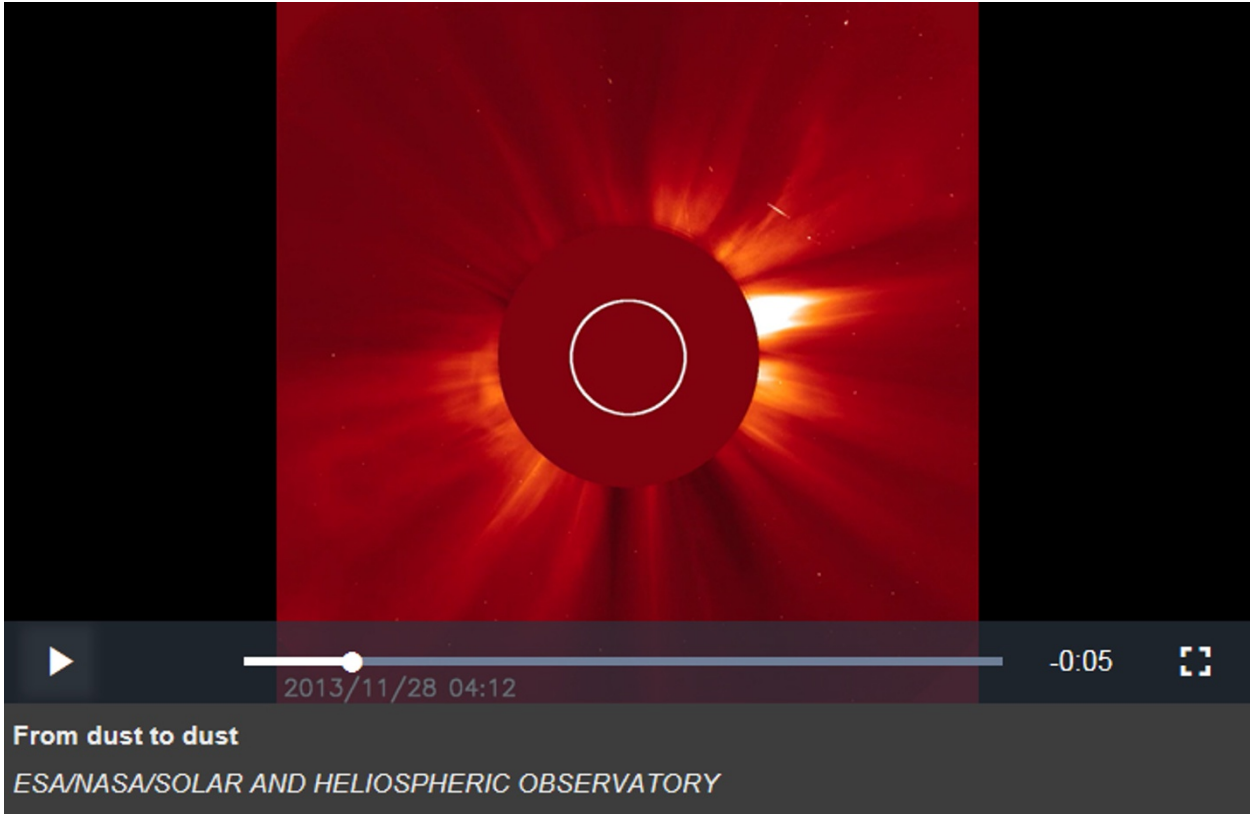


Remnants suggest comet ISON still going

First given up for dead, 'dirty ice ball' may have partially survived close brush with the Sun.

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Comet ISON entered the annals of astronomical history on the night of 28 November, when it flew past the Sun and, latest updates suggest, emerged in tatters on the other side after many skywatchers had given it up as dead.

Still, the most recent images hint that most of ISON's nucleus disintegrated as the comet approached the Sun, leaving only a slim chance there will be anything left to see with the naked eye over the Northern Hemisphere in coming weeks.

Analysis of the light coming from ISON will determine whether it is now just a spray of dust and gas, or whether any significant portion survived, says Gerhard Schwehm, an European Space Agency comet expert based in Noordwijk, The Netherlands and a former head of ESA's Solar System Science Operations Division. "Either there's only a small piece left, or the nucleus is really totally disintegrated and we just see the debris of the comet travelling along," he says.

ISON's future remains unclear, but it has already upended scientific understanding of these 'sungrazing' comets. ISON was making its first, and possibly only, journey from the deep freeze of the outer Solar System into the furnace of the star's outer corona. Never before have researchers followed a comet so pristine coming so close to the Sun.

Blazing radiation and powerful gravitational forces pummelled and stretched the 'dirty ice ball' — as comets are sometimes called in reference to their composition — as it approached the star. Pictures from Sun-watching satellites initially showed ISON as it had appeared for months: a coherent nucleus followed by a broad dust tail and narrow ion tail.

Comet confusion

But as ISON got closer to the star, things became more confusing. Analyses of light captured by NASA's twin STEREO spacecraft seemed to show the comet growing dimmer. Next, pictures from NASA's Solar Dynamics Observatory, which should have captured

ISON on its closest approach to the Sun, showed absolutely nothing.

Then the European–US Solar and Heliospheric Observatory spotted a faint glimmer on the other side of the Sun, on a trajectory where ISON would have been expected to appear.

It looked like a spray that brightened and smeared out sideways as it flew. Whether any sizeable portion of ISON remains intact will be determined during the coming hours and days. Karl Battams, an astrophysicist at the Naval Research Laboratory in Washington DC who specializes in sungrazing comets, summed up the astonishment and frustration of many. On Twitter, after a long day of conflicting updates, he wrote that he and a colleague had “looked at literally a couple of thousand sungrazing comets. We’ve NEVER seen one behave like #ISON. Astounding!”

Russian astronomers discovered ISON in September 2012 using the International Scientific Optical Network. Research suggested that millions of years ago, a passing star knocked it out of a reservoir of comets, far beyond Pluto.

There is no strict definition of sungrazing comets, and most of those known are much smaller than ISON. Perhaps the closest analogy is comet Lovejoy, which in 2011 passed through the uppermost reaches of the solar atmosphere and emerged mostly intact. Lovejoy disintegrated several days later¹, providing a skywatching delight in the Southern Hemisphere. Another sungrazer, Ikeya-Seki, shattered into fragments after flying past the Sun in 1965.

Comet scientists have argued for months whether ISON would survive passing just 1.2 million kilometres away from the Sun (see ‘[Comet expected to survive close Sun encounter](#)’). Its relatively small size, no more than about a kilometre across, suggested that it might be particularly vulnerable to disruption.

“I’d like to know what happened to our half-mile of material,” says Dean Pesnell, project scientist for the Solar Dynamics Observatory and a solar physicist at NASA’s Goddard Space Flight Center in Greenbelt, Maryland.

Based on photometric analysis of the comet’s brightness, Battams says it looks to him as though a “chunk” has survived, but that it is impossible to determine its size with the available instruments. “We would prefer one more day before we speculate on the future for this object, as the possibility remains that it’s a loose collection of rubble that will rapidly fade. That said, right now it appears to be behaving like a comet,” he says.

Despite the fact that no one really knows what happened to it yet, ISON is probably the most observed comet ever.

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References

1. Sekanina, Z. & Chodas, P. W. *Astrophys. J.* **757**, 127 (2012).