Narrow-Line Seyfert 1 (NLS1): Farthest Gamma-Ray Emitting Galaxy

Why in News

Recently, Astronomers have discovered a **new active galaxy** called **Narrow-Line Seyfert 1 (NLS1)** which has been identified as the **farthest gamma-ray emitting galaxy.**

Key Points

- **The Study:**
    - Scientists from **Aryabhatta Research Institute of Observational Sciences (ARIES)** in collaboration with researchers from other institutions, studied around 25,000 luminous **Active Galactic Nuclei (AGN)** from the **Sloan Digital Sky Survey (SDSS).**
        - **AGN** are the most **powerful, long-lived objects and steady sources of luminosity in the Universe.** The emission is spread widely across the **electromagnetic spectrum**, often peaking in the Ultra-Violet , but with significant luminosity in the x-ray and infrared bands.
        - **SDSS** is a major **multi-spectral imaging and spectroscopic** redshift **survey** using a dedicated 2.5-m wide-angle optical telescope at Apache Point Observatory in New Mexico, United States.
            - It has created the **most detailed three-dimensional maps of the Universe** ever made, with deep multi-color images of one third of the sky, and spectra for more than three million astronomical objects.
- **Findings:**
    - They found **a unique object that emits high-energy gamma rays** located at a **high redshift (more than 1)**
        - It was identified as a **gamma-ray emitting NLS1 galaxy**, which is a rare entity in space.
        - The new gamma-ray emitting NLS1 was **formed when the Universe was only about 4.7 billion years old** as compared to its current age of about 13.8 billion years.

Redshift

- **About:**
    - It is the **displacement of spectral lines towards longer wavelengths** (the red end of the spectrum) in radiation from distant galaxies and celestial objects.
    - It **reveals how an object is moving in space and enables astronomers to discover otherwise-invisible planets and the movements of galaxies**, and to uncover the beginnings of our universe.

- **Significance:**
    - Astronomers use redshifts **to measure how the universe is expanding**, and thus to **determine the distance to our universe's most distant (and therefore oldest) objects.**
- **Measurement:**
    - The most accurate way to measure redshift is by using **spectroscopy.**
        - When a beam of white light strikes a triangular prism it is separated into its various components **(ROYGBIV)**. This is known as a spectrum (plural: spectra).
    - Astronomers can look at the **spectra created by different elements and compare these with the spectra of stars.** If the absorption or emission lines they see in the star's spectra are shifted, they know the object is moving either towards us or away from us.

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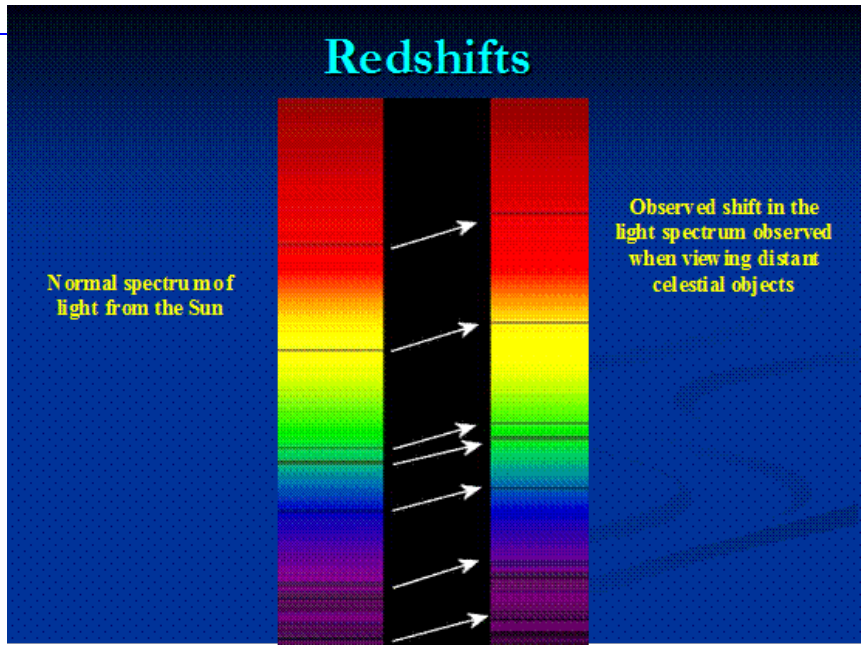


- Astronomers calculate redshift in terms of the redshift parameter (z) which helps in calculating the distance of the object (galaxy,planet etc).
    - With **increasing value of z the distance of the object increases.**

- **Instrument Used:**
    - The scientists used the Japanese **8.2 m Subaru Telescope** which is one of the **largest ground-based telescopes in the world**, located at Hawaii, USA.
    - Its powerful light collecting capability can capture weak light from celestial objects. A **major feature** of the Subaru Telescope is that its **prime focus boasts an overwhelming wide field of view compared to other large telescopes**
- **Significance:**
    - Detection of gamma-ray emission from NLS1 **challenges the idea of how relativistic jets** are formed because **NLS1s are a unique class of AGN** that are powered by **black holes** of low mass and hosted in spiral galaxies.
        - **Relativistic Jets:**
            - Supermassive black holes in the centers of some active galaxies that create **powerful jets of radiation and particles travelling close to the speed**

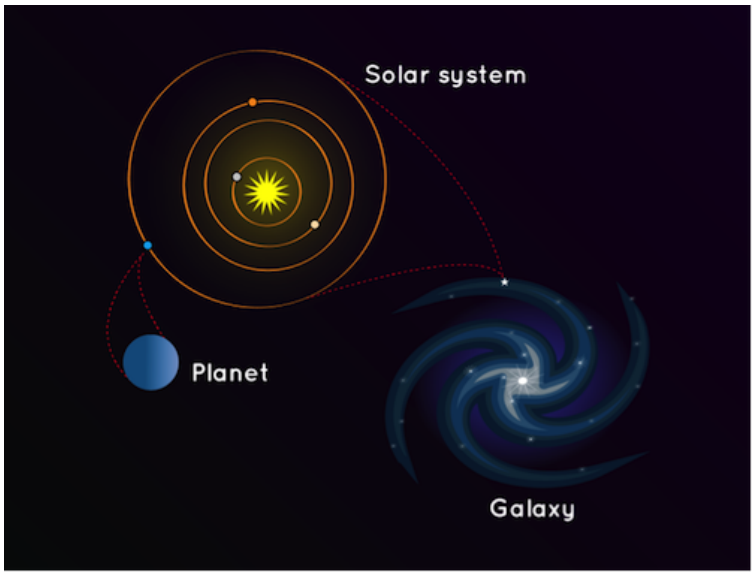
of light are called relativistic jets.
    - These jets are believed to be the **sources of the fastest-travelling particles in the Universe that are cosmic rays.**
- No method was present till date to find **NLS1 at redshifts larger than one.**
- This discovery **opens up a new way to find gamma-ray emitting NLS1 galaxies** in the early Universe.

Aryabhatta Research Institute of Observational Sciences

- ARIES is one of the **leading research Institutes** which **specializes in observational Astronomy & Astrophysics and Atmospheric Sciences** situated in **Nainital,** Uttarakhand.
- It was **established in 1955** and its primary objective has been **to develop facilities for modern astrophysical research in stellar, solar & theoretical branches of astrophysics.** On some selected clear nights the visitors are also shown some celestial objects through the telescopes.

Galaxy

- A galaxy is a **huge collection of gas, dust, and billions of stars and their solar systems, all held together by gravity.**
- Earth is the part of the **Milky Way Galaxy**, which also has a super Massive Blackhole in the middle.



Black Hole

- It refers to a point in space where the **matter is so compressed as to create a gravity field from which even light cannot escape.**
- The concept was **theorized by Albert Einstein in 1915** and the term ‘black hole’ was coined in the mid-1960s by American physicist John Archibald Wheeler.
- All the black holes observed so far belong to **two categories:**
    - One category ranges between a few solar masses and tens of solar masses. These are thought to form when massive stars die.
    - The other category is of **supermassive black holes.** These range from hundreds of thousands to billions of times that of the sun from the Solar system to which Earth belongs.

Gamma Ray Astronomy

- It is the study of astronomical objects and **phenomena that emit gamma rays.** Gamma-ray telescopes are designed to **observe high-energy astrophysical systems.**
- As Earth’s atmosphere blocks most gamma rays, **observations are generally conducted by**

high-altitude balloons or spacecraft.

- Gamma-ray astronomy presents unique **opportunities to explore exotic objects.** By exploring the universe at these high energies, **scientists can search for new physics, testing theories and performing experiments which are not possible in earth-bound laboratories.**

Source:PIB