# One express ticket to Jupiter, please

April 9 2020

Credit: Curtin University

The team from the Desert Fireball Network at Curtin University has found that Earth acted as a slingshot to alter the orbit of a meteor and propel it back into deep outer space near Jupiter.

The team analysed camera footage of the meteor, that lit up Australian skies in July 2017, as it burned over Earth, as well as data associated with the fireball's velocity, angular distance and atmospheric trajectory, to determine the meteor gained net energy allowing it to switch orbit.

Lead researcher Mr Patrick Shober, a Ph.D. Candidate with the Space Science and Technology Centre (SSTC), in Curtin's School of Earth and Planetary Sciences, said it's the first time this 'slingshot event' to alter orbits has been recorded.

"The 2017 fireball was extraordinary on two fronts- the extended length of time it spent in our atmosphere, producing a brilliant 90 second light show, and the fact it didn't crash-land on Earth—but was flung back into space," Mr Shober said.

"The most intriguing quality about this fireball is that it basically used Earth as a type of slingshot, gaining itself an 'express ticket' to Jupiter, where it will most likely spend around 200 thousand years in an orbit near the gas giant. We estimate it will very likely have a close encounter with Jupiter in 2025."

In order to learn more about this fireball or meteoroid, researchers used data collected by the Desert Fireball Network (DFN), the largest single fireball network in the world.

Strategically placed fixed cameras across Western Australia and South Australia continuously monitor and photograph about one-third of Australian skies, to learn more about meteors that enter Earth's atmosphere as meteoroids; fall to Earth as meteorites; or burn up completely before they land.

On the night of 7 July 2017, many people reported an extraordinary light show via the DFN's citizen science app, Fireballs in the Sky. Viewers submitted location data which was linked to the photographs taken by the DFN.

"The DFN was able to photographically image and video record a majority of the fireball's atmospheric trajectory, including where it

entered and exited the atmosphere, using many of the DFN cameras," Mr Shober said.

"Looking at all the data associated with the meteoroid we estimate that it had an initial mass of 60 kilograms when it first entered Earth's atmosphere, but then lost about 20 kilograms before it exited back into space. The 'weight loss' happened when the meteor was burning up in the atmosphere, creating the spectacular light show that so many people saw that evening.

"We believe the meteoroid originated from an Apollo-type orbit and was inserted into a Jupiter-family comet (JFC) orbit, due to the net energy it gained during its close encounter with the Earth. This means that as a result of its grazing encounter with the Earth, the meteoroid was flung into an orbit with a higher energy.

"The geometry associated with its path allowed it to gain angular momentum around the Sun, and as a result, the semi-major axis and eccentricity both increased, due to the increase in energy, and the fireball completely changed its orbit—now headed toward Jupiter."

Researchers have calculated that star-gazers on Earth are unlikely to see this fireball again.

"The most likely time for this to reoccur is in mid-July 2023, but there is still only a one percent chance that it will get within ten times the distance from the Earth to the Moon. We believe that eventually the meteoroid will likely be ejected from the Solar System, or it will be flung into a different orbit again, near Neptune," Mr Shober said.

John Curtin Distinguished Professor Phil Bland, Director of SSTC, said the team was now working on using DFN data to better understand close encounters of centimetre to meter-sized objects with the Earth.

"Our team is aiming to create a model based on DFN data because telescopes are unable to see these small objects in space as they are too dim. The close encounter model could be extremely useful for future space missions to analyse these extremely small bodies as they get very close to the Earth," Professor Bland said.

**More information:** Patrick M. Shober et al. Where Did They Come From, Where Did They Go: Grazing Fireballs, *The Astronomical Journal* (2020). DOI: 10.3847/1538-3881/ab8002

Provided by Curtin University