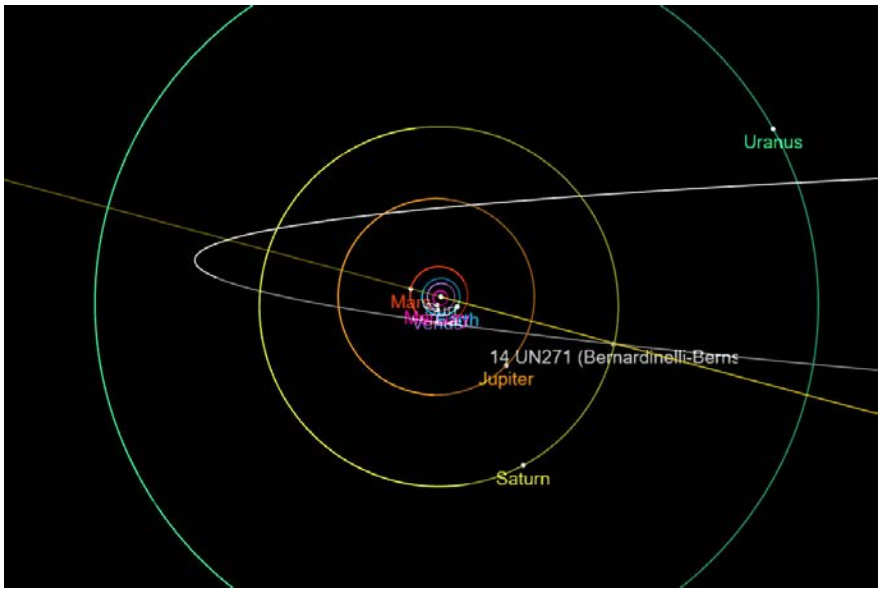
News Feature: The journey of Bernardinelli-Bernstein

John I Davies

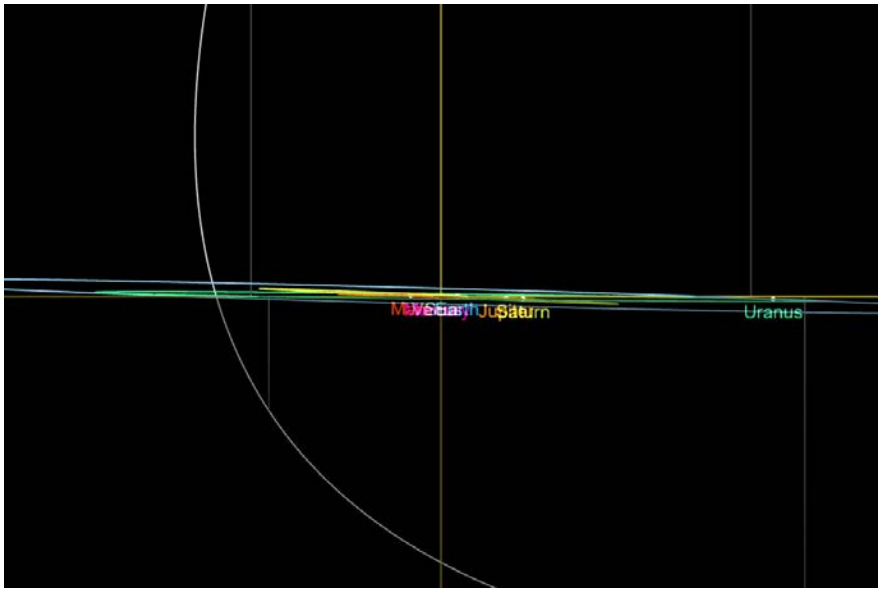


PLAN

Here is a plan view of the Solar system with planets in their almost perfectly circular orbits all lying close to the ecliptic plane but BB diving through with its closest approach to the Sun, perihelion, between the orbits of Saturn and Uranus.

Credit:JPL

The giant comet C/2014 UN271 (Bernardinelli-Bernstein) is diving towards the ecliptic, the fairly flat plane where most Solar System objects live. The NASA Jet Propulsion Lab (JPL) tracks and predicts its journey, alongside many others [1]. JPL allows us to see the classic plan and elevation of its trajectory - showing how Bernardinelli-Bernstein (BB) deviates from the Solar System norm by approaching almost at 90 degrees to the ecliptic. At about 150 km diameter[2] it may well be the largest comet we have ever observed.



ELEVATION

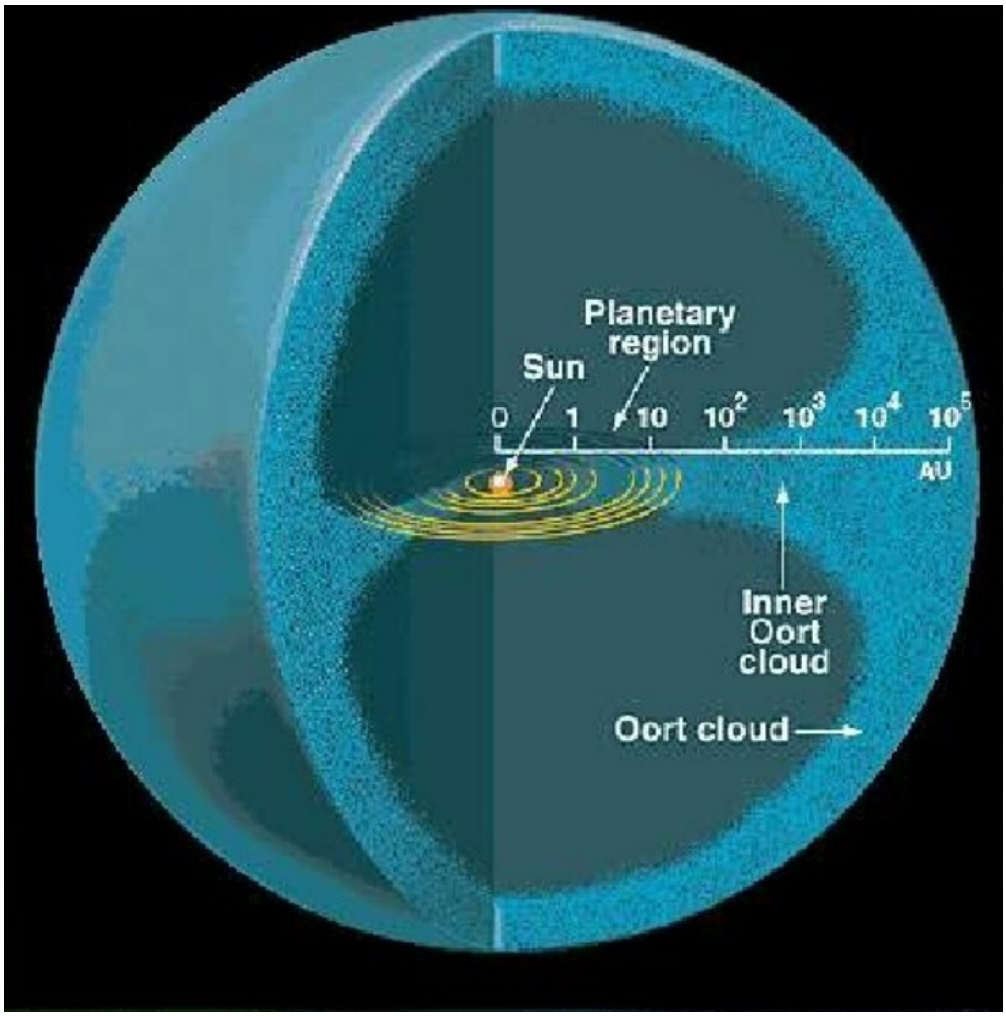
And here is the corresponding elevation of the Solar system with planets in their orbiting almost perfectly into the ecliptic plane. BB approaches from above and passes through the the ecliptic plane at almost 90 degrees.

Credit:JPL

[1] JPL Small-Body Database Browser, C/2014 UN271 (Bernardinelli-Bernstein) - ssd.jpl.nasa.gov/sbdb.cgi?sstr=2014%20UN271;orb=1;cov=0;log=0;cad=0#orb

[2] "Assuming a typical albedo, its diameter of ≈150 km implies a mass 10× larger than Hale-Bopp, and capable of gravitationally binding many of the larger particles ejected from other comets." *C/2014 UN_{271} (Bernardinelli-Bernstein): the nearly spherical cow of comets,* Bernardinelli et al Sep 2021 arxiv.org/abs/2109.09852

BB comes from the outer Oort cloud, like most long-period comets and outer Oort cloud objects lie in a rough sphere around the Sun rather than in the nice flat plane of the ecliptic.



The inner and outer Oort cloud.
www.slideshare.net/whitmers/oort-cloud-v2-adam

Credit: Adam Anderson

Missions to intercept and even rendezvous with BB are possible, as Adam Hibberd and John Davies explained in articles in Principium 34, August 2021 [1]. BB's perpendicular trajectory makes a rendezvous challenging but a flyby mission much easier. The 90 degree plane change is just more deltaV from the point of view of Tsiolkovsky's "tyrannical" rocket equation. As Adam explained in this article, two Rendezvous Missions, a simple direct mission requires a deltaV of at least 20 km/second – about twice that required to place an object into low Earth orbit – and you first have to get your rocket and probe out there. However Adam suggests economising on rocketry using a powered gravitational assist around Jupiter.

We will, of course, be keeping Principium readers up to date on the progress of BB, what we learn about it and what mission possibilities there are.

[1] *News Feature: Mission to 2014 UN271 using OITS*, John I Davies, Principium 34 page 38
i4is.org/wp-content/uploads/2021/08/News-Feature-Mission-to-2014-UN271-using-OITS-Principium34-print-2108231132opt-6-1.pdf

and

2014 UN_{271} Spacecraft Missions, Adam Hibberd, Principium 34 page 42
i4is.org/wp-content/uploads/2021/08/2014-UN271-Spacecraft-Missions-Principium34-print-2108231132opt-7-1.pdf