Quantum For Environment Launch Event

Brainstorm session

June 6, 2023

TQT Transformative Quantum Technologies

Climate Change

- Modeling
- Methane Release (tundra permafrost degradation, clathrates, industrial)
- Greenhouse gases
- Aerosols: composition, albedo, size, including vertical coverage plus global distribution
- Weather prediction for planning how to take care of crops
- Quantum Simulation of materials, greenhouse gases, and aerosols, and how they can be reduced from the environment
- CO2 conversion, improve efficiency & selectivity

Earth Imaging/Explorations

- Satellite/ drone
- Quantum LiDAR: portable semiconductor metasurface quantum sensor
- Quantum Gravimeters
- Increased pixel resolution
- Quantum systems for more precise satellite sensing/imaging systems

Water

- Health of aquatic species
- Sensing under/through ice
- Nanoprobes for sensing
- Feature identification in numerical data
- Magnetic field sensors for environmental RNAs of immune genes from different fish Species
- Sensing aquifer levels to prevent overuse
- Photocatalyst degrade micro-plastic particles in the water
- Water treatment via super radiant emission

Oceans

- O2, T, pH, salinity of currents, pressure
- Currents, turbidity
- Phytoplankton
- Coastal erosion
- Better Beer-Lambert Law for small scale modelling
- Free-space structured light sensors
- Navigational sensors to map out ocean currents

Human Health Impacted by Changing Environment

- Vulnerable communities
- Accurate, light, cheap personal or indoor monitors for aerosol exposure
- Desertification monitoring(?)
- New tech that combines EEG (high temporal) and FMRI (high spatial) to monitor brain activity and health as impacted by environmental changes.

Energy

- Energy transport and transduction
- Energy-efficient materials
- Optimization for power grids
- Water splitting: plasmonic induced combined with 2D materials, e.g.,
- Mos2, conversion of solar energy into H2 bonds.
- Plasmonic-mediated CO2 reduction
- Related to cyber-physical systems, smart homes- specifically measuring /controlling/modelling light sensors. Theory, verification, etc. has been done, but building these and integrating systems still needs to be done.
- Q3: Develop more efficient energy storage- batteries
- Using super radiance (fast charging) and sub radiance (long storage times)
- Quantum technologies for more efficient classical computers:
- Energy monitoring WSC’s
    - Reversible gates/ reversible architectures
    - Adiabatic memory systems
    - Fuel cell, Qds improve efficiency of H2 to H2O
    - Space weather monitoring for the electricity grid.

Natural Resources

- Tree/plant health
- Bio-photons
- Natural resource exploration
- Sensor drone to monitor temperature to detect forest fire. Quantum can improve drone efficiency and sensor range

Agriculture

- Photosynthetically active radiation
- Quantum Gravimeters for soil density
    - Water reservoirs
- Detection of N2 and phosphorus in soil, optimized fertilizer use.
- Quantum monitoring AQI after stubble burning

Pollutants

- Microplastics
- Forever chemicals
- Neonic monitoring (for bees)
- Aerosols (see climate change)
- Mercury, methane, and carbon sensors
- Metasurface based gas sensors

Data security

- Secure reporting
- Secure aggregation of data
- "Blind quantum computation”
- Using quantum to verify data (containing information all over the world)

Finance

- Credit trading
- Financial institutes are moving towards using blockchain technology. Tracking transactions on ledgers, and other computations have a lot of computational cost and power expenditure.
- Ideas from “quantum money” might be relevant

Other

- Analysis of Big data
- Faster & more accurate numerical) solutions to differential equations
- Using random fluctuations to prevent overfitting in training a deep learning network
- Microfluid filters for faster/easier purification of RNA from biological samples
- Quantum Calculator for solving a very specific problem
- More effective data storage using spintronics
- Direct quantification of RNA – not by PCR!
- People are super excited about “quantum” at the moment. Can this excitement be leveraged to make people get more excited about environmental issues
- Optimal routing problem with RAAQS
- Quantum analysis for anthropologists.

    - They, for example, like to study the environment (such as preservation of things in bags, burning crops for agriculture, glass residue to imply migration, etc.) to understand people