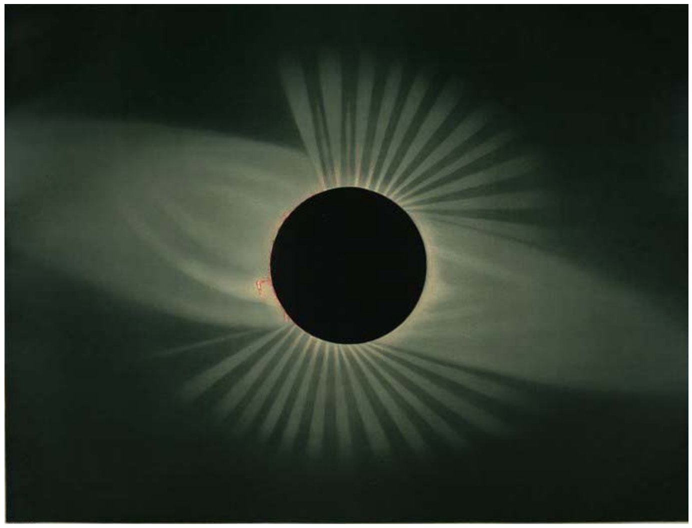
# ECLIPSE
# NEWSLETTER



**The Eclipse Newsletter is dedicated to increasing the knowledge of Astronomy, Astrophysics, Cosmology and related subjects.**

**VOLUMN 2 NUMBER 4**
**SEPTEMBER – OCTOBER 2018**

**PLEASE SEND ALL PHOTOS, QUESTIONS AND REQUST FOR ARTICLES TO**
pestrattonmcag@gmail.com

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## MCAO PUBLIC NIGHTS AND FAMILY NIGHTS.

**The general public and MCAO members are invited to visit the Observatory on select Monday evenings at 8PM for Public Night programs. These programs include discussions and illustrated talks on astronomy, planetarium programs and offer the opportunity to view the planets, moon and other objects through the telescope, weather permitting. Due to limited parking and seating at the observatory, admission is by reservation only.**

**Public Night attendance is limited to adults and students 5th grade and above. If you are interested in making reservations for a public night, you can contact us by calling 302-654-6407 between the hours of 9 am and 1 pm Monday through Friday. Or you can email us any time at KimGreenmcao@gmail.com or mtcuba@physics.udel.edu. The public nights will be presented even if the weather does not permit observation through the telescope. The admission fees are $3 for adults and $2 for children. There is no admission cost for MCAO members, but reservations are still required. If you are interested in becoming a MCAO member, please see the link for membership. We also offer family memberships.**

**Family Nights are scheduled from late spring to early fall on Friday nights at 8:30PM. These programs are opportunities for families with younger children to see and learn about astronomy by looking at and enjoying the sky and its wonders. It is meant to teach young**

**children from ages 6-12 about astronomy in simple terms they can really understand. Reservations are required and admission fees are $3 for adults and $2 for children.**

**MCAO WEB SITE IS**

mountcuba.org

## WHAT ARE THE MESSIER OBJECTS?

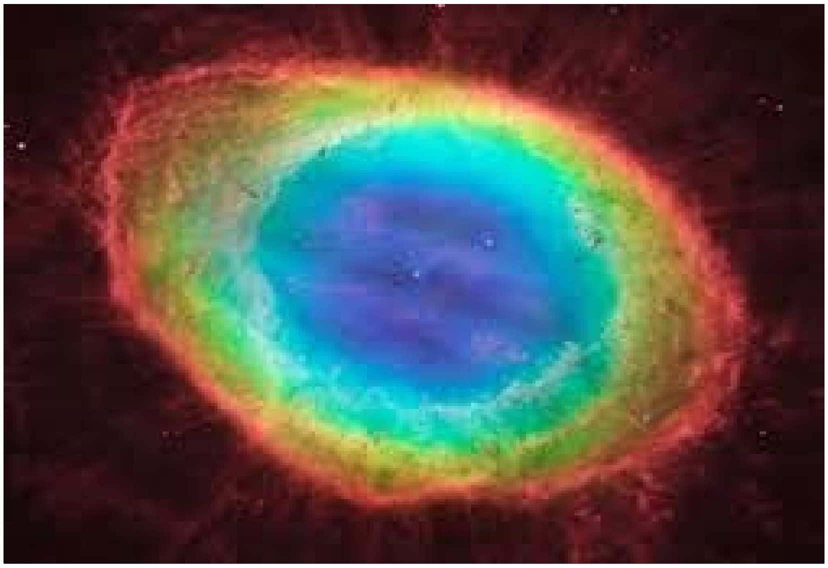
**The Messier objects are a set of over 100 astronomical objects first listed by French astronomer Charles Messier in 1771.[1] Messier was a comet hunter, and was frustrated by objects which resembled but were not comets, so he compiled a list of them,[2] in collaboration with his assistant Pierre Méchain, to avoid wasting time on them. The number of objects in the lists he published reached 103, but a few more thought to have been observed by Messier have been added by other astronomers over the years.**

**For a list of Messier objects:**

https://en.wikipedia.org/wiki/List of Messier objects

## THIS ISSUES MESSIER OBJECT

**THE RING NEBULA #57**

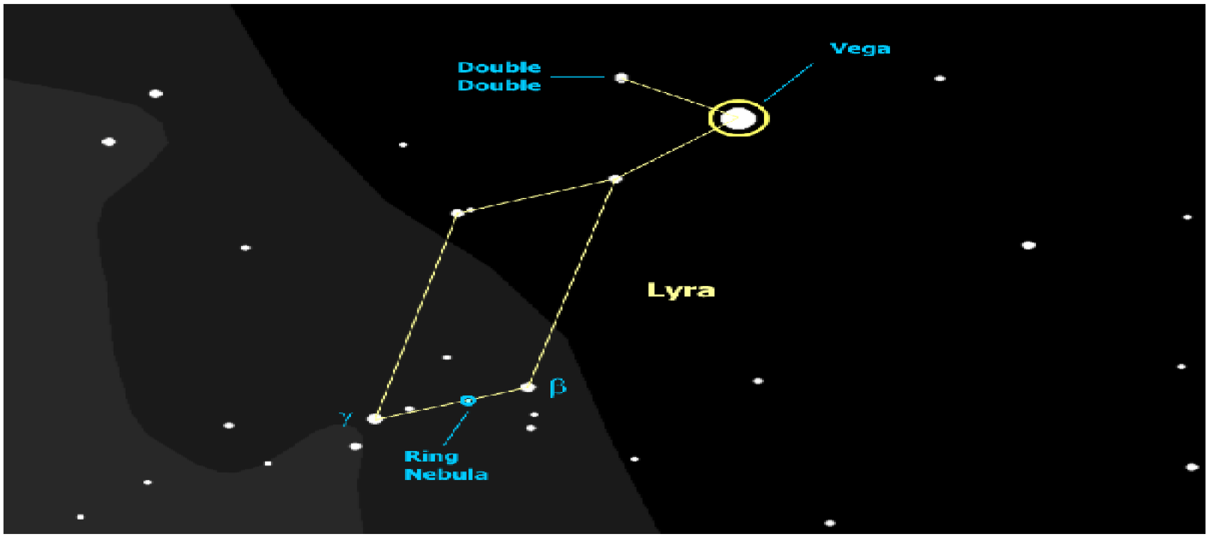


**The Ring Nebula (also catalogued as Messier 57, *M57* or *NGC 6720*) is a planetary nebula in the northern constellation of Lyra.**

**Distance to Earth: 2,283 light years**
**Radius: 1.3 light years**

**A planetary nebula is created when a star blows off its outer layers after it has run out of fuel to burn. These outer layers of gas expand into space, forming a nebula which is often the shape of a ring or bubble. About 200 years ago, William Herschel called these spherical clouds planetary nebulae because they were round like the planets. At the center of a planetary nebula, the glowing, left-over central part of the star from which it came can usually still be seen. The star is nearing its last stage in its evolution before becoming a white dwarf.**

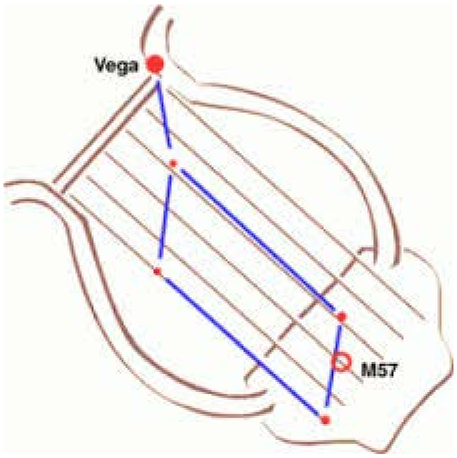
**Locating the Ring Nebula.**




## THIS ISSUES CONSTELLATION.

## You guessed it.

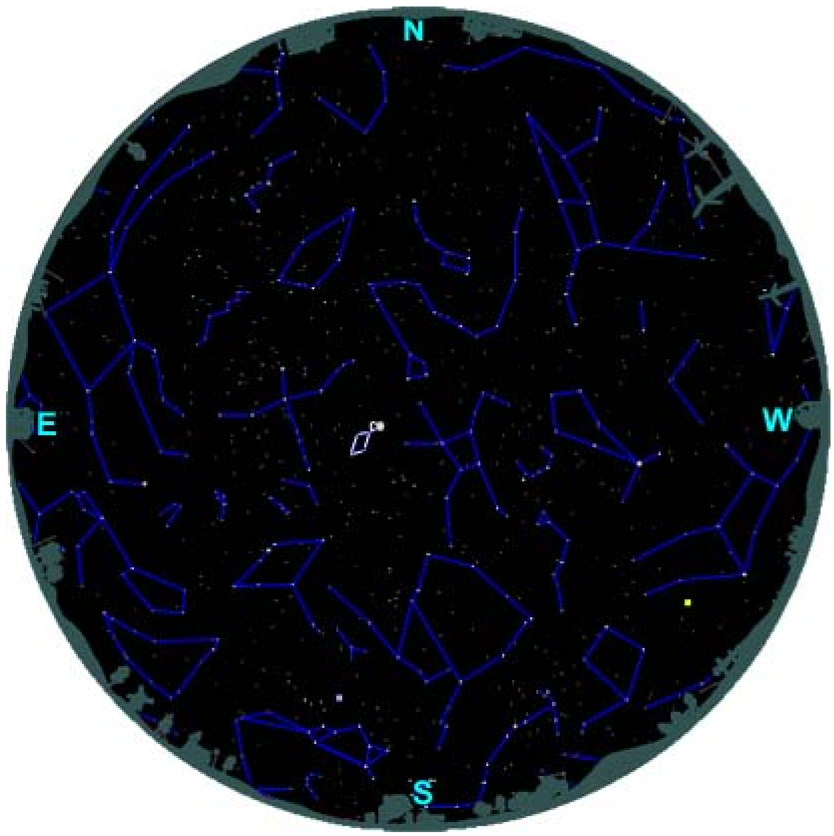
## LYRA




**THE HARP**

**Shining almost directly overhead as darkness falls these days is the brilliant bluish-white star Vega, in the constellation of Lyra, the Harp. Vega is the fifth-brightest star in the night sky, and the third-brightest visible from midnorthern latitudes, trailing just Sirius and Arcturus.**

## Finding Lyra - Northern Hemisphere




**The chart shows the position of Lyra over most of the United States in early-summer at midnight. This chart can also be applied to other areas of the Northern hemisphere such as Canada, the UK and Europe.**
**From April to May Lyra will appear low on the horizon in the north-east around 11pm gradually moving higher in the sky before day breaks.**
**From June to July the constellation will appear in the east around 10 pm gradually moving higher until it is directly overhead.**
**From August to September Lyra will appear overhead around 10 pm, slowly dipping towards the horizon in the north-west over the next few hours.**

**From October to December it will be visible high in the western sky between 6 and 7 pm before disappearing below the horizon several hours later.**

**Lyra Constellation Facts.**

**Lyra is visible in both the Northern and Southern hemispheres.**

**In the Northern hemisphere the constellation can be seen from April to December.**

**In the Southern hemisphere Lyra can be viewed low on the northern horizon in the winter months.**

**The brightest star in this small constellation is Vega, which is also the fifth brightest star in the night sky.**

**Vega is also part of the 'Summer Triangle' asterism, along with the stars Deneb and Altair.**

**The Summer Triangle is formed by the brightest stars in each of the constellations of Lyra, Cygnus and Aquila.**

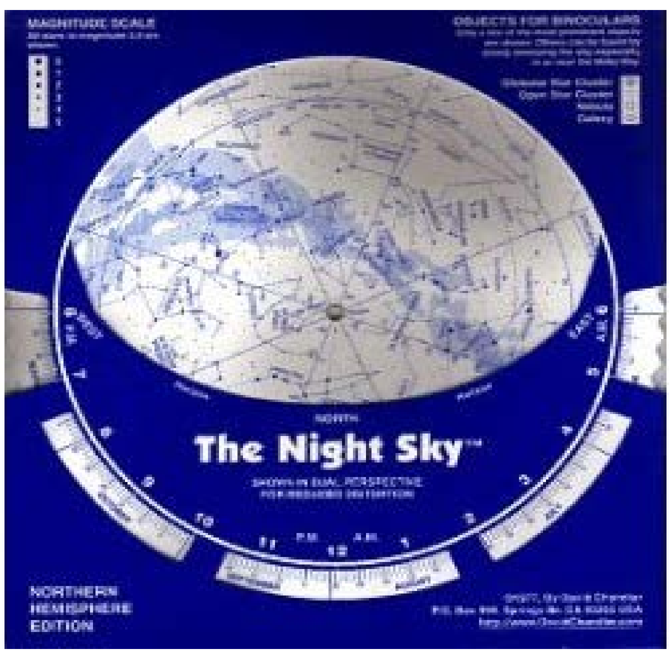
**An asterism is a group of stars which form a pattern in the night sky but is not a constellation in itself.**

**The beautiful Ring Nebula can be found within the Lyra constellation, between the stars of Sulafet and Sheliak.**

**The Ring Nebula is a planetary nebula, these form when stars similar in size to our own sun shed their mass at the end of their lifespan.**

## HOW TO FIND CONSTELLATIONS

**Step 1. Purchase a Star Chart as shown below. Mt. Cuba Astronomical Observatory sells this one for $4.00.**




**Step 2. Orient the Star Chart. You will notice there are two sides to the chart. One side is for viewing the sky to the North. The other side is for viewing to the South. Let's start with the side for the North. You will notice that the white part of the chart rotates. At the**

**bottom, you will see months. Above the month is the date and above that the time. The month and date will rotate so now line them up with the time you are ready for viewing. Simply look at the chart to pick out the object then look up at the sky. Compare the stars on the star chart and the stars you see in the night sky. 3. To view South, turn the chart over and turn around to face South.**

## A rare cosmic collision might let scientists calculate the precise age of the universe.

**A so-far unseen celestial collision could be astronomers' best bet for figuring out just how quickly the universe is expanding.**

**Right now, physicists have two ways of measuring that expansion rate, and both are quite precise — but their answers don't match. That's been frustrating, since the number, known as the Hubble constant, feeds calculations like the ones scientists use to estimate how old the universe is.**

**And that's why they're looking for a third method to pin it down. A pair of scientists based in Massachusetts think the trick will be catching a glimpse of the violent phenomenon of a black hole and a neutron star colliding. [Did a Neutron-Star Collision Make a Black Hole?] "Black hole-neutron star binaries are very complicated systems, which we know very little about," Salvatore Vitale, a physicist at the Massachusetts Institute of Technology, said in a**

**statement. "If we detect one, the prize is that they can potentially give a dramatic contribution to our understanding of the universe."**
**So far, scientists haven't observed the collisions of a mixed pair, only of binary black holes and of binary neutron stars. Most of those observations have included only black holes, so the collision can only be detected using gravitational waves. Astronomers know they also need a light signal to calculate the Hubble constant, which leaves them looking for either pairs of neutron stars or black hole-neutron-star binaries.**

**But when physicists tried to calculate the Hubble constant from the data they gathered during August's neutron-star merger — the first ever observed — they couldn't be very confident in the result. That's because neutron-star collisions are a mess, shooting out material asymmetrically and making it difficult for scientists to figure out just how far away a signal is coming from.**
**Switch out one of those neutron stars for a black hole and the mess becomes more manageable, giving physicists the location, they would need to recalculate the Hubble constant. But scientists think these mixed collisions are rarer, so Vitale and his colleague wanted to check whether the benefit of the more precise location outweighs the handicap of the mergers being less common.**
**That work was detailed July 12 in an article published in the journal Physical Review Letters and posted to the pre-print site arxiv.org.**
**According to their estimates, just one mixed merger should let physicists calculate the Hubble constant as effectively as combining data from 50 different neutron-star collisions.**

**Now, all we have to do is wait for a lucky strike.**

## <u>This_Is_Our_Story</u>.

- ♦ **13.8 Billion years ago : Birth of the universe.**
- ♦ **13.6 Billion years ago: Formation of the Mikey way.**
- ♦ **4.6 Billion years ago : Formation of the planet Earth.**
- ♦ **4.5 Billion years ago : Formation of the moon.**
- ♦ **4.45 Billion years ago : Earth day is 7 hour long.**
- ♦ **4.28 Billion years ago : Water started condensing in liquid form.**
- ♦**3.9 Billion years ago : Birth of organic life.**

**♦ 3.5 Billion years ago : Unicellular life started ( prokaryotes).**
**♦ 2.9 Billion years ago : Pongola glaciation occurred.**
**♦ 2.5 Billion years ago : Oxygen is found in the oceans & atmosphere.**
**♦ 1.6 Billion years ago : Eukaryotic ( Nucleated) cells appeared.**
**♦ 510 million years ago : Vertebrates appeared in the ocean.**
**♦ 420 Million years ago : Land plants & coral reefs appeared.**
**♦ 400 Million years ago : Formation of the first forests.**
**♦ 380 Million years ago : Earth day is 22 hours long.**
**♦ 375 Million years ago : Vertebrates with legs appeared.**
**♦ 350 Million years ago : Transition from water to land.**
**♦ 300 Million years ago : First reptiles appeared.**
**♦ 230 Million years ago : Age of the Dinosaurs.**
**♦ 199 Million years ago : Flying reptiles appeared.**
**♦ 65 Million years ago : Meteor impact, chicxulub crater, Yucatan, Mexico. Mass extinction of the dinosaurs.**
**♦ 63 Million years ago : Appearance of the placental mammals.**
**♦ 45 Million years ago : Modern mammals appeared.**
**♦ 6 Million years ago. : Hominids & chimpanzees diverge from a common ancestor.**
**♦ 1.4 Million years ago : Hominids use controlled fires.**
**♦ 7000 years ago : Tahoe glacial maximum.**
**♦ 11000 years ago : Development of agriculture.**
**♦ 4500 years ago : Pyramids of Giza were build.**
**♦ 1543 years : Modern scientific revolution.**
**♦ 1760 years : First industrial revolution.**
**♦ 1903 years : The invention of flight.**
**♥ 1957 years : The beginning of space age.**

## NOTHING CAN TRAVEL FASTER THAN THE SPEED OF LIGHT
## OR
## FASTER THAN THE SPEED OF LIGHT?

### 4 things that currently break the speed of light barrier.
**BY MICHIO KAKU**

**One frequent question I get is whether we can break the light barrier—because unless we can break the light barrier, the distant stars will always be unreachable.**

**Most textbooks say that nothing can go faster than light, but that statement actually should be qualified: The answer is yes, you can break the light barrier, but not in the way we see in the movies. There are, in fact, several ways to travel faster than light:**

**1. The Big Bang itself expanded much faster than the speed of light. But this only means that "nothing can go faster than light." Since nothing is just empty space or vacuum, it can expand faster than light speed since no material object is breaking the light barrier. Therefore, empty space can certainly expand faster than light.**

**2. If you wave a flashlight across the night sky, then, in principle, its image can travel faster than light speed (since the beam of light is going from one part of the Universe to another part on the opposite side, which is, in principle, many light years away). The problem here is that no material object is actually moving faster than light. (Imagine that you are surrounded by a giant sphere one light year across. The image from the light beam will eventually hit the sphere one year later. This image that hits the sphere then races across the entire sphere within a matter of seconds, although the sphere is one light year across.) Just the image of the beam as it races across the night sky is moving faster than light, but there is no message, no net information, no material object that actually moves along this image.**

**3. Quantum entanglement moves faster than light. If I have two electrons close together, they can vibrate in unison, according to the quantum theory. If I then separate them, an invisible umbilical cord emerges which connects the two electrons, even though they may be separated by many light years. If I jiggle one electron, the other electron "senses" this vibration instantly, faster than the speed of light. Einstein thought that this therefore disproved the quantum theory, since nothing can go faster than light.**

**But actually this experiment (the EPR experiment) has been done many times, and each time Einstein was wrong. Information does go faster than light, but Einstein has the last**

**laugh. This is because the information that breaks the light barrier is random, and hence useless. (For example, let's say a friend always wears one red sock and one green sock. You don't know which leg wears which sock. If you suddenly see that one foot has a red sock, then you know instantly, faster than the speed of light, that the other sock is green. But this information is useless. You cannot send Morse code or usable information via red and green socks**

**4. Negative matter. The most credible way of sending signals faster than light is via negative matter. You can do this either by:**

**a) compressing the space in front of your and expanding the space behind you, so that you surf on a tidal wave of warped space. You can calculate that this tidal wave travels faster than light if driven by negative matter (an exotic form of matter which has never been seen.)**

**b) using a wormhole, which is a portal or shortcut through space-time, like the Looking Glass of Alice.**

**In summary, the only viable way of breaking the light barrier may be through General Relativity and the warping of space time. However, it is not known if negative matter exists, and whether the wormhole will be stable. To solve the question of stability, you need a fully quantum theory of gravity, and the only such theory which can unite gravity with the quantum theory is string theory (which is what I do for a living). Sadly, the theory is so complex that no has been able to fully solve it and give a definitive answer to all these questions. Maybe someone reading this blog will be inspired to solve string theory and answer the question whether we can truly break the light barrier.**

## Can Anything Move Faster Than Light?

**By Sarah Fecht**

**Yes, the universe itself will eventually outpace the speed of light. Just how this will happen is a bit complicated, so let's begin at the very beginning: the big bang. Around 14 billion years ago, all matter in the universe was thrown in every direction. That first explosion is still pushing galaxies outward. Scientists know this because of the Doppler effect, among other reasons. The wavelengths of light from other galaxies shift as they move away from us, just as the pitch of an ambulance siren changes as it moves past.**

**Take Hydra, a cluster of galaxies about three billion light years away. Astronomers have measured the distance from the Earth to Hydra by looking at the light coming from the cluster. Through a prism, Hydra's hydrogen looks like four strips of red, blue-green, blue-violet and violet. But during the time it takes Hydra's light to reach us, the bands of color have shifted down toward the red end—the low-energy end—of the spectrum. On their journey across the universe, the wavelengths of light have stretched. The farther the light travels, the more stretched it gets. The farther the bands shift toward the red end, the farther the light has traveled. The size of the shift is called the redshift, and it helps scientists figure out the movement of stars in space. Hydra isn't the only distant cluster of galaxies that displays a redshift, though. Everything is shifting, because the universe is expanding. It's just easier to see Hydra's redshift because the farther a galaxy is from our own, the faster it is moving away.**

**There is no limit to how fast the universe can expand, says physicist Charles Bennett of Johns Hopkins University. Einstein's theory that nothing can travel faster than the speed of light in a vacuum still holds true, because space itself is stretching, and space is nothing. Galaxies aren't moving through space and away from each other but with space—like raisins in a rising loaf of bread. Some galaxies are already so far away from us, and moving away so quickly, that their light will never reach Earth. "It's like running a 5K race, but the track expands while you're running," Bennett says. "If it expands faster than you can run, you'll never get where you're going."**

**Faster-than-light (also superluminal or FTL) communication and travel are the conjectural propagation of information or matter faster than the speed of light.**

**The special theory of relativity implies that only particles with zero rest mass may travel at the speed of light. Tachyons, particles whose speed exceeds that of light, have been hypothesized, but their existence would violate causality, and the consensus of physicists is that they cannot exist. On the other hand, what some physicists refer to as "apparent" or "effective" FTL[1][2][3][4] depends on the hypothesis that unusually distorted regions of spacetime might permit matter to reach distant locations in less time than light could in normal or undistorted spacetime.**

**According to the current scientific theories, matter is required to travel at slower-than-light (also subluminal or STL) speed with respect to the locally distorted spacetime region. Apparent FTL is not excluded by general relativity; however, any apparent FTL physical plausibility is speculative. Examples of apparent FTL proposals are the Alcubierre drive and the traversable wormhole.**

## THE ORIGINS OF THE OMG PARTICLE.

**By Paul Sutter, Astrophysicist | LiveScience**

**Right now, as you read this very text, your DNA is getting sliced up by tiny, invisible bullets. The damage-dealers are known as cosmic rays, even though they are absolutely not rays — but the name stuck from a historical misunderstanding. Instead, they're particles: electrons and protons, mostly, but occasionally heavier things like helium or even iron nuclei.**

**These cosmic particles are trouble, because a) they're fast, and so have a lot of kinetic energy to toss around and b) they're electrically charged. This means they can ionize our poor DNA nucleotides, ripping them apart and occasionally leading to uncontrollable**

**replication errors (aka, cancer). ['Superstar' Eta Carinae Acts Like a Ginormous Cosmic-Ray Gun, But Why?**

**As if this wasn't bad enough, every once in a while, roughly once per square kilometer per year, a particle comes screaming into our upper atmosphere at truly monstrous speed, knocking against a hapless nitrogen or oxygen molecule and cascading into a shower of lower-energy (but still deadly, of course) secondary particles.**

**There's only one appropriate response when confronted with a particle of such preposterous potential: "OMG."**

## Fastballs

**"OMG" was the nickname given to the first example of what are now known as ultra-high-energy cosmic rays, detected in 1991 by the University of Utah's Fly's Eye cosmic ray detector. That single proton slammed into our atmosphere going roughly 99.9999999999999999999951 percent the speed of light. And no, all those nines aren't just for dramatic effect to make the number look impressive — it really was that fast. This particle had the same amount of kinetic energy as a decently thrown baseball … compressed down into an object the size of a proton.**

**That means this particle had over 10 million times more energy than what our most powerful particle collider, the LHC, can produce. Due to relativistic time dilation, at that speed, the OMG particle could travel to our nearest neighbor star, Proxima Centauri, in 0.43 milliseconds of the particle's own time. It could continue on to our galactic core by the time you've finished reading this sentence (from its own perspective).**

**OMG, indeed.**

**Since that particle's detection, we've continued to watch the skies for these extreme events using specialized telescopes and detectors across the world. All told, we've recorded around a hundred of the OMG-class particles in the past few decades.**

**Those few dozen examples both elucidate and deepen the mysteries of their origins. More data is always good, but what the heck in our universe is powerful enough to give a proton a good enough crack that it could almost — almost — challenge light itself to a race?**

**Knuckleballs**

**To accelerate a charged particle to insane velocities, you need two key ingredients: a lot of energy and a magnetic field. The magnetic field does the work of transferring to the particle whatever energies are in your event (say, the explosive kinetic energy of a supernova blast or the swirling gravitational pull as matter falls toward a black hole). The detailed physics are, naturally, incredibly complicated and not very well-understood. The birthplaces of cosmic rays are frightfully complicated and located in extreme regions of our universe, so a complete physical picture is going to be hard to come by.**

**But we can still make some educated guesses as to where extreme examples like our friend the OMG particle come from. Our first guess might be supernovas, the titanic deaths of massive stars. Magnetic fields? Check. A lot of energy? Check. But not quite enough energy to do the trick. Your garden-variety stellar detonation just doesn't have enough raw oomph to spit out particles at the speeds we're considering.**

**What's next? Active galactic nuclei are strong contenders. These nuclei are created as matter swirls to its doom around a supermassive black hole situated in the center of a galaxy; that material compresses and heats up, forming an accretion disk in its final moments. That twisting inferno generates intense magnetic fields from dynamo actions, forming the potent mixture of ingredients necessary to add some serious horsepower to ejected particles.**

**Except (and you knew there was going to be an "except"), the active galactic nuclei are too far away to produce cosmic rays that reach Earth. At the ludicrous speeds of an ultra-high-energy cosmic ray, cruising through the cosmos is more like trying to plow through a blizzard. That's because at those speeds the cosmic microwave background — the flood of low-energy photons left over from the very early universe — appears highly blueshifted**

**toward higher energies. So, that high-intensity light smacks and swats at the traveling cosmic ray, slowing and eventually stopping it.**

**Thus, we shouldn't expect the most powerful cosmic rays to travel any farther than a hundred million light-years or so — and most of the active galactic nuclei are much, much farther from us than that.**

## Curveballs

**For quite a while, a prime suspect for OMG generation was Centaurus A, a relatively nearby active galactic nucleus that sits somewhere between 10 million and 16 million light-years away. Powerful, magnetic and close — the perfect combo. But while some surveys have hinted that cosmic rays may come from its general direction, there's never been a clear enough correlation to tmove that galaxy from suspect to convict. [A Deep Look at the Strange Galaxy Centaurus A]**

**Part of the problem is that the Milky Way's own magnetic field subtly alters the trajectory of incoming cosmic rays, disguising their original directions. So, to reconstruct the source of a cosmic ray, you also need models for the strength and directions of our galaxy's magnetic field — something we don't exactly have a full handle on.**

**If the OMG generator is not Centaurus A by itself, then perhaps it's the Seyfert galaxies, a certain galactic subclass of generally closer, generally weaker (but still insanely bright and strong) active galactic nuclei. But again, with not even a hundred samples to draw on, it's hard to make a rigorous statistical determination.**

**Perhaps it's gamma-ray bursts, thought to emanate from the peculiar cataclysmic end to some of the most extreme stars. But our understanding of the physics of that situation is (can you believe it?) kinda sketchy.**

**Perhaps it's something more exotic, like topological defects from the earliest moments of the Big Bang or some funky interactions within dark matter. Maybe we're getting physics wrong and our distance-limit calculations aren't accurate. Maybe, maybe, maybe…**

**The true origins of these ultra-high-energy "OMG" particles are tough to pin down, and despite almost 30 years of detection history, we don't have a lot of firm answers. Which is fine — it's good to have at least some mysteries left in the universe. Astrophysicists could use some job security, too.**

## UPCOMING STAR PARTIES

**For more information on DAS STAR PARTIES, visit the mountcuba.org web site. Select Delaware Astronomical Society DAS.**

**Select Events at top and then STAR PARTIES.**