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# REVIEW PAPER

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# Quasars : the brightest mystery of our universe

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## Abstract :-

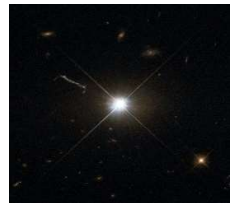
Exploring the enigmatic brilliance of quasars, this project dives into the cosmic mysteries surrounding these luminous celestial objects. Unwinding their origins, behaviour, and impact on the universe, the paper aims to shed light on the brightest yet perplexing phenomena in our cosmic landscape. Join the journey to uncover the secrets of quasars and deepen our understanding of the vastness beyond.

## Keywords :-

AGN, QUASARS, SUPERMASSIVE BLACK HOLES, QUASAR JETS, DIRECT COLLAPSE, DEATH RAYS.

## Introduction :-

A quasar is an extremely active and luminous type of active galactic nucleus (**AGN**). Quasars are amongst the most luminous objects in the known Universe, typically emitting thousands of times more light than the entire Milky Way. They are distinguished from other **AGNs** by their enormous luminosity, and their enormous distances from Earth. They possess large amount of energy like trillions of suns packed in an area just small as our solar system. The quasar in *pic 1*. Is situated 2 billion light years away from us in virgo constellation, yet it seems so bright that scientists first mistook it as a nearby bright star. They are not seen in every galaxy but only in them which have super massive black holes at their centre. Quasars also indicate that there is something unusual going on in the accretion disc of the black hole associated with it. A quasar is said to be a



Pic 1. Quasar 3C 273

normal event in the development of a galaxy. 200,000 of them has been discovered till now. Oldest quasar was found just 600-700 million years after the big bang and the black hole supporting it was 800 million times the sun.

Scientists don't have a proper answer that how a black hole like that was present so early in the universe but most probable theory proposed is the **direct collapse** theory.

### Ingredients required for a quasar :-

1. A galaxy.
2. A supermassive blackhole (billions of times to the mass of sun).
3. A large amount of gas, dust and matter falling in the black hole.

### Formation theory :-

In the accretion disc of the super massive black hole, the friction increases a lot as the gas and dust and other matter speeds up to a speed Comparable to light or almost to the speed of light and due to this the temperature rises over million times and then this heat of tremendous energy is Dissipated in the form of light, which is visible to us even from the edge of the universe over 13 billion light years away.

We can say it like :-

**“The darkest object in the universe, hence powers the brightest object in the universe.”**

### What triggers a quasar :-

We are not much sure but there can be various of reasons ,

1. A galaxy merger .
2. The black hole swallowing large amount of matter.
3. Or an exploding star in the accretion disc of the black hole can act as a catalyst.

## Types of quasars based on their spectra :-

1. Type 1 quasars :-  
They have broad emission line spectrum.
2. Type 2 quasars :-  
They have narrow emission line spectrum.
3. Anomalous narrow-line quasars :-  
They are sub-class of type 1 **AGN**. They are anomalous narrow line in their spectra. They appear to have Broad Lines, narrow lines and some broadened narrow lines.

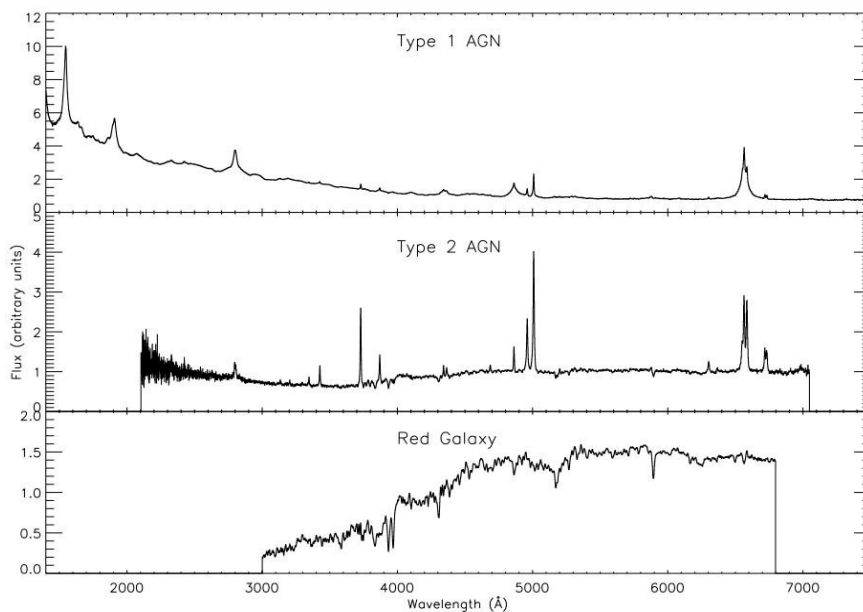


Fig:-1. This figure (from Trump et al. 2008) shows examples of three types of spectra: a broad-line AGN, a narrow-line AGN, and a normal elliptical galaxy.

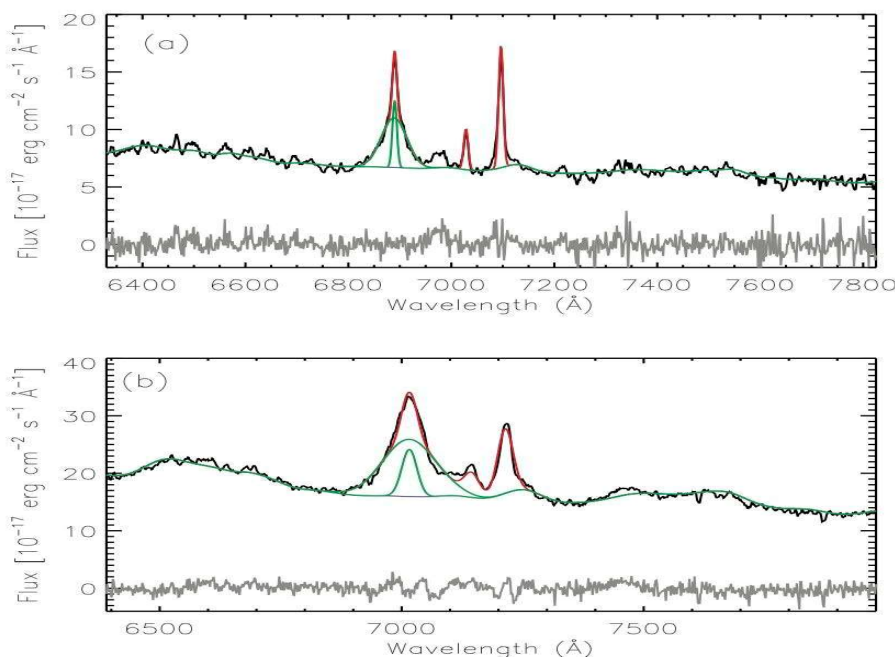


Fig:-2. This figure shows the difference in spectral features between a normal broad-line quasar (top), and an anomalous narrow-line quasar (bottom). The total fit is shown in red; the continuum and several line fits are shown in green.

## Types of quasars based on radio emissions :-

### 1. Radio loud quasars:-

Radio loud quasars are quasars with powerful jets that are strong sources of radio-wavelength emission.

### 2. Radio quiet quasars :-

Radio quiet quasars are those quasars which lack powerful jets and have relatively weaker radio emissions.

## Quasar jets :-

Let's understand what are **quasar jets**.

They form when many million and billion times mass of the sun is accelerated to speed near the speed of light. Some of the mass in the accretion disk is funneled away from the black hole in a highly luminous, magnetically collimated jet. Moving million of miles per hour they heat above trillions of degrees. The hot accretion disk along with the jet combine to make the galactic nucleus shine so bright that it can be seen far across the universe.

The largest known jet is about 1.4 megaparsec in length. The jet blasts out from the poles of the black hole at the 99 percent of the speed of light.

But these quasars with jets are very rare species, only 10 percent of them have it.



Pic 2. A quasar with a jet

## What do they do in our universe :-

1. Quasars with jets that can produce hole in a galaxy if they blast through them at close to light speed, for this reason they are also known as **death rays**.
2. Quasars act like a switch to the galaxy, when they are on they possess jets which inhibit the formation of stars and when they are off the star formation begins once again.  
Just imagine, what will happen if too many stars are formed simultaneously, many newly formed blue giant stars can go supernova

frequently which can lead too many black hole formation and that will disturb a galaxy too much, which can eventually lead to the death of the galaxy.

Hence, quasars regulate a galaxy.

We can say that :- **“sometimes destruction is nessesary for regulation.”**

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