Quantum Education Pathways:
an open-source modifiable presentation to High School & College Students

Donn Silberman

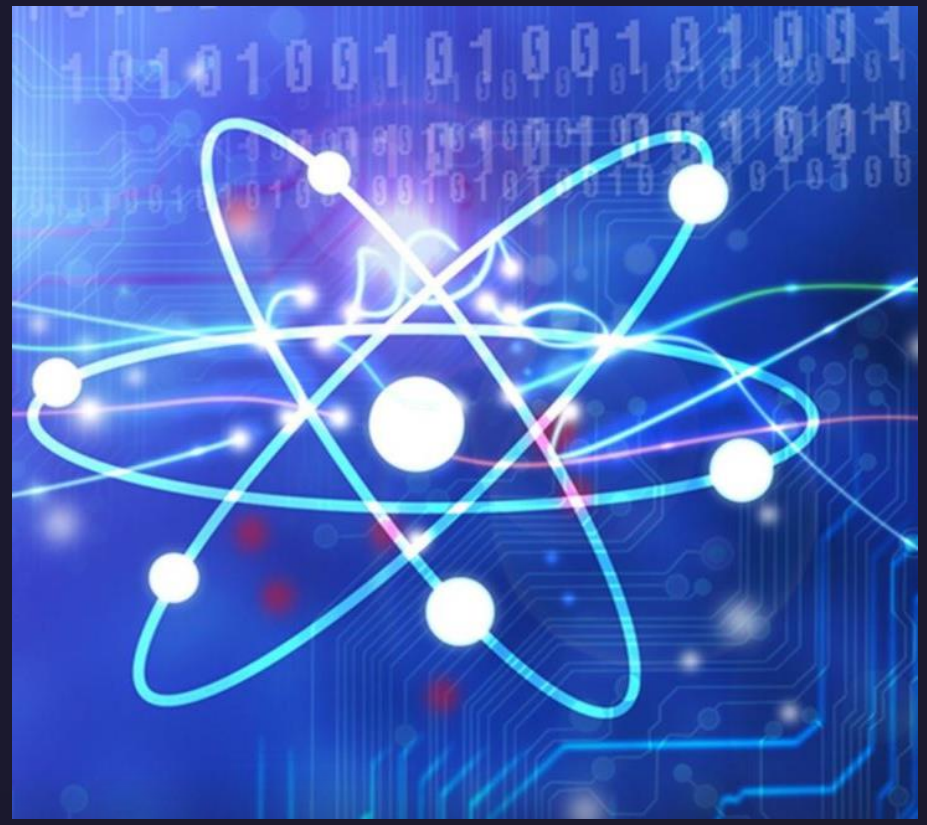
Optics Institute of Southern California

http://oisc.net

SPIE. Optics & Photonics

Conference 12213
Optics Education and Outreach VII
22 August 2022

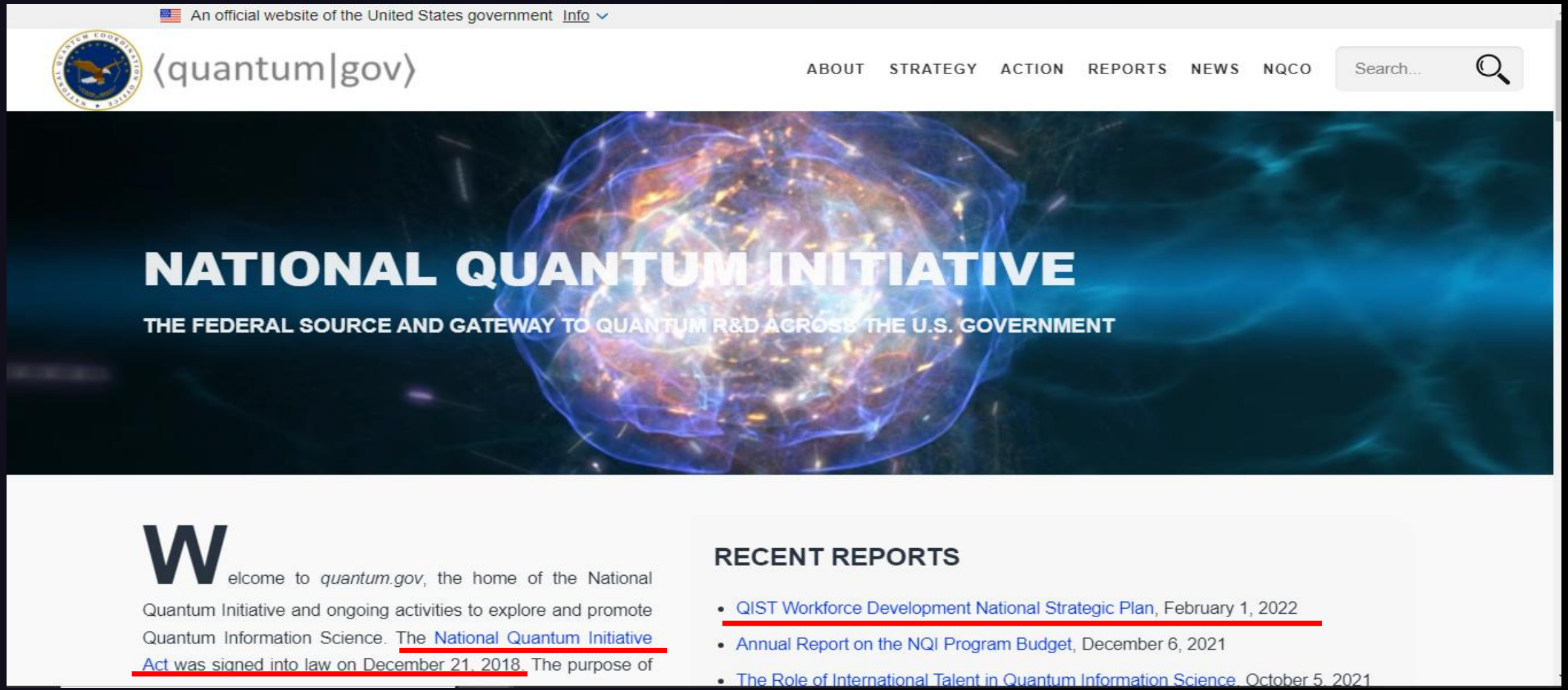
Paper 12213-38



Topics for today

1. **Motivation for creating an open-source modifiable presentation to High School & College Students**
2. The modifiable content
3. Laser Diffraction Demonstration (a Quantum Device)
4. Using ‘Kahoot! For Schools’ - Realtime quizzes
5. Additional resources for presenters, teachers and students
6. Logistics (how to get the modifiable presentation)
7. Results so far (this is good !!) >>> Future Work
8. Questions & Answers

Motivation : (History)



Not enough people with the required education and skills to fill the current and future…..

Quantum jobs

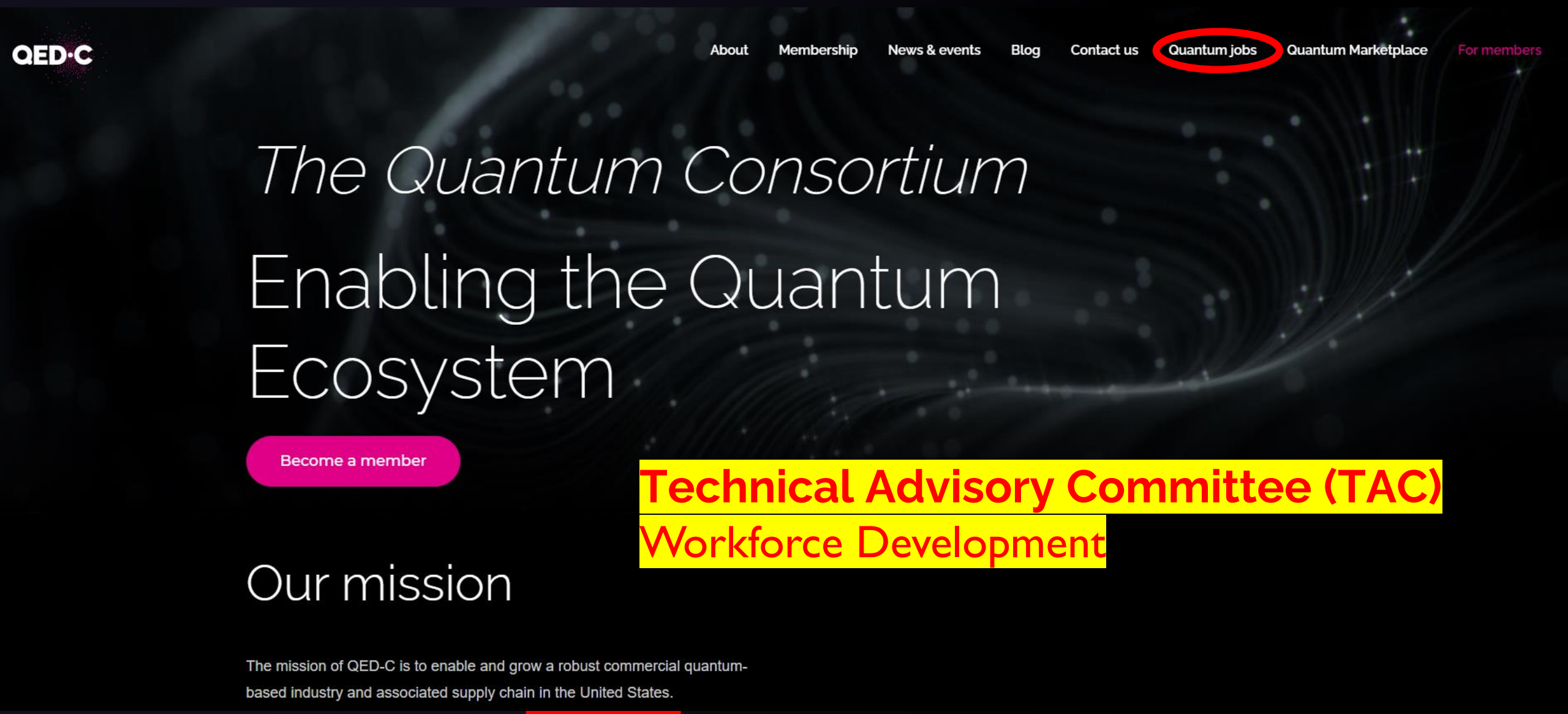
Check out available listings of employment opportunities at QED-C members companies. Members include corporations, academic institutions, national laboratories and government agencies working in quantum.

QED-C thanks Quantum Computing Report and Harrisburg University of Science and Technology for contributing to this list.

CORPORATE ACADEMIC GOV'T/NAT'L LABS/OTHER

Show 20 entries Search:

Organization	Position	Link	Location	Date Added
Aliro	Community Manager (Deep Tech, Boston Preferred or Remote)		USA; Massachusetts; Brighton	2022-04-16
Aliro	Senior/Principal Software Developer (Embedded Systems)		USA; Massachusetts; Boston	2022-04-16
Aliro	Senior/Principal Software Developer (Quantum Network Controller)		USA; Massachusetts; Boston	2022-04-16
Aliro	Senior/Principal Software Developer (Quantum Network Protocols)		USA; Massachusetts; Boston	2022-04-16
Amazon	2022 Fall Applied Science Internship - Automated Reasoning, Computer Vision,		Canada; Ontario;	2022-05-


QED·C
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Blog
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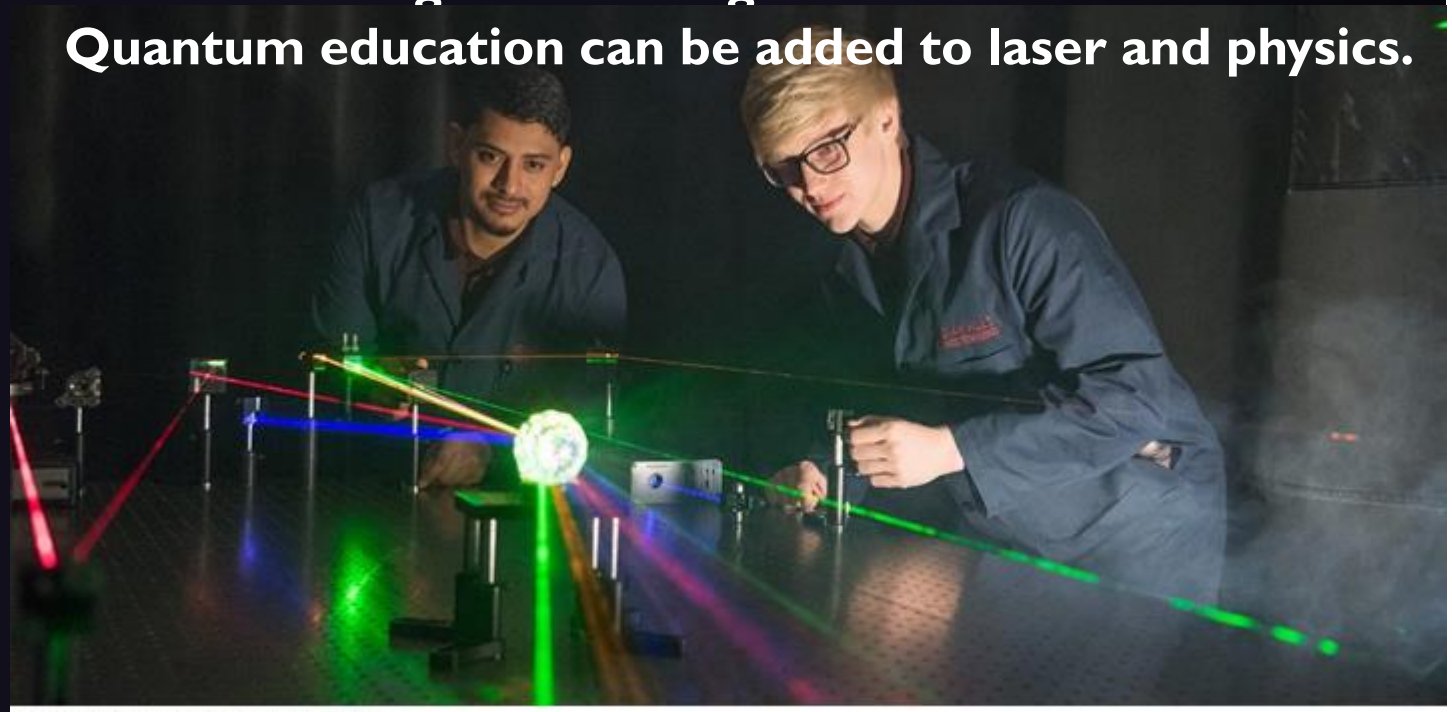
Quantum jobs
Quantum Marketplace
For members
The Quantum Consortium
Enabling the Quantum Ecosystem
Become a member
Technical Advisory Committee (TAC)
Workforce Development
Our mission
The mission of QED-C is to enable and grow a robust commercial quantum-based industry and associated supply chain in the United States.

Quantum Technician Skills and Competencies for the Emerging Quantum 2.0 Industry (SPIE Optical Engineering)
Authors: Mo Hasanovic, Chrys Panayiotou, Donn Silberman, Paul Stimers, and Celia Merzbacher
Available on-line Apr. 9, 2022 - Open Access at the link above. To be published in hardcopy form August 2022

OPTICAL ENGINEERING
VOL. 61 · NO. 8 | AUGUST 2022

Education and Training in Quantum Sciences and Technologies (11)

We are educating and training tomorrow's workforce now.
Quantum education can be added to laser and physics.



Credit: Indian Hills Community College

Administration

BRIEFING ROOM

FACT SHEET: President Biden Announces Two Presidential Directives Advancing Quantum Technologies

MAY 04, 2022 • STATEMENTS AND RELEASES

QUANTUM INFORMATION SCIENCE AND TECHNOLOGY WORKFORCE DEVELOPMENT NATIONAL STRATEGIC PLAN

A Report by the
SUBCOMMITTEE ON QUANTUM INFORMATION SCIENCE

COMMITTEE ON SCIENCE

of the
NATIONAL SCIENCE & TECHNOLOGY COUNCIL

February 2022

Who We Are

The National Q-12 Education Partnership includes tech companies, scientific professional societies, academics, and the NSF-funded Q2Work Program. Together, we aim to support and grow a quantum workforce that is diverse and equitable, such that the QIS innovators of tomorrow can make discoveries, invent new technologies and drive societal change. We want to increase opportunities, access, and quality of age-appropriate QIS educational experiences for students from all backgrounds.

National Q-12 Education Partnership

[Home | National Q-12 Education Partnership | UIUC (q12education.org)]

PCC LASERTECH

Are you seeking a career with cutting-edge technology that pays well? With the in-demand skills of laser technology, you can work in aerospace, medicine, robotics, manufacturing, entertainment, forensics, or defense!

The Optics and Photonics College Network (OPCN) is Association of Postsecondary Photonics Technician Educators.

LASER-TEC

A National Science Foundation Center

LASER-TEC – Center for Laser & Fiber Optics Education

44

Partner Colleges

Pasadena City College

http://pasadena.edu/academics/degrees-and-certificates/certificates-of-achievement/laser-technology.php

NASA Jet Propulsion Laboratory
California Institute of Technology

Not enough students enrolling in programs like this one. Especially from local high schools.

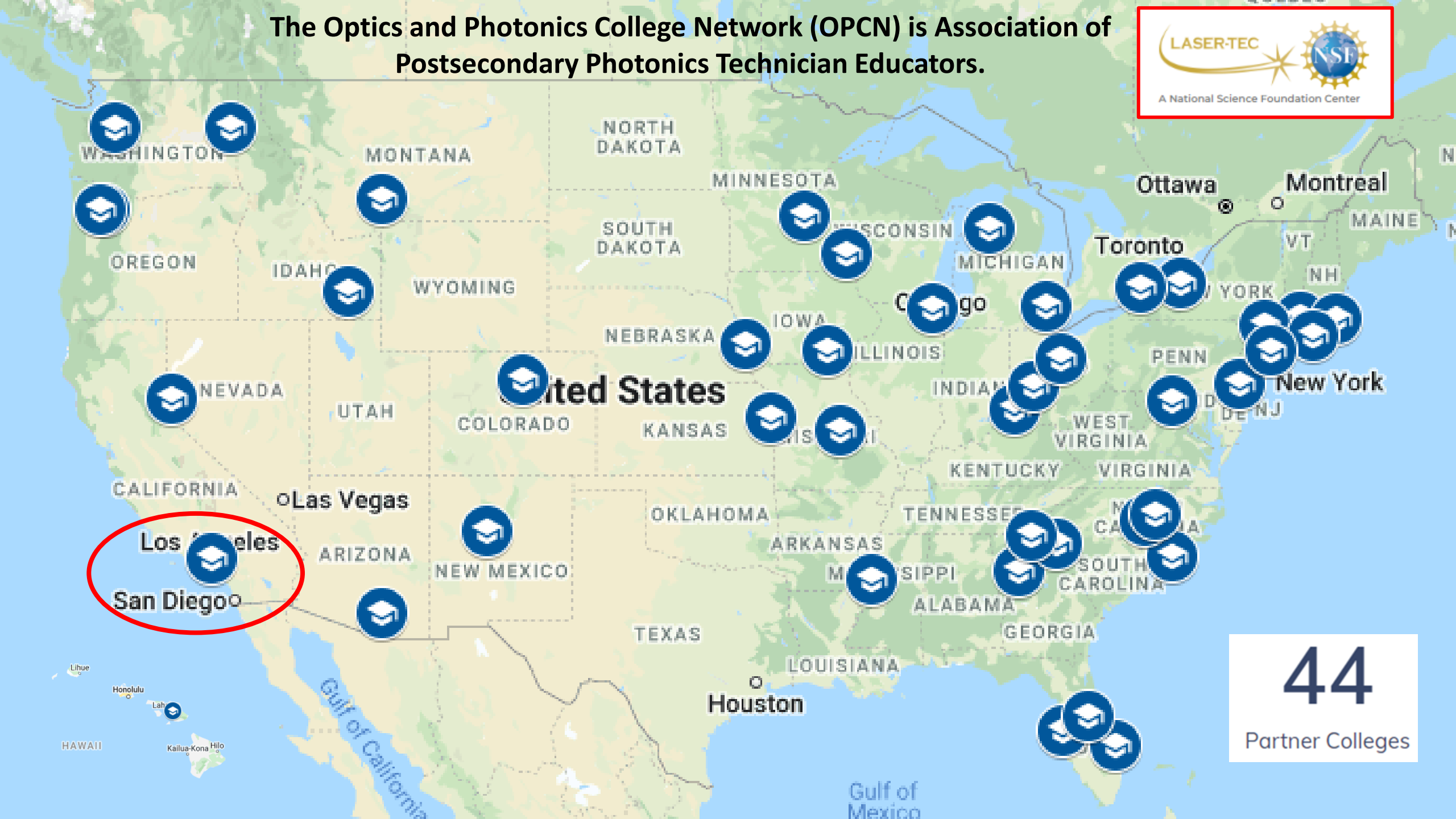
Be Laser-Focused

LaserTech is the use of lasers, cameras, lenses, mirrors, sensors, displays, fiber optics, and other technical devices that interact with light.

- ✓ Earn skills to be immediately hired as a technician
- ✓ Be prepared for success in a university engineering program
- ✓ Advance your careeer by mastering more technically demanding skills

naturalsciences@pasadena.edu

The Optics and Photonics College Network (OPCN) is Association of Postsecondary Photonics Technician Educators.



44

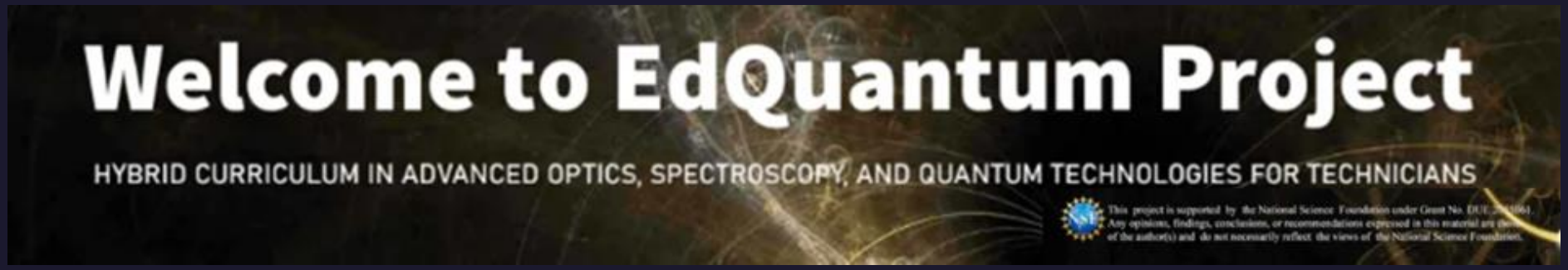
Partner Colleges

Motivation : (History)

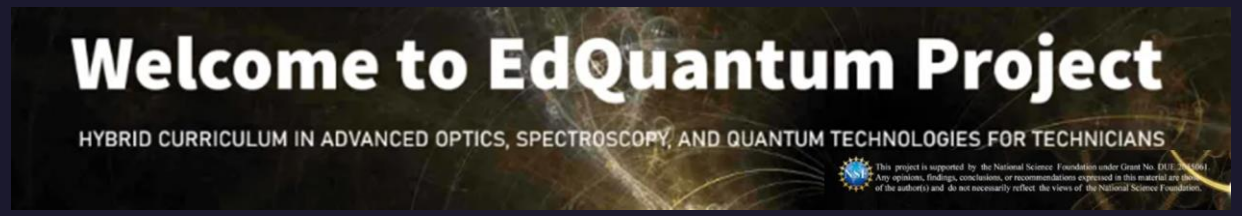
National Center for Optics and Photonics Education (OP-TEC)

LASER-TEC NSF
A National Science Foundation Center

PASADENA CITY COLLEGE
Laser Technology Program



Motivation:



12213-19

Upskilling photonics technicians to meet challenges of quantum 2.0 revolution

Author(s): Moamer Hasanovic, Indian River State College (United States); Chrysanthos Panayiotou, LASER-TEC, National Ctr. for Laser-Photonics and Fiber Optics Education (United States); Donn Silberman, Optics Institute of Southern California (United States)

A presentation to be given this afternoon.

Hide Abstract –

Recent advances in quantum research have created a significant mismatch between quantum science and the emerging quantum industry, as there is no sizable trained workforce to support product commercialization. Part of this new workforce will be developed through upskilling of incumbent photonics technicians whose current qualifications present a solid foundation for the new quantum-related competencies. To provide the greatest access to these new skills, the curriculum requirements need to be delivered via flexible distance-learning platforms. In this paper, we describe our efforts to produce an open-access educational curriculum to introduce new quantum-related competencies to an incumbent workforce. A detailed list of the competencies sought by the quantum industry is given followed by the results of a survey through which the proposed competencies were assessed. This project pioneers the introduction of the complex subject of quantum science to advanced technological education. The proposed curriculum is expected to help the US maintain the world lead in quantum technologies. This project is funded by the NSF Advanced Technological Education grant that focuses on the education of technicians for advanced technologies that drive the nation's economy.

Quantum Technician Skills and Competencies for the Emerging Quantum 2.0 Industry (SPIE Optical Engineering)
Authors: Mo Hasanovic, Chrys Panayiotou, Donn Silberman, Paul Stimers, and Celia Merzbacher
Available on-line Apr. 9, 2022 - Open Access at the link above. To be published in hardcopy form August 2022

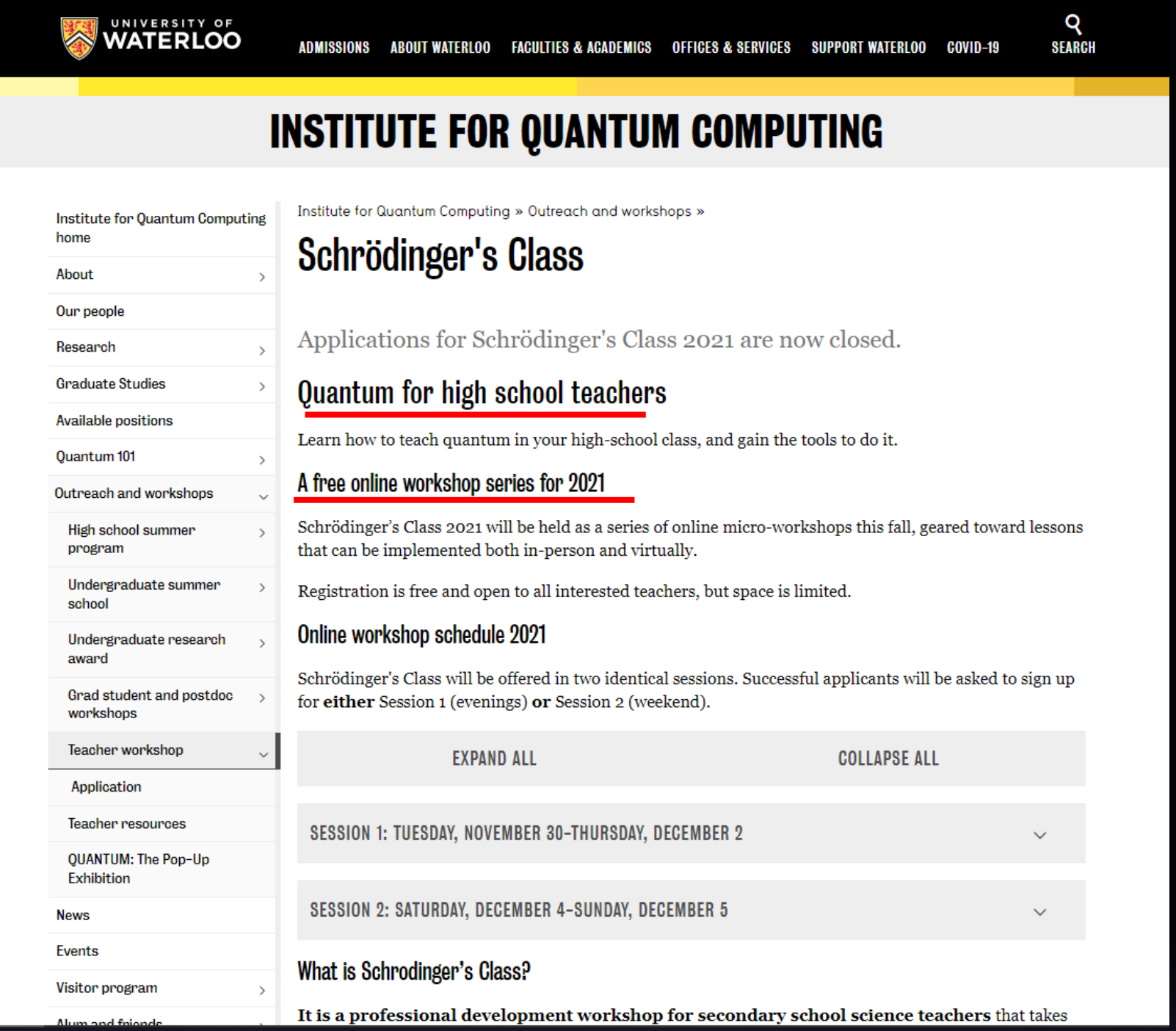
Motivation:

Quantum Technician Skills and Competencies for the Emerging Quantum 2.0 Industry (SPIE Optical Engineering)

6 Alignment with the NSB Vision 2030 Roadmap

Finally, to support the global science and engineering community, the EdQuantum project will seek partnerships with compatible educational institutions in Canada and Europe. Such a collaboration has already been established with the Institute for Quantum Computing at University of Waterloo[35] regarding curriculum and materials for teaching quantum science to high school students. A future EdQuantum efforts may involve reaching out and cooperating with professional societies such as SPIE and Optica as well as with photonics clubs at colleges and universities in Central America, South America, and the Caribbean to share our curriculum and materials for teaching quantum science.

Have begun working with SPIE Student Chapter Coordinator to get this material to SPIE Student Chapters.



This is an important concept.

I attended this workshop and have all

The course materials that can be shared

Or new similar materials can be developed

I ask the students if they are interested in attending a local Quantum Education Workshop ??

Motivation:

Quantum Technician Skills and Competencies for the Emerging Quantum 2.0 Industry (SPIE Optical Engineering)

6 Alignment with the NSB Vision 2030 Roadmap

The EdQuantum project will specifically develop STEM talent for America by researching any ongoing quantum educational efforts at a middle and high school level using the support structure and network of our partners such as LASER-TEC. To develop a smart workforce, the EdQuantum will integrate into the curriculum higher-level skills such as critical thinking, problem-solving, creativity, and digital literacy as well as the STEM pedagogy and practices for diversity and inclusion. To help fill the quantum education pipeline for future years, the EdQuantum project will use educational tools and recruiting networks for K-12 so EdQuantum students, teachers, and professional industry volunteers can work with K-12 educators in their local regions to prepare K-12 students for college and university programs that include quantum technologies. To expand our outreach across the country, the EdQuantum team will leverage the assets of the Optics and Photonics College Network (OPCN)—currently consisting of 44 college programs in 29 states (see Fig. 4)—to promote the quantum educational content.

Topics for today

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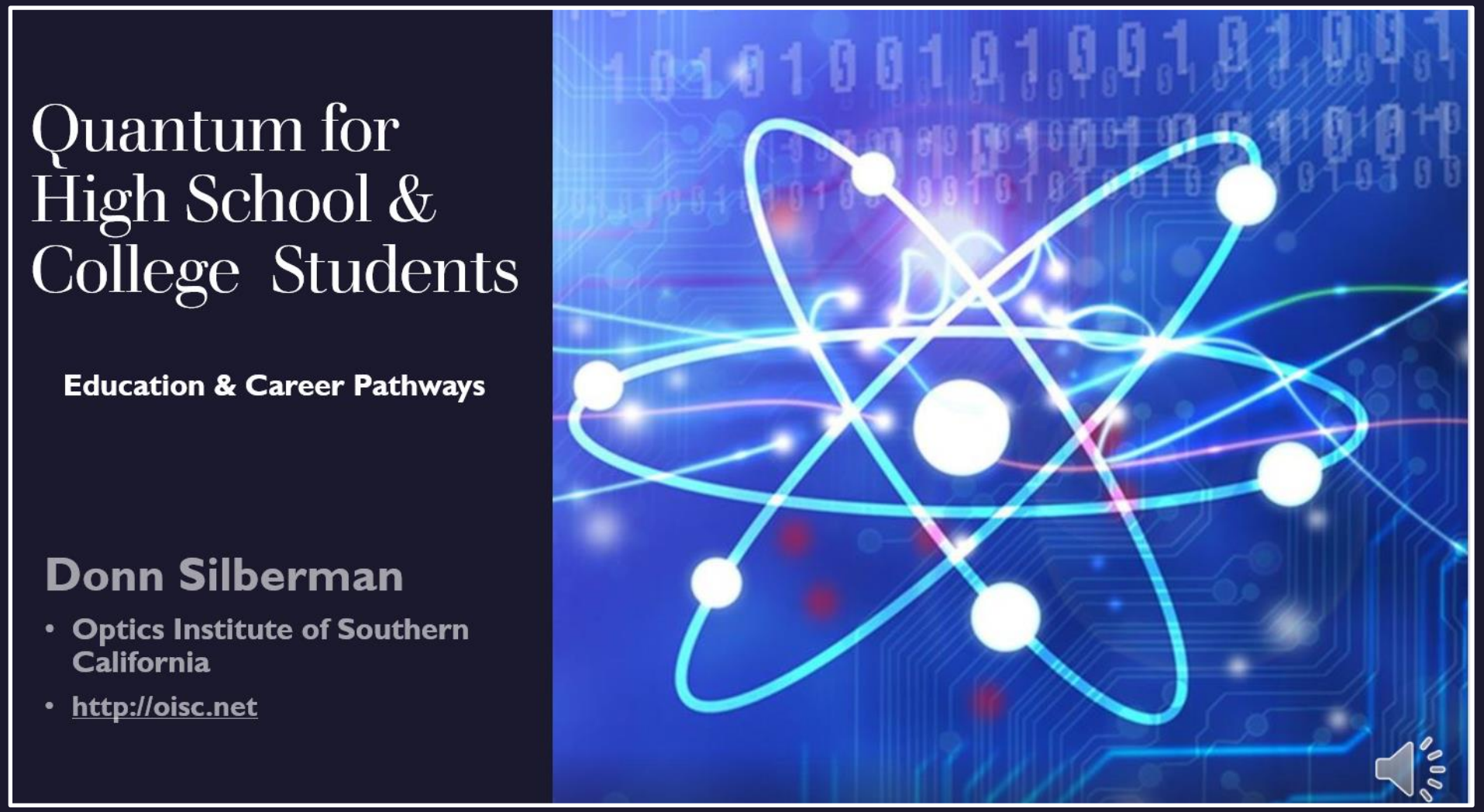
Modifiable Content :

Title slide for open-source modifiable presentation to High School & College Students



Modifiable Content :

Self Introduction of the presenter: make yourself relatable.

What did you do when you were their age and how did you get to be presenting this information??

Introduction

Who am I?

And Why am I here talking to you?

- QuantumOpticsAge –
- https://donn601.wixsite.com/opticsage

Society of Physics Students

Modifiable Content:

(Use this slide or not at the presenter's option.)

What is Light? (this has a lot to do with quantum)
What is Money? (this has to do with careers)
What is Truth / Trust? (this has to do with life and science in general)
What is Love? (this has to do with mentors)

This is slide is animated so you click through and talk about each topic of ~ 15 seconds.

Light, Money, Truth / Trust & Love are all abstract concepts that people are familiar with. This may help them understand quantum phenomenon.

Modifiable Content:

This slide is of my Mentors. Each presenter needs to make their own slide with their story.

Mentors

Frank Memmer
High School
Astronomy Teacher

Ke Chiang Hsieh

William Bickel

College Physics Professors

Steve Jacobs
Univ. of Rochester
Optics Suitcase
Light Outreach

Modifiable Content:

Call to Action:

This is my Get Involved slide. Each presenter should make their own slide.

Get involved with the Quantum World.

1. **Find good mentors**
   1. Start with your Physics Teacher
2. **Take Action:**
   1. Go to my website, click on links and read articles
   2. Watch YouTube videos on Quantum
   3. Find hands-on workshops close to home
   4. Take on-line courses
   5. Got to a college that offers quantum courses
   6. Take an internship that works in the field
   7. Join a club or start one your self

This QR Code is a link to my web page for this presentation with all the materials and references.

This is my business card – you can have one - FREE

Each presenter should share their business card.

Modifiable Content:

This is a contact slide from my website. Each presenter can make their own contact slide.

Experience Life in the QuantumOptics Age

OpticsAge is a focal point for Donn Silberman's past Optics Education Adventures
Donn has retired from most of his educational outreach activities and his fulltime job at Starrett.
This website will be periodically maintained as an educational resource.

Donn is now focused on his Quantum Explorations and is consulting on EdQuantum.

Follow the Digital White Rabbit

To learn more about:

Contact Us

First Name

Last Name

Email *

Write a message

Submit

Modifiable Content:

This is my Summary slide. Each presenter should make their own Summary slide.

Topics for today

1. Motivation for creating an open-source modifiable presentation to High School & College Students
2. The modifiable content
3. **Laser Diffraction Demonstration (a Quantum Device)**
4. Using ‘Kahoot! For Schools’ - Realtime quizzes
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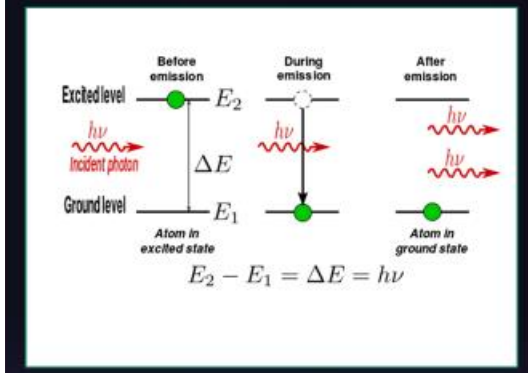
6. Logistics (how to get the modifiable presentation)
7. Results so far (this is good !!) >>> Future Work
8. Questions & Answers

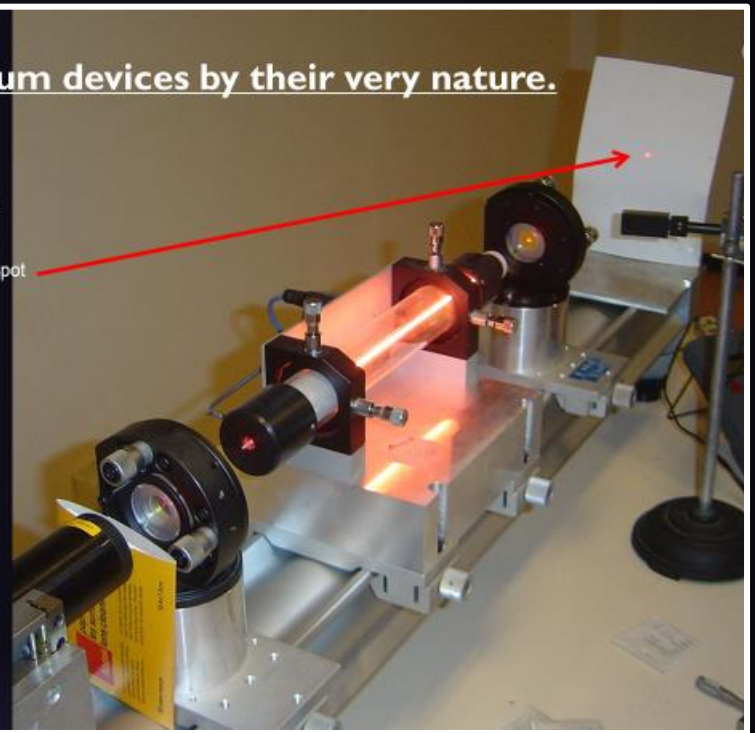
A brief introduction to lasers as quantum devices and
A nice diffractive optics demonstration to keep their attention.

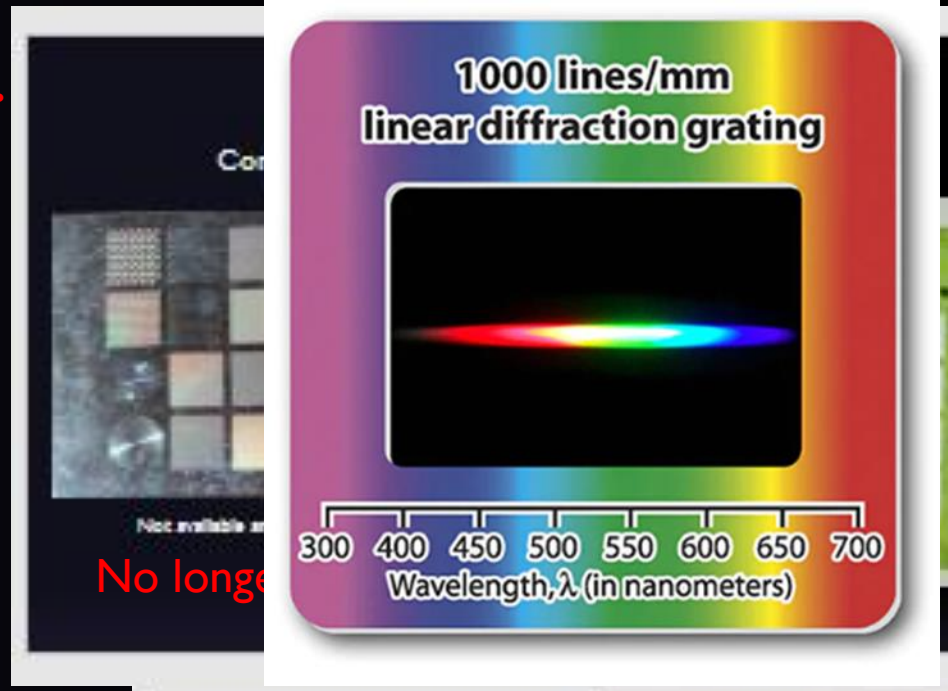
There is a video of the demonstration if presenters do not have a nice diffractive demo slide.)

Lasers are intrinsically quantum devices by their very nature.

A helium–neon laser demonstration. The glow running through the center of the tube is an electric discharge. This glowing plasma is the gain medium for the laser. The laser produces a tiny, intense spot on the screen to the right. The center of the spot appears white because the image is overexposed there.



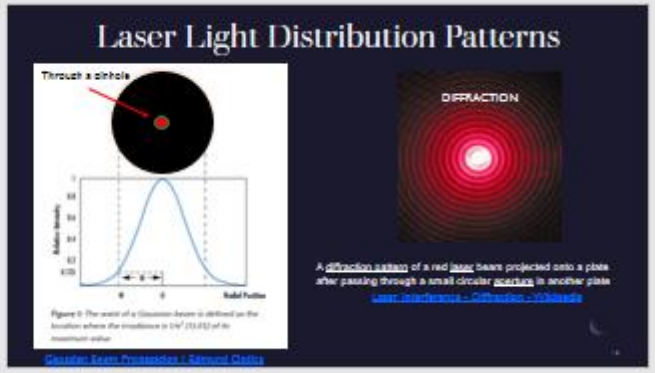


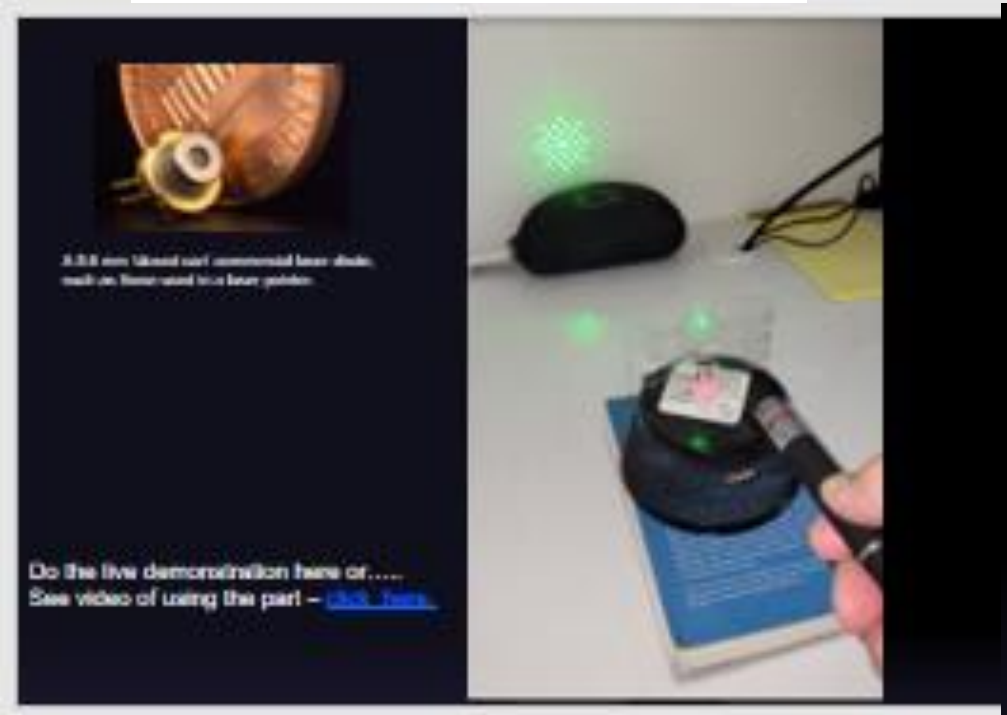


THE LASER

All the animations and explanations on www.toutmiquantique.fr

Also included is a short video on laser basics.





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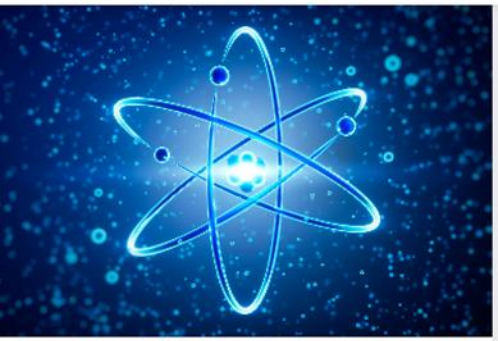
Kahoot #1

CLICK HERE FOR LINK.

Kahoot!

This is the screen you will see after clicking on the link.



QUANTUM WORLD PART 1

4 plays · 4 players

A public kahoot

KAHOOT__DONN159
Updated 6 days ago

New to Kahoot!?

Welcome! You can play this game as a guest without an account. Sign up to save game results, search millions of awesome kahoots, create your own or duplicate and edit existing ones!

Sign up | Play as guest

Already a user? Log in

Questions (7) Show answers

1 - Quiz

WHAT BEST DESCRIBES THE TERM "QUANTUM"?

2 - Slide

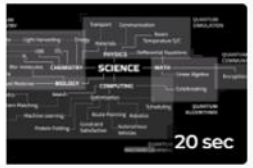
QUANTUM MECHANICS

3 - Quiz

WHY WAS QUANTUM THEORY DEVELOPED?

4 - Quiz

WHICH FIELDS ARE BEING IMPACTED BY QUANTUM MECHANICS?



5 - Quiz

Join at **www.kahoot.it**
or with the **Kahoot! app**

Game PIN:

203 6588

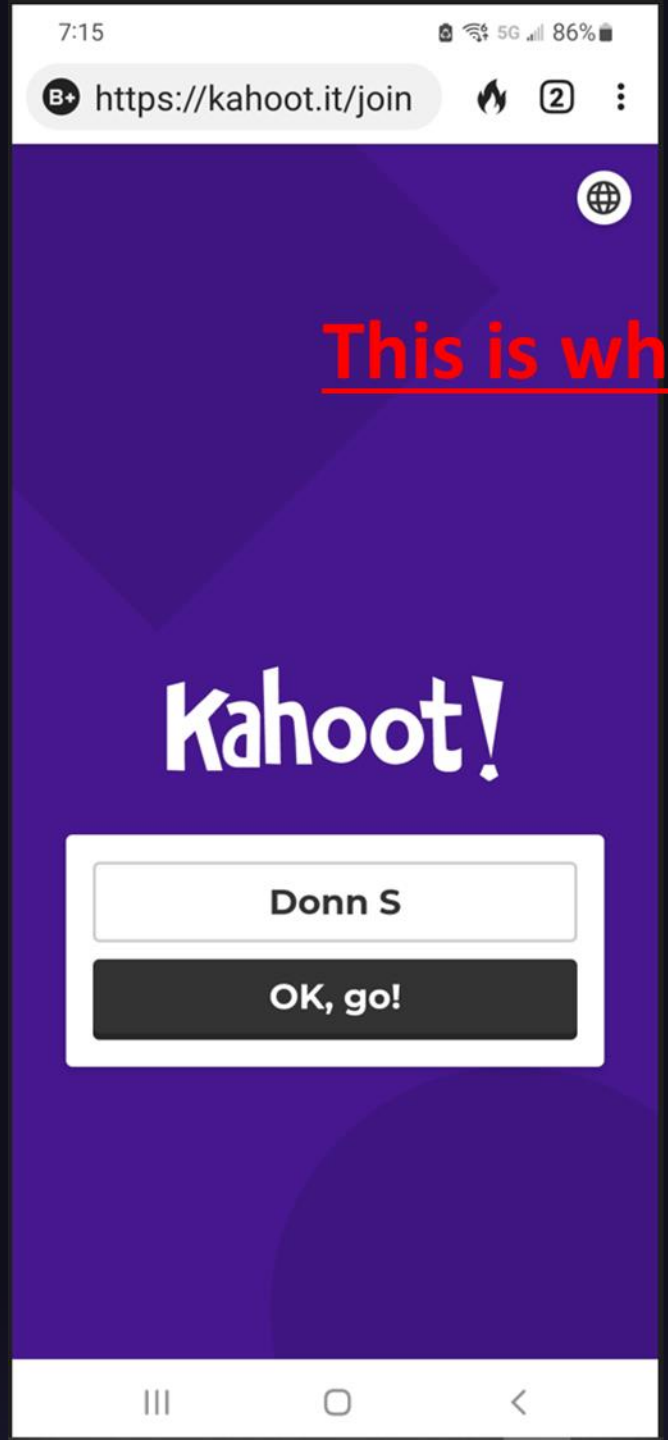
This number changes each time the game is played.

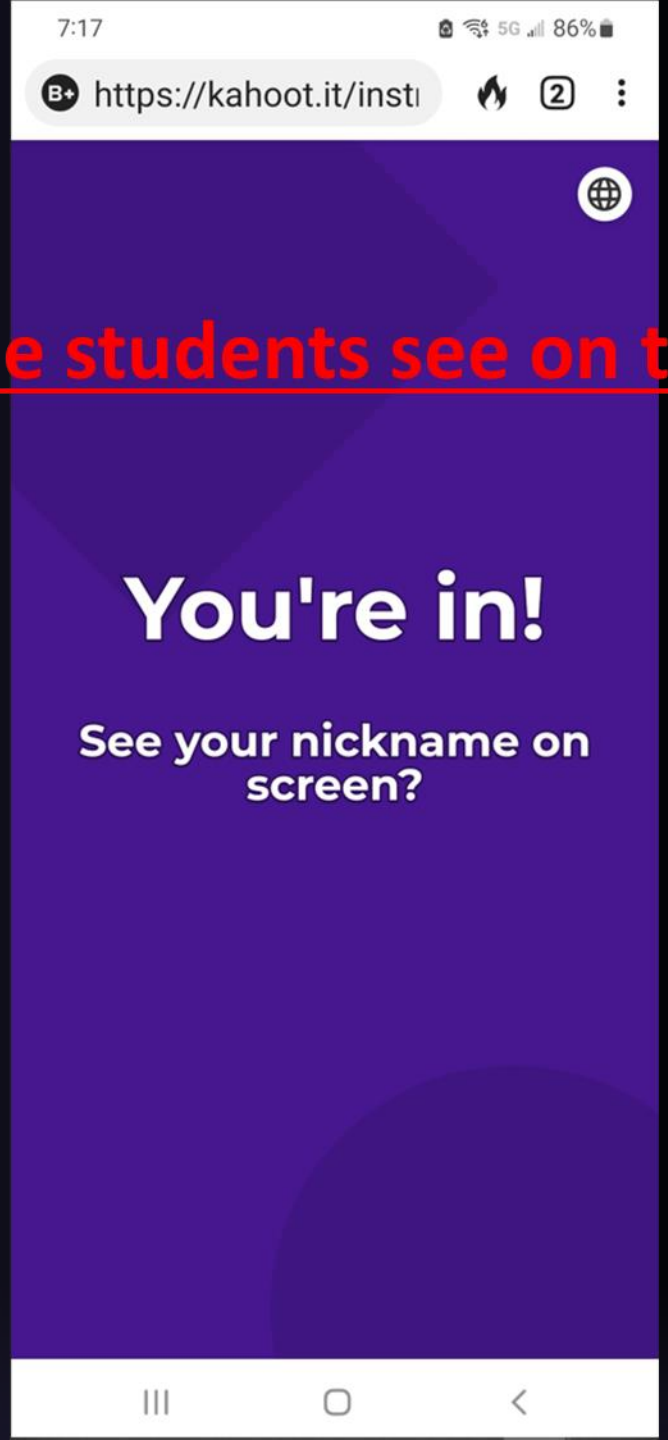
0

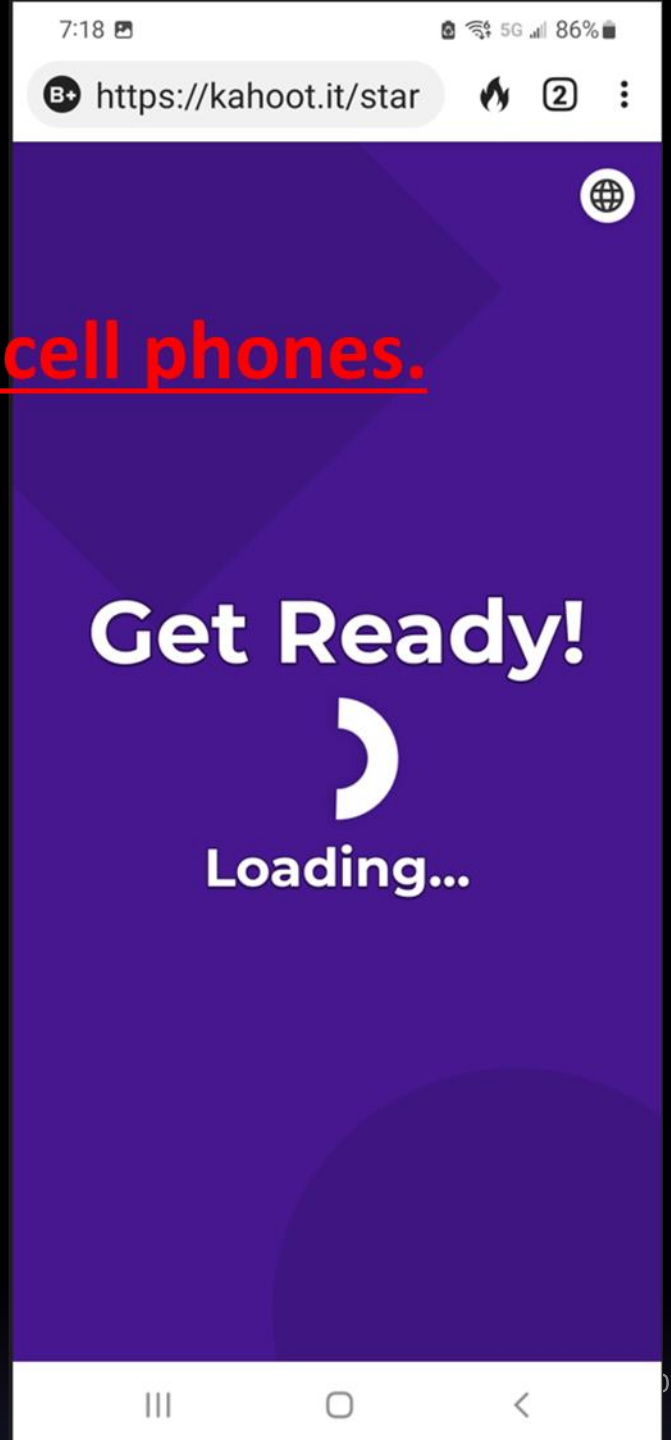
Kahoot!

Start

Waiting for players...







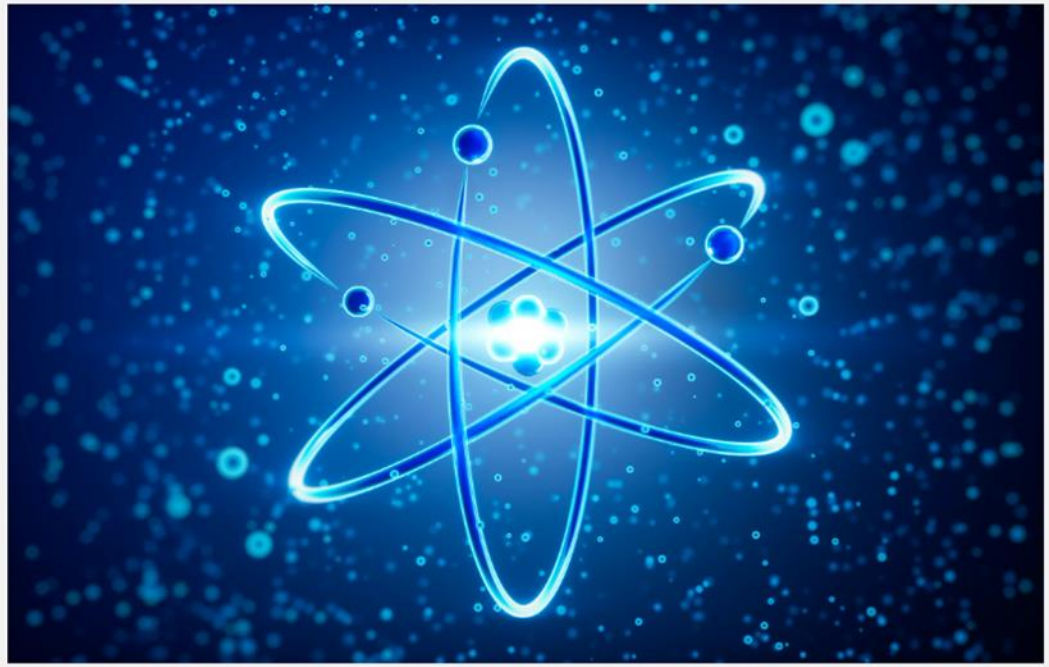
This is what the students see on their cell phones.

Kahoot!

Example screen shot of Kahoot quiz question.

Skip

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.

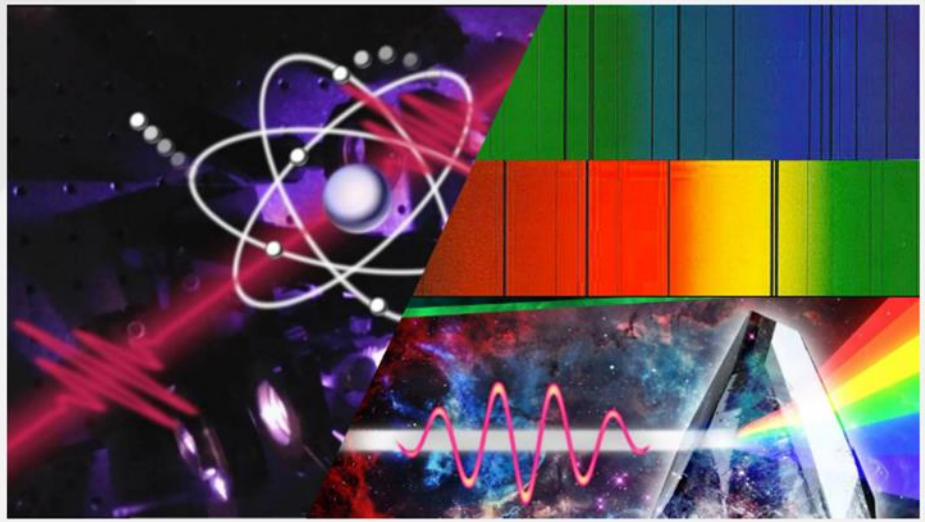
Kahoot!

Example screen shot of Kahoot definition.

Next

QUANTUM MECHANICS

More details about using Kahoot are available in the references.



QUANTUM MECHANICS IS A BRANCH OF PHYSICS THAT PROVIDES A DESCRIPTION OF THE PHYSICAL PROPERTIES OF NATURE AT THE SCALE OF ATOMS AND SUBATOMIC PARTICLES.

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Content Summary: Agenda Slide

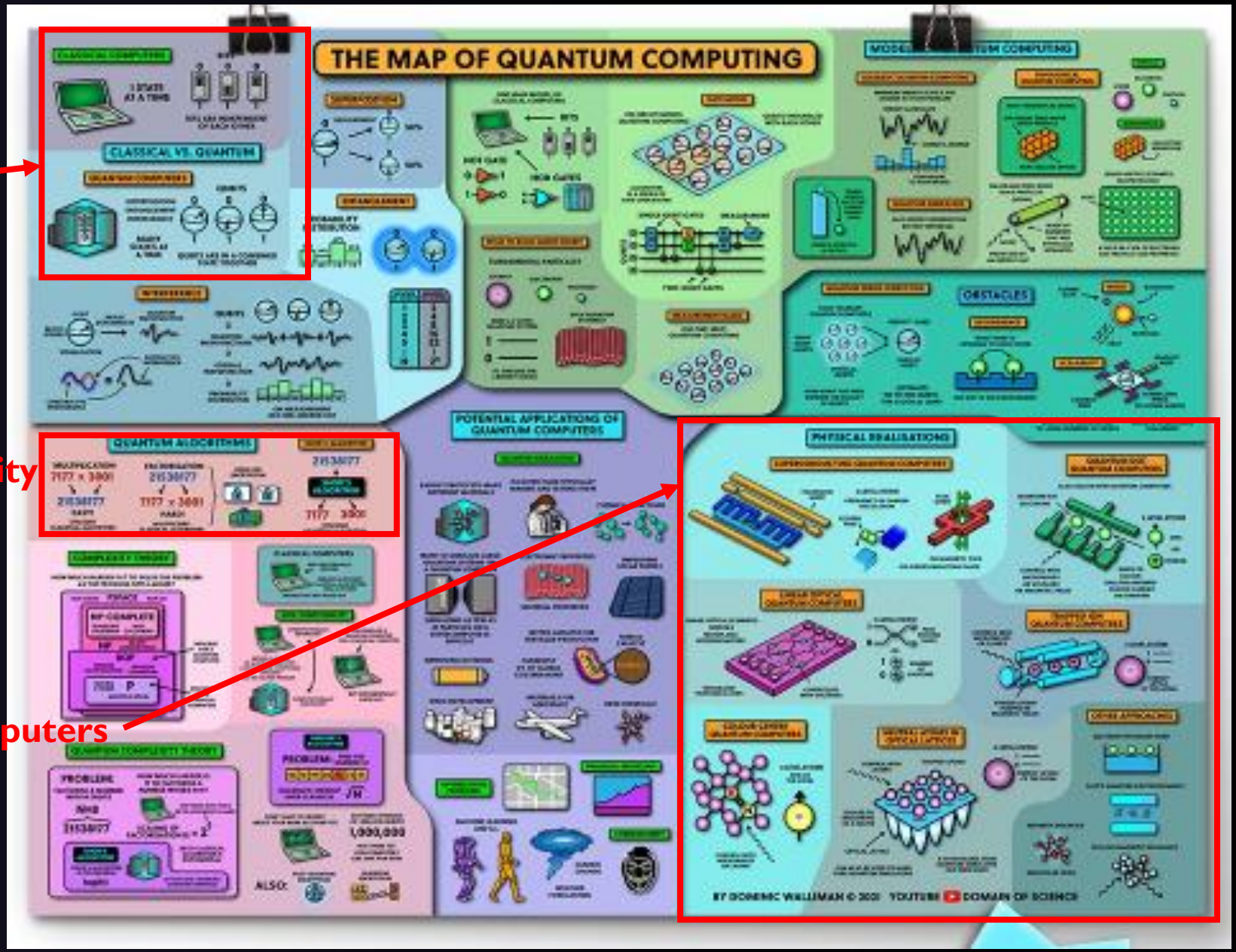
Agenda

1. What is Quantum & why should you care?
2. Quantum Computers & Cybersecurity (Kahoot #1)
3. Many More Quantum Applications
4. Pathways for High School & College Students
5. On-line and In-Person Resources (Kahoot #2)
6. Questions & Answers

Differences between Classical & Quantum Computers

Quantum Algorithms and Cyber Security

Physical Realizations of Quantum Computers



Domain of Science | Map of Quantum Computing Poster – DFTBA

Content Summary: Quantum Applications

There is a slide of each of these seven applications – students can apply quantum in many fields

Quantum Computing Applications

1. The Future of Quantum Drug (medicine) Discovery - Cambridge Quantum
2. Quantum computer models a chemical reaction (scitation.org)
3. Quantum Computing: Accelerating the Digitization of Chemistry • EFMaterials Blog
4. Inside Google's Quantum Computing Data Center
5. Quantum ML - Quantum: Machine Learning & Analytics
6. Exploring quantum computing use cases for manufacturing | IBM
7. University of Arizona Awarded $26M to Architect the Quantum Internet

High School Quantum | opticsage (donn601.wixsite.com)

1. Financial Services – Investing, transacting
2. Oil & Gas Exploration and distribution
3. Better Batteries
4. Cleaner Fertilization
5. Traffic Optimization
6. Weather Forecasting and Climate Change
7. Improving Solar Panels
8. Quantum Systems Simulations
9. Quantum Sensors

Lots of content slides and detailed notes are downloadable now – open-access

Additional Resources: for presenters, teachers, & students

Quantum Educational Resources

Available Courses | qBraid

DoS - Domain of Science - YouTube

Map of Quantum Computing Poster – DFTBA

Qiskit - IBM's Open Source Quantum Computing Resource

Quantumapalooza 2020 Harrisburg University

QuVis (st-andrews.ac.uk)

Key Concepts for Future QIS Learners (illinois.edu)

Schrödinger's Class | Institute for Quantum Computing | University of Waterloo (uwaterloo.ca)

(for the Schrödinger's Class materials, contact Donn directly or go to.....)

Teacher resources | Institute for Quantum Computing | University of Waterloo (uwaterloo.ca)

Quantum Computing for High School Students - text book by Yuly Billing

Stanford University - High School Quantum Course

Not all web resources are equal.
Some do not add value to the readers learning.

These were chosen because they seem to add value.

These educational weblinks and many more are organized on the authors webpage.

Quantum for Students | opticsage (donn601.wixsite.com)

Additional Resources: for presenters, teachers, & students

Big Tech Quantum Websites

Microsoft Quantum overview | Microsoft Azure
Quantum Computing | IBM
Quantum Computing - Intel
Quantum | Honeywell
Google Quantum AI
Quantum Computing Service—Amazon Braket–Amazon Web Services

Quantum Computing Companies

Quantum Solutions | Keysight
IonQ | Our Trapped Ion Technology
PsiQuantum | Building the world's first useful quantum computer.
Home - Atom Computing (atom-computing.com)
Bleximo
ColdQuanta - Making Quantum Matter - Making Quantum Matter
D-Wave Systems | The Practical Quantum Computing Company (dwavesys.com)
EeroQ
ENTANGLEMENT - QUANTUM COMPUTING
Equal 1

Quantum On-Line Resources

Quantum Computing Report - Market Analysis, News & Resources
Inside Quantum Technology
IQT - San Diego May 10-12 2022 pdf
Quantum Economic Development - Consortium (QED-C)
Quantum for All
Home | National Q-12 Education Partnership | UIUC (q12education.org)

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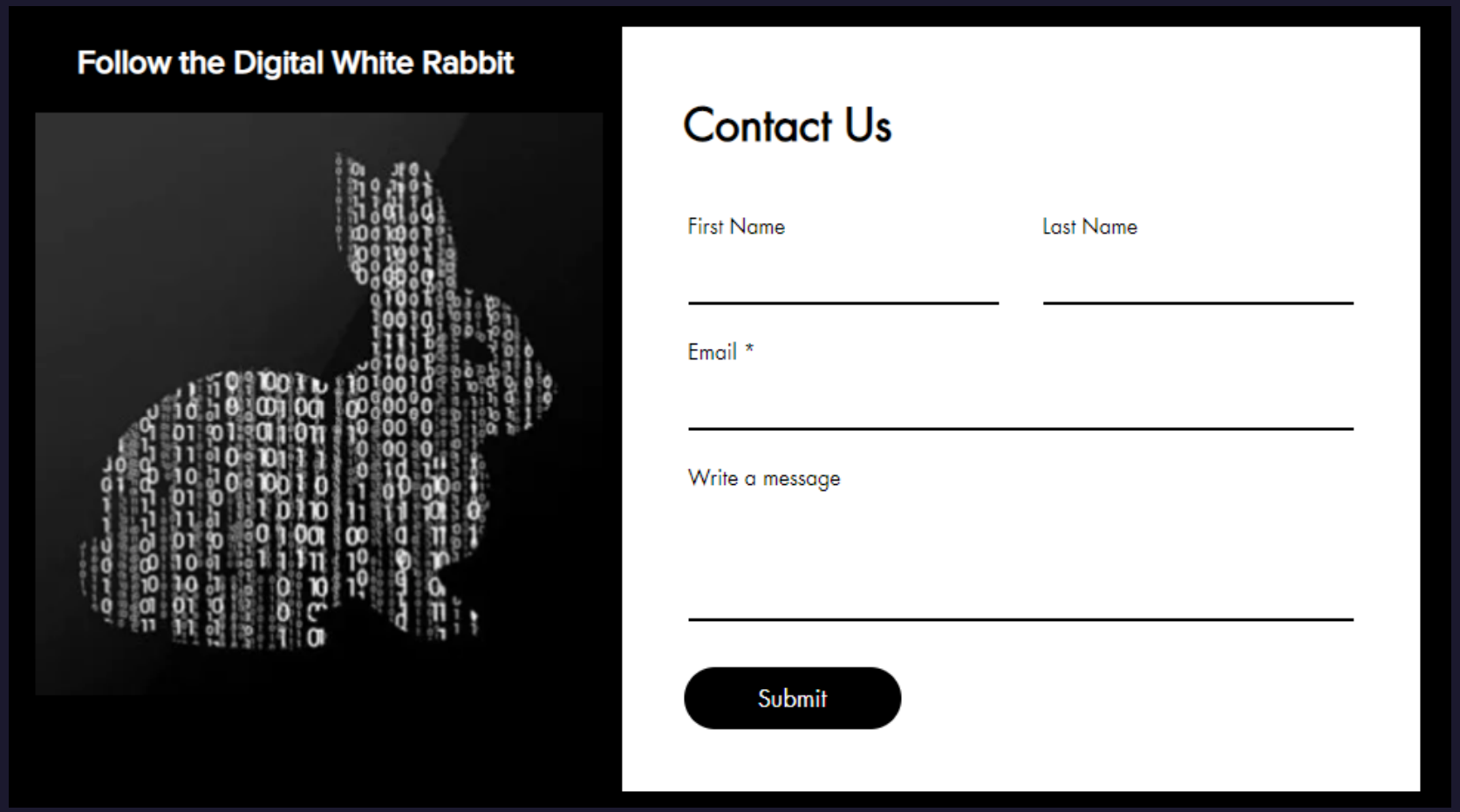
How to get the Presentation

Quantum for Students | opticsage (donn601.wixsite.com)

Contact | opticsage (donn601.wixsite.com)



Results so far:

Public Charter School for all students - no tuition fees.

Who followed the Digital White Rabbit??

Two presentations were given at the Samueli Academy just before the end of the academic year.

Two Samueli students are preparing to start a Quantum Club in August with mentors from Chapman University's Institute for Quantum Studies.

We had a hands-on workshop Friday Aug. 19th.

Another presentation was given near the beginning of a summer program

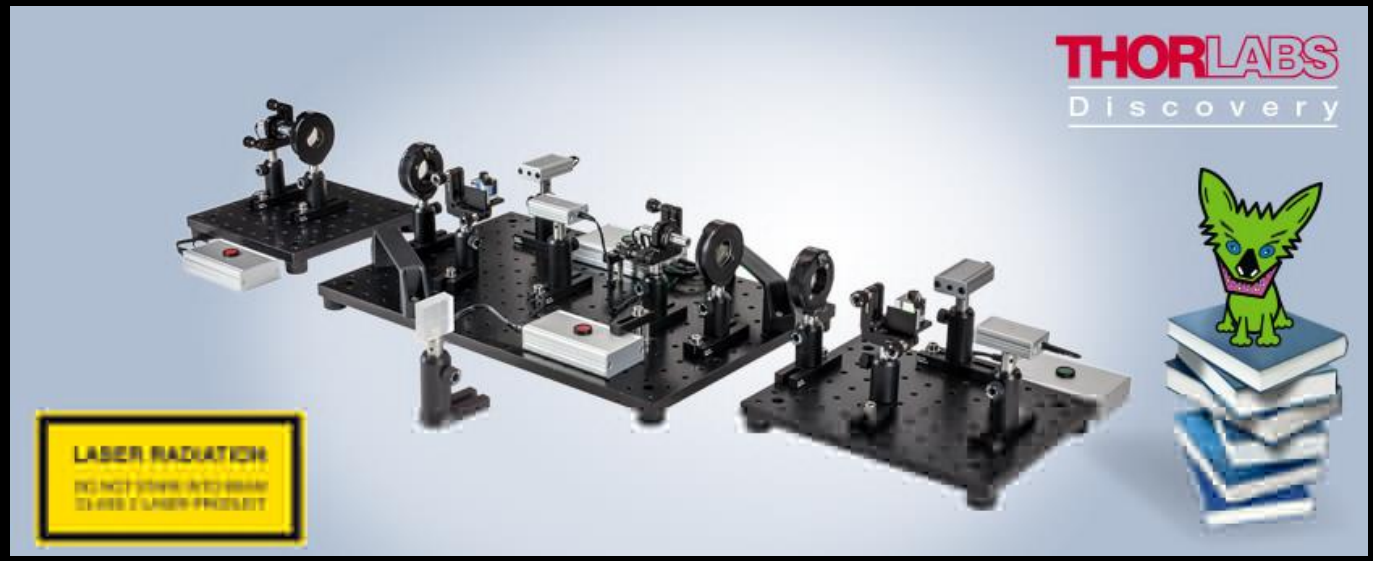
The Achievement Institute's outcome-driven model is an intensive two-year program with the first year focused on STEM career awareness, and the second year concentrated on college readiness.

Many students who saw the presentation discussed it with those who did not. They wrote letters to the author expressing their interest and thanking him.

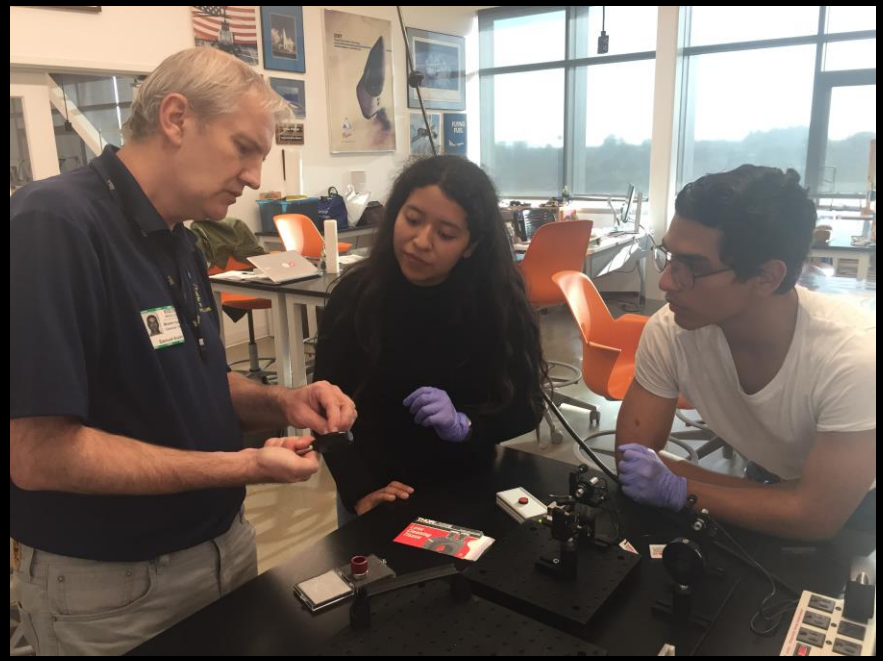
There may be a follow up presentation to more students.

SAMUELI ACADEMY

We had a hands-on workshop Friday Aug. 19th.



Quantum Cryptography Analogy Demonstration Kit



A new presentation for Middle School Students and the General Public

Rainbows, Stars & Atoms

Quantum 4 Kids
Of All Ages !!!

The size of things &
How they are related

Donn Silberman

Optics Institute of Southern California

http://oisc.net

Future Work with:

vital link

Career Explorations

ARIZONA
PHOTONICS
DAYS
JANUARY 19-21, 2022
TUCSON, ARIZONA

Summary

- Modifiable presentation for High School & College Students.
- Laser Diffraction Demonstration is included
- Used 'Kahoot for Schools' – Realtime quizzes & definitions,
- Additional resources for presenters, teachers & students
- Logistics – where to get all these materials – authors website
- Results so far >>> Future Work

Thank You

Donn Silberman

Optics Institute of Southern California

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Any Questions ???