Opportunity Title: Solid-State Qubits in Extreme Environments
Opportunity Reference Code: ICPD-2022-33

Organization	Office of the Director of National Intelligence (ODNI)
Reference Code	ICPD-2022-33

How to Apply

Create and release your Profile on Zintellect – Postdoctoral applicants must create an account and complete a profile in the on-line application system. **Please note: your resume/CV may not exceed 2 pages.**

Complete your application – Enter the rest of the information required for the IC Postdoc Program Research Opportunity. The application itself contains detailed instructions for each one of these components: availability, citizenship, transcripts, dissertation abstract, publication and presentation plan, and information about your Research Advisor co-applicant.

Additional information about the IC Postdoctoral Research Fellowship Program is available on the program website located at: https://orise.orau.gov/icpostdoc/index.html.

If you have questions, send an email to ICPostdoc@orau.org. Please include the reference code for this opportunity in your email.

Application Deadline 2/28/2022 6:00:00 PM Eastern Time Zone

Description

Research Topic Description, including Problem Statement:

Qubits based on superconducting circuits and spins in semiconducting quantum dots typically require operation at mK temperatures and in a pristinely filtered and shielded environment. Furthermore, variations in measurement setup often results in varying results from lab to lab, even with nominally identical devices. Operation in more extreme environments could enable lower complexity and lower cost cryogenic setups; operation in large magnetic fields for novel research directions or less sensitivity to precise details of the experimental setup.

This topic aims to develop schemes for operation of superconducting and/or spin-based gate-defined quantum dots in extreme environments:

1. At cryogenic temperatures above 300mK; thus avoiding the requirement of dilution refrigeration technology
2. In large magnetic fields to enable novel research directions
3. In poorly filtered and shielded environments to enable consistent operation in different laboratories, test setups and global environments

Example Approaches:

Examples of work for operation in extreme environments:

1. Development of active cooling procedures to enable high fidelity state preparation at elevated temperatures. Such procedures could be analogous to laser cooling techniques used in the atomic community. This work may also require design and optimization of the qubit energy-level structure to enable such techniques.
2. Novel material exploration compatible with operation in high magnetic field and/or high temperature operation. This work may also involve novel component development e.g. high temperature Josephson Junctions
3. Engineering of the qubit environment. For example: modification of the qubit substrate to enhance isolation; enhanced thermalization of components such as qubit chip and I/O; novel filtering schemes both on-chip and in the I/O; and autonomous pumping schemes to remove excess excitations without user intervention
4. Demonstration of state-of-the-art qubit control and readout fidelities in an extreme environment
5. Qubit circuit and chip design to reduce sensitivity to environmental perturbations e.g. IR radiation, high-energy impacts. Alternatively, on-chip sensors to detect a disruptive event and/or to minimize

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environmental perturbations

Relevance to the Intelligence Community:

Leading solid-state quantum computing approaches require operation in cold and highly controlled environments. Best practices for maintaining such environments have been built-up over time, but vary from laboratory to laboratory and qubit-to-qubit. Developing techniques, designs and methods to reduce reliance on these practices would enable broader adoption and more consistent experimental results.

Key Words: Quantum Computing, Qubits, Temperature, Magnetic Field, Radiation

Qualifications

Postdoc Eligibility

- U.S. citizens only
- Ph.D. in a relevant field must be completed before beginning the appointment and within five years of the application deadline
- Proposal must be associated with an accredited U.S. university, college, or U.S. government laboratory
- Eligible candidates may only receive one award from the IC Postdoctoral Research Fellowship Program

Research Advisor Eligibility

- Must be an employee of an accredited U.S. university, college or U.S. government laboratory
- Are not required to be U.S. citizens

Eligibility Requirements

- **Citizenship:** U.S. Citizen Only
- **Degree:** Doctoral Degree.
- **Discipline(s):**
  - **Communications and Graphics Design** (2 👁)
  - **Computer, Information, and Data Sciences** (16 👁)
  - **Earth and Geosciences** (21 👁)
  - **Engineering** (27 👁)
  - **Environmental and Marine Sciences** (14 👁)
  - **Life Health and Medical Sciences** (46 👁)
  - **Mathematics and Statistics** (10 👁)
  - **Other Non-S&E** (2 👁)
  - **Other Physical Sciences** (12 👁)
  - **Other S&E-Related** (1 👁)
  - **Physics** (16 👁)
  - **Social and Behavioral Sciences** (27 👁)