Opportunity Title: Deleterious Effects on Atoms Due to Nearby Surfaces
Opportunity Reference Code: ICPD-2023-22

Organization Office of the Director of National Intelligence (ODNI)

Reference Code ICPD-2023-22

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:**

We seek to understand the interaction between atoms and surfaces when the atoms are very close to the surface (100 nm – 100 um). The atoms can be neutral, charged, or molecules. This topic has been widely studied over many decades [1]. Atoms are often captured near surfaces to explore a pathway towards compact integrated systems where chip wires carrying currents combined with integrated photonics may offer a plethora of advantages in fields such as trapped ion quantum computing, ultra-cold neutral atom interferometry, and quantum clocks. However, at these very small atom surface distances, several problems arise. Of particular interest is solving some of the challenges encountered by trapped ion devices (e.g. anomalous heating) [2]. Such deleterious surface issues maybe caused by a combination of different effects. It is of great interest to the government to quantify such effects and work towards their minimization or elimination. A thorough study of this field shall benefit efforts aimed at improving qubit fidelity for quantum computing or making chip-based quantum sensors.

Example Approaches:

The approach to solve deleterious surface effect problem is two-fold: a view from physicists and another view from material scientists. The judicious approach should be a combination of the two perspectives and to attack this problem at a fundamental level to identify why some approaches are successful and some not. It is commonly known that for trapped-ions, cryogenically cooling the chip reduces the heating rate, hence many trapped-ion scientists are heading that way. Another method to mitigate the heating problem is ion-milling in-situ or ex-situ which is understood to eject much of the contaminants that are present on the chip. This topic encourages a materials-first approach, where a detailed characterization and understanding of microscopic material properties could lead to advances in qubit performance levels.

Opportunity Title: Deleterious Effects on Atoms Due to Nearby Surfaces
Opportunity Reference Code: ICPD-2023-22

[1] Amico, L., M. Boshier, G. Birkl, A. Minguzzi, C. Miniatura, L.-C. Kwek, D. Aghamalyan, et al. “Roadmap on Atomtronics: State of the Art and Perspective.” AVS Quantum Science 3, no. 3 (September 2021): 039201. https://doi.org/10.1116/5.0026178.

[2] Deslauriers, L., S. Olmschenk, D. Stick, W. K. Hensinger, J. Sterk, and C. Monroe. “Scaling and Suppression of Anomalous Heating in Ion Traps.” Physical Review Letters 97, no. 10 (September 8, 2006): 103007. https://doi.org/10.1103/PhysRevLett.97.103007.

Relevance to the Intelligence Community (IC):

High fidelity qubit control is required for fault-tolerant quantum computing. Often the accuracy of gate operations is limited by the materials, interfaces and defects that make-up the qubit and its surrounding environment. This topic aims to overcome and deepen the understanding of this limitation by uncovering strong correlations between quantum gates and state-of-the-art material characterization techniques.

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: #Anomalous Heating, #Electric Field Noise, #Heating Rate, #Ion Trap

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 👁)

Opportunity Title: Deleterious Effects on Atoms Due to Nearby Surfaces
Opportunity Reference Code: ICPD-2023-22

- **Science & Engineering-related** (1 👁)
- **Social and Behavioral Sciences** (29 👁)