

Opportunity Title: Miniaturized Quantum Light Sources: Robust PIC-Based Entanglement Generation for Space Applications

Opportunity Reference Code: 0338-NPP-NOV26-JPL-TechDev

Organization National Aeronautics and Space Administration (NASA)

Reference Code 0338-NPP-NOV26-JPL-TechDev

How to Apply All applications must be submitted in [Zintellect](#)

Please visit the NASA Postdoctoral Program website for application instructions and requirements: [How to Apply | NASA Postdoctoral Program \(orau.org\)](#).

A complete application to the NASA Postdoctoral Program includes:

1. Research proposal
2. Three letters of recommendation
3. Official doctoral transcript documents

Application Deadline 11/1/2026 6:00:59 PM Eastern Time Zone

Description About the [NASA Postdoctoral Program](#)

The [NASA Postdoctoral Program \(NPP\)](#) offers unique research opportunities to highly-talented scientists to engage in ongoing NASA research projects at a NASA Center, NASA Headquarters, or at a NASA-affiliated research institute. These one- to three-year fellowships are competitive and are designed to advance NASA's missions in space science, Earth science, aeronautics, space operations, exploration systems, and astrobiology.

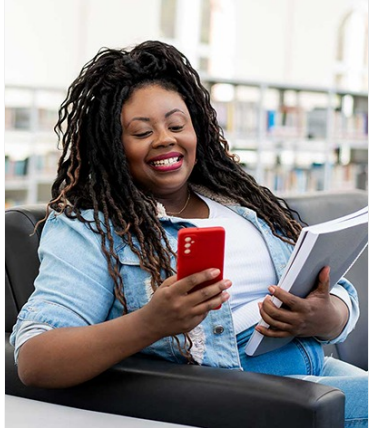
Description:

Future NASA missions ranging from deep-space navigation to high-precision gravitational wave detection will increasingly rely on quantum-enhanced technologies. However, the current state-of-the-art for generating entangled photons involves bulky, alignment-sensitive bulk-optic assemblies. These systems are ill-suited for the rigorous vibration, thermal cycling, and radiation environments of space flight. To bridge the gap between laboratory-grade quantum optics and flight-ready hardware, there is an urgent need for **Photonic Integrated Circuit (PIC)** platforms that can generate high-fidelity entanglement on a robust, chip-scale architecture.

2. Background and Relevance to NASA

This research directly supports NASA's mission to develop disruptive technologies for the **Integrated Network (IN)** and **Quantum Sensing** initiatives. By shifting entanglement generation to an integrated nonlinear platform, we can achieve unprecedented levels of stability and scalability. This technology is a critical enabler for:

- **Space-to-Ground Quantum Networks:** Providing the "quantum backbone" for secure data transmission.
- **Quantum-Enhanced Sensing:** Enabling sub-shot-noise interferometry



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and high-resolution imaging for Earth science and planetary exploration.

- **Fundamental Physics:** Facilitating long-baseline Bell tests and relativistic quantum experiments in microgravity environments.

3. General Methodology

The postdoctoral researcher will focus on the design, fabrication oversight, and characterization of high-performance integrated quantum sources. The research plan includes:

- **Resonant and Non-Resonant Design:** Optimizing waveguide geometries and micro-resonator architectures to enhance nonlinear optical conversion efficiency (e.g., via SPDC or SFWM) while maintaining high spectral purity.
- **Dispersion Engineering:** Tailoring the phase-matching conditions to generate entanglement across various degrees of freedom (polarization, time-energy, or frequency).
- **Robustness Characterization:** Evaluating the source performance under environmental constraints relevant to NASA, including power-efficiency metrics and thermal stability of the chip-to-fiber interfaces.
- **System-Level Validation:** Performing quantum state tomography and coincidence measurements to verify entanglement fidelity against mission-specific benchmarks.

4. Expected Results and Significance

The primary output of this project will be a **high-brightness, chip-scale entangled photon source** that demonstrates a significant reduction in Size, Weight, and Power (SWaP) compared to traditional sources.

Expected outcomes include:

- Demonstration of high-rate pair generation with **fidelities exceeding 90-95%** on an integrated footprint.
- Validation of a **modular architecture** that can be integrated into larger NASA quantum payloads.
- A comprehensive performance map of the PIC source across a range of operational temperatures, ensuring reliability for varied mission profiles.

By miniaturizing these sources, this work paves the way for the deployment of quantum nodes on SmallSats and CubeSats, democratizing access to quantum-enhanced capabilities across NASA's fleet.

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>.

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

Questions about this opportunity? Please email npp@orau.org

Qualifications Ideal candidates should hold a Ph.D. in Electrical Engineering, Applied Physics, Physics, or a closely related field. Required expertise includes design and simulation of integrated photonic components using Lumerical or COMSOL Multiphysics, with specific experience modeling nonlinear optical processes. Candidates must demonstrate expertise in lithographic mask design and GDSII generation for layout and tape-out.

Extensive hands-on cleanroom fabrication experience is essential, specifically with advanced nanofabrication techniques such as Electron Beam Lithography (EBL), high-resolution photolithography, and dry etching. Proficiency in thin-film characterization and metrology using SEM, AFM, and ellipsometry is required.

Characterization skills must include sensitive hands-on experience with fiber-to-chip coupling and visible/IR free-space optics. The candidate should be proficient in performing Bell-state measurements, measuring Coincidence-to-Accidental Ratios (CAR), and conducting Quantum State Tomography to verify entanglement fidelity. Strong proficiency in Python, MATLAB, or LabVIEW for automated instrument control and data analysis is expected. Preferred qualifications include familiarity with 1K or 4K cryostat operations for integrated detector testing and experience with high-speed electro-optic modulation.

Point of Contact [Mikeala](#)

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