National Aeronautics and Space Administration

CARRUTHERS GEOCORONA OBSERVATORY

LAUNCH PRESS KIT

Artist's concept of the Carruthers Geocorona Observatory, IMAP, and SWFO-L1 spacecraft in space.
Credit: U.S. Naval Research Laboratory

INTRODUCTION

The Carruthers Geocorona Observatory (abbr: "Carruthers") is a NASA small satellite mission that will orbit the Sun-Earth Lagrange Point 1 (L1), roughly 1 million miles from Earth along the Sun-Earth line. From this vantage point, Carruthers will observe Earth's outermost atmospheric layer — the exosphere — by capturing the ultraviolet light "glow" it emits, known as the geocorona. Observations of this little-understood region are critical for advancing our understanding of space weather, planetary atmospheric evolution, and the long-term history of water on Earth.

Carruthers was selected under the Solar Terrestrial Probes program in 2019 as a Mission of Opportunity and is designated as a Category 3 Project/Class D mission. Formerly known as GLIDE (Global Lyman-alpha Imagers of the Dynamic Exosphere), the mission was renamed on December 2, 2022 in honor of Dr. George R. Carruthers (1939-2020), a visionary scientist, engineer, educator, and inventor of the first ultraviolet camera whose work provides the scientific foundation for the Carruthers Geocorona Observatory.

3 THINGS TO KNOW ABOUT THE CARRUTHERS GEOCORONA OBSERVATORY

1. Mapping Earth's Exosphere

Carruthers will capture ultraviolet (UV) light emissions from Earth's upper atmosphere — a faint glow of light known as Earth's "geocorona." This geocoronal light is emitted by hydrogen atoms in our planet's outermost atmospheric layer, the exosphere. The exosphere stretches a vast distance from approximately 310 to 119,000 miles above Earth's surface (500 to 192,000 kilometers), or about halfway to the Moon. Only four images of Earth's global exosphere have ever been taken.

2. Honoring a Space Science Pioneer

The mission was named in honor of Dr. George Carruthers, a pioneer in UV instrumentation and space science. Dr. Carruthers' far-ultraviolet camera, placed on the Moon by Apollo 16 astronauts, captured the first view of Earth's geocorona and still resides on the Moon today.

3. Positioned at L1 for Continuous Views

Carruthers will orbit around the Sun–Earth Lagrange Point 1 (L1) approximately 932,000 miles (1.5 million kilometers) from Earth. L1 is a location in space where the gravitational forces of the Sun and Earth are balanced, allowing for a smaller object like a satellite to maintain a relatively stable position. L1 is four times farther from Earth than the Moon, giving Carruthers a perpetual view that takes in all of Earth's vast geocorona.

CARRUTHERS GEOCORONA OBSERVATORY
LAUNCH PRESS KIT

National Aeronautics and Space Administration

WHY CARRUTHERS MATTERS

The Earth's exosphere is our planet's outermost atmospheric layer, a critical boundary between Earth and the vastness of space. Understanding this region is vital for several key reasons:

- Protecting Our Planet from Space Weather: Processes within the exosphere significantly influence geomagnetic storms, which are disturbances to Earth's magnetic field caused by eruptions and outflow from the Sun. These storms can disrupt satellite communications, power grids, and even pose risks to astronauts. Carruthers will provide crucial insights into how these storms develop, propagate, and dissipate, helping us better predict and prepare for them in the future.
- Understanding Earth's Water History: The exosphere, as the boundary between the atmosphere and the vacuum of space, is where planets can lose mass, particularly through the escape of hydrogen atoms. This process is directly linked to the permanent loss of surface water over geological timescales, a phenomenon observed on planets like Mars. By studying this escape, Carruthers helps us understand the long-term evolution of planetary habitability, revealing mechanisms for how planetary atmospheres change over time and how those changes can affect conditions for life.
- Filling a Critical Knowledge Gap: Despite its importance, our current understanding of the exosphere is limited. Comprehensive, wide-field images of this region are extremely rare: only four such images have ever been taken. Carruthers is designed to fill this critical knowledge gap by delivering unprecedented, continuous, high-cadence, and high-resolution imaging of the global exosphere.
- Pioneering New Observations: In orbit around L1, Carruthers will offer an unobstructed, continuous view of the entire geocorona. Its orbit around L1 gives Carruthers a constantly changing viewing angle of the exosphere, allowing scientists to reconstruct its 3D structure. This mission is set to make history as the first SmallSat to operate at L1 and the first to provide continuous exospheric observations from this unique vantage point.

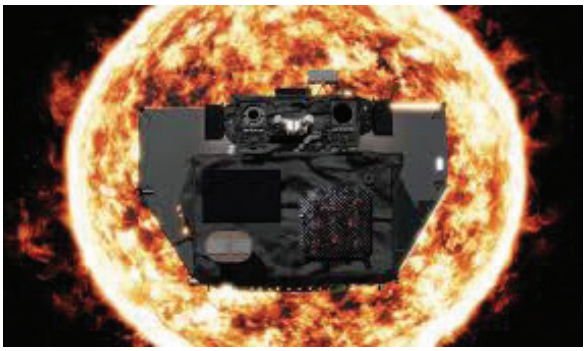
DETAILS OF THE MISSION

Name

Carruthers Geocorona Observatory (abbr: "Carruthers")[1]

Science Objectives

- **Map the geocorona's space weather response.** The geocorona is Earth's frontline defense against the solar wind. Carruthers will provide a constant, global view to track how this boundary changes. This continuous view will reveal how solar storms and other space weather events change the shape of our atmosphere's outer regions.
- **Untangle the sources of the geocorona.** The hydrogen in the geocorona comes primarily from water vapor in the lower atmosphere, but the processes that transport it to such extreme altitudes are poorly understood. By tracking the geocorona's structure and behavior in detail, Carruthers will help scientists understand these fundamental atmospheric dynamics, providing crucial data for improving our models of space weather and its potential impacts on satellites and astronauts.



[1]To respect the legacy of Dr. Carruthers, please do not use an acronym (e.g. "CGO") or any shorthand other than "Carruthers" when referring to the Carruthers Geocorona Observatory.

PARTNERS

- The Carruthers Geocorona Observatory is led by Dr. Lara Waldrop at the University of Illinois Urbana-Champaign, the institution where Dr. Carruthers was a 3-time alumnus (Bachelors, Masters, PhD). University of Illinois Urbana-Champaign also houses the Science Data and Operations Center (SDOC).
- NASA's Solar Terrestrial Probes program at NASA's Goddard Space Flight Center in Greenbelt, Maryland, manages the mission for the agency's Heliophysics Division at NASA Headquarters in Washington.
- BAE Systems built the spacecraft and performed satellite-level testing and integration of the observatory.
- The University of California at Berkeley Space Sciences Laboratory provided the Carruthers GeoCoronal Imager (the mission's sole science instrument suite) and houses the Mission Operations Center (MOC), providing mission management and operating the spacecraft.
- NASA's Launch Services Program, based at the agency's Kennedy Space Center in Florida, in partnership with NASA's Science Mission Directorate is providing the launch service.

Dr. George Carruthers, right, and William Conway, a project manager at the Naval Research Institute, examine the gold-plated ultraviolet camera/spectrograph, the first Moon-based observatory that Carruthers developed for the Apollo 16 mission.

Credit: U.S. Naval Research Laboratory

LAUNCH DETAILS

Carruthers is launching as a secondary payload alongside the Interstellar Mapping and Acceleration Probe (IMAP) mission and NOAA's Space Weather Follow On - Lagrange 1 (SWFO-L1) mission.

- **Date:** No earlier than September 23, 2025
- **Launch Site:** NASA's Kennedy Space Center, Launch Complex 39A (LC-39A)
- **Launch Vehicle:** SpaceX Falcon 9

SPACECRAFT AND INSTRUMENTS

Mass: 531 pounds (241 kilograms) • **Volume:** 67.8" W x 42.5" H x 38.1" D (About the size of a loveseat sofa) • **Power:** 194 W

Instruments: The Carruthers Geocorona Observatory carries a single instrument, the Carruthers GeoCoronal Imager, developed and built by University of California Berkeley's Space Sciences Lab. The payload comprises two co-aligned, nested ultraviolet imagers designed for simultaneous observations of Earth's exosphere: the Narrow Field Imager (NFI) and the Wide Field Imager (WFI).

- **Narrow Field Imager (NFI):** The NFI provides high spatial resolution observations of the inner exosphere (within 7 Earth radii of Earth center) from the exobase, where the exosphere is brightest, through the region where its radiance falls most rapidly.
- **Wide Field Imager (WFI):** The WFI offers wide-field observations of the entire exosphere, which is believed to extend out as far as 30 Earth radii and simultaneously captures the surrounding interplanetary hydrogen (IPH) background emission.

CARRUTHERS GEOCORONA OBSERVATORY

LAUNCH PRESS KIT

National Aeronautics and Space Administration

THE MISSION

Carruthers will be deployed to L1 alongside the Interstellar Mapping and Acceleration Probe (IMAP) mission and NOAA's Space Weather Follow On - Lagrange 1 (SWFO-L1) mission.

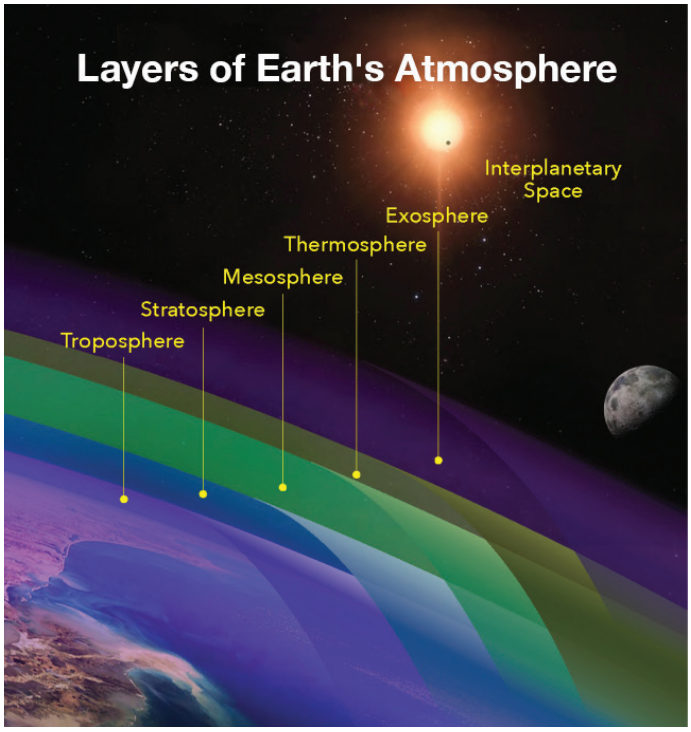
Mission Duration: After launch, the spacecraft will commence a four-month cruise phase to the L1 point, followed by an additional month for initial on-orbit checkout. The 24-month science phase will begin in March 2026. The mission is planned for at least two years to image geocoronal emissions, but the spacecraft carries enough fuel to operate for ten years or longer.

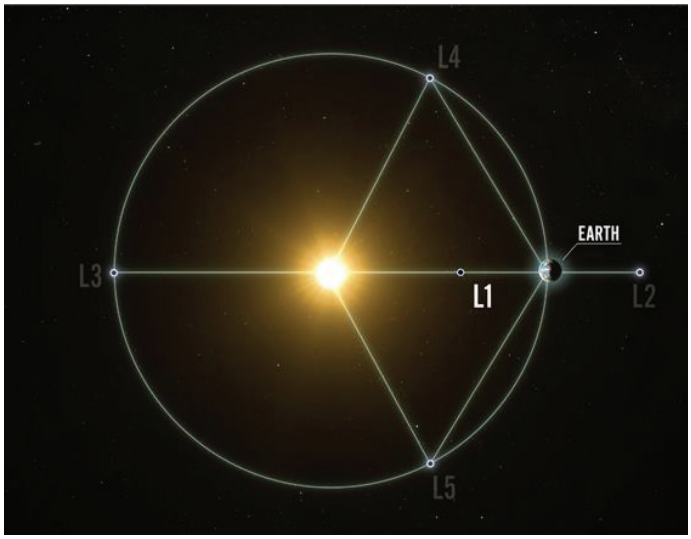
Orbit: Halo orbit around the Sun-Earth Lagrange point 1 (L1).

THE DATA

Carruthers will send data back to Earth via the Deep Space Network (DSN). During the science phase of the mission (commencing March 2026), Carruthers will deliver data via two 6-hour passes per week. After downlinking from the spacecraft through the DSN, the data will be sent to the mission operations center (MOC) located at UC Berkeley, which will share it with the science data and operations center (SDOC) located at University of Illinois Urbana-Champaign.

The first dataset will be available to the public six months after completion of commissioning, then subsequent datasets will be delivered on a monthly basis. All Carruthers data will be published through the Space Physics Data Facility, ensuring open access to the scientific community and public.





An artist's concept of the Sun-Earth Lagrange points in space, where gravitational forces allow smaller objects to remain in stable orbits. The Carruthers Geocorona Observatory will be stationed at Lagrange Point 1 (L1).

Credit: NASA's Conceptual Image Lab/Krystofer Kim

CARRUTHERS TEAM

Media Contacts

- *NASA Heliophysics Division:*
  - Sarah Frazier (sarah.frazier@nasa.gov)
  - Abbey Interrante (abbey.a.interrante@nasa.gov)
- *University of Illinois Urbana-Champaign:*
  - Libby Kacich (lkacich@illinois.edu)
- *University of California, Berkeley Space Sciences Laboratory:*
  - Bryan Mendez (bmendez@ssl.berkeley.edu)

Mission Team

- *Lara Waldrop, Principal Investigator*
  - University of Illinois Urbana-Champaign
- *John Clarke, Deputy Principal Investigator*
  - Boston University
- *Aly Mendoza-Hill, NASA Program Executive*
  - NASA Headquarters
- *Kelly Korreck, NASA Program Scientist*
  - NASA Headquarters
- *Alex Glocer, Mission Scientist*
  - NASA's Goddard Space Flight Center
- *Robert Michell, Deputy Mission Scientist*
  - NASA's Goddard Space Flight Center
- *Tom Immel, Carruthers Project Scientist*
  - UC Berkeley Space Sciences Laboratory
- *William Craig, Carruthers Mission Project Manager*
  - UC Berkeley Space Sciences Laboratory
- *John Troeltzsch, Carruthers Program Manager*
  - BAE Systems

IMPORTANT LINKS

News Releases, Features, Advisories, and Blog

Progress reports on Carruthers' road to launch, including the latest information on launch dates, can be found at:
https://science.nasa.gov/blogs/carruthers-geocorona-observatory/

News, updates, and feature stories about the Carruthers mission are available at:
science.nasa.gov/mission/carruthers-geocorona-observatory/

Video and Images
B-roll and animations for media and public use are available at:
https://svs.gsfc.nasa.gov/gallery/carruthers-geocorona-observatory/

Read NASA's image use policy:
https://www.nasa.gov/nasa-brand-center/images-and-media/

Live Launch Feed

News briefings and commentary will be streamed on NASA+ https://plus nasa.gov/, NASA's Live Events page nasa.gov/live, NASA's YouTube channel, youtube.com/NASA, and NASA's channel on X, https://x.com/NASA.

On-demand recordings will also be available on YouTube after the live events have finished. For more information about the NASA+ programming schedule, visit https://www.nasa.gov/ntv.

Additional Resources on the Web

- A PDF version of this press kit is available at the NASA Science Carruthers Geocorona Observatory webpage: https://science.nasa.gov/mission/carruthers-geocorona-observatory/
- BAE Systems Carruthers Webpage: https://www.baesystems.com/en/product/carruthers
- UC Berkeley Space Science Laboratory Carruthers Fact Sheet: https://www.ssl.berkeley.edu/earth-geospace/carruthers-observatory-fact-sheet/
- Space Weather Explorers (Carruthers Outreach Website, UC Berkeley): https://spaceweather.ssl.berkeley.edu
- Carruthers Geocorona Observatory official renaming announcement: https://www.nasa.gov/general/nasa-names-mission-in-honor-of-dr-george-r-carruthers-visionary-behind-first-moon-based-telescope/
- Learn more about NASA Heliophysics: https://science.nasa.gov/heliophysics/
- Learn more about the Sun: https://science.nasa.gov/sun/

Technicians work on the Carruthers Geocorona Observatory in a BAE Systems clean room in Boulder, Colorado.

Credit: NASA/BAE Systems Space & Mission Systems

SOCIAL MEDIA

General Updates
Join the conversation and get updates from these accounts:

X: @NASASolarSystem, @NASA

Facebook: @NASA Solar System Exploration, @NASA

Instagram: @NASASolarSystem, @NASA

Launch Day Updates
Updates on Launch Day will also be available from

X: @NASAKennedy

Facebook: @NASAKennedy