Quasars

By: Justin McCubbin

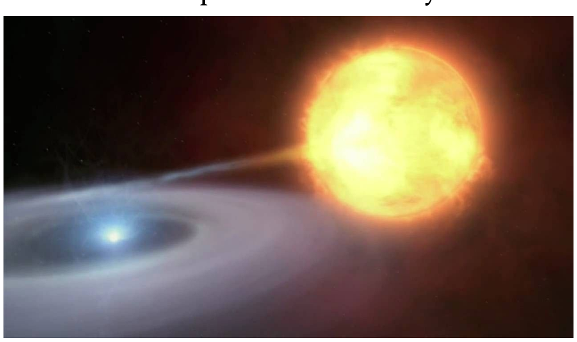
"Twinkle, twinkle, little star,
We know exactly what you are:
Nuclear furnace in the sky,
You'll burn to ashes, by and by.

But twinkle, twinkle quasi-star,
Biggest puzzle from afar;
How unlike the other ones;
Brighter than a trillion suns.

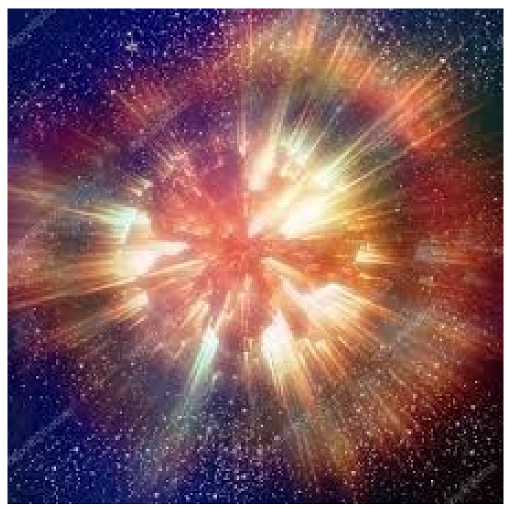
Twinkle, twinkle, quasi-star,
How we wonder what you are…"
— George Gamow and N. Calder, Newsweek, 25 May 1964.

"Quasars – in the heart of each one sits a monster."
— Universe & Pulsar & Quasar ibid.

Quasars are objects in space that emit very large amounts of radio radiation. These star-shaped celestial spheres have long eluded astronomers as to what they were or how they formed. The quasars can be as powerful as a trillion suns, but are only seen clearly by radio telescopes and are really just the size of one, measly sun. From examining quasars' discovery, relative size, and how they work, it is clear that the research of quasars has been quite fruitful in the past half-century.



Quasars (Quasi-Stellar Radio Sources), or Quasi-Stellar Objects (QSO's), have been a mystery to astronomers since the first radio telescope was made, in 1937. It was then discovered that huge amounts of radio waves were emanating from the center of our galaxy, the Milky Way. Soon, bigger and more precise telescopes were made that could narrow down the locations of the emitters of these massive amounts of radiation. The objects found were named quasars and astronomers have discovered out what they are and how they work.



Quasars are powered by massive black holes and their gravity. The black hole is about the size of the sun, but the accretion disk is about the size of the solar system. The jets of gas and radiation coming into the poles are spinning to keep the gas on a vortex, then both jets collide and are flung into a Lynden-Bell friction heated accretion disk, which generates most of the radio waves seen.

Quasars are usually more than 10,000,000,000 light years away from earth. They let off very little to no visible light. When the black holes that quasars are made of get too big and cannot shred a star, the quasar will decay and cease to exist. Quasars can also shut themselves off if there is not enough material to keep them alive. Since black holes can spin, these black holes are spun up by the accretion disk close to maximum spin.

Quasars are understood more each day. Astronomers now understand how they were formed, data about their size, and how they work. The invention of radio telescopes was the discovery that allowed this research to happen. Scientists are still uncovering their secrets every year.

Work Cited:

Freedman, Roger A., et al. *Universe*. W.H.
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Tate, K. *Know Your Novas: Star Explosions Explained*. Space. 14 Jan 2016. <https://www.space.com/31608-supernovas-star-explosions-infographic.html>. 21 Jan. 2020.

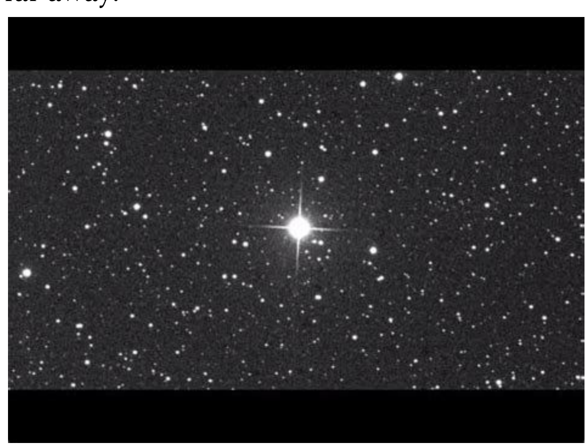
Novae and Supernovae

By: Justin McCubbin

“The nitrogen in our DNA, the calcium in our teeth, the iron in our blood, the carbon in our apple pies was made in the interiors of collapsing stars. We are made of star stuff.”
— Carl Sagan

“Like a snowplow in overdrive, a supernova shockwave might sweep away any gas clouds in its path.”
— Neil deGrasse Tyson

It is to wonder what happens when a star dies. The knowledge seeked will now be known! Novae and Supernovae are phenomena that happen to spars in space. They both produce a lot of light and heat while exploding. They also give out a very large amount of energy. Star explosions are needed to be known to the general public because they are strange, bright, and very far away.

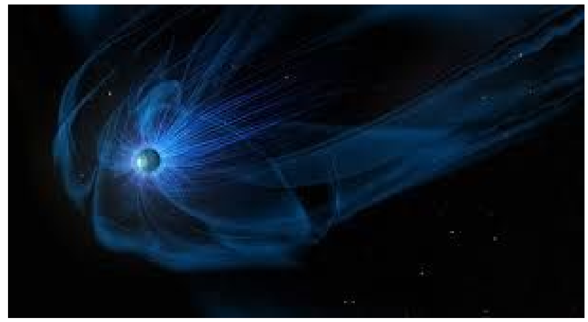


Nova:

A nova (plural novae) is when a star gets very bright for a little while. In the 1950's, astronomers discovered that novae only occurred in close binary systems with a white dwarf and a normal or big star. New hydrogen is transferred from the big star to the white dwarf and is compressed into a dense layer. More mass and more compression means the temperature rises. Once the temperature rises to around 100,000,000°C, fusion flash ignites and that's a nova. The brightness can last for up to 2-3 weeks. A system can have multiple novae in its lifetime because the white dwarf survives the explosion.

Supernova:

Supernovae are giant explosions at the end of a star's life, where the core of the star contracts and heats. This ignites the successive layers of fusion until the iron builds up in the core and the star loses pressure. The core is briefly held together by degenerate electron pressure, until the star's core reaches about 1.4 M⊙. This limit, the Chandrasekhar limit, is also the limit of the size of a white dwarf and the force that holds it together. When the core passes the threshold, it collapses. Temperatures can reach 10,000,000,000°C or so. Gamma rays that are emitted from the explosion break down most of the iron into helium and blast apart the core. This is called photodisintegration. In a fraction of a second, the core gets so dense that the positive and negative electrons combine to make neutrons and release a lot of neutrinos ($e^- + p \rightarrow n + \nu$). After about 0.25 seconds the contraction reaches nuclear density, which is the density of the nucleus of an atom(4 x 1017 kg/m3). Matter at this density is very hard to compress further and becomes very stiff and nonmoving. This makes the contraction stop and the inner core bounces back, sending a shockwave out. The neutrinos carry the energy out and ejects the dead star material in space. The rest of the core becomes its relative celestial object according to its size.



Novae and Supernovae are large interstellar explosions that end the life of a star. Novae are when stars self-ignite. Supernovae are bigger explosions. There is a good amount of knowledge on these phenomena, supernova particularly, but there is still information to be gleaned from watching the stars.

Work Cited:

Thorne, Kip S., and Stephen William Hawking. *Black Holes and Time Warps: Einstein's Outrageous Legacy*. W Norton, 2014.

Tyson, Neil deGrasse. *Death by Black Hole: and Other Cosmic Quandaries.* W W Norton & Co Inc, 2010

Novae and Supernovae

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II. Novae
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IV. Conclusion

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