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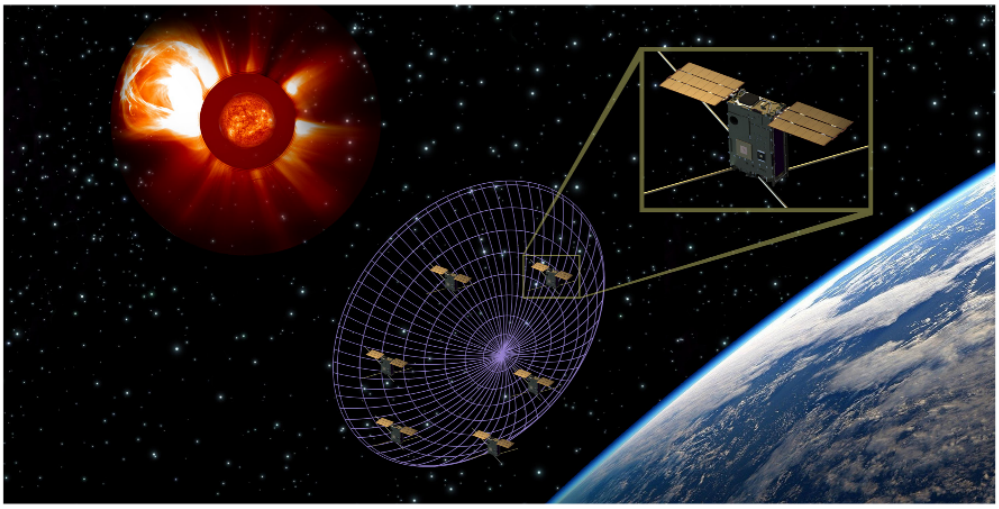
SunRISE
Six Small Satellites to Study the Sun



NASA's Sun Radio Interferometer Space Experiment (SunRISE) mission will send a fleet of six SmallSats into orbit around Earth to work together as one radio telescope to investigate radio waves coming from the Sun. By doing this, SunRISE will help scientists better understand space weather events.

The mission will detect and study what are known as solar radio bursts, or emissions of radio waves in the Sun's outer atmosphere, or corona. These radio waves are created when particles traveling near the speed of light escape from the solar vicinity and they directly point scientists to the location where the particles originate and are accelerated.

These radio wave emissions are created by accelerated solar particles called solar energetic particles (SEPs), which are flung into space by solar events. SunRISE will support both scientific exploration and humankind as these SEPs can have enough energy and intensity to damage spacecraft and pose a serious threat to the health of astronauts traveling through space.

SunRISE is led by the University of Michigan in Ann Arbor and managed by NASA's Jet Propulsion Laboratory, a division of Caltech in Southern California, for NASA.

Solar "Storms"

Solar radio bursts, which SunRISE will study, come from the same area of the Sun where particles (usually protons) are emitted by the Sun and accelerated. This particle acceleration can spark space weather events, sometimes called solar particle storms, which take place when SEPs escape the Sun's atmosphere and burst into interplanetary space.

These "storms," driven by SEPs, can be sparked by events like coronal mass ejections (CMEs), explosive outbursts of plasma and magnetic field from the Sun's corona that are followed by a shock that accelerates solar particles. CMEs are often accompanied by solar flares, emissions of radiation in the Sun's atmosphere that also accelerate solar particles.

When these events occur, SEPs are flung out into space with remarkable energy and at extreme speeds. 93 million miles (150 million kilometers) away from the Sun, these particles reach Earth.

Because the SEPs are so energetic, once at Earth they are able to pierce through Earth's magnetosphere, which, typically, shields our planet from solar particles. SEPs hurtling through space during space weather events

can have enough energy to damage spacecraft and even potentially affect the health of astronauts in space.

Science Goals and Objectives

With this mission, the Sun will act as a "local laboratory," allowing scientists to compare the Sun with other stars elsewhere in the universe. SunRISE will explore the results of solar activity and variations in the environment surrounding the Sun. The mission will study two types of solar radio bursts: one created by electrons near CMEs and another that is released by solar flares.

The SunRISE mission will focus on these main science objectives:

- Investigate the mechanism driving SEPs that are associated with CMEs by creating detailed 3D maps of where radio bursts are emitted in the Sun's atmosphere.
    - This will help scientists to locate particle acceleration and solar radio bursts relative to where CMEs occur and investigate if elements of CMEs could lead to radio bursts.
- Map the Sun's magnetic field lines as they extend out into our solar system and through interplanetary space.

SunRISE Mission

NASA selected SunRISE in 2017 as a Mission of Opportunity proposal. In 2019, the mission continued with an 11-month extended formulation study. In 2020, the mission was approved to begin the preliminary design phase.

The SunRISE mission will fly six small, solar-powered satellites, or SmallSats. Roughly the size of toaster ovens, each vehicle weighs less than approximately 26 pounds (12 kilograms) and measures about 14.2 inches (36 centimeters) tall, 9.4 in (24 cm) long and 4.7 in (12 cm) wide.

The fleet will travel above geosynchronous orbit, flying approximately 22,400 miles (36,000 kilometers) above Earth's surface. At this altitude, the satellites will be operating in a "graveyard orbit" where, typically, defunct satellites are sent to reduce the risk of collisions in orbit. The SunRISE satellites will work together, acting as a single radio telescope that would measure 6.2 miles (10 km) in diameter.

After the fleet arrives in orbit, the mission will undergo a one-month commissioning phase. In the first week of this phase, the team will make contact with each SmallSat using the Deep Space Network (DSN), ensure the satellites are receiving power from their solar panels, check out hardware, and use cold gas thrusters located on each satellite to nudge them into the correct placement in orbit. After a week, the team will check in again and make any necessary adjustments to the SmallSat's orbits.

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Once the space vehicles are determined to be working correctly and in the correct placement in orbit, the team will extend the boom antennas located on each vehicle. These antennas receive the radio signals coming from the Sun. After confirming that the satellites are receiving radio signals, SunRISE will begin a 12-month observation mission, recording these signals 24/7, except when communicating with the DSN. Every week, the operations team will collect data from the fleet. This data is processed and used to create a detailed 3D map of radio emissions coming from the Sun's atmosphere, pointing to the locations of powerful radiation bursts. The mission will also map the Sun's magnetic field lines.

The team will closely track the location of the SmallSats using Global Navigation Satellite System (GNSS) technology. With this knowledge, the team requires only minimal control over the fleet, but if any small position adjustments need to be made throughout the mission, the team can remotely control the fleet's cold gas thrusters to adjust the orbits.

Project Team

The SunRISE mission is led by the University of Michigan in Ann Arbor, Michigan and managed by NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California. The six SmallSats launched with the mission are built by The Space Dynamics Laboratory at Utah State University.

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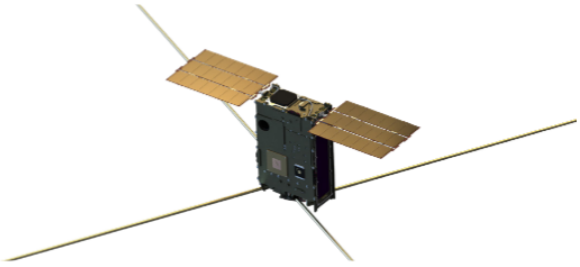

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