Work Experience at the Australian Synchrotron

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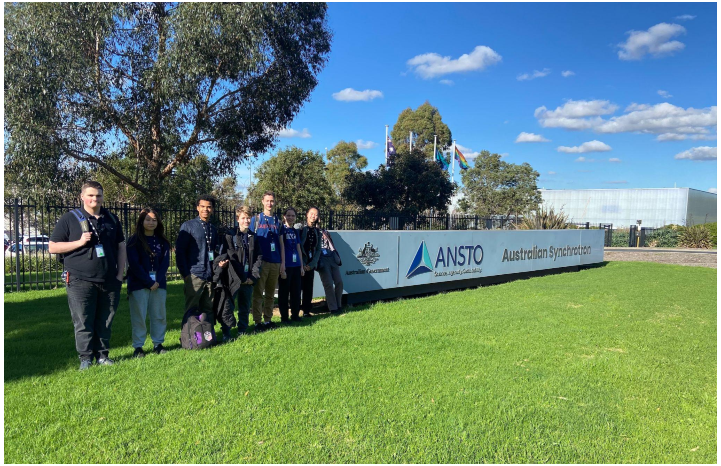
Overview

The Year 10s recently spent a week doing work experience to introduce us to the world of working and get us thinking about our careers.

I completed my work experience for Australia's Nuclear Science and Technology Organisation (ANSTO) at the Australian Synchrotron, an internationally recognised scientific research institute in Clayton.

With seven other Year 10s from around the country, I learned all about how the Synchrotron works and the cutting edge research that is done there. We also had Q&A sessions with a number of brilliant scientists who spoke about their careers including the steps that led them to the Synchrotron, and explained the work they are currently doing.



(me)

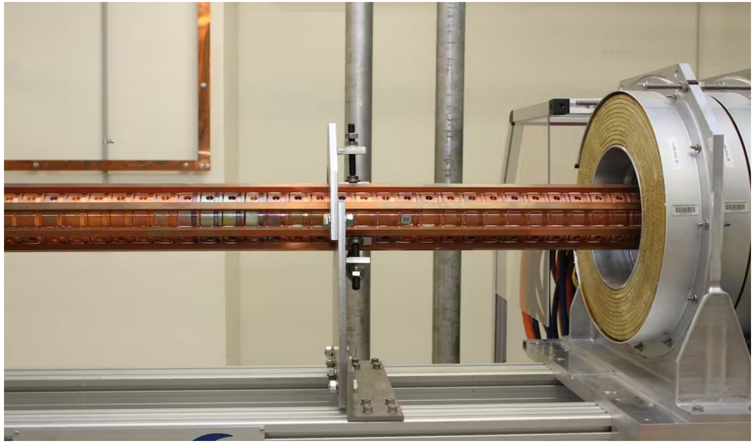
What is the Synchrotron?

One of Australia's most significant pieces of scientific infrastructure, the Australian Synchrotron is a particle accelerator and one of two Synchrotrons in the Southern Hemisphere!

When you hear ‘particle accelerator’ you may think of the Large Hadron Collider in Europe. The LHC is primarily used to collide particles (protons). Synchrotrons do not do this. Instead they accelerates bunches of electrons, the negatively charged particles that orbit atoms, close to the speed of light to produce ‘Synchrotron light’ which is used for a wide range of scientific research.

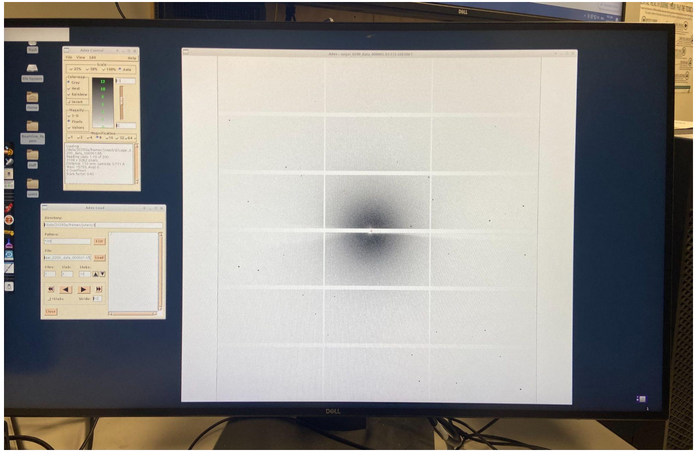
How does the Synchrotron accelerate electrons?

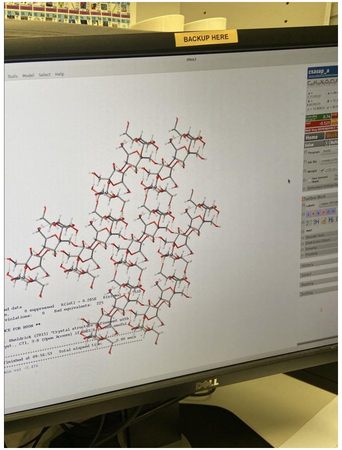
A machine within the Synchrotron called an electron gun is responsible for sourcing the electrons. It does this by heating a tungsten-based electrical conductor to about 1000ºC which by a process called thermionic emission separates electrons from their atoms. These electrons are then shot out of the electron gun and into the linear accelerator which begins the acceleration process by emitting RF (radiofrequency) waves at the electrons. After just the first metre of acceleration in the linear accelerator, the electrons are travelling at more than 99.99% of the speed of light. They then move into to the booster ring which further accelerates them to 99.999985% of the speed of light! Finally, the electrons are transferred to the storage ring where they are kept at speed by metallic chambers that contain RF waves called RF cavities. Magnets ensure the electrons follow the circular path of the ring.

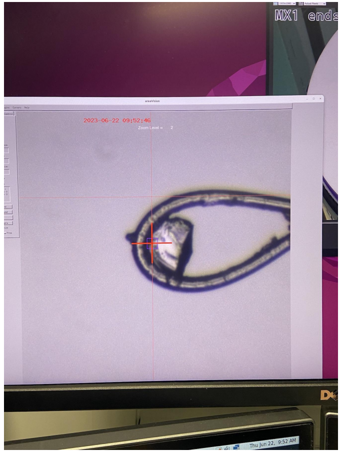


Synchrotron light

Synchrotron light or Synchrotron radiation is what the elaborate process of accelerating electrons is ultimately for. It is the electromagnetic radiation, ranging from infrared to x-rays, that is produced when electrons in the storage ring enter the strong magnetic fields created by ‘bending’ magnets. Synchrotron light is 1,000,000 times brighter than sunlight - its intensity and brilliance is what makes it unique. It is collected at ‘beamlines’ - pipes that extend from the storage ring at tangents and serve to deliver Synchrotron light to experiment stations. Beamline scientists use Synchrotron light to study the structure, properties and behaviour of organic and inorganic matter. They do this by isolating a specific frequency range of the light and then exposing it (in various ways) to matter. Each beamline is dedicated to a specific frequency range and for a particular field of study. For example, the crystallography beamline isolates x-rays and passes them through crystals to acquire diffraction patterns which are used to study the structure of crystals and the composition of their comprising molecules. *The images on the right provide an example of how the crystallography beamline is used. The top image shows the diffraction pattern created by a sugar crystal (bottom-right) that has has been probed by x-rays. The image on the bottom-left is a digital model of the structure of the sugar crystal created from the diffraction pattern.*



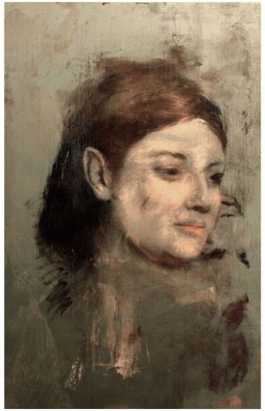


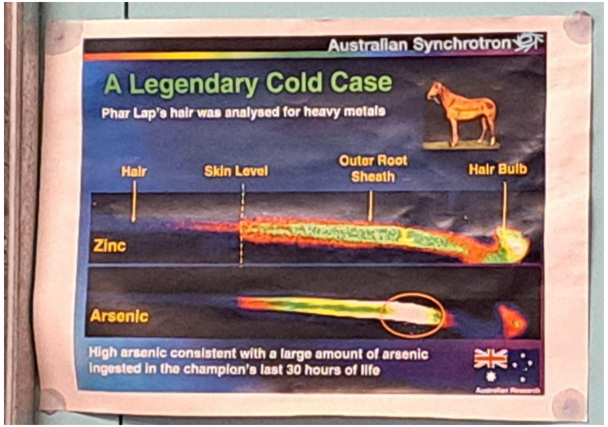


How has the Synchrotron helped to advance our understanding of science?

Among a myriad of groundbreaking scientific strides made at the Synchrotron:

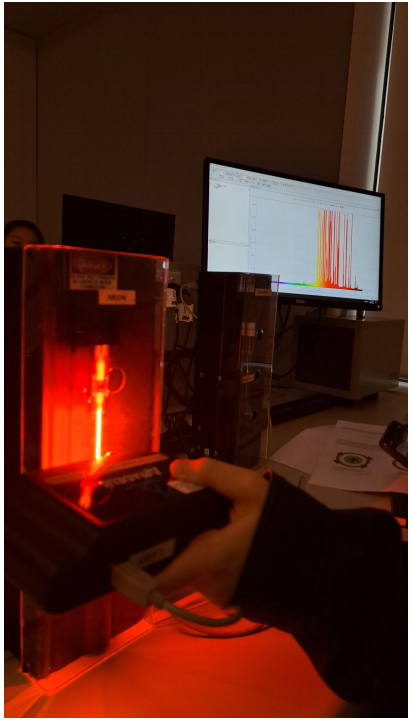
- 3D-imaging of rat lungs using the Synchrotron helped to cure a chronic lung disease that is common in premature human babies,
- The Imaging and Medical Beamline (IMBL) is being used to develop a new approach to breast cancer detection,
- Scientists at the Synchrotron in 2008 were able to determine the cause of death of legendary racehorse Phar Lap having found arsenic in a hair of his (bottom),
- And, perhaps my favourite: using elemental mapping techniques, X-ray fluorescence microscopy (XFM) beamline scientists found a hidden painting underneath Edgar Degas' famous painting 'Portrait of a Woman' (top)

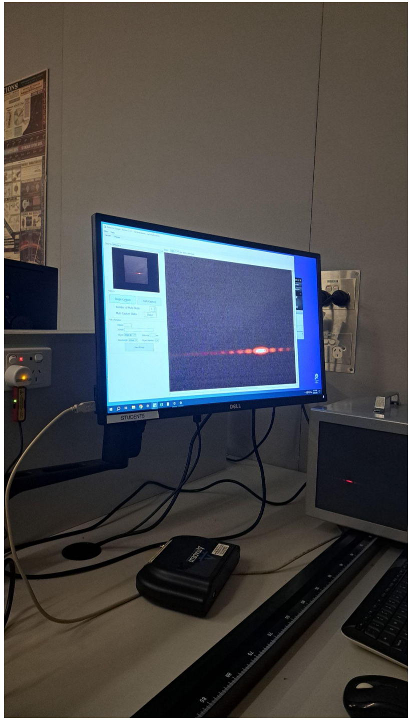




What did we do?

On our first day, we did a comprehensive tour of the Synchrotron and did some lab experiments which mimicked those conducted using the Synchrotron. These included diffraction experiments using laser light (image on the right) and simple spectroscopy experiments with noble gases (image on the left). On Tuesday, we spoke to some of Australia's best scientists working at the Synchrotron. We visited a few of the beamlines and also learnt about other ANSTO facilities. On Wednesday we spoke with some more scientists and visited the Monash Biomedical Facility and chemistry labs at Monash University. On Thursday, we went to the remaining beamlines (and were even given the opportunity to use some of the instruments in one)!



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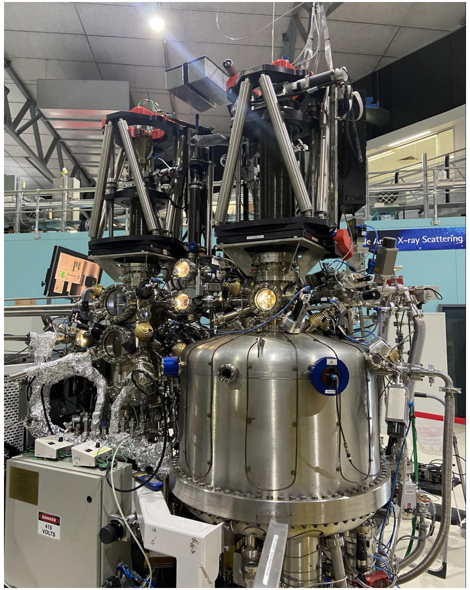
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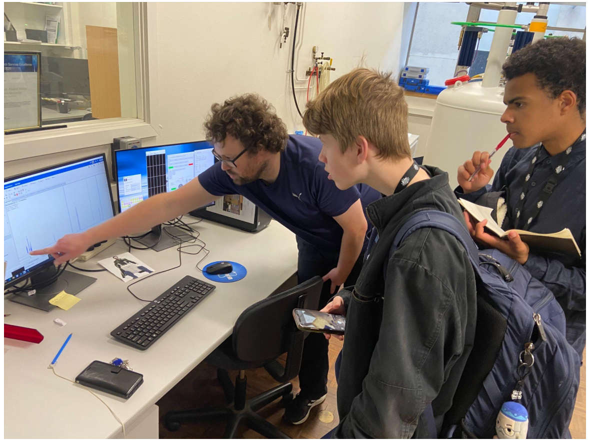

Thank you CHS!

Of course, this amazing experience would not have been possible without the school! I want to express my gratitude to our Year 10 work experience coordinator Christina Scholzhorn for helping to organise my placement and to the school for allowing me the opportunity.