



# California State University, Los Angeles applying for membership in LSC

P.I., **Riccardo DeSalvo**\*

Senior Resident Scientist

College of Natural and Social Sciences

Grad students: **Lamar Glover**\*\* , Greta O'Dea<sup>+</sup>,  
Julian Bouzanquet, Morgan Shaner<sup>+</sup>,

X. Talbot-Thiebaut<sup>+</sup>, S. Linker, R. Gonzales

Last quarter's Undergrads: E. Arriaga,

E. Barragan, E. Do\*\*\*, M. Goff\*\*\*, C. Fajardo\*\*\*,

J. Patel, E. Villarama S. Gallardo, A. Mkrtchyan



Note: only a part of these students  
Will join the LSC group, TBD  
Only the **BOLD** certain at this time

## PUSHING BOUNDARIES



\* Already LSC council member through USannio

\*\* Already LSC member through USannio

\*\*\* Continuing last quarter act. as grad or undergrad.

+ Parallel activity?

LVC meeting 08/28-09/02/16 LIGO-G1601681

See also: LIGO LIGO-G1600383 1



# About Cal State LA



- Founded in 1947 in the heart of LA
- Minority serving institution dedicated to **engagement, service, and the public good**
- 27,000 students, 87% low income commuters, 82% first generation college students
- Undergraduate and Master's programs
- Alliance with **University of Sannio** allowing Cal State LA students to continue their PhD thesis work at both institutions



# About Cal State LA



- Cal State LA has a strong desire to boost its contributions to scientific research, including **making significant contributions towards GW astronomy**
- **RdS appointed in Senior Resident Scientist position:**
  - annually renewed
  - **40% teaching 50% research 10% service**
- **Mandate: Involve undergraduate students in active research as part of their BS curriculum while training graduate students as future mentors**
- **Use LIGO as main source of research projects**



# About the physics department



- Small department (10 Faculty):
- ~60 Physics undergrads, ~36 Master's students
- Provides physics teaching for  $> 2,000$  students/semester from other departments
- Strong in **condensed matter**: Oscar Bernal, Radi Jishi, Jose Rodriguez, Edward Reyazi, Guo-Meng Zhao
- **Astrophysics**: Susan Tereby
- **Cosmology**: Milan Mijic
- **Nuclear Physics**: Konrad Aniol
- **Bio Physics**: Paul Nerenberg



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Bernal's lab of super-conductivity<sup>4</sup>



# About my labs at Cal State LA

- Advanced Physics laboratory
- Each grad student runs a project with help of undergrads
- Undergrads involved for credit
- **Aim to generate more interest in STEM disciplines**
- Students learn mentoring and teaching while doing new physics

REVIEW OF SCIENTIFIC INSTRUMENTS 85, 075003 (2014)

**Design and initial characterization of a compact, ultra high vacuum compatible, low frequency, tilt accelerometer**

A. O'Toole,<sup>1, a), b)</sup> F. E. Peña Arellano,<sup>2</sup> A. V. Rodionov,<sup>3, c)</sup> M. Shaner,<sup>4, d)</sup> E. Sobacchi,<sup>5</sup>  
V. Dergachev,<sup>6</sup> R. DeSalvo,<sup>6, a), e)</sup> M. Asadoor,<sup>7, f)</sup> A. Bhawal,<sup>8, g)</sup> P. Gong,<sup>9, h)</sup> C. Kim,<sup>10</sup>  
A. Lottarini,<sup>11, i)</sup> Y. Minenkov,<sup>12</sup> and C. Murphy<sup>13</sup>

<sup>1</sup>Department of Mechanical and Aerospace Engineering, University of California, Los Angeles



Advanced Physics lab



Materials engineering lab

High School Student

Undergrad student

Grad student

-G160168



# Some work already started

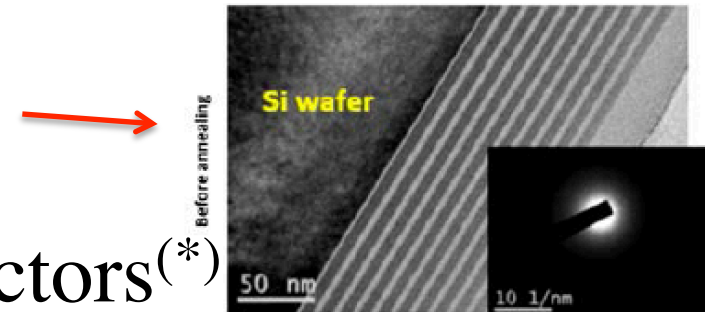


- *Undergrad projects developed on LIGO problems last quarter*
- *T1600274 **G O'Dea**, A Mkrtchyan, S. Gallardo*
- *T1600275 E Arriaga, C Fajardo, **L Glover**, J Patel, E Villarama*
- *T1600276 E Arriaga, E Barragan, E Do, M Goff, **L Glover***
- *Related docs: G1600430/G1600431*
  
- *Those works are followed up by some of the same students*



# Cal State LA proposed contributions

1. Continued studies on scattering points of dielectric mirror coatings and their origin
2. Continue collaboration with USannio and Tsing Hua University in nanocoating development
3. Studies of coating Quality factors<sup>(\*)</sup>
4. Study of dissipation in metals<sup>(\*)</sup>





# Preliminary results

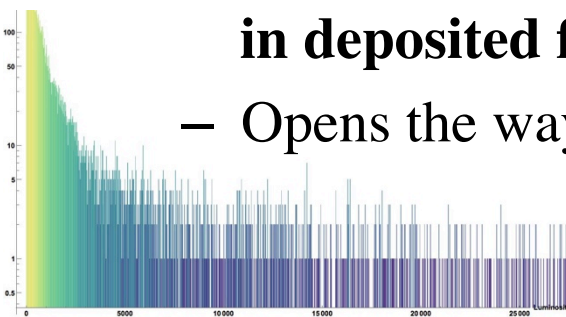
1

Lamar Glover



1. Continued studies on scattering points on dielectric mirrors and their origin
  - Lamar found  **$>10^5$  scattering points** of diminishing amplitude within stored beam profile
  - Appearing distributed through the depth of layers
  - Only a **thermodynamic origin** (classical nucleation theory) can explain this large number
  - Interface between crystallite nuclei and glass is strongly frustrated, it **may explain anomalous mechanical dissipation in deposited films**
  - Opens the way to **further thermal noise reduction!**

LIGO-G1600430  
LIGO-G1600431







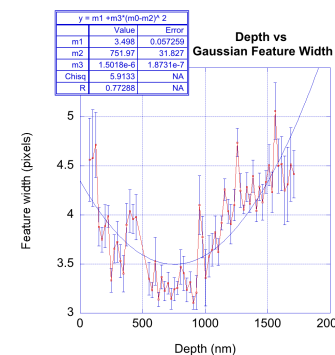
# Preliminary results

## 2



Undergrads

- Determined procedure to increase scatterer detection dynamic range in advanced LIGO mirrors illuminated by stored beam
- Identify position of scattered to camera diffraction limit
- Developing tracking procedures to provide tracking tool for micro-movements of stored beam on mirror
- *T1600275 E Arriaga, C Fajardo, L Glover, J Patel, E Villarama*





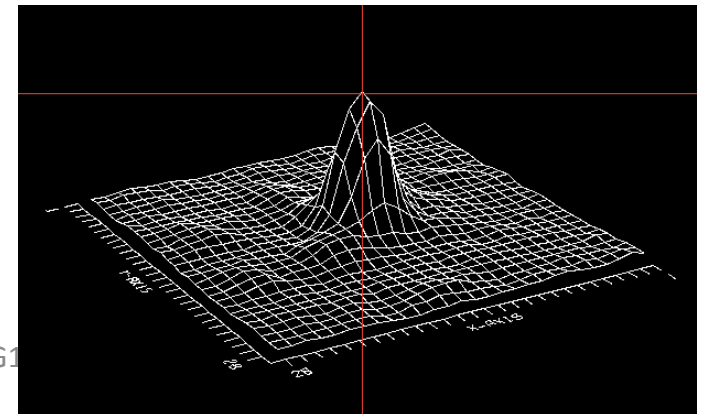
# Preliminary results

## 3



Undergrads

- Developed bright field microscope technique to determine depth and position of features within a coating structure with **50 nm depth resolution**
- Study methods to scan witness samples and actual mirrors for scatterers, as a diagnostic tool to develop lower thermal noise coatings
- T1600276 *E Arriaga, E Barragan, E Do, M Goff, L Glover*





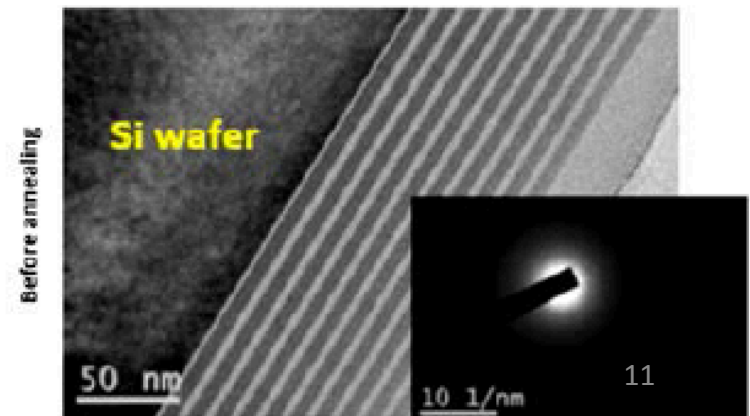
# Cal State LA proposed contributions



Tsing

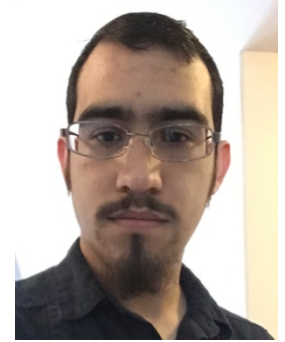
- Continue collaboration with USannio and Hua University in nanocoating development
- **Nano-layering below nuclei minimal size may suppress nucleation**
- **Thermal noise will be reduced** if crystallite nuclei are the location of mechanical losses
  - Will apply for financial support from NSF to send person(s) to USannio to commission/run the new coating facility

LIGO-G1600431



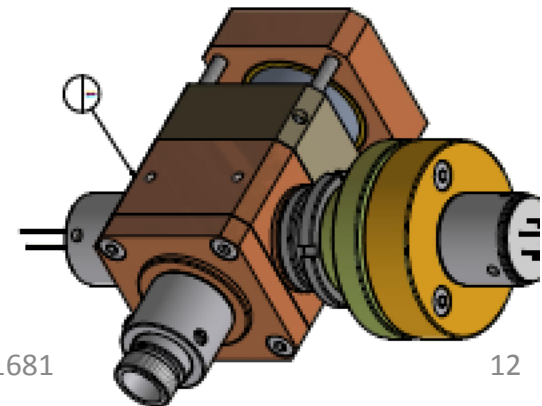
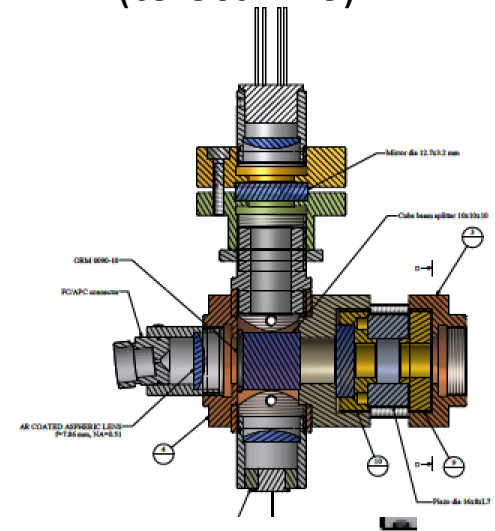


# Cal State LA proposed contributions



Julian Bouzenquet  
(to Usannio)

- Julian (perspective PhD student):
- Develop techniques for Q-factor measurement on sub- $\mu\text{m}$  thickness SiN substrates
  - Starting using USannio resources
  - Will apply for NSF financing for continuation of studies





# Other Cal State LA possible contributions



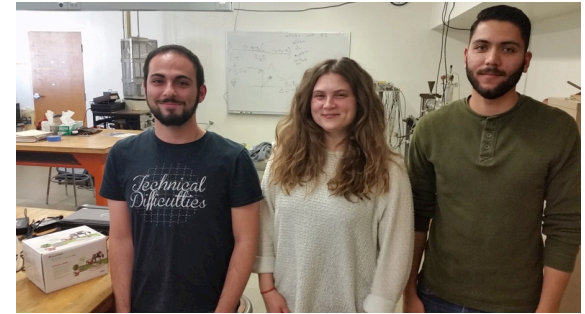
Greta O'Dea

- Greta in his thesis project started to:
  - Study of dissipation in metals *repeating with modern means*  
*Kimbal, Lovell, “Internal friction of solids” Phys. Rev. 1927*
  - Looking for **Maraging replacements** in view of lower frequency suspensions/seismic attenuation
- Synergic with big-G measurement studies
  - Longer term development Started using internal mini grant
  - apply for external financing for continuation



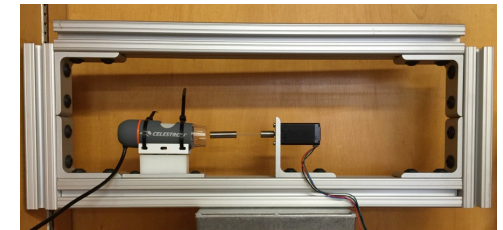
# Preliminary results

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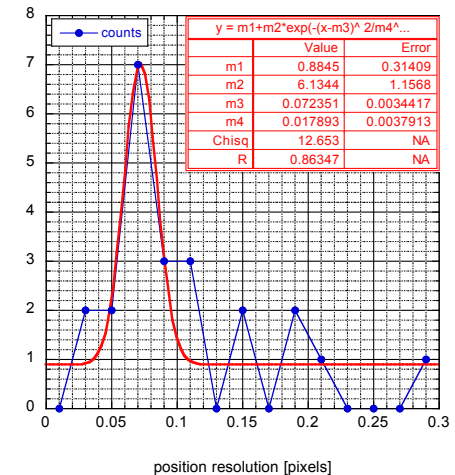
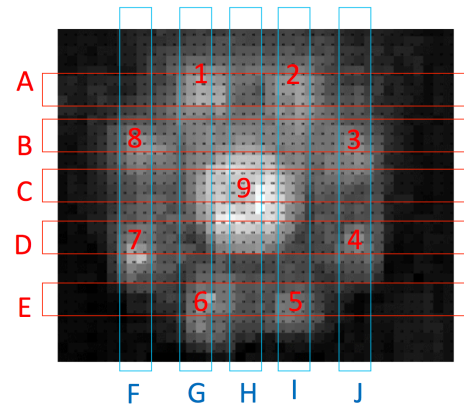


Undergrads

- **Preliminary Results:**
- Established feasibility of determining marker position with **60 nm resolution**



- *T1600274 G O'Dea, A Mkrtchyan, S. Gallardo*





- Thanks for your attention
- The Cal State LA group will strive to give its **strong contribution to the future of Gravitational Wave Astronomy**



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