solar orbiter
LAUNCH MEDIA KIT

#SolarOrbiter  #WeAreAllSolarOrbiters
Solar Orbiter's mission is to perform unprecedented close-up observations of the Sun and from high-latitudes, providing the first images of the uncharted polar regions of the Sun, and investigating the Sun-Earth connection.

The spacecraft carries 10 state-of-the-art instruments. Remote sensing payloads will perform high-resolution imaging of the Sun's atmosphere – the corona – as well as the solar disc. Other instruments will measure the solar wind and the solar magnetic fields in the vicinity of the orbiter. This will provide unprecedented insight into how our parent star works in terms of the 11-year solar cycle, and how we can better predict periods of stormy space weather.

Solar Orbiter will take just under two years to reach its initial operational orbit, taking advantage of gravity-assist flybys of Earth and Venus to enter a highly elliptical orbit around the Sun.

Solar Orbiter follows in the legacy of missions such as Ulysses (1990-2009) and SOHO (1995-present) and will also provide complementary datasets to NASA's Parker Solar Probe that will allow more science to be distilled from the two missions than either could achieve on their own.

Exploring the Sun
Solar Orbiter will address big questions in space science to help us understand how our star creates and controls the giant bubble of plasma – the heliosphere – that surrounds the whole Solar System and influences the planets within it. It will concentrate on four main areas of investigation: very broadly:

- **Solar wind**: What drives the solar wind and the acceleration of solar wind particles?
- **Polar regions**: What happens in the polar regions when the solar magnetic field flips polarity?
- **Magnetic field**: How is magnetic field generated inside the Sun and how does it propagate through the Sun's atmosphere and outwards into space?
- **Space weather**: How do sudden events like flares and coronal mass ejections impact the Solar System, and how do solar eruptions produce the energetic particles that lead to extreme space weather at Earth?

**Operations**
Solar Orbiter will communicate with Earth via ESA's deep space tracking network, ESTRACK. All operations are conducted by the European Space Operations Centre (ESOC) in Darmstadt, Germany. The Science Operations Centre located at ESA's European Space Astronomy Centre, ESAC, in Villanueva de la Cañada, Spain, will be responsible for science operations planning, and for archiving the mission's data for scientists to use.

**Partners**
Solar Orbiter is a space mission of international collaboration between ESA and NASA. The spacecraft has been developed by Airbus. Numerous industrial partners and scientific institutes across ESA Member States and the US have contributed to the construction of the spacecraft and the scientific instruments.

**About this media kit**
This is an interactive media kit. Navigate between pages from the contents page or with the arrows at the bottom of each page. Explore scientific and technological themes of the Solar Orbiter mission through the series of infographics. Roll over the graphic elements to discover hyperlinks to more information on related webpages. Click on the symbol to directly access the infographic download page. Links to recommended images, videos and animations are provided towards the end of this media kit. An internet connection is required to access the external webpages.
EVENT PROGRAMME

Provisional schedule at ESA’s Space Operations Centre (ESOC), Darmstadt, Germany. All times local CET [Central European Time]. Check esa.int/solarorbiter for programme and updates.

7 February

SocialSpace event We Are All Solar Orbiters for social media enthusiasts. Participants will receive a guided tour of ESA’s mission control, meet the Solar Orbiter flight director and other mission experts, and receive briefings on solar physics, space weather and space debris.

8 February

Main media launch briefing

Programme begins one hour before launch.

Experts will present the mission, supplemented with live transmissions from Cape Canaveral including the moment of liftoff. The spacecraft will separate from the launcher around 53 minutes after launch, followed by the announcement of acquisition of spacecraft signal, which will be communicated live from ESOC.

A Q&A session and opportunities for individual interviews will be included in the programme.

The briefing will end approximately one hour after launch with breakfast.

How to get to ESOC

LIVE UPDATES

Webstreaming

ESA will cover the launch live at esawebtv.esa.int starting approximately 30 minutes before launch. Check website for schedule.

Twitter

For live updates throughout the launch period follow @ESASolarOrbiter.

The official hashtags are #WeAreAllSolarOrbiters #SolarOrbiter

General information about the mission: esa.int/solarorbiter

In-depth information about the mission: sci.esa.int/solar-orbiter

Facebook.com/EuropeanSpaceAgency

Youtube.com/ESA

Instagram.com/europeanspaceagency
SOLAR ORBITER: WHAT'S NEW

- First mission to provide images of the Sun's poles
- Driving future space exploration with new high-temperature technologies
- Unlocking the secrets of how our star works by combining in-situ and remote sensing observations
- Exploring the Sun-Earth connection to better understand space weather
- Taking Europe to within the orbit of planet Mercury for the first time
- A world-class scientific mission in collaboration with NASA
SOLAR ORBITER: ANSWERING THE BIG QUESTIONS

**Magnetic field**
How is the Sun’s magnetic field generated inside the Sun, and how does it propagate through the corona outwards into space?

**Polar regions**
What happens in the polar regions when the solar magnetic field flips polarity?

**Solar wind**
What drives the solar wind, and the acceleration of solar wind particles?

**Space weather**
How do sudden solar events like flares and coronal mass ejections impact the Solar System?

**How do solar eruptions produce the energetic particles that lead to extreme space weather at Earth?**
SOLAR ORBITER: OPERATING IN EXTREME ENVIRONMENTS

42 million kilometres
Closest approach to the Sun, inside the orbit of planet Mercury

Small sliding doors in heatshield let sunlight in to remote sensing instruments situated behind; special windows block heat

Up to 13 times the heating of Earth-orbiting satellites

Many instruments sit in shadow of heatshield

Rotating solar arrays point away from Sun to prevent damage when close-by, or face-on when farther way to generate enough power

The heatshield, tested to withstand up to 500°C, includes titanium, carbon fibre and aluminium
SOLAR ORBITER INSTRUMENTS

- Heliospheric Imager (SoloHI)
- Energetic Particle Detector (EPD)
- Magnetometer (MAG)
- Radio and Plasma Waves (RPW)
- Spectral Imaging of the Coronal Environment (SPICE)
- Solar Wind Plasma Analyser (SWA)
- X-ray Spectrometer/Telescope (STIX)
- Extreme Ultraviolet Imager (EUI)
- Coronagraph (Metis)
- Polarimetric and Helioseismic Imager (PHI)

IN SITU INSTRUMENTS
REMOTE SENSING INSTRUMENTS
SOLAR ORBITER LAUNCH AND DEPLOYMENT SEQUENCE

Launch
7 February 2020
23:15 EST (Eastern Standard Time)
8 February 2020
04:15 GMT (Greenwich Mean Time)
05:15 CET (Central European Time)

1. L+57 min
   Earliest acquisition of signal
   Solar array deployment

2. L+29 hours
   Radio and Plasma Waves (RPW) antenna deployment

3. L+ 36 hours
   Instrument boom deployment

4. L+ 42 hours
   RPW antenna deployment

5. L+ 42 hours
   RPW antenna deployment

6. L+ 49 hours
   High gain antenna deployment

L+ 4 min 09 sec
Atlas-Centaur stage separation

L+ 4 min 27 sec
Fairing separation

L+ 2 min 20 sec
Booster separation

L+ 53 min
Solar Orbiter separation
SOLAR ORBITER JOURNEY AROUND THE SUN

Close approaches to the Sun
- Feb 2021 – within 0.5 au*
- Oct 2022 – within 0.3 au

Launch
- 7 February 2020 (EST)
- 8 February 2020 (GMT)

Earth gravity assist manoeuvre
- 26 Nov 2021

Venus gravity assist manoeuvre
- 26 Dec 2020
- 08 Aug 2021
- 03 Sep 2022
- 18 Feb 2025
- 24 Dec 2026
- 17 Mar 2028
- 10 Jun 2029
- 02 Sep 2030

First polar pass > 17° latitude
- Mar 2025

First polar pass > 24° latitude
- Jan 2027

First polar pass > 30° latitude
- Apr 2028

Polar pass > 33° latitude
- July 2029

300 million km
Maximum distance between Earth and Solar Orbiter

16.5 min
Maximum time for a radio signal to travel one way between Earth and Solar Orbiter

22 orbits
around the Sun

Nov 2021
Start of main mission

Dec 2026
Expected start of extended mission

*1 au = average distance between Sun and Earth (149 597 870 700 m)
EXTREME EXPLORATION WITH SOLAR ORBITER AND PARKER SOLAR PROBE

Solar Orbiter

- **42 million** kilometres to the Sun at closest approach
- **10 instruments** to observe the turbulent solar surface, its hot outer atmosphere, and changes in the solar wind
- **First images** of the Sun’s poles: the key to understanding the Sun’s activity and solar cycle

Providing **complementary measurements** and putting each other’s **data in context**

Answering key questions about **how our star works** and the fundamental processes that lead to space weather at Earth

Using the **gravity of Venus** to get closer and closer to the Sun

Parker Solar Probe

- **6.2 million** kilometres to the Sun at closest approach
- **4 instruments** to study magnetic fields, plasma, energetic particles and solar wind
- **Flies through** the Sun’s inner atmosphere to trace how energy flows through the corona

Providing complementary measurements and putting each other’s data in context
Convective zone
Rapid heating of plasma creates currents of heated and cooled gas

Radiative zone
Energy created in the core diffuses slowly through the plasma

Core
Where the Sun generates its energy via thermonuclear reactions

Corona
The Sun’s outer atmosphere, which extends millions of kilometres into outer space

Coronal mass ejection
Vast eruption of billions of tonnes of plasma and accompanying magnetic fields from the Sun’s corona

Solar wind
A continuous stream of charged particles released from the corona
MISSIONS STUDYING THE SUN

- Parker Solar Probe (2013-present)
- Solar Orbiter (2020-present)
- Solar Dynamics Observatory (SDO) (2010-present)
- Interface Region Imaging Spectrograph (IRIS) (2013-present)
- Solar Wind Magnetosphere Interstellar Link Explorer (SMILE) (2019-present)
- Advanced Composition Explorer (ACE) (1997-present)
- Transition Region and Coronal Explorer (TRACE) (1998-present)
- Solar and Heliospheric Observatory (SOHO) (1995-present)
- Wind (1994-present)
- Yohkoh (1991-2001)
- Sun Earth Connection 2006-2010
- Hinode (2006-present)
- Cluster (1999-present)
- Double Star (2008-present)
- Rosetta Mission (2004-2016)
- Solar Terrestrial Relations Observatory (STEREO) (2006-present)
- E-Athra (2008-present)
- Heliothermal Associated Regional Observing System (HARPS) (2008-present)
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### MEET THE SUN

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Mass</th>
<th>Volume</th>
<th>Temperature</th>
<th>Age</th>
<th>Light travel time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.392 684 km</td>
<td>1.9 x 10³⁰ kg</td>
<td>1.4 x 10²⁷ m³</td>
<td>15 million°C in the Sun’s core</td>
<td>4.6 billion years</td>
<td>8 min for light to reach Earth</td>
</tr>
</tbody>
</table>

- **About 109 Earth diameters**
- **About 333 060 Earths**
- **1.3 million Earths could fit inside the Sun**
- **5500°C at the Sun’s surface**
- **The Sun is halfway through its life**

### Impressive characteristics

- **Rotation**
  - 36 days at the poles
  - 25 days at the equator
- **Speed**
  - 220 km/s around the galaxy
  - 250 million years to orbit the centre of the Milky Way
- **Flipping magnetic field**
  - every 11 years
- **Biggest solar storm to hit Earth**
  - recorded in 1859
- **Largest sunspot**
  - measured in 1947
  - 35 times Earth’s area
SOLAR ORBITER TEAM

KEY MISSION SPOKESPEOPLE

César García Marrodriga
ESA Project Manager

Anne Pacros
ESA Payload Manager

Daniel Mueller
ESA Project Scientist

Yannis Zouganelis
ESA Deputy Project Scientist

Andrea Accomazzo
ESA Flight Director

Sylvain Lodiot
ESA Spacecraft Operations Manager

Haydee Maldonado
NASA Project Manager

Holly Gilbert
NASA Project Scientist

Teresa Nieves-Chinchilla
NASA Deputy Project Scientist

CONTENTS

SCIENCE TEAM PRINCIPAL INVESTIGATORS

EPD: Energetic Particle Detector
Javier Rodríguez-Pacheco
University of Alcalá
Spain

EUI: Extreme Ultraviolet Imager
David Berghmans
Royal Observatory
Belgium

MAG: Magnetometer
Tim Horbury
Imperial College London
United Kingdom

METIS: Coronagraph
Marco Romoli
INAF, University of Florence
Italy

PHI: Polarimetric and Helioseismic Imager
Sami Solanki
Max-Planck-Institut für Sonnensystemforschung
Germany

RPW: Radio and Plasma Waves Instrument
Milan Maksimovic
LESIA, Observatoire de Paris
France

SoloHI: Heliospheric Imager
Russell A. Howard
US Naval Research Laboratory
Washington, D.C., USA

SPICE: Spectral Imaging of the Coronal Environment
Frédéric Auchère
IAS, Orsay
France

STIX: X-ray Spectrometer/Telescope
Säm Krucker
FHNW, Windisch
Switzerland

SWA: Solar Wind Plasma Analyser
Christopher Owen
Mullard Space Science Laboratory
United Kingdom
ANIMATIONS AND VIDEOS

- Solar Orbiter Array Deployment Test
- Building Solar Orbiter Timelapse
- Solar Orbiter Launch
- Solar Orbiter Fairing Separation
- Solar Orbiter Separation from Launcher
- Solar Orbiter Solar Array Deployment
- Solar Orbiter Boom and Antenna Deployments
- Solar Orbiter Earth Flyby
- Solar Orbiter Venus Flyby
- Solar Orbiter Facing the Sun
- Solar Orbiter Facing the Sun
- Solar Orbiter's Journey Around the Sun
Multimedia

A variety of photographs, illustrations, graphics and animations are available via:

- ESA Space in Images
- ESA Space in Videos
- ESA’s Photo Library for Professionals
- ESA’s Video Library for Professionals

See also pages 16-19 in this media kit for recommended multimedia products

Solar Orbiter on social media

- Twitter: @ESASolarOrbiter
- Official hashtags: #WeAreAllSolarOrbiters #SolarOrbiter

Solar Orbiter online

- General information: esa.int/solarorbiter
- In-depth information: sci.esa.int/solar-orbiter
- Solar Orbiter at NASA: nasa.gov/solarorbiter
THANK YOU FOR JOINING US FOR THE LAUNCH OF SOLAR ORBITER!