Opportunity Title: Astrophysics and Solar System Science: High Angular Resolution with Space-Enabled Adaptive Optics
Opportunity Reference Code: 0218-NPP-MAR24-GSFC-Astrophys

Organization National Aeronautics and Space Administration (NASA)

Reference Code 0218-NPP-MAR24-GSFC-Astrophys

Application Deadline 3/1/2024 6:00:59 PM Eastern Time Zone

Description In recent decades Hubble and other space telescopes have provided images of unprecedented clarity that have led to major advances in our understanding of astronomical phenomena. NASA relies on large ground-based telescopes to provide confirmation and follow-up observations, without which the science remains incomplete. Such telescopes, such as the Keck Observatory on Mauna Kea, use adaptive optics (AO) to provide partial correction of the atmospheric turbulence which blurs the images. Natural guide stars bright enough for the purpose are rare and the stray light they produce in the instruments prevents their use for general astrophysics. Therefore, to measure atmospheric turbulence, current technology uses lasers projected from the ground to excite sodium fluorescence in the upper atmosphere. This is sufficient for near IR wavelengths but for shorter wavelengths suffers from the cone effect, tip tilt instability, wavelength-dependent AO correction errors, and other limiting factors. An innovative way to obtain the needed clarity is to provide a modest laser signal (< 1 W) from an orbiting small satellite, pointed at the observatory, to provide an enhanced AO correction. This enables nearly diffraction-limited images across a range of visible and NIR wavelengths, an improvement of orders of magnitude over traditional AO.

Our team at NASA Goddard Space Flight Center has joined with the Keck Observatory to develop the Orbiting Configurable Artificial Star (ORCAS) concept. ORCAS consists of a small satellite with the laser and calibrated flux illumination system in a steerable astro-stationary orbit, and an enhanced AO system at the observatory. Space telescopes provide diffraction-limited imagery; the ORCAS laser system will allow the much larger ground-based telescopes to provide nearly diffraction-limited observations at visible wavelengths for the first time. In anticipation of the launches of the James Webb Space Telescope (JWST, 2021 LRD) and the Wide Field Infrared Survey Telescope (WFIRST, 2026 LRD), it is imperative that NASA develop ORCAS to provide the required near-diffraction-limited and precise absolute flux-calibrated observations at visible and NIR wavelengths. The technology is not limited to the Keck observatory, and can be readily extended to the Giant Magellan Telescope and the Thirty Meter Telescope. Current AO telescopic observations are not adequate to address the anticipated science questions. Arguably as important, ORCAS can provide observations in the visible band in a post-Hubble world. The potential of near-diffraction-limited and precise absolute flux-calibrated imaging and spectroscopy at NIR and visible wavelengths from the ground is immense and will profoundly affect planning priorities for astronomy. ORCAS will prove to be an enabling technology for several types of observations of urgent interest to NASA, including solar system objects, exoplanets, galaxy evolution, black holes, extreme stellar dynamics, general relativity, dynamics of the galactic center, dark matter and dark energy.

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We are currently seeking observational, orbital mechanics, and adaptive optics experience to help us design and test an array of mission designs that could be supported by ORCAS. Current interests include: 1) development of the scientific observation program, working with members of the astronomy and solar system communities, 2) validation and optimization of a mission design reference, from an orbit management perspective, and 3) modeling and designing adaptive optics systems performance from the ground.

Location:
Goddard Space Flight Center
Greenbelt, Maryland

Field of Science: Astrophysics

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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

Eligibility Requirements

- **Degree:** Doctoral Degree.