Quasars

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Our expanding universe is filled with millions of galaxies, yet the universe consists of mostly empty space. One can't help but admire the beauty of this vast emptiness. Our universe consists of almost an infinite number of entities ranging from planets to stars to black holes, each with their unique properties, beauty, and purpose. The size of our universe is mind-boggling; it is something we will never comprehend. Quasars or quasi-stellar objects are one of the universe's mystical spectacles.

In the 1960s quasars were referred to as radio stars because astronomers discovered that they were a strong source of radio waves. Astronomers at that time, using the first radio telescopes to explore space, discovered these small bright objects now known as quasars. According to Fraser Cain from *universetoday.com,* the first quasars that were discovered seemed to move away at one-third the speed of light or about 100,000km/s. Cain also states that at that time astronomers got creative about explaining quasars. They thought that quasars weren't really bright and our understanding of the universe was incorrect. One theory they had was that an advanced civilization somehow managed to harness all the stars in their galaxy and use it as a source of energy! I too as an astronomer might get creative with theory, after all, most of astronomy is based on theory, for example, the big bang.

Quasars are classified as active galactic nuclei; they emit a lot of energy and are very bright; they can be compared to a glowing spinning top. Astronomers consider quasars to be probably one of the most distant and brightest objects in the universe! The light from quasars travels billions of years to reach Earth, which proves that they are one of the universe's most distant objects. The most distant quasars that have been observed are from as far as 10 billion light years away. This means we are seeing 10 billion years into the past and these quasars that we observe may no longer exist. Perhaps our observations of quasars are the early stages of the formation of galaxies that occurred 10 billion years ago! Probably our very own Milky Way galaxy was a quasar 10 billion years ago.

Quasars give off a very high redshift, in other words, an effect or phenomenon that occurs when electromagnetic radiation from an object that's moving away from us increases in wavelength. This causes the electromagnetic radiation to shift towards the red side of the spectrum. An example that correlates to this phenomenon is when a police car, its sirens blaring, passes you. As the car approaches you, the frequency of its sound (pitches) increases, and when it is moving away from you, it decreases. This effect occurs similarly in quasars because of our expanding universe, except we're able to see the redshift in a quasar because its redshift is much bigger than the redshift any object on Earth can

produce. Although they tend to go towards the red side of the spectrum, they are still some of the brightest and strongest energy-emitting objects throughout the universe. They are so strong that they can emit a thousand times more energy than what our beloved Milky Way galaxy can produce! If we could only harness a fraction of the energy emitted from a quasar, we would have an unimaginable amount of power. With this much energy we could probably send space probes all across the galaxy and possibly even send manned space-crafts.

These entities are usually found at the center of active developing galaxies and younger galaxies. Although the power of quasars might make us think of them as monstrously huge, they are in fact no bigger than our solar system. You might think our solar system is big, but compared with the size of our galaxy, it is just a speck of dust. At the heart of quasars and galaxies, you can find supermassive black holes that are so strong, even light traveling at 300,000 km/s can't escape. These black holes can be up to a billion times bigger than the sun! But, despite the fact that they have massive black holes, quasars are still able to emit jets of energy formed by the escape of the absorbed surrounding gases under gravitational pressure and friction. These jets are created outside of the massive black hole.

What can possibly power these powerful giants and cause them to emit so much energy? Quasars are thought to be powered by the accretion of material into the supermassive black holes in the nuclei of distant galaxies. These accretion disks that surround the black hole are created from surrounding matter, like gases, and use it to power it. This material gets heated up by millions of degrees from the immense gravitational pressure. It ends up exploding and releasing the energy. We see quasars blasting out twin straight cosmic jets of energy because of the magnetic field created by the black hole. The jets are emitted from the black hole's north and south poles. Quasars can also be formed from colliding galaxies, their collisions providing a source of energy to the black hole. Scientists theorize that a quasar could be formed within the next 3 to 10 billion years when the Andromeda galaxy collides with our very own Milky Way galaxy.

Quasars have multiple names depending on the angle by which we view them according to the jets of energy. For example when the jets are perpendicular to what we see, astronomers call it a radio galaxy. If they are at an angle, it is called a quasar, if the jet of energy is directly pointing at us, it is called a blazar. Our galaxy isn't a quasar because the massive black hole at the center of our galaxy doesn't have anything to power it up. These black holes at the center of every galaxy don't always feed off materials. If there is nothing to use to turn it into energy, the jets of energy slowly start to dissipate and stop emitting energy until something they can use to turn into energy comes nearby.

Think of an old-fashioned wood-burning furnace. To keep it powered you would need to keep feeding it wood. When the fire starts to die out, you put more wood on and start the process again. We are lucky not to have a quasar at the center of our galaxy. According to Ben Brumfield, astronomer Maarten Schmidt said if Earth were to be close to a quasar, "we would all be dead. It would cook the Earth's surface with massive bursts of …gamma rays…the quasar would devour…our

whole solar system, in a matter of months…the largest ones can eat a hole out of the center of a galaxy."

With the help of the Hubble telescope, over 2,000 quasars have been discovered in our universe as of today. The first quasar discovered was 3C 273 in 1960; it was located in the Virgo constellation about 260 light years away. 3C 273 is the closest and brightest visible quasar. It lies at the center of an elliptical galaxy and can only be seen during May, around the same time we are able to see the Virgo constellation. Another quasar that has been discovered that I think is probably one of the coolest is the APM 08279+5255 quasar, which is located in the Lynx constellation and is known as the brightest quasar and object in the universe! The quasar is about 12 billion light years away; what makes this quasar so cool is that it contains water vapor. Its water vapor forms a giant cloud-type object; this cloud contains the oldest and largest mass of water in the universe! If we think that the two-thirds of our planet that is water is a lot, then imagine how much water there would be if multiplied by 140 trillion. APM 08279+5255 contains 140 trillion times more water than Earth! The water vapor clouds spiral around one of the biggest black holes discovered, standing at a whopping 20 billion solar masses; in other words the black hole mass is about 20 billion times bigger than our sun. The discovery of APM 08279+5255 shows that water has existed for a very long time, about a billion times earlier than what astronomers had originally thought.

Quasars are mysterious objects. We still have a lot to learn about them. They are strange beings. They stand out from everything else in the universe; they shine so bright they are the universe's lighthouses. As time progresses and our technology advances, I believe that we will learn more and more about them. Maybe one day we may learn how to harness the energy of a nearby quasar and be able to explore the cosmos. Astronomers and humans still have a long way to go to understand everything that's out beyond our solar system.

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