

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.

Research Title:

Postdoctoral researcher / Precision measurement of thermophysical quantities

The work will entail:

NIST seeks a postdoctoral researcher with an interest in the precision measurement of thermophysical quantities. Example quantities of interest include thermodynamic temperature, pressure, refractive index, thermal expansion, density virial coefficients, magnetic susceptibility. A unifying principle of the work is that all measurements are based on precision optical interferometry.

For example, one branch of interest is to develop a cryogenic gas thermometer. The working principle is refractive index gas thermometry, using a Fabry-Perot cavity resonator filled with helium gas; temperature is derived from the ideal gas law. The system targets a temperature range of 4 K to 303 K, with current art performance realizing the SI unit kelvin.

Another branch of interest is the development of an accurate, air-based dilatometer to measure the thermal expansion coefficient of materials important to dimensional metrology. The working principle is displacement interferometry with a linear slide translation stage. The system targets accuracy of about $3 \times 10^{-8} / K$ on the thermal expansion coefficient in the temperature range 283 K to 313 K.

A third branch of interest is to measure the magnetic susceptibility of gases important to thermodynamic metrology. The working principle is a “Faraday balance”, which consists of balancing a suspended dumbbell in a magnetic field; as the volume around the dumbbell is filled with the test (diamagnetic) gas, the dumbbell will rotate, and the magnetic susceptibility is proportional to the rotation. The undertaking aims to resolve large disagreements between historic measurement and recent ab initio calculation of the magnetic susceptibility of helium, neon, argon, and nitrogen.

Key responsibilities will include but are not limited to:

- Conduct research and development into precision interferometry, and its application to the measurement of thermophysical quantities
- Instrumentation of apparatus, including optical, electrical, mechanical, and control automation
- Instrument control, data acquisition and curation, and final analysis all performed in python
- Publishing results of research to relevant journals and presentation at conferences

U.S. Citizen Preferred

Qualifications

- PhD in Physics, Chemistry, or Chemical or Electrical Engineering
- Experience with optics, laser control and feedback electronics, and temperature and pressure measurements
- Experience with frequency metrology (optical and rf)
- Familiarity with measurement uncertainty and error analysis
- Ability to work with the python programming language.

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.