Opportunity Title: ICAR- Emergence of a Complex Biochemical System: Evolutionary Paths to Coded Protein Synthesis
Opportunity Reference Code: 0014-NPP-NOV23-ABProg-Astrobio

Organization National Aeronautics and Space Administration (NASA)

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How to Apply All applications must be submitted in Zintellect

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

Description **Description:**

Complex biological systems must emerge through the evolution of simpler intermediate forms, which themselves need to be advantageous to an organism in its environment. A major evolutionary transition out of the RNA World and toward the earliest cells is defined by the emergence of the genetic code of protein translation. However, the emergence of the genetic code remains conceptually mysterious, largely because, while the advantage of a fully instantiated code is clear, the evolutionary advantage of simpler forms and smaller parts of the system is not obvious. In other words, what good is 5% of the genetic code? Our goal is to understand the evolutionary advantages and dynamics of the molecular parts and simpler forms of the genetic code. Evolutionary advantages may be similar to the function of the ultimate system, or selection may have been initially for completely different functions, with evolution co-opting the molecules and subsystems for the later function (a molecular bricolage). We hypothesize that parts and intermediate forms leading to coded protein synthesis could have conferred advantages to a primitive cell initially unrelated to protein translation, such that the apparatus of the genetic code emerged as a co-option of these parts. Once a minimally required complexity was reached by these intermediates, a very primitive system could be directly selected for protein translation. We propose to study three general stages of this process: 1) Experimental and computational determination of evolutionary advantages of translation parts in a protocell context; 2) Theoretical modeling of the evolutionary dynamics of the transition from selection for parts to selection for higher function, inspired by mechanisms and parameters discovered experimentally; 3) Experimental measurements and computational simulations defining possible evolutionary advantages of the earliest translation systems.

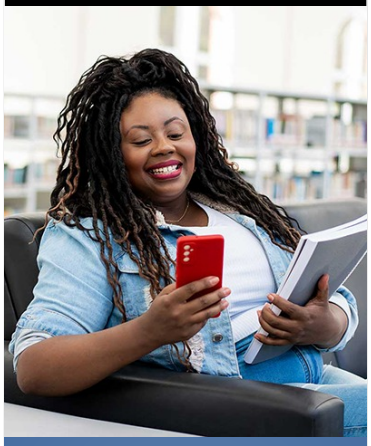
For research opportunities in protocell evolution and biophysics, contact Irene Chen (ireneachen@ucla.edu).
For research opportunities in experimental protein evolution and genetic code evolution, contact Burckhard Seelig (seelig@umn.edu).

Interested applicants are encouraged to propose research that seeks to address any of the above questions or that are at the intersection of any of the above themes.

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.

NPP NASA Postdoctoral Program

ORAU Pathfinder



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Field of Science: Astrobiology

Advisors:

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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.