

Zooming into the sun with Solar Orbiter

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ESA's Solar Orbiter mission will face the sun from within the orbit of Mercury at its closest approach. Credit: ESA/ATG medialab

Solar Orbiter's latest images shows the full sun in unprecedented detail. They were taken on 7 March, when the spacecraft was crossing directly between the Earth and sun.

One of the images, taken by the Extreme Ultraviolet Imager (EUI) is the highest resolution image of the sun's full disk and [outer atmosphere](#), the corona, ever taken.

Another image, taken by the Spectral Imaging of the Coronal Environment (SPICE) instrument represents the first full sun image of its kind in 50 years, and by far the best one, taken at the Lyman-beta wavelength of ultraviolet light that is emitted by hydrogen gas.

The images were taken when Solar Orbiter was at a distance of roughly 75 million kilometers, half way between our world and its parent star. The high-resolution telescope of EUI takes pictures of such high spatial resolution that, at that close distance, a mosaic of 25 [individual images](#) is needed to cover the entire sun. Taken one after the other, the full image was captured over a period of more than four hours because each tile takes about 10 minutes, including the time for the [spacecraft](#) to point from one segment to the next.

In total, the [final image](#) contains more than 83 million pixels in a 9148 x 9112 pixel grid. For comparison, this image has a resolution that is ten times better than what a 4K TV screen can display.

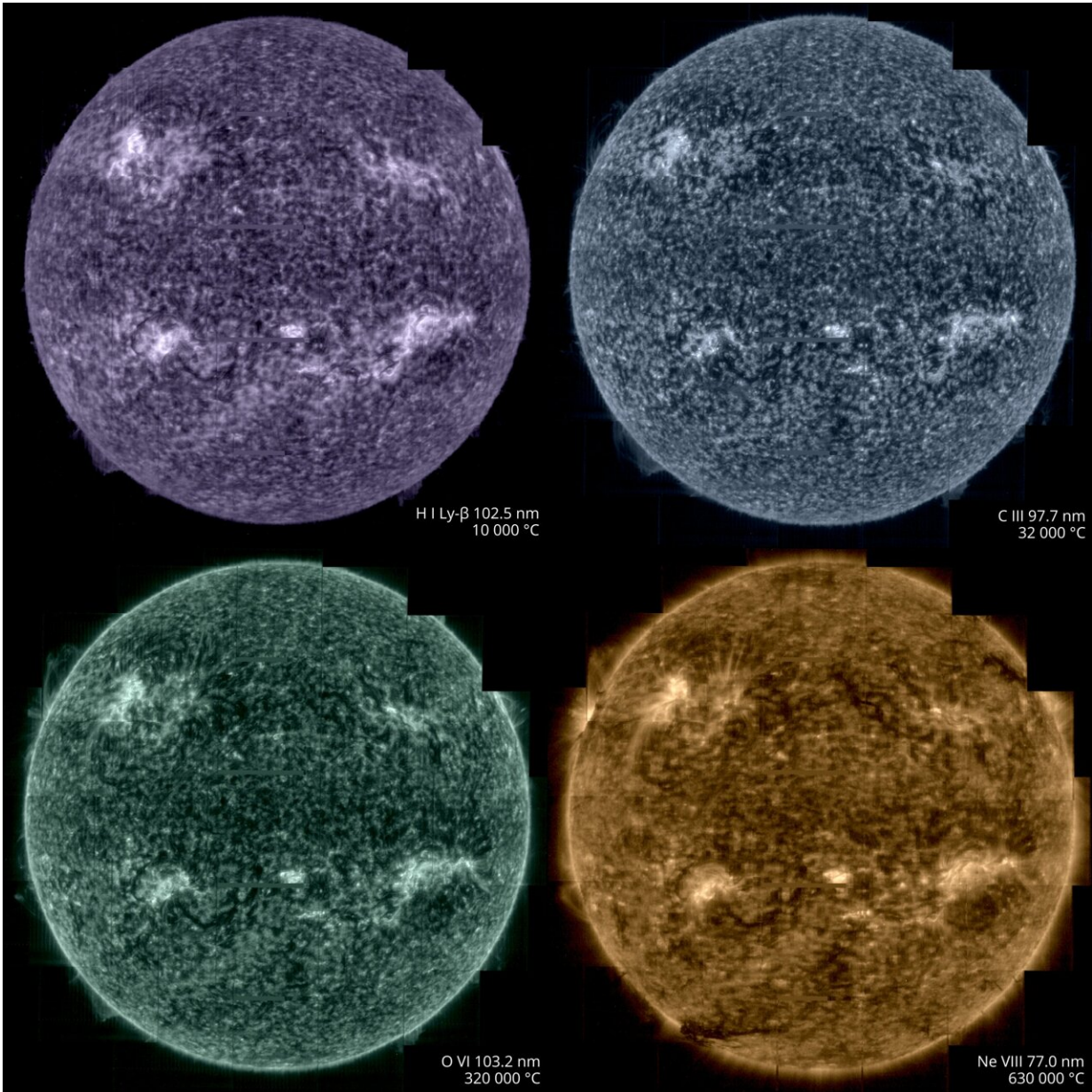
EUI images the sun at a wavelength of 17 nanometers, in the extreme ultraviolet region of the electromagnetic spectrum. This reveals the sun's upper atmosphere, the corona, which has a temperature of around a million degrees Celsius.

At the 2 o'clock (near the image of the Earth for scale) and 8 o'clock positions on the edges of the sun, dark filaments can be seen projecting away from the surface. These "prominences" are prone to erupt, throwing huge quantities of coronal gas into space and creating "space weather" storms.

In addition to EUV, the SPICE instrument was also recording data during the crossing. These too needed to be pieced together as a mosaic.

SPICE is designed to trace the layers in the sun's atmosphere from the corona, down to a layer known as the chromosphere, getting closer to the surface. The instrument does this by looking at the different wavelengths of extreme ultraviolet light that come from different atoms.

In the SPICE sequence of images purple corresponds to hydrogen gas at a temperature of 10,000°C, blue to carbon at 32,000°C, green to oxygen at 320,000°C, yellow to neon at 630,000°C.



Solar Orbiter took images of the sun on 7 March, from a distance of roughly 75 million kilometres, using its Spectral Imaging of the Coronal Environment (SPICE) instrument. SPICE takes simultaneous “spectral images” at several different wavelengths of the extreme ultraviolet spectrum by scanning its spectrometer slit across a region on the sun. The different wavelengths recorded correspond to different layers in the sun’s lower atmosphere. Purple corresponds to hydrogen gas at a temperature of 10 000°C, blue to carbon at 32 000°C, green to oxygen at 320 000°C, yellow to neon at 630 000°C. Each full-sun image is made up of a mosaic of 25 individual scans. It represents the best full sun image

taken at the Lyman beta wavelength of ultraviolet light that is emitted by hydrogen gas. Credit: ESA & NASA/Solar Orbiter/SPICE team; Data processing: G. Pelouze (IAS)

This will allow solar physicists to trace the extraordinarily powerful eruptions that take place in the corona down through the lower atmospheric layers. It will also allow them to study one of the most puzzling observations about the sun: how the temperature is rising through the ascending atmospheric layers.

Usually the temperature drops as you move away from a hot object. But above the sun, the corona reaches a million degrees Celsius whereas the surface is only about 5000°C. Investigating this mystery is one of the key scientific objectives of Solar Orbiter.

The images were taken on 7 March, precisely when Solar Orbiter crossed the sun-Earth line, so the images can be compared with Earth-bound solar instruments and cross-calibrated. This will make it easier to compare results from different instruments and observatories in future.

On 26 March, Solar Orbiter reaches another mission milestone: its first close perihelion. The spacecraft is now inside the orbit of Mercury, the [inner planet](#), taking the highest resolution [images](#) of the sun it can take. It is also recording data on the solar wind of particles that flows outwards from the sun.

And this is just the start, over the coming years the spacecraft will repeatedly fly this close to the sun. It will also gradually raise its orientation to view the sun's previously unobserved polar regions.

Solar Orbiter is a space mission of international collaboration between

ESA and NASA.

Provided by European Space Agency

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