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Fireball trail leads to ancient space rock

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A time-lapse photo of the meteor's 91km trail as it entered the Earth's atmosphere in April 2002 (Pic: DLR Institute of Space Sensor Technology and Planetary Exploration, Berlin)

A meteor seen streaking across the European sky last year has been found where it was predicted to land – an extremely rare achievement that offers insights into the history of our solar system.

Czech and German scientists describe in today's issue of *Nature* how they used photographic evidence to trace the meteorite's trajectory, predict its likely impact area in the mountains of Bavaria, and deduce its original orbit around the Sun.

The scientists are part of the European Fireball Network, an array of 30 stations with all-sky cameras in Germany, Austria, and the Czech Republic. For three hours each day over the last 40 years, the network has monitored more than a million square kilometres of night sky to record space rocks entering the Earth's atmosphere as 'shooting stars'.

Despite being seen quite often, it is very rare to actually catch a falling star. In 43 years, fireball networks in Europe, Canada and the United States have been able to trace just four meteorites from their fiery trails to their final resting place: the famous Príbram meteorite of Czechoslovakia in 1959; Oklahoma in 1970; Canada in 1977; and that was it – until this one, called the 'Neuschwanstein'.

Late one April night in 2002, many people saw a fireball brighter than a full moon scorching 91km across the central European sky for more than five seconds, with a roar heard 100km away that shook the ground and rattled windows.

Recording by the European Fireball Network shows the luminous trajectory started at an altitude of 85km as the 300kg meteor hurtled towards Earth at an angle of nearly 50 degrees and a speed of 21km/sec.

A 1.75kg fragment of the meteorite that was recovered from near Neuschwanstein, Bavaria, where it landed after a 48 million year journey thrugh our solar system (Pic: D Heinlein)

Three months later, a 1.75kg stony meteorite fragment was found in rugged mountain terrain – 400 metres south of its computed trajectory – near the well-known German castle of Neuschwanstein, after which it was named.

Before Neuschwanstein collided with Earth, the astronomers believe that its aphelion (furthest point of orbit from the Sun) was in the asteroid belt, like many fireballs that produce meteorites.

What really surprised them, however, is that Neuschwanstein's orbit was practically identical to the 1959 Príbram meteorite's orbit, even though their ages and compositions are quite different.

Príbram, along with the 1970 and 1977 finds, are fairly ordinary space rocks known as H5 chondrites – primitive and undifferentiated stones with small spheres of silica (chondrules) from the nebula that gave birth to our solar system.

By contrast, the Neuschwanstein meteorite is classified as an EL6 enstatite chondrite, which has less iron oxide, magnesium, calcium, aluminium, and

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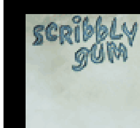

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titanium with its silicates than the other three, and little or no evidence of chondrules.

In addition, Neuschwanstein has a cosmic-ray exposure age – a measure of the time it has been travelling through space since separating from its parent body – of 48 million years, compared with 12 million years for Príbram. Both ages are longer than the typical survival times of meteoric streams.

While it is unlikely that the two came from the same parent body, statistical evidence suggests they are part of the same 'Príbram stream'. This stream comprises about a thousand million meteorite-producing bodies with similar orbits, but with a greater variety of structures, compositions and ages than previously believed.

One theory proposed is that spinning 'rubble piles' loosely bound by gravity could be exposed to tidal forces in close encounters with planets. This would dislodge surface rocks but leave them in similar orbits to their parent bodies, which might explain the diversity of rock chemistries and ages in meteor streams.

Mark Horstman – ABC Science Online

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