Centre for Astro-Particle Physics

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University of Johannesburg

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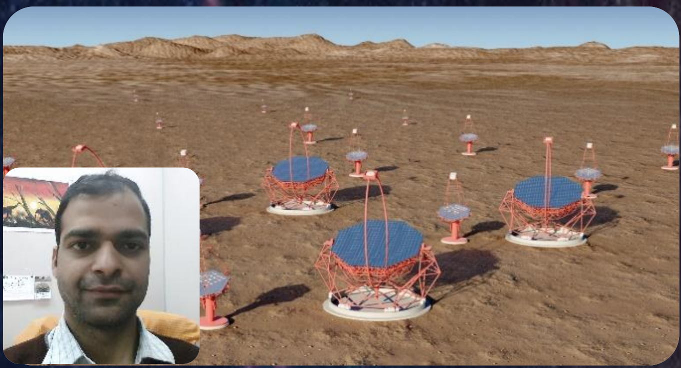
OUR RESEARCH

Jagdish Joshi (CTA)



The ground based Cherenkov Telescope Array (CTA) is a combination of the set of telescopes located at La Palma, Spain and in Chile. These telescopes have a larger field of view and better sensitivity compared to the H.E.S.S. telescope located in Namibia.

In my work, I will use ctool, to estimate the sensitivity of CTA for the detection of GeV component produced via the proton synchrotron or inverse Compton processes.

Feraol F. Dirirsa (Fermi)

My project is to model radiation from GRBs (Gamma Ray Bursts) and standardize these objects as cosmological standard candles, like supernovae (SNe) Type Ia.

Since GRBs have been detected to higher redshift (> 9) than any other astrophysical objects, they can probe the evolution of cosmological model parameters at an early Universe.

The main purpose of this study is to advance understating of the GRBs phenomenological correlations between the spectral properties and energetics to extend the Hubble diagram to high redshift and constrain the Hubble constant and dark-energy density in the ΛCDM model.

I have used the data of these GRBs with measured redshift detected by the Fermi Gamma-ray Space Telescope and Swift observatories.

Salvador Miranda-Palacios (KM3NET)

During my postdoctoral position under the supervision of Professor Soebur Razzaque, my focus is on the study of neutrino oscillations.
In particular the area of sterile neutrinos.
Not much is known about neutrinos when it comes to their properties such as mass, number of families and whether or not they are Majorana or Dirac particles.

According to the Standard Model, with the existence of three active neutrinos we can explain the majority of phenomenology, including solar and atmospheric neutrino experiments.
However the Short Baseline experiments, reactor and chemical anomalies suggested the existence of at least 1 sterile neutrino of mass of the order of $1\ eV$.

We study two different possible schemes: the mass mixing scheme and the flavour mixing scheme. In the first one the sterile neutrino mixes only with mass states 3 and 4, and in the flavour mixing scheme mixing angle theta_{34}=0. Cases with only initial conventional atmospheric flux and conventional plus prompt contributions are considered.

In our calculation we considered the same IceCube detector response as in the recent sterile neutrino search. Results could be useful as reference between appearance and disappearance experiments.
These calculations could be used in future neutrino experiments as well as studies beyond the standard model.

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Welcome to another edition of our newsletter

You can view our website to see events, the latest news, images, and info regarding the research of our group members as they happen and when they happen.

https://www.uj.ac.za/faculties/science/capp/

or

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You can also contact us at capp@uj.ac.za

Jessica-Sheay Verrall~

Creator and editor of newsletter and website

LATEST NEWS AND DISCOVERIES

No life in the Omega Centauri system

Any possible exoplanets present near stars found in Omega Centauri will not be able to sustain life.

PAGE 6

What galaxy clusters reveal about dark matter

"Galaxy clusters are remarkable windows into the mysteries of the universe. By studying them, we can learn more about the evolution of large-scale structure of the universe, and its early history, as well as dark matter and dark energy," Miyatake

PAGE 7

Finding water on Jupiter

Jupiter has 2 to 9 times more oxygen than the Sun.

PAGE 8

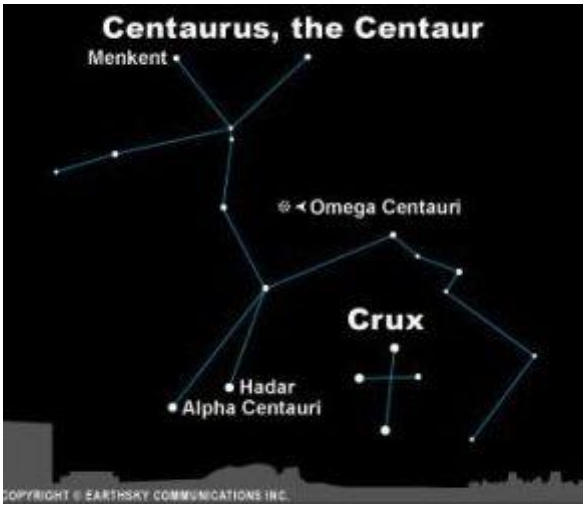
Black hole destroys star

Astronomers have directly imaged the formation and expansion of a fast-moving jet of material ejected when the powerful gravity of a supermassive black hole ripped apart a star that wandered too close to the massive monster.

PAGE 9

NO LIFE IN THE OMEGA CENTAURI SYSTEM

Omega Centauri, orbiting through the milky way, contains several million Population II stars and is about 12 billion years old

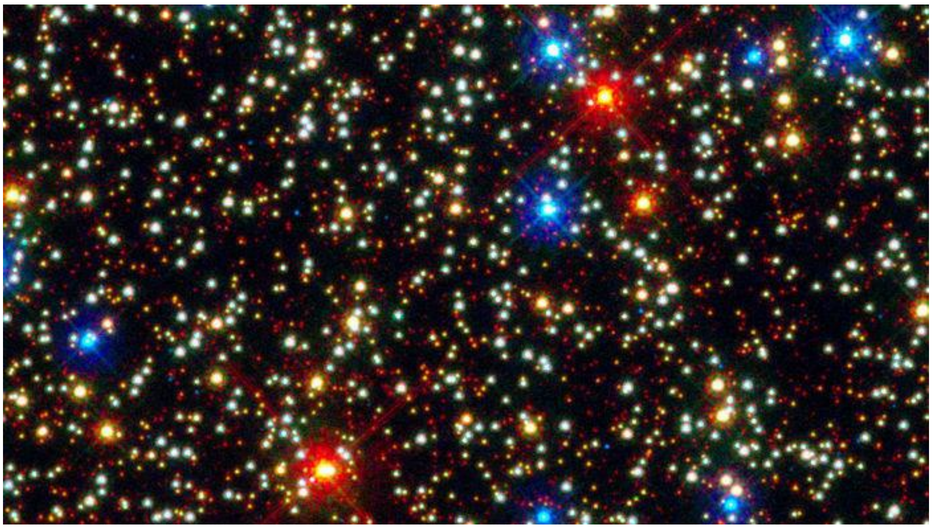


Researchers performed studies on some of the stars found in Omega Centauri.

Inside the massive star cluster's core were an estimated 350,000 stars, leading scientists to believe they could contain life-supporting planetary systems.

The researchers began by calculating the stars' habitable zones, using the stars' temperature, age and the orbital range at which water might be possible.

It was concluded after numerous calculations that all the stars were too closely packed. This means that any possible exoplanet present near these stars will be unable to sustain life due to the heat they will be exposed to.



Gamillo, E. (2018). No life in the Omega Centauri system, scientists say. [online] Science | AAAS. Available at: http://www.sciencemag.org/news/2018/08/no-life-omega-centauri-system-scientist-say [Accessed 30 August 2018].

WHAT GALAXY CLUSTERS REVEAL ABOUT DARK MATTER

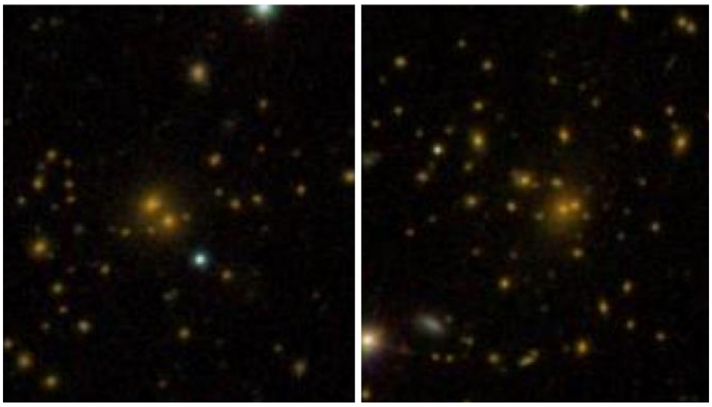
Dark matter and dark energy are cosmic phenomena that account for 95% of our universe. It is called dark matter since it cannot be seen or touched

Scientists can infer the presence of dark matter by looking at how normal matter behaves around it.

Galaxy clusters, which consist of thousands of galaxies, are important for exploring dark matter. Scientists believe that the heavier a cluster is, the more dark matter it has in its environment.

Researchers studied approximately 9,000 galaxy clusters and divided them into two groups based on their internal structures: one in which the individual galaxies within clusters were more spread out, and one in which they were closely packed together.

Scientists had used a technique called 'gravitational lensing' - looking at how the gravity of these clusters bends light from other objects - to confirm that both groups had similar masses. Normally, galaxy clusters are separated from other clusters by approximately 100 million light-years. But for the group of clusters with closely packed galaxies, there were fewer neighbouring clusters at this distance than for the scarcer clusters. This means that the surrounding dark-matter environment determines how 'packed' a cluster is with galaxies.



This comparison of galaxy clusters from the Sloan Digital Sky Survey DR8 galaxy catalogue shows a spread-out cluster (left) and a more densely-packed cluster (right). A new study shows that these differences are related to the surrounding dark-matter environment.

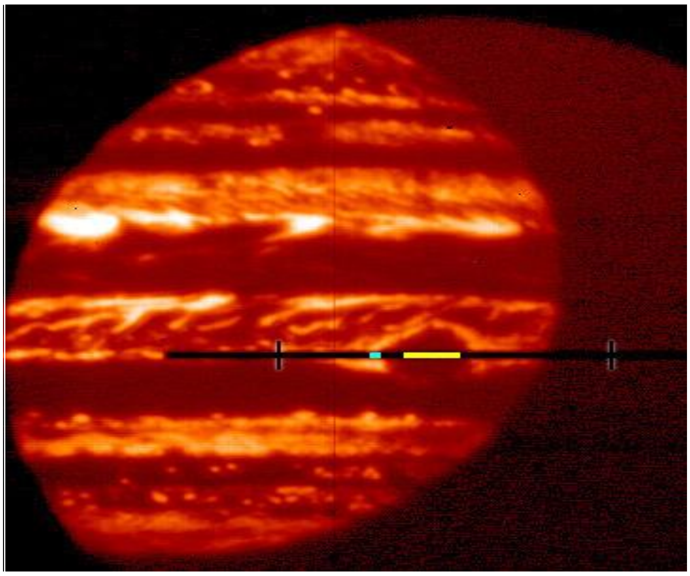
Credits: Sloan Digital Sky Survey

Studies show that the cluster's mass is the most important factor in determining its macro properties. Younger clusters live in different large-scale dark-matter environments than older clusters.

The results are in line with predictions about the origins of our universe. Scientists say the galaxy clusters we see today have resulted from fluctuations in the density of matter in the early universe. After an event known as cosmic inflation, which is a period of less than a trillionth of a second after the big bang, there were small changes in the energy of space called quantum fluctuations. These changes triggered a non-uniform distribution of matter.

NASA. (2018). *Galaxy Clusters Reveal New Dark Matter Insights*. [online] Available at: https://www.nasa.gov/feature/jpl/galaxy-clusters-reveal-new-dark-matter-insights [Accessed 3 Oct. 2018].

FINDING WATER ON JUPITER



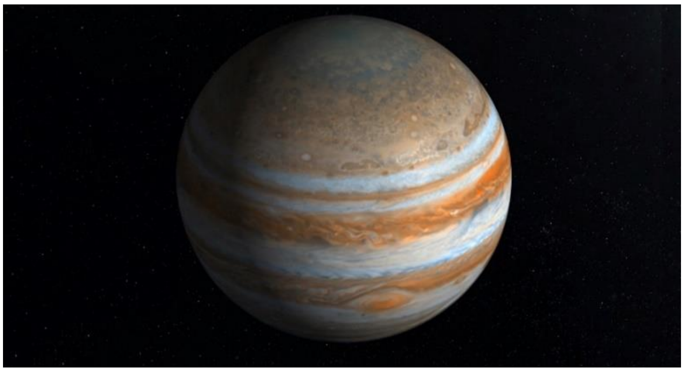
Is there water deep in Jupiter's atmosphere, and if so, how much?

For centuries, scientists have worked to understand the makeup of Jupiter. This mysterious planet is the biggest one in our solar system by far, and chemically, the closest relative to the Sun. Understanding Jupiter is key to learning more about how our solar system formed, and even about how other solar systems develop.

By looking from ground-based telescopes at wavelenaths sensitive to thermal radiation leaking from the depths of Jupiter's persistent storm, the Great Red Spot, they detected the chemical signatures of water above the planet's deepest clouds. The pressure of the water combined with their measurements of another oxygen-bearing gas, carbon monoxide, imply that Jupiter has 2 to 9 times more oxygen than the Sun. This finding supports theoretical and computer-simulation models that have predicted abundant water (H_2O) on Jupiter made of oxygen (O) tied up with molecular hydrogen (H_2).

The Great Red Spot is full of dense clouds, which makes it hard for electromagnetic energy to escape and teach astronomers anything about the chemistry within.

New spectroscopic technology and sheer curiosity gave the reserachers a boost in peering deep inside Jupiter, which has an atmosphere thousands of miles deep.



NASA. (2018). *Looking Into the Depths of the Great Red Spot to Find Water*. [online] Available at: https://www.nasa.gov/feature/goddard/2018/how-a-nasa-scientist-looks-in-the-depths-of-the-great-red-spot-to-find-water-on-jupiter [Accessed 8 Dec. 2018].

BLACK HOLE DESTROYS STAR

Astronomers see a distant eruption

For the first time, astronomers have directly imaged the formation and expansion of a fast-moving jet of material ejected when the powerful gravity of a supermassive black hole ripped apart a star that wandered too close to the massive monster.

The scientists tracked the event with radio and infrared telescopes, including the National Science Foundation's Very Long Baseline Array (VLBA) and NASA's Spitzer Space Telescope, in a pair of colliding galaxies called Arp 299. The galaxies are nearly 150 million light-years from Earth. At the core of one of the galaxies, a black hole 20 million times more massive than the Sun shredded a star more than twice the Sun's mass, setting off a chain of events that revealed important details of the violent encounter. The researchers also used observations of Arp 299 made by NASA's Hubble space telescope prior to and after the appearance of the eruption.

Only a small number of such stellar deaths, called tidal disruption events (TDEs), have been detected. Theorists have suggested that material pulled from the doomed star forms a rotating disk around the black hole, emitting intense X-rays and visible light, and also launches jets of material outward from the poles of the disk at nearly the speed of light.

NASA. (2018). *Astronomers See Distant Eruption as Black Hole Destroys Star*. [online] Available at: https://www.nasa.gov/feature/jpl/Astronomers-See-Distant-Eruption-as-Black-Hole-Destroys-Star [Accessed 8 Dec. 2018].