

Comets heading near earth

NZASE Science Communicator **Mike Stone** on the science of comets.

Two comets

Two comets are currently racing toward the inner solar system.

Comet Swan, also known as C/2020 F8, was discovered in March 2020 by instruments aboard NASA's SOHO observatory, which is orbiting the sun. At the beginning of May, Comet Swan had a brightness of magnitude 5.5, visible to the naked eye in rural skies and with binoculars in cities.

This comet can be seen from the southern hemisphere on May 6, very low in the eastern sky in Pisces, about an hour before sunrise. On May 12 it will pass to within 84 million kilometres from earth, about half as close as Mars, and may reach magnitude 3.5 brightness on May 23.

Comet Atlas, C/2019 Y4, was detected in December 2019 when it was quite dim. During March and April it became much brighter (see graph), potentially heralding spectacular sightings. The comet was visible in the northern hemisphere until mid-April, when it broke into pieces. It is not expected to survive its journey around the sun.

Comet Atlas was named after the Asteroid Terrestrial-impact Last Alert System in Hawaii, the observatory which found it. This observatory is a pair of 0.5m robotic optical telescopes, placed 160km apart. Separating two telescopes doubles the survey speed and reduces the chances of the sky being obscured by clouds.

The ATLAS system, operating since 2017, is designed to detect near-Earth objects

which could potentially impact Earth. As well as finding about 100 asteroids more than 30m wide every year, the observatory also occasionally discovers comets.

Definitions

BCE – Before the common era

Ecliptic – The sun's apparent path among the stars over the course of a year. The sun, moon, and many planets appear to move along the plane of ecliptic.

ESA – European Space Agency.

Inner solar system – Mercury, Venus, Earth, Mars.

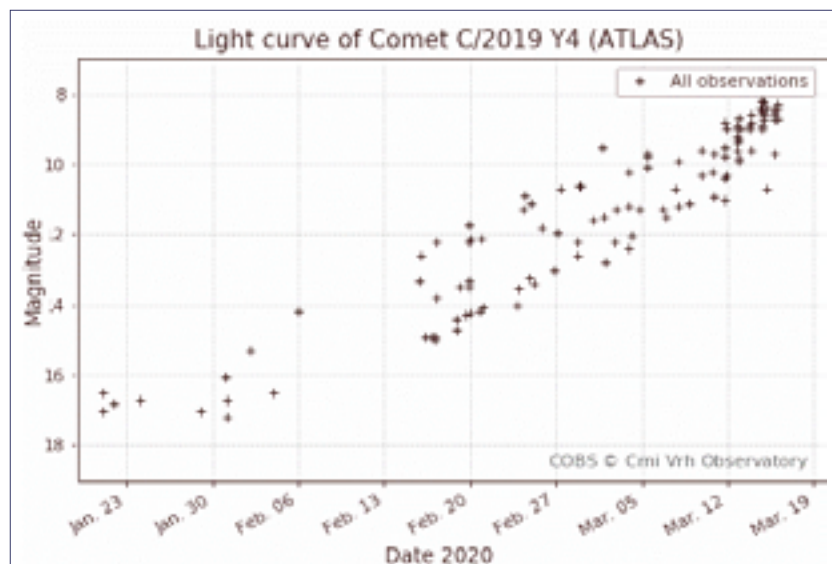
Long period comets – Orbit the sun in more than 200 years

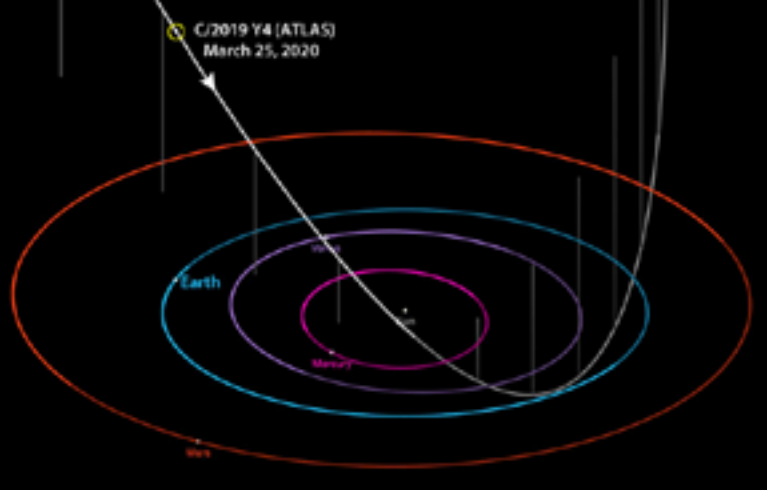
Magnitude (m) – A logarithmic measure of the brightness of astronomical objects from the Earth, depending on luminosity, distance, and interstellar dust. Smaller numbers are brighter.

NASA – National Aeronautics & Space Administration (responsible for America's space programme).

Short period comets – Orbit the sun in less than 200 years.

A view of Comet Atlas from the Hubble Space Telescope on April 23, 2020 as it breaks into more than a dozen pieces. Photo: NASA, ESA, STScI & D. Jewitt, UCLA.





The Comet Atlas orbit is tilted at 45° to the plane of the ecliptic; NASA, JPL Horizons

About comets

Comets are 'dirty snowballs' of frozen methane, ammonia and water, rock and dust about the size of a small town tumbling through space. Scientists know of about 3,600 comets, all of which orbit the sun on elongated elliptical paths, originating a long distance out in space.

A comet's period is the time it takes to go once around the sun. Short-period comets originate from the Kuiper Belt, and are usually inclined at less than 35 degrees to the ecliptic. Long-period comets originate from the Oort Cloud, and have unpredictable orbits which are inclined at more than 35 degrees to the ecliptic.

As a comet nears the sun, solar radiation heats the core (nucleus) of the comet and the ice starts to sublime (change from solid straight to gas). A tail of gas and dust starts to stream out behind the comet and away from the sun for millions of kilometres. A glowing gas and dust cloud, called a coma, forms around the nucleus, and expands to a size larger than most planets.

The behaviour of comets is notoriously difficult to predict. Comets can:

- Become spectacularly bright
- Become dimmer, once the volatile materials are depleted
- Break up and disappear as they approach the sun.

One of the best known comets is Halley's Comet, right, also called 1P, which has been observed and recorded by astronomers and others since at least 240 BCE. The comet is named after English astronomer Edmond Halley who determined that it's period is approximately 76 years. It is expected back in the inner solar system around 2061.

Probing comets

Scientists have used probes to observe comets since 1985 and Halley's was one of the earliest to be approached. Three probes were sent, working together: Sakigake (Japan) made long distance measurements while Vega 1 and 2 (Soviet Union) located the nucleus. This information was sent back to the independent Giotto probe (ESA) so it could precisely manoeuvre very close to the nucleus. Giotto was not expected to survive high speed collisions with dust particles streaming off the comet.

On March 14, 1986, Giotto succeeded in getting to within 600km of Halley's Comet, surviving being hit by debris, spun off its axis briefly and having its camera destroyed. Giotto found that Halley's Comet:

- Was 15km long by eight km wide and shaped like a peanut
- Was made up of 80 percent H₂O, 10 percent CO, and a mix of CH₄, NH₃, Fe and Na.
- Had a dark nucleus, suggesting a thick covering of dust, that was rough, porous and lightweight
- Ejected material at a rate of three tonnes/second from seven jets
- Was formed from some of the earliest material in the solar system, about 4.5 billion years old.

Scientists have even managed to land on a comet. In 2014 ESA's Rosetta spacecraft, launched in 2004, released Philae which landed on comet 67P/Churyumov-Gerasimenko. Its evidence showed that:-

- The water on the comet contained more deuterium (a heavier isotope of H) than water on earth

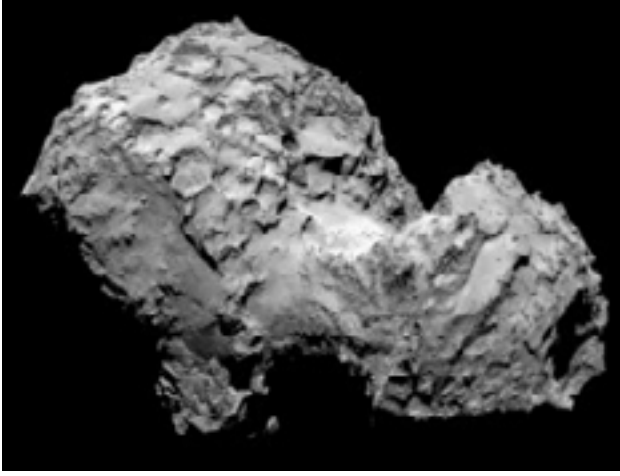
Halley's Comet; NASA.



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Comet Churyumov-Gerasimenko/67P on August 3, 2014; its double-lobes with a narrow neck is different from the more common potato shape. Photo: ESA, Rosetta, MPS for OSIRIS Team MPS, UPD, LAM, IAA, SSO, INTA, UPM, DASP, IDA

- The gas and dust contained carbon- and nitrogen-rich organic compounds
- The comet is ancient, made from a cold interstellar cloud rather than a warmer nebula surrounding the forming sun.

Collisions and trails

Comet collisions are rare but spectacular. P/ Shoemaker-Levy 9 was a short-period comet discovered orbiting Jupiter in 1993. The planet's powerful gravity tore the comet into multiple fragments and NASA's probes Galileo and Voyager, as well as the Hubble Space Telescope, watched 23 of them smash into Jupiter's cloud tops (right).

This huge collision caused plumes 2,500km high, and heated the atmosphere by 35,000°C, leaving dark, ringed scars, which gradually cleared. This spectacle allowed scientists to work out the composition of the comet and to track high-altitude winds on Jupiter.

Comets leave a trail of fine particles in their wake even after the comet has left our solar system. When the earth crosses one of these dust clouds we see meteor showers. We may see thousands of meteors in a few minutes (a meteor storm) if the cloud is very small and dense, or a few meteors each hour for several days if the dust particles are widely spread.

Meteor showers arrive at the same time each year and can be quite spectacular. For example, the Orionids meteor shower is made up of fragments from Halley's Comet and is generally visible in late October.

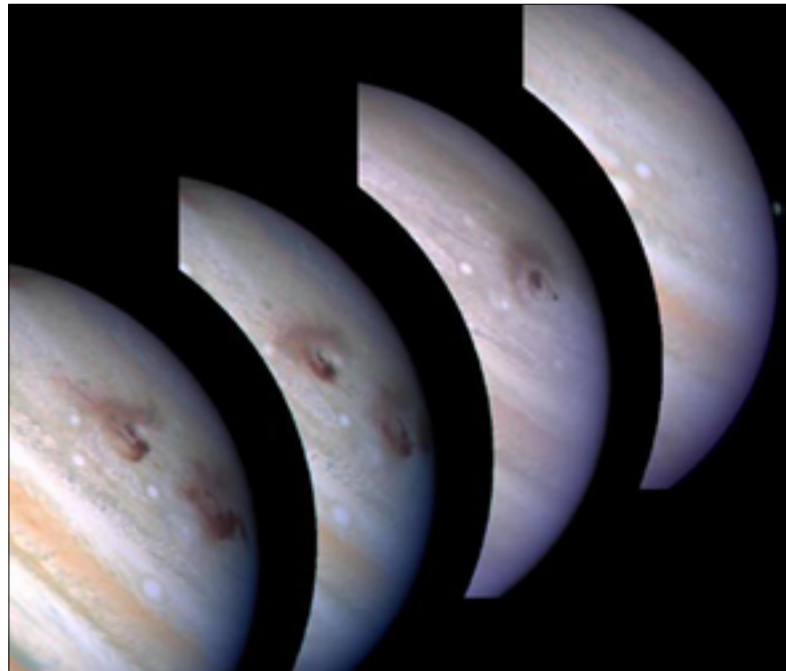
Sources

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- [NASA](#) - Shoemaker-Levy-9, Dec 2019
- [NASA Science](#) - Comets, Solar System Exploration
- [Sky & Telescope](#) - April 7, 2020
- [Southern Comets](#) - C/2019 Y4 ATLAS
- [Space.com](#) - July 2011
- [Spaceweather.com](#) - March 18
- [Wikipedia](#) - Giotto
- [Wikipedia](#) - Halley's Comet

Ngā Kupu

- [Hine-i-tiweka](#) or [Pareārau](#) - Jupiter
- [Hīrere kōkiri](#) - Meteor shower
- [Karu whātata](#) - Telescope
- [Puaroa](#) or [unahiroa](#) - Comet
- [Rerenga o Tamanuiterā](#) - Solar system
- [Taupuni ātea](#) - Space station
- [Whānau mārama](#) - Celestial bodies (stars, moons, planets, comets)
- [Whare mātai ātea](#) - Observatory
- [Whetū](#) - Stars, comets
- [Whetū a Heri](#) - Halley's Comet

From Te Aka Maori Dictionary and Poekupu



The July 1994 impact of Comet Shoemaker-Levy 9 on Jupiter, captured by the Hubble Space Telescope. Photo: R. Evans, J. Trauger & H. Hammel, HST Comet Science Team, NASA.



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