

Opportunity Title: Emerging Application for Superconducting Electronics

Opportunity Reference Code: ICPD-2023-20

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 2/28/2023 6:00:00 PM Eastern Time Zone

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

With the end of Dennard scaling and now Moore's law, future advances in computing will increasingly come from novel approaches to microelectronics. Superconducting electronics (SCE) offers the possibility of energy-efficient computing and/or high clock speeds, bypassing the power dissipation and signal distribution limitations of high-density chips. However, present-day SCE have low circuit densities, especially for memory, making the implementation of conventional CPU architectures in SCE difficult.

This topic aims to identify emerging computing problems that can utilize the unique advantages of SCE and for which the lack of dense superconducting memory is not a fundamental impediment.

Example Approaches:

1. Superconducting hardware accelerators: customized hardware for performing specific computational tasks extremely fast and/or efficiently.
2. Design of novel processing-unit architectures that leverage low-dispersion superconducting interconnects to better utilize off-chip low-density memory, possibly utilizing chip stacking.
3. Digital signal/image processing of data streams generated by cold sensors: radar/communications receivers, transition edge sensors, superconducting analog-to-digital converters.
4. Neuromorphic and stochastic computing implemented with superconducting technology.
5. Novel interfaces between SCE and cold CMOS to enable the use of dense CMOS memory in SCE architectures.


Relevance to the Intelligence Community (IC):


Over the last several decades, maintaining a competitive advantage in




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computing could be sustained by a continued miniaturization of CMOS electronics. With end of Moore's law, advances will come less and less from decreased transistor size and more from (1) innovation and specialization of computing hardware, and (2) new and unconventional approaches to electronics. The work described above would identify specialized applications where SCE can excel in the short-term while continuing long-term investment in this potentially revolutionary approach to high-speed and energy-efficient computing.

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: #superconductivity, #Microelectronics, #Computer Architecture, #Digital Signal Processing, #Neuromorphic Computing.

Eligibility Requirements

- **Citizenship:** U.S. Citizen Only
- **Degree:** Doctoral Degree.
- **Discipline(s):**
 - **Chemistry and Materials Sciences** ([12](#))
 - **Communications and Graphics Design** ([6](#))
 - **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](#))