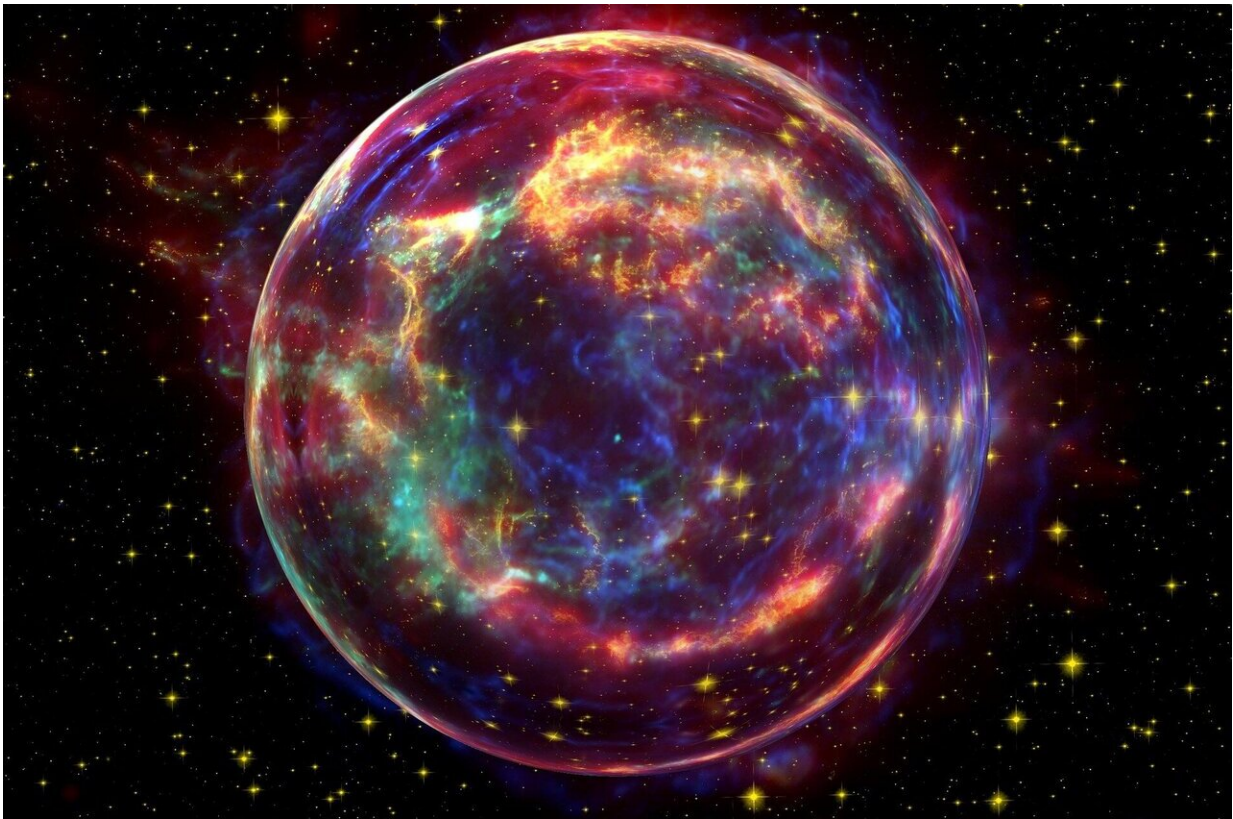


# At the heart of the Milky Way, stars draw closer, threatening planets in their orbit

June 9 2020, by Matt Williams

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At the center of our galaxy resides the galactic bulge, a densely packed region of stars, dust and gas. Within this massive structure, which spans thousands of light-years, there are an estimated 10 billion stars, most of

which are old red giant stars. Because of this density, astronomers have often wondered if a galactic bulge is a likely place to find stars with habitable planets orbiting them.

Essentially, stars that are closely packed together are more likely to experience close encounters with other stars, which can be catastrophic for any planets that orbit them. According to a new study from Columbia University's Cool Worlds Lab, most stars in the [bulge](#) will experience dozens of close encounters over the course of a billion years, which could have significant implications for long-term habitability in this region.

The study, in prepublication and set to appear in the [Monthly Notices of the Royal Astronomical Society](#), was led by Moiya McTier—an NSF Graduate Research Fellow at Columbia University and a member of Cool Worlds Lab. She was joined by Prof. David Kipping (founder of the Cool Worlds Labs) and Kathryn Johnston, the chair of Astronomy at Columbia and a member of the Flatiron Institute's [Center for Computational Astrophysics](#).

To put it simply, stellar close encounters are relatively common in our galaxy, occurring once every 50,000 years or so. As the stars in the galactic disk orbit around the center of the Milky Way, their individual paths cause them to occasionally pass closer to one another. The last time our solar system experienced a close stellar encounter was roughly 70,000 years ago.

At this time, the binary system known as Scholtz's Star (WISE 0720-0846) passed about 52,000 astronomical units (0.25 parsecs; 0.82 light-years) from the sun, disturbing the Oort Cloud and the orbits of comets and asteroids in the solar system. This was not the first time Scholz's Star passed near to our solar system—roughly 80,000 years ago, it passed within ~66,000-70,000 AU from the sun.

For the most part, these encounters have resulted in long-period comets and asteroids being kicked out of the Oort Cloud—a few of which collided with Earth and caused extinction-level events. However, stellar encounters can get much closer (as close as ~20,000 AUs) and have a detrimental effect on planetary systems. This include the possibility that planets will be stripped away from their stars or have their orbits destabilized.

As McTier explained to *Universe Today* via email: "Close stellar encounters can have dangerous consequences for planets, but the exact results depend on a lot of factors: the mass ratio of the two stars involved, how fast they're moving, the angle of approach, and of course, the encounter distance. But in general, these close encounters can potentially rip planets from their host stars or destabilize their orbits so that they get flung out of the system many years after the fly by. Both of those would render a planet uninhabitable according to the most common criteria."

In a [previous study](#) that appeared in *MNRAS* last year, a team of Swedish astronomers found that sun-like stars in open clusters have a 25% chance of losing their outer planets to a close flyby. Two similar studies that were also released last year (both led by astronomers from the [Leiden Observatory](#) in the Netherlands) found that 14% of planets in dense stellar clusters will be lost from their stars within ten million years of formation.

Naturally, this raises the question of what would occur in the [galactic bulge](#), where stellar densities are much higher than in the Milky Way's disk. To calculate the rate at which close encounters happen in the bulge, Moiya and her team simulated the orbits of the millions of stars that reside there. They then used the analytic density profile for each star's position to estimate the number of flybys that occur.

As McTier indicated, it was a time-consuming process that led to some interesting findings: "We found that 80% of bulge stars should come within 1000 AU of another star every billion years. Half of the stars have dozens of such encounters in the same timeframe. The encounter rate goes down when you consider closer fly bys, but encounters within 100 AU are still quite common."

Beyond an increased risk of stellar close-encounters, planets located around stars in the galactic bulge are also at greater risk of "sterilizing energetic events." These occur when stars in closely packed clusters undergo gravitational collapse and explode in a supernova, which results in nearby star systems (and their [planets](#)) being hit by the resulting gamma-ray bursts (GRBs) and the release of heavy (and radioactive) elements.

During the past [11 million years](#), supernovae that have taken place in near-Earth space have been linked to sudden periods of global warming on Earth, the depletion of the ozone layer, and the surface becoming exposed to harmful levels of solar and cosmic radiation as a result. For [stars](#) that are grouped closer together, supernovae would have a far greater impact, as they would happen more often and closer by.

It is little wonder that astronomers believe galaxies like ours also have "habitable zones," which reside between the galactic bulge and the spiral arms. Whereas the bulge is a dangerous place for life because of the increased risk of [close encounters](#) and radiation, the spiral arms pose an elevated risk due to higher rates of star formation.

Aside from the rigorous nature of their study, McTier indicated that it is also significant because it offers additional confirmation for this theory. "Our results are novel because we took a new dynamics approach to understanding galactic habitability, but we really just confirmed what astronomers already knew: the bulge likely isn't a stable place for life,"

she said.

Studies like this one could also have a significant impact on the search for habitable exoplanets, not to mention the search for extraterrestrial intelligence (SETI). By knowing that life is most likely to arise and evolve within the galactic habitable zone (GHZ), the part of the disk located between the core and the periphery, scientists can narrow their search efforts and increase the odds of finding life.

**More information:** 8 in 10 Stars in the Milky Way Bulge Experience Stellar Encounters Within 1000 AU in a Gigayear:

[arxiv.org/pdf/2005.00026.pdf](https://arxiv.org/pdf/2005.00026.pdf)

Daohai Li et al. Fly-by encounters between two planetary systems I: Solar system analogues, *Monthly Notices of the Royal Astronomical Society* (2019). [DOI: 10.1093/mnras/stz1794](https://doi.org/10.1093/mnras/stz1794)

Provided by Universe Today

Citation: At the heart of the Milky Way, stars draw closer, threatening planets in their orbit (2020, June 9) retrieved 25 April 2024 from <https://phys.org/news/2020-06-heart-milky-stars-closer-threatening.html>

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