Special Feature

An Icy Traveler Sweeps Past Mars

By NASA's Amazing Space reporters
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ABOUT A MILLION YEARS ago, an icy comet began its journey from its home in our distant solar system, hundreds of times farther out than any planet. Now, the comet has finally reached our inner solar system neighborhood as it follows its long path around the Sun. Like the planets in our solar system, the icy comet, nicknamed Siding Spring, is bound by the Sun's gravity.

Comet Siding Spring was discovered in 2013 by astronomers at the Siding Spring Observatory in Australia. Since Comet Siding Spring's discovery, astronomers have observed it with many telescopes, including the Hubble Space Telescope. Hubble images taken in October 2013 and March 2014 show two jets of dust coming from the comet's core, or nucleus. The jets arise as the comet nears the Sun. The Sun's heat warms

Caution: Comet crossing! Hubble captures comet as it whizzes past Mars

Hubble images of Comet Siding Spring and Mars are combined to show their close encounter on Oct. 19, 2014. At their closest, the distance between the comet and Mars was about a third of the distance between the Moon and Earth, or about 87,000 miles. Although the passage was a “near miss” in solar system terms, one can see from this image that the size of the comet’s cloudy coma was not big enough to have a strong effect on the Red Planet.

Astronomers made a composite image, using separate Hubble observations of the comet and of Mars, for two main reasons. First, it is a challenge to image bright and faint objects at the same time. Mars is about 10,000 times brighter than Comet Siding Spring. To get a clear image of both Mars and the comet, a separate image must be taken of each object.

Second, the comet and Mars are moving across the sky in different directions. Astronomers can only program Hubble to follow one object’s motion at a time. Other objects with different motions will be blurred. Using a composite image, Hubble can illustrate the encounter and show each object clearly.

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the comet’s ice, turning it into gas that is blown off as jets.

The comet has created plenty of excitement among astronomers because it passed very close to Mars. In fact, the comet’s record-breaking flyby on Oct. 19 was only one-third of the distance between Earth and the Moon.

**Collisions with solar system planets**

Astronomers, however, have actually witnessed a comet striking a solar system planet. In 1994, two dozen pieces of Comet Shoemaker-Levy 9 smashed into Jupiter. The collision didn’t damage the planet, but it left behind black scars in Jupiter’s clouds. The Hubble telescope took images of the mushroom-shaped fireballs of hot gas sent into the planet’s upper atmosphere by huge explosions as the pieces disintegrated.

Astronomers also have evidence of solar system objects striking Earth. More than a century ago, a comet or a meteor may have exploded in the sky above the Tunguska River valley in Russia. The explosion knocked down millions of trees over hundreds of miles. More than 65 million years ago, a larger comet may have hit Earth, leading to the demise of the dinosaurs and most of the planet’s other species.

**Visitors from the distant solar system**

Besides Comet Siding Spring’s close brush with Mars, astronomers are interested in the icy visitor because of its birthplace. Many of the famous comets are short-period comets, which orbit the Sun in less than

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**Comet Siding Spring spews multiple jets**

![Images showing Comet Siding Spring](https://example.com/comet_images)

These Hubble telescope images show Comet Siding Spring in observations taken on March 11, 2014.

**Left:** In this image, the solid, icy nucleus is too small to be resolved by Hubble, but it lies at the center of a dust cloud, called a coma, that is roughly 12,000 miles across.

**Right:** Image processing reveals what appear to be two jets of dust coming off the nucleus in opposite directions. The jets are created when sunlight warms the comet’s surface, turning the ice into gas. The gas is ejected from the comet as jets.

**Aftermaths of comet collisions**

**Comet impact sites:**

- **Jupiter, 1994**
- **Siberian impact site, 1908**

Astronomers witnessed a rare event in 1994 when they watched the shattered Comet Shoemaker-Levy 9 smash into Jupiter piece by piece. This was the first time scientists knew in advance where to train their sights to view the collision of two bodies in space. The comet broke apart before striking Jupiter. The pieces exploded as they streaked through Jupiter’s atmosphere, creating a line of dark smudges across the bottom of the planet, as revealed in this Hubble image.

One of the most powerful natural explosions ever observed on Earth occurred in 1908 when a comet or a meteor exploded above the Tunguska River in Siberia, Russia. The event destroyed trees more than 25 miles away and caused a powerful earthquake. The above picture was taken almost 20 years after the event. Estimates of the object’s size range from 200 feet to more than 3,000 feet in diameter.
Sources of short-period and long-period comets

Short-period comets take less than 200 years to orbit the Sun and originate in the Kuiper Belt. Since their paths are deflected inward by the giant planets, most short-period comets orbit in the same region as the asteroid belt, located between the orbits of Mars and Jupiter. The relatively flat Kuiper Belt lies at the outer edge of the planets, beyond Neptune’s orbit. Its radius is between 30 and 50 astronomical units (AU). There may be as many as 100 million objects in the Kuiper Belt.

Long-period comets require more than 200 years to orbit the Sun, generally taking many thousands to a few millions of years. They are usually only observed once. They come from the vast region in the outer reaches of our solar system known as the Oort Cloud. The Oort Cloud is a huge sphere of ancient, icy objects that envelopes the region of the planets. The Oort Cloud extends a thousand times farther than the Kuiper Belt. It is 50,000 AU in radius.

*Definition of astronomical unit (AU):
The average distance between Earth and the Sun, which is about 150 million kilometers (93 million miles). This unit of length is commonly used for measuring the distances between objects within the solar system.
200 years. These comets originate in the Kuiper Belt, a broad region beyond the orbit of Neptune containing perhaps 100 million small objects made of ice and rock.

Comet Siding Spring is one of the long-period comets, those that require more than 200 years to orbit the Sun. These comets come from the Oort Cloud, a sphere of about a trillion ancient, icy objects located hundreds to thousands of times farther than the planets' orbits. Although astronomers have never seen objects at the great distance of the Oort Cloud, they have plenty of evidence of its existence. Every year astronomers observe comets that come from the distant solar system and travel back out again.

Astronomers suggest that material in the Oort Cloud remains relatively unchanged since the birth of our solar system 4.5 billion years ago. The Oort Cloud is so far away from the Sun that its icy objects are not warmed much by the Sun's heat. The objects are frozen fossils from the early solar system.

Comet Siding Spring, therefore, may be a time capsule that gives astronomers a better understanding of our solar system's beginnings, including the birth of Earth and the other planets. Once Comet Siding Spring leaves the inner solar system, it will not come back for a couple million years. ★

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