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Quantum

DMR-1906325

Foundry >



Quantum Foundry Overview

Foundry for accelerated discovery and control of materials that support protected quantum states with unprecedented coherence and scalable entanglement.



Elings Hall, home of the Quantum Foundry at UCSB

Three pillars

- **Research:** Address the materials challenge of controlling coherence of entangled quantum states (create, characterize, and control quantum coherent states)
- **Workforce Development:** Train a diverse Quantum Workforce to drive and harness material advances in emerging quantum technologies.
- **Industry Partnership:** Catalyze partnership with industry in both QIS research and workforce training

Funding start date: Sept. 15, 2019

Budget: ~\$25 Million over 6 years (including ~\$6.7 Million in equipment)

The role of the Quantum Foundry

- Center for innovation in new **materials/architectures** for QIS
- Center for innovation in **probe/technique development** for understanding coherence and new quantum states
- Collaborative hub for **materials growth and characterization**
 - Distinct from user facility model
 - Instead form collaborative network that jointly explores forefront materials/architectures

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Experiment Theory Computation



Ania Jayich
Physics



Stephen Wilson
Materials



Susanne Stemmer
Materials



John Harter
Materials



Chris Palmstrøm
ECE/Materials



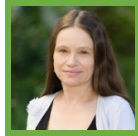
Andrea Young
Physics



Vojtech Vitek
Chemistry



Dirk Bouwmeester
Physics



Linda Petzold
C.S./Mech. Eng.



Ram Seshadri
Chem./Materials



David Weld
Physics



Chris Van de Walle
Materials



Xi Dai
Materials



Galan Moody
ECE



Leon Balents
Physics



Bolin Liao
Mech. Eng.



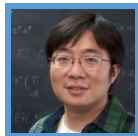
Raphaela Clemente
Materials



Mark Sherwin
Physics



John Bowers
ECE/Materials



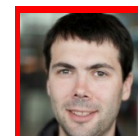
Cenke Xu
Physics



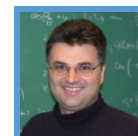
Wojtech Zurek
Physics



Kunal Mukherjee
Materials



Sergey Frolov
Physics



Claudio Chamon
Physics/Materials



Ilkay Altintas
Data Curation

25 Principle Investigators
(21 UCSB PIs and 4 external)

Five disciplines mixed among
Sciences and Engineering



Quantum Foundry Team and Partners at UC Santa Barbara

Low- T nano-SQUID

Free electron laser

MBE Facility

Microscopy Suite

Floating Zone Facility

Diamond Foundry

Low- T Optical Facility

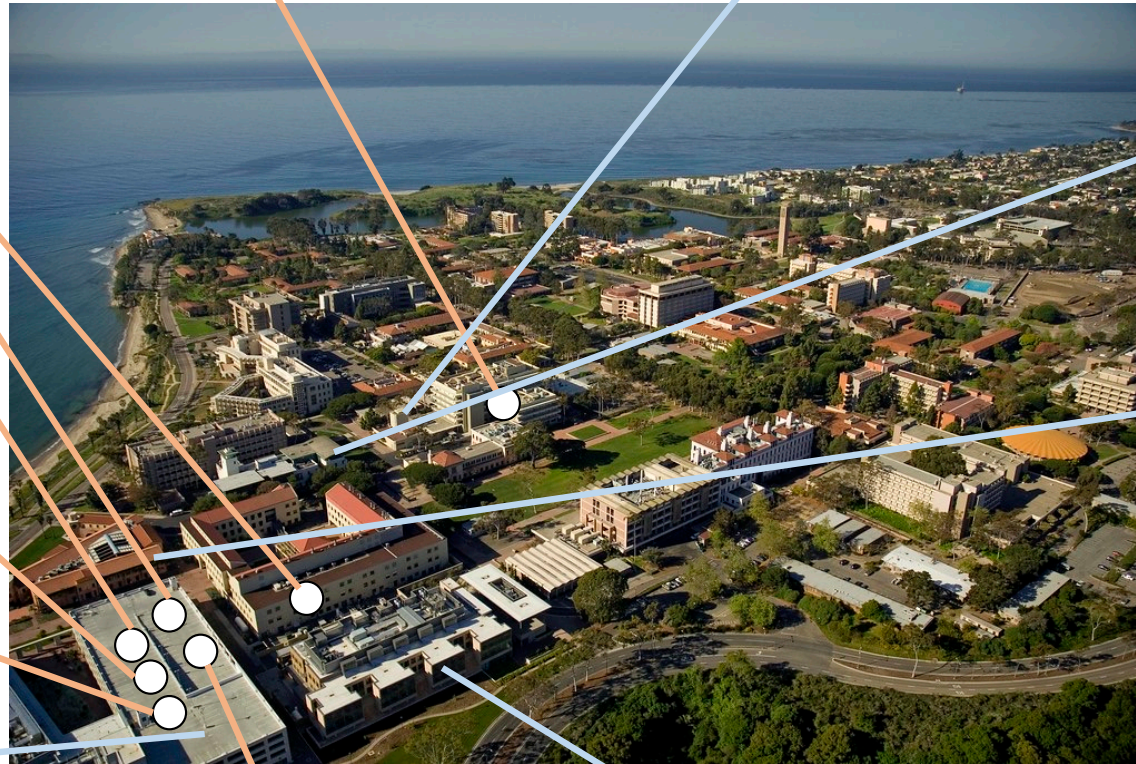


vdW Assembly Facility

Nanofab clean room

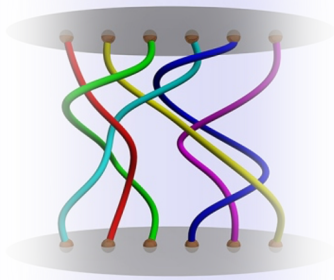
Materials Research Laboratory (NSF MRSEC at UCSB)

Kavli Institute for Theoretical Physics



Three Scientific Thrusts

Thrust 1

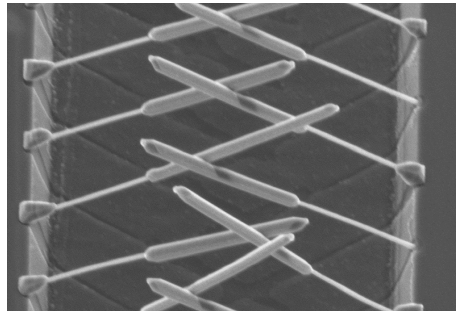


Natively entangled materials

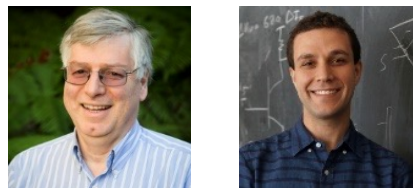


Stemmer/Harter

Thrust 2

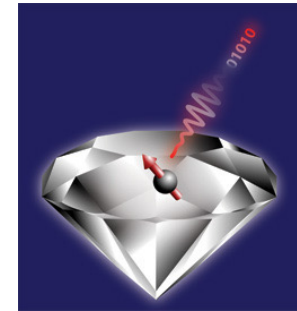


Interfaced topological states



Palmstrøm/Young

Thrust 3



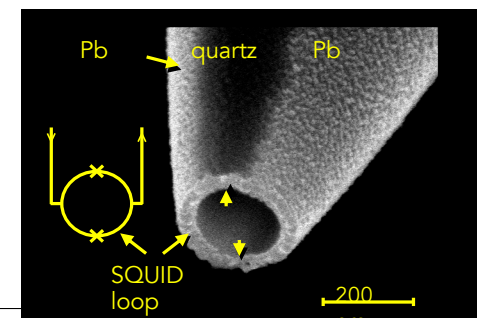
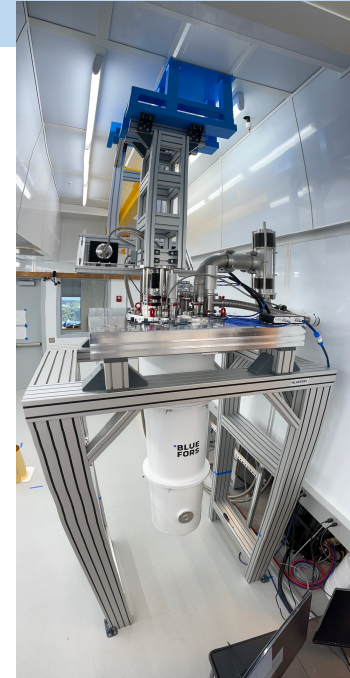
Coherent quantum interfaces



Van de Walle/Bouwmeester

Instrumentation

- High-pressure (10k atm) Laser (3kW) Floating Zone furnaces
- Dedicated dual-chambered MBE
- Van der Waals heterostructure assembly
- Diamond Foundry
- nanoSQUID on tip
- Low-temperature Optical Facility













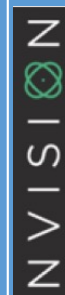












Industry Partners (now at 23)



- Multiple engagement modalities
 - Research
 - Equipment
 - Workforce development and education

• Next IAB call in November 2021

Diverse Industry Engagement

| |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------|---|---|---|---|---|---|---|---|---|--|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IAB | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Thrust | all | all | all | all | all | 3 | all | 3 | 3 | 3 | 3 | 3 | | 2 | 2,3 | | 3 | | | all | | 3 | 3 |
| Research | | √ | | | | √ | | √ | | √ | √ | √ | | √ | √ | | | | | √ | | √ | √ |
| Equipment Development | | | | | | | | | | | | | | | √ | √ | | √ | √ | | | | |
| Seminars/Classes | √ | √ | √ | √ | √ | | √ | √ | | √ | √ | | | | √ | | | | | √ | | | √ |
| Internships | (√) | √ | | √ | | √ | | | | | (√) | | | | | (√) | | | | | | (√) | |
| Workforce/Network | √ | √ | | √ | √ | | | √ | | | | √ | | √ | √ | √ | √ | √ | | √ | √ | | √ |

Research Partnerships

- Research Collaborations

- Microsoft + Palmstrøm, Young
 - Superconductor/III-V semiconductor nanowires and theory
- Somalogic + Jayich (NSF Convergence Phase I)
 - High-throughput Proteomics Technology Based on Quantum Sensing
- Nexus Photonics + Weld, Thorlabs + Moody
 - Integrated quantum photonics
- Lake Diamond + Jayich, NVision + Jayich
 - Diamond growth and characterization; sample exchange

- Research Co-location

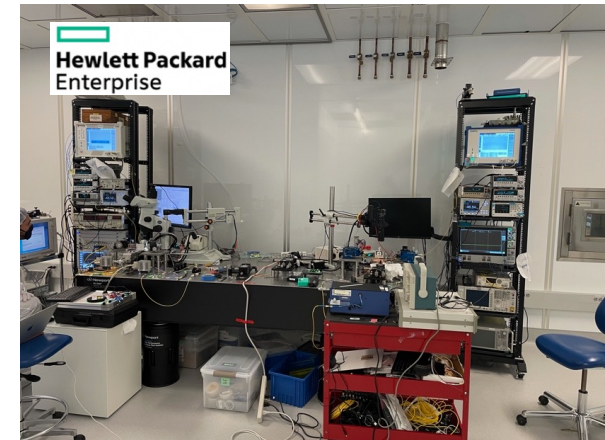
- HPE optical testing equipment in CNSI NCF/QF



Garrett Cole



Tin Komljenovic



Industry Engagement in Knowledge Sharing

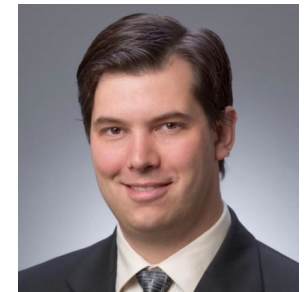
- QF Seminar Series
 - Six industry speakers to date
 - Aiming for 1-2 industry speaker / quarter
- January 2021 Winter School
 - 17 industry participants from 6 companies
 - Sessions by IBM and Google (incl. virtual tour)
- Industry/Academia Workshops
 - Support for single-partner workshops
- QF Quantum Information Grad Course
 - Matthew Rakher (HRL)
 - Philipp Neumann (NVision)
 - David Deen (Honeywell)
- Quantum Photonics Lab
 - Newport + Moody



Matthew Rakher
HRL
5/27/20



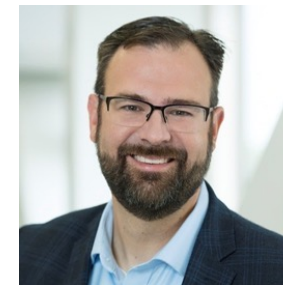
Pauline Alvarez
Oxford Inst.
7/29/20



Mike Larsen
NGC
11/18/20



Jason Cleveland
SomaLogic
2/10/21

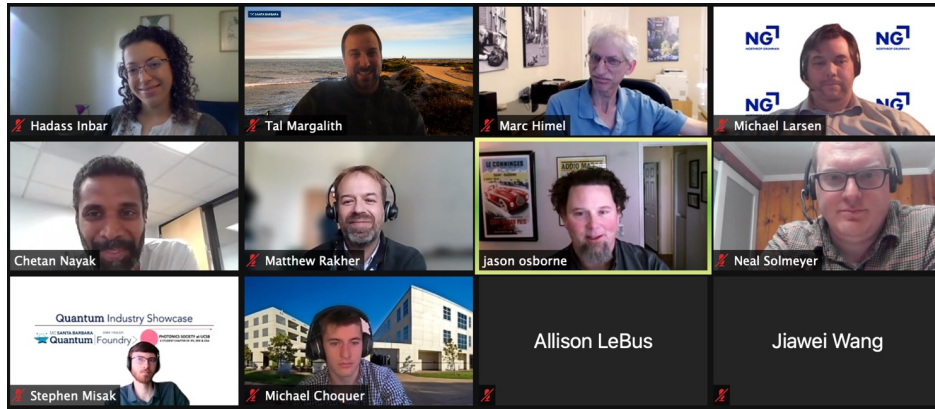


James Clarke
Intel
5/5/21



Siamak Dadras
TOPTICA
6/9/21

Quantum Industry Showcase 2021 (April 22-23)



Fireside chat with Himel (MKS), Larsen (NG), Nayak (Microsoft), Rakher (HRL), Osborne (Bruker), and Solmeyer (Honeywell)

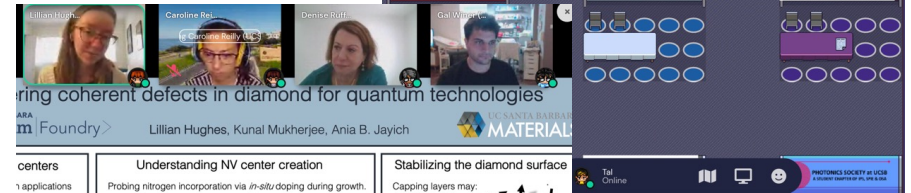
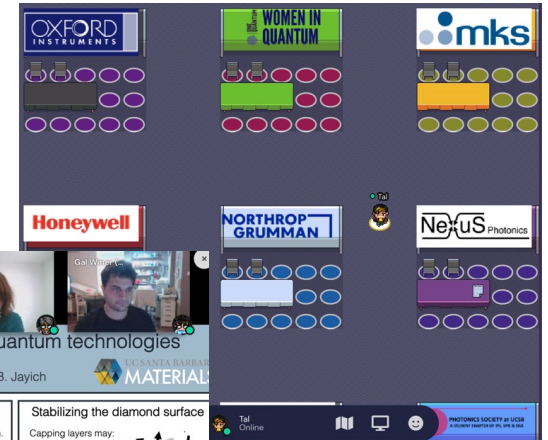
- 56 student registrants, 25 industry reps from 16 companies/organizations
- Industry Videos; Student Posters

Keynote

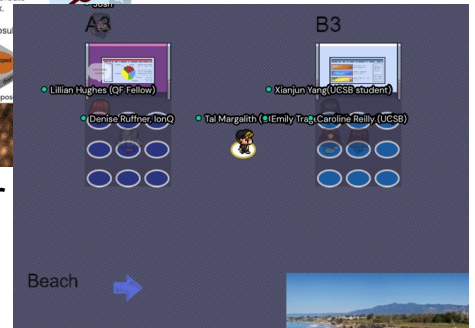


Sponsors **THORLABS** **ThermoFisher SCIENTIFIC**

Networking and poster sessions on Gather.town



Ruffner (IonQ) and Winer (Quantum Machines)



Upcoming engagement modes

- Network for Quantum Information Science and Technology (NET-QuIST)

- Pending funding as part of NSF 'Triplets' program
- Provides funding for a graduate student to work at interface of academia and industry, co-advised by industry or national labs mentor and academic mentor



Neal Solmeyer

Honeywell

- Research Opportunities

- Honeywell + Jayich (diamond sensors)
- Somalogic + Jayich (NSF Convergence Accelerator – Phase II)

- Equipment Development

- Northrop Grumman + Young (nanoSQUID)
- Thermo Fisher + Jayich (heated electron irradiation stage)



Dan Gostovic

ThermoFisher
SCIENTIFIC

Thank You!

Questions?

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or

qf-admin@cnsi.ucsb.edu