Opportunity Title: Modular Quantum Computing
Opportunity Reference Code: ICPD-2023-17

Organization Office of the Director of National Intelligence (ODNI)

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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 3/2/2023 3:00:00 PM Eastern Time Zone

Description **Research Topic Description, including Problem Statement:**

Today's state-of-the-art quantum computers are typically built using a single chip or quantum module. This approach has been successful in reaching on the order of 100 qubits, but going forward, it will be challenging to continue to increase the number of qubits on a single chip due to frequency collisions, signal routing, and crosstalk. One approach to scaling to larger quantum processors is to connect several individual modules together to create a larger, distributed quantum computer. In order for this approach to work, the operations between modules must be fast and high fidelity. This call aims to increase the fidelity and speed of module-to-module interactions to be on par with those within a single module by focusing on high speed and high fidelity two qubit gates for superconducting, spin, trapped ion, or atomic qubits. Projects should focus on novel schemes for realizing remote two qubit gates and culminate in a proof-of-concept demonstration on a small-scale device.

Example Approaches:

1. Waveguide coupling
2. Resonant microwave photon coupling
3. Phonon-mediated coupling
4. Spin shuttling
5. Transduction to flying qubits via mechanical resonators, atomic elements, electro-optics, etc.
6. Entanglement generation via specialized communication qubit

Relevance to the Intelligence Community (IC):

As the quantum computing community seeks to increase the number of qubits and operate larger quantum processors, there are several challenges to building larger devices. As the number of qubits increase, the

probabilities of an on-chip defect, qubit frequency collisions, and crosstalk will increase, which will lead to a lower chip yield and potentially slow progress toward realizing large scale devices. Distributed or modular quantum architectures seek to overcome these challenges by using small, reproducible, high-fidelity nodes that are linked together to create a larger distributed quantum computer. This call aims to increase the fidelity and speed of module-to-module interactions to be on par with those within a single module by focusing on high speed and high fidelity 2 qubit gates. This directly aligns with “computing” category of the identified IC wide S&T needs.

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

Key Words: #Quantum Computing, #Qubits, #Multi-Qubit Devices, #Modular, #Superconducting Qubits, #Spin Qubits, #Trapped Ions

Eligibility Requirements

- **Citizenship:** U.S. Citizen Only
- **Degree:** Doctoral Degree.
- **Discipline(s):**
  - **Chemistry and Materials Sciences** (12 👁)
  - **Communications and Graphics Design** (5 👁)
  - **Computer, Information, and Data Sciences** (17 👁)
  - **Earth and Geosciences** (21 👁)
  - **Engineering** (27 👁)
  - **Environmental and Marine Sciences** (14 👁)
  - **Life Health and Medical Sciences** (48 👁)
  - **Mathematics and Statistics** (11 👁)
  - **Other Non-Science & Engineering** (2 👁)
  - **Physics** (16 👁)
  - **Science & Engineering-related** (1 👁)
  - **Social and Behavioral Sciences** (29 👁)