Quantum Information Science Trends and Opportunities

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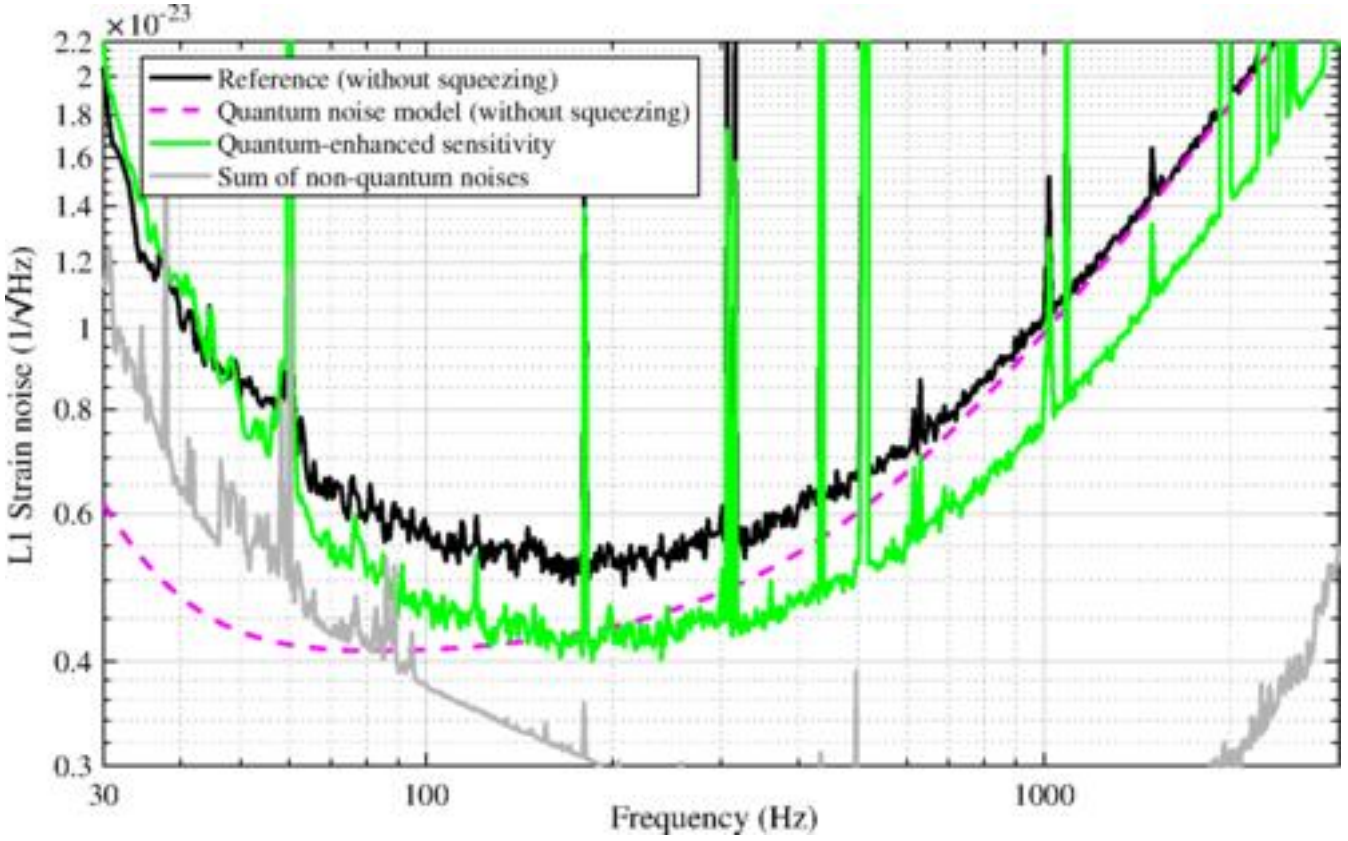
Quantum Information Science Trends and Opportunities

- Ultrasensitive measurements
- Revolutionary approaches to computing
- New materials, tools, and applications
- Cooperation and collaboration opportunities

Squeezed Light Improves LIGO



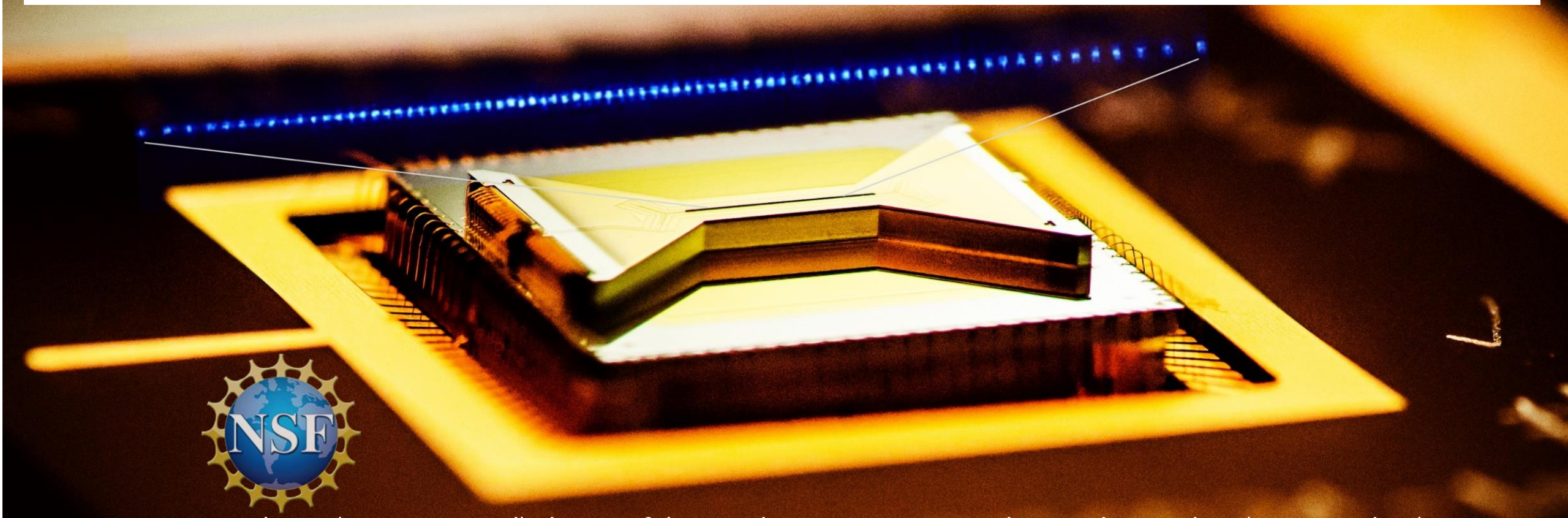
Quantum-Enhanced Advanced LIGO Detectors in the Era of Gravitational-Wave Astronomy, M. Tse et al., *Phys. Rev. Lett.* 123, 231107, December 5, 2019

Collaboration on Gravitational Wave Detection

Reproduced from OSA workshop presentation by Kasevich

Software-Tailored Architecture for Quantum co-design (STAQ)

NSF Award 1818914 for a Practical Fully-Connected Quantum Computer

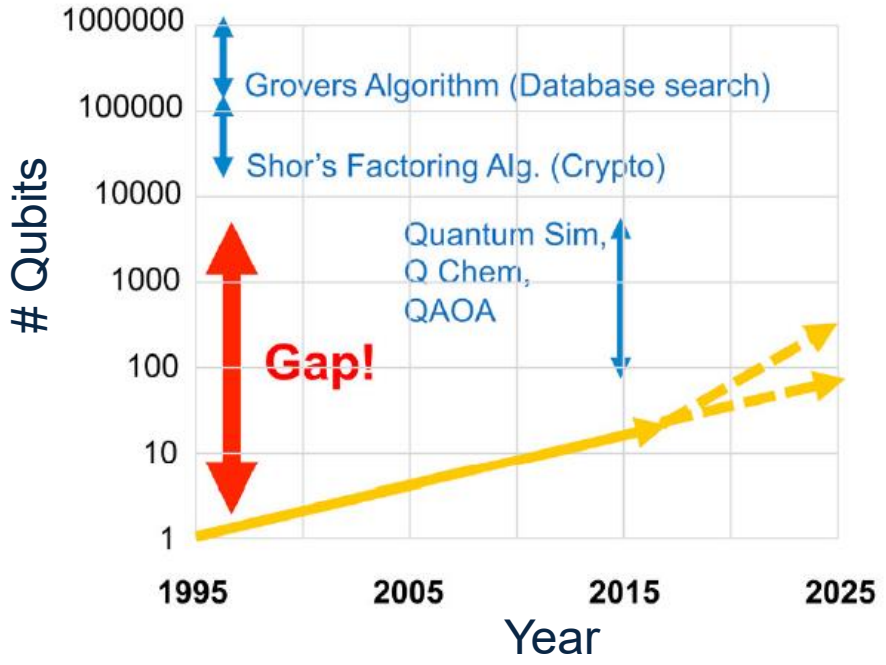


Trapped ions (superimposed) above a fabricated trap to capture and control ion qubits (quantum bits).
Image Credit: *K. Hudek, Ion Q & E. Edwards, JQI*

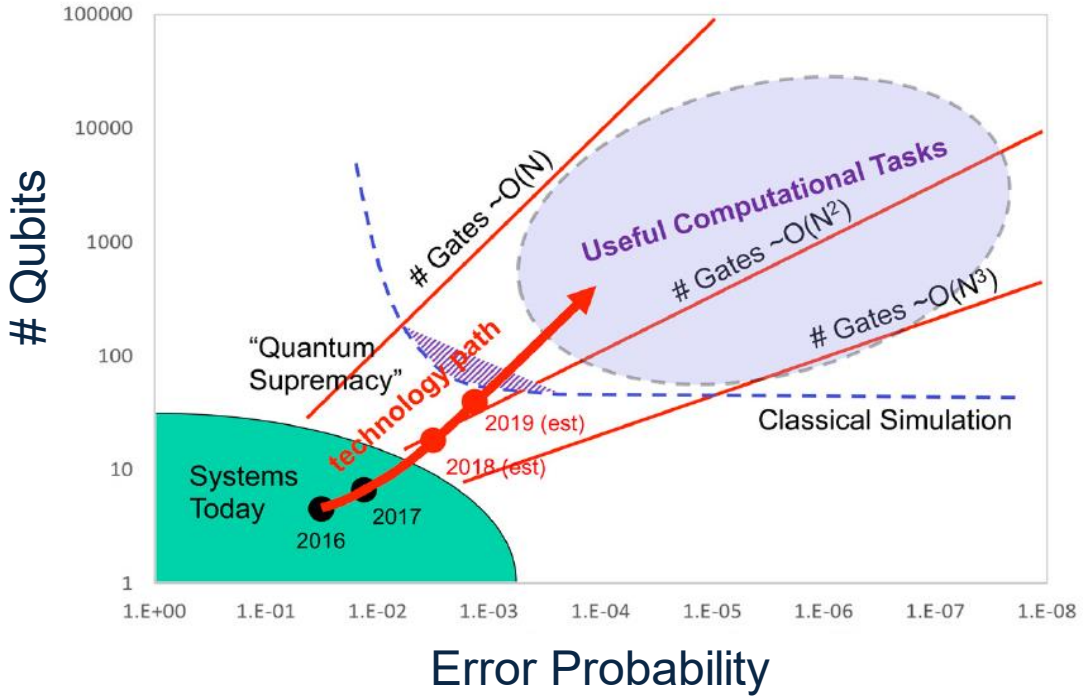
Brings together physicists, computer scientists, and engineers to construct a quantum computer capable of showing an advantage over current computer technology.

Fundamental Science Challenges

Algorithms to Machines Gap



Applications for NISQ Systems

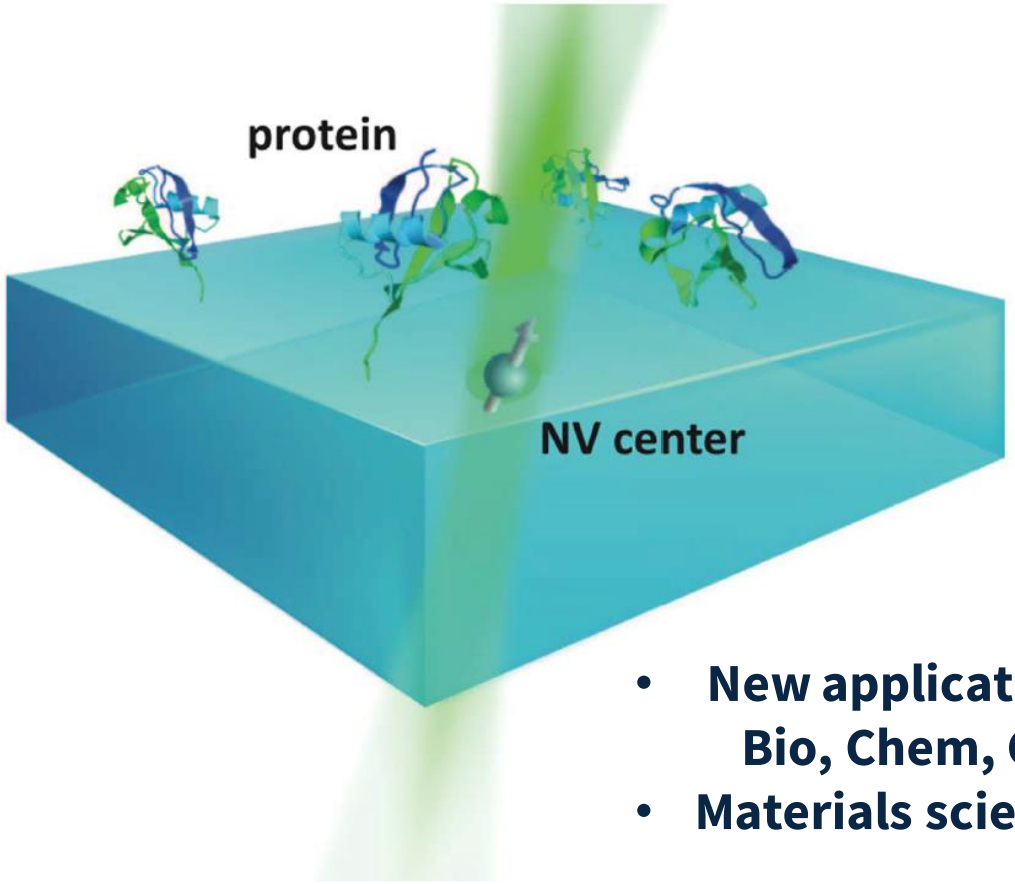


Perspectives from CCC '18 workshop:

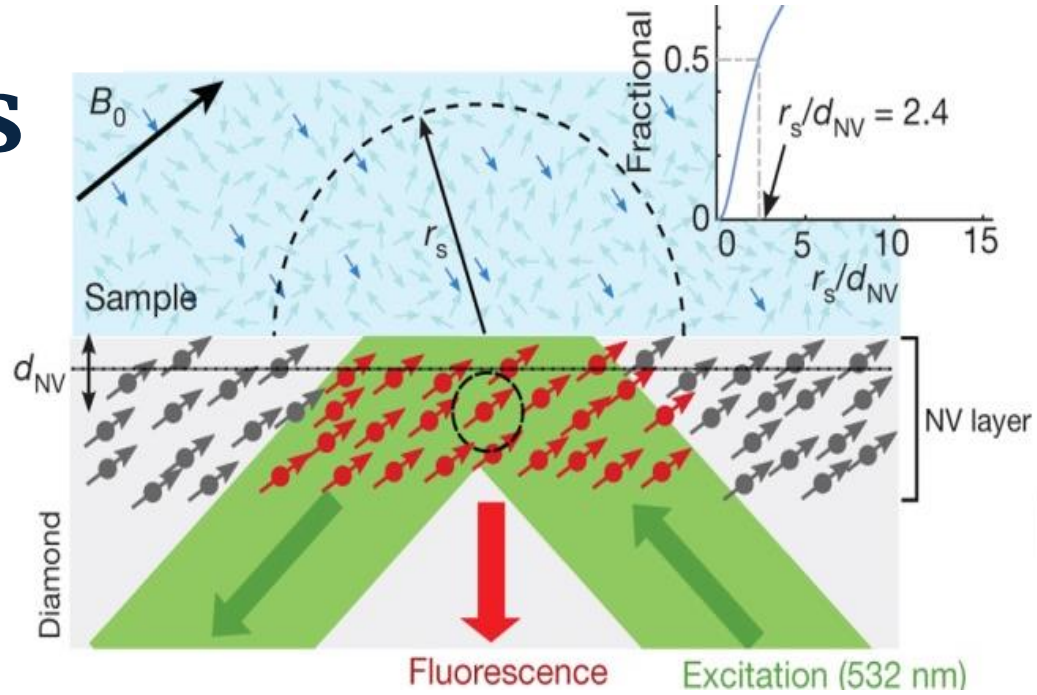
2018 Computing Community Consortium

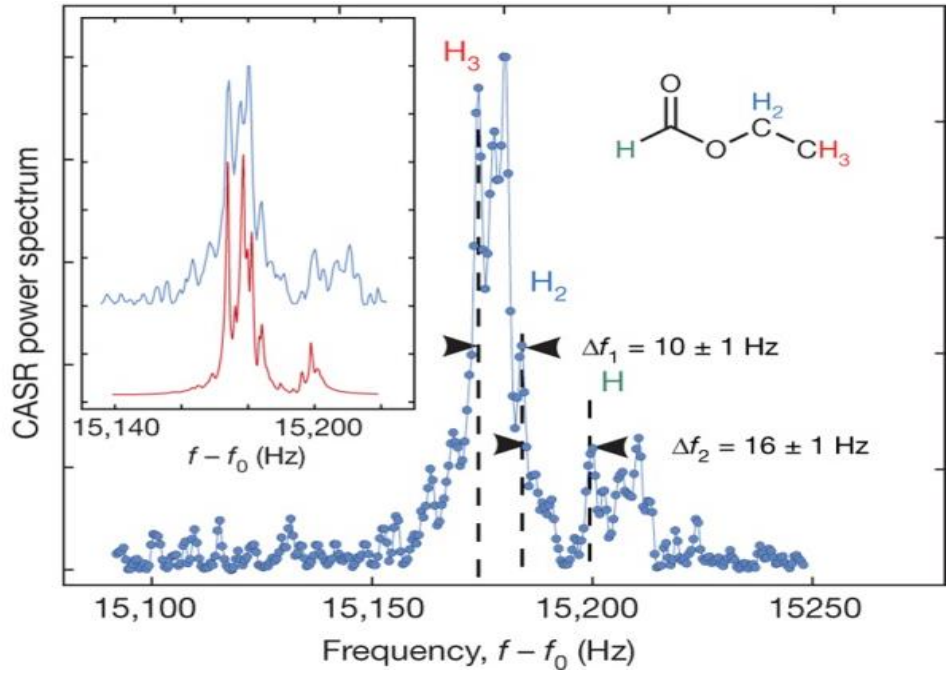
- **New algorithms**
- **Better qubits**
- **Quantum engineering, software, abstraction**
- **Computation beyond classical capabilities**
- **Verification & validation**
- **Fault tolerance & Quantum error correction**

Fundamentally New Sensors



- **New applications in:**
  Bio, Chem, Geo, Phy
- **Materials science Issues**

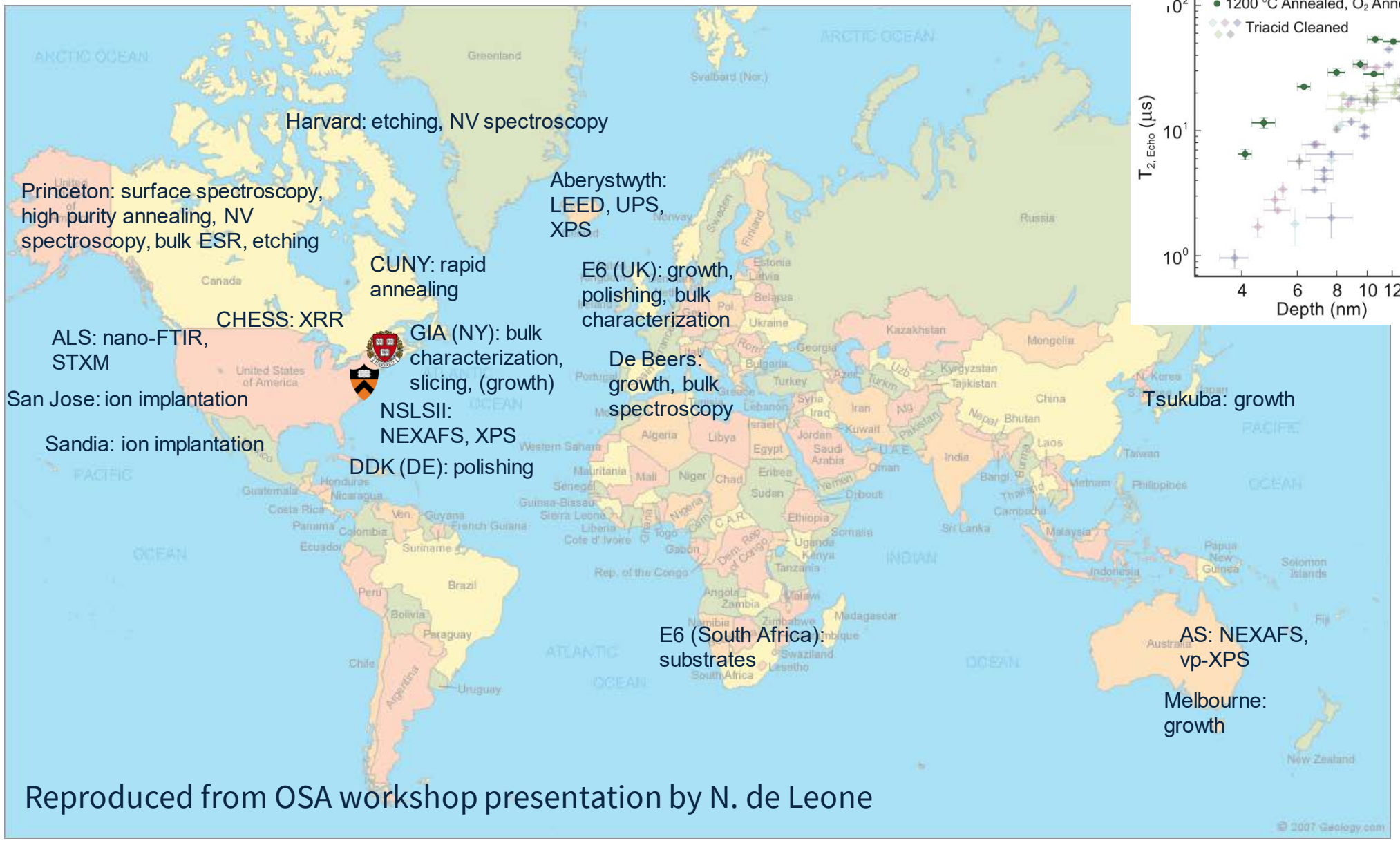


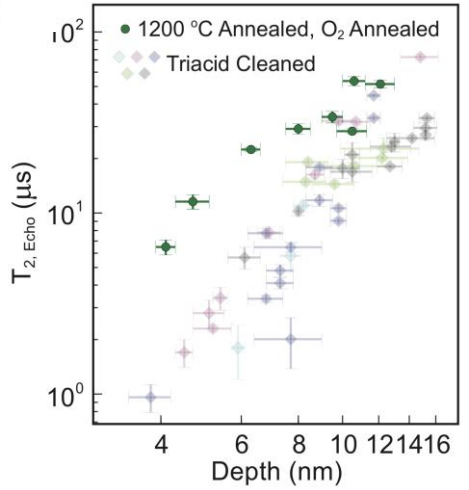


nature

D R Glenn *et al. Nature* **555**, 351–354 (2018)
doi:10.1038/nature25781

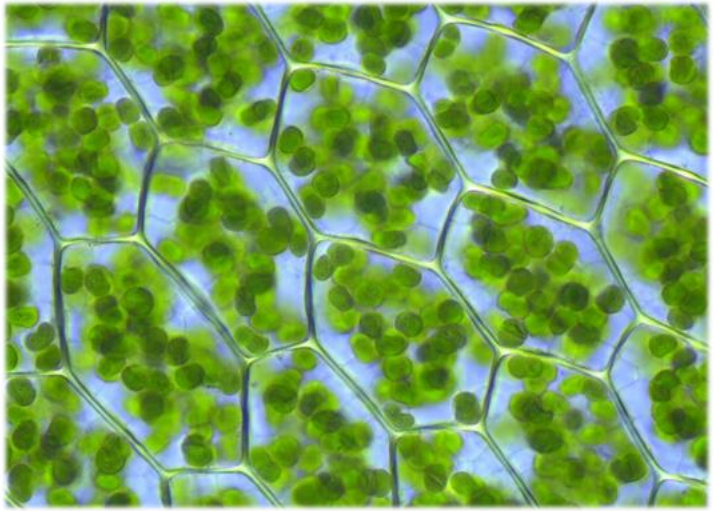
Example of Global Collaboration: NV centers

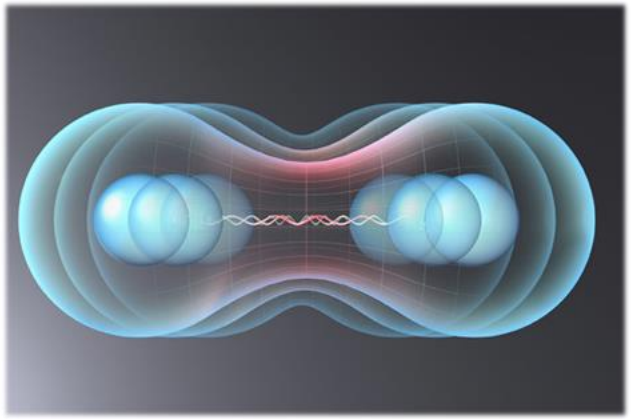


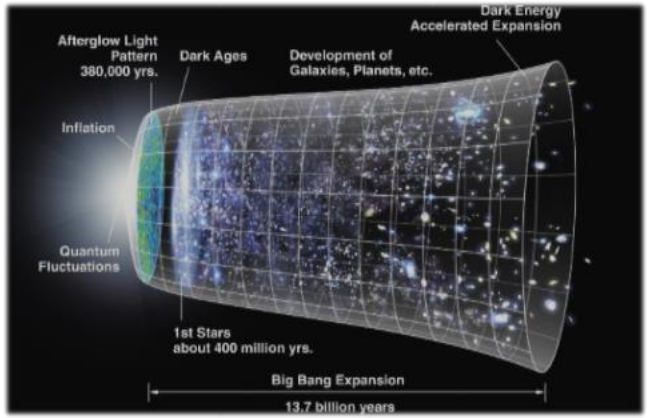


Fundamental Science Challenges

Are there fundamental limits for **coherence and entanglement**?

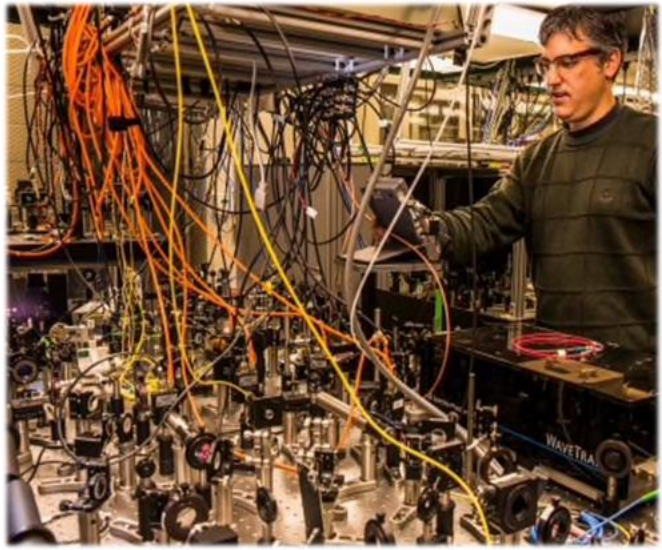






What can we learn from **naturally-occurring** and **engineered** quantum systems?

How do we galvanize the science and engineering **community** to enable quantum technologies that **surpass classical** capabilities?



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