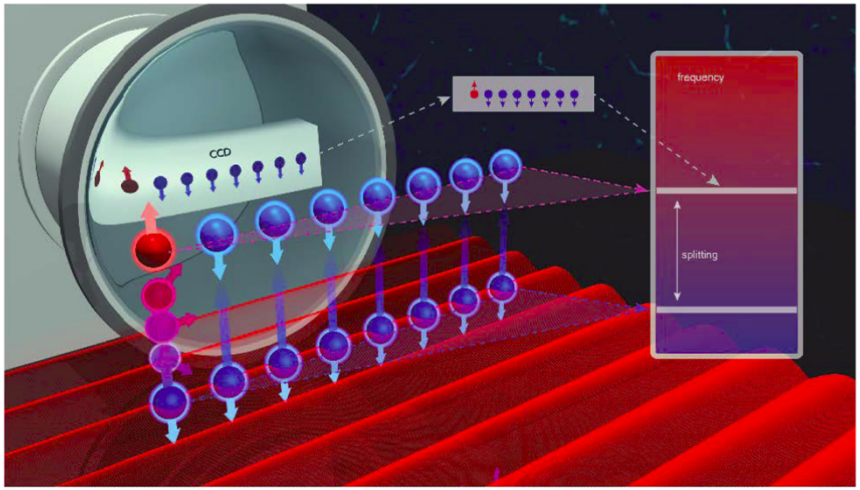
2022 NSF/DOE/AFOSR Quantum Science Summer School

Joe Checkelsky (MIT)
Natalia Drichko (JHU)
Liang Fu (MIT)
Kyle Shen (Cornell)
Stephen Wilson (UCSB)
Andrea Young (UCSB)
Jun Zhu (PSU)

About QS^3 : Quantum Computing, Quantum Materials, Quantum Devices

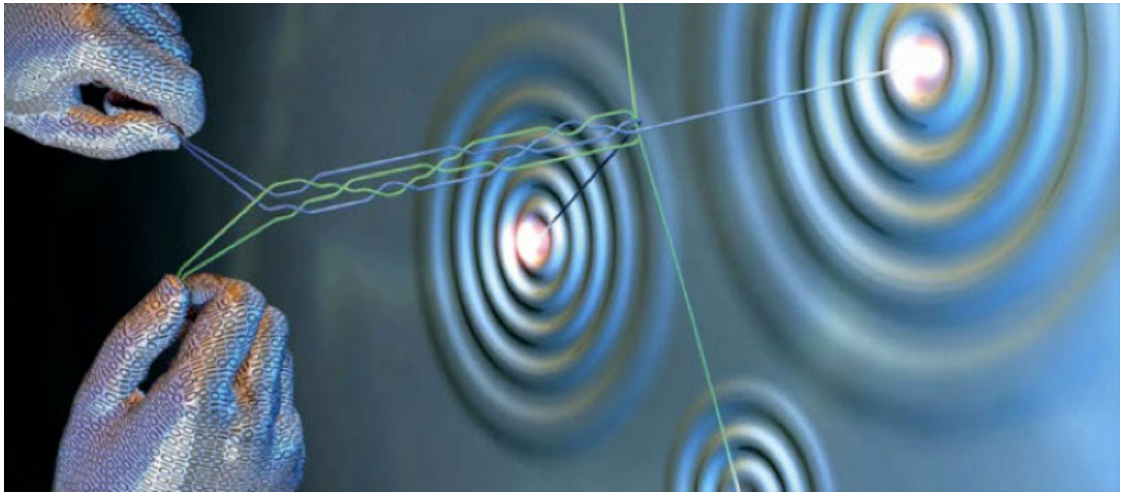
The Quantum Leap: Leading the Next Quantum Revolution



NSRC Portal
Community Website

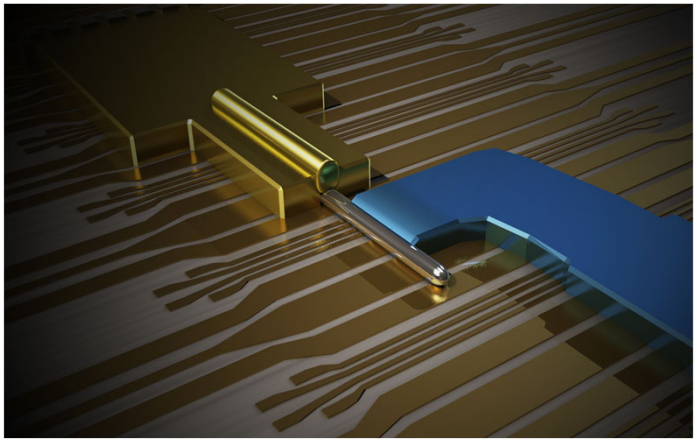
U.S. DEPARTMENT OF ENERGY

Quantum Materials



S.J. Lomonaco/University of Maryland, Baltimore County

Quantum devices



Mourik et al, Science 336, 1003 (2012)

The QS³ is an annual summer school with the mission of training graduate students and postdocs in physics, chemistry, engineering, mathematics, materials science, computer science and related fields for the next "quantum revolution."

$$\left|\begin{matrix}\textbf{Quantum}\\ \textbf{Scientist}\end{matrix}\right\rangle = c_1\left|\text{Materials \& Chemistry}\right\rangle + c_2\left|\text{Engineering}\right\rangle + c_3\left|\text{Physics}\right\rangle + c_4\left|\text{Computer Science}\right\rangle$$

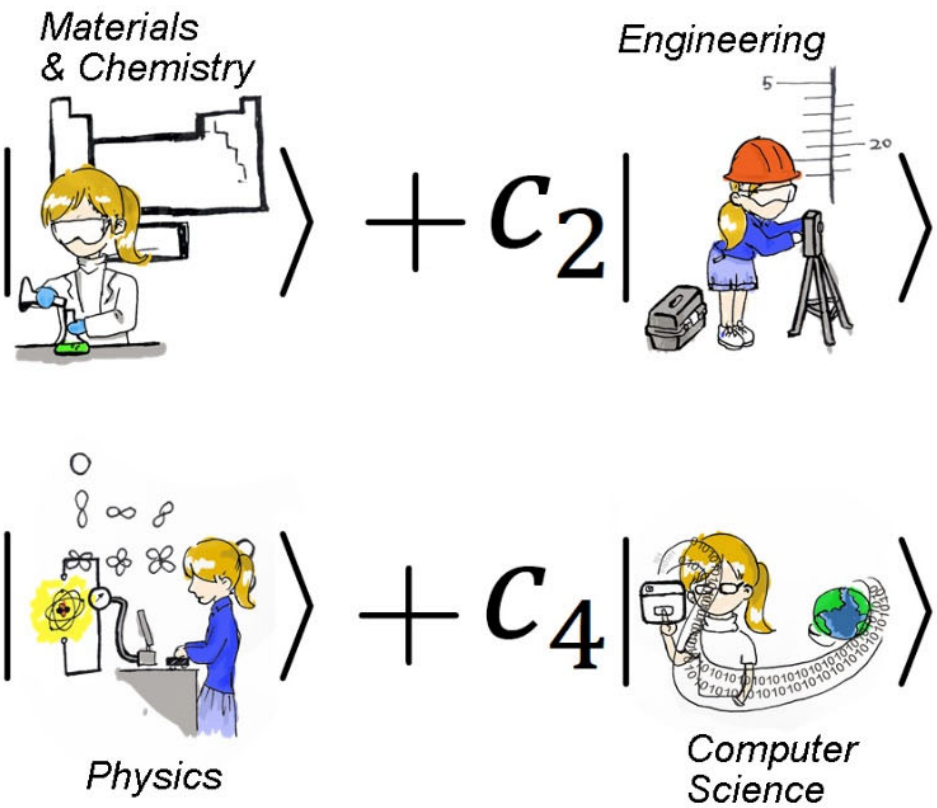
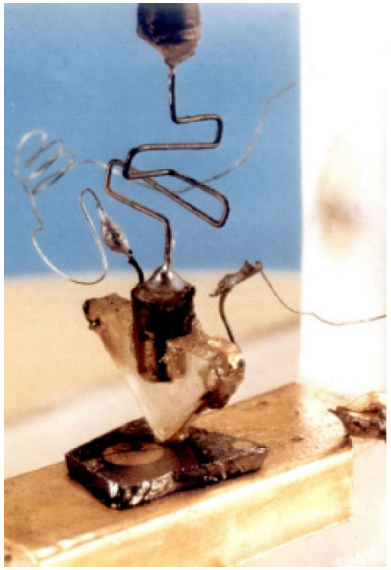


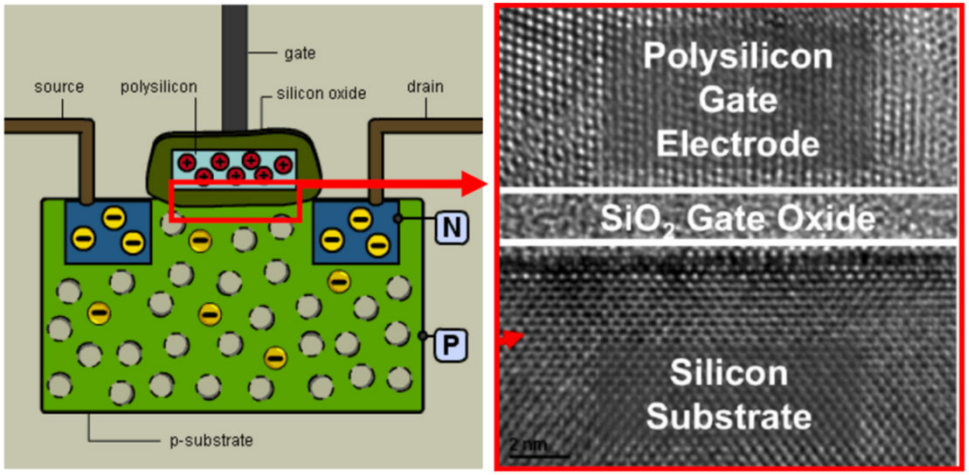
Image Credit: L. Ye

Theory, Experiment, Simulation, Algorithm, Application

Example of Quantum Leap: Computing

http://www.nobelprize.org/educational/physics/transistor/





Modern Classical Computers:
Product of 20th Century Quantum Leap

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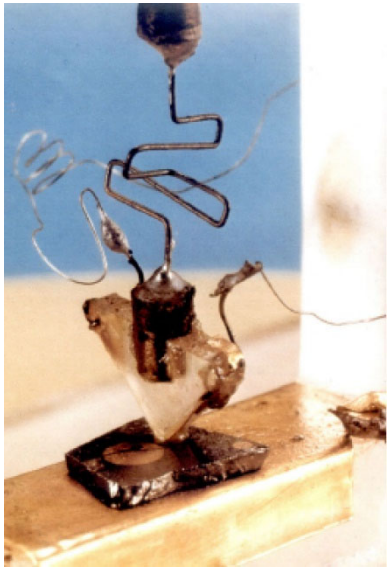

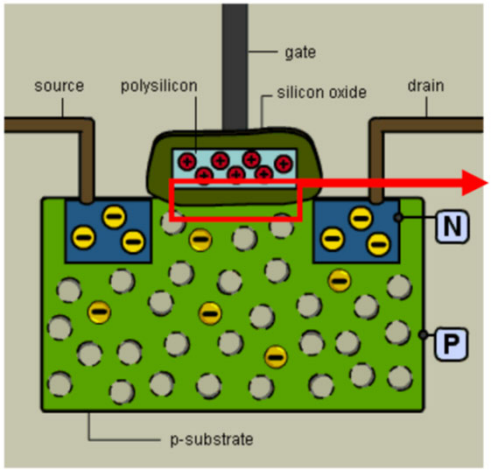

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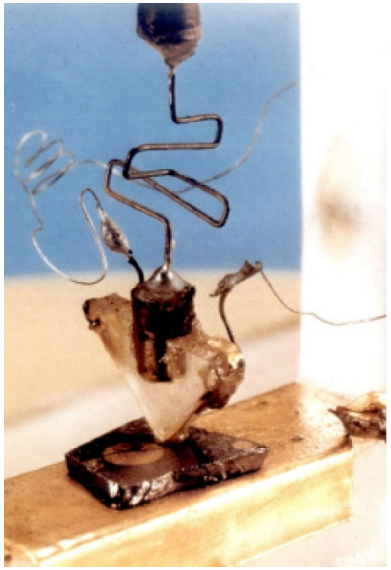

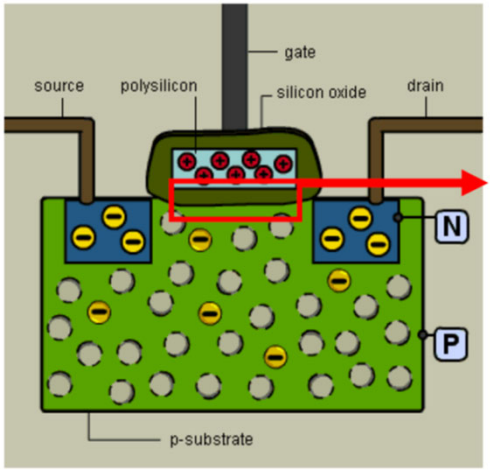

Modern Classical Computers:
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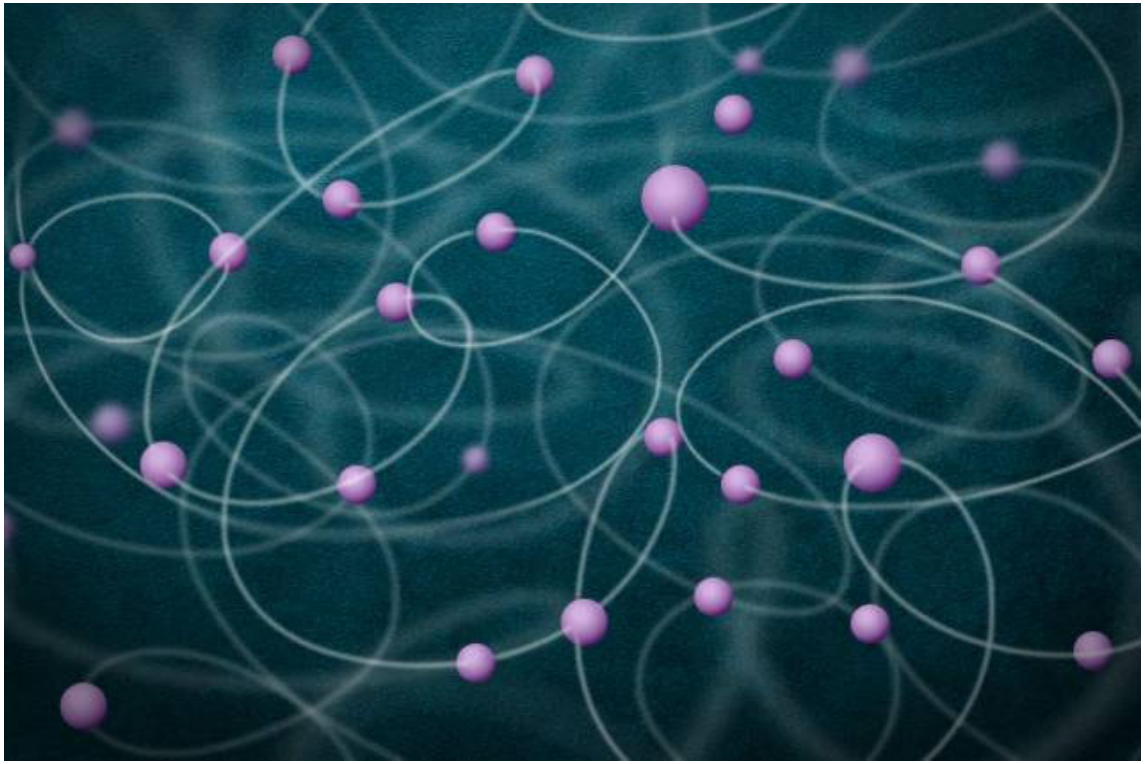
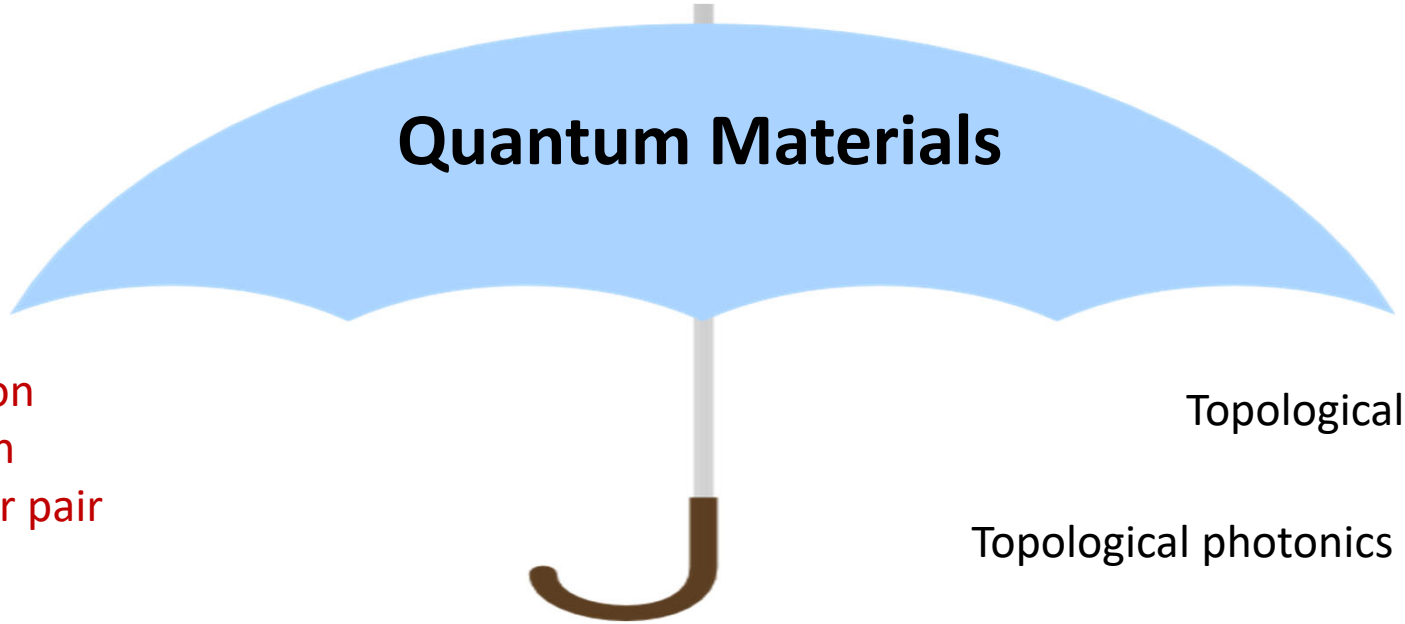
MIT news / Vuletic



Quantum Computation
Product of 21st Century Quantum Leap?

Modern Synthesis of Quantum Materials



Electron
Photon
Cooper pair
Spin
Valley
Exciton
Magnon
Zero modes

Topological edge states

Topological photonics

Topological spintronics

Majorana zero modes

Light-Matter States

Topological superconductivity

2D materials

Bulk Crystals

Topological quantum computing

Moiré Systems

Oxides

Thin films

Electrochemical Materials

School Outline

QS3 2022

Location: UCSB

Week 1: July 18-22

	Monday 18	Tuesday 19	Wednesday 20	Thursday 21	Friday 22
8:40-9:00	Opening				
9:00-10:00	Narang I	Narang II	Jin I	Jin II	Stemmer I
10:00-10:30	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
10:30-11:30	Dean I	Dean II	Searles I	Searles II	Wilson I
11:30-13:30	Lunch	Lunch	Lunch	Lunch	Lunch
13:30-15:00	Crystal Modeling A	Crystal Modeling B	Open Lab Visits (13:30 - 16:00)	Active Learning 1	Hands-on (13:30 - 16:00)
15:00-16:00	Introductions	Poster Talks 1		Group Photo	
Evening		Posters 1 (16:00-18:00)			

Week 2: July 25-29

	Monday 25	Tuesday 26	Wednesday 27	Thursday 28	Friday 29
9:00-10:00	Stemmer II	Mitrano I	Mitrano II	Falson II	Cano II
10:00-10:30	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
10:30-11:30	Wilson II	Karunadasa I	Karunadasa II	Cano I	School Summary
11:30-13:30	Lunch	Lunch	Lunch	Lunch	Lunch
13:30-15:00	Hands-on (13:30-16:00)	Zheng	Falson I (13:30 - 14:30)	Active Learning 2	
15:00-16:00		Poster Talks 2	Industry Panel (14:30-16:30)		
Evening	School BBQ (17:30-20:00)	Posters 2 (16:00-18:00)			

- 21 lectures (Elings Hall)
- 2 poster sessions (with hors d'oeuvres)
- 1 visits to faculty labs (see participating list)
- 2 facility tour/hands-on activities (TBD)
- 2 active learning sessions
- 1 panel discussion (Industry)
- 1 picnic at the Beach

https://qs3.mit.edu/index.php/summer-school-program

- Hands-on activities (July 22 and 25, see schedule, grouping and meeting place on website)
- Poster sessions (July 19 and 26, outside Elings Hall)
- Group photo (July 21, after active learning)

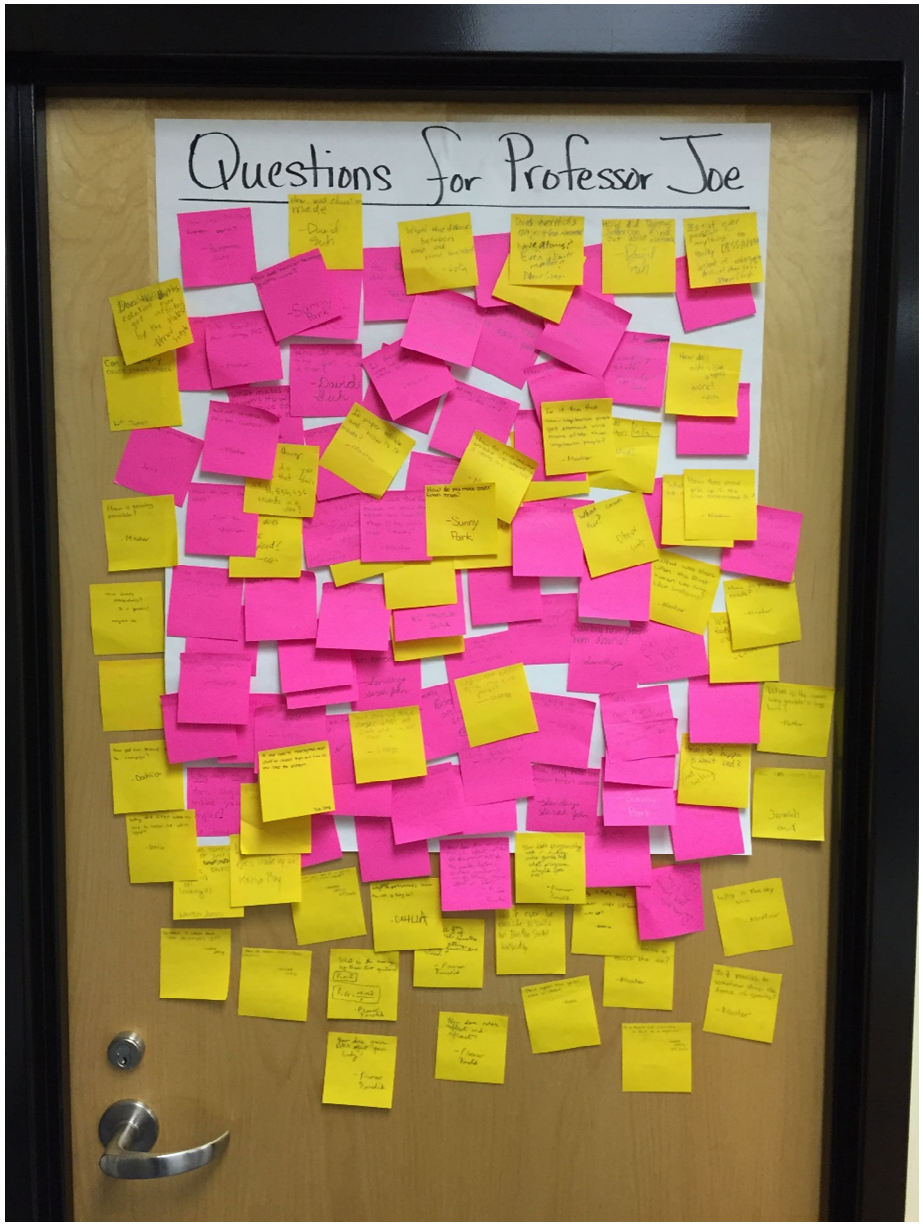
Please Submit Designs for our School T-shirt

Fast Turnaround: Please submit art by end of Monday

Selected Designs will be shared for voting by lunch Tuesday

Please fill out Google form for shirt ASAP

Questions, Exchanges and Feedback



Ask questions throughout lectures and the entire school

- Active Learning Sessions (Thursday afternoons)

  Informal discussions
  Recap lecture points
  Go deeper in your thinking
  Stimulate connections between subjects

- Panel discussions on Wednesday July 27
  Submit questions to our (mostly) industry panelists before Tuesday night.

- Feedback and input for the future

  Fill out the questionnaire

Location University of California, Santa Barbara

- Established 1944
- One of 9 UC campuses
- 24,000 students @ UCSB

Founded at Penn State in 1973

MATERIALS RESEARCH INSTITUTE

Research Centers and Facilities

UC SANTA BARBARA Quantum Foundry

DMR-1906325

UC SANTA BARBARA Kavli Institute for Theoretical Physics

UC SANTA BARBARA MRL Materials Research Laboratory

NSF Materials Research Science and Engineering Center [DMR 1720256]

Local industry efforts: Microsoft + Google both in Goleta

Google Quantum AI Microsoft

(Some) Quantum Materials and Devices at UCSB

Ania Jayich

Quantum defects

Galan Moody

Nanophotonics

Stephen Wilson

Material synthesis
Scattering

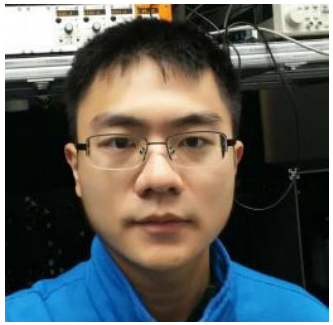
Dirk Bouwmeester

Optomechanics

Andrea Young

Van der Waals
heterostructures

Chenhao Jin



Optics, TMDs

Susanne Stemmer

Oxide MBE
TEM

Chris Palmstrom

MBE Heteroepitaxy

Where to go over the weekend

Jen Cano

Cory Dean

Joe Falson

Chenhao Jin

Hema Karunadasa

Matteo Mitrano

Pri Narang

Thomas Searles

Susan Stemmer

Stephen Wilson

Kent Zheng

Questions?

qs3.mit.edu

HOME | 2022 SUMMER PROGRAM | INFORMATION | FINANCIAL | ABOUT UCSB | PREVIOUS SUMMER PROGRAMS

Organizers

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Modern Synthesis of Quantum Materials

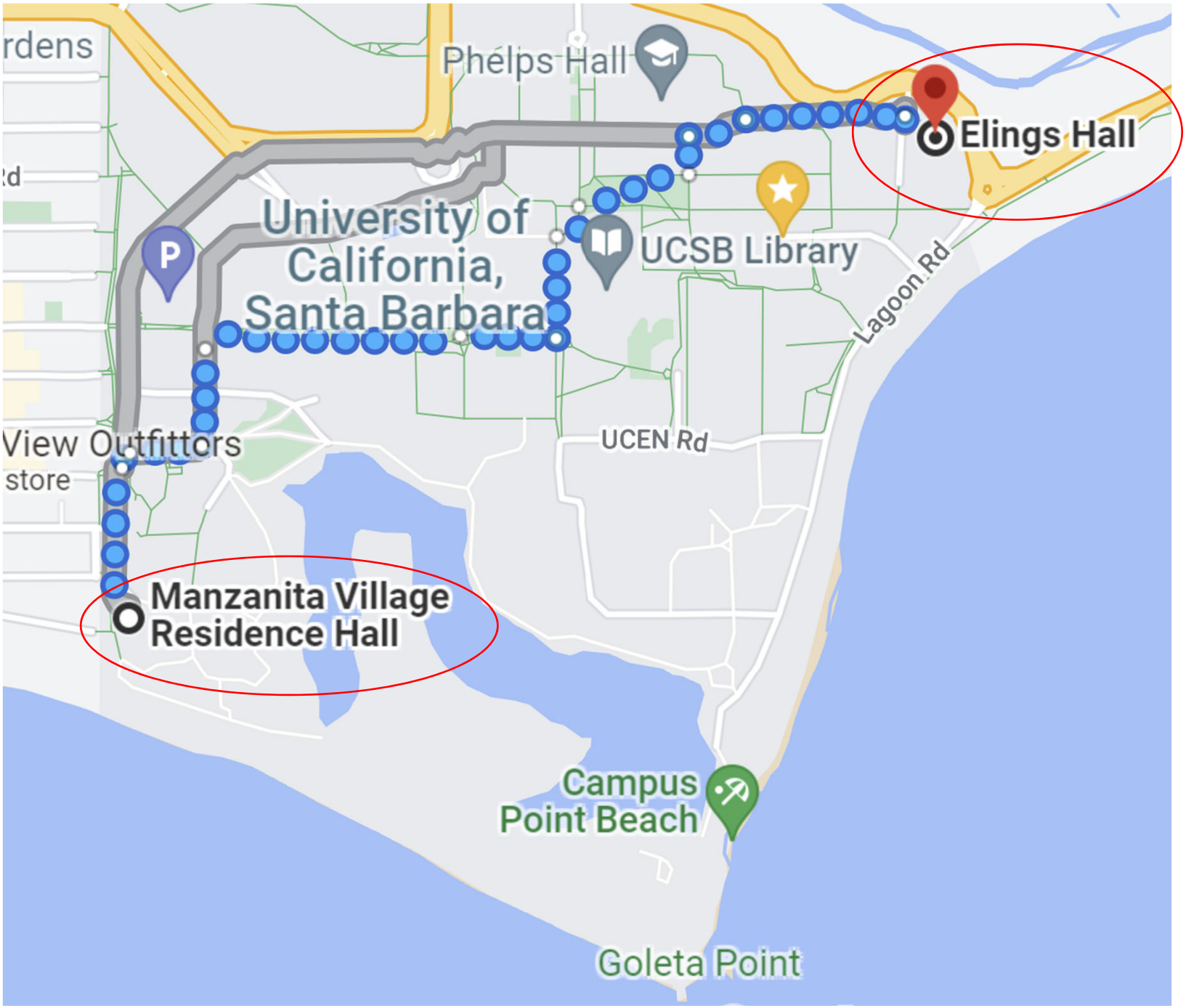
Program Details:

Summary Schedule

Detailed Schedule

→ Information to be posted here

Questions (including Reimbursements):
Kelsey Leonard Moore
cnsi-qf-admin@ucsb.edu


rdens
Phelps Hall
Elings Hall
University of California, Santa Barbara
UCSB Library
Lagoon Rd
View Outfitters
store
UCEN Rd
Manzanita Village Residence Hall
Campus Point Beach
Goleta Point

Software to Install

VESTA : jp-minerals.org/vesta/en/download.html

During coffee break, make sure you can connect to wifi

→ Need this from 2pm for crystal modeling

→ If there are any issues, ask organizer during coffee or lunch

Jen Cano

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