

**Opportunity Title:** ICAR - Advancing Multi-Messenger Biosignature Techniques with Machine Learning

**Opportunity Reference Code:** 0041-NPP-MAR26-ABProg-Astrobio

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

**Reference Code** 0041-NPP-MAR26-ABProg-Astrobio

**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** 4/2/2026 6:00:59 PM Eastern Time Zone

**Description** About the [NASA Postdoctoral Program](#)

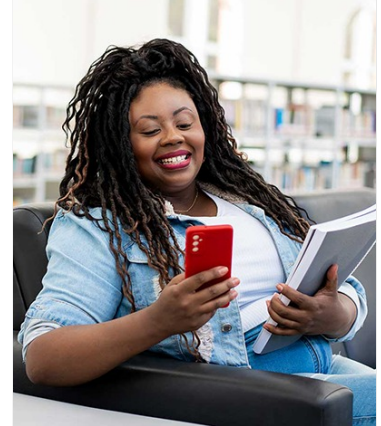
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**Description:**

The Interdisciplinary Consortia for Astrobiology Research (ICAR) project on Advancing Multi-Messenger Biosignature Techniques using Machine Learning seeks suitable applicants to work on any of a variety of areas within the project. This opportunity could involve placement with team members at Carnegie Science's Earth and Planetary Laboratory in Washington D.C. or at NASA's Ames Research Center in Mountain View, CA.

This ICAR project seeks to address the overarching question: Is there extant or extinct life elsewhere in the solar system, and can multiple types of measurements and evidence be combined using machine learning (ML) to help us find it? Astrobiology uses many different forms of analysis to capture data about the features -- or biosignatures -- of living systems in the world: whether in molecular fossils, active metabolisms, or physical structures. These data can contain biological and non-biological features that exhibit extremely complicated, correlative, informational properties that are challenging to interpret and exploit. ML approaches show enormous potential for decoding such features and enhancing our ability to detect and characterize living systems.

An interdisciplinary program of lab and modeling work will develop a foundational dataset and suite of ML models to systematically meld



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biosignature information from different analysis techniques (a "multi-messenger" approach), to enhance the detection of extinct or extant life, and directly inform the optimization of flight-ready instruments and science strategies.

Coordinated research modules will start with construction of a 1000+ sample set of organic-rich materials suitable for laboratory analysis to generate a cornerstone dataset. These samples will include: a diversity of extant life, with bacterial, archaeal, and eukaryotic species; a range of taphonomically degraded samples representing ancient life (coal, shale, chert, etc.); abiotic meteoritic samples (e.g., carbonaceous chondrites); as well as synthetic chemistry experiments that approximate the products of geochemical organosynthesis. This sample set will be uniformly analyzed for compositional/molecular fingerprints of life and non-life using state-of-the-art, largely flight-ready methods: pyrolysis--gas chromatography--mass spectrometry; Raman spectroscopy, via deep-UV, visible, and near-infrared excitation; and isotope-ratio mass spectrometry.

The resultant dataset will be the highest-fidelity multi-method biosignature calibration for ML model development and analysis possible at this time. To augment this data and build a merged, foundational dataset, historical data on lab and planetary samples will be mined and carefully standardized to study/simulate the effects on end data of sample processing and instrument sensitivity and to assess the challenge of heterogeneous data as "real world" input with "degraded" information.

A suite of ML models will be developed for detection of biogenicity and to explicitly combine data from across analysis techniques. These ML approaches will include unsupervised and supervised learning models, and anomaly detection. The goals are to (1) develop ML models that effectively detect and integrate biosignature data and (2) understand how and why these methods succeed, shedding light on the fundamental features of life and the informational fingerprints of living systems.

Finally, the ML results will be used to study optimization of flight-ready instrument packages (e.g. minimizing false positives) to deliver recommendations and deliverable ML models for developing future astrobiology mission payloads and operations. This project will provide a highly interdisciplinary approach to astrobiology's core question of life detection, with an ultimate focus towards enhancing flight instrument efficacy.

Applicants would contribute directly to at least one of the areas of focus in this project, including analytic techniques, data science, machine learning, and biosignature science.

**Field of Science:** Astrobiology

**Advisors:**

Caleb Scharf

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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

**Questions about this opportunity?** Please email [npp@orau.org](mailto:npp@orau.org)

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