

**Opportunity Title:** ICAR - Bringing RNA to Life Emergence of Biological Catalysis

**Opportunity Reference Code:** 0015-NPP-NOV23-ABProg-AstroBio

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

**Reference Code** 0015-NPP-NOV23-ABProg-AstroBio

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

**Application Deadline** 11/1/2023 6:00:59 PM Eastern Time Zone

**Description Description:**

**How could catalytic RNAs (ribozymes) have emerged and functioned to support early life?** RNA world theories feature prominently in Origins-of-Life models, which propose that RNA or a similar polymer played major roles in biological catalysis, in addition to storing heritable genetic information. While some RNA world elements are well supported by experimental data, the biological viability of such ribo-organisms remains speculative or requires extrapolation well beyond the existing data. In particular, it is well-established that RNA can promote several classes of chemical reactions in single-turnover format with non-biological substrates, but it is unknown whether RNA can provide the necessary catalysis to support complex cellular functions, or how such catalysts might emerge. Indeed, the dearth of robust RNA catalysts for small molecule transformation is the single biggest bottleneck in the construction of model riboorganisms.

Our ICAR team uses *in vitro* selection and engineering of new ribozymes, biophysical and informatic analysis of existing ribozymes and aptamers, and *in vivo* ribozyme evaluation in engineered bacterial strains to explore these questions. Our [long-term goal](#) is to build and study RNA-catalyzed metabolisms that will help us define the potential of RNA to sustain cellular metabolism and will empower synthetic biology applications. These themes bridge the gap between bottom-up and top-down approaches to RNA world research, thereby touching on both the PCE3 and FECM Research Collaborative Networks (RCNs). Our [immediate objective](#) is to **build new, robust, multiple-turnover ribozymes for biologically relevant reactions**. Some of the targeted reactions include NTP synthesis, aminoacyl-tRNA synthesis, nucleotide cofactor synthesis, alkyl and methyltransfer, and redox. Two of the [core challenges](#) for this field are 1) to define how best to manipulate RNA sequences and modules to achieve those goals, and 2) to provide appropriate selection and analytical frameworks to support identification, analysis, and optimization of the emerging ribozymes. The proposed research will provide experimental underpinning to a critical missing piece of the RNA world puzzle: emergence of robust, truly catalytic, multiple-turnover ribozymes as precursors to contemporary metabolic pathways.

Team leads are all eligible to host an NPP fellow, and they are located at University of Missouri (Burke), Saint Louis University (Baum), UC Irvine (Lupták), UC San Diego (Müller), Purdue University (Golden), Southern Mississippi University (Huang).

Interested candidates should contact Dr. Burke (PI for this ICAR team) or any of the team leads, ideally early in proposal development. To maximize



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potential interest in your NPP application, please consider (and propose) **what innovations, insights, and skills you can bring to bear on the scientific and technical challenges noted above** and articulate **how NPP training in ribozyme technologies would align with and help you to achieve your professional goals.**

Applicants who apply for this research opportunity and are subsequently selected for an NPP award are expected to attend the Astrobiology Graduate Conference (AbGradCon) and/or the Astrobiology Science Conference (AbSciCon) using the travel funds that are conferred as part of the NPP award.

**Field of Science:** Astrobiology

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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

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