysis also emphasizes the importance of visual inspection, scored blind to genotype, as a valuable tool in studies of quiescence.

Reagents

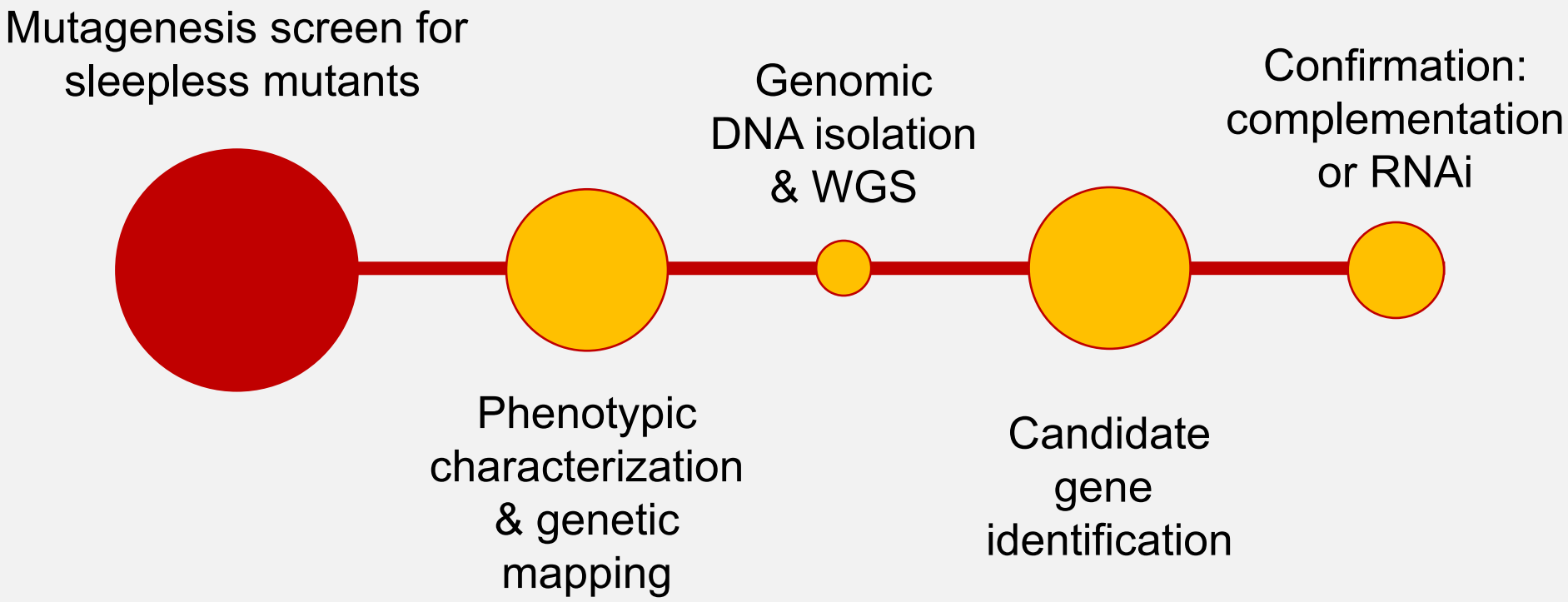
Strains available from the CGC: N2 wild type, *IB16 ceh-17(np1)*, DA609 *npr-1(ad609)*, HBR227 *aptf-1(gk794)*, HBR232 *aptf-1(tm3287)*. Cry5B-expressing bacteria, received from Raffi Aroian, is available from our lab.

Acknowledgments: Many thanks to David Raizen for helpful comments on this microPublication, and to the worms for reminding us that we need to look at them.

References

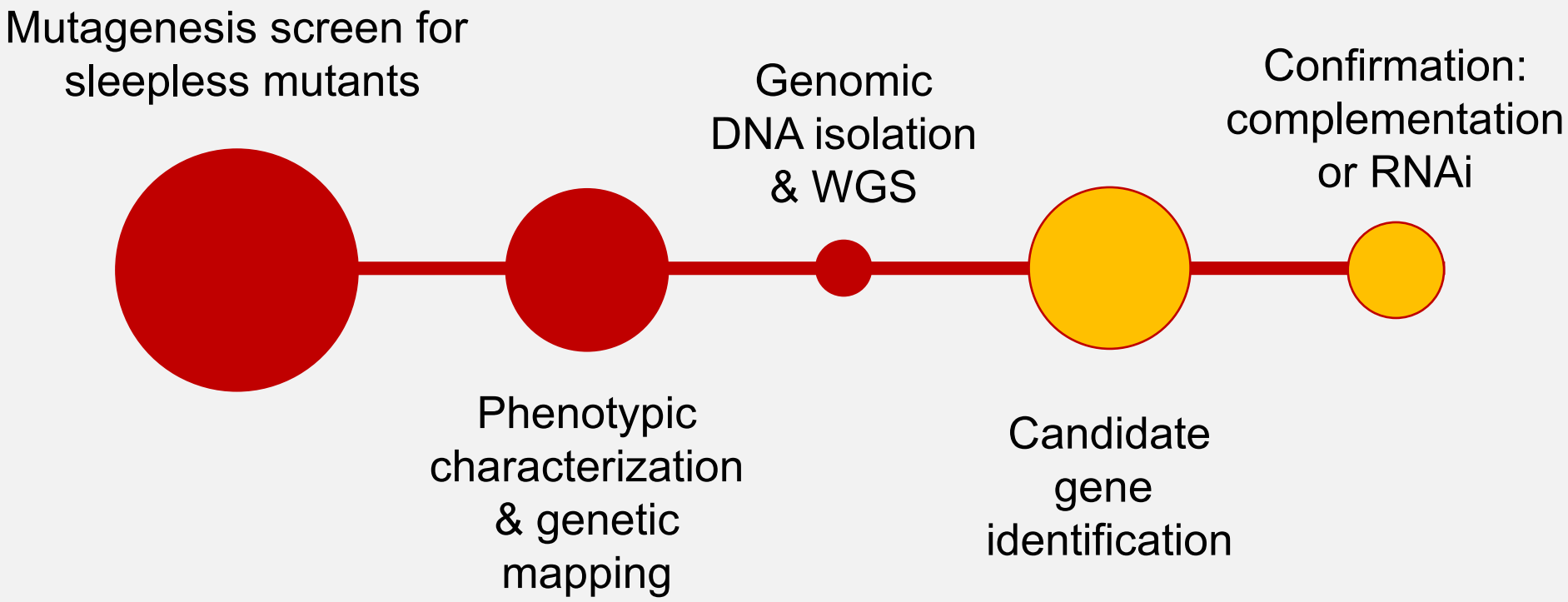
Cheryl Van Buskirk *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

FIRE lab: project progresses each semester



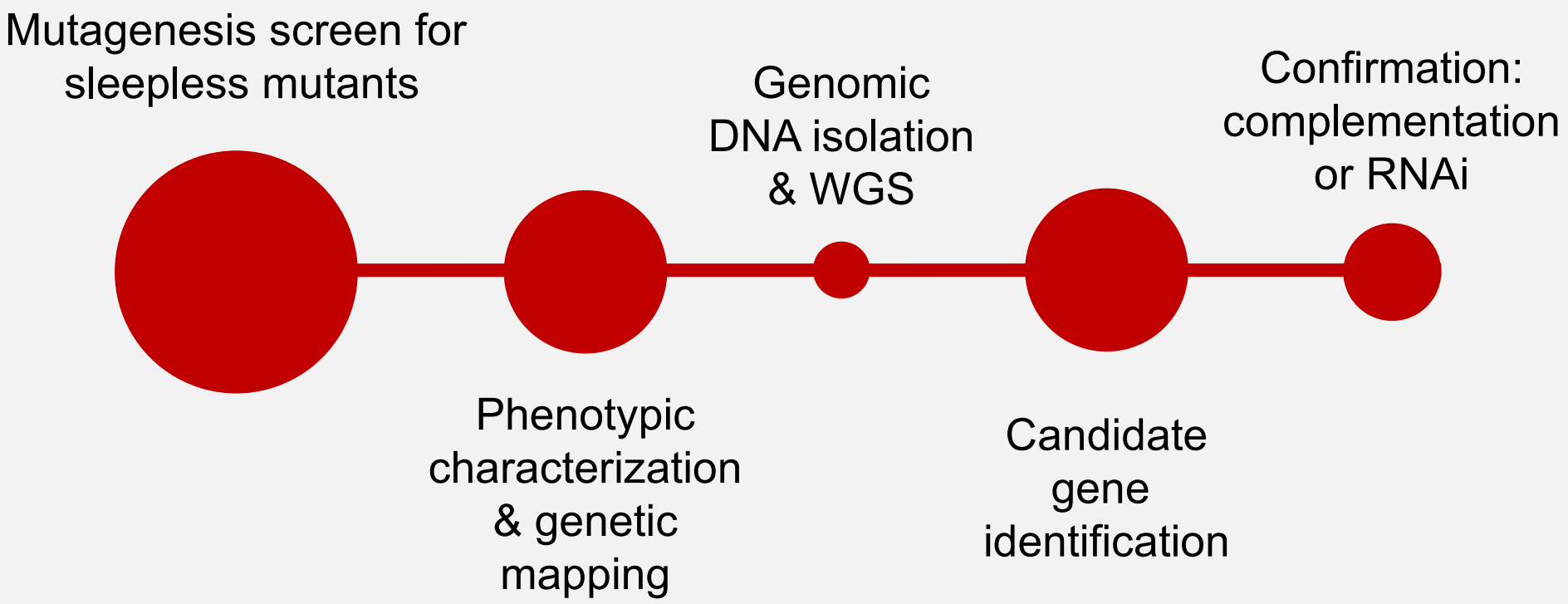
Cheryl Van Buskirk *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

FIRE lab: project progresses each semester



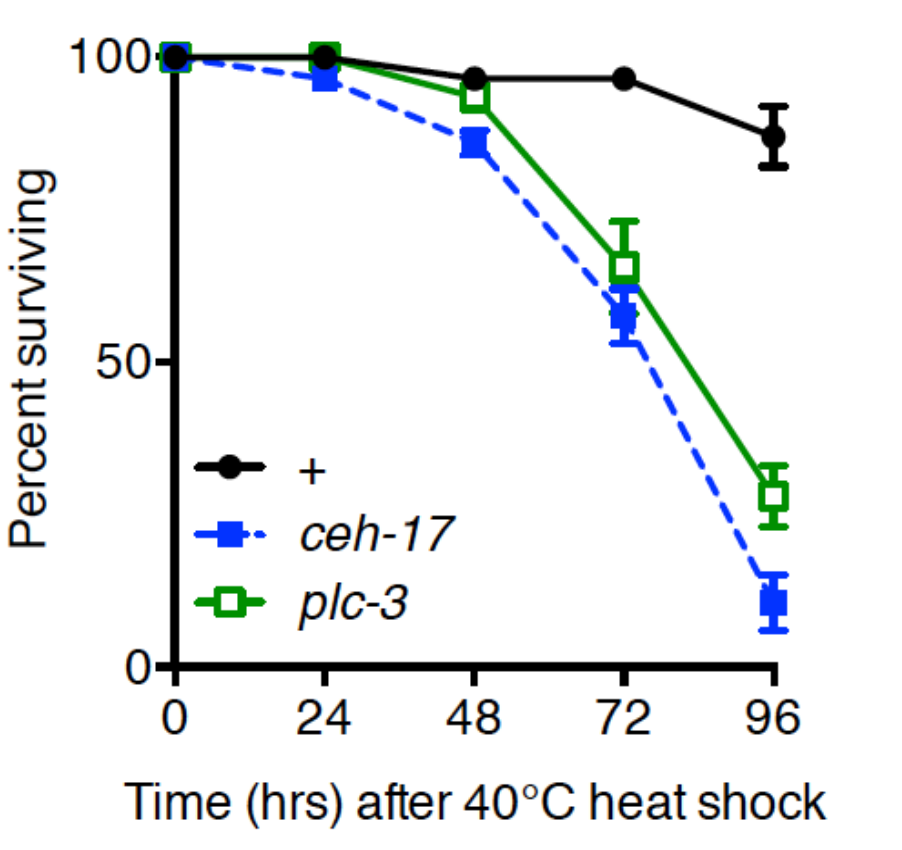
Cheryl Van Buskirk *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

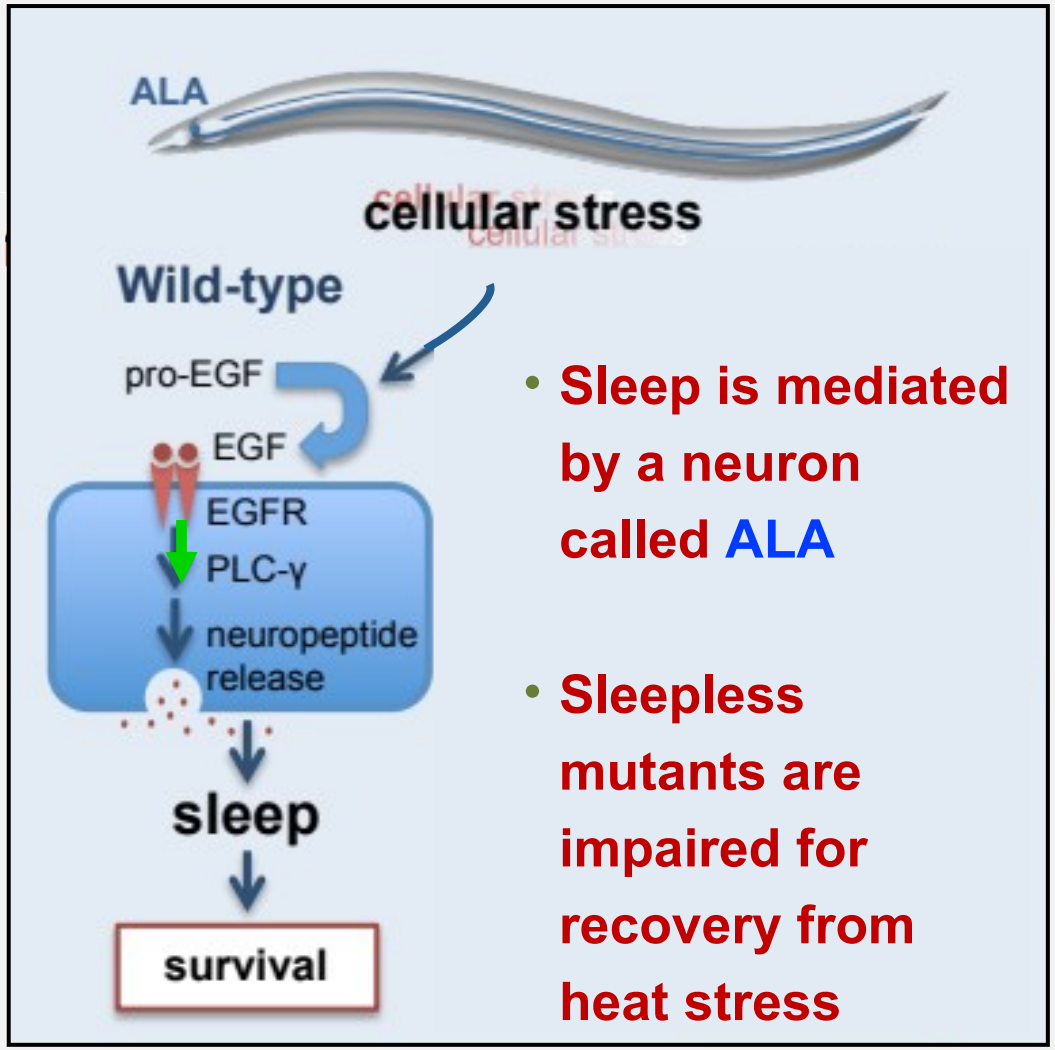
FIRE lab: project progresses each semester



Cheryl Van Buskirk *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

Research Highlights



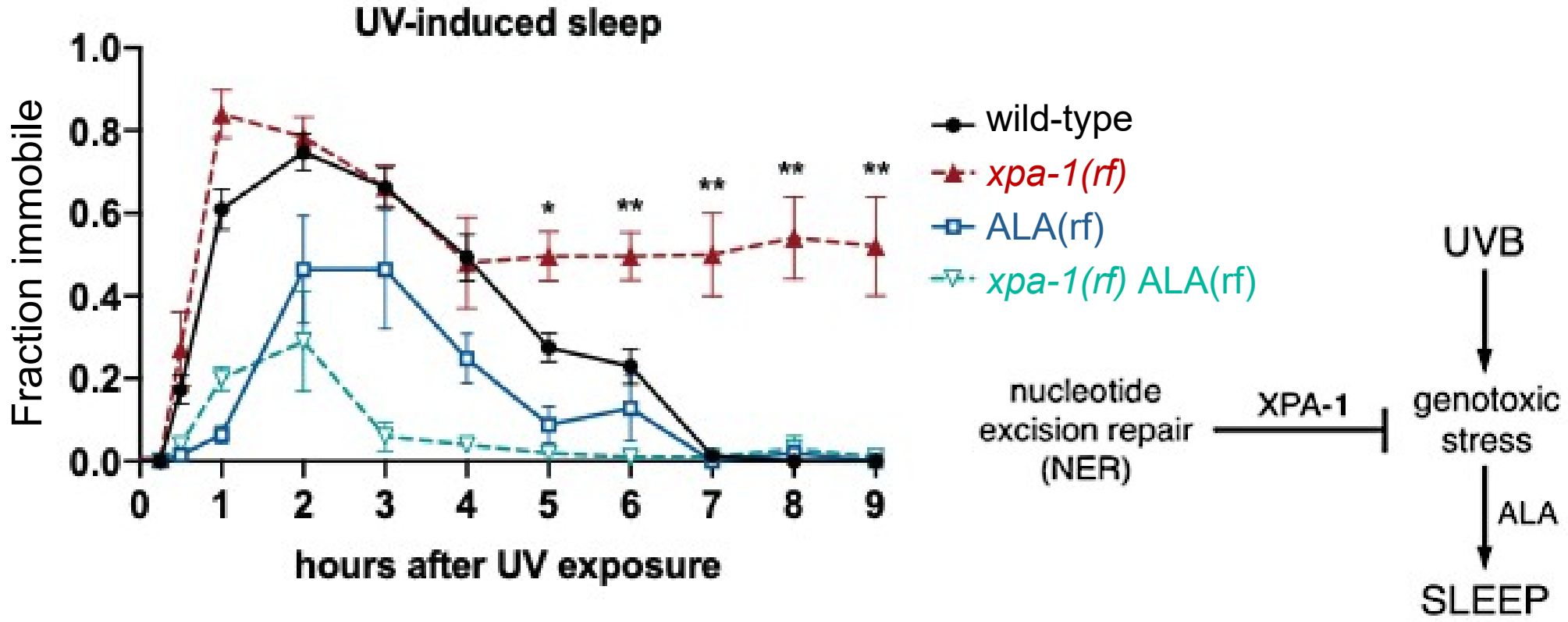


- Sleep is mediated by a neuron called ALA
- Sleepless mutants are impaired for recovery from heat stress

Cheryl Van Buskirk *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

Research Highlights

Cellular repair limits sleep duration



Cheryl Van Buskirk *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

Lessons Learned

Worm genetics is challenging for most students

and

Teaching a CURE is a lot of work

but

NSF support of Course-based Undergraduate Research promotes highly effective integration of research and education

Cheryl Van Buskirk *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

Next Steps/Long-Term Plans

- Pipeline CURE: repeated exposure in core classes to concepts and model system used in FIRE
- Align future research program to better match student background

‘Spreading FIRE’: expand CUREs at CSUN, with common objectives

23 **Cheryl Van Buskirk** *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

Summary

- Cellular damage, at least in some organisms, appears to contribute to sleep pressure

- For NSF-CAREER, education and research components should be mutually beneficial

Cheryl Van Buskirk *CSUN Biology* *cheryl.vanbuskirk@csun.edu*

A Geologic Perspective on Assessing Seismic Risk in California, and How my CAREER Grant relates

Kimberly Blisniuk– San Jose State University

Kimberly Blisniuk, Associate Professor

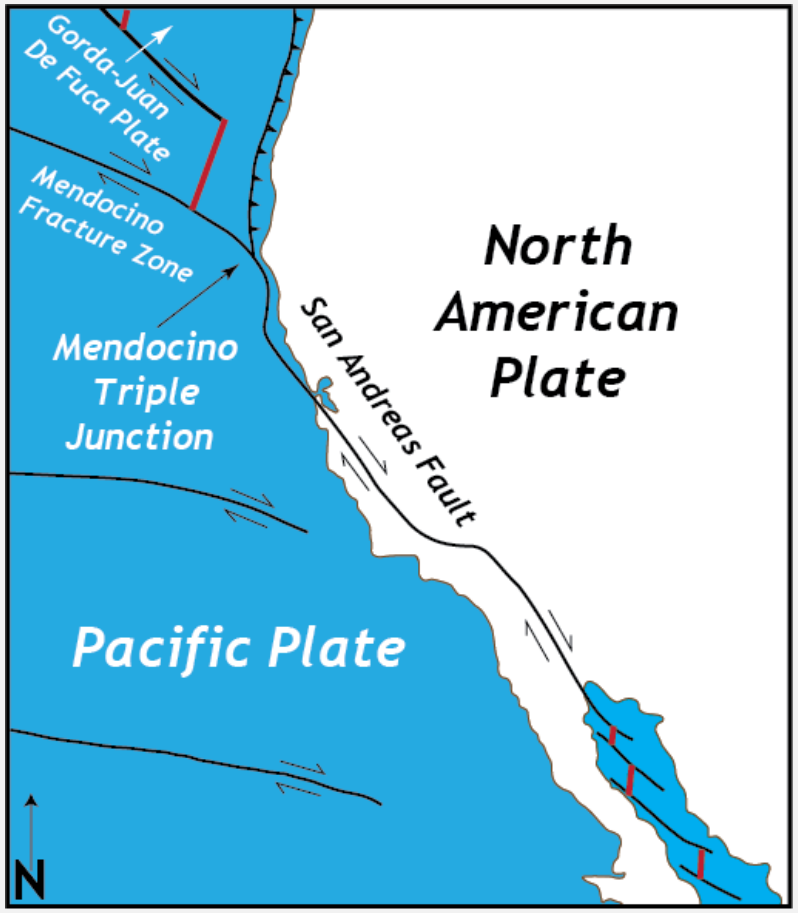
San Jose State University, Department of Geology

Kimberly.Blisniuk@sjsu.edu

Geology in hazard assessment

- What is the role of geology in hazard assessment

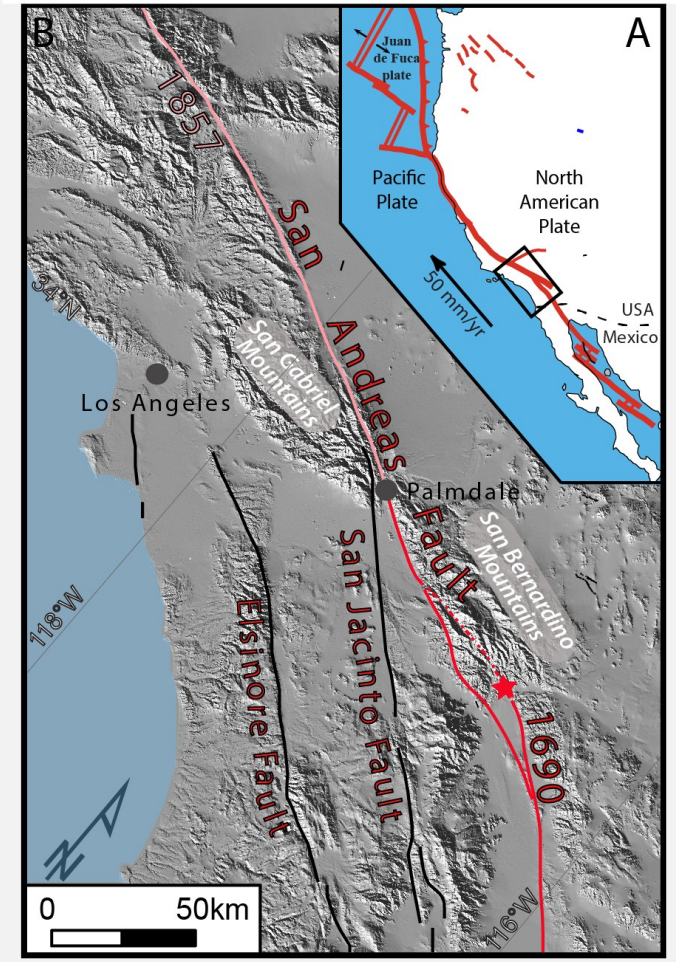
Geology provides deformation models for earthquake hazard assessment and earthquake probabilities



Kimberly Blisniuk *SJSU/Geology* *Kimberly.Blisniuk@sjsu.edu*

Deformation models and fault slip rates

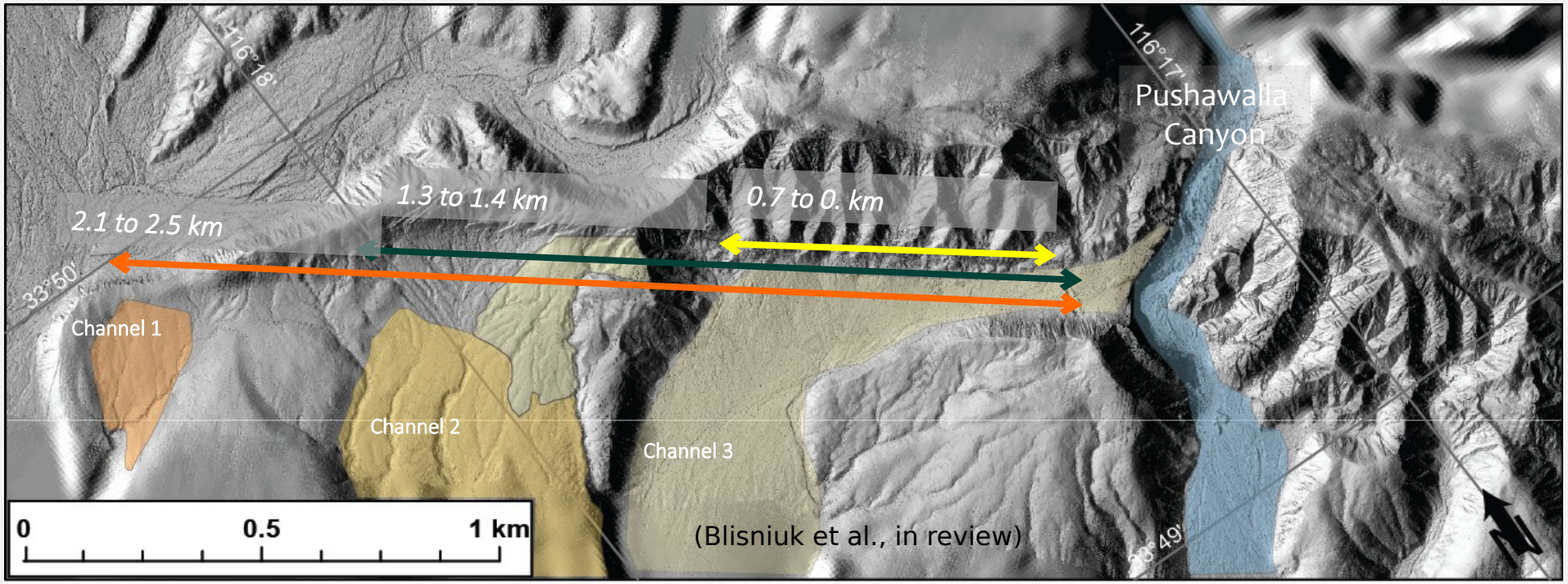
- A fault's slip rate is directly proportional it's hazard potential
- Geologic fault slip rates are estimated by measuring the rate at which a landform moves over times



Kimberly Blisniuk *SJSU/Geology* *Kimberly.Blisniuk@sjsu.edu*

A Geologic Perspective on Assessing Seismic Risk in California, and How my CAREER Grant Relates

San Andreas Fault slip rates and hazard probability



Fault slip rates: $22\ ^{+2}/_{-2}$ *mm/yr*

Kimberly Blisniuk *SJSU/Geology* *Kimberly.Blisniuk@sjsu.edu*

A Geologic Perspective on Assessing Seismic Risk in California, and How my CAREER Grant Relates

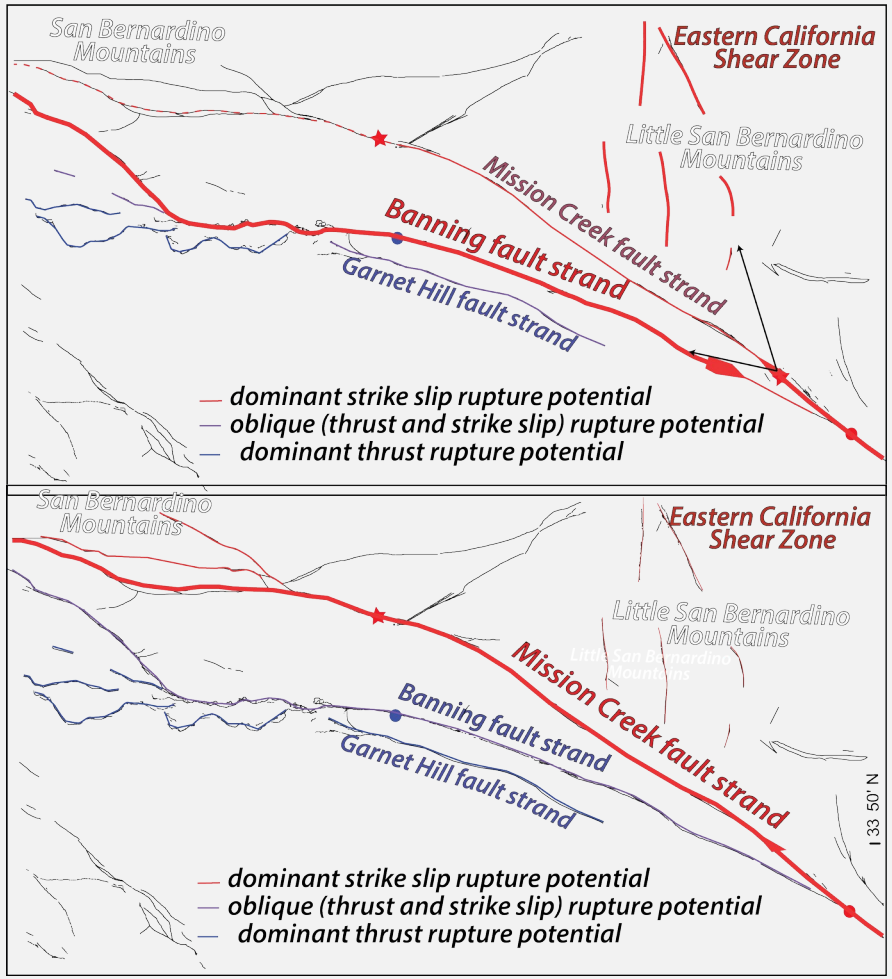
Hazard model for EQ ruptures

Preferred hazard model based on previous studies

a southern SAF earthquake will likely rupture on the Banning fault strand through a broadly distributed zone of right-lateral, thrust and oblique faults.

Alternative hazard model based on this study

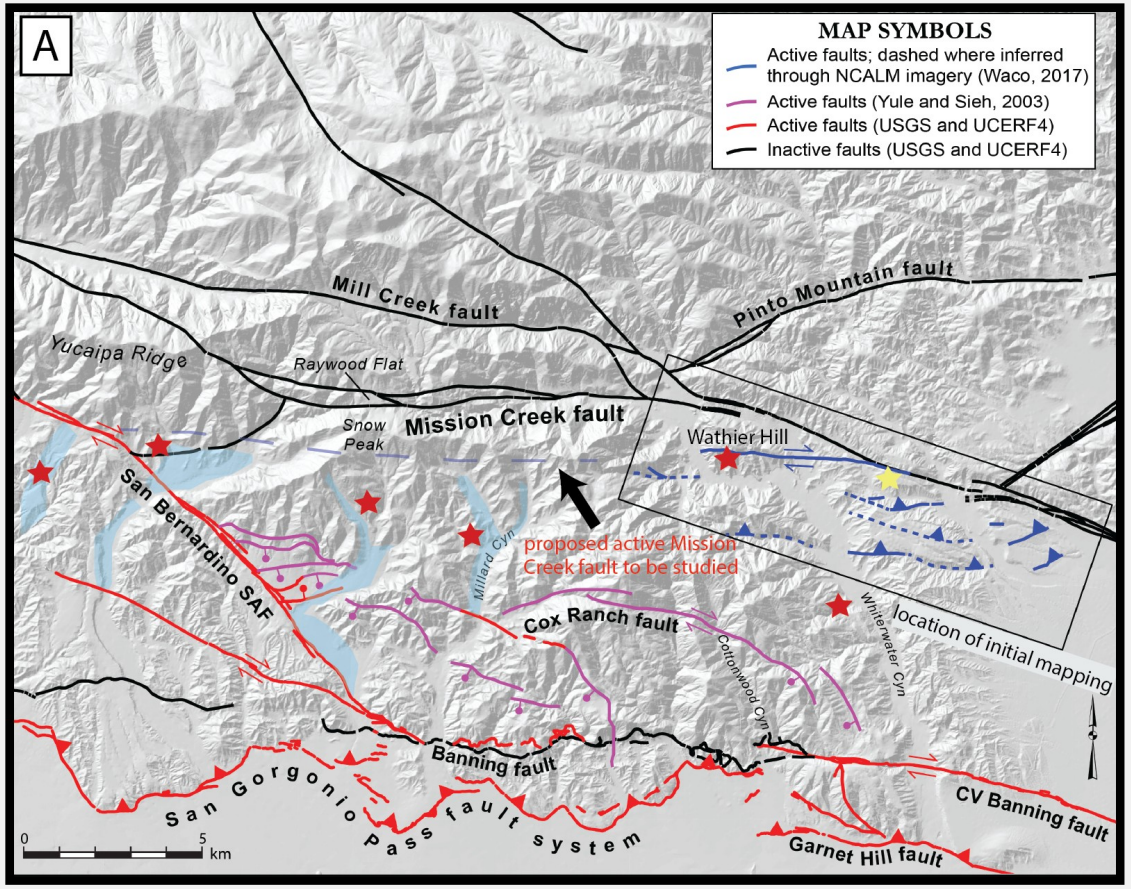
A southern SAF earthquake may rupture on the Mission Creek fault and continue northward on a narrow structure through the San Gorgonio Pass, instead of following the Banning fault strand.

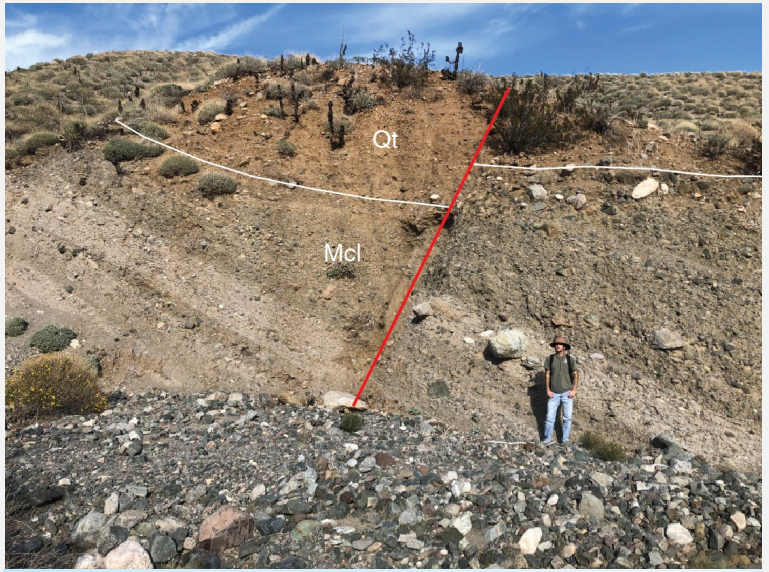


Kimberly Blisniuk *SJSU/Geology* *Kimberly.Blisniuk@sjsu.edu*

A Geologic Perspective on Assessing Seismic Risk in California, and How my CAREER Grant Relates

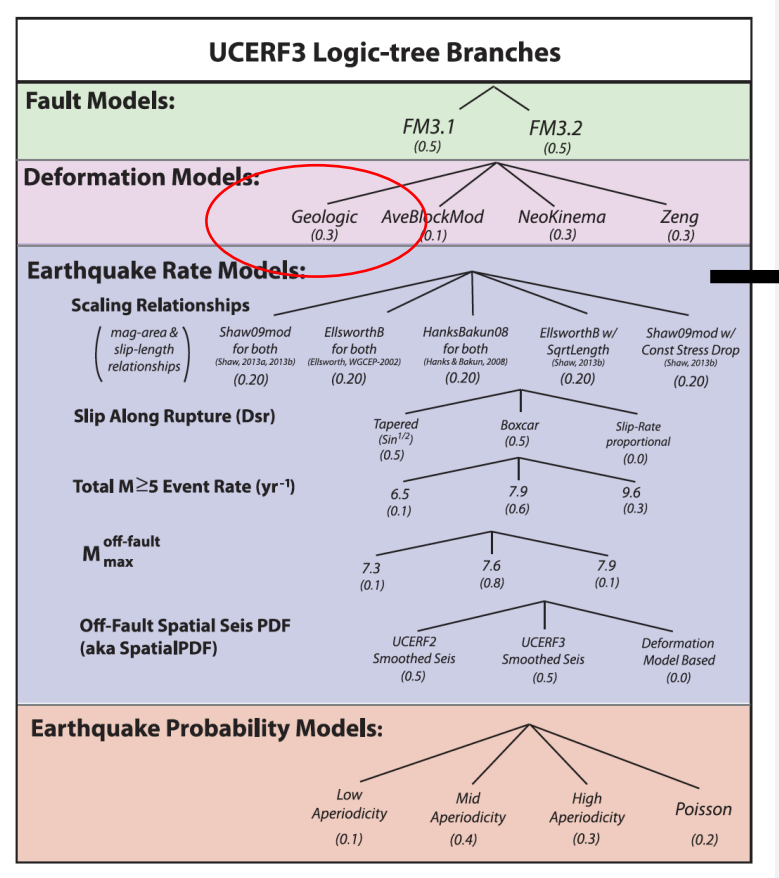
5 year NSF CAREER grant

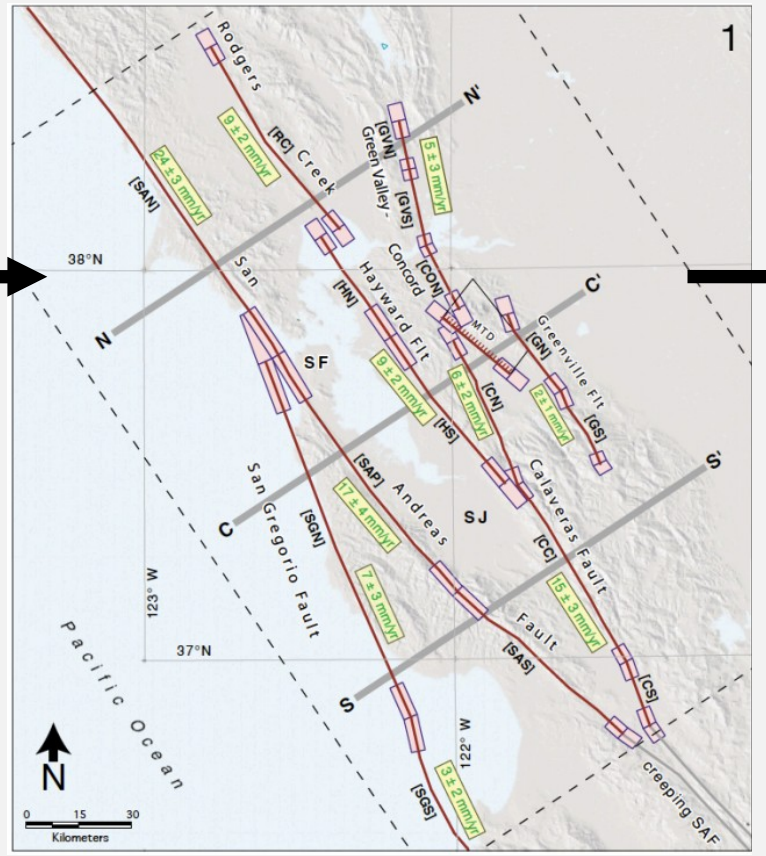


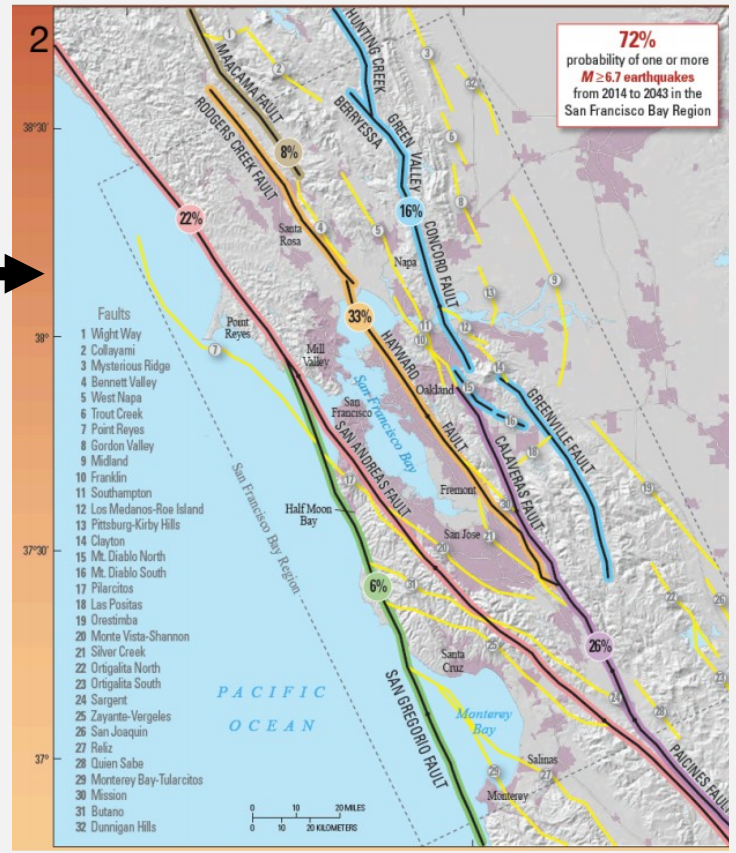


A Geologic Perspective on Assessing Seismic Risk in California, and How my CAREER Grant Relates

Geology is critical to EQ hazard assessment







Kimberly Blisniuk *SJSU/Geology* *Kimberly.Blisniuk@sjsu.edu*

Asymmetric ER Partitioning as a Pathway for Cell Fate Specification

Blake Riggs – San Francisco State University

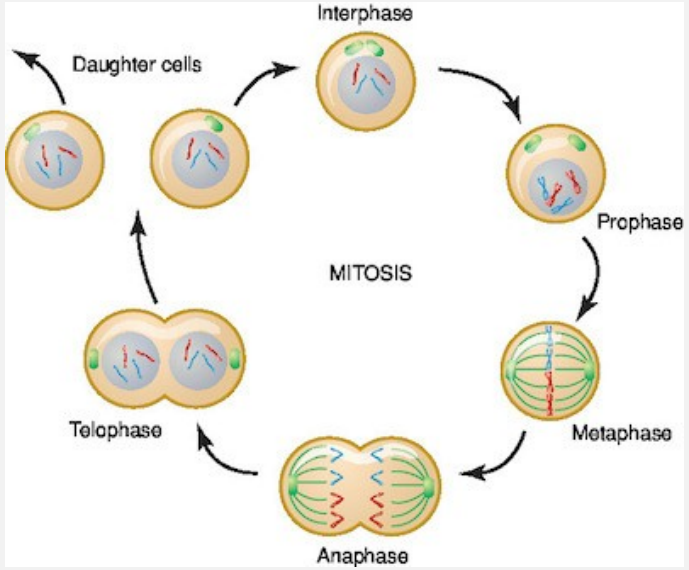
Blake Riggs, Associate Professor

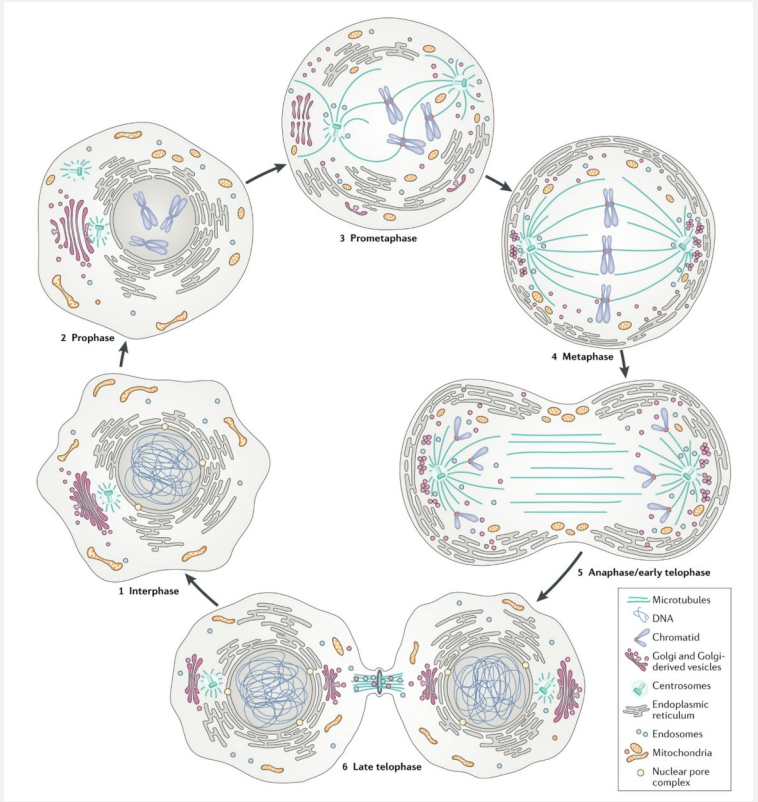
San Francisco State University, Department of Biology

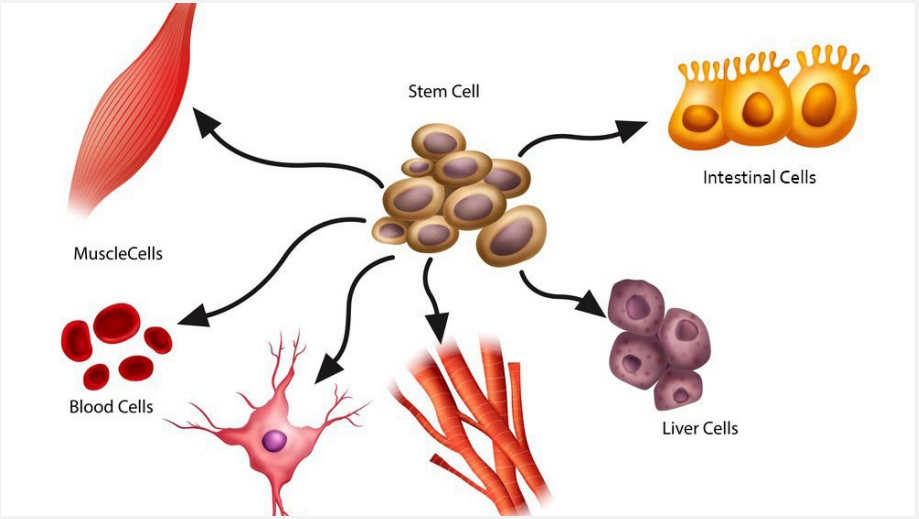
riggs@sfsu.edu

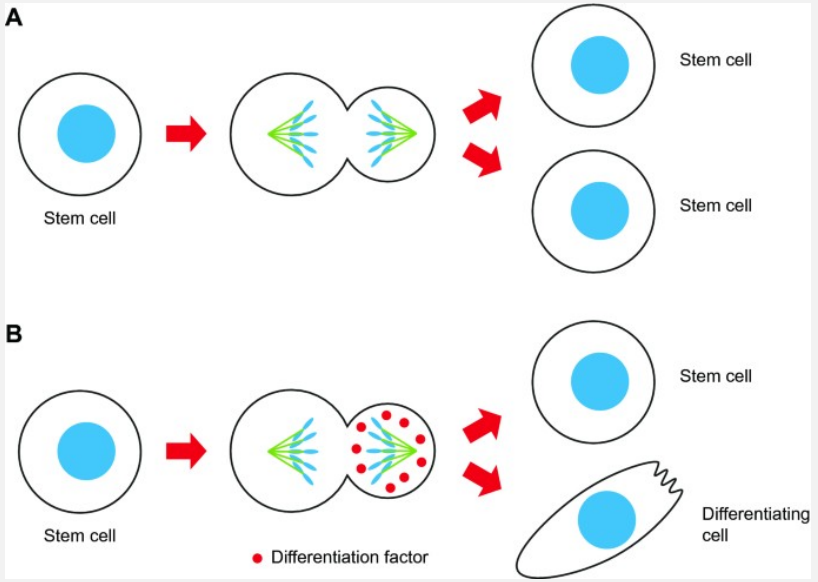
Asymmetric ER partitioning as a pathway for cell fate specification

Project Overview







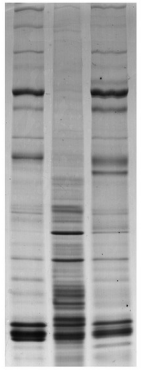


Blake Riggs *San Francisco State University/Biology* *riggs@sfsu.edu*

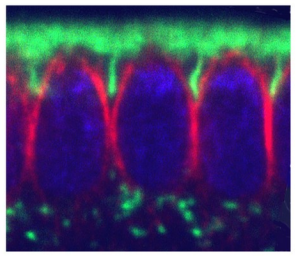
Activities

The “Fruit Fly”
Drosophila melanogaster

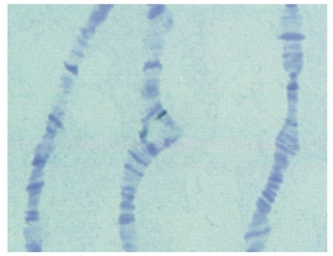
Biochemistry



Cell Biology



Genetics



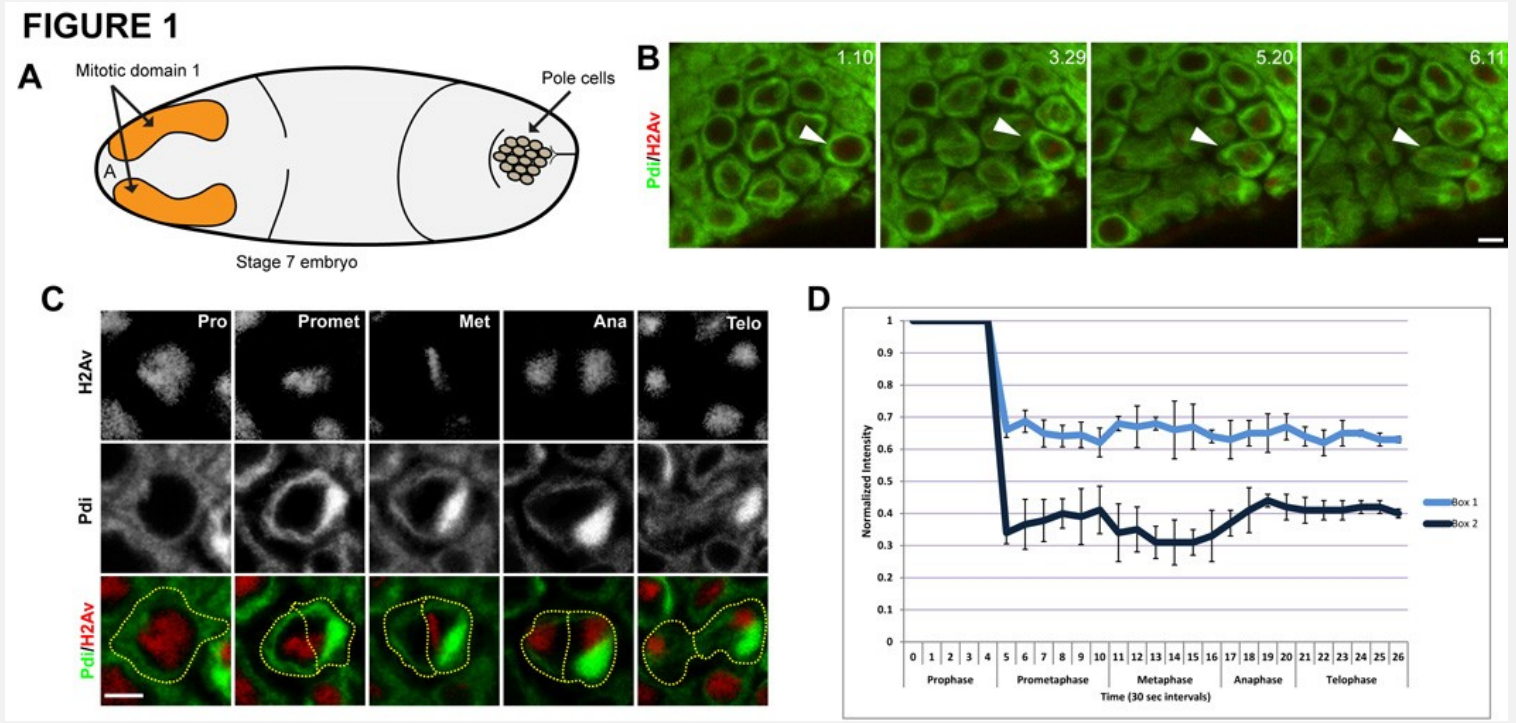
- **Investigate cytoplasmic organization during cell division**
- **Understanding the dynamic nature of organelles during mitosis**
- **Deepen our understanding of the role of cytoplasmic organization and the function of cell division and generation of cell diversity.**

Blake Riggs *San Francisco State University/Biology* *riggs@sfsu.edu*

The Endoplasmic Reticulum is partitioned asymmetric during early Drosophila embryogenesis

Results

ER / DNA



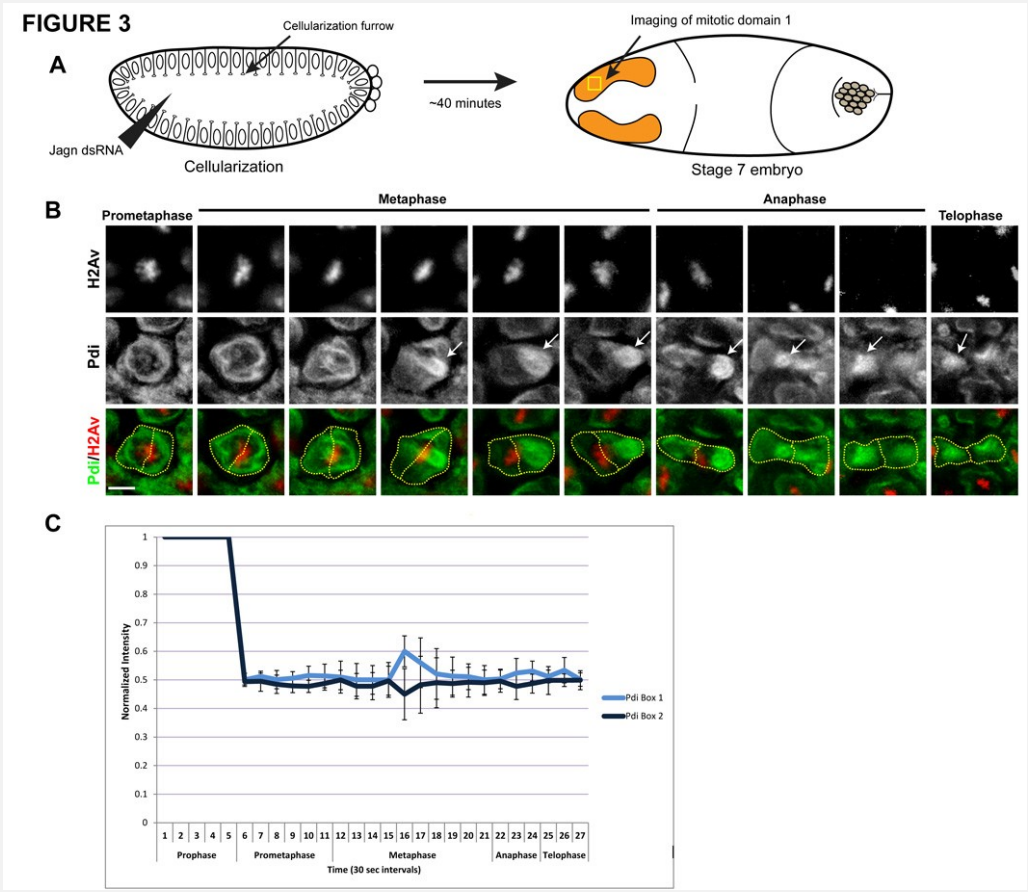
Eritano et al. 2017, MBoC, *28*, 1530–1538.

Blake Riggs *San Francisco State University/Biology* *riggs@sfsu.edu*

ER asymmetric partitioning relies on the integral membrane protein Jagunal (Jagn)

Results

ER / DNA

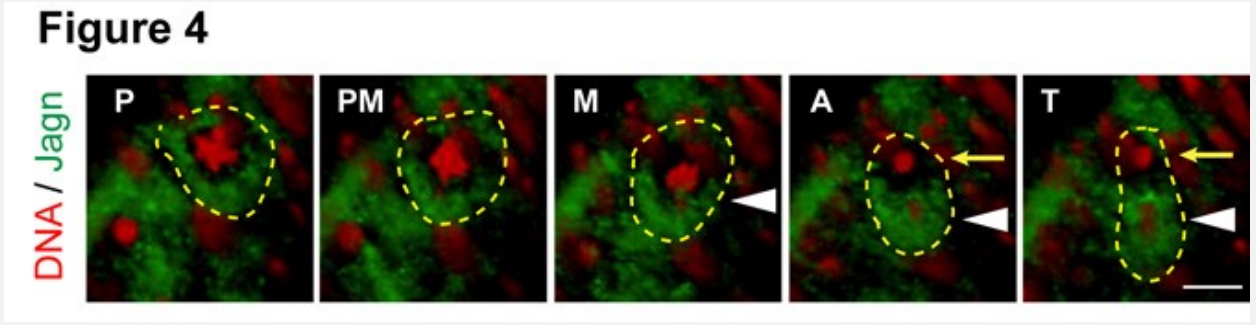


Eritano et al. 2017, MBoC, *28*, 1530–1538.

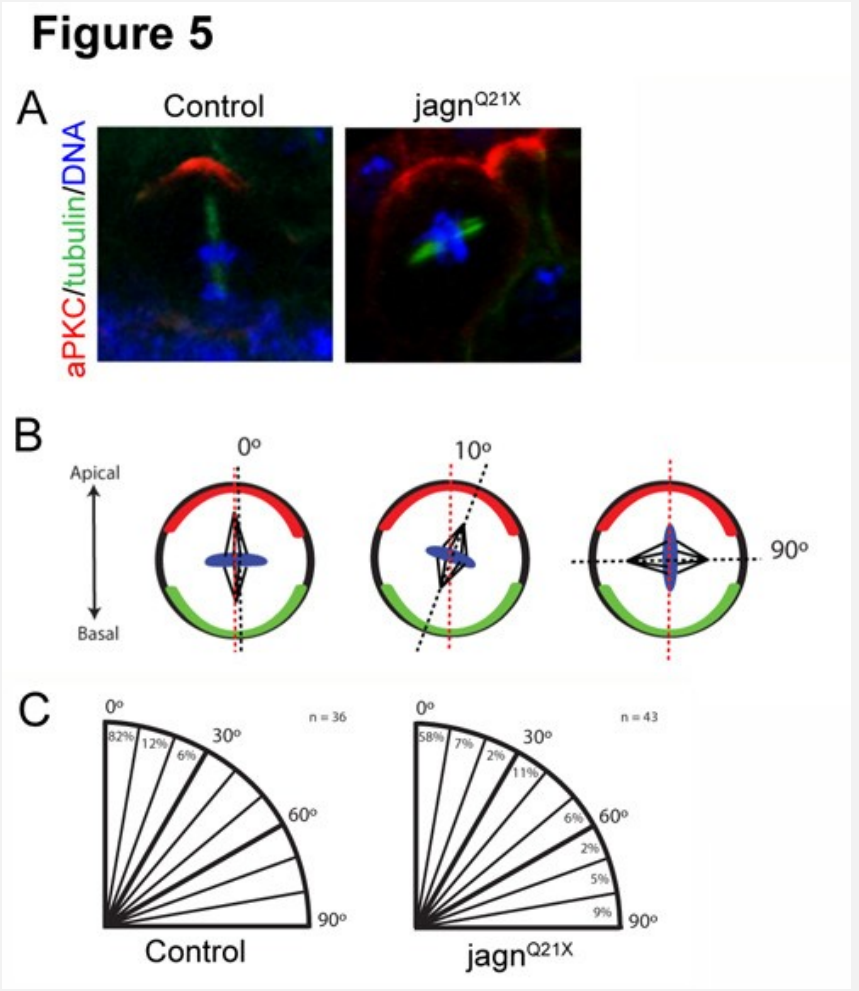
Blake Riggs *San Francisco State University/Biology* *riggs@sfsu.edu*

Jagn is partitioned asymmetrically in pro-Neuroblast (NB) and display spindle rotation defects in NB deficient for *jagn*

Results



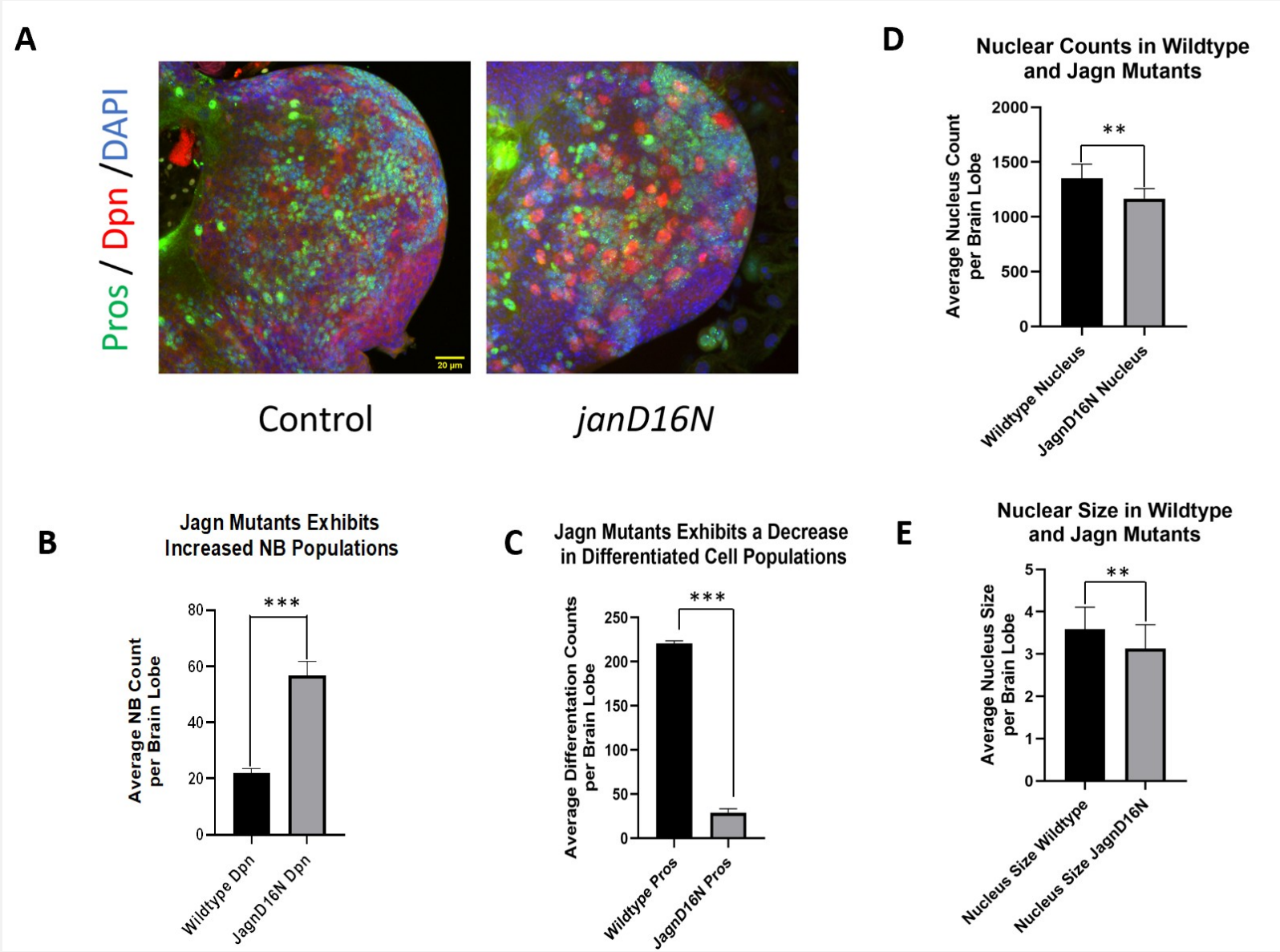
Eritano et al. 2017, MBoC, *28*, 1530–1538.



Blake Riggs *San Francisco State University/Biology* *riggs@sfsu.edu*

Jagn deficient brain lobes display defects in cell fate selection

Results

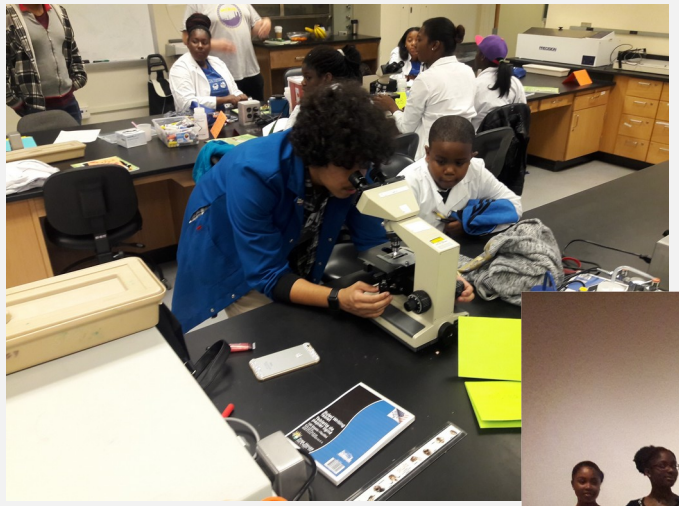


Blake Riggs *San Francisco State University/Biology* *riggs@sfsu.edu*

Broader Impacts: connecting SFSU students with the community

STEM day at SFSU with Carver Scholars

Dinner with a Scientist



Riggs lab members being recognized by the City of SF

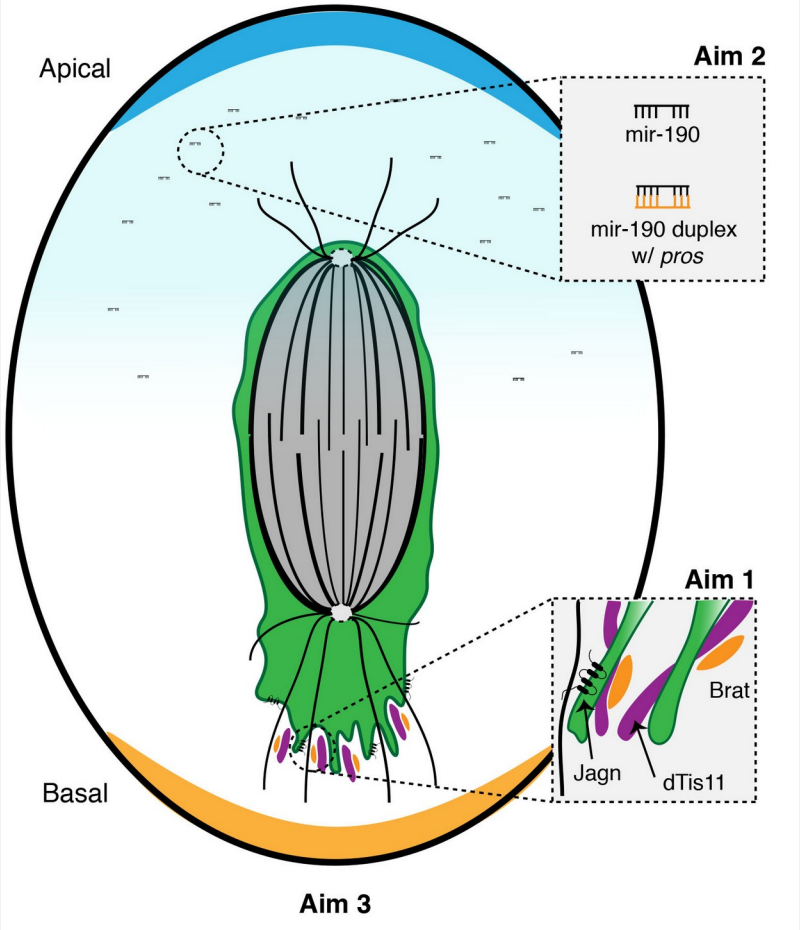
Lessons Learned

- Organization and outlining of projects is key in a master's serving institution
- Learn when to change course and let go of projects
- Less sometimes can be more
- Practice empathy
- Everyone can do science (growth mindset)
- Find likeminded scientist and collaborators
- Remember who you are and why you are here
- Never give up!

Blake Riggs *San Francisco State University/Biology* *riggs@sfsu.edu*

Asymmetric ER Partitioning as a Pathway for Cell Fate Specification

Next Steps/Long-Term Plans



- More Funding!!!
- Characterizing the structural role of the ER in organization and delivery of cell fate determinants during neurogenesis
- Understanding the role of microRNAs in regulation of cell fate selection
- Investigating the connection between organelles during cell division
- Endosomal networks
- Mitochondria
- *Create a service-learning course dedicated to STEM mentoring*

Blake Riggs *San Francisco State University/Biology* *riggs@sfsu.edu*

Summary

- The ER is partitioned asymmetrically in pro-neuronal cells in the early Drosophila embryo
- Asymmetric ER partitioning relies on the highly conserved ER membrane protein Jagunal
- Jagunal is involved in the pathway for neuronal cell fate selection
- Broader Impacts: Connected SFSU students to the SF community and helped create a Black STEM group, BE-STEM
- 13 of MS students trained in my lab are in R1 PhD programs

Gerson Ascencio
Emily Conrad
Alia Edington
Nicole Rodrigues (Marshall Lab, UCSF)
Alma Aracely Martinez Peraza
Rozhin Lak,
Ricardo Solis
Matthew DeCruz,
Jessica Bolivar-McPeek
Bethany Ramos Morin
Cynnie Tam
Jose Ortega
Tserendavaa "David" Mendsaikhan
Katharine Eichelberger
Jamarc Allen-Henderson
Jessica Paz

Blake Riggs *San Francisco State University/Biology* *riggs@sfsu.edu*

Computational Gravitational-Wave Physics and Astronomy at California State University, Fullerton

Geoffrey Lovelace – California State University, Fullerton

Collaborators:
Simulating eXtreme Spacetimes Collaboration,
LIGO Scientific Collaboration

Geoffrey Lovelace, Associate Professor

California State University, Fullerton, Department of Physics

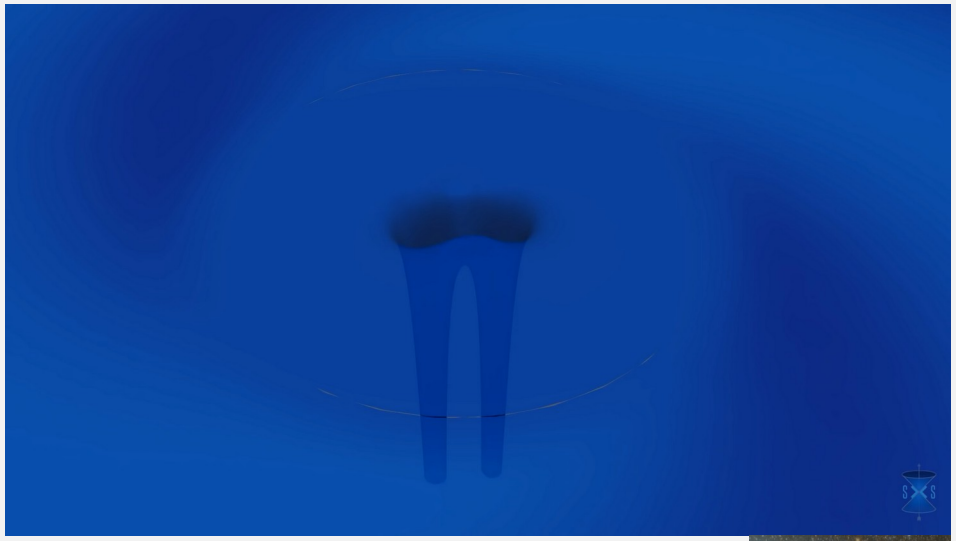
glovelace@Fullerton.edu

CALIFORNIA STATE UNIVERSITY FULLERTON

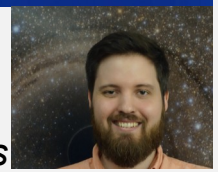
Computational Gravitational-Wave Physics and Astronomy at California State University, Fullerton

Project Overview

- Nicholas & Lee Begovich Center for Gravitational-Wave Physics and Astronomy
  - Research, education, & outreach in gravitational-wave science
  - 4 faculty members, 25 students, 33 alumni in Ph.D. programs, industry, and teaching
- CAREER: Computational gravitational-wave science and education in the era of first observations
  - Modeling colliding black holes & neutron stars
  - Modeling thermal noise in gravitational-wave optics
  - 1-week summer workshop for community-college students



Geoffrey Lovelace *Cal State Fullerton/ Physics*
glovelace@Fullerton.edu



Simulation by Nick Demos

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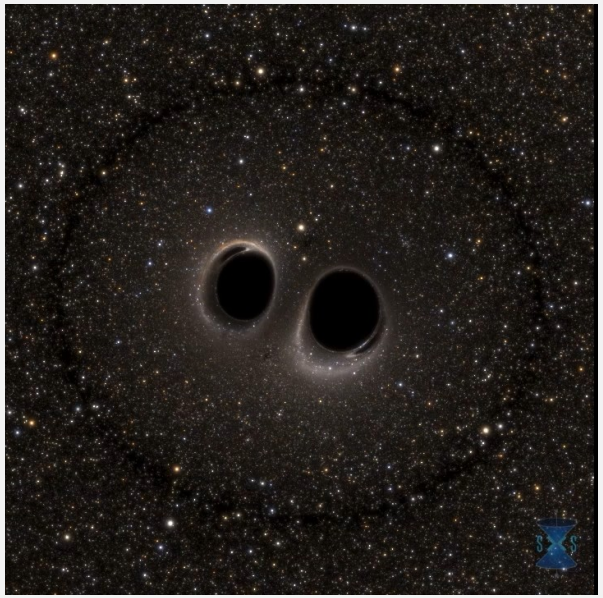
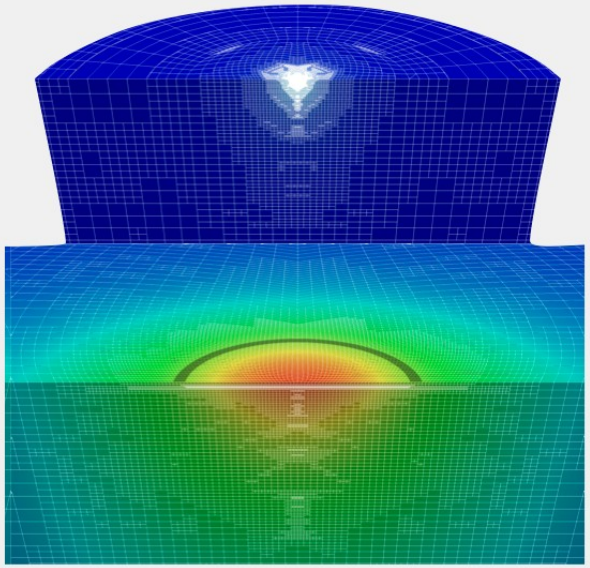
Computational Gravitational-Wave Physics and Astronomy at California State University, Fullerton

Activities

- Merging black holes and neutron stars
  - Use Spectral Einstein Code (SpEC), supercomputers to calculate gravitational waves & warped spacetime
  - Results help interpret observations
- Thermal noise in crystalline mirror coatings
  - Error from approximating crystal as glass?
- Workshop
  - Gravitational waves & high-performance computing
  - Numerical Python programming
  - Simulate & visualize colliding black holes with SpEC
  - Interact with students in my research group



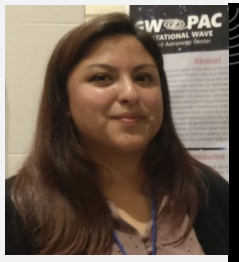


Geoffrey Lovelace *Cal State Fullerton/ Physics* *glovelace@Fullerton.edu*

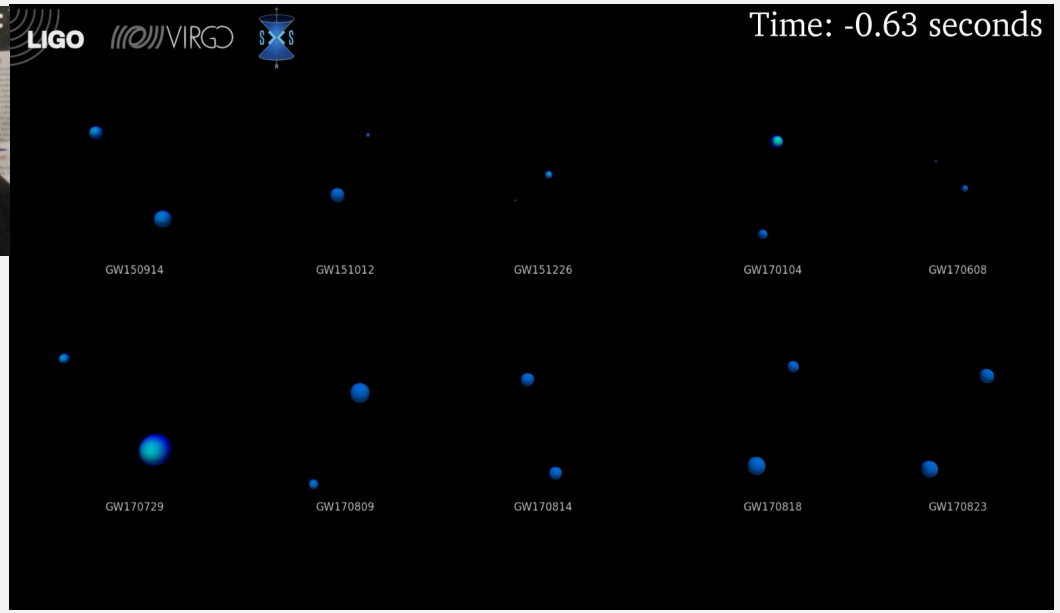
CALIFORNIA STATE UNIVERSITY FULLERTON

Computational Gravitational-Wave Physics and Astronomy at California State University, Fullerton

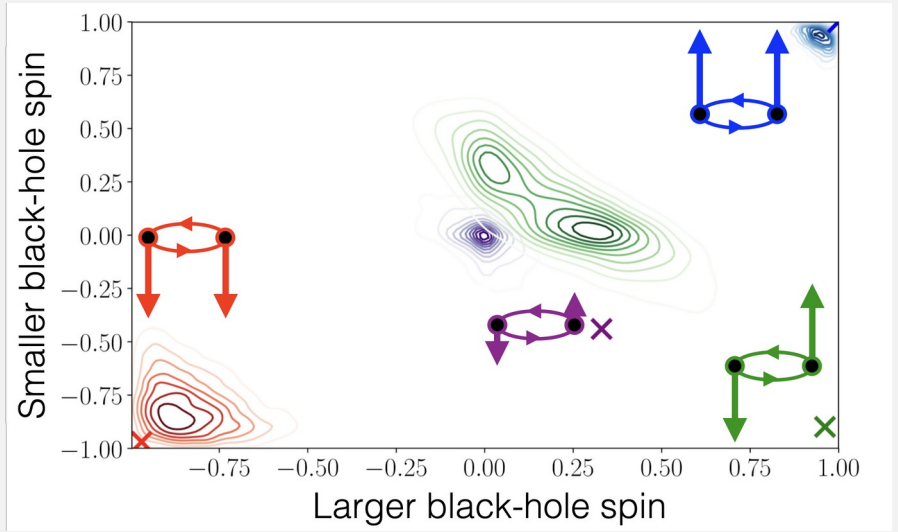
Results



Movie courtesy CSU Fullerton undergraduate Teresita Ramirez



- Research
  - Contribute calculations, help assess accuracy of catalog of 2000+ simulated colliding black holes
    Boyle et al, Class. Quantum Grav. **36**, 195006 (2019), Fullerton authors include GL, N Afshari, N Demos, A Garcia, R Katebi, H Khan, T Ramirez, S Rodriguez
  - Challenging to measure rapid black-hole spins from gravitational-wave observations
    K Chatziioannou, GL, et al Phys. Rev. D **98**, 044028 (2018)
  - Treat crystal as glass: ~3% change in thermal noise
    GL, N Demos, H Khan, Class. Quantum Grav. **35**, 025017 (2017)
- Workshop
  - Held in 2018, 2019 with ~20 Citrus College students each year
  - Marlo Morales: 2019 participant, now member of my research group



CALIFORNIA STATE UNIVERSITY FULLERTON

Computational Gravitational-Wave Physics and Astronomy at California State University, Fullerton

Lessons Learned

- Flexibility in research direction
  - Simulations with neutron stars proved challenging
  - Solution: help build SpECTRE, next-generation numerical-relativity code (https://spectre-code.org)
- Proposal strategy
  - Year 1 — RUI (awarded)
  - Year 4 — RUI (awarded) + CAREER (declined)
  - Year 5 — CAREER (awarded)
    - Build a track record with other funding first
    - Research component must sparkle
    - Don’t neglect the educational component
    - Play to our strengths in the CSU integrating research and education

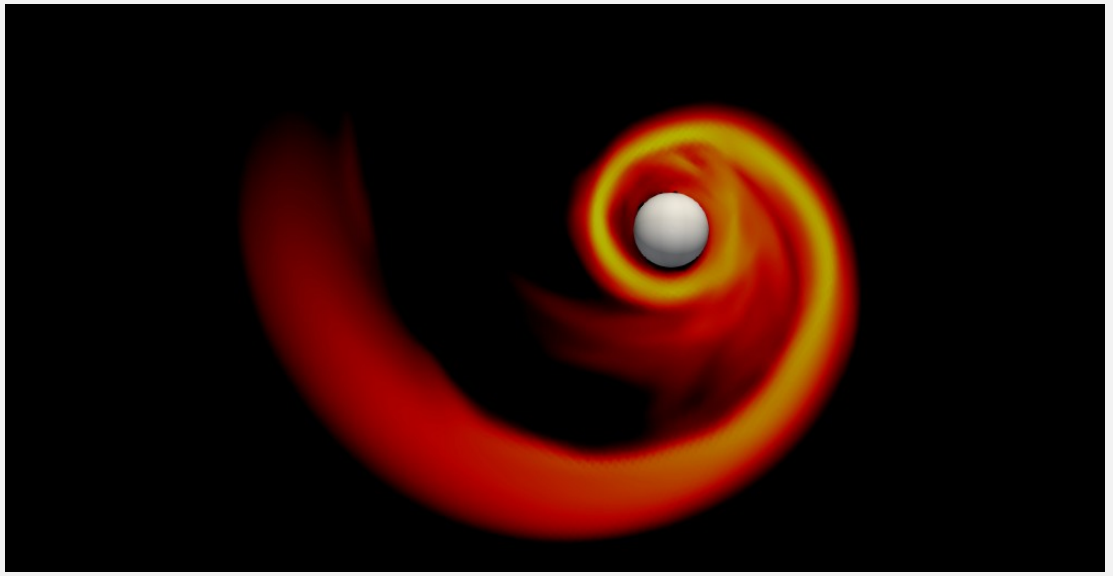


Image & simulation by Jennifer Sanchez

Geoffrey Lovelace *Cal State Fullerton/ Physics* *glovelace@Fullerton.edu*

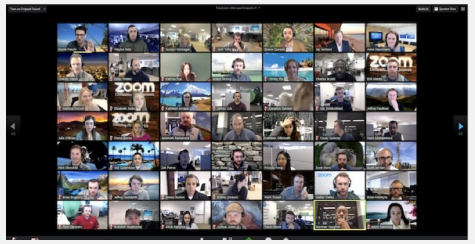
CALIFORNIA STATE UNIVERSITY FULLERTON

Computational Gravitational-Wave Physics and Astronomy at California State University, Fullerton

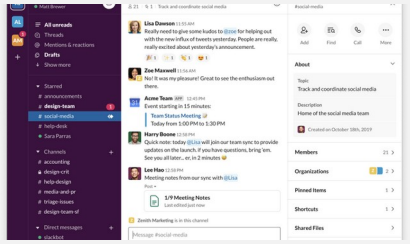
Next Steps/Long-Term Plans

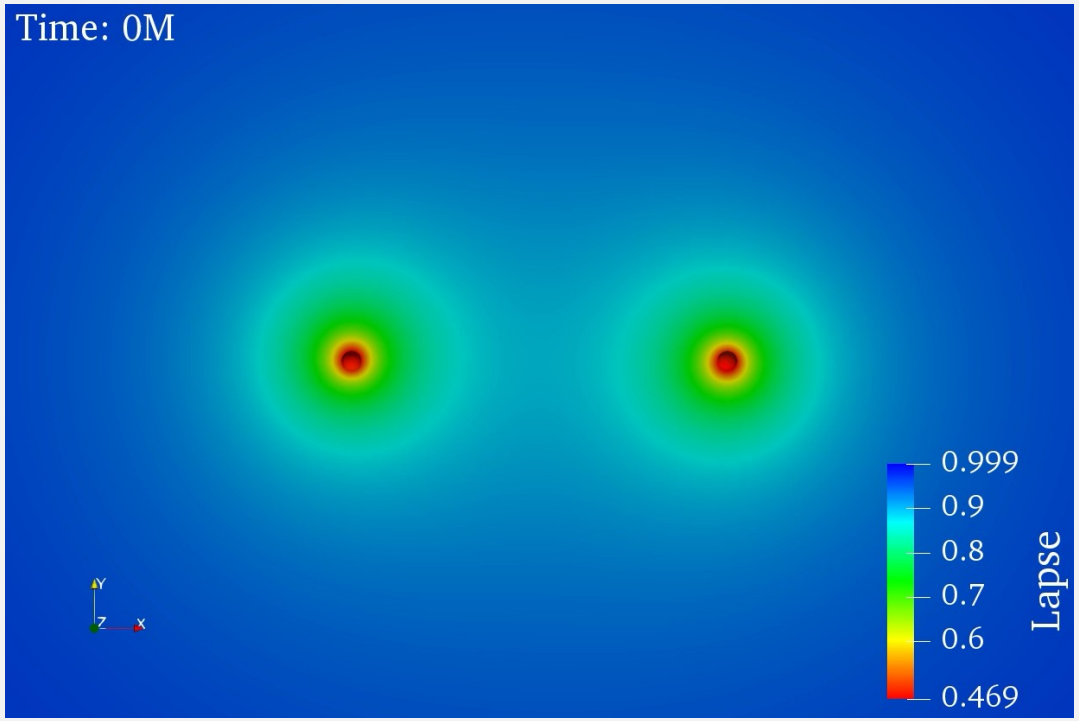
- Next steps
  - Enable SpECTRE to simulate merging black holes
    - Uses new techniques enabling it to run effectively on 100,000 cores (vs. 50 cores for Spectral Einstein Code)
      - Example: task-based parallelism
  - Apply SpECTRE code to thermal-noise modeling
  - Workshop assessment and followup
- Long term plans
  - Apply SpECTRE calculations to interpreting high-precision results from future gravitational-wave detectors

Simple parallelism: "Zoom"
Many sync points



Task-based parallelism: "Slack"
Few sync points





First SpECTRE simulation of binary black hole
Color: how much slower clocks tick compared to far away

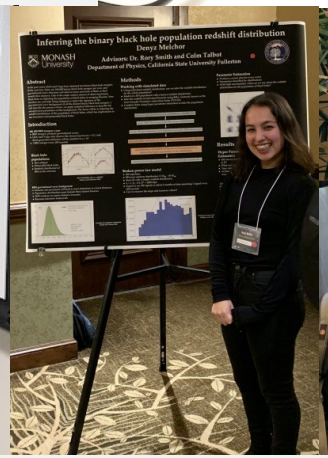
Geoffrey Lovelace *Cal State Fullerton / Physics* *glovelace@Fullerton.edu*

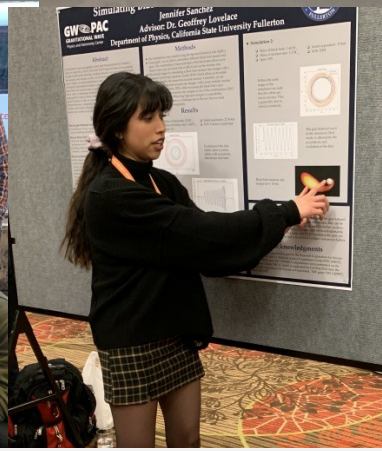
CALIFORNIA STATE UNIVERSITY FULLERTON

Computational Gravitational-Wave Physics and Astronomy at California State University, Fullerton

Summary

- Computational gravitational-wave science & education
  - Model colliding black holes & neutron stars
  - Model thermal noise in detector optics
  - Introduce community college students to computing & gravitational waves





Geoffrey Lovelace *Cal State Fullerton / Physics* *glovelace@Fullerton.edu*

BUILD: Bringing the Universe to IE and LA Districts

Matthew Povich– Cal Poly Pomona

Collaborators – CPP alumni (current affiliation):
B. A. Binder (CPP) • T. Jayasinghe (Ohio State) • D. M. Dixon (Vanderbilt) • J. T. Maldonado • G. Nguyen (San Diego State) • L. K. Townsley & P. S. Broos (Penn State) • H. A. Kobulnicky (U. Wuyoming) • E. H. Nuñez & M. A. Kuhn (Caltech)

Matthew Povich, Associate Professor
Cal Poly Pomona, Department of Physics and Astronomy
mspovich@cpp.edu

CalPolyPomona

Project Overview

- **Intellectual Merits**: A new calibration of galactic star formation rate indicators and spatially-resolved maps of the present-day star formation rate in our own Milky Way Galaxy.
- **Broader Impacts**: Expand opportunities for members of underrepresented minority groups to participate in astronomy.

Principal outcomes, by the numbers…

- **15 peer-reviewed papers** published + 2 in preparation by project team members, *including two led by undergraduate students.*
- **>20 conference presentations and invited talks** by the PI, postdoc, and undergraduate students
- **12 undergraduate researchers** involved in project activities; **8 proceeded to graduate school** in physics or astronomy
- **>45,000 citizen scientists** contributed to the online Milky Way Project
- **>3,000 attendees at 24 BUILD public-outreach events**

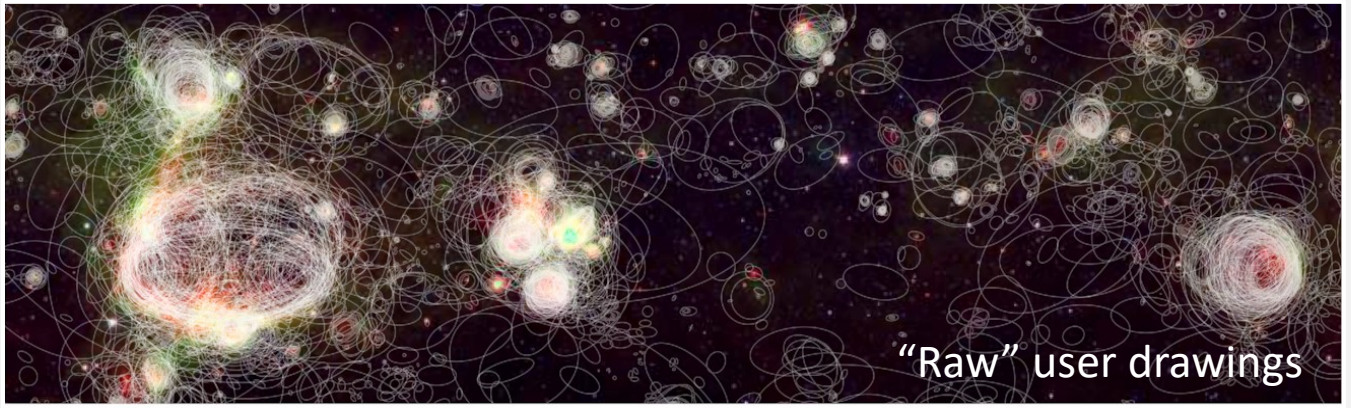
Matthew S. Povich *CPP Department of Physics & Astronomy* *mspovich@cpp.edu*

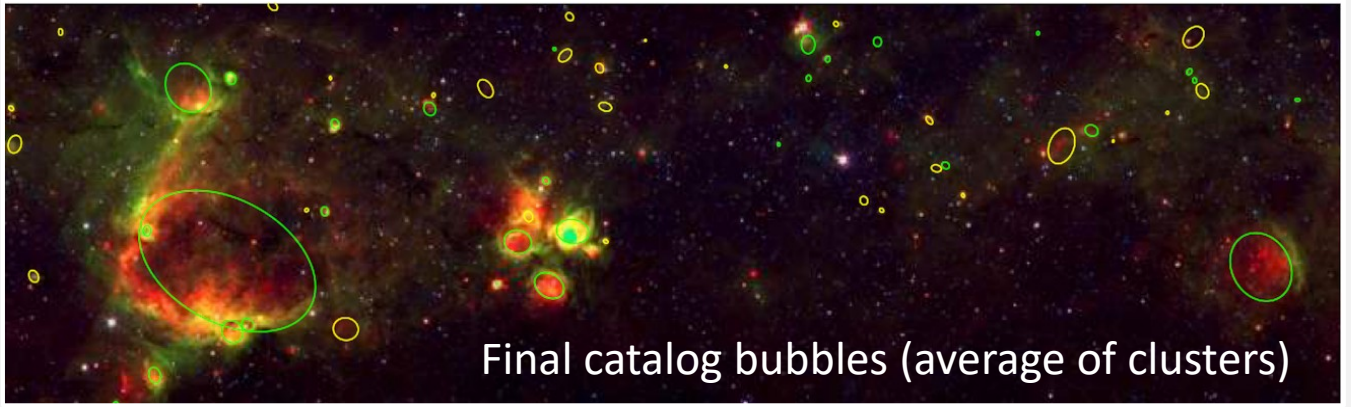
CalPolyPomona

The Milky Way Project

Jayasinghe et al. 2019, *MNRAS,* **488**, 1141

- **Led by CPP undergraduate T. Jayasinghe** (class of 2017), who designed and implemented a brand-new data reduction pipeline.
- Aggregated 3 million classification drawings **by >45,000 volunteer citizen scientists** on MWP website from 2010–2018.
- Published **catalogs of 2600 IR bubbles and 599 IR bow shocks**, including 341 new candidate *massive* stars.



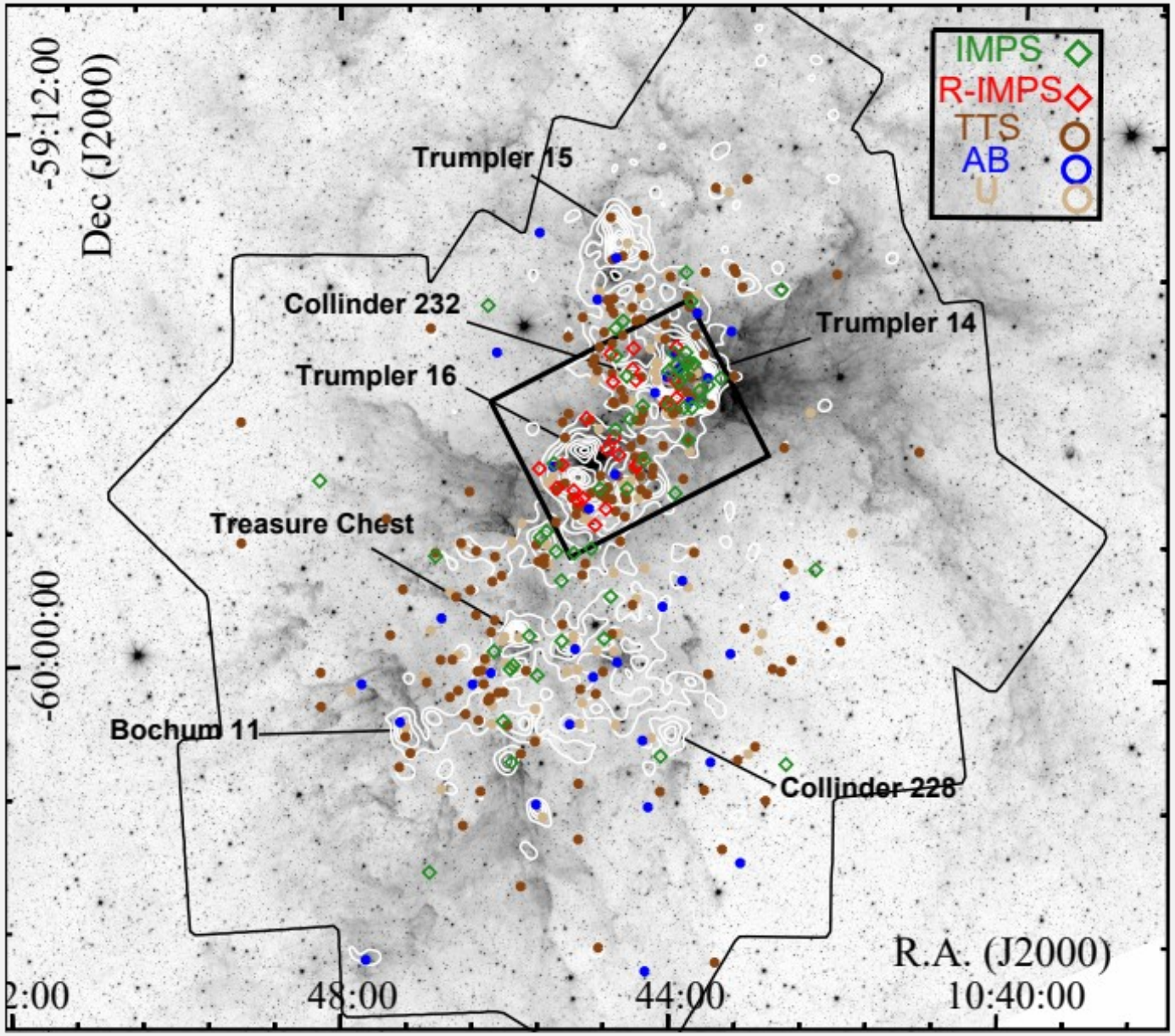


Matthew S. Povich *CPP Department of Physics & Astronomy* *mspovich@cpp.edu*

CalPolyPomona

Bright X-ray Stars in Carina

- CPP alumnus E. H. Nuñez et al. (2020, in prep) analyzed X-ray observations of intermediate-mass (2–5 $M_{\odot}$) pre-main-sequence stars (IMPS) in the Carina Nebula.
- **Fully-convective IMPS** are more X-ray luminous than other coronal-flaring X-ray sources.
- **Radiative-IMPS** fade dramatically in X-rays during the first few Myr of their lives, making them a useful stellar population for age-dating star-forming regions.



Matthew S. Povich *CPP Department of Physics & Astronomy* *mspovich@cpp.edu*

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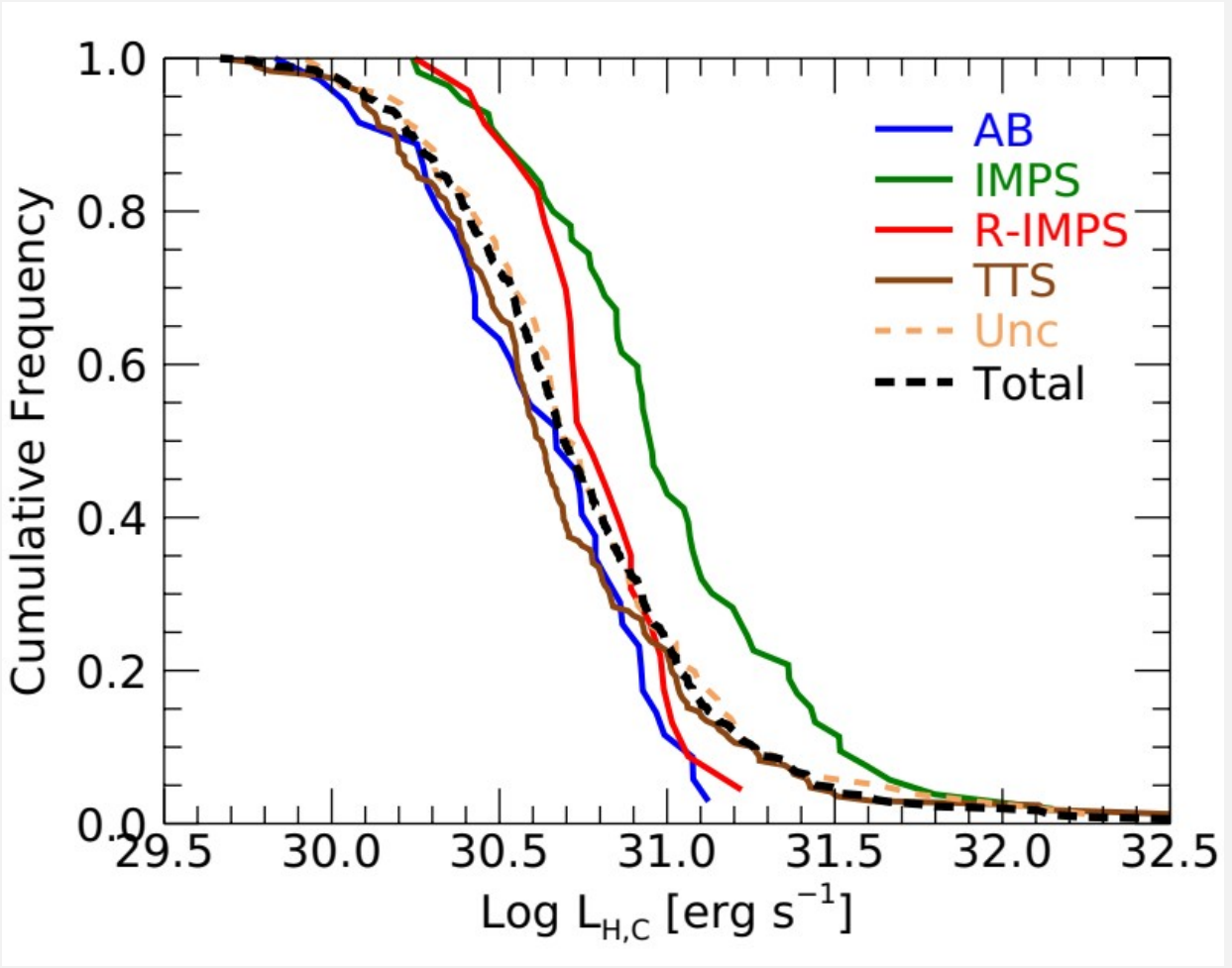


Hard-band (2–8 keV) X-ray luminosity functions for full 370 stars in the Carina Nebula.

Matthew S. Povich *CPP Department of Physics & Astronomy* *mspovich@cpp.edu*

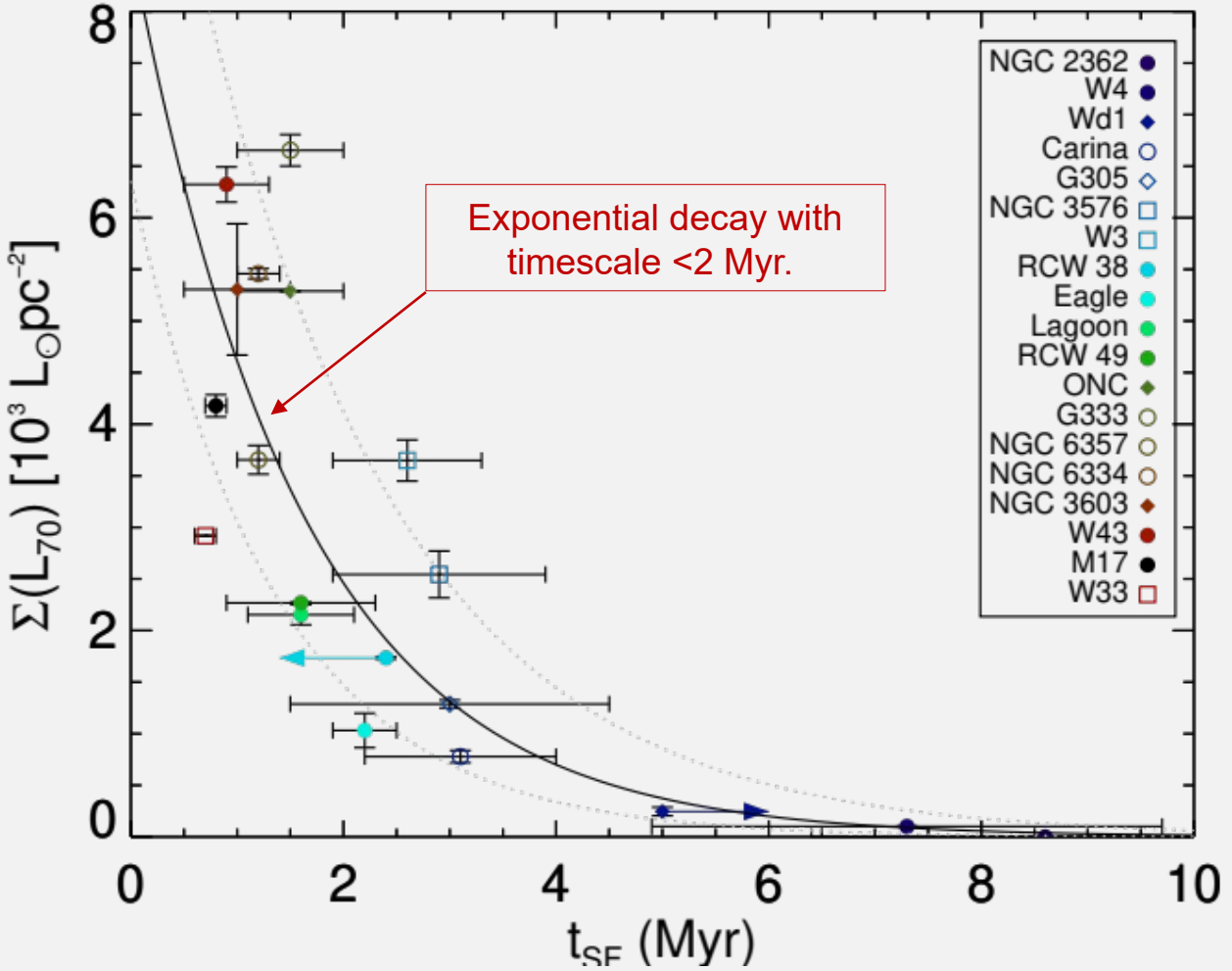
CalPolyPomona

Synthesis: Stars+Nebulae

Observational tracers for Milky Way and extragalactic star formation rates are *generally* consistent, assuming:

- universal distribution of stellar masses.
- same models to describe radiative output and winds of massive stars.

However, massive stellar winds and radiation remove dust from ionized nebulae within 2 Myr. *Typical observational tracers assume longer timescales and hence may* ***underestimate actual star formation rates.***

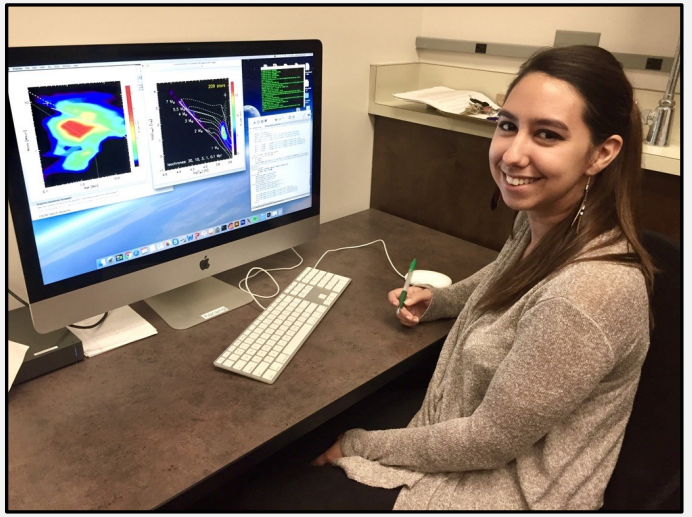


Thermal IR surface brightness versus age measured from resolved, X-ray-selected IMPS populations (Povich+19 and in prep.)

Matthew S. Povich *CPP Department of Physics & Astronomy* *mspovich@cpp.edu*

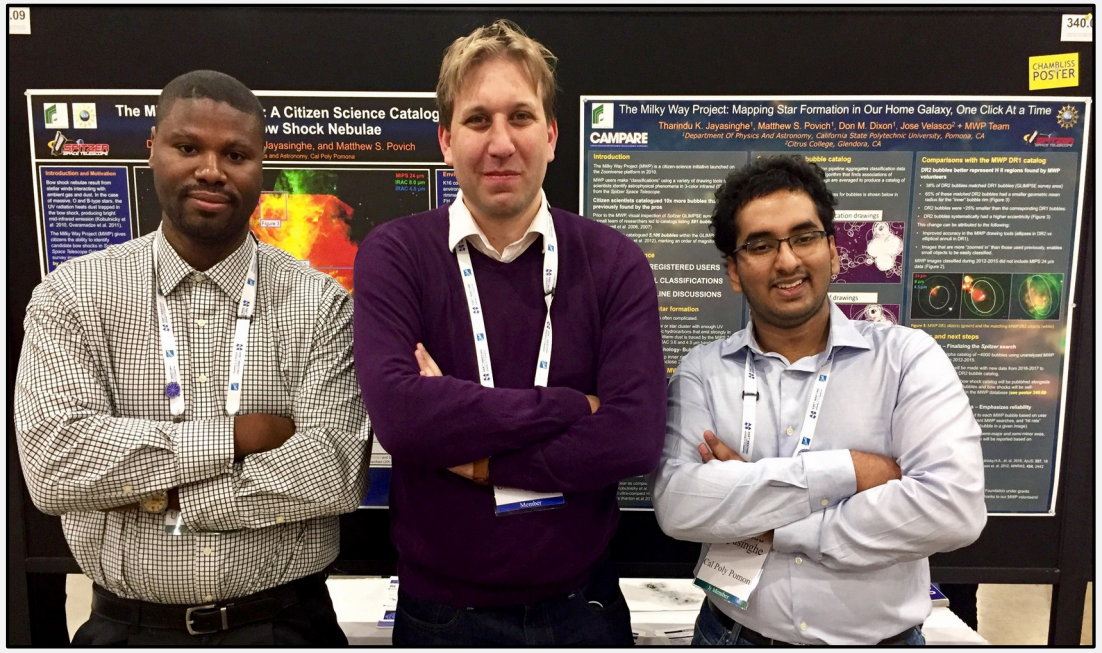
CalPolyPomona

Successful students

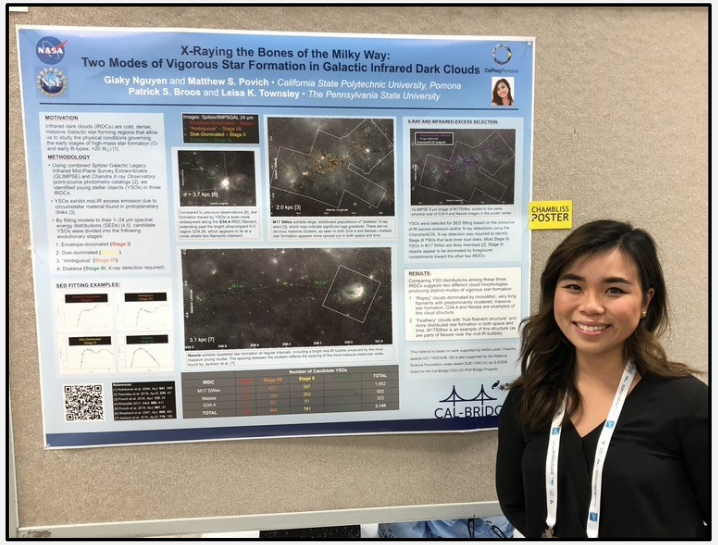


J. Maldonado (CPP ’16 → Michigan State M.S. ’18)

PI Povich and E. H. Nuñez (CPP ’19 → Caltech Ph.D. + NSF GRF)



D. Dixon (CPP ’17 → Vanderbilt Ph.D.), C. J. Lintott (Zooniverse PI), & T. Jayasinghe (CPP ’17 → Ohio State Ph.D.)



G. Nguyen (CPP ’20 → San Diego State M.S.)

Matthew S. Povich *CPP Department of Physics & Astronomy* *mspovich@cpp.edu*

BUILD

BRINGING THE UNIVERSE INTO L.A. DISTRICTS

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Future Plans/Lessons for JCs

- Currently, I'm completely swamped with teaching a full load of remote classes! *Junior colleagues (JCs): get your reassigned time from grants to stay productive!*
- Research priorities (1) read through Evan's draft, polish, and send to the 3 coauthors for final comments before submission, (2) finish drafting my own latest paper, and do the same. *JCs: Try to balance student projects with your own research and writing.*
- Submit re-proposal to NSF for grant that would extend our IR bow shocks+citizen science work for 3 more years. Was turned down last year. *JCs: when rejected, try and try again!*
- Still waiting for outcome of a big NASA collaborative proposal to do a multi-institutional project on searching for extraterrestrial technosignatures. Decisions clearly delayed by COVID-19, unclear how funding has been impacted. *JCs: **Be patient**! Tenured colleagues: **Be understanding**!*
- My public-outreach project had the brakes slammed on it by COVID-19, which coincided with expiration of funding. Will I have time/energy to try and restart it next year? *JCs: Sustainability is **hard.***

Matthew S. Povich *CPP Department of Physics & Astronomy* *mspovich@cpp.edu*

Research Highlights Since Receipt of the NSF CAREER Award

Nina Robson– California State University, Fullerton

Nina Robson, Associate Professor

Cal State Fullerton, Department of Mechanical Engineering

nrobson@Fullerton.edu

CALIFORNIA STATE UNIVERSITY FULLERTON

Research Highlights Since Receipt of the NSF CAREER Award

CAREER Research Overview

Problem: Many industry-related labor-intensive manual tasks are difficult to automate due to high levels of variations/uncertainties within the operating environment.



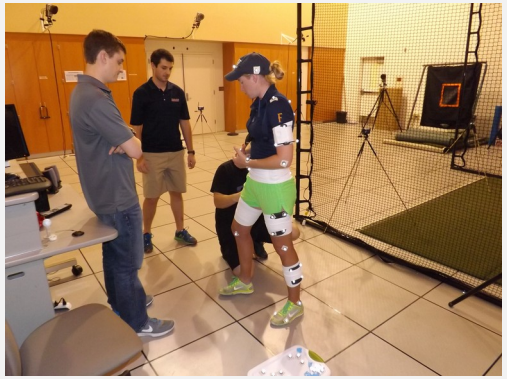
Goal: Advance basic knowledge on human-robot interaction and environment uncertainties and incorporate some of those conditions on design level leading to next generation robotic devices working alongside with humans.

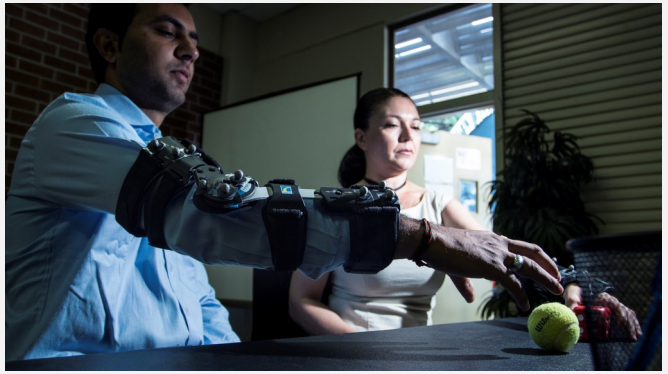



Nina Robson *CSUF, Mechanical Engineering* *email: nrobson@fullerton.edu*

Proposed Design Framework Assessment

Solving several design problems provided by industry collaborators and engaging students' in the development, validation and dissemination process





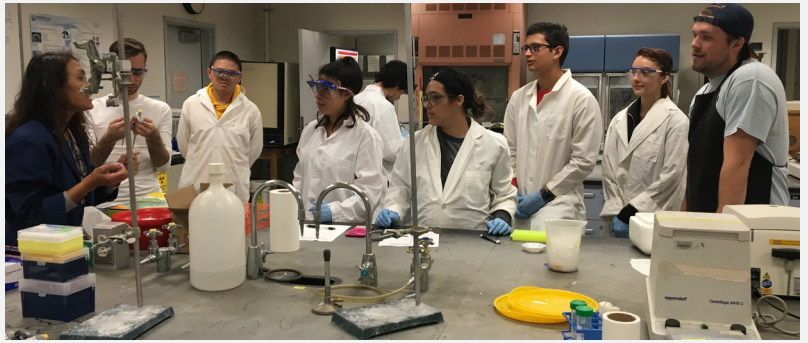
Healthcare Community: Explore the automation of a repetitive manual tasks related to physical training of upper and lower extremity for post-stroke patients (St. Jude Center for Rehabilitation and Wellness, CA).

Biomedical Industry: Automating a repetitive manual biomedical sewing process of an implantable cloth used in artificial heart-valve surgery (Edwards Lifesciences, CA).

Agricultural Industry: Automating a labor-intensive manual harvesting and potato sorting on a conveyor belt tasks (Spudnik Equipment, ID).

Nina Robson *CSUF, Mechanical Engineering* *nrobson@fullerton.edu*

CAREER Educational and Outreach



Goal: Prepare the next generation of engineers of a broad diversity

- Enhancing the mechanical design curriculum by emphasizing early cross-disciplinary research, innovation and entrepreneurship activities

- Middle/high-school summer program on Increasing Diversity in Engineering And Labor-force (IDEAL)

- Targeted Student Research (TranSfeR) outreach program

Nina Robson *CSUF, Mechanical Engineering* *nrobson@fullerton.edu*

Highlights: NSF Innovation Corps (I-Corps) Teams

CSUPERB I-Corps (1-week duration in San Diego, CA)

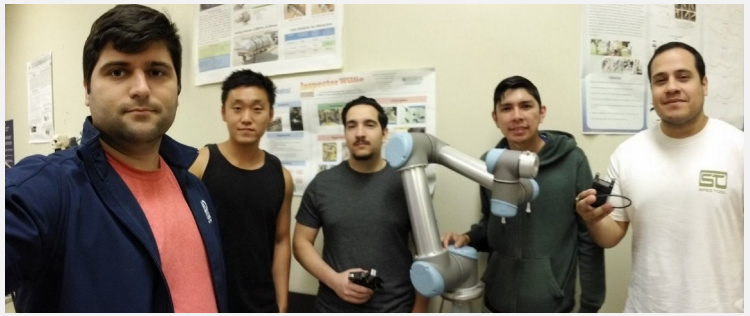
Curriculum Goal: Focus beyond the University lab to explore the commercial potential of a novel Augmented Reality WEarable Device (ARWED)

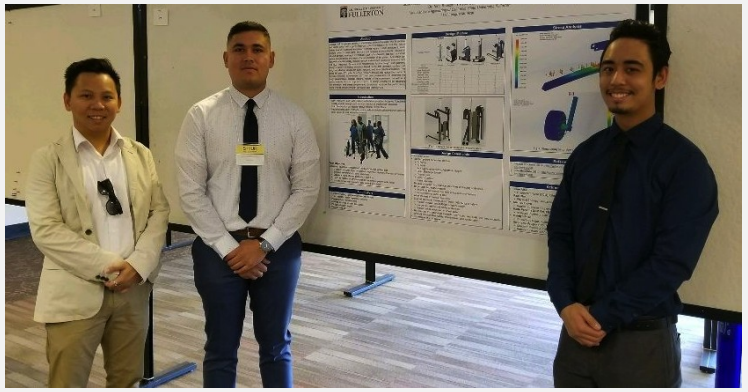
Advanced to NSF I-Corps Team Curriculum

LA Cohort (2 months online with two 3-day in person meetings)

Nina Robson *CSUF, Mechanical Engineering* *nrobson@fullerton.edu*

Highlights: Senior Design Project Course

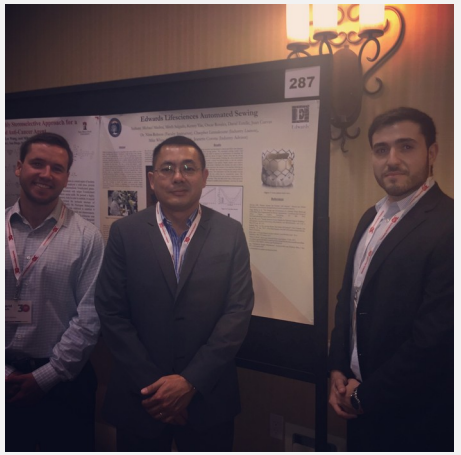




Bristol Industries Team: Initiated the automation of hazardous manual chemical processes for Bristol Industries, Brea, CA

Intensive Care Unit (ICU) **Patient Walker Team at SCCUR:** Worked with a start up company in CA to assist them in getting a newly designed and manufactured ICU Walker on the market

Edwards Lifesciences Team at CSUPERB:
Submitted a joint US Patent Application on automating the manual sewing of a biomedical cloth used in artificial heart-valve replacement surgery



08/19 Automated Heart-Valve Sewing, Edwards Lifesciences Corporation, U.S. Patent Application, docket # GSC-9365US01, serial # 621617114 (jointly with CSUF students).

Nina Robson *CSUF, Mechanical Engineering* *nrobson@fullerton.edu*

CAREER Proposal Advice/Tips

- Talk to industry, business partners, users of products/technologies, colleagues, etc. to find out what the needs are and think how you/your students can address them. Apply for CSUPERB/NSF I-Corps and go through the curriculum.
- Establish a lab from grants and start up funds, where students can be hired to work on research. Engage students in research. Generate pilot data and publish research papers on the proposed CAREER topic.
- Propose a broad research agenda with high societal impact and think of ways to show that it could be even broader.
- Prepare a Summary of your proposed research and educational activities, send it to NSF PD and schedule a meeting. Keep in mind that after talking to the PD you might have to tweak your idea to fit within the areas of interest.
- Don’t be afraid to show that the research you are proposing is complex/ambitious and you/your students would not be able to accomplish it on your own. Include partners in the proposal that are excited about collaborating with you.
- Schedule at least one additional meeting with the PD to discuss any concerns that you might have, before the submission deadline. When discussing concerns BE HONEST AND OPEN. Remember that the NSF PDs are there to HELP YOU TO BE SUCCESSFUL.

Nina Robson *CSUF, Mechanical Engineering* *nrobson@fullerton.edu*

Future Work at the Human-Technology Frontier NSF 10 Big Ideas for the Future Investment

"The workplace of tomorrow is going to be a symbiotic co-existence and collaboration among humans, machines and cyberspace. Interdisciplinary science and engineering research is needed to understand the benefits and risks of the new technologies and to enable the creation of these technologies with which humans will collaborate to enrich their lives in the future workplaces."

https://youtu.be/Gh3UX7XvXhM

Nina Robson *CSUF, Mechanical Engineering* *nrobson@fullerton.edu*

Questions & Answers

NSF CAREER Awardees

Speaker Contacts

Chantal Stieber, Cal Poly Pomona
sestieber@cpp.edu

Cheryl Van Buskirk, CSUN
cheryl.vanbuskirk@csun.edu

Kimberly Blisniuk, San Jose State University
kimberly.blisniuk@sjsu.edu

Blake Riggs, San Francisco State University
riggs@sfsu.edu

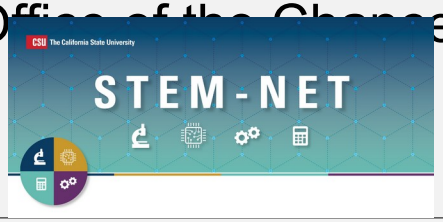
Geoffrey Lovelace, Cal State Fullerton
glovelace@Fullerton.edu

Matthew Povich, Cal Poly Pomona
mspovich@cpp.edu

Nina Robson, Cal State Fullerton
nrobson@Fullerton.edu

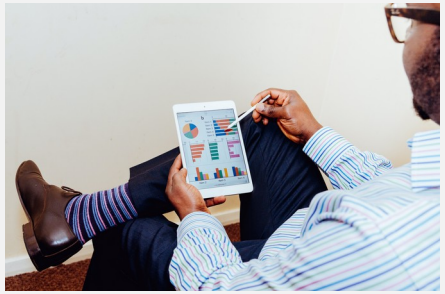
Next Steps/Closing Remarks

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



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

STEM-NET COMMUNITY & FEEDBACK



Webcast Feedback Survey

Please take a few moments to tell us about your webcast experience
https://forms.gle/828DBpeoKEMbqkDz8

Join our CSU STEM-NET Community listserv

csustemnet@lists.calstate.edu

Begin a Conversation with Colleagues and Join our Private CSU STEM-NET Facebook Group

https://www.facebook.com/groups/2629611737269292

Frank A. Gomez *CSU Office of the Chancellor* *fgomez@calstate.edu*

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STEM-NET Upcoming Events

Register Today and Join Us

STEM-NET Virtual Research Café 10.0 4th Event

November 5th @ 2pm-3pm

Register Here:
https://tinyurl.com/y3wu39ed

Meet The Presenters
https://www.youtube.com/watch?v=LgjyGnQjEMw

Frank A. Gomez *CSU Office of the Chancellor* *fgomez@calstate.edu*

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STEM-NET Upcoming Events

Save the Dates

Registration Opens Soon

"Applications in Artificial Intelligence/Machine Learning"
Thursday, November 19th "@10am-12pm

"Exemplars in Biology"
Thursday, December 10th "@10am-12pm

Frank A. Gomez *CSU Office of the Chancellor* *fgomez@calstate.edu*