The National Quantum Initiative
and Quantum Computing

Dr. Sandy Irani, UC Irvine & Dr. Jonathan Habif, USC

OSSC Annual Business Meeting
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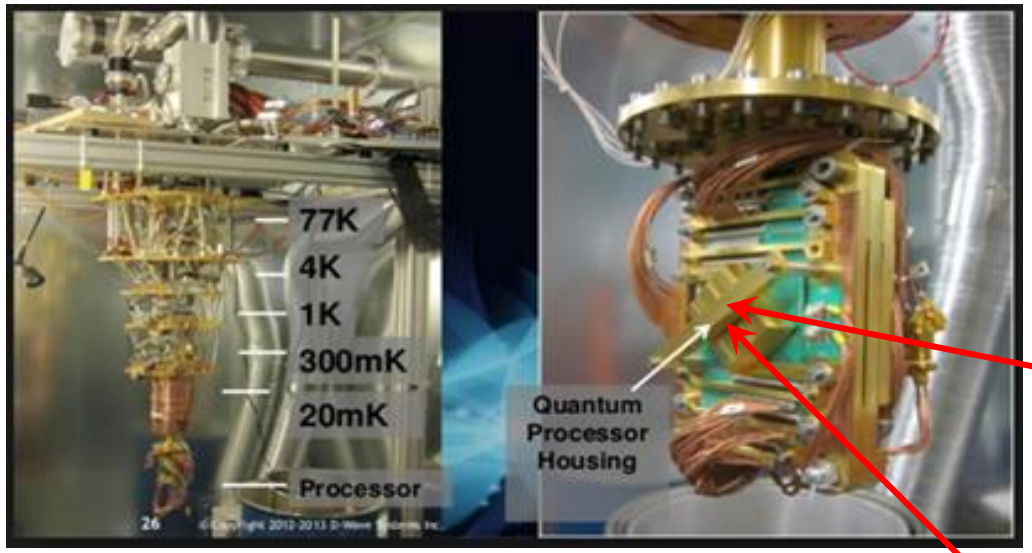
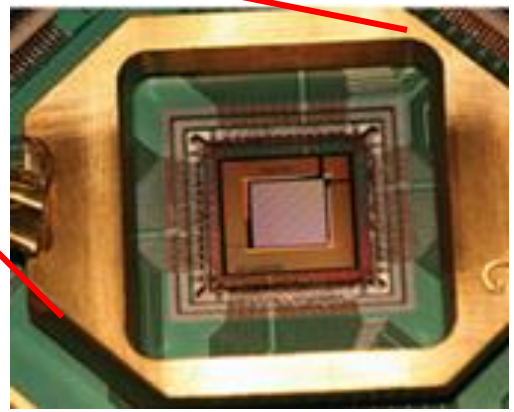
Brea Civic & Cultural Center





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Goals for tonight:……

Learn about the NQI, what is it, why is it important

- Learn about the theoretical aspects of Quantum Computing
  - Proving that a quantum computer can out-perform a classical computer
  - Using interactive protocols to formally verify that a quantum computer is really "quantum“
  - Quantum algorithms for NISQ (Noisy Intermediate-Scale Quantum) Computers
- See how the theory, math and algorithms move to the real world
  - Describe the fundamental physical realm of Quantum Computing
  - Get introduced to the experimental apparatus used to build a Quantum Computer
  - Review some preliminary data sets / results from initial real live tests
  - Learn about Workforce Development opportunities to support the NQI
- Future works - Q&A

NPI NATIONAL PHOTONICS INITIATIVE

Last Congress, legislation establishing the NQI was approved with overwhelming bipartisan support and signed into law in December 2018.

The NQI will help bridge significant workforce gaps in the United States that exist between the leading quantum researchers and industrial product developers and catalyzing a new sector in the science, technology, engineering and math (STEM) workforce.

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NPI NATIONAL PHOTONICS INITIATIVE

IMPLEMENTATION OF NATIONAL QUANTUM INITIATIVE CRITICAL TO LONG-TERM SECURITY AND COMPETITIVENESS OF U.S.

The NQI establishes a framework that will:

- Engage and produce a world-leading industrial **quantum technology workforce**;
- Engineer, industrialize and automate quantum technology, including quantum computers, communications systems and sensors;
- Provide access to emerging quantum computer and communications systems;
- Develop conventional technology and intellectual property needed to support and enable quantum technology.

QUANTUM RESEARCH INVESTMENTS NEEDED FOR FY ‘20

The NPI recommends the following funding levels for Fiscal Year ’20:

- NIST: $80 million for QIS research and activities
- NSF: $85 million for QIS research and $10 million per center for 5 NSF Quantum Centers
- DOE: $120 million Quantum Research and $20 million per Center for 5 DOE Quantum Centers

QUANTUM TECHNOLOGY AND APPLICATIONS

Quantum information science (QIS) holds great potential to revolutionize many sectors of the economy including:

1. Healthcare
2. Financial Services
3. Transportation
4. Manufacturing
5. Weather Prediction

Each of these sectors can be advanced by:

A. **Increased Efficiency Logistics**
B. **Development of New Innovative Materials**
C. **Secure Communications**

Increased Efficiency Logistics

Rapidly sort through data sets that are too large to be stored on conventional devices, such as real-time video of the entire surface of the earth.

Potential uses for this technology include

1. autonomous vehicle navigation
2. weather prediction
3. machine learning
4. economic market analysis
5. code-breaking
6. logistics for energy and transportation systems.

Development of New Innovative Materials

Simulate the behavior of complex molecules and materials beyond the reach of conventional computers.

This technology could yield the discovery of new :

1. **substances with exotic electrical/mechanical properties**
2. **designer molecules for efficient drug activity**
3. **efficient materials for the conversion of energy between light and electricity.**

Secure Communications

All financial transactions conducted over the internet (paying bills, using ATMs, stock market buy/sell) require secure communications.

Quantum communication can improve the robustness of these secure communications.

Dr. Sandy Irani, UC Irvine

received her PhD from UC Berkeley in 1991 after which she was a University of California President's Postdoctoral Fellow at UCSD. She joined the faculty of UC Irvine in 1992 where she is currently a full professor. Much of her research has focused on **algorithm design** and analysis with an emphasis on applications to computing systems. In the last few years she has been working in **Quantum Computation and Quantum Information Science.**

Dr. Jonathan L. Habif, USC

is an **experimental physicist and research lead** at the University of Southern California information Sciences Institute (ISI). His research has focused on photon-starved, classical communication and imaging, quantum-secured optical communications in free-space and fiber, and integrated nano-photonic for both classical and non-classical applications. Prior to joining ISI, Dr. Habif was with BBN technologies where he served as principal investigator for a number of DARPA-sponsored research programs, partnering with university collaborators to demonstrate revolutionary optical technologies impacting traditional communications, sensing and computation systems.