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Centre for Astro-Particle Physics (CAPP)
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BREAKING NEWS

First-ever image of a black hole captured in the centre of the Milky Way
Credits: Event Horizon Telescope Collaboration

First Ever-Image Captured of a Black Hole in the Centre of the Milky Way Proves Its Existence

Written by Anna Samara Larmuth

Despite many article titles stating that the first-ever direct image has been captured of the black hole, Sagittarius A*, in the centre of our galaxy, it is actually the second-ever direct image captured of a black hole. The first-ever direct image of a black hole was of a black hole captured in the centre of galaxy M87. M87 is equivalent to the mass of six and half billion suns, which is a lot larger than Sagittarius A*, the size of Mercury's orbit around our sun. M87 is also a whopping 55 million light years away, which makes Sagittarius A*, look like it is right on our door step at only 26,000 light years away.

Even though the black holes are different sizes and at different distances, the images are pretty much the same. Both images depict what can be said as the shadow of the black hole, as black holes cannot actually be seen because of the light that falls and becomes trapped in it. The only evident difference between the images is the distance at which they are captured. Sagittarius A* is captured at a closer distance to what M87 is captured.

How was the image captured?
The Event Horizon Telescope, known as EHT, is a worldwide network of radio observatories that used the highest resolution technique, Very Long Interferometry (VLBI), to capture the image. This technique can essentially be described as combining all the radio observatories of the world into one giant-sized telescope of the Earth.

Why has it taken so long to capture the image?
Think of it as taking a picture of a fast moving object on a camera, the faster the object moves the harder it is to take a clear picture of it. This is the same principle used when capturing an image of a black hole. The size of Sagittarius A* makes it especially difficult for an image to be captured clearly, in addition to the fast moving matter surrounding it. The matter surrounding the black holes moves at a faster pace, which in return constantly changes the appearance of the black hole. This is why it has taken astronomers as long as it has to get a clear image of Sagittarius A*.

Reference Article: https://www.scientificamerican.com/video/the-black-hole-in-the-middle-of-our-galaxy-looks-like-this/#:~:text=That's when they got the,much smaller but much closer

LATEST NEWS

A warm farewell to one of our visiting research associates, Dr. Feraol Dirirsa. We hope to see you soon, and have safe travels!
Also in the picture: One of our new Masters students, Ms. Dimakatso Maheso (Left) and Dr. Dirirsa's wife, Mrs. Agitu Minkefu Duresse (Middle).

After receiving the Postdoctoral Fellows Research Award in 2021, Dr. Ushak Rahaman was awarded with a gift voucher in honour of this award, which he graciously donated to the centre. The centre was able to buy astronomy and physics books for the students to read.

LATEST PUBLICATIONS

2022

A Gamma-ray Pulsar Timing Array Constrains the Nanohertz Gravitational Wave Background
Fermi-LAT Collaboration • M. Ajello et al.
Published in: Science 376 (2022) 6592, abm3231
e-Print: 2204.05226 [astro-ph.HE]
DOI: 10.1126/science.abm3231

A Review of the Tension between the T2K and NOvA Appearance Data and Hints to New Physics
Ushak Rahaman, Soebur Razzaque, Sankagiri Uma Sankar
Published in: Universe 8 (2022) 2, 109, Universe 8 (2022) 109
e-Print: 2201.03250 [hep-ph]
DOI: 10.3390/universe8020109

Implementation and first results of the KM3NeT real-time core-collapse supernova neutrino search
KM3NeT Collaboration • S. Aiello et al.
Published in: Eur.Phys.J.C 82 (2022) 4, 317
e-Print: 2109.05890 [astro-ph.HE]
DOI: 10.1140/epjc/s10052-022-10137-y

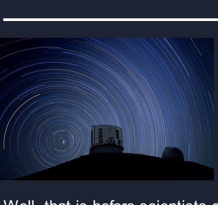
Cosmogenic gamma-ray and neutrino fluxes from blazars associated with IceCube events
Saikat Das, Soebur Razzaque, Nayantara Gupta
Published in: Astron.Astrophys. 658 (2022) L6, Astron.Astrophys. 658 (2022) L6
e-Print: 2108.12120 [astro-ph.HE]
DOI: 10.1051/0004-6361/202142123

Combined sensitivity of JUNO and KM3NeT/ORCA to the neutrino mass ordering
KM3NeT and JUNO Collaborations • S. Aiello et al.
Published in: JHEP 03 (2022) 055
e-Print: 2108.06293 [hep-ex]
DOI: 10.1007/JHEP03(2022)055

Determining the Neutrino Mass Ordering and Oscillation Parameters with KM3NeT/ORCA
KM3NeT Collaboration • S. Aiello et al.
Published in: Eur.Phys.J.C 82 (2022) 1, 26
e-Print: 2103.09885 [hep-ex]
DOI: 10.1140/epjc/s10052-021-09893-0

Non-unitary neutrino mixing in the NO\nuvA near detector data
Ushak Rahaman, Soebur Razzaque
Published in: Universe 8 (2022) 4, 238
e-Print: 2108.11783 [hep-ph]
DOI: 10.3390/universe8040238

LATEST STORIES



A Bigger and Better Jupiter?

Written by Anna Samara Larmuth

Jupiter, the largest planet in our solar system and a gas giant, a ball of gas made of mostly hydrogen and helium. Nothing can compare to it.

Well, that is before scientists discovered what can be described as an exoplanet estimated to be 8 times the size of Jupiter. An emphasis on the word 'estimated' because the planet is still 'in the womb' undergoing an intense process called gravitational or disk instability, which is when a planet forms from a gas that is collapsing due to its own gravitational pull. This is a controversial conclusion to come to, as it opposes the well-known and popular theory of planet formation.

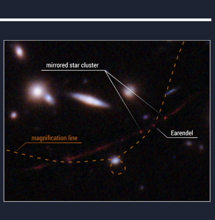
What sparked the interest in this particular exoplanet?
Scientists were initially interested in studying a nearby star, AB Aurigae, because it was as young as 1 million to 4 million years old and it presented the potential of prototype planet formation in its disk, which contained kinked spiral features. Scientists zoomed in on a bright blob discovered in one of the spiral's arms located in AB Aurigae's disk with the use of the Subaru Telescope and the Hubble Space Telescope. This bright blob could just be a denser portion of the disk scattering more light, but scientists insist it's illuminated from within by a protoplanet that's still burning hot from formation, based on the nature of the light. The large blob, now dubbed AB Aurigae b, is as large as the distance between the Sun and the Earth, and only growing in size as it is still encased in gas.

Some scientists are not yet convinced of these findings because they believe that direct imaging can often distort the image. Two other giant optical telescopes have also attempted to locate the exoplanet, but no activity at that location was detected. Read more about the opposing theories and the formation of this newly discovered exoplanet here.

Image Reference: SHIGEMI NUMAZAWA/ATLAS PHOTO BANK/SCIENCE SOURCE

Looking Back in Time Through the "Lens" of the Most Distant Star Ever Captured

Written by Anna Samara Larmuth



The most distant star to ever be observed in space has been discovered by NASA's Hubble Space Telescope. The star goes by the name of Earendel, which means morning star.

If you think the sun is bright and large in size, Earendel is 50 times the mass and millions of times brighter. Even though the sun is clearly visible, Earendel is usually not. Earendel aligned itself behind a large galaxy cluster whose gravity bent the light from the star, causing it to become brighter and more focused, thereby creating a lens.

How can Earendel be seen from Earth?
Earendel's existence can be dated back to the first billion years after the Big Bang. Scientists make use of a concept called 'the lookback time' in order to find out the amount of time that has passed since the light was first detected on Earth and when it was initially emitted by the source. When scientists look at Earendel's light, they see a light that was initially emitted from the star 12.9 billion years ago. In the time it took for the light to reach Earth, the galaxy had already expanded quite drastically, making Earendel 28 billion light years away from us now.

NASA's Hubble Space Telescope is predicted to detect earlier stars in the galaxy, however, the stars have to be perfectly aligned in order to create a "gravitational lens" to see them. Read more about the star and why it is important to look back in time here.

Image Reference:
Science: NASA, ESA, Brian Welch (JHU), Dan Coe (STScI); Image processing: NASA, ESA, Alyssa Pagan (STScI)

UP-AND-COMING CONFERENCES

4	00	01	46	33
MONTHS	DAYS	HOURS	MIN	SEC

The Tenth International Fermi Symposium

Due to the COVID-19 pandemic, the Ninth International Fermi Symposium was meant to take place in 2020 at Misty Hills, however, it had to be postponed to 2021, and was held virtually. The lifting of bans and easing of restrictions has allowed for the Tenth International Fermi Symposium to be held in person for participants from around the world at Misty Hills Country Hotel, Conference Centre, and Spa from the 9th-15th October 2022.

Visit the Tenth International Fermi Symposium's Indico Page here.

Important Deadlines

Please take note of the important deadlines for the Tenth International Fermi Symposium below. Abstract submissions are now open from the 1 May 2022 – 31 July 2022 here. To avoid any confusion when uploading abstracts or poster submissions, please ensure that you are using the same email address you made use of when registering for the conference. Make use of the 'Indico Help Guide' to help you with this. Registration opens from the 1 June 2022 – 2 September 2022.

FURTHER YOUR STUDIES

Cutting Edge Research by CAPP Members

Scientists and students at the Centre for Astro-Particle Physics focus on research in Gamma-ray Astrophysics, Neutrino Astrophysics, Neutrino Physics, and Gravitational Wave Physics. We perform theoretical studies as well as data analysis and modelling. All three experimental facilities that we are involved in, namely the Fermi Gamma-ray Space Telescope; the Cherenkov Telescope Array, and the KM3NeT Neutrino Telescope, perform cutting edge research. Thus, working at CAPP can provide students and postdoctoral fellows opportunities to get involved in the science of these state-of-the-art experiments, learn the latest techniques and interpret data collected with various instruments.

Research in Astro-Particle Physics requires a strong background in Physics, Mathematics, and computer programming. Although some theoretical studies are still done on papers with pencils, numerical computations and simulations on computers are the main tools to make theoretical predictions these days. Data analysis and modeling also require significant computer skills and learning specialised software. Students who would like to pursue postgraduate studies in Astroparticle Physics should choose Physics and Mathematics for their BSc degree.

The BSc Honours programme at the Department of Physics offers a wide range of advanced courses, including Astrophysics courses, that can prepare students for future MSc and Ph.D. research in Astro-Particle Physics. Honours students also get a taste of research by doing a project that helps them to prepare for MSc and Ph.D. studies. A limited number of top-up bursaries are available for MSc and Ph.D. students from CAPP.

Interested students should contact **Ms. Anna Samara Larmuth** (capp@uj.ac.za) with their academic transcripts.

LATEST OPPORTUNITIES

Postdoctoral Research Fellowship Position

The Centre for Astro-Particle Physics (CAPP) at the University of Johannesburg, South Africa invites applications for 2+1 year Postdoctoral Fellowship in the area of Multimessenger Astrophysics Theory. Candidates interested in the GRB-GW and/or AGN-neutrino connection(s) are particularly encouraged to apply. The successful candidate will also have the opportunity to get involved in the Fermi-Large Area Telescope Collaboration, Cherenkov Telescope Array Consortium and the KM3NeT Neutrino Observatory.

Candidates are required to obtain a doctoral degree, not more than 5 years prior to the starting date of the fellowship in order to be eligible for applying. Interested candidates should send
Curriculum Vitae
List of publications
Proposed research plan
Names and email addresses of 2 referees
or any enquiry directly to **Ms. Anna Samara Larmuth** (capp@uj.ac.za). Applications received by 1 July 2022 will receive full consideration.

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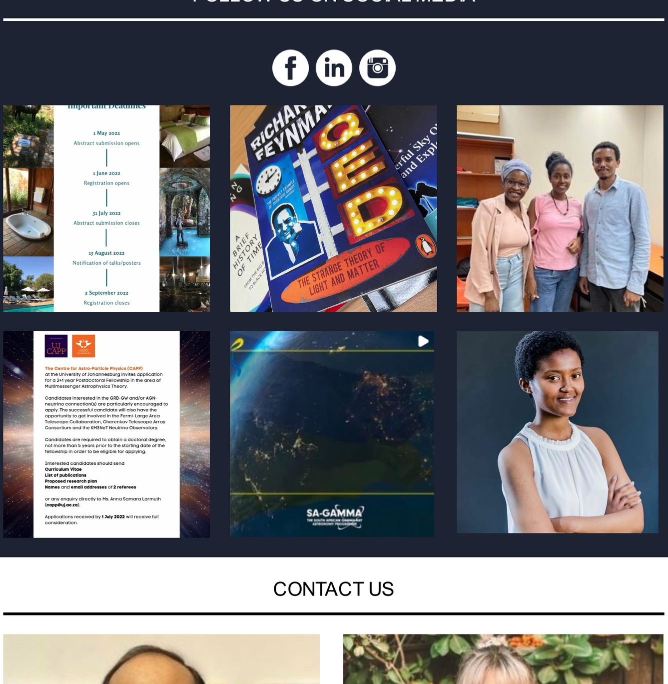

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