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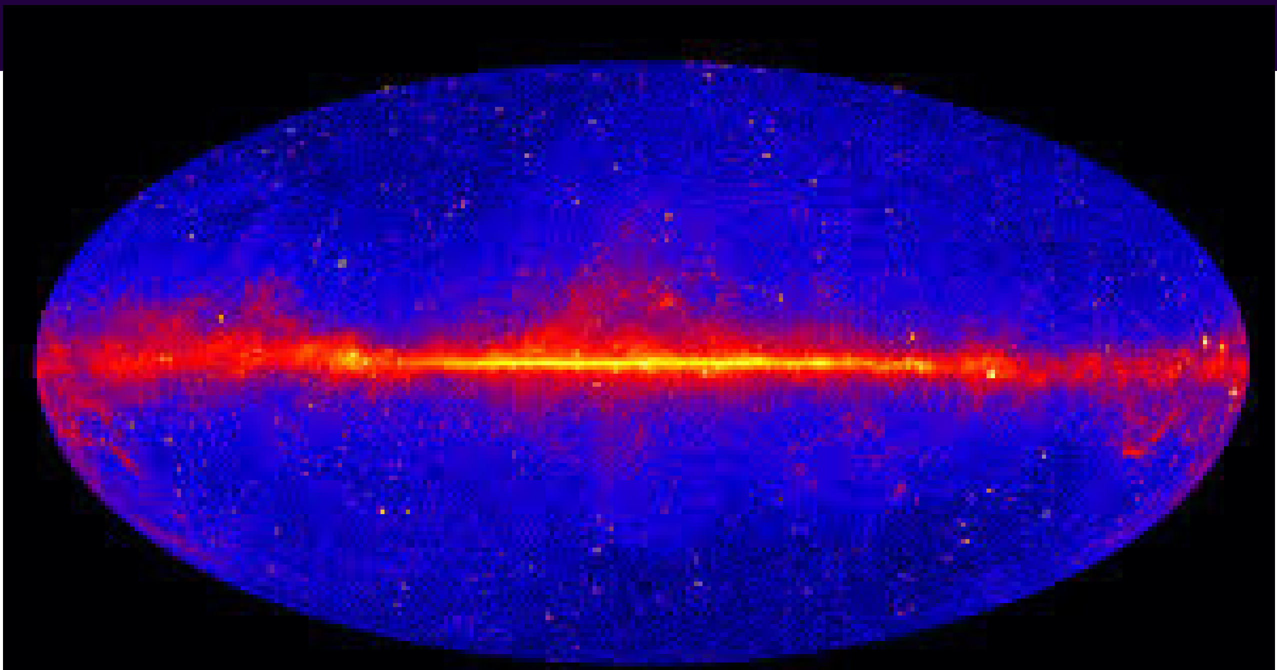
CENTRE FOR ASTRO-PARTICLE PHYSICS



Credit: NASA

NEWSLETTER OF THE CENTRE FOR ASTRO-PARTICLE PHYSICS
UNIVERSITY OF JOHANNESBURG
THIRD EDITION
DATE: 07-03-2019

Designed by Jessica-Sheay Verrall

FURTHER YOUR STUDIES

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..

Cutting edge research by CAPP group members.

Research in Astro-Particle Physics requires 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 Astro-Particle Physics should choose Physics and Mathematics for their BSc degree. The BSc Honours programme at the Department of Physics offer a wide range of advanced courses, including Astrophysics courses, that can prepare students for future MSc and PhD 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 PhD studies.

A limited number of top-up bursaries are available for Honours, MSc and PhD students from the CAPP. Interested students should contact Ms Jessica-Sheay Verrall (capp@uj.ac.za) with their academic transcripts.

FOLLOW US

For every action, there is an equal and opposite reaction, plus a social media overreaction.

WEBSITE

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.
www.uj.ac.za/capp

INSTAGRAM

You can follow us on Instagram @ ujcapp.

EMAIL

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

FOR MORE INFORMATION

Telephone: 011 559 4144

EVENTS PAGE

Public lecture and seminar by visiting research associate Dr. Gopolang Mohlabeng.

During the week of 25 February to 1 March, CAPP had the pleasure of hosting Dr. Gopolang Mohlabeng, a visiting research associate from the Brookhaven National Laboratory in the USA.

Dr. Gopolang Mohlabeng is a native of South Africa and studied at the University of Pretoria for his undergraduate degree and at the University of Cape Town for his BSc (Honours) degree under the National Astronomy and Space Science Program (NASSP). He performed his Doctoral research at the University of Kansas and at the Fermi National Accelerator Laboratory, both in the USA. His research areas are High Energy Physics Phenomenology as well as Astroparticle Physics and Cosmology. He has received numerous awards and fellowships during his study in South Africa and in the USA.

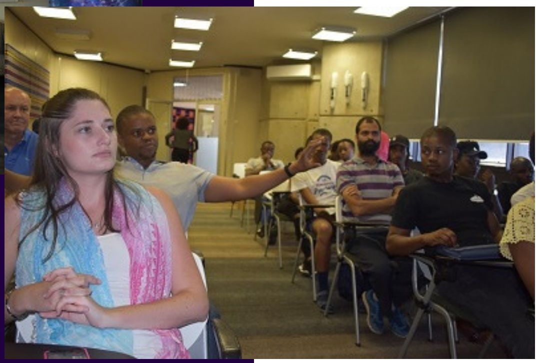
Dr. Mohlabeng gave both a seminar and a public lecture during his visit:

The seminar he presented took place in the Physics Department seminar room on the 28th of February at 13h00.
He discussed the Dark Photon explanation of the Muon g-2 Anomaly.
A massive U(1)’ gauge boson, ``dark photon'' or A’, has long been proposed as a potential explanation of the muon g-2 anomaly. However, recent experimental results have excluded this possibility for a dark photon exhibiting exclusively visible or invisible decays. In this work the parameter space was investigated in which A’ may still explain the muon g-2 anomaly if it displayed a more exotic decay topology. It was considered an inelastic dark matter model in which A’ couples directly to dark matter and an excited dark sector state, leading to a semi-visible decay channel. Examination of previous constraints from B-factories, missing momentum as well as beam dump experiments, found that these bounds are weakened in the presence of this decay mode. Hence, parameter space is opened up whereby this model can simultaneously explain both the muon g-2 anomaly and account for the thermal dark matter component in the Universe. Interestingly, it is possible that the semi-visible events we discuss may have been vetoed by experiments searching for invisible dark photon decays, hence a re-analysis of the data may uncover this exotic decay mode.

The public lecture took place on the 1st of March in the APK campus library, level 5 at 12h00.

For this public lecture his topic of discussion was "A Journey into the Dark Universe".
There are still many unsolved mysteries in our Universe. Among all of these, few are as puzzling as the nature of Dark Matter. Dark matter is a type of matter that neither emits nor absorbs any light, thus we cannot see it. Yet astrophysics and cosmology tells us not only that dark matter exists, but that it exists in proportions that are much larger than we can imagine. In this lecture he discussed the what, why and how of dark matter, as well as presented what we know about it, why we study this elusive matter and how we may go about looking for it.

There are more stars in our universe than there are grains of sand on every beach and desert.- Dr. Gopolang Mohlabeng



The latest news and discoveries

"LIGHT ECHOES" SHOWN FROM ERUPTING BLACK HOLE

Moskowitz, C. (2019). Erupting Black Hole Shows Intriguing "Light Echoes". [online] Scientific American. Available at: https://www.scientificamerican.com/article/erupting-black-hole-shows-intriguing-light-echoes/ [Accessed 29 Jan. 2019].

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PLUTO PROBE ENCOUNTERS

Powell, C. (2019). Pluto Probe Encounters a Pristine World in the Solar System's Suburbs. [online] Scientific American. Available at: https://www.scientificamerican.com/article/pluto-probe-encounters-a-pristine-world-in-the-solar-systems-suburbs1/ [Accessed 29 Jan. 2019].

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HAVE WE FINALLY ZOOMED IN ON THE BEGINNING OF TIME?

ScienceDaily. (2019). Cosmic telescope zooms in on the beginning of time. [online] Available at: https://www.sciencedaily.com/releases/2019/01/190110082707.htm [Accessed 29 Jan. 2019].

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10 YEAR CHALLENGE: HOW SCIENCE AND THE WORLD HAVE CHANGED

Wong, S. (2019). 10 year challenge: How science and the world have changed. [online] New Scientist. Available at: https://www.newscientist.com/article/2191249-10-year-challenge-how-science-and-the-world-have-changed/ [Accessed 29 Jan. 2019].

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“LIGHT ECHOES” SHOWN FROM ERUPTING BLACK HOLE

A recently spotted black hole (named MAXI J1820+070), nearly 10,000 light years away, was found erupting an enormous explosion of x-ray light. This has given scientists one of the clearest pictures of what happens when black holes erupt with energy.
This black hole had been totally invisible to telescopes prior to the outburst and is now one of the brightest objects (in terms of x-ray light) in the entire sky. It was first spotted by the Monitor of All-sky X-ray Image (MAXI) experiment on the International Space Station. Besides the astronomer’s observations of the brightening of the black hole, they also observed what is called “light echoes”- time lags between the X-ray light coming from two different areas around the black hole.

Some light travels straight from a region called the corona which is made up of electrons and other charged particles close in to the black hole. Farther out and perpendicular to the corona is the “acceleration disk”- a wider pancake of gas swirling around the hole and falling into it.

Another experiment on the International Space Station called Neutron star Interior Composition Explorer (NICER) also watched the eruption and noticed the time between echoes became shorter and shorter, indicating that the distance between the disk and corona was shrinking, however, the boundaries of the disk were not changing, so they concluded the corona itself must be getting shorter and thus light did not have to travel so far to reach the disk.

This illustration shows X-rays from the black hole’s corona (blue) echoing off its accretion disk (orange). Timing these echoes helped scientists determine that the corona was shrinking over time. Credit: NASA’s Goddard Space Flight Center.

The black hole in this study holds about 10 times the mass of the sun. The new observations should help astronomers understand not just star-size black holes like this one but also the gargantuan “supermassive” black holes that are located at the centers of galaxies and contain millions of times more mass.

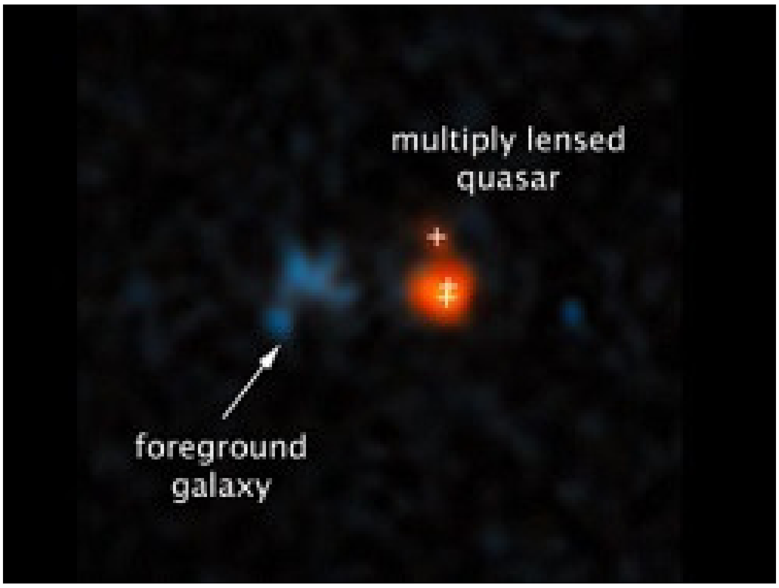
PLUTO PROBE ENCOUNTERS

The great hope of the New Horizons team was that they would see an intact survivor from the solar system’s birth. The first images of Ultima, showing its delicately stacked snowman shape, fully justify those hopes. It matches up exactly with models of how clouds of gas and dust around young stars clump together into larger and larger objects—a process that has been well studied in theory, but never observed until now.

NASA’s New Horizons probe flew past at 12:33 AM US Eastern time on January 1st 2019, it had completed its historic exploration of a small body in the Kuiper belt, the sprawling population of dwarf planets and comet-like objects out beyond Neptune. Ultima was over four billion miles from the Sun and is therefore, by far the most distant object ever visited by spacecraft. It is also one of the coldest with a temperature of 35 Kelvins (400 degrees below zero Fahrenheit).

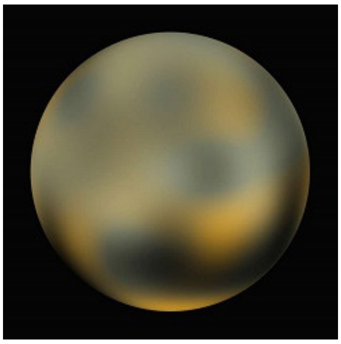
At these low temperatures it was found that Ultima preserves its initial, ancient composition and it is also dynamically cold, part of what’s known as the ”cold classical” Kuiper belt, meaning that it circles the sun in a settled orbit that was undisturbed by all the chaotic events that buffeted Earth and other planets as they came together more than four billion years ago.

HAVE WE FINALLY ZOOMED IN ON THE BEGINNING OF TIME?



This is a Hubble Space Telescope image of a very distant quasar (at right) that has been brightened and split into three images by the effects of the gravitational field of a foreground galaxy (left). The crosses mark the centers of each quasar image. The quasar would have gone undetected if not for the power of gravitational lensing, which boosted its brightness by a factor of 50. The gravitational field of the foreground galaxy (seen at left) warps space like a funhouse mirror, amplifying the quasar's light. Shining with the brilliance of 600 trillion suns, the quasar is fueled by a supermassive black hole at the heart of a young galaxy in the process of forming. The image shows the quasar as it looked 12.8 billion years ago - only about 1 billion years after the big bang. The quasar appears red because its blue light has been absorbed by diffuse gas in intergalactic space. By comparison, the foreground galaxy has bluer starlight light. The quasar, cataloged as J043947.08+163415.7 (J0439+1634 for short), could hold the record of being the brightest in the early universe for some time, making it a unique object for follow-up studies.
Credit: NASA, ESA, Xiaohui Fan (University of Arizona)

10 YEAR CHALLENGE: HOW SCIENCE AND THE WORLD HAVE CHANGED



BEFORE

AFTER

Pluto
Ten years ago, Pluto was at a low point. The International Astronomical Union stripped it of planet status in 2006, reclassifying Pluto as a dwarf planet. Pluto was out of favor, and the best images we had of it were blurry photos from the Hubble Space Telescope.

In 2015, that changed, as NASA's New Horizons spacecraft gave us a closeup view of Pluto for the first time. The beautiful pictures it sent back enchanted and surprised us with its hazy atmosphere, smooth expanses and frozen mountains, winning Pluto a new generation of admirers.