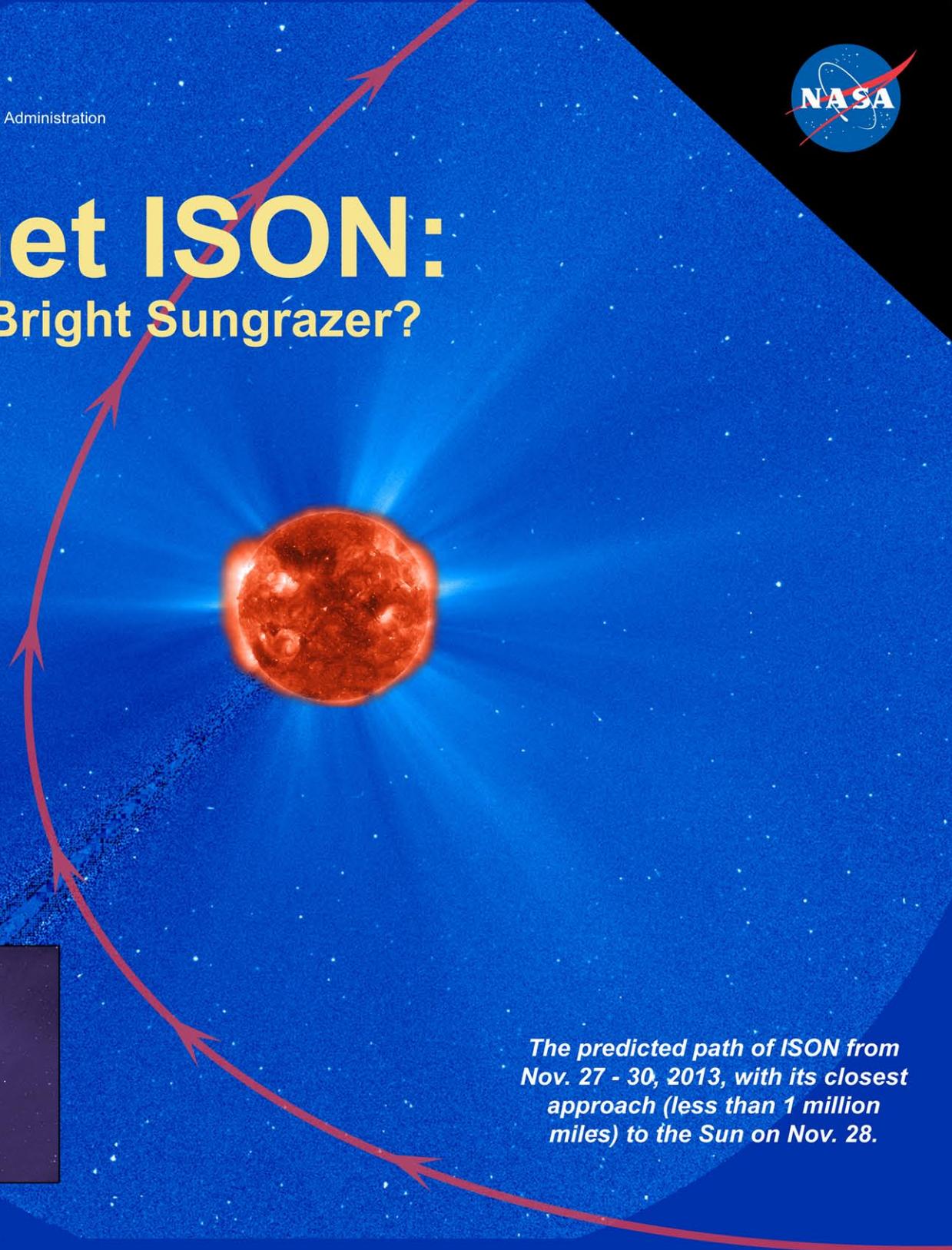




# Comet ISON: The Next Bright Sungrazer?

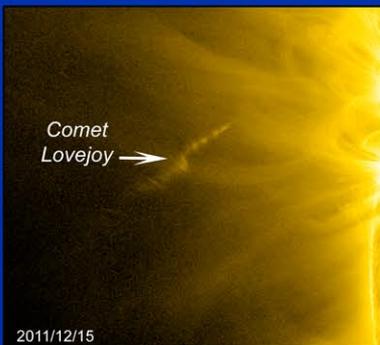


[www.nasa.gov](http://www.nasa.gov)

*The predicted path of ISON from Nov. 27 - 30, 2013, with its closest approach (less than 1 million miles) to the Sun on Nov. 28.*



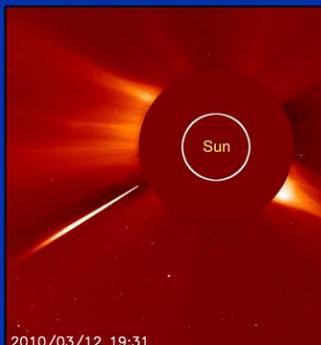
*Comet McNaught observed from Earth*



*Comet Lovejoy* →

2011/12/15

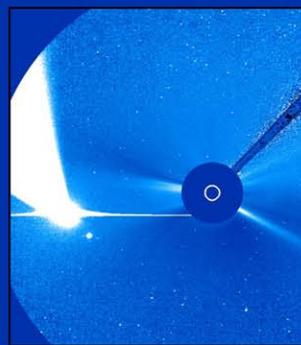
*Comet Lovejoy moving through the Sun's atmosphere*



Sun

2010/03/12 19:31

*Comet diving towards the Sun*



Sun

*Comet McNaught orbiting by the Sun (2007)*



Comet C/2011 L4 (Pan-STARRS)  
NASA STEREO/SECCHI HI-1B  
March 12, 2013 16:09UT

Earth

*Comet Pan-STARRS captured by the STEREO spacecraft*

# COMET ISON:

## Why is Comet ISON of Special Interest?

In November 2013, comet C/2012 S1 (ISON) will pass the Sun at just about 730,000 miles (or 1.2 million km) above the solar surface, classifying it as a Sungrazing Comet, and potentially a spectacular one! Comet ISON has the potential to reach significant brightness, to the point that when it is closest to the Sun in late November, it may briefly be bright enough to be seen in the daytime skies next to the Sun. It might even be visible in the night skies for months. Then again, the possibility certainly exists that this comet may not attain these levels of brightness, and indeed could even “fizzle” before reaching us. Yet this comet is large: an estimated 3 miles (5 km) across. So, we’ll have to wait and see. It is already within the orbit of Mars, sprinting towards the Sun.

Based on ISON’s orbit, astronomers think the comet is making its first-ever trip through the inner solar system. Before beginning its long fall toward the Sun, the comet resided in the Oort comet cloud, a vast shell of perhaps a trillion icy bodies that is believed to be way out in the outer reaches of the planetary system. It was first spotted when it was near Jupiter by two Russian astronomers Vitali Nevski and Artyom Novichonok in September, 2012. It bears the name of their night-sky survey program, the International Scientific Optical Network (ISON).

## What is a Comet?

A comet is a cosmic snowball of frozen gases, rock and dust roughly the size of a small town. When a comet’s orbit brings it close to the sun, it heats up and spews dust and gases into a giant glowing head larger than most planets. The dust and gases form a tail that stretches away from the sun for millions of kilometers. Comets come from beyond our solar system and are believed to be left over pieces of matter from the our solar system was formed. The solid nucleus or core of a comet consists mostly of ice and dust coated with dark organic material, with the ice composed mainly of frozen water but perhaps other frozen substances as well, such as ammonia, carbon dioxide, carbon monoxide and methane. The nucleus might have a small rocky core.

As a comet gets closer to the sun, the ice on the surface of the nucleus begins turning into gas, forming a cloud known as the coma. Radiation from the sun pushes dust particles away from the coma, forming a dust tail, while charged particles from the sun convert some of the comet’s gases into ions, forming an ion tail, usually seen in a bluish tone. Since comet tails are shaped by sunlight and the solar wind, they always point away from the Sun.



*Comet Hale-Bopp, photographed in 1997*

## What Does It Look Like?

This NASA Hubble Space Telescope image of Comet (C/2012 S1) ISON was photographed on April 10, 2013 when the comet was slightly closer than Jupiter's orbit at a distance of 386 million miles from the Sun (394 million miles from Earth). Even at that great distance the comet is already active as sunlight warms the surface and causes frozen elements to burn off. A detailed analysis of the dust ball surrounding the solid, icy nucleus reveals a strong, jet blasting dust particles off the sunward-facing side of the comet's core.

Preliminary measurements from the Hubble images suggest that the nucleus of ISON is no larger than three or four miles across. This is remarkably small considering the high level of activity observed in the comet so far, said researchers. Astronomers are using these images to measure the activity level of this comet and constrain the size of the nucleus, in order to predict the comet's activity when it skims 700,000 miles above the sun's roiling surface on November 28. The comet's dusty coma, or head of the comet, is approximately 3,100 miles across, or 1.2 times the width of Australia. A dust tail extends more than 57,000 miles, far beyond Hubble's field



*Comet ISON on April 10, 2013*

of view. More careful analysis is currently underway to improve these measurements and to predict the possible outcome of the sungrazing perihelion passage of this comet. This image was taken in visible light. The blue false color was added to bring out details in the comet structure.

## How Will NASA Observe this Comet?

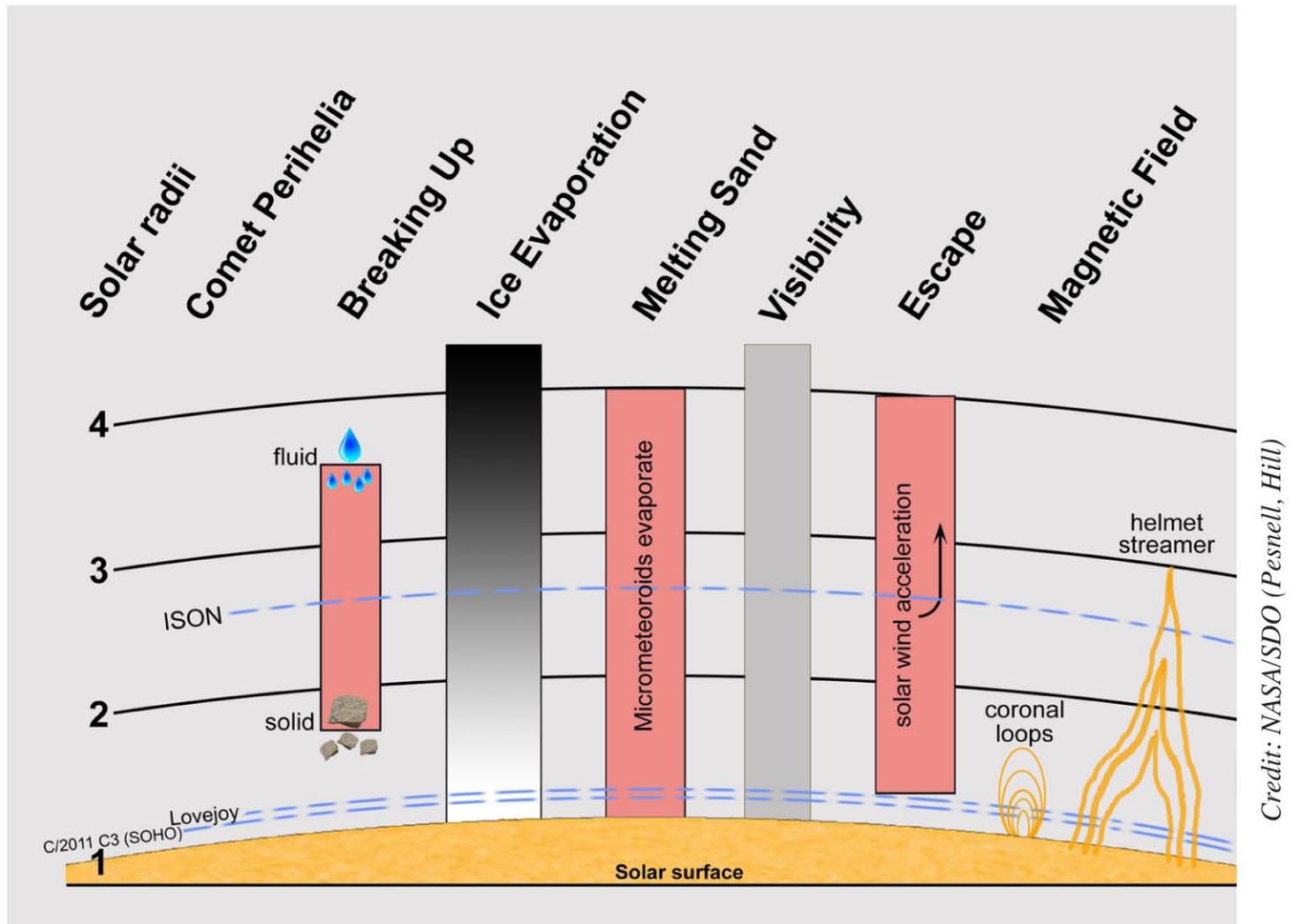
Teams of NASA scientists are making detailed plans to study this unusual event. Numerous ground-based observatories are preparing to coordinate their observations. The National Science Foundation is also enthusiastic about observers proposing to study ISON.

For space-based mission, observing campaigns are planned by the SOHO, STEREO and Solar Dynamics Observatory (SDO) solar missions; by Spitzer, Chandra and Hubble space telescopes; and by the Deep Impact, JUNO, Mercury MESSENGER, Mars Odyssey and Mars Reconnaissance Orbiter missions. Other missions at or on Mars are looking into observing ISON, as are a handful of other NASA Planetary missions. And, astronomers around the world are planning studies to characterize its behavior leading up to, and hopefully following, its solar passage. Of particular interest will be observations of ISON when it is very close to the Sun where extensive comet studies are rare.

# Comet of the Century?

## How Might ISON React to its Solar Passage?

The major solar missions are particularly excited to see what happens when the comet travels so close to the Sun. The ability to observe this did not exist before SDO was launched in 2010, and SDO has only observed two comets to date. On **November 28, 2013**, comet ISON will reach perihelion (its closest point to the Sun) at a distance less than 3 solar radii. Although they are numerous, most comets



of this class are very small and faint, and don't survive their close approach to the Sun. Those that do, however, tend to be very spectacular. ISON became active when it was over 5 AU (Astronomical Units) from the Sun (beyond Jupiter's orbit), which means it is different from more typical sungrazing comets and may have a nucleus large enough to survive its perihelion passage. NASA's SDO will adjust its cameras and turn them towards the comet when it nears the Sun so that scientists can see in great details how it reacts. A lot can be learned about the chemistry of the comet this way.

As the graphic (above) shows, part of the comet may break up due to the extreme heat. The close passage should cause it to brighten considerably as its surface begins to burn off. Note, it will fly above the height of coronal loops. At its quick pace, it should disappear and reappear around the Sun in about an hour.

## How Does ISON Compare?

Some people compare ISON to Comet Lovejoy, a smaller comet which flew through the Sun's atmosphere in 2011 at a lower level. Lovejoy emerged intact and wowed observers with a garish tail for weeks. Comet ISON is probably at least twice as big as Comet Lovejoy and will pass a bit farther from the Sun's surface, which would seem to favor Comet ISON surviving and putting on a good show. One exciting possibility would be a partial break-up. "If Comet ISON splits, it might appear as a 'string of pearls' when viewed through a telescope," speculates Karl Battams, a sungrazing comet specialist. "It might even resemble the famous Comet Shoemaker-Levy 9 that hit Jupiter in 1994." However, a break-up would pose no threat to Earth. Comet ISON is not on a collision course. If it breaks up, the fragments would continue along the same trajectory as the original comet.



Great Comet of 1680, by Lieve Verschuier (c.1680).

The orbit of Comet ISON also has an interesting similarity with another bright sungrazing comet, the Great Comet of 1680. The two comets don't have the same orbits, but the similarity between these two bright sungrazers is remarkable. One thing, however, is for sure: they are not the same comet. Comet 1680 is currently 250 AU from the Sun, and isn't due back for 9000 years. But the similarity suggests they have a common origin. Perhaps they are two fragments of a much larger comet? The Great Comet of 1680 has the distinction of being the first comet discovered by telescope and became one of the brightest comets of the 17th century – reportedly visible even in daytime – and was noted for its spectacularly long tail.

Whatever happens, northern sky watchers will get a good view. For months after it swings by the Sun, Comet ISON will be well placed for observers in the Northern Hemisphere. It will pass Earth on Dec. 26, approaching within 39.9 million miles (64.2 million km). It will pass almost directly over the North Pole, making it an object visible all night long.

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## Links to Additional Resources:

Many NASA links and resources on ISON are online here:

<http://solarsystem.nasa.gov/ison>

Trace ISON's orbit from various points of view in this animation:

<http://svs.gsfc.nasa.gov/vis/a010000/a011200/a011222/>

Solar Dynamics Observatory close-up, live coverage of ISON going around the Sun, Nov. 28, 2013

<http://sdo.gsfc.nasa.gov>

STEREO spacecraft watching ISON, Oct. 10 - Dec. 7, 2013

[http://stereo-ssc.nascom.nasa.gov/comet\\_ison/](http://stereo-ssc.nascom.nasa.gov/comet_ison/)

An overview on comets:

<http://solarsystem.nasa.gov/planets/profile.cfm?Object=Comets>

Build your own comet activity (Grade 5-8):

[http://solarsystem.nasa.gov/educ/lesson-view.cfm?LS\\_ID=706](http://solarsystem.nasa.gov/educ/lesson-view.cfm?LS_ID=706)