

## **PREP Research Associate**

This position is part of the National Institute of Standards (NIST) Professional Research Experience (PREP) program. NIST recognizes that its research staff may wish to collaborate with researchers at academic institutions on specific projects of mutual interest, thus requires that such institutions must be the recipient of a PREP award. The PREP program requires staff from a wide range of backgrounds to work on scientific research in many areas. Employees in this position will perform technical work that underpins the scientific research of the collaboration.

The associate will assist with designing, building, and operating the world's first optical network of superconducting quantum computers. Specifically, this project entails the design and construction of optical systems capable of generating quantum states of light, which are quantified with precision measurements and distributed as an entanglement resource. At the nodes of the network, novel microwave-optical transduction devices are operated in a cryogenic environment to establish the vital link to the superconducting quantum processors. Through a cleanroom engineering effort, the transducers will be made into reliable, telecom-ready devices. The associate will make use of and strengthen a diverse array of skills through hands-on laboratory tasks as well as design challenges, data analysis, and theoretical considerations.

The work will entail:

### **Key responsibilities may include but are not limited to:**

- Design and construct resonant nonlinear systems such as optical parametric amplifiers to generate non-classical, squeezed states of light.
- Design and construct stable opto-mechanic launch systems to efficiently couple non-classic light into and out of resonant optical cavities.
- Implement feed-back control systems to stabilize optical frequency, phase, polarization, and mechanical motion to enable coherent optical interactions and measurements.
- Perform precision homodyne tomography of squeezed optical and electrical states to quantify their suitability for network operation.
- Perform precision optical and electrical measurements of novel transducer devices in various operating modes and interpret results.
- Learn to design and fabricate telecom-ready opto-mechanical-electrical transducer devices in a semiconductor cleanroom facility.
- Operate and maintain a cryogenic dilution refrigerator capable of millikelvin temperatures.
- Provide technical input to research problems which have been recognized as critical obstacles to progress in quantum networking.
- Prepare journal manuscripts, attend research conferences, and present technical results.
- Work as a member of a collaborative, interdisciplinary team.

### **Qualifications**

- Bachelor or doctorate degree in a field of science, technology, engineering, or mathematics.
- Background knowledge of quantum physics and quantum information theory.
- Experience with ultra-stable lasers, entangled light sources, filter cavities, phase-locked loops, balanced detection, low-noise receiver design, polarization optics, and optical modulators.

- Experience with optical measurement techniques such as: coherent detection, quantum tomography, beam diagnostics, laser diagnostics, noise characterization, and statistical optics.
- Experience with semiconductor clean room fabrication methods and tools would be useful.
- Knowledge of cryogenics and dilution refrigerator operating principles is advantageous.
- Experience with classical optical communications, fiber optics, and timing synchronization is very desirable.
- Ability to code with, or learn to code with MATLAB, LabView, and Python is required.
- Familiarity with optical system design software (e.g. Zemax, Code V, OSLO) is advantageous.
- Experience with electrical circuit design, soldering, and debugging is required.
- Familiarity with opto-mechanic design, computer-aided design, and machine shop skills is desirable.
- Familiarity with building materials, hardware, and basic construction and assembly methods.
- Comfortable working with hands doing manual tasks.
- Strong oral and written communication skills.

### **Privacy Act Statement**

**Authority:** 15 U.S.C. § 278g-1(e)(1) and (e)(3) and 15 U.S.C. § 272(b) and (c)

**Purpose:** The National Institute for Standards and Technology (NIST) hosts the [Professional Research Experience Program \(PREP\)](#) which is designed to provide valuable laboratory experience and financial assistance to undergraduates, post-bachelor's degree holders, graduate students, master's degree holders, postdocs, and faculty.

PREP is a 5-year cooperative agreement between NIST laboratories and participating PREP Universities to establish a collaborative research relationship between NIST and U.S. institutions of higher education in the following disciplines including (but may not be limited to) biochemistry, biological sciences, chemistry, computer science, engineering, electronics, materials science, mathematics, nanoscale science, neutron science, physical science, physics, and statistics. This collection of information is needed to facilitate administrative functions of the PREP Program.

**Routine Uses:** NIST will use the information collected to perform the requisite reviews of the applications to determine eligibility, and to meet programmatic requirements. Disclosure of this information is also subject to all the published routine uses as identified in the Privacy Act System of Records Notices: NIST-1: NIST Associates.

**Disclosure:** Furnishing this information is voluntary. When you submit the form, you are indicating your voluntary consent for NIST to use of the information you submit for the purpose stated.