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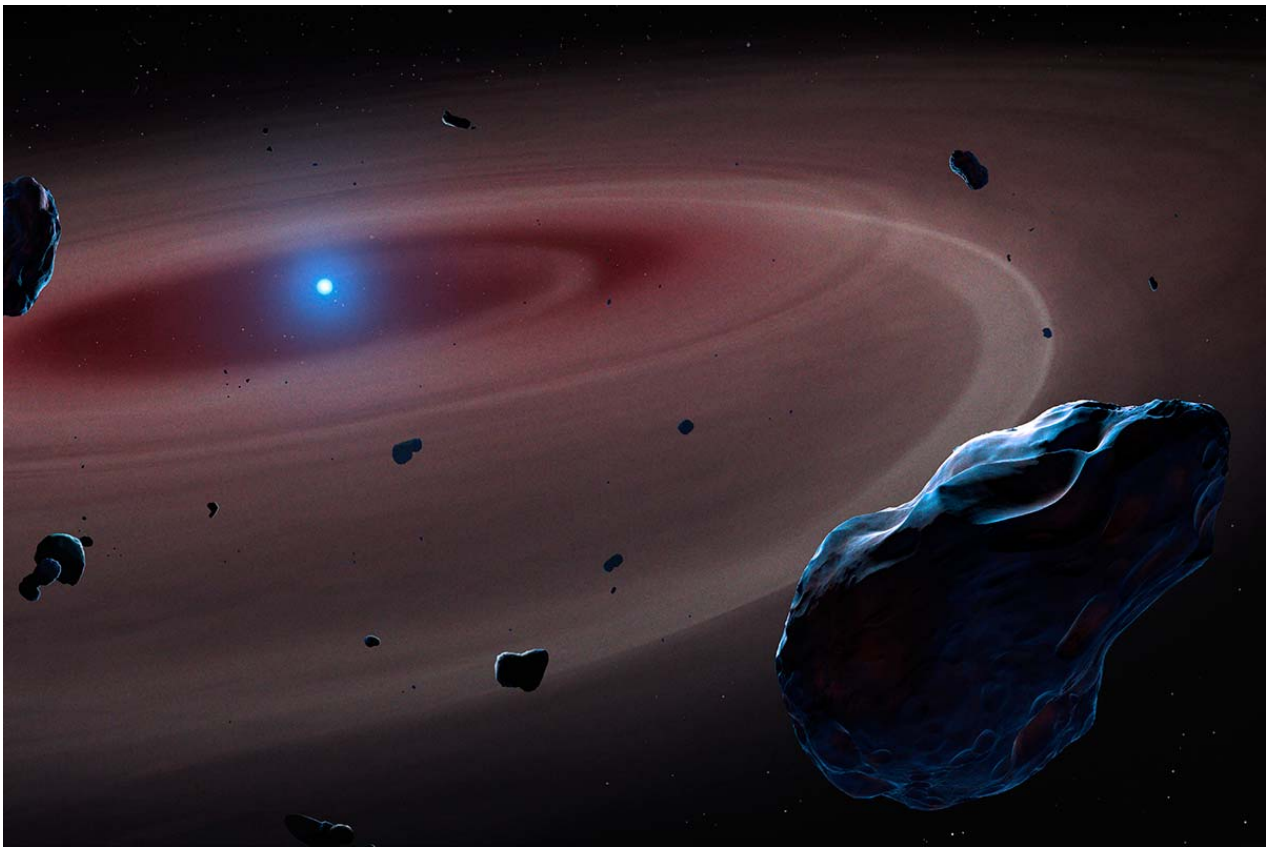
Extreme radiation around small stars may not doom life nearby



It's a tough neighbourhood
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By **Mika McKinnon**

Could our Milky Way's many red and white dwarf stars be home to alien life? These tiny, dim stars seem inhospitable with intense flares, destructive tidal forces, and narrow windows for liquid water, but with just the right circumstances planets could protect lifeforms from their volatile stars.

Our galaxy is full of small, cool stars. Red dwarfs are common but rambunctious stars that lash out in fierce flares. White dwarfs are calmer smoldering remnants of dying stars too small to explode in a nova, but only form after a star swells into a planet-destroying red giant.

These dwarf stars have narrow habital zones — the region around each star that could have liquid water – yet their prevelance makes them tempting targets in the search for life.

Any planet inside a dwarf star's habitable zone is close enough to be tidally-locked into a perpetual blazing dayside and frigid eternal night, or, worse, shredded by tidal forces. "There is a relatively limited range of distances where a planet can be habitable and not ripped apart by the strong tides," says Avi Loeb of Harvard University.

White dwarf dilemma

"If you park a planet in a habitable zone around a white dwarf, it will stay there for a very, very long time — potentially enough time for life to manifest. The problem is getting them there," says Jason Nordhaus of Rochester Institute of Technology.

When a star like our sun dies, it puffs into a red giant that engulfs and shreds nearby planets before collapsing into a white dwarf. Any planet in a white dwarf's habitable zone must either form from rubble of freshly destroyed planets or migrate in from system outskirts after the star's collapse.

Planets can migrate if a large object yanks its orbit, says Nordhaus. But migrating planets need to shed enormous energy to snuggle close to its star, burning into an ember and leaving a desiccated husk unable to support life unless comets restore its water.

While a white dwarf's stability is hospitable to life, the turbulent conditions necessary to place a rocky world in the proper orbit are so rare that we've yet to discover any candidates.

Up to 75 per cent of the stars in the Milky Way are red dwarfs, many hosting Earth-sized exoplanets like those around our nearest neighbor Proxima Centauri or the tantalizing TRAPPIST-1.

Red dwarfs are incredibly long-lived, creating stable solar systems where life might evolve. But they also hurl violent flares that swamp planets in radiation while powerful solar winds strip protective atmospheres.

Shielding life

Strong magnetic shields could protect a planet from solar winds, as could a thick haze like the one that engulfed primordial Earth or currently swathes Saturn's moon Titan. "Floating droplets of hydrocarbon vapour clouds are really efficient at absorbing ultraviolet radiation," says

Jaymie Matthews at the University of British Columbia. "It's not an ozone layer; it's a smog shield."

Loeb and his team suggest searching slightly outside the habitable zone where planetary surface temperatures drop below freezing. Even without an atmosphere oceans could survive protected by ice. If they're relatively deep, says Matthews, those oceans could shield life from radiation.

In the last thirty years, we've found thousands of worlds in more variety than we ever imagined. "Earth is not an extremely rare gem in the jewel box of the sky," says Matthews. As this explosion of planetary discovery continues, we're gaining a more colourful palette of places where life could evolve.

References: arxiv.org/abs/1711.08484, arxiv.org/abs/1711.09691

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