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Comet Elenin: Cosmic Threat or Celestial Visitor

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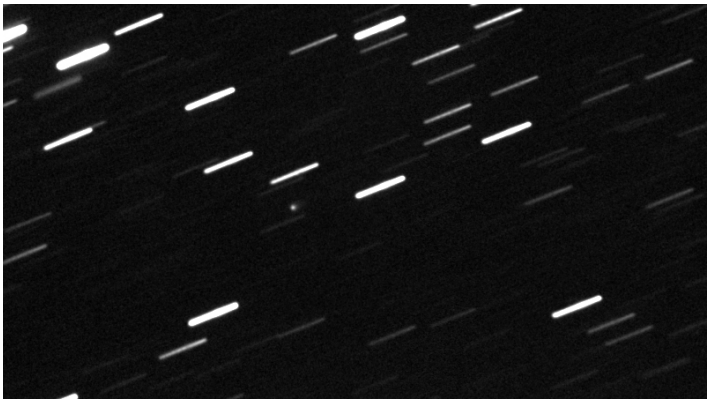
Editor's Introduction

Former ASP President and distinguished planetary scientist David Morrison keeps the "Ask the Astrobiologist" web site which is one of NASA's prime contacts with the concerns of the public. In an earlier edition of *Astronomy Beat*, he chronicled the internet scare about the coming of the end of the world in late 2012 due to an astronomical disaster. This time, he alerts our readers to a new public concern, caused by the misunderstanding of a recent astronomical discovery.



Comet Elenin on March 6, 2011. In this image, the telescope stays with the moving comet in the center; therefore the stars move during the exposure and each star looks like a short line. *(Photo by Bernhard Hausler)*

Will Comet Elenin destroy the Earth this year?

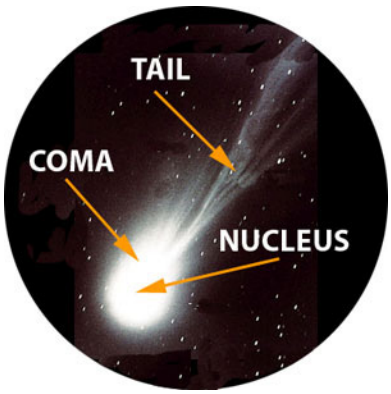
Remarkably, there are many websites suggesting just that. For the moment, the cosmic conspiracy theorists are pushing aside the end of the world on 12/21/12 (see *Astronomy Beat #32)* to make room for a more urgent threat from Comet Elenin, a faint long-period comet discovered in December 2010. Long-period comets are chunks of ice and rock left over from the early days of the solar system, moving around the Sun in orbits that take more than 200 years to come around again.

I have been receiving many questions about Comet Elenin sent to "Ask an Astrobiologist". Because the comet is very faint and there has been limited media coverage, credible information is in short supply. This vacuum is being filled with misinformation on Internet conspiracy sites, where this comet is being blamed for the March 10 Japan earthquake and tsunami, and it is supposed to either hit the Earth or knock us off our axis in October. Some say it is not a comet at all but a black hole or brown dwarf star, or that it is a precursor of Nibiru, the 2012 "death planet," or even that the comet is orbiting Nibiru.

Elenin seems to be generating the first big comet scare since Hale-Bopp, a bright comet seen in 1997. For this earlier comet, a mistaken observation by an amateur astronomer led to the widely publicized rumor that some sort of alien spacecraft was following Hale-Bopp. Comet Elenin is much smaller and fainter than Hale-Bopp, but the Internet has grown tremendously since 1997, so misinformation can now spread almost instantly around the world. One of the worst consequences of the Hale-Bopp space-ship claim was the mass suicide by members of the Heaven's Gate cult. We must be alert to head off any similar tragedy stimulated by wild rumors about Comet Elenin.

Comet Elenin is not unusual, and it is not a threat to Earth. C2010 X1 Elenin (to give its full name) is a long-period comet, which takes about 10,000 years to complete one orbit around the Sun. It was discovered with a robotic telescope in New Mexico on 10 December 2010 by Russian amateur astronomer Leonid Elenin. When comets or asteroids are first discovered, their orbits are quite uncertain; usually it takes several months of observations to firmly establish the orbit. Elenin's perihelion (closest approach to the Sun) will take place on 10 September 2011 at a distance from the Sun of 72 million km. It will be closest to Earth on 16 October, at a distance of 34 million km, which is nearly a hundred times farther than the Moon. Although the comet never comes close to the Earth, it is expected to be visible in binoculars during October, after perihelion, and perhaps also to the naked eye if we are lucky. Much of the limited information so far on this comet comes from amateur astronomers, who have made hundreds of observations. Our knowledge of its orbit is constantly improving, with updates available from the Minor Planet Center, at the Harvard-Smithsonian Center for Astrophysics: http://ubasti.cfa.harvard.edu/~cgi/ReturnPrepEph?d=c&o=CK10X010.

Leonid Elenin



Parts of a comet

Part of the Internet chatter concerns the size of Elenin. Comets are exceedingly small and enveloped in a tenuous cloud of gas and dust, so the only way to be sure of their actual dimensions is to visit with a spacecraft. Half a dozen comets have been the targets of spacecraft missions, and all of them (even Comet Halley) are less than 10 km in diameter. There is no reason to think Elenin is any different. This means its mass is less than one billionth the mass of the Earth.

To understand why people get confused about the size of a comet, you must distinguish between the small solid nucleus of rock and ice and the large atmosphere (coma) and tail that develop as a comet approaches the Sun. In the case of Comet Elenin, the nucleus has not been measured. The coma was reported to be about 80,000 km across in early April, with a tail estimated at ten times that length. These are not unusual values for a comet, and both coma and tail are expected to grow as the comet approaches the Sun (it is still beyond the orbit of Mars at this writing on April 15). Some comets have developed atmospheres that can be more than a million km across. But please remember that the atmosphere (coma and tail) is extremely tenuous, far less dense than the best vacuum that can be produced in the lab. In 1910, the Earth passed directly though the tail of Comet Halley with no measurable effects. Still, when people who don't know much astronomy read about a comet that's 80,000 km across, they may get confused and think something solid that size is approaching.

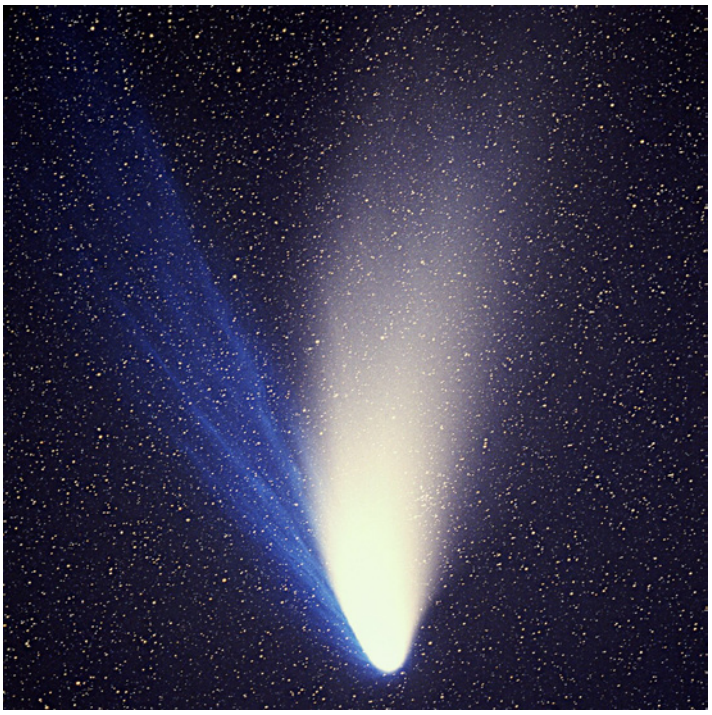
Some websites are making wild claims that Elenin will disturb our orbit, or cause large tides, or interact with our magnetic field, or change the rotation of the Earth. Such claims are pure fiction. One of the worst examples is a video that someone posted on the NASABuzzroom website at the end of February, claiming that the magnetic field of the comet at its March 2011 opposition would cause a large shift in the rotation axis of the Earth and produce mega-

earthquakes on March 15. In reality, comets don't have magnetic fields, and magnetic fields can't change Earth's rotation axis or cause earthquakes no matter how large they are. Adding to the craziness is a claim that this same comet caused the Earth's axis to shift by 3 degrees in February 2010 and caused the Chile Earthquake. In fact, the comet was far away a year ago, and there was no change in Earth's rotation axis. The 2010 Chile earthquake was a normal slippage in an active fault that has produced many previous earthquakes, including the one witnessed by Charles Darwin in 1835.

There was no pole shift on March 15, and hence no global earthquakes. However, on March 10 there was the great Japan earthquake and tsunami. Immediately the conspiracy websites stated saying that the comet had caused this earthquake, in spite of the missing factor of a pole shift. Some said that because Elenin had such an effect on the Earth, it could not be a comet, but instead was a super-massive object like a black hole. The reality is that the March 10 earthquake in Japan took place on an active subduction fault, the same fault that caused the even more destructive Yokohama quake of 1923. On our planet, earthquakes are the consequence of plate tectonics and are unrelated to the gravitational pull of the Moon or any other celestial object.

There are many photos of Comet Elenin already posted on the web, but be careful: the great majority of the images that come up in a Google search are not of Comet Elenin but of other comets or artist impressions (and some are fakes). Quite a few posted photos are of Comet 81P/Wild, probably substituted for Elenin because it is much brighter.

Some people writing to me on the NASA *Ask an Astrobiologist* web site seem convinced that there is a conspiracy to suppress information about Elenin. Someone wrote: "NASA supposedly has limited info and no pictures. Oh, really? Not from the WISE satellite, designed specifically to look at low light objects (like dwarf stars) with high sensitivity infrared? What about the South Pole telescope which has excellent IR detection capabilities? How about Hubble? Nothing! Why doesn't NASA ever talk anything about it?" Here are the facts. (1) The WISE (Wide-field Infrared Survey Explorer) telescope ceased operations at about the time Elenin was discovered. This little



Comet Hale-Bopp on April 4, 1997 *(E. Kolmhofer, H. Raab; Johannes-Kepler-Observatory, Linz, Austria)*

comet, then in the asteroid belt, was probably too faint to be picked up by WISE. (2) In the first 5 months after the discovery of Elenin, the South Pole was mostly in continuous daylight, making this one of the worst places to go to study this comet. (3) The Hubble Space Telescope will undoubtedly study Elenin, but most astronomers will wait until it is brighter. (4) To date there is no reason that NASA (or the media) would be commenting on this small faint comet.

Alas, it is clear that many people who are making comments about the comet on websites don't know as much basic science as we might hope. Some think that the comet's orbit will change suddenly and it may hit the Earth, whereas in reality it cannot come much closer than 100 times the distance to the Moon. Orbits of comets (or any other object) don't change without a reason. Some question what mysterious force is pulling on the comet to bend its path; they seem to forget that this comet is in orbit around the Sun. Some think that we must know its mass to calculate its orbit; they have apparently forgotten the simple experiment credited to Galileo who showed that objects of different mass behave the same way in response to gravity (for example, cannon balls of different mass fall at the same rate when dropped from a tower).

One suggestion is that perhaps Elenin is not a comet,

but might be a planet (perhaps Nibiru, the mythical planet touted as the cause of the Earth's destruction in 2012) or a brown dwarf star or a massive black hole masquerading as a comet. But think about what a comet is. By definition, a comet is a small object that sheds an extensive thin atmosphere of gas as it approaches the Sun. If it were massive (such as a planet, brown dwarf, or black hole), its gravity would hold on to the gas and it could not develop a coma or tail, as Elenin has already started doing.

As I have discussed in my earlier *Astronomy Beat* article, we live in nervous times, and conspiracy theories and predictions of disaster are more popular than ever. I like to use the word *cosmophobia* for this growing fear of astronomical objects and phenomena, which periodically runs amuck on the Internet. Ironically, in pre-scientific times, comets were often thought to be harbingers of disaster, mostly because they seemed to arrive unpredictably (unlike the movements of the planets and stars, which could be tracked on a daily and yearly basis.)

One of the great triumphs of the Renaissance was our ability to use Newton's laws to predict the motion of the comet that came to be known as Halley's Comet and then to have it return in 1758, as predicted. Eventually, with observations from the ground and visits by spacecraft, comets became well-understood members of the solar system, and the fear that accompanied each new comet evaporated. What a pity it would be to revive these ancient fears in our technological age.

About the Author

David Morrison is a planetary astronomer who is perhaps best known for his leadership in defining the threat of Earth-threatening asteroids. Morrison was also one of the founders of the new interdisciplinary science of astrobiology and recently served as the Director of the NASA Lunar Science Institute. Currently he is a senior scientist at NASA's Ames Research Center and the Director of the Carl Sagan Center for the Study of Life in the Universe at the SETI Institute. He was

Halley's Comet in 1986, crossing the Milky Way *(from NASA's Kuiper Airborne Observatory)*

President of the ASP from 1983 to 1985 and received the Society's Klumpke-Roberts Award for a lifetime of contributions to popularizing astronomy in 1993. He is a Fellow of the Committee for Scientific Inquiry, and writes frequent articles for *Skeptical Inquirer* magazine, debunking astronomical pseudoscience.

Resources for Further Information

There is a good Wikipedia entry on Comet Elenin: http://en.wikipedia.org/wiki/C/2010_X1

For amateur astronomer reports on the comet, see: http://www.aerith.net/comet/catalog/2010X1/2010X1.html

For future reports on the comet as it approaches, check out the web sites of *Sky & Telescope* and *Astronomy* magazines: http://www.skyandtelescope.com and http://www.astronomy.com

A nice collection of articles on serious amateur observing projects involving comets can be found at: http://www.skyandtelescope.com/observing/objects/comets

Hale, A. "Hale-Bopp Comet Madness" in *Skeptical Inquirer*, Mar/Apr. 1997, p. 25. On the cult that saw a spaceship behind the comet: http://www.csicop.org/si/show/hale-bopp_comet_madness/

Burnham, Robert *Great Comets*. 2000, Cambridge U. Press. Chapter 6 discusses the "Heaven's Gate" affair

(where cult members committed suicide).

David Morrison's introduction to and debunking of "doomsday 2012" is available on the public part of the ASP web site at:
http://www.astrosociety.org/2012

For a general introduction to comets, see "Introduction to Comets" (by Don Yeomans):
http://www.nasa.gov/worldbook/comet_worldbook.html

For a short video about Comet Elenin by David Morrison see:
http://www.youtube.com/watch?v=AwZb-ERpY-U ✦

More on Comet Elenin

by David Morrison *(NASA Ames Research Center)*
June 2011

There continues to be a lot of interest in and concern about Comet Elenin since I wrote this column. In fact, NASA and the Jet Propulsion Laboratory recently took the unusual step of releasing an early report about Comet Elenin that you can read at: http://www.jpl.nasa.gov/news/news.cfm?release=2011-135&cid=release_2011-135

The story quotes Don Yeomans, NASA's top comet scientist: "Long-period comets come in from way outside our planetary system. They make these long, majestic, speedy arcs through our solar system, and sometimes they put on a great show. But not Elenin. Right now that comet looks kind of wimpy. Some cometary visitors arriving from beyond the planetary region — like Hale-Bopp in 1997 — have really lit up the night sky where you can see them easily with the naked eye. But Elenin is trending toward the other end of the spectrum. You'll probably need a good pair of binoculars, clear skies, and a dark, secluded location to see it even on its brightest night."

Yeomans noted that, despite the Internet rumors, "Comet Elenin will not encounter any dark bodies that could perturb its orbit, nor will it influence us in any way here on Earth. It will get no closer to Earth than 35 million kilometers. Comet Elenin will not only be far away, it is also on the small side for comets. So you've got a modest-sized icy dirtball that is getting no closer than 35 million kilometers. It will have an immeasurably miniscule influence on our planet. By comparison, my subcompact automobile exerts a greater influence on the ocean's tides than comet Elenin ever will."

Some people writing to the "Ask an Astrobiologist" web site have asked how we know that this is a small comet and not a massive object like a brown dwarf. (A brown dwarf is a "failed star," glowing mostly in the infrared, whose encounter with the inner solar system would be far more serious than the passage of a small comet.)

First, observations of Elenin clearly indicate that it fits the definition of a comet: It is a solar system object with an elongated (eccentric) orbit that is outgassing a tenuous atmosphere (coma) and tail as it approaches the Sun. Comets are defined operationally by the presence of the visible coma and tail. Second, Elenin can not possibly be a massive object like a brown dwarf. If it were, it would not have a coma or tail, since gas cannot escape from an object with substantial gravity. In addition, if it were massive we would be seeing its gravitational influence on the orbits of the planets, especially Mars and Earth, but there is no change in these orbits. Finally, if it were a brown dwarf it would have been easily detected in various previous astronomical surveys, including the recent infrared WISE mission, even when it was still in the outer solar system.