

## Gemini captures Comet ISON hurtling toward uncertain destiny with the Sun

May 30 2013



Images of Comet ISON obtained using the Gemini Multi-Object Spectrograph at Gemini North on February 4, March 4, April 3, and May 4, 2013 (left to right, respectively; Comet ISON at center in all images). The three images on left are through an r-band filter only, and the color composite on right includes g, i, and r bands. All are integrated for 2 x 45 seconds with the February 4 image integrated for 2 x 75 seconds (increasing the comet's apparent brightness). During the period of this sequence, the comet shined at about magnitude 15.5-16.5 in visible light. In these images north is up [need to flip image top/bottom] east is left, and the field-of-view is about 2.5 arcminutes across, which corresponds to about 270,000-290,000 miles (435,000-470,000 kilometers) at the distance of the comet. Color composite produced by Travis Rector, University of Alaska Anchorage. Credit: Gemini Observatory/AURA



(Phys.org) —A new series of images from Gemini Observatory shows Comet C/2012 S1 (ISON) racing toward an uncomfortably close rendezvous with the Sun. In late November the comet could present a stunning sight in the twilight sky and remain easily visible, or even brilliant, into early December of this year.

The time-sequence images, spanning early February through May 2013, show the <u>comet</u>'s remarkable activity despite its current great distance from the Sun and Earth. The information gleaned from the series provides vital clues as to the comet's overall behavior and potential to present a spectacular show. However, it's anyone's guess if the comet has the "right stuff" to survive its extremely close brush with the Sun at the end of November and become an early morning spectacle from Earth in early December 2013.

When Gemini obtained this time sequence, the comet ranged between roughly 455-360 million miles (730-580 million kilometers; or 4.9-3.9 astronomical units) from the Sun, or just inside the orbital distance of Jupiter. Each image in the series, taken with the Gemini Multi-Object Spectrograph at the <u>Gemini North telescope</u> on Mauna Kea, Hawai'i, shows the comet in the far red part of the optical spectrum, which emphasizes the comet's dusty material already escaping from what astronomers describe as a "dirty snowball." Note: The final image in the sequence, obtained in early May, consists of three images, including data from other parts of the optical spectrum, to produce a color <u>composite image</u>."

The images show the comet sporting a well-defined parabolic hood in the sunward direction that tapers into a short and stubby tail pointing away from the Sun. These features form when dust and gas escape from the comet's icy nucleus and surround that main body to form a relatively extensive atmosphere called a coma. <u>Solar wind</u> and <u>radiation pressure</u> push the coma's material away from the Sun to form the comet's tail,



which we see here at a slight angle (thus its stubby appearance).

Discovered in September 2012 by two Russian amateur astronomers, Comet ISON is likely making its first passage into the inner Solar System from what is called the Oort Cloud, a region deep in the recesses of our Solar System, where comets and icy bodies dwell. Historically, comets making a first go-around the Sun exhibit strong activity as they near the inner Solar System, but they often fizzle as they get closer to the Sun.

## Sizing up Comet ISON

Astronomer Karen Meech, at the University of Hawaii's Institute for Astronomy (IfA) in Honolulu, is currently working on preliminary analysis of the new Gemini data (as well as other observations from around the world) and notes that the comet's activity has been decreasing somewhat over the past month.

"Early analysis of our models shows that ISON's brightness through April can be reproduced by outgassing from either carbon monoxide or carbon dioxide. The current decrease may be because this comet is coming close to the Sun for the first time, and a "volatile frosting" of ice may be coming off revealing a less active layer beneath. It is just now getting close enough to the Sun where water will erupt from the nucleus revealing ISON's inner secrets," says Meech.

"Comets may not be completely uniform in their makeup and there may be outbursts of activity as fresh material is uncovered," adds IfA astronomer Jacqueline Keane. "Our team, as well as astronomers from around the world, will be anxiously observing the development of this comet into next year, especially if it gets torn asunder, and reveals its icy interior during its exceptionally close passage to the Sun in late November."



NASA's Swift satellite and the Hubble Space Telescope (HST) have also imaged Comet ISON recently in this region of space. Swift's ultraviolet observations determined that the comet's main body was spewing some 850 tons of dust per second at the beginning of the year, leading astronomers to estimate the comet's nucleus diameter is some 3-4 miles (5-6 kilometers). HST scientists concurred with that size estimate, adding that the comet's coma measures about 3100 miles (5000 km) across.

The comet gets brighter as the outgassing increases and pushes more dust from the surface of the comet. Scientists are using the comet's brightness, along with information about the size of the nucleus and measurements of the production of gas and dust, to understand the composition of the ices that control the activity. Most comets brighten significantly and develop a noticeable tail at about the distance of the asteroid belt (about 3 times the Earth-Sun distance — between the orbits of Mars and Jupiter) because this is when the warming rays of the Sun can convert the water ice inside the comet into a gas. This comet was bright and active outside the orbit of Jupiter—when it was twice as far from the Sun. This meant that some gas other than water was controlling the activity.

Meech concludes that Comet ISON "...could still become spectacularly bright as it gets very close to the Sun" but she cautions, "I'd be remiss, if I didn't add that it's still too early to predict what's going to happen with ISON since comets are notoriously unpredictable."

## A Close Encounter

On November 28, 2013, Comet ISON will make one of the closest passes ever recorded as a comet grazes the Sun, penetrating our star's million-degree outer atmosphere, called the corona, and moving to within 800,000 miles (1.3 million km) of the Sun's surface. Shortly



before that critical passage, the comet may appear bright enough for expert observers using proper care to see it close to the Sun in daylight.

What happens after that no one knows for sure. But if Comet ISON survives that close encounter, the comet may appear in our morning sky before dawn in early December and become one of the greatest comets in the last 50 years or more. Even if the comet completely disintegrates, skywatchers shouldn't lose hope. When Comet C/2011 W3 (Lovejoy) plunged into the Sun's corona in December 2011, its nucleus totally disintegrated into tiny bits of ice and dust, yet it still put on a glorious show after that event.

The question remains, are we in for such a show? Stay tuned...

## **Comet ISON: The View from the North and South**

Regardless of whether Comet ISON becomes the "Comet of the Century," as some speculate, it will likely be a nice naked-eye and/or binocular wonder from both the Northern and Southern Hemispheres in the weeks leading up to its close approach with the Sun.

By late October, the comet should be visible through binoculars as a fuzzy glow in the eastern sky before sunrise, in the far southeastern part of the constellation of Leo. By early November, the comet should be a much finer binocular object. It will steadily brighten as it drifts ever faster, night by night, through southern Virgo, passing close to the bright star Spica. It is during the last half of the month that observations will be most important, as the comet edges into Libra and the dawn, where it will brighten to naked-eye visibility and perhaps sport an obvious tail.

The comet reaches perihelion (the closest point in its orbit to the Sun) on November 28th, when it will also attain its maximum brightness, and perhaps be visible in the daytime. If Comet ISON survives perihelion, it



will swing around the Sun and appear as both an early morning and early evening object from the Northern Hemisphere. The situation is less favorable from the Southern Hemisphere, as the comet will set before the Sun in the evening and rise with the <u>Sun</u> in the morning.

By December 10th, and given that everything goes well, Comet ISON may be a fine spectacle in the early morning sky as viewed from the Northern Hemisphere. Under dark skies, it may sport a long tail stretching straight up from the eastern horizon, from the constellations of Ophiuchus to Ursa Major. The comet will also be visible in the evening sky during this time but with its tail appearing angled and closer to the horizon.

Provided by Gemini Observatory

Citation: Gemini captures Comet ISON hurtling toward uncertain destiny with the Sun (2013, May 30) retrieved 28 April 2024 from <u>https://phys.org/news/2013-05-gemini-captures-comet-ison-hurtling.html</u>

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