National Aeronautics and Space Administration

# PUNCH

POLARIMETER TO UNIFY THE CORONA AND HELIOSPHERE

## LAUNCH PRESS KIT

www.nasa.gov

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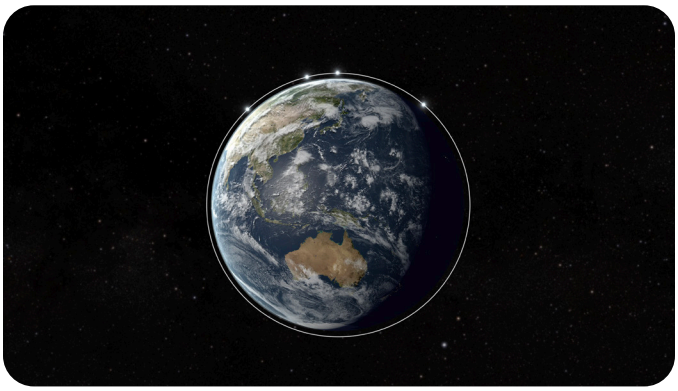
# PUNCH Press Kit

## Introduction

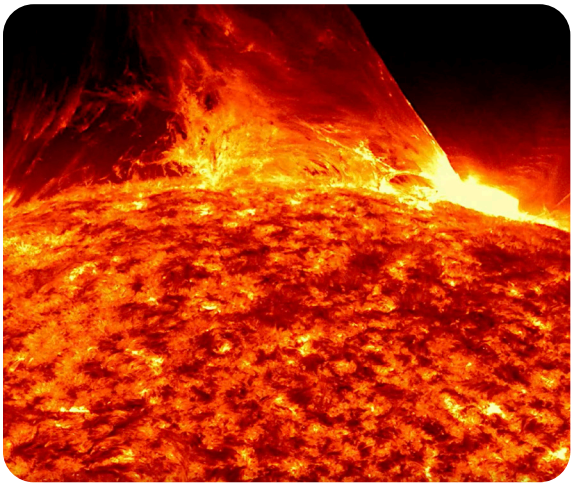
NASA's PUNCH mission is a constellation of four small satellites in low Earth orbit that will make global, 3D observations of the Sun's outer atmosphere, the corona, to learn how the mass and energy there become the solar wind.

By imaging the Sun's corona and the solar wind together, scientists hope to better understand the entire inner heliosphere — Sun, solar wind, and Earth — as a single connected system.



## Four Things to Know About PUNCH

Launching as a rideshare with NASA's SPHEREx mission, the four PUNCH satellites will map out the region where the Sun's outer atmosphere, called the corona, transitions to the solar wind, the constant outflow of material from the Sun.

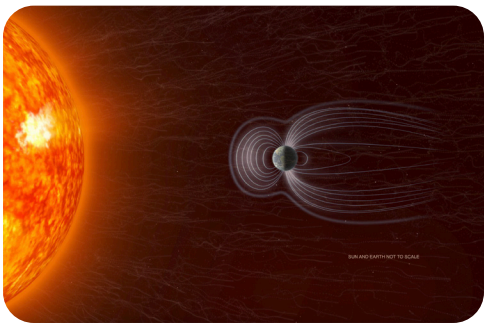


### 1. Wide Field View

The PUNCH mission's four suitcase-sized satellites have over-lapping fields of view that combine to cover a larger-than-ever swath of sky than any previous mission focused on the corona and the solar wind. The satellites will be spread out around Earth along the day-night line to construct a global view of the solar corona and its transition to the solar wind.

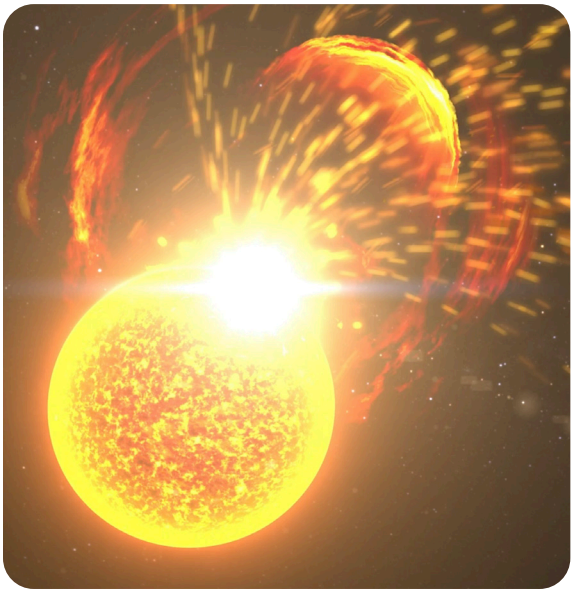
Current coronagraphs and heliospheric imagers can show solar wind and solar storms like coronal mass ejections (CMEs) as they leave the Sun but don't have the sensitivity or coverage to show their evolution through the solar system. PUNCH's wide-angle view reveals this part of their journey in unprecedented detail across a 90-degree-wide field centered on the Sun.

## 2. Beyond the Solar Wind



The PUNCH mission will explore the formation and evolution of transient space weather events in the solar wind (such as coronal mass ejections and stream interaction regions) which can spark strong space weather effects at Earth. These satellites will provide the first global view of how these events travel and evolve from the corona into interplanetary space.

The mission will also shed new light on the formation of shock waves in interplanetary space, which can accelerate benign particles into storms of energetic particle radiation that can endanger spacecraft and astronauts.

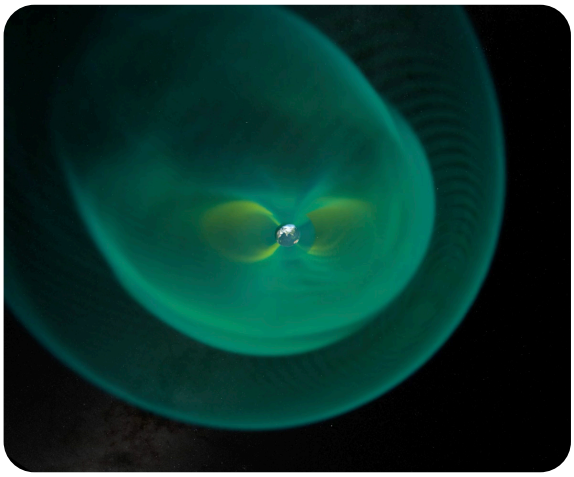


## 3. A New Perspective from Polarized Light

By taking advantage of the polarization of light by electrons, PUNCH will measure 3D information about the structures it sees. When particles, such as electrons, scatter sunlight, the waves of light become aligned in a particular way — this is polarized light. By measuring the light using polarizing filters similar to polarizing sunglasses, PUNCH scientists can make a 3D map of the features they see throughout the corona and inner solar system. The polarimeter in each PUNCH spacecraft uses three different polarizing filters in front of the main camera. The amount of light that can be seen through each filter reveals how much the light from space weather features is polarized, and reveals the features' position in three dimensions.

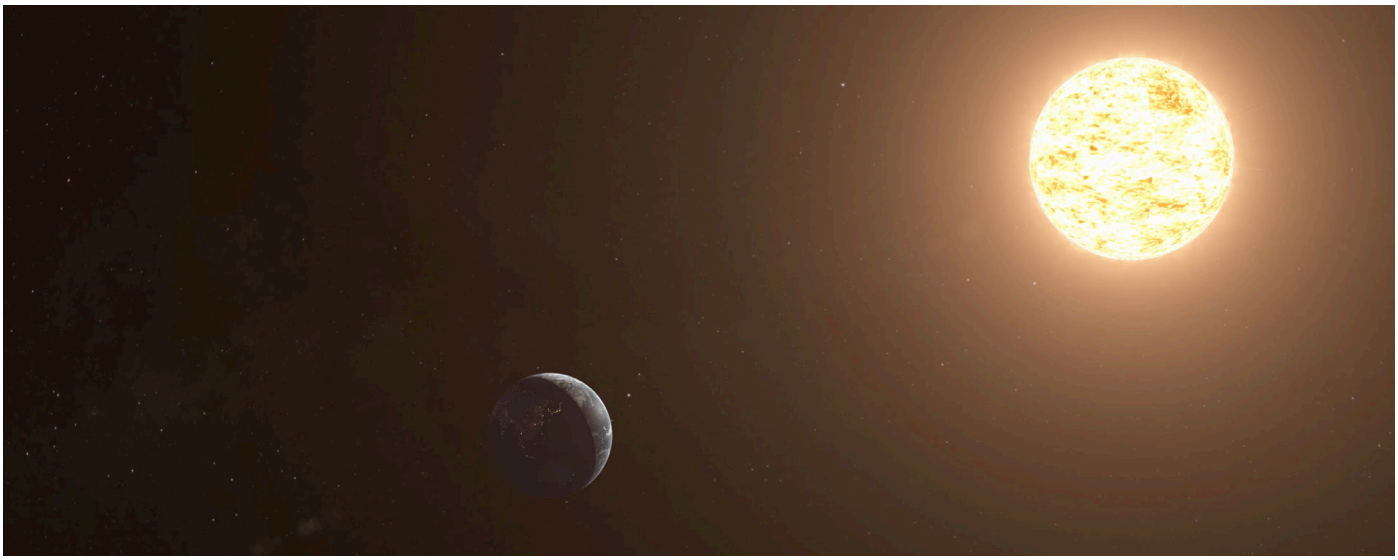
This new perspective will allow scientists to discern the exact trajectory and speed of coronal mass ejections as they move through the inner solar system, improving on current instruments that only measure the corona itself and cannot measure motion in three dimensions.

## 4. Impacts at Earth and in Heliophysics



The PUNCH mission advances the science of heliophysics, (the study of the Sun and its influence throughout the solar system), by providing an unprecedented 3D, wide-angle view of the solar wind and space weather events as they leave the Sun and cross the solar system. These phenomena can have an enormous impact on human society and technology, from sparking and intensifying aurora to interfering with satellites or triggering power outages.

The measurements from PUNCH will provide scientists with new information about how these potentially disruptive events form and evolve, which could lead to more accurate predictions about the arrival and impact of space weather events at Earth and impact on humanity's robotic explorers in space.



# The Details of the Mission

## Name

***Polarimeter to Unify the Corona and Heliosphere***, or PUNCH

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## Objectives

The PUNCH science goal is to determine the physical processes at different scales that unify the solar corona with the rest of the solar system environment (the heliosphere):

**Objective 1:** Understand how coronal structures become the ambient solar wind.

**Objective 2:** Understand the evolution of transient structures (such as CMEs) in the young solar wind.

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## Partners

PUNCH is led by the Southwest Research Institute's (SwRI) offices in San Antonio, Texas, and Boulder, Colorado. SwRI built the four spacecraft and the wide field imagers and will manage operations of the mission.

The mission is managed by the Explorers Program Office at NASA's Goddard Space Flight Center in Greenbelt, Maryland, for NASA's Science Mission Directorate in Washington.

NASA's Launch Services Program (LSP), based at the agency's Kennedy Space Center in Florida, is responsible for management of the launch services.

Rutherford Appleton Laboratory (RAL) Space in Didcot, United Kingdom, built the cameras on the spacecraft and will be coordinating with other institutions in the United Kingdom to do research with PUNCH data.

The U.S. Naval Research Laboratory provided calibration facilities for the spacecraft and built the Narrow Field Imager for the mission.

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# PUNCH Launch Kit

## Launch Details

The PUNCH mission is launching as a secondary payload with NASA's next astrophysics observatory, SPHEREx (Spectro-Photometer for the History of the Universe, Epoch of Reionization and Ices Explorer).

Learn more about SPHEREx at ***go.nasa.gov/spherexpresskit.***


### Date

No earlier than **Feb. 27, 2025**

### Launch Site

**Space Launch Complex 4E**
Vandenberg Space Force Base, Central California

### Vehicle

SpaceX Falcon 9 rocket

## Spacecraft

### Spacecraft Dimensions

Four 140-pound (64-kilogram) small satellites, each about 1 x 2 x 3 feet (0.5 x 0.7 x 1 meter) in size

### Duration

The PUNCH mission is scheduled to conduct science for at least two years, following a 90-day commissioning period after launch.

### Orbit

The four PUNCH spacecraft will be in a polar (Sun-synchronous) low Earth orbit in a dawn/dusk alignment and spread out around Earth along the day-night line. This means the satellites will be near the terminator line, which is the area that separates day from night on Earth. This enables each spacecraft to nearly always be in sunlight and the spacecraft constellation will have a clear view in all directions around the Sun.

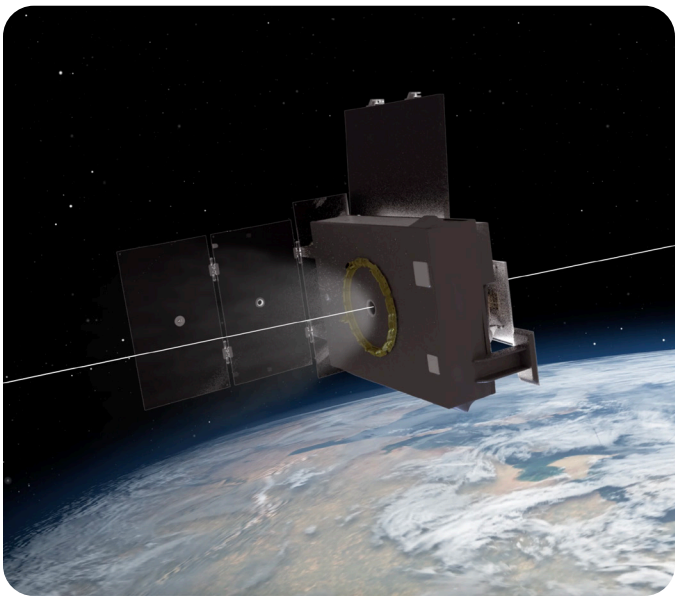
# Instruments

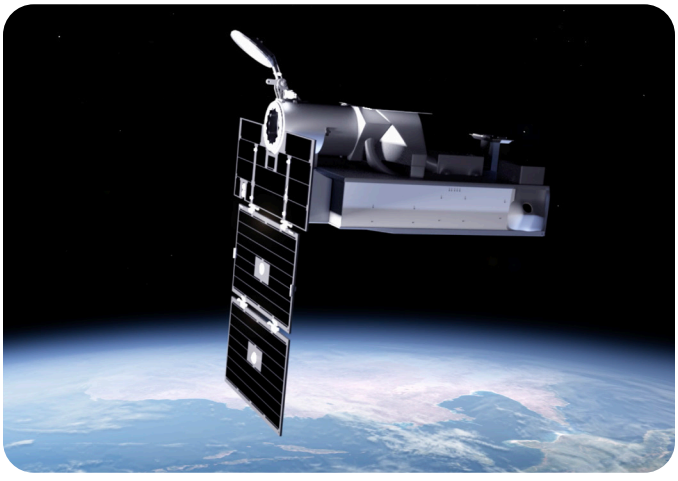
Three of the PUNCH satellites will carry a Wide Field Imager (WFI), and the fourth will carry the Narrow Field Imager (NFI).

## The Wide Field Imager (WFI)

The Wide Field Imager (WFI) is a heliospheric imager, a device that provides views from 18 to 180 solar radii (45 degrees) away from the Sun in the sky. Heliospheric imagers use an artificial “horizon” and deep baffles to view the very faint outermost portion of the solar corona and the solar wind itself.

The instrument reduces direct sunlight by over 16 orders of magnitude, which is like the ratio between the mass of a human and the mass of a cold virus. The wide-field imaging optics are based on the design of the famous Nagler eyepieces, which are known among observational astronomers for their clarity, low distortion, wide field, and achromatic focus. Three of the PUNCH spacecraft will carry a WFI instrument.





## The Narrow Field Imager (NFI)

The Narrow Field Imager (NFI) is a coronagraph, a type of device that blocks out the bright light from the Sun to better see details in the Sun’s outer atmosphere, or corona. The coronagraph will have a similar field of view as the SOHO (Solar and Heliospheric Observatory) Large Angle and Spectrometric Coronagraph (LASCO) C3 field, from 6 to 32 solar radii in the sky, and it will view the corona in both polarized and unpolarized light.

# The Data

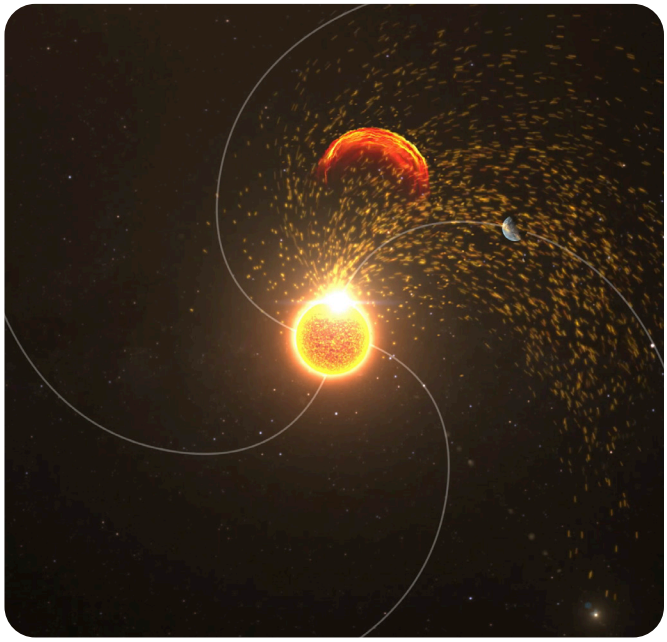
All four spacecraft are synchronized to serve as a single “virtual instrument” that spans the whole PUNCH constellation. Every four minutes, each camera will collect three raw images through three different polarizing filters. In addition, each camera will take a clear (unpolarized) image every eight minutes, which will help to calibrate the polarized images.

The  PUNCH mission will downlink data multiple times a day via ground-based antennas on Earth that are managed by the Swedish Space Corporation (SSC). Then, the data will be sent to the mission operations center at SwRI in Boulder, Colorado, which will share it with the science operations center, also at SwRI.

The data will be available to the public at the same time it is available to the science team. All PUNCH data will be published through the Solar Data Analysis Center at NASA’s Goddard Space Flight Center in Greenbelt, Maryland, ensuring open access to the scientific community and public.

# Connections to Other Missions

The PUNCH mission builds upon and contributes to NASA's Heliophysics program, which studies a vast, interconnected system from the Sun to the space surrounding Earth and other planets, to the farthest limits of the Sun's constantly outflowing streams of solar wind. This mission will provide key information about how the Sun's outer atmosphere transitions to the solar wind, and how eruptive events and other changes in the solar wind move through the solar system, where they shape the space environment for spacecraft, Earth, the planets (including Earth), and other bodies in the solar system.



Other heliophysics missions are spread across the solar system, including some that are within or near the Sun's corona. These missions each provide crucial observations of the Sun and its environment, and the entire fleet of spacecraft works together to build on the knowledge from each one. Combining observations provides important context for the entire heliophysics system.

## The Missions

### Parker Solar Probe

Parker Solar Probe, the first spacecraft to "touch" the Sun, flies through the Sun's corona three times a year to sample the physical processes that occur there. As Parker flies through this area, imaging the solar wind in three dimensions, scientists can combine and compare data — seeing both the big picture with PUNCH and the up-close details from Parker. Working together, Parker Solar Probe and PUNCH span a field of view from a little more than half a mile (1 kilometer) to over 160 million miles (about 260 million kilometers).

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### Coronal Diagnostic Experiment (CODEX)

The CODEX instrument is a solar coronagraph installed on the International Space Station to gather important information about the solar wind and how it forms. A portion of the area that CODEX views is closer to the Sun than PUNCH will observe, but parts of their fields of view overlap. Joint CODEX-PUNCH studies will connect the Sun's inner corona to the solar wind itself.

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## Solar Orbiter

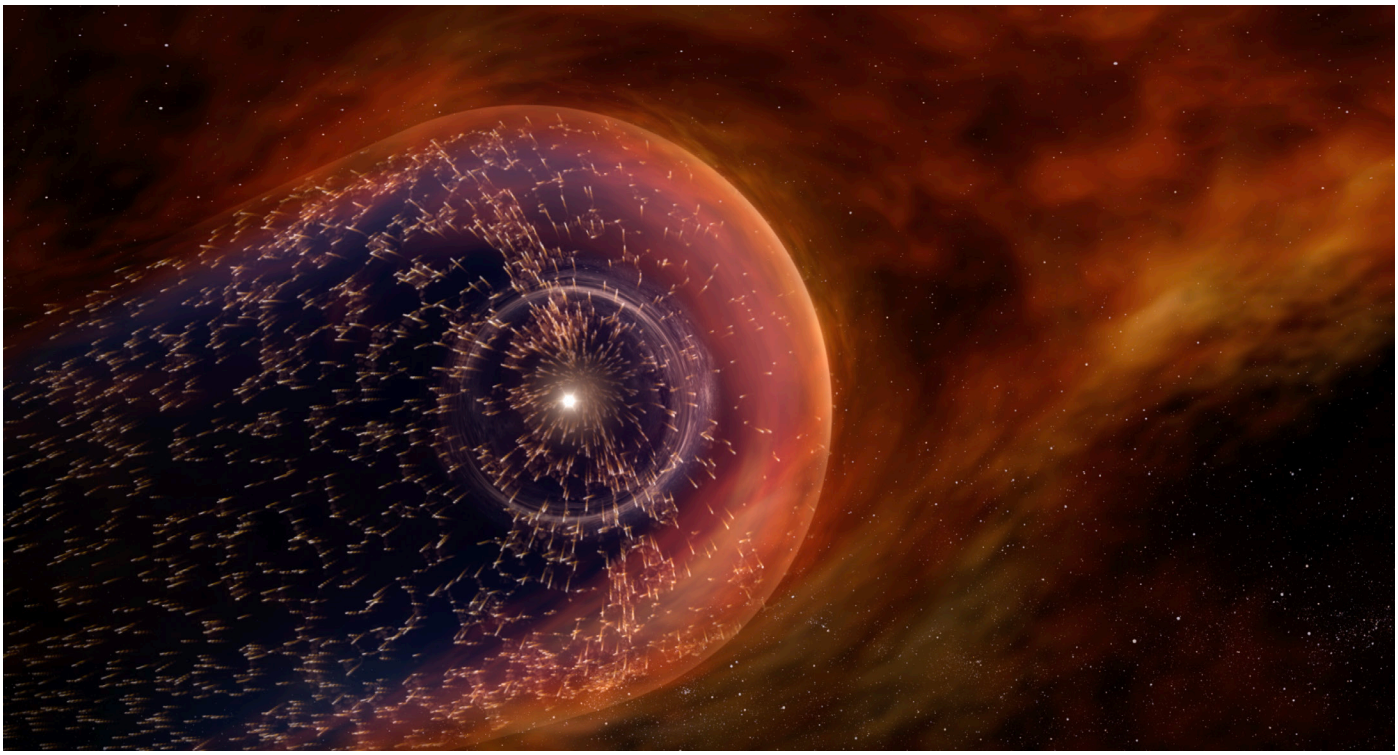
A joint mission by ESA (European Space Agency) and NASA, Solar Orbiter is a Sun-observing satellite with 10 science instruments viewing the Sun from out of the ecliptic plane. When a windstream in the Sun's corona is detected by Solar Orbiter, PUNCH's view will provide the context for what else is happening in that area.

## Electrojet Zeeman Imaging Explorer (EZIE)

The EZIE mission is a set of three SmallSats that will study the auroral electrojet, which are electrical currents flowing about 60 to 90 miles above Earth's poles that link the aurora to the Earth's magnetosphere. While PUNCH's primary mission is to study the corona and solar wind, PUNCH will also make some observations of high-altitude auroras, and these observations can be compared.

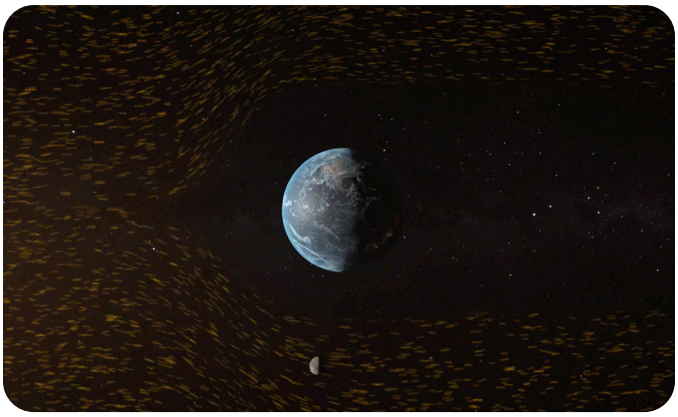
## Solar Terrestrial Relations Observatory (STEREO)

Providing a revolutionary view of the Sun-Earth system from deep space, STEREO captures stereoscopic images revealing the 3D structure of the Sun's coronal mass ejections. The STEREO coronagraph will provide a different perspective than PUNCH's view, enabling scientists to compare structures in the corona from different viewpoints.



# PUNCH Team

## Media Contacts



### NASA

Sarah Frazier • sarah.frazier@nasa.gov
Abbey Interrante • abbey.a.interrante@nasa.gov

### Southwest Research Institute

Deb Schmid
deb.schmid@swri.org

## Mission Team

***Craig DeForest***, Principal Investigator
Southwest Research Institute

***Ronnie Killough,*** Project Manager
Southwest Research Institute

***Jennifer Campbell,*** Deputy Project Manager
Southwest Research Institute

***Sarah Gibson,*** Project Scientist
NCAR High Altitude Observatory

***William Wells***, Project Systems Engineer
Southwest Research Institute

***David Cheney,*** NASA Program Executive
NASA Headquarters

***Tyrone Dillard,*** NASA Explorers Mission Manager
NASA Goddard Space Flight Center

***Madhulika Guhathakurta,*** NASA Program Scientist
NASA Headquarters

***Nicholeen Viall,*** NASA Mission Scientist
NASA Goddard Space Flight Center

***Glenn Laurent,*** WFI Instrument Manager
Southwest Research Institute

***Robin Colaninno,*** NFI Instrument Lead
U.S. Naval Research Laboratory

# Important Links

## News Releases, Features, Advisories, and Blog

Progress reports on PUNCH's road to launch, including the latest information on launch dates, can be found at ***blogs.nasa.gov/punch*** and ***https://blogs.nasa.gov/kennedy/.***

News, updates, and feature stories about the PUNCH mission are available at ***science.nasa.gov/mission/punch.***

## Video and Images

B-roll and animations for media and public use are available at: ***https://svs.gsfc.nasa.gov/gallery/punch/***

Read ***NASA's image use policy.***

## Media Events

A prelaunch news conference and a science news conference open to accredited news media will take place at ***Vandenberg Space Force Base (VSFB)*** in central California in the days before launch.

All news briefings will be livestreamed.

# How to Watch

Watch key coverage on NASA+. Learn how to watch NASA content through a variety of platforms, including social media at ***nasa.gov/general/watch-nasa-programming.***

Programming will also be streamed live on the agency's website ***www.nasa.gov/live***, ***YouTube.com/NASA, YouTube.com/NASAJPL,*** the NASA app, and NASA social media channels. (On-demand recordings will also be available on YouTube post-event.)

For more information about NASA's live programming schedule, visit plus.nasa.gov/scheduled-events.

## Live Launch Feed

A live video feed of key launch activities and commentary from mission control at VSFB will be broadcast. Media outlets interested in a "clean feed" of the launch without NASA TV commentary should contact ***nasa-dl-nasaplus-programming@mail.nasa.gov.***

## Audio Only

Audio-only launch coverage will be carried on the NASA "V" circuits, which may be accessed by dialing ***321-867-1220, -1240, or -7135***. On launch day, "mission audio" — the launch conductor's countdown activities without NASA TV launch commentary — will be carried on ***321-867-7135.***

# On-Site Media Logistics

Read **NASA's media accreditation policy:**
***https://www.nasa.gov/general/nasa-agencywide-media-accreditation-policy/.***

Media accreditation for on-site access closed for international media on *Jan. 20, 2025*, and will close on *Feb. 6* for U.S.-based media (U.S. citizens and permanent residents).

Accredited media will have access to VSFB for launch and pre-launch activities related to the SPHEREx and PUNCH missions. Closer to launch, NASA will release an events-and-briefings advisory with additional information.

Accredited news media can arrange on-site interviews by emailing ***Abbey Interrante*** at *abbey.a.interrante@nasa.gov* and ***Sarah Frazier*** at *sarah.frazier@nasa.gov.*

# Additional Resources on the Web

A PDF version of this press kit is available at ***science.nasa.gov/mission/punch.***

Find additional information about the PUNCH mission at ***punch.space.swri.edu.***

Learn more about NASA Heliophysics at ***science.nasa.gov/heliophysics*** and the Sun at ***science.nasa.gov/sun.***

# Social Media

## General Updates

Join the conversation and get updates from these accounts:

**X:** *@NASASun, @NASASolarSystem, @NASA*

**Facebook:** *NASA Sun Science, NASA Solar System, NASA*

**Instagram:** *@NASA Goddard, @NASA Solar System, @NASA*

## Launch Day Updates

Launch-day updates will also be available from:

**X:** *@NASA_LSP*

**Facebook:** *@NASALSP*