

**Opportunity Title:** Development of Single Cooper Pair Boxes for Quantum Computing and Photo-detection

**Opportunity Reference Code:** 0044-NPP-NOV23-JPL-TechDev

**Organization** National Aeronautics and Space Administration (NASA)

**Reference Code** 0044-NPP-NOV23-JPL-TechDev

**Application Deadline** 11/1/2023 6:00:59 PM Eastern Time Zone

**Description** Our effort is focused on studying artificial two level quantum systems based on mesoscopic superconducting devices dubbed Single Cooper Pair Boxes. The main objective of the work is to develop quantum bits for quantum computation as required by our funding agency. The same devices can be used for exquisite photo-detection with spectral resolution from sub millimeter wavelengths to X-Rays. We are currently developing a dispersive readout based on the quantum capacitance of the Single Cooper Pair Boxes. This involves measuring the phase of the reflected RF carrier which is modulated by the quantum capacitance. We use frequency multiplexing to read out two SCBs at the same time and are looking for signs of entanglement between the two quantum bits. Candidates working in this area would receive broad training in microfabrication, RF and low temperature techniques, including measurements in the milliKelvin range. We will be exploring the possibility of using the SCBs to read Cooper Pairs broken by radiation in a concept for a spectral resolving broadband high sensitivity detector with frequency multiplexing capabilities. This technology could fill a needed gap in JPL's long-wavelength detector development effort by providing a detector that is both compatible with a multiplexed readout and that has enough sensitivity to be useful for medium-resolution spectroscopy from a cold space telescope, where NEP~ $2 \times 10^{-20}$  is needed. Sample publications: "Characterization of a Differential Radio-Frequency Single-Electron Transistor", J.F. Schneiderman, P. Delsing, M.D. Shaw, H.M. Bozler, and P.M. Echternach, APPLIED PHYSICS LETTERS 88 (8): Art. No. 083506 FEB 20 2006, "Free Evolution of Superposition States in a Single Cooper Pair Box", A. Guillaume, J.F. Schneiderman, P. Delsing, H.M. Bozler and P.M. Echternach, PHYSICAL REVIEW B 69 (13): Art. No. 132504 APR 2004

**Location:**

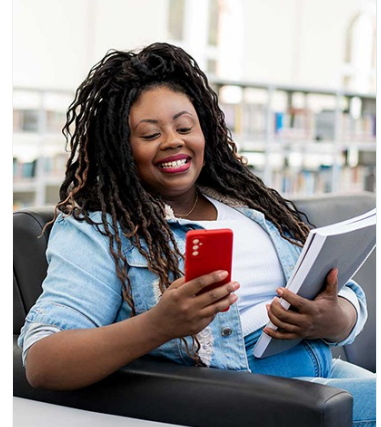
Jet Propulsion Laboratory  
Pasadena, California

**Field of Science:** Technology Development

**Advisors:**

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**Applications with citizens from Designated Countries will not be accepted at this time, unless they are Legal Permanent Residents of the United States.** A complete list of Designated Countries can be found at: <https://www.nasa.gov/oiir/export-control>.



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Eligibility is currently open to:

- U.S. Citizens;
- U.S. Lawful Permanent Residents (LPR);
- Foreign Nationals eligible for an Exchange Visitor J-1 visa status; and,
- Applicants for LPR, asylees, or refugees in the U.S. at the time of application with 1) a valid EAD card and 2) I-485 or I-589 forms in pending status

**Eligibility Requirements** • **Degree:** Doctoral Degree.