IMPLICATIONS OF WANDERING STARS PASSING THROUGH OUR SOLAR SYSTEM

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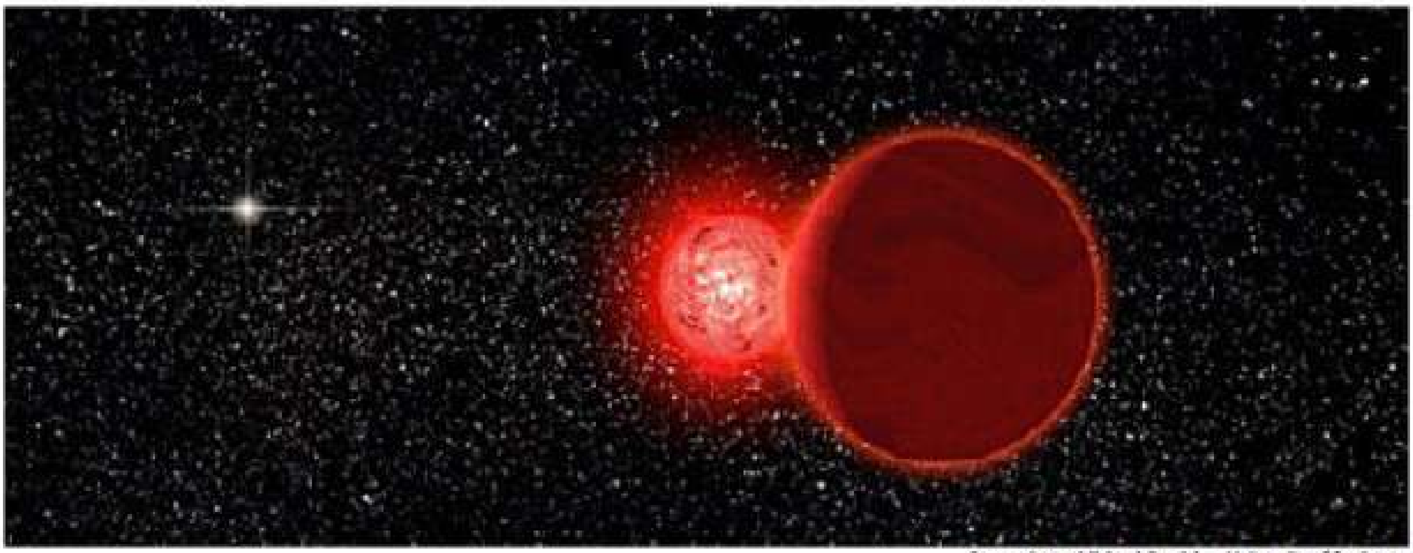

Cover photo: Michael Osadciw - University of Rochester

INTRODUCTION

Perturbations by passing stars on Oort cloud comets have previously been proposed as the source of long-period comets visiting the planetary region of the solar system and possibly for generating Earth-crossing comets that produce biological extinction events.

Approximately 30% of craters with diameters >10 km on the Earth and Moon are likely due to long-period comets from the Oort Cloud. Periodic increases in the flux of Oort cloud comets due to a hypothetical substellar companion have been proposed in the past, however recent time series analysis of terrestrial impact craters are inconsistent with periodic variations and sensitive infrared sky surveys have yielded no evidence for any wide-separation substellar companion (Mamajek *et al*, 2015).

But our sun has had close encounters with other stars in the past, and it's due for a dangerously close one in the not-so-distant future. Every 50,000 years or so, a nomadic star passes near our solar system. Most brush by without incident. But, every once in a while, one comes so close that it gains a prominent place in Earth's night sky, as well as knocks distant comets loose from their orbits.

A group of astronomers from the U.S., Europe, Chile, and South Africa have determined that a recently discovered dim star is likely to have passed through the solar system's distant cloud of comets, the Oort Cloud. No other star is known to have ever approached our solar system this close, five times closer than the current closest star, Proxima Centauri.

This famous stellar objects is called Scholz's Star. This small binary star system was discovered in 2013. Its orbital path indicated that, about 70,000 years ago, it passed through the Oort Cloud, the extended sphere of icy bodies that surrounds the fringes of our solar system. At the time of the discovery, some astronomers even think Scholz's Star could have sent some icy bodies tumbling into the inner solar system when it passed.

THE DISCOVERY OF SCHOLZ'S STAR (W0720)

At the end of 2013, Eric Mamajek of NASA's Jet Propulsion Laboratory was visiting a friend and fellow astronomer, Valentin Ivanov, at the offices of the European Southern Observatory in Santiago, Chile. While the two were working, Ivanov was looking at recent observations of a star cataloged as WISE J072003.20–084651.2. The star caught Mamajek's interest because it was just about 20 light-years away, but astronomers hadn't noticed it because of its dim nature and tiny apparent movement across the sky.

Since the star didn't appear to be moving much side to side, it was likely moving toward our solar system or away from it, at a breathtaking pace. Ivanov measured the star's radial velocity to learn how quickly it was moving toward or away from our Sun. When they got the results, both were in shock, the star came within a parsec [3.26 light-years] of the Sun in the past.

To work out its trajectory, the astronomers needed both pieces of data, the tangential velocity and the radial velocity. Ivanov and collaborators had characterized the recently discovered star through measuring its spectrum and radial velocity via Doppler shift. These measurements were carried out using spectrographs on large telescopes in both South Africa and Chile: The Southern African Large Telescope (SALT) and the Magellan Telescope at Las Campanas Observatory, respectively.

Once the researchers pieced together all the information, they figured out that Scholz's star was moving away from our solar system and traced it back in time to its position 70,000 years ago, when their models indicated it came closest to our Sun.
The star is part of a binary star system: a low-mass red dwarf star with mass about 8 percent that of the Sun and a "brown dwarf" companion with mass about 6 percent that of the Sun. Brown dwarfs are considered "failed stars"; their masses are too low to fuse hydrogen in their cores like a star, but they are still much more massive than gas giant planets like Jupiter.

The formal designation of the star is WISE J072003.20-084651.2 or W0720, but it has been nicknamed "Scholz's star" to honor its discoverer: astronomer Ralf-Dieter Scholz of the Leibniz-Institut für Astrophysik Potsdam in Germany, who first reported the discovery of the dim nearby star in late 2013. The "WISE" part of the designation refers to NASA's Wide-field Infrared Survey Explorer (WISE) mission, which mapped the entire sky in infrared light in 2010 and 2011, and the "J-number" part of the designation refers to the star's celestial coordinates.

Currently, Scholz's star is a small dim red dwarf in the constellation Monoceros, about 20 light-years away. However, at the closest point in its flyby of the solar system, Scholz's star would have been a 10th-magnitude star, about 50 times fainter than can normally be seen with the naked eye at night. It is magnetically active, which can cause stars to "flare" and briefly become thousands of times brighter. So, it is possible that Scholz's star may have been visible to the naked eye for minutes or hours by ancient humans 70,000 years ago (Figure 1).

70,000 years ago our world was a very different planet. Back then Earth was shared by at least four separate types of human being. Tough and sturdy Neanderthal folk hunted mammoths and built huts across the chilly forests, mountains and plains of Eurasia, from Portugal and Wales in the west, across to the Altai Mountains of Siberia. Further east the mysterious Denisovan people settled from valleys of Siberia to southeast Asia. Tiny Homo floresiensis made a warmer home in the rainforested islands of today's Indonesia, carefully avoiding giant monitor lizards, the local apex predators. Meanwhile in Africa our direct ancestors bided their time, never dreaming that one day that all of this wonderful planet would be their's alone.

Figure 1. A wandering star passed within one light-year of the Sun roughly 70,000 years ago. At the time, modern humans were just beginning to migrate out of Africa, and Neanderthals were still sharing the planet with us.
Source: José A. Peñas/SINC

However, Scholz's Star is relatively small and rapidly moving, which should have minimized its effect on the solar system and probably didn't have a huge impact. But in recent years, scientists have been finding that these kinds of encounters happen far more often than once expected. Scholz's Star wasn't the first flyby, and it won't be the last. In fact, we're on track for a much more dramatic close encounter in the not-too-distant future.

THE GAIA SATELLITE

While the close flyby of Scholz's star likely had little impact on the Oort Cloud, there are other dynamically important Oort Cloud perturbers that may be lurking nearby. The European Space Agency launched in 2013 the Gaia satellite, which is capable of mapping out the distances and measure the velocities of a billion stars. With the Gaia data, astronomers are able to tell which other stars may have had a close encounter with our solar system in the past or will in the future.

Researchers used Gaia data to plot our Sun's future meet-ups with other stars. They discovered nearly 700 stars that will pass within 15 light-years of our solar system over just the next 15 million years. However, the vast majority of close encounters have yet to be discovered. Researchers calculated that roughly 20 stars should pass within just a couple light-years of us every million years. Nonetheless, a few stars should still come surprisingly closer. And if a large, slow-moving star did pass through the edge of the Oort Cloud, it could really shake up the solar system.

The Gaia mission (Figure 2), is a space-based observational survey of over 1 billion stars in our local neighbourhood, the Milky Way. It will measure the precise position of stars using a technique known as astrometry. This will give a detailed three-dimensional map of the Milky Way and is complemented by spectroscopic measurements of the same stars. Along with the precise position of stars in the Milky Way, the Doppler effect is used to find relative velocities of stars by a shift in wavelength of their observed light. The result will be detailed kinematic map of stars in our local neighbourhood.

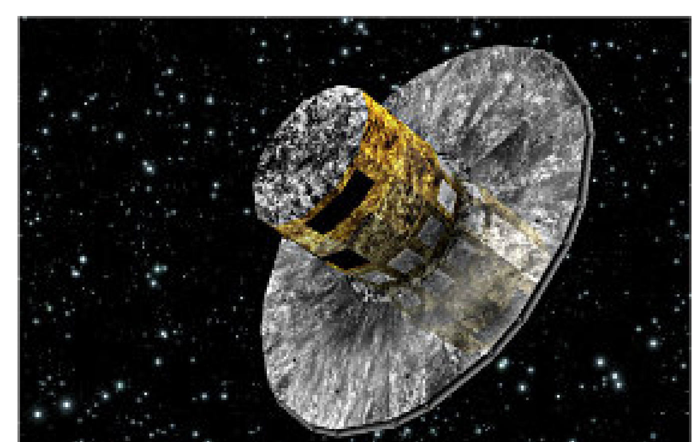

Figure 2. The Gaia satellite will provide the data with the position and brightness of millions of stars. Source: ESA

GLIESE 710 IS COMING !

A massive star steamrolling through the outer solar system is exactly what Gaia data show will happen less than 1.4 million years from now. A star called Gliese 710 (GL 710) will pass within 10,000 astronomical units (1 AU is equal to the average Earth-Sun distance of 93 million miles). That is a close shaving within the outer edge of the Oort Cloud.

At half the mass of the Sun, Gliese 710 is much larger than Scholz's Star, which is just 15 percent the mass of the Sun. This means Gliese 710's hulking gravity could potentially disrupt on the orbits of icy bodies in the Oort Cloud. And while Scholz's Star was so tiny it would have been barely visible in the night sky, Gliese 710 is larger than our current closest neighbor, Proxima Centauri, so when Gliese 710 reaches its closest point to Earth, it will burn as a brilliant orange orb that will outshine every other star in our night sky.

Based on the data from the space mission Gaia, Berski & Dybezynski (2016) have found new parameters of the close approach of Gliese 710. From their calculations it can be expect that this star will have the strongest influence on the Oort Cloud objects in the next million years. Even in last several million years there has not been any such important object near the Sun. At minimum distance, this star will be the brightest and the fastest object on the night sky, formed outside the solar system. The flyby of Gliese 710 will generate a large flux of new long-period comets and many of them will be able to reach the inner part of the solar system.

These results additionally show how important the Gaia mission is for the knowledge of the solar neighborhood. Results based on the work of this spacecraft have significantly improved the accuracy of close stellar approach parameters. In the short future astronomers will be able to describe the history and future of such phenomena, including also small objects such as brown dwarfs (Figure 3).

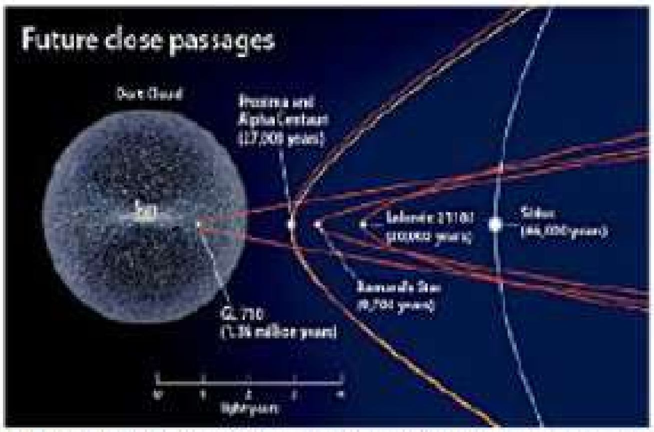

Figure 3. Many nearby stars will pass close to the Oort Cloud, but only one will move through it. In about 1.35 million years, Gliese 710 likely will gravitationally perturb millions of comets, sending a sizable number on a potential collision course with Earth. Source: Astronomy - Roen Kelly

Fortunately, the inner solar system is a relatively tiny target, and even if Gliese 710 does send comets flying our way, it would take thousands and thousands of additional years for these icy bodies to reach Earth. That should give any surviving future humans, plenty of time to take action and save the planet.

REFERENCES

Berski, F. & Dybezynski, A. 2016. Gliese 710 will pass the Sun even closer - Close approach parameters recalculated based on the first Gaia data release. Astronomy &Astrophysics 595, L10 (2016) DOI: 10.1051/0004-6361/201629835

Mamajek, E., et al 2015. The closest known flyby of a star to the Solar System. The Astrophysical Journal Letters. 800(1) L17 DOI: 10.1088/2041-8205/800/1/L17

https://astronomy.com/news/2020/05/wandering-stars-brush-past-our-solar-system-surprisingly-often?utm_source=asytwitter&utm_medium=social&utm_campaign=asytwitter

https://www.astronomy.com/science/wandering-star-shook-up-the-prehistoric-solar-system/?webSyncID=9b65bc90-ab29-d045-2c2d-c9845770a551&sessionGUID=6c33847a-a83d-e1d9-8904-83779d7e7515

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