

Astronomy 7010 – Dr. McGimsey
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LAB 2 WEB Based Resources
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University of Sydney. (2020, July 29). Strange Dismembered Star Cluster found at Galaxy's Edge. *ScienceDaily*. Retrieved July 28, 2020 from

www.sciencedaily.com/releases/2020/07/200729114824.htm

Z. Wan, G.F. Lewis, Li, T.S. et al. The Tidal Remnant of an Unusually Metal-Poor Globular Cluster. *Nature*, DOI: 10.1038/s441586-020-2483-6.

Astronomers have found the remnant of strange dismembered globular cluster at the edge of the Milky Way Galaxy that are upending theories about how heavy elements formed in early stars. The study was conducted by a team of international astronomers who discovered that this ancient collection of stars was ripped away from the Earth's galaxy over two billion years ago. This remarkable find of shredded globular cluster is astonishing, as the stars in this galactical archeological discovery have much lower qualities of heavier elements than those found in other such clusters. This is a globular cluster whose birth and life were not the same as those that remain today. Thus, the evidence strongly suggests that the original structure was the last of its kind.

Additionally, the Milky Way is home to approximately one hundred and fifty global clusters. Each of these are made up of a ball of a million or so stars that orbit in the galaxy's tenuous stellar halo. The findings reveal that a cluster destroyed billions of years ago, was formed from the composition of stars in the early universe. Hydrogen and helium existed in substantial amounts in the universe after the Big Bang. These, along with later stellar generations, contained

heavier elements that were formed. The list of elements consisted of calcium, oxygen, and phosphorus which aid in the strengthening of our bones.

Consequently, global cluster populations declined at a steady rate. This is due to the gravitational forces of the Milky Way. The galaxy tore them to shreds, thus absorbing their stars into the main body of the galactic system. This means that the stream is a relatively temporary phenomenon which will dissipate over time. University of Sydney Ph.D. student, Zhen Wan stated that researchers had found the remains of the cluster before it faded forever into the Milky Way's Halo. Dr. Jeffrey Simpson from the University of Wales says that in astronomy once they find a new object, it suggests that there are more of them out there.

New York University (2020, July 28). Astrophysicist Investigates the Possibility of Life below the Surface of Mars. *ScienceDaily*. Retrieved July 28, 2020 from www.sciencedaily.com/releases/2020/07/200728113541.htm

D. Atri (2020). Investigating the Biological Potential of Galactic Cosmic Ray-Induced Radiation-Driven Chemical Disequilibrium in the Martian Subsurface Environment. *Scientific Reports*, 10 (1) DOI: 10.1038/s41598-020-68715-7.

No life has been detected on the Martian surface. However, a new study from astrophysicist and research scientists find that conditions below the surface could potentially support life. The subsurface has never been explored, even though it is less harsh and has traces of water. Mounting evidence suggests the presence of an aqueous environment on ancient Mars. This raises the

question of the possibility of a life-supporting environment. The Martian atmosphere endured drastic changes in the climate due to erosion. Surface water disappeared which led to habitable places on the planet shrinking.

Afterwards, there remained just a small portion of water supply near the surface. This limited supply of water was in the form of brines and water-ice deposits. A scientist hypothesized that galactic cosmic radiation which can penetrate several meters beneath the surface, will induce chemical reactions. These reactions can be used for metabolic energy by extant life, and host organisms using mechanisms seen in similar chemical and radiation environments on earth.

A rover will be launched on a mission to Mars in 2022. It will be equipped to dig into the Martian surface to detect microbial life suspected to be as few as two meters below the surface. It is exciting to see if life can survive the harsh conditions on Mars.

Penn State. (2020). Cosmic Tango Between the Very Small and the Very Large: theory of loop quantum cosmology describes how tiny primordial features account for anomalies at the largest scales of the universe. ScienceDaily. Retrieved July 29, 2020 from www.sciencedaily.com/releases/2020/07/200729205012.htm

Abhay Ashtekar, Brajesh Gupt, Donghui Jeung, V. Sreenath (2020). Alleviating the Tension in the Cosmic Microwave Background Using Planck-Scale Physics. *Physical Review Letters*, 125(5) DOI: 10.1103/PhysRevLett.125.051302.

Some of the largest-scale properties of the universe still remain a mystery. Einstein's Theory of general relativity explains fascinating astrophysical and cosmological phenomena on a small-scale. A new study using loop quantum cosmology accounts for two major mysteries. Radiation that was emitted when the universe was 380 thousand years young can still be seen today in Cosmic Microwave Background (CMB). The abnormalities are difficult to explain using known physics. They caused a possible crisis in cosmology. Two of the abnormalities have been resolved using quantum loop cosmology.

In the early universe research shows that the inhomogeneities were stretched under gravities influence during quantum fluctuations. The inflations were seeded in the Cosmic Microwave Background. Looking closely at the early universe, we can see that the fabric of space time is woven by quantum threads. It's like looking a shirt and first noticing that it is two dimensional and basically flat. Upon closer inspection with a microscope, you can see that it is constructed by tightly packed, dense threads. The general relativity that Einstein described, breaks down, similar to this example, as two-dimensional surfaces are closely inspected.

Additionally, researchers also explored that Big Bounce and universal inflation to that has replaced the Big Bang Theory. The universe was once thought to have emerged form nothing. The Big Bounce contends that a super-compressed mass was previously compressed and is now expanding.

Massachusetts Institute of Technology. (2020). In a First, Astronomers Watch a Black Hole's Corona Disappear, then reappear: a colliding star may have triggered the drastic transformation.

ScienceDaily. Retrieved July 29, 2020 from
www.sciencedaily.com/releases/2020/07/200716101557.htm

C. Ricci, E. Kara, Loewenstein, B. Trakhtenbrot, et al. (2020). The Destruction and Recreation of the X-Ray Corona in a Changing-look Active Galactic Nucleus. *The Astrophysical Journal* 898 (1): L1DOI: 10. 3847/2041-8213/ab91a1.

As Corona appears on Earth, astronomers watch as a supermassive black hole's own corona, the ultra-bright, billion-degree ring of high-energy particles that encircles a black hole's event horizon, is destroyed abruptly. For the first time in history, astronomers at MIT and elsewhere have witnessed the destruction of unclear origins.

Consequently, the researchers believe, a star caught in the black holes gravitational pull may have caused the dramatic transformation. Researchers also guess that the star may have ricocheted through the black holes dick of swirling material. The high-energy particles of the corona and everything near it, suddenly plummeted into the black hole. "With the caveat that this event happened from a stellar tidal disruption, this would be some of the strictest constraints we have on where the corona must exist," Kara, a project researcher, says.

In under one year, astronomers observed a precipitous and surprising drop in the black holes brightness by a factor of 10,000. Changing by a factor of 100 in eight hours is mind blowing and unheard of. After the corona's disappearance, it was able to regenerate itself in a few months. By pulling together material from its outer edges and spinning up high energy X-rays close to the event horizon of the black hole. Although it is 100 million light years from Earth, the research team, funded in part by NASA, will continue to monitor the corona in real time.

Northwestern University. (2020). Spectacular Ultraviolet Flash May Finally Explain How White Dwarfs Explode: event also could give insight into dark energy and the creation of iron. ScienceDaily. Retrieved July 30, 2020 from <https://www.sciencedaily.com/releases/2020/07/200723115907.htm>

A.A. Miller, M. R. Magee, A. Polin, K. Maguire, et al. (2020) The Spectacular Ultraviolet Flash from the Peculiar Type Ia Supernova 2019yvq. *The Astrophysical Journal*, 2020; 898 (1): DOI: 10.3847/1538-4357/ab9eo5.

Astrophysicists have spotted a spectacular flash of ultraviolet (UV) light accompanying a white dwarf explosion. Dense amounts of dead stars, called White Dwarfs, explode. The material moves further away from the source. As time passes, we can see deeper and deeper into the material as it thins, viewing all the way to the center of the explosion after about one year.

Nonetheless, this is only the second time ever that this extremely rare type of supernova has been witnessed. Longstanding mysteries are being uncovered and insight given to ideas including how dark energy accelerates the cosmos, how the universe creates heavy metals, such as iron, and what causes white dwarfs to explode.

Although the supernova was spotted using the Zwicky Transient facility in CA in Dec. 2019- just a day after it exploded, the event occurred in a galaxy 140 million light years from Earth. It is relatively nearby and very close to the dragon shaped constellation, Draco. The special flash of UV light and X-ray wave lengths, had astronomers within hours studying and observing the supernova at NASA's Neil Gehrels Swift Observatory.

Consequently, the rare flash of light lasted for a couple of days, puzzling astronomers. Usually white dwarfs become cooler as they age. The influx of heat indicated that something was

incredibly hot. This perplexed Miller and his team, but gave them a clue that can over turn the mystery in this field. Four potential scenarios will be studied and an explanation determined within a year, uncovering more secrets of dark energy.