TAURANGA ASTRONOMICAL SOCIETY

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Issue No. 28 – December 2010

LHC transition to lead ion, Antimatter atoms produced and trapped.

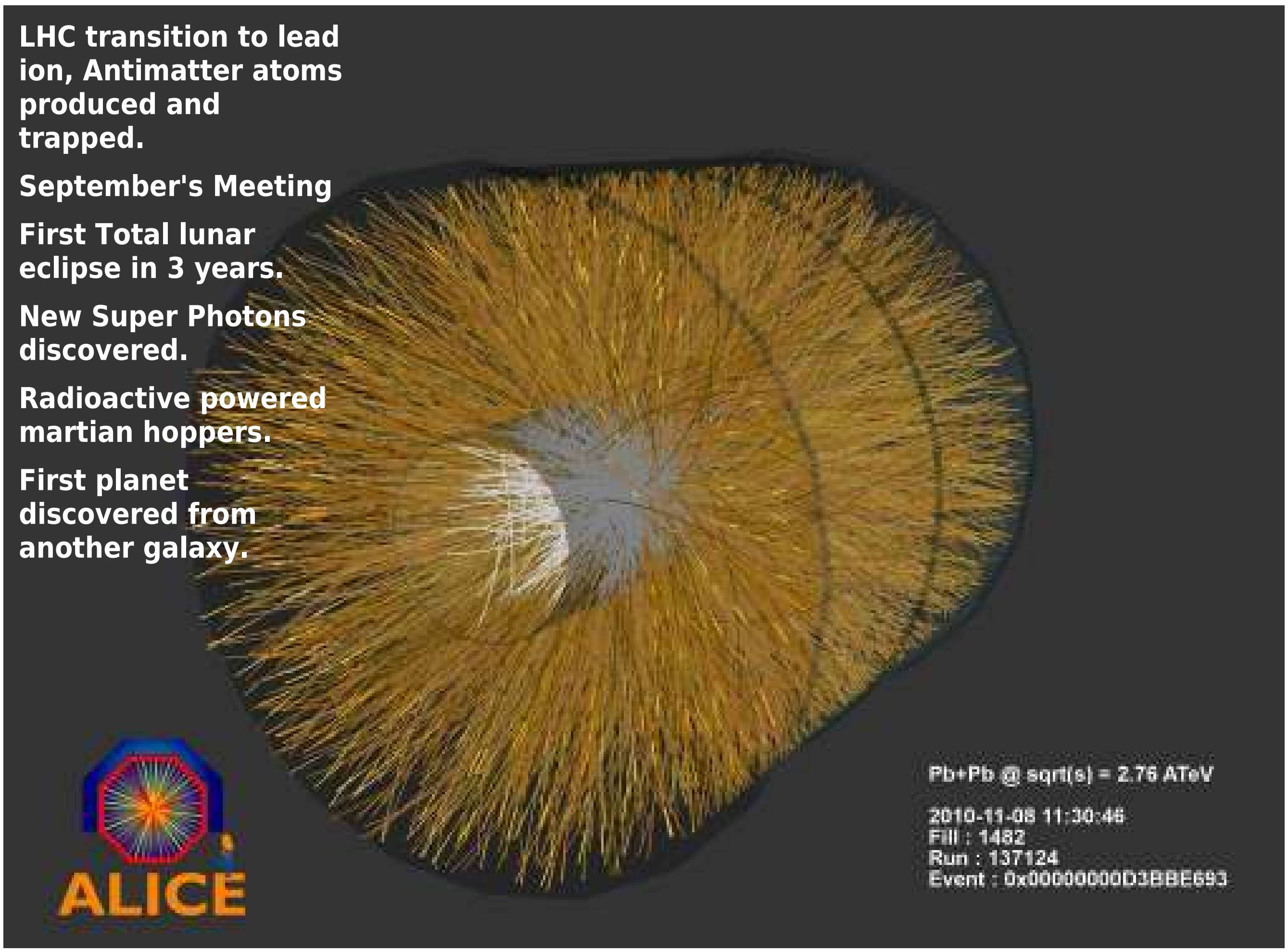
September's Meeting

First Total lunar eclipse in 3 years.

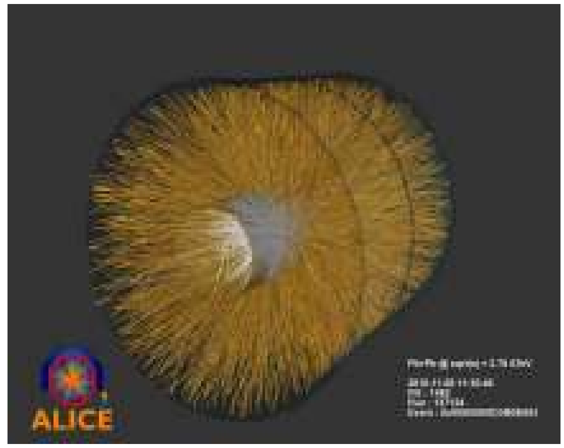
New Super Photons discovered.

Radioactive powered martian hoppers.

First planet discovered from another galaxy.



CERN completes transition to lead-ion running at the LHC



Geneva, 8 November 2010. Four days is all it took for the LHC operations team at CERN[1] to complete the transition from protons to lead ions in the LHC. After extracting the final proton beam of 2010 on 4 November, commissioning the lead-ion beam was underway by early afternoon. First collisions were recorded at 00:30 CET on 7 November, and stable running conditions marked the start of physics with heavy ions at 11:20 CET today.

“The speed of the transition to lead ions is a sign of the maturity of the LHC,” said CERN Director General Rolf Heuer. “The machine is running like clockwork after just a few months of routine operation.”

Operating the LHC with lead ions – lead atoms stripped of electrons - is completely different from operating the machine with protons. From the source to collisions, operational parameters have to be re-established for the new type of beam. For lead-ions, as for protons before them, the procedure started with threading a single beam round the ring in one direction and steadily increasing the number of laps before repeating the process for the other beam. Once circulating beams had been established they could be accelerated to the full energy of 287 TeV per beam. This energy is much higher than for proton beams because lead ions contain 82 protons. Another period of careful adjustment was needed before lining the beams up for collision, and then finally declaring that nominal data taking conditions, known at CERN as stable beams, had been established. The three experiments recording data with lead ions, ALICE, ATLAS and CMS can now look forward to continuous lead-ion running until CERN’s winter technical stop begins on 6 December.

“It's been very impressive to see how well the LHC has adapted to lead ions,” said Jurgen Schukraft, spokesperson of the ALICE experiment. “The ALICE detector has been optimised to record the large number of tracks that emerge from ion collisions and has handled the first collisions very well, so we are all set to explore this new opportunity at LHC.”

“After a very successful proton run, we’re very excited to be moving to this new phase of LHC operation,” said ATLAS spokesperson Fabiola Gianotti. “The ATLAS detector has recorded first spectacular heavy-ion events, and we are eager to study them in detail.”

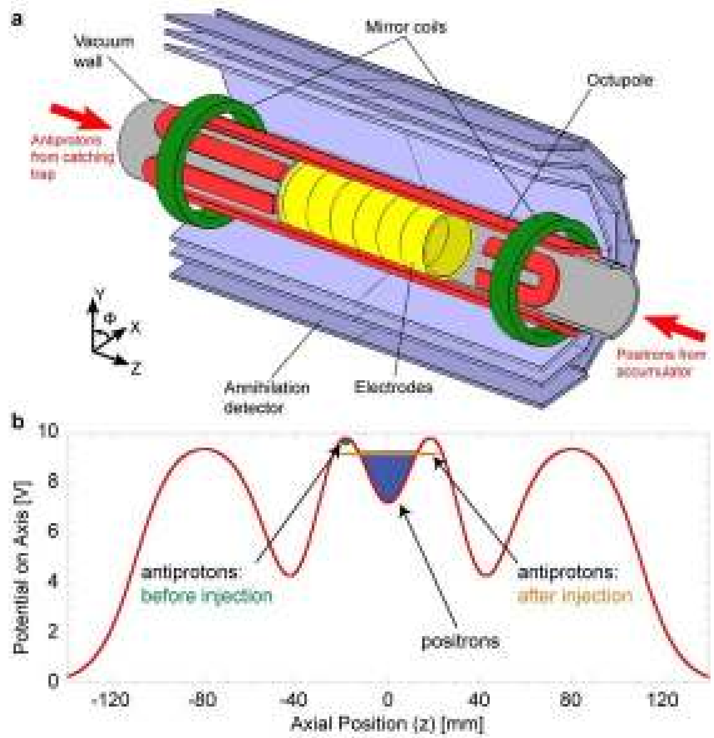
“We designed CMS as a multi-purpose detector,” said Guido Tonelli, the collaboration’s spokesperson, “and it’s very rewarding to see how well it’s adapting to this new kind of collision. Having data collected by the same detector in proton-proton and heavy-ion modes is a powerful tool to look for unambiguous signatures of new states of matter.”

Lead-ion running opens up an entirely new avenue of exploration for the LHC programme, probing matter as it would have been in the first instants of the Universe’s existence. One of the main objectives for lead-ion running is to produce tiny quantities of such matter, which is known as quark-gluon plasma, and to study its evolution into the kind of matter that makes up the Universe today. This exploration will shed further light on the properties of the strong interaction, which binds the particles called quarks, into bigger objects, such as protons and neutrons.

Following the winter technical stop, operation of the collider will start again with protons in February and physics runs will continue through 2011.

Antimatter atoms produced and trapped at CERN

Antimatter – or the lack of it – remains one of the biggest mysteries of science. Matter and its counterpart are identical except for opposite charge, and they annihilate when they meet. At the Big Bang, matter and antimatter should have been produced in equal amounts. However, we know that our world is made up of matter: antimatter seems to have disappeared. To find out what has happened to it, scientists employ a range of methods to investigate whether a tiny difference in the properties of matter and antimatter could point towards an explanation.



One of these methods is to take one of the best-known systems in physics, the hydrogen atom, which is made of one proton and one electron, and check whether its antimatter counterpart, antihydrogen, consisting of an antiproton and a positron, behaves in the same way. CERN is the only laboratory in the world with a dedicated low-energy antiproton facility where this research can be carried out.

The antihydrogen programme goes back a long way. In 1995, the first nine atoms of man-made antihydrogen were produced at CERN. Then, in 2002, the ATHENA and ATRAP experiments showed that it was possible to produce antihydrogen in large quantities, opening up the possibility of conducting detailed studies. The new result from ALPHA is the latest step in this journey.

Antihydrogen atoms are produced in a vacuum at CERN, but are nevertheless surrounded by normal matter. Because matter and antimatter annihilate when they meet, the antihydrogen atoms have a very short life expectancy. This can be extended, however, by using strong and complex magnetic fields to trap them and thus prevent them from coming into contact with matter. The ALPHA experiment has shown that it is possible to hold on to atoms of antihydrogen in this way for about a tenth of a second: easily long enough to study them. Of the many thousands of antiatoms the experiment has created, ALPHA's latest paper reports that 38 have been trapped for long enough to study.

"For reasons that no one yet understands, nature ruled out antimatter. It is thus very rewarding, and a bit overwhelming, to look at the ALPHA device and know that it contains stable, neutral atoms of antimatter," said Jeffrey Hangst of Aarhus

University, Denmark, spokesman of the ALPHA collaboration. "This inspires us to work that much harder to see if antimatter holds some secret."

In another recent development in CERN's antimatter programme, the ASACUSA experiment has demonstrated a new technique for producing antihydrogen atoms. In a paper soon to appear in Physical Review Letters, the collaboration reports success in producing antihydrogen in a so-called Cusp trap, an essential precursor to making a beam. ASACUSA plans to develop this technique to the point at which beams of sufficient intensity will survive for long enough to be studied.

"With two alternative methods of producing and eventually studying antihydrogen, antimatter will not be able to hide its properties from us much longer," said Yasunori Yamazaki of Japan's RIKEN research centre and a member of the ASACUSA collaboration. "There's still some way to go, but we're very happy to see how well this technique works."

"These are significant steps in antimatter research," said CERN Director General Rolf Heuer, "and an important part of the very broad research programme at CERN."

September Meeting

Gordon Hudson from the Wellington Astronomical society gave us a very interesting presentation entitled "The preservation of 4 very old and famous refracting telescopes in NZ" which he had refurbished. Each one was over 100 years old.

He also has his own fully automated observatory where he does minor planet occultations and variable star work. See his web page. www.kpo.org.nz
Gordon showed some of the other instruments that he had refurbished and not just telescopes.
His main work (part time) these days is telescope restoration, he has done about a dozen throughout the North Island.

Gordon also works (part time) for the Carter Observatory as their curator of instruments. He is also their archivist which means he has to catalogue everyone of their books and their photographs as well. Approx 5,000 books and 10,000 glass lantern slided and glass negatives taken through the Carter telescope.
Gordon recently sold the old Carter Observatory Planetarium to the northland Astronomical Society and will be installing that later this year.

Lunar eclipse to be visible over New Zealand

Some New Zealanders will soon get the chance to see a total lunar eclipse, an opportunity which has not arisen for nearly three years.

In a lunar eclipse the moon is obscured as it passes through the Earth's shadow.

The eclipse will begin before moonrise on December 21. In the north the moon will rise in partial eclipse, further south in total eclipse, but in the lower South Island only the tail-end of the eclipse will be visible.

The eclipsed moon was likely to appear coloured, caused by a scattering of sunlight as it passed through the Earth's atmosphere, Stardome astronomer Dr Grant Christie said.

"You will need a clear eastern horizon to be able to see it. Over water would be ideal, and the further north you are located the better," he said.

The eclipse will be visible to the naked eye.

The last total lunar eclipse was on February 20, 2008

A Special Thank You

A special Thankyou to the Pakeke Lions of Tauranga, for their generous grant of $2,400 funding for the storage unit, we recently hosted 40 of their members to a visit at our Observatory. Perfect weather and a clear sky allowed great viewing of the moons craters and jupiter, using the 8 inch and 14 inch telescopes.

Pictured on the left is Sylvia Daly, President of the Pakeke Lions Mr Neil Motion to the right.

Super-photon: a completely new source of light

Physicists from the University of Bonn have developed a completely new source of light, a so-called Bose-Einstein condensate consisting of photons. Until recently, expert had thought this impossible.

This method may potentially be suitable for designing novel light sources resembling lasers that work in the x-ray range. Among other applications, they might allow building more powerful computer chips.

The scientists are reporting on their discovery in the upcoming issue of the journal Nature.

By cooling Rubidium atoms deeply and concentrating a sufficient number of them in a compact space, they suddenly become indistinguishable. They behave like a single huge "super particle." Physicists call this a Bose-Einstein condensate.

For "light particles," or photons, this should also work. Unfortunately, this idea faces a fundamental problem. When photons are "cooled down," they disappear. Until a few months ago, it seemed impossible to cool light while concentrating it at the same time. The Bonn physicists Jan Klärs, Julian Schmitt, Dr. Frank Vewinger, and Professor Dr. Martin Weitz have, however, succeeded in doing this – a minor sensation.

How warm is light?

When the tungsten filament of a light bulb is heated, it starts glowing – first red, then yellow, and finally bluish. Thus, each color of the light can be assigned a "formation temperature." Blue light is warmer than red light, but tungsten glows differently than iron, for example. This is why physicists calibrate color temperature based on a theoretical model object, a so-called black body. If this body were heated to a temperature of 5,500 centigrade, it would have about the same color as sunlight at noon. In other words: noon light has a temperature of 5,500 degrees Celsius or not quite 5,800 Kelvin (the Kelvin scale does not know any negative values; instead, it starts at absolute zero or -273 centigrade; consequently, Kelvin values are always 273 degrees higher than the corresponding Celsius values).

When a black body is cooled down, it will at some point radiate no longer in the visible range; instead, it will only give off invisible infrared photons. At the same time, its radiation intensity will decrease. The number of photons becomes smaller as the temperature falls. This is what makes it so difficult to get the quantity of cool photons that is required for Bose-Einstein condensation to occur.

And yet, the Bonn researchers succeeded by using two highly reflective mirrors between which they kept bouncing a light beam back and forth. Between the reflective surfaces there were dissolved pigment molecules with which the photons collided periodically. In these collisions, the molecules 'swallowed' the photons and then 'spit' them out again. "During this process, the photons assumed the temperature of the fluid," explained Professor Weitz. "They cooled each other off to room temperature this way, and they did it without getting lost in the process."

A condensate made of light

The Bonn physicists then increased the quantity of photons between the mirrors by exciting the pigment solution using a laser. This allowed them to concentrate the cooled-off light particles so strongly that they condensed into a "super-photon."

This photonic Bose-Einstein condensate is a completely new source of light that has characteristics resembling lasers. But compared to lasers, they have a decisive advantage, "We are currently not capable of producing lasers that generate very

short-wave light – i.e. in the UV or X-ray range," explained Jan Klärs. "With a photonic Bose-Einstein condensate this should, however, be possible."

This prospect should primarily please chip designers. They use laser light for etching logic circuits into their semiconductor materials. How fine these structures can be is limited by the wavelength of the light, among other factors. Long-wavelength lasers are less well suited to precision work than short-wavelength ones – it is as if you tried to sign a letter with a paintbrush.

X-ray radiation has a much shorter wavelength than visible light. In principle, X-ray lasers should thus allow applying much more complex circuits on the same silicon surface. This would allow creating a new generation of high-performance chips – and consequently, more powerful computers for end users. The process could also be useful in other applications such as spectroscopy or photovoltaics.

Radioactive Powered Martian Hoppers

Scientists are examining the feasibility of constructing hopping vehicles powered by radioactive material to more effectively explore the rugged surface of Mars.

According to Space.com, one concept floated by NASA engineers envisions a solar-powered vehicle capable of splitting carbon dioxide into oxygen and carbon monoxide, which it could then burn as fuel in conventional rockets. Chinese researchers proposed a similar paradigm that would use electricity generated from batteries to suck in and heat carbon dioxide. However, a French team adopted a different approach by suggesting that future exploratory missions could be powered by magnesium powder, albeit for a limited number of jumps, or hops. Meanwhile, British scientists opined that radioactive isotopes should be employed to help squeeze gas into thrusters and heat it up for propulsion.

"Radioisotope power sources have been launched as part of spacecraft numerous times," explained Hugo Williams, an aerospace engineer at the University of Leicester in England.

"A hopper would draw on these experiences and design standards and would be subject to an extensive test program to demonstrate compliance with safety requirements." "[And] because the vehicle can collect propellant in-situ from the atmosphere, it has the potential to have a very long life, and therefore visit many sites of interest."

Just found: The planet from another galaxy

Scientists have discovered the first planet from another galaxy, sort of.

While some 500 planets have been identified in other parts of our galaxy – the Milky Way – none has been reported in other galaxies.

Now one has been discovered orbiting a star called HIP 13044, located about 2,000 light year away. While this star is now in the Milky Way, researchers reported in Thursday's online edition of the journal Science that it originated in a separate galaxy that was later cannibalized by ours.

That makes the new planet, which is about 20 percent larger than Jupiter, the first found to have originated in another galaxy.

“This discovery is very exciting,” Rainer Klement of Germany’s Max Planck Institute for Astronomy, said in a statement.

“For the first time, astronomers have detected a planetary system in a stellar stream of extragalactic origin. Because of the great distances involved, there are no confirmed detections of planets in other galaxies. But this cosmic merger has brought an extragalactic planet within our reach.”

The new planet is orbiting a star from what is known as the Helmi stream – a group of stars that originally belonged to a dwarf galaxy that was devoured by the Milky Way about six to nine billion years ago.

The researchers say the new planet is also one of the few planets known to have survived the period when its host star expanded massively after exhausting the hydrogen fuel supply in its core. The star has now contracted again, they report.

Johny Setiawan, also from the Max Planck Institute, added that “this discovery is particularly intriguing when we consider the distant future of our own planetary system, as the Sun is also expected to become a red giant in about five billion years.”

The study also raises questions about the formation of giant planets, the researchers said, since the host star appears to contain very few elements heavier than hydrogen and helium.

“It is a puzzle for the widely accepted model of planet formation to explain how such a star, which contains hardly any heavy elements at all, could have formed a planet. Planets around stars like this must probably form in a different way,” said Setiawan.

School Children get up close to the big Meade

Last month President George Stewart was put in the " hot seat" by some 25 six year old children from nearby Matua Primary School, during a special visit to see what a big astronomical telescope looked like. Mrs Bell, their teacher, had them well primed up for the visit, and several questions on the origin of the Universe from some of the children had our president scambling for answers !

While there were no stars to see, each child had a look through the front of the Meade and was able to see the two mirrors, as well as their own reflections. One of the highlights was watching the entire roof slide away, which is still an " armstrong operation" using ropes and pulleys.

The photo shows some of the Matua children up close with the telescope in the viewing platform

We also had recent special visits by the Tauranga Video club, Pakeke Lions Club of Tauranga, who were greatly impressed with the new Observatory.

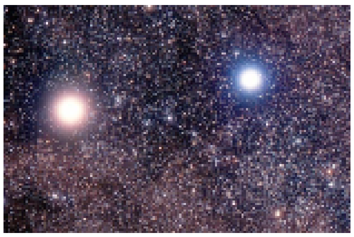
FOR SALE

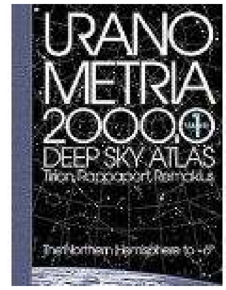
"Short Tube" NEWTONIAN f/ 8.7
F = 1000 mm
D = 114 mm
Eyepieces: 20mm, 12mm, 4 mm, Moon filter.
Telescope is mounted on an adjustable timber tripod.

Ideal for beginner. Complete with carry-bag and manual. Produces excellent images of the moon's craters

Price $200.00 or near offer. Proceeds to go to the Observatory fund

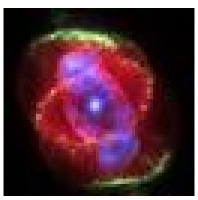
Enquiries to George Stewart tel (07) 576 6170



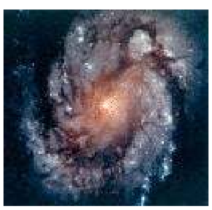


And on a final note....

On the 12th day of Christmas my true love sent to me
Twelve alpha stars



Eleven brand new dew caps
Ten solar filters
Nine setting circles
Eight official planets
Seven deep sky atlases
Six Canon cameras
Five nebulae....................(rhythm change here....!)



Four galaxies
Three hip flasks
Two woolly mitts

And a BRAND NEW OBSERVATORY.............

By Ursula Macfarlane

Tauranga Astronomical Society Wish you a happy Christmas and a safe and enjoyable holiday, we look forward to seeing you in the new year!

BACK PAGE

The Tauranga Astronomical Society holds a monthly meeting on the fourth Tuesday of each month at the Otumoetai Sport and Recreation Club, Fergusson Park, Tilby Dr, Matua. The meeting begins at 7.30pm and all are welcome.

New comers are invited to attend two meetings free of charge, however, after this a charge of $5.00 per meeting will apply if membership of the society is not taken up.

Current membership fees are below and may be paid to the treasurer on any club night.

Full Time Student	$15
Ordinary Membership	$20
Family	$30

Meetings consist of a presentation of roughly one hour either by a society member or an invited guest on an astronomical subject. After light refreshments this is followed by viewing through one of the society's telescopes, including our new Meade, weather permitting, or the screening of an Astronomical DVD.

The Tauranga Astronomical Society Newsletter is published quarterly each January, April, July and October. Our editors welcome contributions from members provided they are on an Astronomy related subject and are original. Articles for the newsletter may be submitted electronically by email to: sabelcher@value.net.nz

T.R.O.G (Tauranga Roving Observers Group)

TROG is a list of persons interested in observing from a dark sky site. We have been currently meeting approximately once a month at random locations. Another location previously used is Bell Road Papamoa and other sites are welcomed.

Things have been quiet for us lately, but if interested in observing contact Noel Petersen on 578-0031. The group is informal and no previous experience is required. Just bring along a telescope or binoculars if you have them, any star charts you might need and your enthusiasm.

Your Committee is:

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