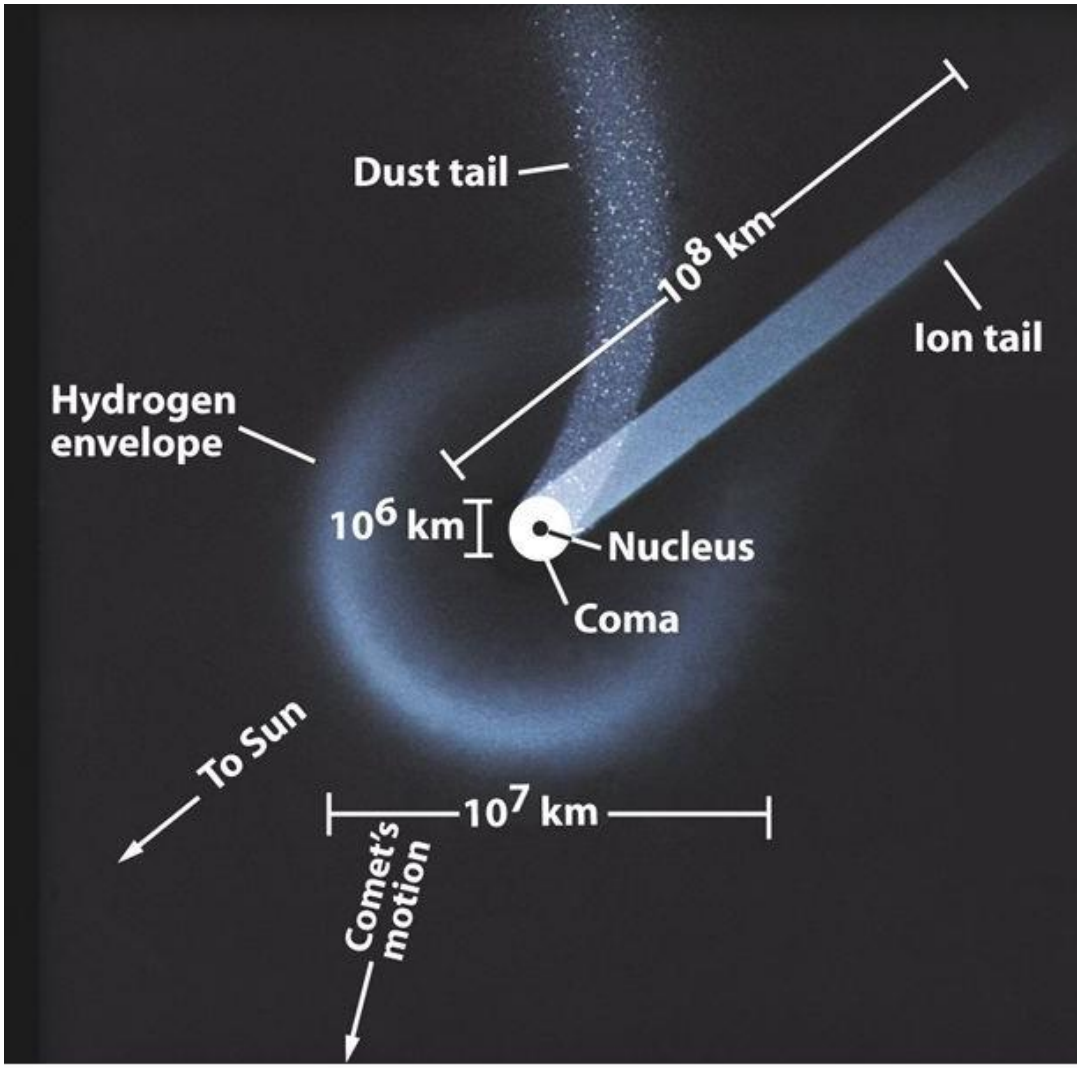
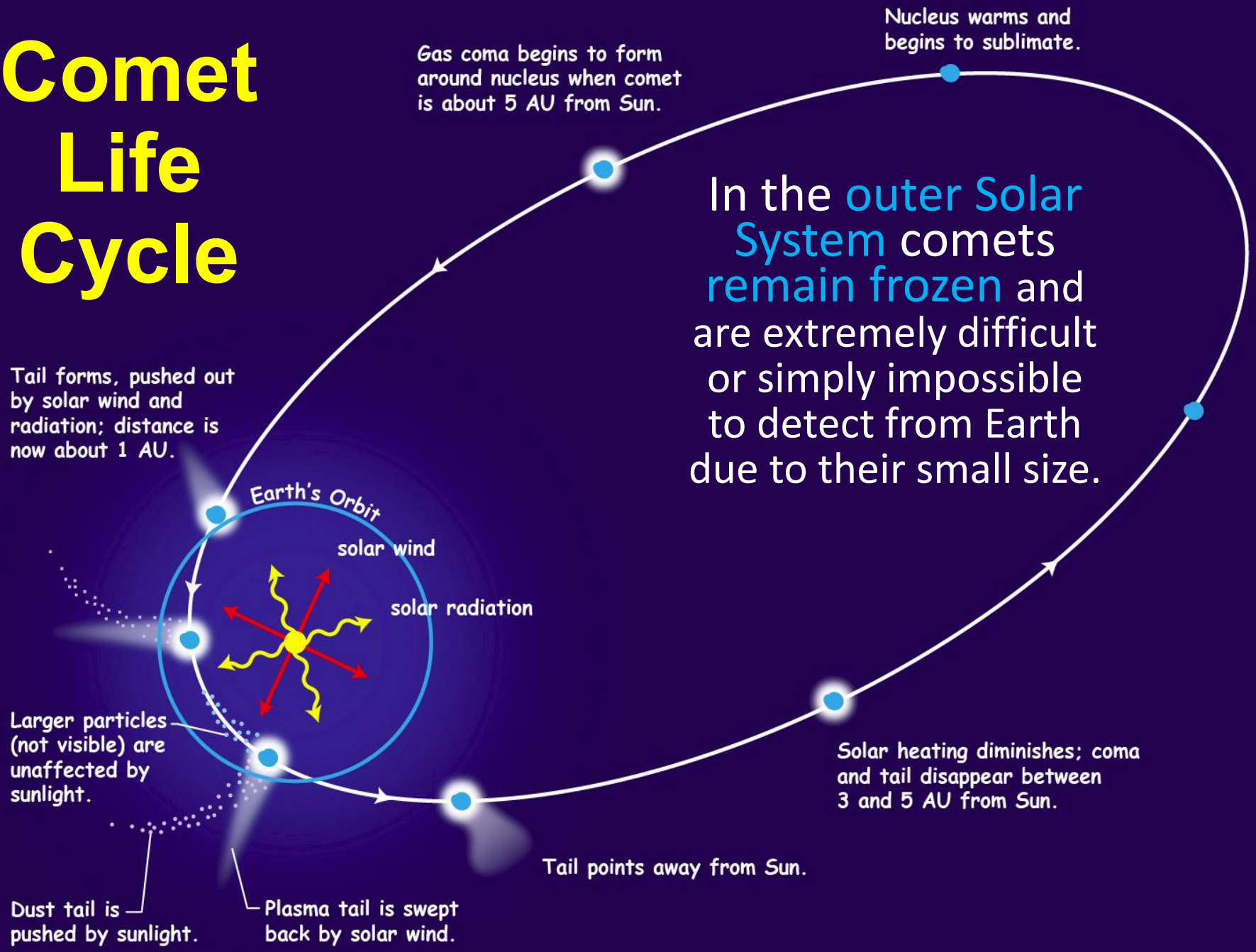
GUESTS FROM FAR FAR AWAY

Comets are small cosmic bodies composed of ice and dust that often form tails as they approach the Sun.

- **Comet structure:**
  - **Nucleus** (~10 km "Dirty Snowball"; usually <50 km)
  - **Coma** (cloud of evaporated ices and ions; can be ~1,000,000 km in diameter)
  - **Hydrogen envelope**
  - **Tail** (*dust, curved* and ions, straight; always points away from the Sun)



Comet Life Cycle



Comet Tail

- **Dust tail**: up to **10 million km long** composed of smoke-sized dust particles driven off the nucleus by escaping gases; the **most prominent part of a comet to the naked eye**.
- **Ion tail**: as much as **several hundred million km long** composed of plasma and laced with rays and streamers caused by interactions with the solar wind; points straight out.

When a comet is gone, is there anything left behind?

Meteor Showers

happen when the Earth passes through a stream of *meteoroid debris*, also known as a "dust trail", spread along a comet's orbit.

- **Orionids (October)**
  Comet Halley
- **Leonids (November)**
  Comet Tempel-Tuttle
- **Perseids (July-August)**
  Comet Swift-Tuttle
- **Lyrids - Comet Thatcher (April 16-25 TONIGHT!)**

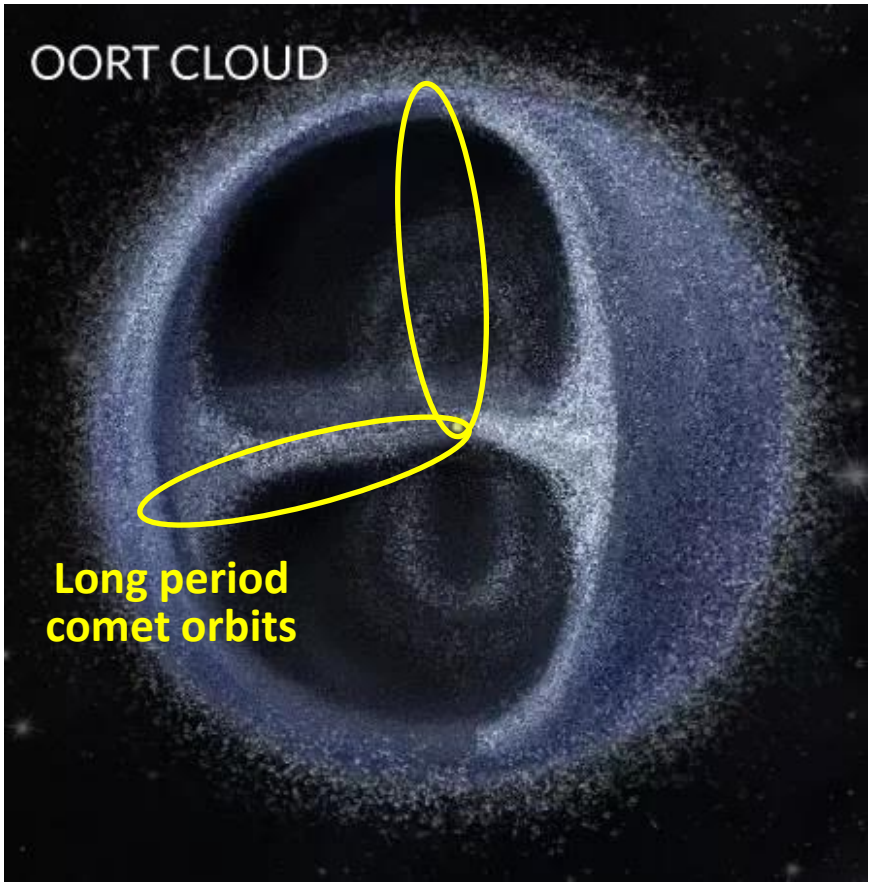
What causes meteoroids to burn in the atmosphere?

- The **fastest meteoroids** travel through the Solar System at a speed of **~42 km/sec** (~26 mi/sec).
- When a meteoroid **enters Earth's atmosphere**, it can travel **as fast as 70 km/sec**, much faster than a bullet leaving a gun barrel!

- **Air in front of meteoroid gets rapidly compressed:** as it compresses, it **heats** and causes surface of the meteoroid to **melt** (producing **glow**) and **vaporize**, and sometimes **disintegrate** (that is, **blow up**).

Comet Orbits: Long Period

- **Long period comets (orbital period more than 200 years, usually thousands and possibly millions of years) come from the Oort cloud, a huge *hypothetical* spherical cloud of icy bodies that is located roughly one light-year from the Sun.**



- **Long-period comets tend to be the most spectacular comets we see in the night sky!**
- **Their brilliance is due to the fact that they have not made many (if any) passes through the inner Solar System, and so still retain a large percentage of their ices – they simply have more material with which to put on a show!**

Comet Hale-Bopp

- The most widely observed comet of the 20th century: "The Great Comet of 1997".
- One of the brightest seen for many decades. It was visible to the naked eye for a record 18 months.
- May have been observed by ancient Egyptians during the reign of pharaoh Pepi I (2332–2283 BC): "long haired star" mentioned in the text in his pyramid.

Next approach: ~4385.

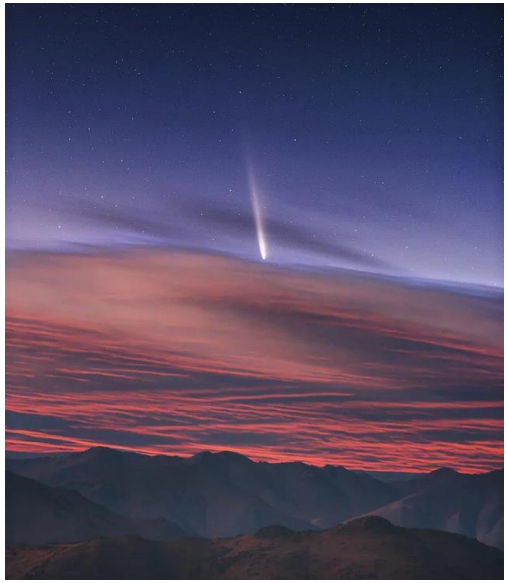
Comet NEOWISE

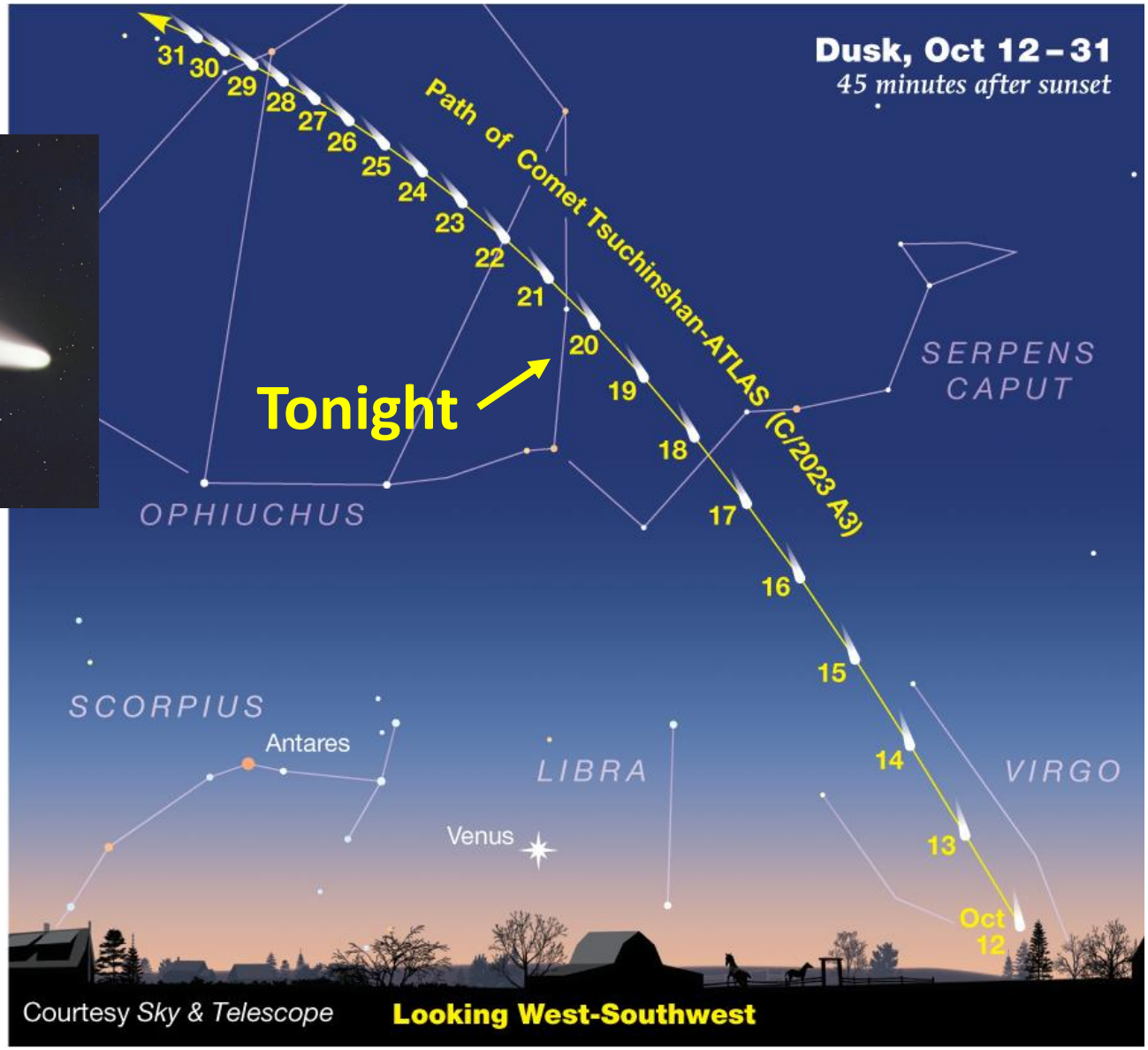
JULY 2020
(discovered in March)

Next approach: ~8,786

Comet Tsuchinshan-ATLAS 2024

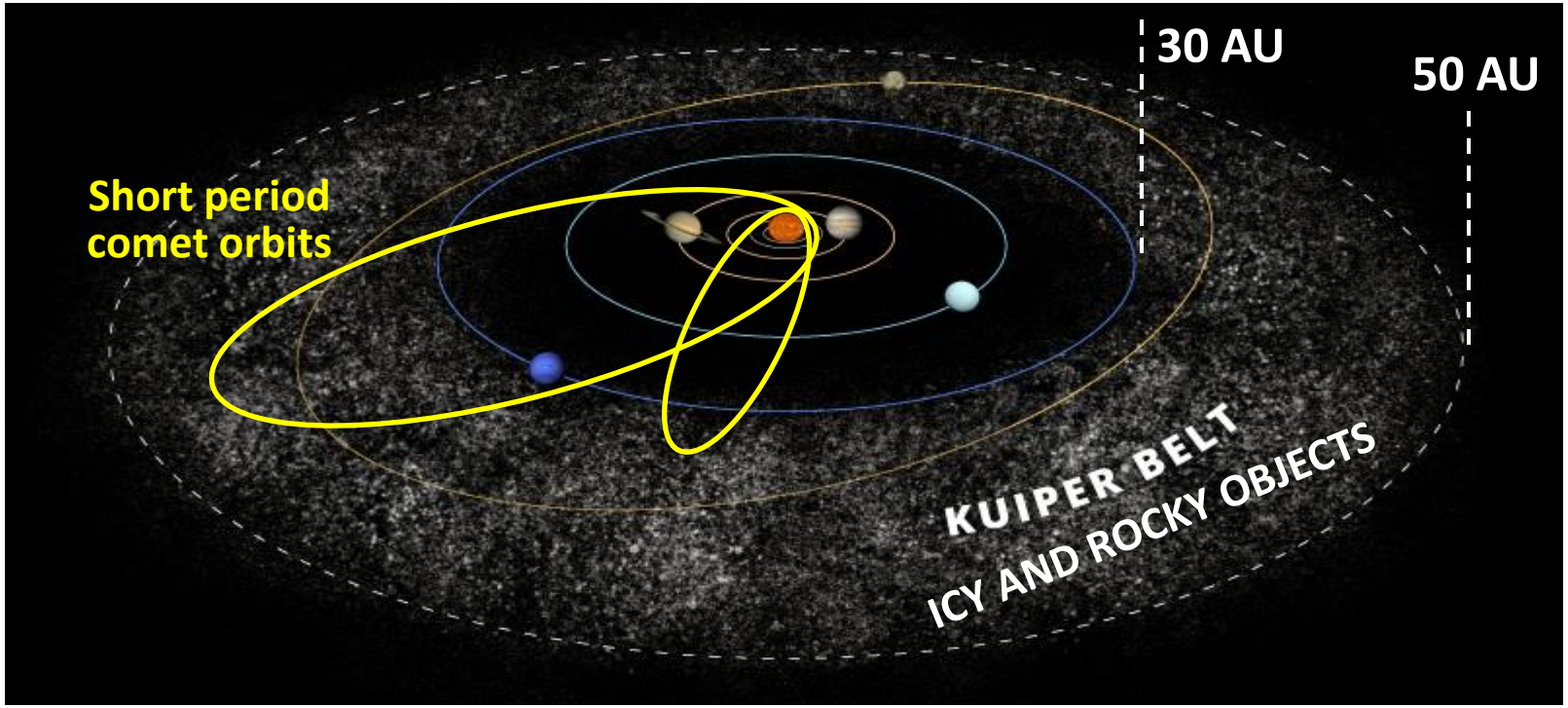
Period >1 million yrs – may be *ejected*!





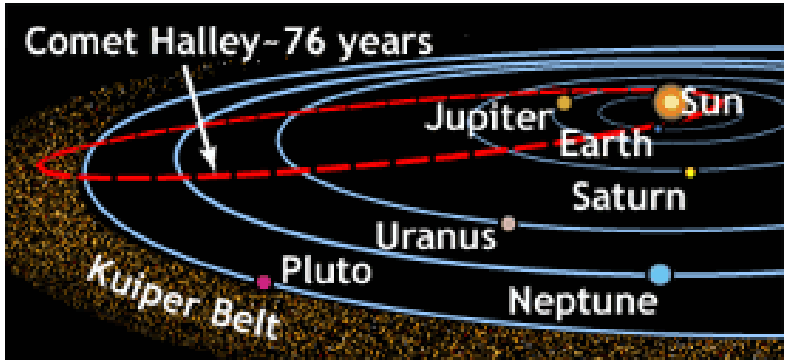
Comet Orbits: Short Period

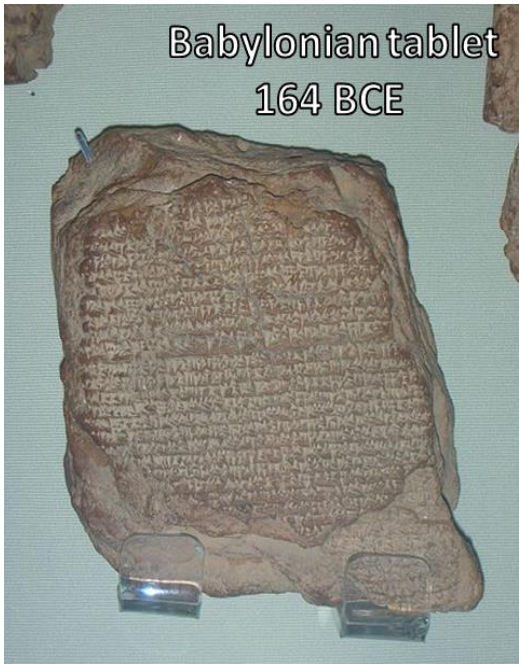
- **Short period comets** (those having orbital period less than 200 years) originate in the **Kuiper belt**, a donut-shaped cloud of icy and rocky objects located beyond the orbit of Neptune.

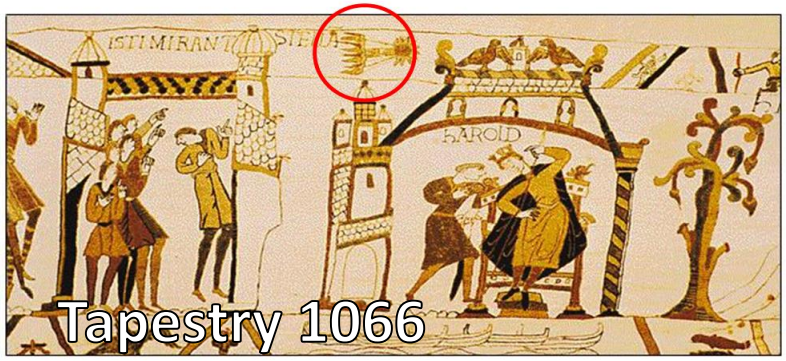


- About **60 Halley-type** (between 20-200 years) and more than **400 Jupiter-family** (orbital period <20 years) comets are known.

Comet Halley





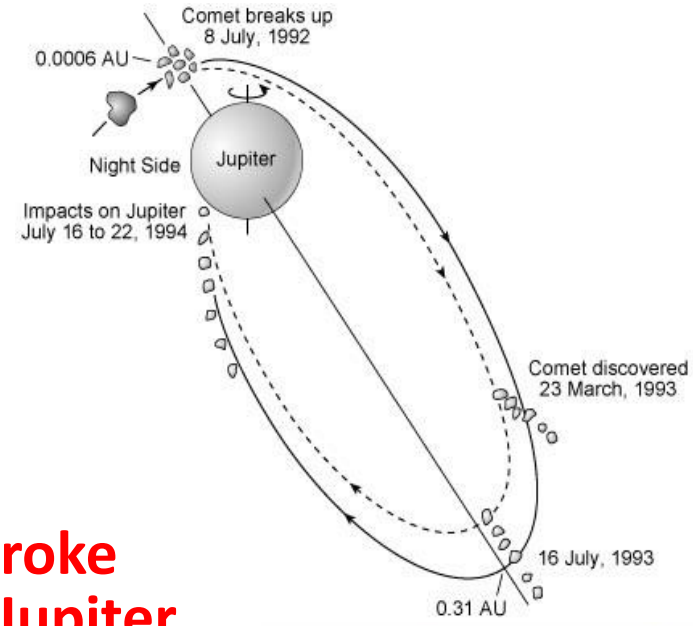


- **The best-known of the *short-period comets* is visible from Earth every 75–76 years.**
- **First historical record: description from 240 BC (Chinese chronicle Shiji).**

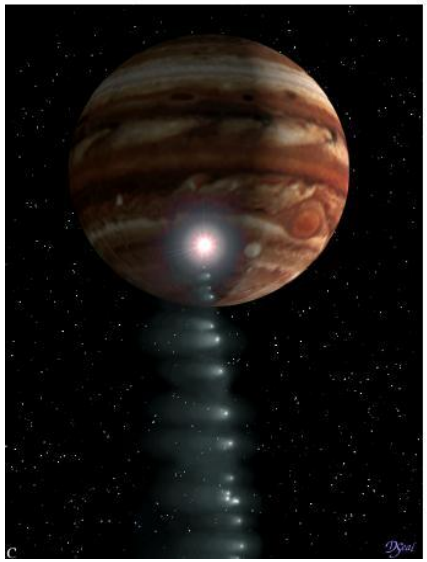
Next appearance: mid-2061

Comet Shoemaker-Levy 9

- Discovered in March 1993.
- Orbital studies of the comet revealed that it was *orbiting Jupiter* (captured about 20-30 years earlier) *rather than the Sun*, unlike all other comets known at the time.

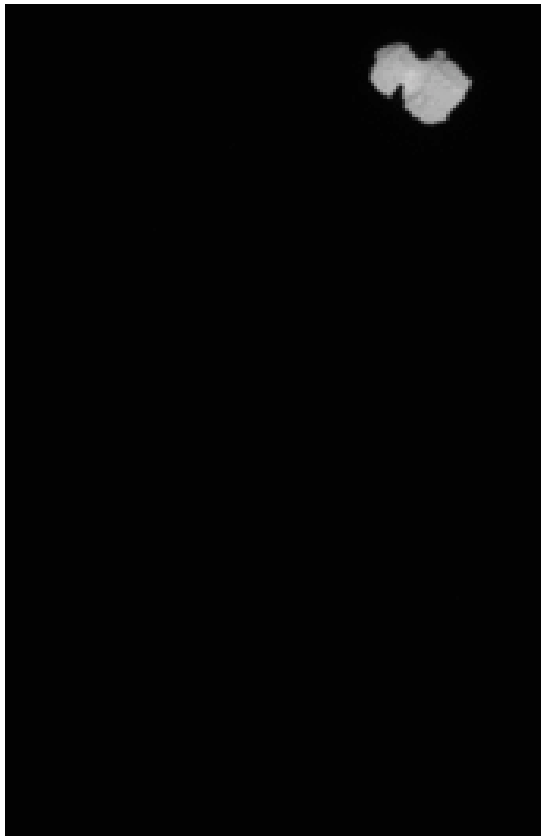


- In July 1994 the comet broke apart and collided with Jupiter, providing the first direct observation of an extraterrestrial collision of Solar System objects.
- Hypothesis: Jupiter's huge mass acts as a "cosmic vacuum cleaner" to provide increased protection against asteroids and comets for the inner planets.



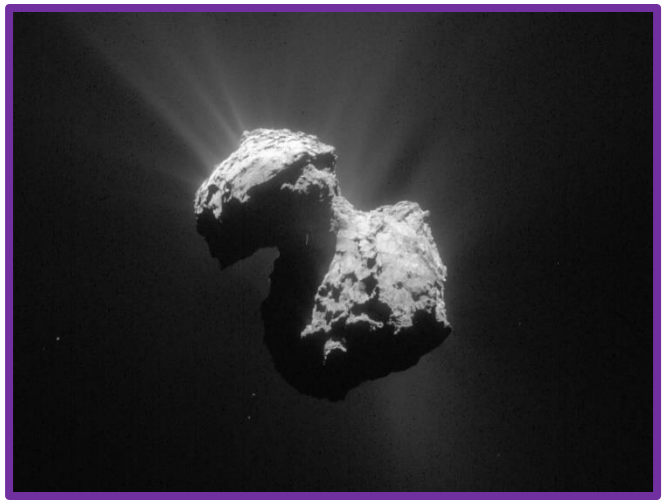
Comet Churyumov-Gerasimenko

The first comet to welcome a spacecraft to land on!

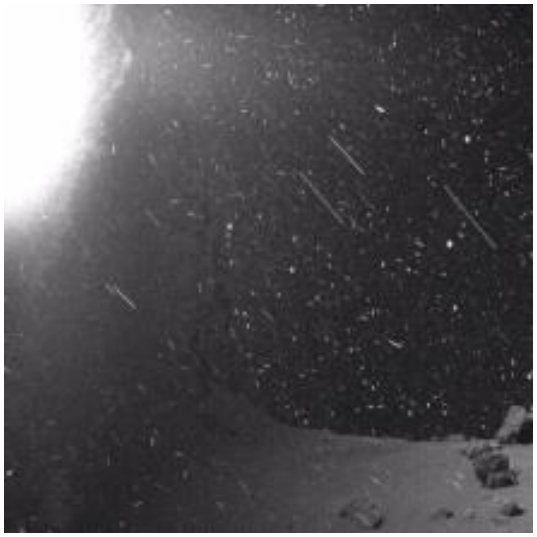


What is it like approaching a comet?

European Space Agency's Rosetta mission:
launched on 2 March 2004, entered the comet's orbit on 10 September 2014, sent Philae lander on 12 November 2014, Rosetta itself landed on the comet's surface on 30 September 2016.



"Rubber Duck"
outgassing



Dust and cosmic rays