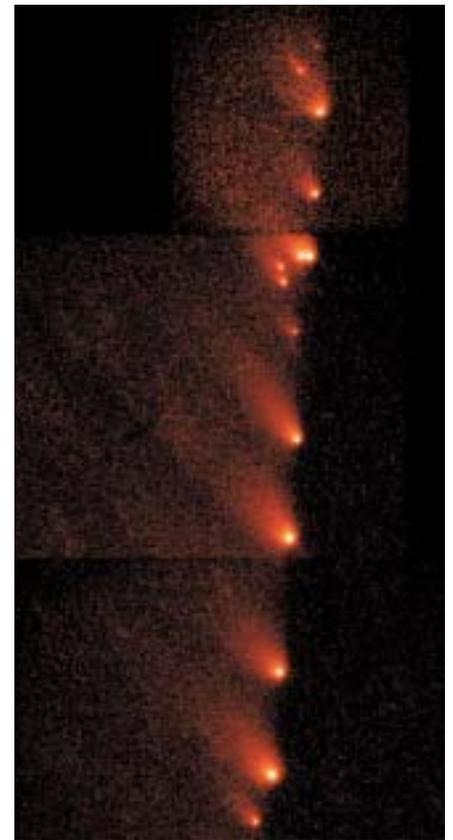




National Aeronautics and
Space Administration

Comets





Throughout history, people have been both awed and alarmed by **COMETS**, stars with “long hair” that appeared in the sky unannounced and unpredictably. We now know that comets are dirty-ice leftovers from the formation of our solar system around 4.6 billion years ago. They are among the least-changed objects in our solar system and, as such, may yield important clues about the formation of our solar system. We can predict the orbits of many of them, but not all.

Around a dozen “new” comets are discovered each year. Short-period comets are more predictable because they take less than 200 years to orbit the Sun. Most come from a region of icy bodies beyond the orbit of Neptune. These icy bodies are variously called Kuiper Belt Objects, Edgeworth-Kuiper Belt Objects, or trans-Neptunian objects.

Less predictable are long-period comets, many of which arrive from a distant region called the Oort cloud about 100,000 astronomical units (that is, 100,000 times the mean distance between Earth and the Sun) from the Sun. These comets can take as long as 30 million years to complete one trip around the Sun. (It takes Earth only 1 year to orbit the Sun.) As many as a trillion comets may reside in the Oort cloud, orbiting the Sun near the edge of the Sun’s gravitational influence.

Each comet has only a tiny solid part, called a nucleus, often no bigger than a few kilometers across. The nucleus contains icy chunks and frozen gases with bits of embedded rock and dust. At its center, the nucleus may have a small, rocky core.

As a comet nears the Sun, it begins to warm up. The comet gets bright enough to see from Earth while its atmosphere—the coma—grows larger. The Sun’s heat causes ice on the comet’s surface to change to gases, which fluoresce like a neon sign. “Vents” on the Sun-warmed side may release fountains of dust and gas for tens of thousands of kilometers. The escaping material forms a coma that may be hundreds of thousands of kilometers in diameter.

The pressure of sunlight and the flow of electrically charged particles, called the solar wind, blow the coma materials away from the Sun, forming the comet’s long, bright tails, which are often seen separately as straight tails of electrically charged ions and an arching tail of dust. The tails of a comet always point away from the Sun.

Most comets travel a safe distance from the Sun itself. Comet Halley comes no closer than 89 million kilometers from the Sun, which is closer to the Sun than Earth is. However, some comets, called sun-grazers, crash straight into the Sun or get so close that they break up and vaporize.

Impacts from comets played a major role in the evolution of the Earth, primarily during its early history billions of years ago. Some believe that they brought water and a variety of organic molecules to Earth.

In September 2001, NASA’s *Deep Space 1* spacecraft will fly by Comet Borrelly. In January 2004, NASA’s *Stardust* mission is expected to encounter Comet Wild 2. Coming within 150 kilometers of the comet, it will study the comet’s nucleus and the composition of comet dust, and it will capture dust samples to bring back to Earth in 2006. In 2005, NASA’s *Deep Impact* mission is scheduled to create a crater in Comet Tempel 1 and to study the freshly exposed material for clues to the early formation of the solar system. Another NASA mission, *Contour*, is scheduled to fly by comets Encke and Schwassman-Wachmann-3 to study the diversity of comet nuclei.

Significant Dates

- 1618** First comet observed telescopically: Johann Baptist Cysat of Switzerland and John Bainbridge of England.
- 1858** First photograph of a comet: Comet Donati by William Usherwood.
- 1864** First comet examined by a spectroscope: Comet Tempel.
- 1985** First spacecraft to visit a comet: NASA’s *ICE* observes Comet Giacobini-Zinner.
- 1986** International flotilla of spacecraft observes Halley’s Comet.
- 1994** Comet Shoemaker-Levy 9 impacts Jupiter’s atmosphere.
- 1997** Comet Hale-Bopp easily observable to the naked eye.
- 1998** European Space Agency’s *Solar and Heliospheric Observatory (SOHO)* observes sun-grazing comets.

About the Image

(Left) Comet Hale-Bopp, with its bluish tail of ions and white tail of dust, is expected to be visible again from Earth in about 2,380 years (*JPL Table Mountain Observatory image*).

(Right, top and bottom) In July 1994, Comet Shoemaker-Levy 9 broke up into more than 20 pieces and collided with Jupiter over several days. Eight impact sites (brown dots stretching from lower left to upper right below Great Red Spot) can be seen in this image from NASA’s *Hubble Space Telescope*. This was the first time observers could actually watch a comet collide with another body. Shoemaker-Levy 9 fragments are false color.

References

- 1) Missions to Comets: http://sse.jpl.nasa.gov/missions/comet_missns/comet-stardust.html
- 2) Asteroids, Comets, and NASA Research: <http://www.hq.nasa.gov/office/pao/facts/HTML/FS-023-HQ.html>
- 3) Near Earth Objects: <http://neo.jpl.nasa.gov>
- 4) Comet Shoemaker-Levy 9 Collision with Jupiter: <http://www.jpl.nasa.gov/sl9>
- 5) Planetary Photojournal: <http://photojournal.jpl.nasa.gov>
- 6) Stardate: <http://stardate.org>