Keeping An Eye On COMET ISON

BY TAMMY PLOTNER

Tammy is a professional astronomy author, President Emeritus of Warren Rupp Observatory and retired Astronomical League Executive Secretary. She was the first woman astronomer to achieve Comet Hunter's Gold Status.

With Comet PANSTARRS exiting stage left, it's time for anxious amateur astronomers to focus their attention on Comet C/2012 S1 ISON. This icy visitor from the Oort Cloud just emerged from the Sun's glare as it apparently passed through the constellation of Gemini. While it was briefly invisible to telescopes, it certainly left behind a wealth of information–and controversy.

On June 13, 2013, astronomers used the NASA Spitzer Space Telescope's onboard Infrared Array Camera to examine what might be carbon dioxide emissions coming from ISON. Along with dust, carbon dioxide is a main ingredient in the comet's 186,400-mile tail. The presence of carbon dioxide in comets is well known, and Comet ISON is producing it in copious amounts.

"We estimate ISON is emitting about 2.2 million pounds (1 million kilograms) of what is most likely carbon dioxide gas and about 120 million pounds (54.4 million kilograms) of dust every day," said Carey Lisse, leader of NASA's Comet ISON Observation Campaign and a senior research scientist at the Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland. "Previous observations made by NASA's Hubble Space Telescope, the Swift Gamma-Ray Burst Mission, and Deep Impact spacecraft gave us only upper limits for any gas emission from ISON. Thanks to Spitzer, we now know for sure the comet's distant activity has been powered by gas."

As we have learned, comets are conglomerates of rock, frozen ammonia, methane, carbon monoxide and carbon dioxide. At the time of Spitzer's observation, Comet ISON was positioned about 312 million miles from the Sun, about 3.35 times farther than Earth. Scientists estimate it's about 3 miles in diameter and a weighs between 7 billion and 7 trillion pounds–about the size of a small mountain.

"Spitzer has placed a size constraint on Comet ISON of 0.2 to 20 km," says Karl Battams, an astrophysicist and computational scientist based at the Naval Research Laboratory in Washington, DC. "It will probably be near the middle of this range, about 1 km or so."

Comet ISON is making its first journey through our solar system and will

Image Credit: NASA, ESA, J.-Y. Li (Planetary Science Institute), and the Hubble Comet ISON Imaging Science Team

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pass within 724,000 miles of the Sun on November 28, 2013. With the comet rapidly shedding gas and dust, some wonder if it will last that long.

"As much as 10 percent of the comet's diameter may erode away, but this probably won't devastate it," explains Matthew Knight, an astronomer at Lowell Observatory in Arizona.

Some in the media speculate that Comet ISON's sustained brightness is a sign it won't perform as expected–but that's just speculation.

"The mismatch we detect between the amount of dust and water produced tells us that ISON's water sublimation is not yet powering its jets because the comet is still too far from the Sun," said Dennis Bodewits, an astronomer at UMCP. "More volatile materials, such as carbon dioxide or carbon monoxide ice, evaporate at greater distances and are now fueling ISON's activity."

All comets and comet behaviors are unique. There are many explanations for ISON's peculiar behavior: it could be water deficient, or there may be surface deposits of rock or non-volatile silicate dust.

"ISON's brightness remained more or less stable for much of the early part of the year, but this doesn't surprise us enormously," explains Battams. "It is still outside of what we call the 'frost line'–the point in space at which water-ice (the dominant component of comets) begins to sublimate."

The next milestone for Comet ISON will happen on October 1, when the speedy comet passes about 6.7 million miles (10.8 million km) from Mars.

"During this close encounter, Comet ISON may be observable to NASA and ESA spacecraft now working on Mars," said Michael Kelley of the University of Maryland's Department of Astronomy. "Personally, I'm hoping we'll see a dramatic postcard image taken by NASA's latest Mars explorer, the Curiosity rover."

After its rendezvous with Mars, ISON begins a fifty-eight day journey towards the Sun. That's when the icy comet endures its trial by fire. As it nears perihelion at a speed of 47,000 miles per hour, ISON will withstand temperatures as high as 2,700 degrees Celsius.

"As ISON gets closer to the Sun, its ices will begin to melt at an increasing rate, releasing more trapped dust and gases into its diffuse coma and tail. At closest approach to the Sun, ISON will be passing through the million-degree solar corona, though as long as the surface area of the comet is large enough, the evaporation of water from the comet's surface should keep it at a relatively comfortable temperature, much the way humans sweat to maintain a body temperature." explains Battams.

Fire and ice–truly a mixture of extremes. Just as the controversy about ISON goes from one extreme to another, we must remain cautiously optimistic about this long-awaited celestial event.

COMETWATCH OCTOBER 1ST: ISON BEGINS A FIFTY-EIGHT DAY JOURNEY TOWARDS THE SUN