


Quantum Education

High School and Community College

Donn Silberman



Good Afternoon and thank you for being here today to hear about my experiences with Quantum Education in high schools and community colleges.

	Building on the Past Optics, Lasers, Fiberoptics, Polarization, Diffraction, Spectroscopy	Lab work Hands-On Physical experiments for students in the classroom	Content Going from the familiar to the Quantum Realm
	Virtual Work Quantum Computing Qubit x Qubit IBM's Qiskit	Professional Societies Local & Student Chapters	Local Non-Profits Linking Industries to Local Schools

The six parts of this presentation are:

1. Building on the Past use of optics, lasers, fiber optics, polarization, diffraction & spectroscopy;
2. making sure to include hands-on lab work in the form of physical experiments in the classroom;
3. including content that students are familiar with that can lead them to the unfamiliar quantum realm;
4. doing virtual work like quantum computing as taught by Qubit x Qubit with IBM's Qiskit;
5. networking with professional societies local and student chapters;
6. and working with local non-profits that link industry sponsors with local schools.

Donn M. Silberman

Founding Director, The Optics Institute of Southern California
SPIE Fellow, Optica Sr. Member, OSSC Fellow & Past President
UC Irvine Div. of Continuing Education, Optics Program Founder
Pasadena City College Laser Tech Program Advisor (formerly at Irvine Valley College)
Vital Link Board Member



Over 20 years of volunteer optics education & outreach



My name is Donn Silberman and I have been a volunteer doing informal and formal optics education for almost 20 years and several years ago I have layered quantum concepts on top to introduce students of all ages to the quantum world.

I founded the Optics Institute of Southern California in 2003 to work with SPIE, OSA (now Optica) and the Optical Society of Southern California in many aspects of optics education.

I have been closely associated with Irvine Valley College's Laser Technology program, for over 25 years, which moved to Pasadena City College near Cal Tech and the Jet Propulsion Laboratory during the COVID lockdown. In 2009, I started the UC Irvine Optical Engineering and Instrument Design Programs through their Division of Continuing Education.

For 5 years before COVID, I was a volunteer with Vital Link, a local non-profit linking local industry sponsors with local schools and this year I joined their board.

Building on the Past with Hands-on Labs



Get students working with their hands as soon as possible. Start with something familiar, like polarizing sunglasses.

Polarization Filters with a Polarized Laser



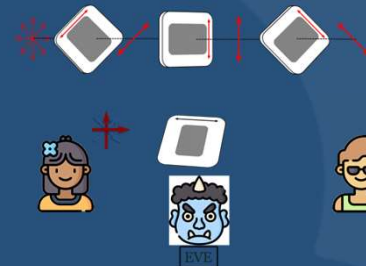
Laser with P(h+v) filters



Laser with P(h+ v + 45) filters



Schrödinger's Class



If the eavesdropper intercepts, they'll disturb the polarization state

Quantum Key Distribution

Go from classical cyber security to Quantum

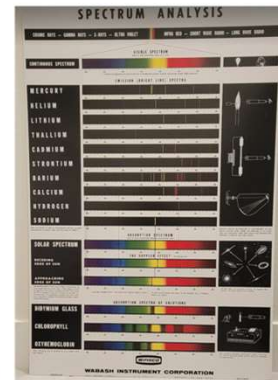
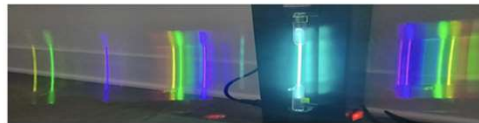
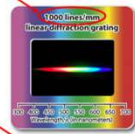


Building on the past with hands-on optics labs, I took a short course for high school educators in the summer of 2021, offered by the University of Waterloo called Schrödinger's Class and have adopted their curriculum on Quantum Key Distribution using the same polarizing filters I have been using for many years to teach students about light in general.

Students may have heard about polaroid sunglasses, so that is something familiar that I use to get them into the quantum mysteries.

Building on the Past with Hands-on Labs

Spectroscopy & Diffraction Gratings



Community Colleges and Universities have outreach to high schools



Photos by Donn Silberman

Quantum
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Another readily available tool from the past is diffraction gratings, these are low cost enough that I like to let the students keep them so they can take them home and share with their friends and family. They can do hands-on experiments with a laser pointer and measure the Distances to the 1st order diffraction spots and also look at the spectrum of various light sources and compare them to the spectrum of known sources. We provide worksheets for both these activities.

The Laser-Tec program has about 44 college partners across the country, including Pasadena City College; and the EdQuantum program is building several courses on top of the Laser-Tec Program so students can be ready for quantum technician jobs in industry.

All of these colleges have outreach programs to local high schools and can be used to teach Quantum as the opportunities present themselves.



The first high school that I was fortunate enough to give my Quantum for High School Students presentation to was the 11 & 12 grade engineering classes at the Samueli Academy in Santa Ana, California. This opportunity came to me by way of the Vital Link ‘Re-Launch’ event this past June; since they had been closed down due to COVID for almost two years. An old outreach friend of mine is the engineering instructor and one of his students was at the Vital Link event.

After hearing my presentation, two 11th grade students decided they wanted to start their own Schrodinger’s Quantum Club over the summer and when the time to recruit student members came around at the beginning of the Fall semester, they had about a dozen members sign up.

Here you can see some students working on their hands-on labs and the photo in the top right is of the Club President at an Open House for their Engineering Fab Lab. You can see she is displaying two Quantum Map posters from the Domain of Science that I donated so they can use them as guides during their meetings.

Use this as a learning tool
students are already familiar.

Example screen shot of Kahoot quiz question.

WHAT BEST DESCRIBES THE TERM "QUANTUM"?

15

0 Answers

▲ A PARTICLE OF LIGHT

◆ AN ELECTRON

● A PHYSICAL ENTITY THAT HAS ONLY DISCRETE VALUES.

■ VERY SMALL THINGS AT THE SUBATOMIC LEVEL.

This was a Python class at a local high school.

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One teaching tool that was new to me when I started last Spring was Kahoot !! This is an on-line tool that teachers use to get their students engaged in the material being taught. I have created several of these, each with 6 or 7 questions, to go along with various versions on my Quantum for High School Students presentations. The students compete in real time to see who can get the highest number of correct answers.

This one here asks the question “ What best describes the term Quantum?” I use one Kahoot in the middle of the presentation and a second one near the end.

This photo was taken during a Python programming course at the local high school in Corona Del Mar, California

Virtual Work

Quantum Computing Qubit x Qubit IBM's Qiskit

Quantum Computing for High School Students – an All-On-Line Course
 QubitxQubit (qubitbyqubit.org)

TRAINING THE FUTURE DIVERSE QUANTUM WORKFORCE

Interested in bringing quantum to your school?
 We offer free workshops and courses for K-12 schools and universities.
[Learn More](#)

Introduce this into high school Python programming courses.

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The virtual work I have been engaged with is the Qubit x Qubit program offered by the Coding School. This program is for high school students, but they have let me take the course so I can be an ambassador in Southern California and augment my outreach efforts with their materials and help recruit more students, teachers and schools to take their full programs in the coming years.

This program is sponsored by IBM and uses Qiskit as the main focus.

I am looking forward to seeing how I can help integrate Qiskit into some high school Python programming courses.

Professional Societies

Local & Student Chapters

OSSC EDUCATION & OUTREACH
Optical Society of Southern California

Current OSSC Event
Combined In-Person & Webinar
Wed, Nov 16, 2022
"The Quantum Industry, Education & Outreach - an Overview"
by Donn Silberman & Doug Finke
Reception: 6:00pm Dinner: 7:00pm
Presentation: 8:00pm

Donn Silberman
Doug Finke

SPIE The International Society for Optics and Photonics
Student Chapters and Clubs

OPTICA formerly OSA
Get Involved Student Chapters

Working with local SPIE, Optica, IEEE Photonics and other College Student Clubs to reach out to local high schools

Quantum Education Pathways:
an open-source modifiable presentation to High School & College Students
[Publications | opticsage \(donn601.wixsite.com\)](http://opticsage (donn601.wixsite.com))

SPIE Optics & Photonics
Conference 12213
Optics Education and Outreach VII
22 August 2022
Paper 12213-38

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A couple weeks ago, Doug Finke and I spoke at the November OSSC meeting in Tustin, California providing an overview of the quantum industry, education & outreach. This was a live in-person meeting that was also live-streamed for people who live and work to far away to make the commute in the Southern California traffic.

The OSSC always invites students from local college and university optics & photonic clubs because they are the near term future workforce, but they also reach out to local high schools to recruit younger students into our fields.

As I mentioned at the beginning of this talk, I have been associated with the OSSC, SPIE and Optica for several decades, as a member and volunteer outreach leader. Both SPIE & Optica have local and student chapter worldwide and they are great resources to help get quantum education out to local high school students.

In August, I gave a presentation to the SPIE Optics Education & Outreach Conference where I discussed that my presentation "Quantum for High School Students" can be modified and used by other volunteers so they don't have to create an outreach presentation from scratch. This can be very helpful for the student clubs. Both Optica and SPIE have provided this information to their student clubs and you too can use it if you would like. Details are on my website.

Professional Societies

Local & Student Chapters

Friends of the OSSC

OSA Local Sections & Student Chapters

- OSA Local Sections
- OSA Student Chapters
- Venture OSA Local Section

OSA Student Chapters in California

- California Institute of Technology - OSA Student Chapter
- Cal Poly Pomona Optics & Photonics Club
- Stanford University, Stanford Optical Society
- University of California, Berkeley, "PhotoBears" (Joint OSA, SPIE & IEEE Student Chapter)
- University of California, Riverside, Photonics Society (Joint SPIE & OSA Student Chapter)
- University of California, San Diego, Light Quantum at UCSD
- University of California, Santa Barbara, Photonics Society, (OSA, SPIE & IEEE Student Chapter)

Help Local & Student Chapters reactivate after COVID

- Irvine Valley College (IVC) Student Chapter (not active)
- San Francisco State University, OSA Student Chapter (not active)
- University of California, Davis, Optics Club (not active)
- University of California, Irvine, Photonics@UCIS (Joint OSA & SPIE Student Chapter) (not active)
- University of California, Los Angeles (Joint OSA & SPIE Student Chapter) (not active)
- University of California, Merced (not active)

OPTICA Formerly OSA

OSSC
Optical Society of Southern California

<https://ossc.org>

SPIE.
UC San Diego

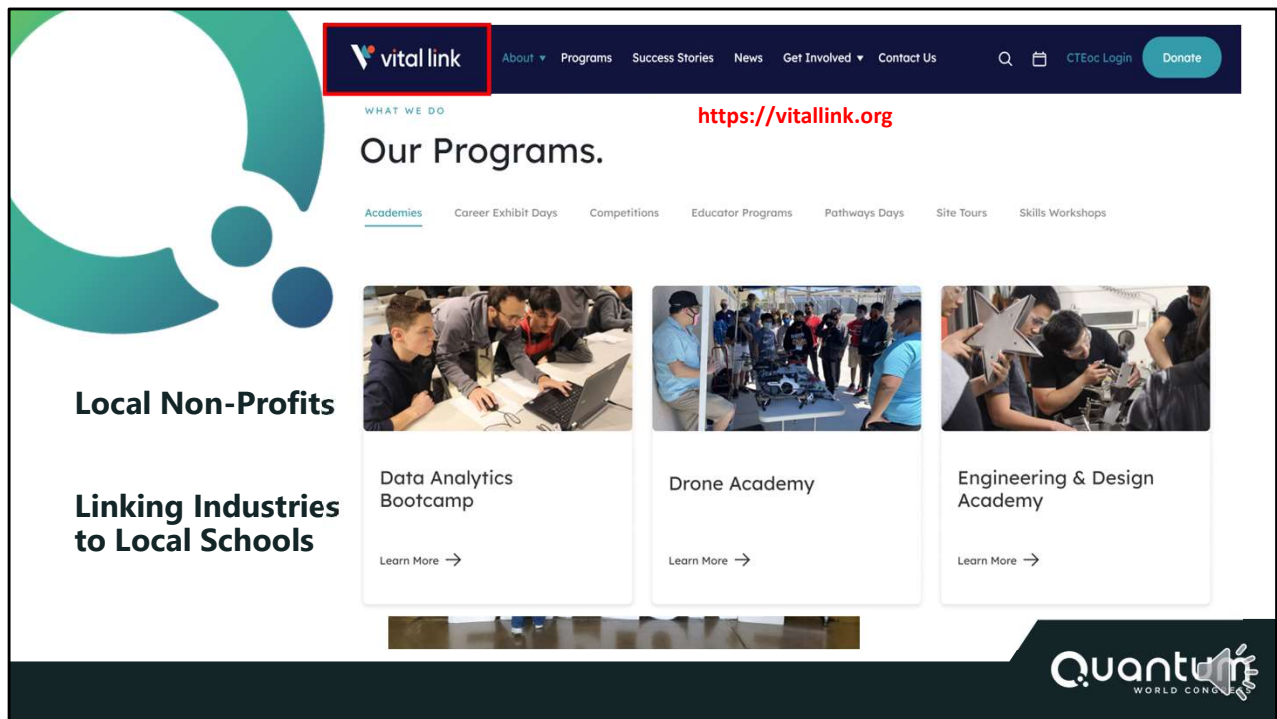
Student Chapter Recruitment
Hands-On Lab Demonstrations
Fri. Nov. 18

Quantum
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The OSSC maintains a web page on their website that lists some student clubs in California. Some of them have already reactivated after COVID, some have not.

One goal of the OSSC is to reach out to these colleges and universities in Southern California and help them with recruit new members and then help them with their high school outreach programs.

Here is a photo of the UC San Diego SPIE Student Club during a recent recruiting effort where they had some hands-on demonstration available in their undergraduate teaching lab.



I have mentioned Vital Link a number of times during this presentation and I want to end with some thoughts about local non-profits.

This organization has been around for over 20 years, but during COVID they took the time to reorganize themselves with some new staff (including a new President) and board members. They have had many events that they have led and many that they participate in with other organizations. STEM is their top priority, but they do work in other fields too.

The screenshot displays the Vital Link website interface. At the top, the Vital Link logo is highlighted with a red box, along with navigation links for 'About', 'Programs', 'Success Stories', 'News', 'Get Involved', and 'Contact Us'. A search bar and a 'Donate' button are also visible. The main content area is divided into three sections:

- Local Non-Profits:** This section features the text 'Local Non-Profits' and 'Linking Industries to Local Schools'. Below this is a banner for the 'Welcome to EdQuantum Project'.
- Donors & Sponsors:** A grid of logos representing various organizations, including FB Fullerton Business, 100% THAT CARE, HomeLight, United Way, Urban Workshop, Hoag Orthopedics, Reborn Cabinets Inc., Let's Pony Up Kids, Eli, EDISON, CMTC, Career Launch, EY, ONE ZERO, TELCOMPREHENSIVE SOLUTIONS, and webex Events.
- Educational Partners: School Districts:** A grid of logos for various school districts and colleges, including UNLIMITED YOU, Brea Olinda Unified School District, Santa Ana Unified School District, Laguna Beach Unified School District, Newport-Mesa Unified School District, PLYUSD, Santa Ana Community College, Saddleback College, and Coastline Community College.

The bottom right corner of the website features the 'Quantum' logo with the tagline 'WORLD CONQUERERS'.

They have many local industry sponsors and educational partners; so I have found that working with Vital Link is my best path to reach the local schools. I highly recommend looking for and partnering with similar local non-profits in your area.

Take-Aways

- Build on the past – relationships, technologies & programs
- Use hands-on labs to get the students involved right away
- Use content & context to take students from the familiar to Quantum
- Use virtual Quantum Education programs that are established
- Partner with local & student chapters of professional societies
- Partner with local non-profits that are already connected to local businesses, schools and school districts – K-12 + Community Colleges



So to summarize the points I feel are most important

- Build on the past – relationships, technologies & programs
- Use hands-on labs to get the students involved right away
- Use content & context to take students from the familiar to Quantum
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- Partner with local non-profits that are already connected to local businesses, schools and school districts – K-12 + Community Colleges

THANK YOU

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Learn more at:

<https://oisc.net> old

<https://donn601.wixsite.com> new

Publications | [opticsage \(donn601.wixsite.com\)](https://opticsage.donn601.wixsite.com)



Thank you very much for your time and attention.

You can find my information on my websites.


And I think we have time for a couple questions.

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Experience Life in the QuantumOptics Age


OpticsAge is a focal point for Donn Silberman's Optics Education Adventures

Weirdness and wonder: Quantum entanglement work wins 2022 Nobel Prize for Physics (spie.org)



Quantum Pubs &

- [Quantum for Students](#)
- [Quantum for Volunteers](#)
- [Quantum Edu & Work](#)
- [Quantum Cybersecurity](#)
- [Donn's Quantum Explorations](#)
- [EdQuantum - Industry Survey](#)




OSSC
Optical Society of Southern California

FELLOW


Donn's OSSC Bio
OSSC Annual Report 2017-2018

Welcome to EdQuantum Project


HYBRID CURRICULUM IN ADVANCED OPTICAL SPECTROSCOPY AND QUANTUM TECHNOLOGIES FOR TECHNOLOGY




QUBIT X QUBIT
High School Students
program starts soon.



Quantum
WORLD CONGRESS
Nov. 29 - Dec. 1, Washington, D.C.



SPIE Fellow



OPTICA
SENIOR MEMBER


COLLEGE OF OPTICAL SCIENCES
COLLEGE OF ENGINEERING

UCI Division of Continuing Education
Optical Engineering & Optical Instrument Design

UCI Optical Engineering 10 yrs - Photonics Spectra
from Sept 2019 Photonics Spectra Magazine
Information Session - August 2019 - YouTube

OptoBoticssm
Robbts need eyes too

This website is now for archival purposes only to be an educational resource.




The Optics Institute
of Southern California

This website is now for archival purposes only to be an educational resource.


Las Americas

This website is now for archival purposes only to be an educational resource. alas Americas is closed for business. Thank you for your past support.



Starrett

THE UNIVERSITY OF ARIZONA



Physics

HONORS COLLEGE
50th Anniversary 2012

JWST at the UA


PASADENA CITY COLLEGE
Laser Technology Program

Optics Outreach Materials donated from the OISC

Career Assistance Here

SPIE
OPTICS & PHOTONICS
GLOBAL SALARY REPORT 2022

[New Career Assistance page](#)



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[Weirdness and wonder: Quantum entanglement work](#), [New HOME Draft](#), [Optics \(spie.org\)](#)

[Career Assistance](#)

[UC Irvine DCE On-Demand](#)

[Wm. Bickel - Collected sayings](#)

[New HOME Draft](#)



Career Assistance

This web page has links to various career assistant and job search websites for the physics, optics, photonics and quantum fields.

More will be added as time goes on. For high school students in Orange County CA, see [Vital Link of Orange County](#)

[Careers | Optica](#)

[Optics and Photonics Jobs](#)

[SPIE Career Development | Membership \(spie.org\)](#)

[Education & Careers - IEEE Photonics Society](#)

[Physics Today Jobs](#)

[Quantum Computing Jobs \(quantumcomputingreport.com\)](#)

[Homepage - Quantum Jobs.net](#)

[QED-C | Quantum Jobs | QED-C \(quantumconsortium.org\)](#)