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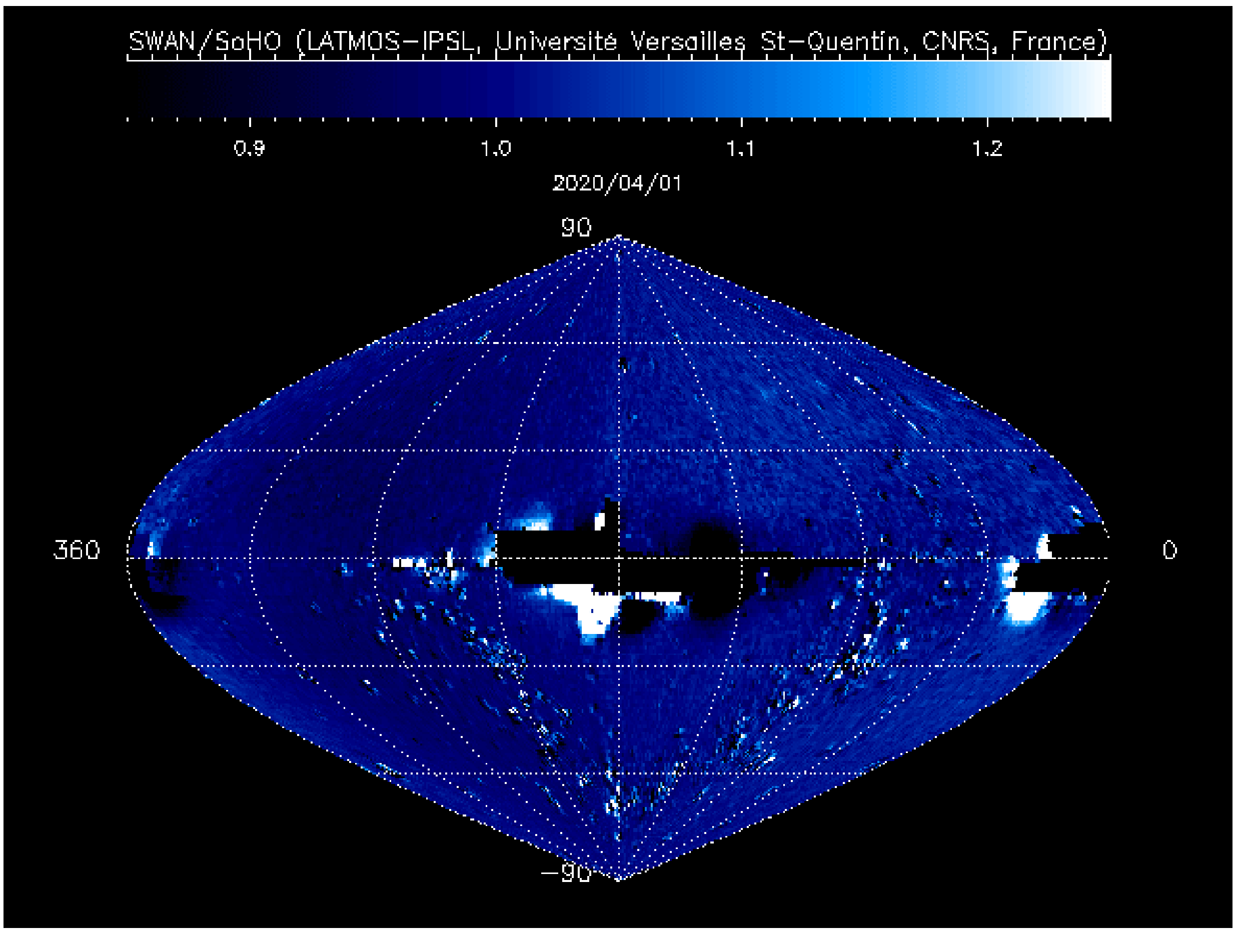
The discovery of Comet SWAN by solar-watcher SOHO

May 13 2020



Spotting a comet in the all-sky maps from SOHO's instrument SWAN. Credit: ESA/NASA/SOHO

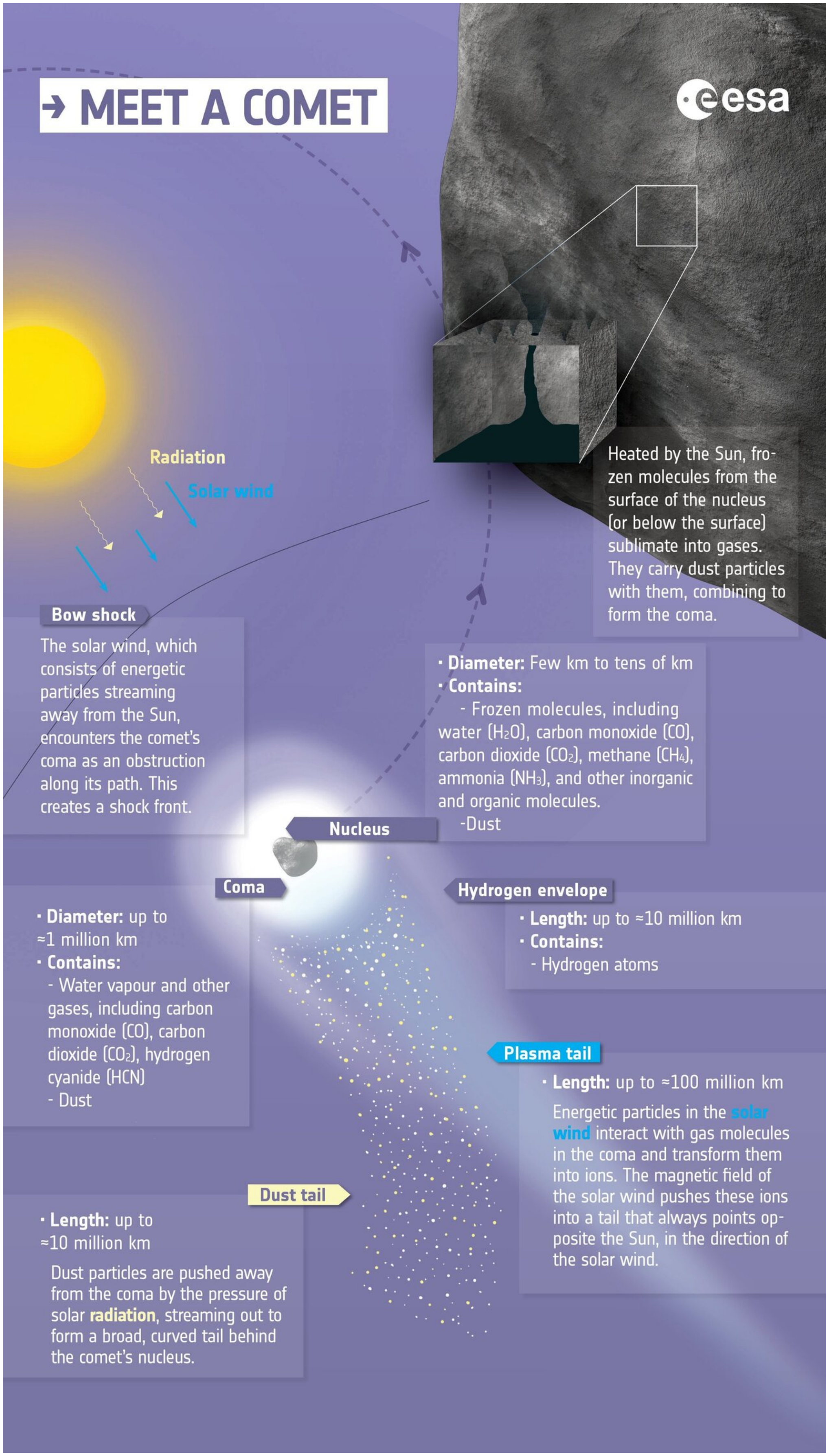
Currently crossing the skies above Earth, Comet C/2020 F8 (SWAN) has the potential to become a more prominent naked eye object by late May or early June. Yet it wasn't discovered by someone looking up at the night sky. Instead, the person was looking at a computer screen.

Amateur astronomer Michael Mattiazzo from Australia spotted this icy visitor from the outer Solar System while inspecting images that had been posted online from the Solar Wind ANisotropies (SWAN) instrument aboard SOHO, the ESA/NASA Solar and Heliospheric Observatory.

SWAN captures images in ultraviolet light, including a specific ultraviolet wavelength called Lyman alpha. This is a wavelength that is characteristically emitted by hydrogen atoms. The instrument's primary goal is to map changes in the solar wind, the variable flow of charged particles that is continuously released by the Sun into interplanetary space. In addition, it has become an effective discoverer of comets too because comets are also sources of hydrogen.

In the case of a comet, the hydrogen comes from the water vapour the icy core releases into space when heated by the Sun. And there is more, as solar radiation can break water molecules (H_2O) into a single hydrogen atom (H) and a hydrogen-oxygen pair (which scientists call a hydroxyl radical, or OH). The result is a cloud of hydrogen that surrounds the comet, giving off a bright spot of Lyman-alpha light that can be spotted in the SWAN maps.

Almost every day, SWAN records a complete map of the sky. These raw sky maps are full of stars, making it difficult to pick out new comets, which may arrive at random from any direction. To make the job easier, successive maps are automatically subtracted from one another, removing the stars and leaving only variable or moving sources visible.


→ MEET A COMET
esa
Heated by the Sun, frozen molecules from the surface of the nucleus (or below the surface) sublimate into gases. They carry dust particles with them, combining to form the coma.
Radiation
Solar wind
Bow shock
The solar wind, which consists of energetic particles streaming away from the Sun, encounters the comet's coma as an obstruction along its path. This creates a shock front.
• Diameter: Few km to tens of km
• Contains:
- Frozen molecules, including water (H_2O), carbon monoxide (CO), carbon dioxide (CO_2), methane (CH_4), ammonia (NH_3), and other inorganic and organic molecules.
-Dust
Nucleus
Coma
• Diameter: up to ≈1 million km
• Contains:
- Water vapour and other gases, including carbon monoxide (CO), carbon dioxide (CO_2), hydrogen cyanide (HCN)
- Dust
Hydrogen envelope
• Length: up to ≈10 million km
• Contains:
- Hydrogen atoms
Plasma tail
• Length: up to ≈100 million km
Energetic particles in the solar wind interact with gas molecules in the coma and transform them into ions. The magnetic field of the solar wind pushes these ions into a tail that always points opposite the Sun, in the direction of the solar wind.
Dust tail
• Length: up to ≈10 million km
Dust particles are pushed away from the coma by the pressure of solar radiation, streaming out to form a broad, curved tail behind the comet's nucleus.

Anatomy of a comet - Infographic. Credit: European Space Agency

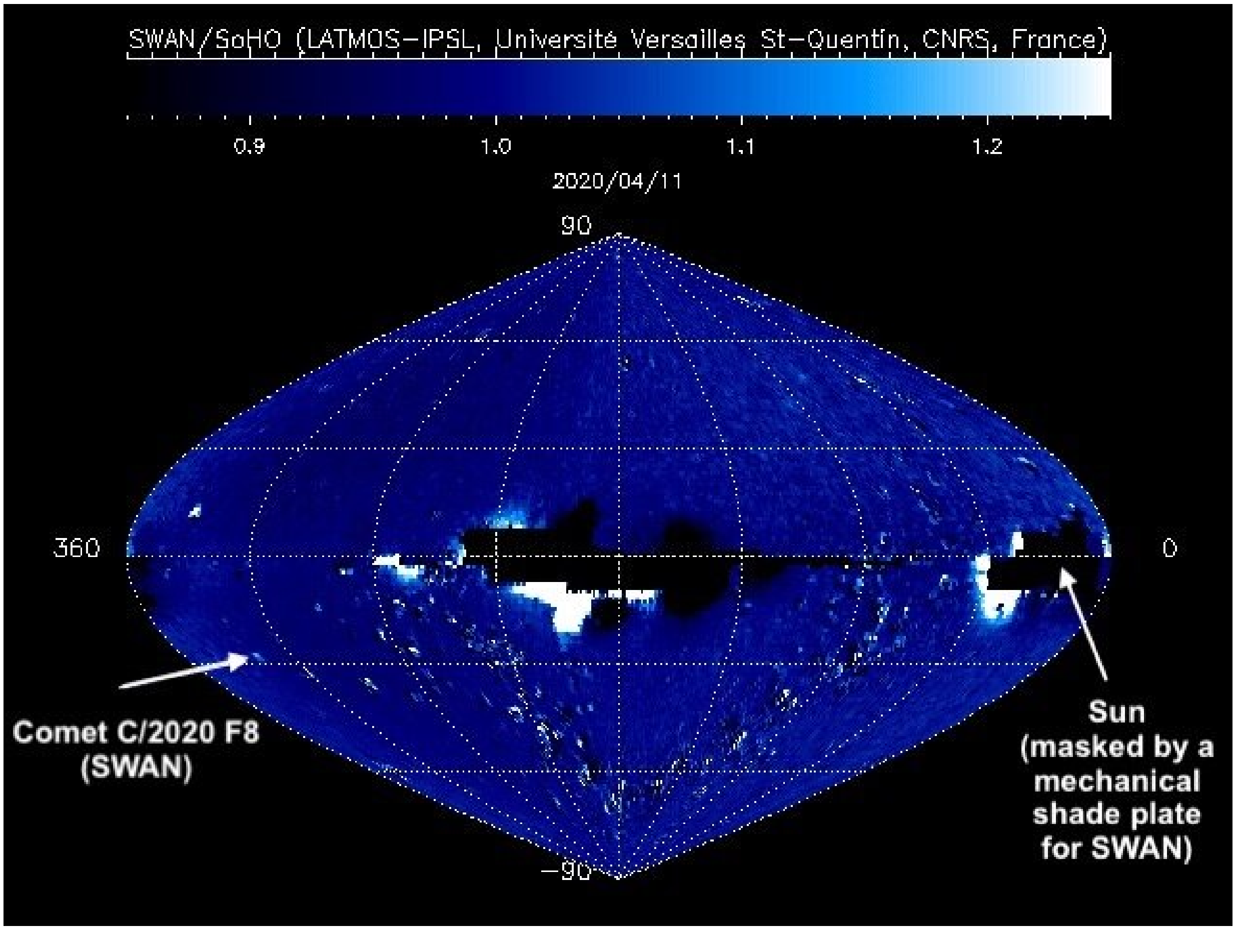
These 'difference images' are regularly posted online on the SOHO website, meaning that anyone with internet access can look at these 'comet tracker's maps' and join the search for new comets. To date, twelve of them have been spotted in the SWAN data since 1996, all of them by amateur astronomers, or citizen scientists as they are also known.

In the case of this current comet, Mattiazzo (who has already discovered eight comets using this method) found it by comparing the SWAN maps from several days in early April 2020.

From discovery to observation

Once the comet had been announced, Austrian astrophotographer Gerald Rhemann obtained a beautiful image of it from the desert in Namibia, clearly showing the spherical gas cloud of the comet's coma and its extended ion tail. When the image was published as Astronomy Picture of the Day (APOD) on 29 April, it helped bring the comet to wide scale attention.

Another image, taken a few days later by British astrophotographer Damian Peach using a remote telescope in Chile and also featured as APOD, portrays the impressive comet's tail as it closed in on Earth. The closest approach is estimated for today, 13 May, at around 85 million km from our planet.



Comet SWAN in all-sky map from SOHO. Credit: ESA/NASA/SOHO

The SWAN team's comet expert, Michael Combi from the University of Michigan, estimates that by 15 April the comet was ejecting about 1300 kg of water vapour every second, or about 4.4 x 10^{28} H_2O molecules every second. That is a fast rate of ejection when compared to other comets.

"This is already three times more than Comet 67P/Churyumov-Gerasimenko at its best, when it was visited by ESA's Rosetta mission between 2014 and 2016," says Jean-Loup Bertaux, former principal investigator and proposer of the SWAN instrument.

Will Comet SWAN become an obvious naked eye object?

The comet's vigour could be significant for observers on Earth. The more material ejected from the comet, the more sunlight it reflects and the more visible it becomes. Currently moving from the southern to the northern skies, it is just faintly visible to the naked eye, but current estimates suggest that, by the end of May, it could be significantly brighter—if it survives that long.

Comets are fragile objects, and can often break apart as they approach the Sun. In late April, the much anticipated Comet ATLAS suffered this fate, breaking into at least 30 fragments. Comet SWAN is now entering the 'danger zone' and will reach its closest point to the Sun on 27 May—at this time, the solar heating will be at its maximum.

It can be extremely difficult to predict the behaviour of comets that make such close approaches to the Sun, but scientists are hopeful that Comet SWAN will remain bright enough to see as it continues its journey. If the comet survives, star gazers on Earth should look for it near the bright star Capella in the constellation of Auriga, the Charioteer. This is almost certainly the only time the comet will be visible in our lifetimes: estimates are not yet fully precise, but it is clear that the comet's orbital period is measured in thousands or even millions of years.

Provided by European Space Agency