Opportunity Title: Quantum Solid State Magnetometers and other Quantum Sensors (Silicon Carbide, NV Diamond)
Opportunity Reference Code: 0286-NPP-JUL24-JPL-TechDev

Organization National Aeronautics and Space Administration (NASA)

Reference Code 0286-NPP-JUL24-JPL-TechDev

How to Apply All applications must be submitted in Zintellect

Application Deadline 7/1/2024 6:00:59 PM Eastern Time Zone

Description **Description:**

Magnetometry plays a crucial role in a wide range of remote sensing applications. On Earth, it aids in GPS-denied navigation, geological surveying, and submarine detection. In space, it contributes to planetary science, Earth science, and Heliophysics. For space missions, magnetometers are positioned on a spacecraft boom to minimize interference with other instruments' magnetic noise. To ameliorate the formulation and implementation cost associated with spacecraft booms, an appealing alternative approach is the placement of numerous small sensors to perform gradiometry, map and cancel self-induced magnetic noise. To achieve this, new sensors with extremely low SWaP (size, weight, and power) and the ability to measure magnetic fields with absolute accuracy are required.

A promising category of magnetometers is based on optically detected magnetic resonance (ODMR) or electrically detected magnetic resonance (EDMR), utilizing the spin properties of quantum centers/defects in large band gap materials like diamond, silicon carbide (SiC), or hexagonal boron nitride. In terms of sensitivity, NV centers in diamond stand out. However, to reach this level of performance, a magnetic bias field is usually required to decouple the energy levels corresponding to the defect's different orientations. A simpler configuration is offered by the silicon vacancy in SiC, which possesses only one orientation. This makes magnetometry at zero field achievable, a favorable feature for spacecraft applications.

The OPuS-MAGNM project is looking for a postdoc to join our group in support of NASA's quantum sensing effort. OPuS-MAGNM strives to be an integrated magnetometer system, use spin/magnetic sensitive quantum centers in wide-bandgap semiconductors such as diamond, silicon carbide or hexagonal boron nitride. We're striking out to build the next heritage spaceflight magnetometer! Responsibilities will include:

Mature the existing optically pumped benchtop magnetometer system, integrating opticcs-on-a-chip solution

Author peer-review publications about scientific and technological progress

Other responsibilities will include support collaborating with the science community to architect missions, leveraging the advantages of solid state quantum magnetometers, mentorship of graduate student employees and/or summer students. Active participation in opportunities offered by JPL for continuing education, such as trainings, lunchtime talks and social events, is also desirable.

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Relevant papers:

A. Gottscholl, C.J. Cochrane, H. Kraus, Operation Modes of an Optically Pumped 6H┐SiC Quantum/Solid State Magnetometer, IEEE Sensors (2024), doi:10.1109/JSEN.2024.3391191

Cochrane, C., Blacksberg, J., Anders, M. et al. Vectorized magnetometer for space applications using electrical readout of atomic scale defects in silicon carbide. Sci Rep 6, 37077 (2016). https://doi.org/10.1038/srep37077

Field of Science:

- Technology Development

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Applications from 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.

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

Qualifications We are looking for a motivated individual, a self-starter who thrives in a multidisciplinary team. JPL offers a huge bandwidth of science and technology, a future colleague who loves to look beyond their immediate field will find a multitude of opportunities here.

PhD in physics or a related discipline, with emphasis on experimental optics, magnetic resonance, and/or integrated photonic devices

Experience operating VIS/NIR laser excitation and detection systems, experience with confocal microscopy is a plus

Experience operating/customizing electron paramagnetic spectrometers, with experience in ODMR (optically detected magnetic resonance) and EDMR (electrically detected mag- netic resonance) is a plus.

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Experience with wide-bandgap semiconductor materials and their crystal defects, i.e. silicon carbide, diamond NV-centers

A record of relevant peer-reviewed publications and presentations at major international scientific meetings and conferences

Experience in programming in a science context (e.g. LabView, Matlab, Python, Arduino), and data analysis and visualization (e.g. Origin, IgorPro)

Eligibility Requirements

- **Degree:** Doctoral Degree.