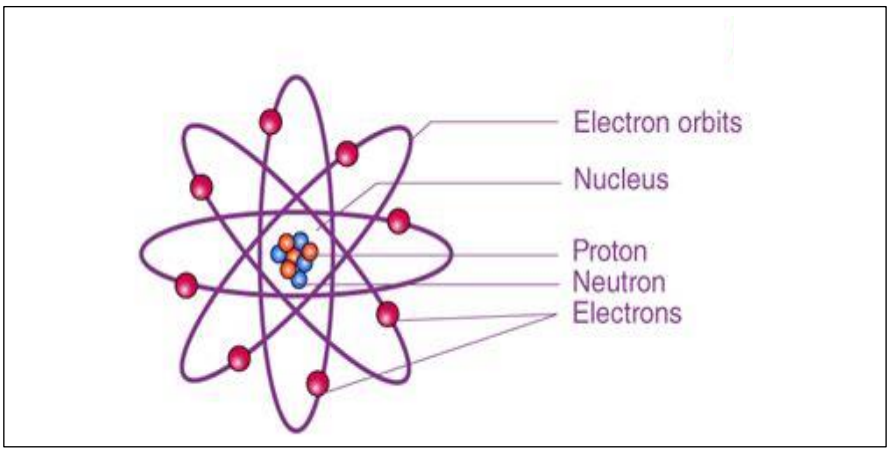
Visting Australian Synchrotron on 20.03.2025

The Australian Synchrotron is one of Australia's largest science facilities, and it's all driven by electrons herded into tiny bunches and accelerated through intense magnetic fields to nearly the speed of light. (ANSTO)

Basics:



Particles which constitute the atom are:

- Electrons
- Protons
- Neutrons

Standing around the Synchrotron’s maquette.

Pic.1

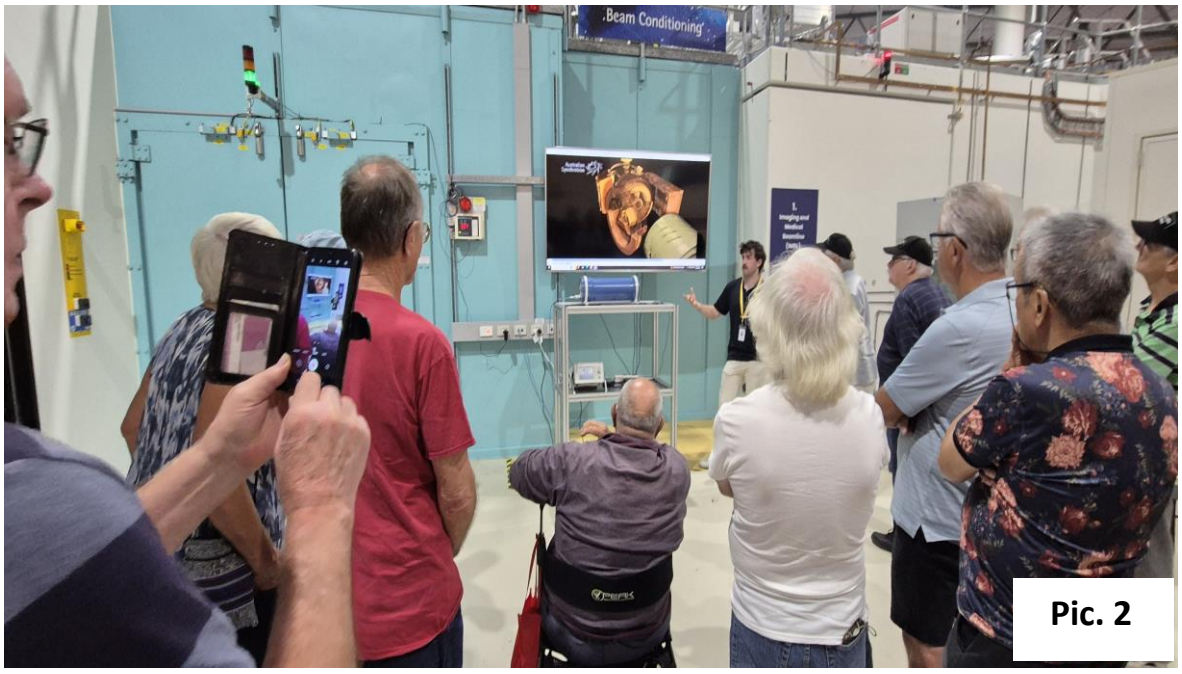
Particle Accelerator unit

A **particle accelerator (Pic 1)** is a machine that uses changing electromagnetic fields to propel charged particles to very high speeds and energies to contain them in well-defined beams.

Pic. Accelerated particles (electrons) flowing in the vacuumed, coiled copper tubes where huge electromagnets steer and focus those particles while they travel through for multiple times.

Brian O, Bob, Rommie, Will, Glen and Trevor are listening to our guide Declan.

Imaging and Medical Beamline



Pic. 2

Pic.3

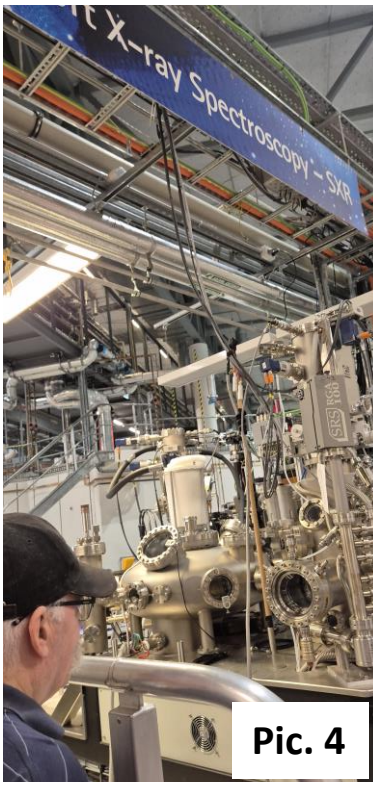
The Imaging and Medical Beamline provides medical researchers with 'x-ray vision': dynamic 3D x-ray imaging at incredibly high resolution.

It can visualise blood vascularisation, air movement in the lung, and tissue and organ structure in far greater detail than that possible with MRI.

The beamline (IMBL) provides an exciting discovery space for accelerated research into treating tumours, chronic lung disease, haemorrhage and inflammation of the brain, bone growth and replacement, and various heart-related conditions.

(Pic. 2 & 3) A 3D image of a complete engine where every inside detail is visible without physically taking it apart.

Soft x-ray spectroscopy

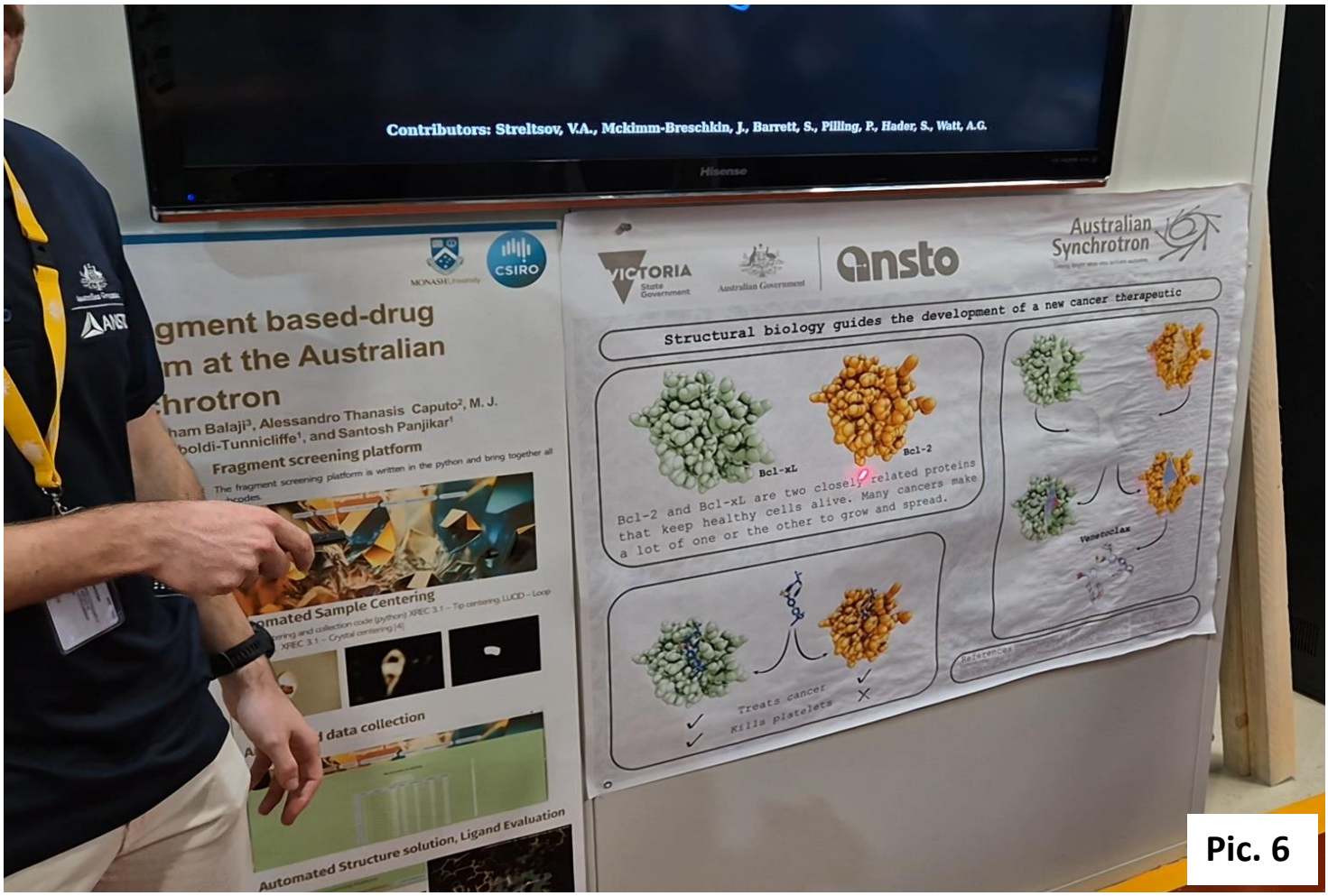


Pic. 4

Synchrotron soft x-ray techniques are opening up new ways to address the complex problems arising from earth resource utilisation to increase in areas such as environmentally sustainable ore extraction, mineral processing, coal combustion and soil use.
The aim is to minimise the generation of undesirable species such as NOx in coal combustion.
Clean coal could be one of our future energy resources.
(Pic 4) Will admires the Soft x-ray spectroscopy.
(Pic. 5) The Soft X-ray Spectroscopy is being introduced and explained by our tour guide Declan**.**

Pic. 5

Fragment-based drug discovery



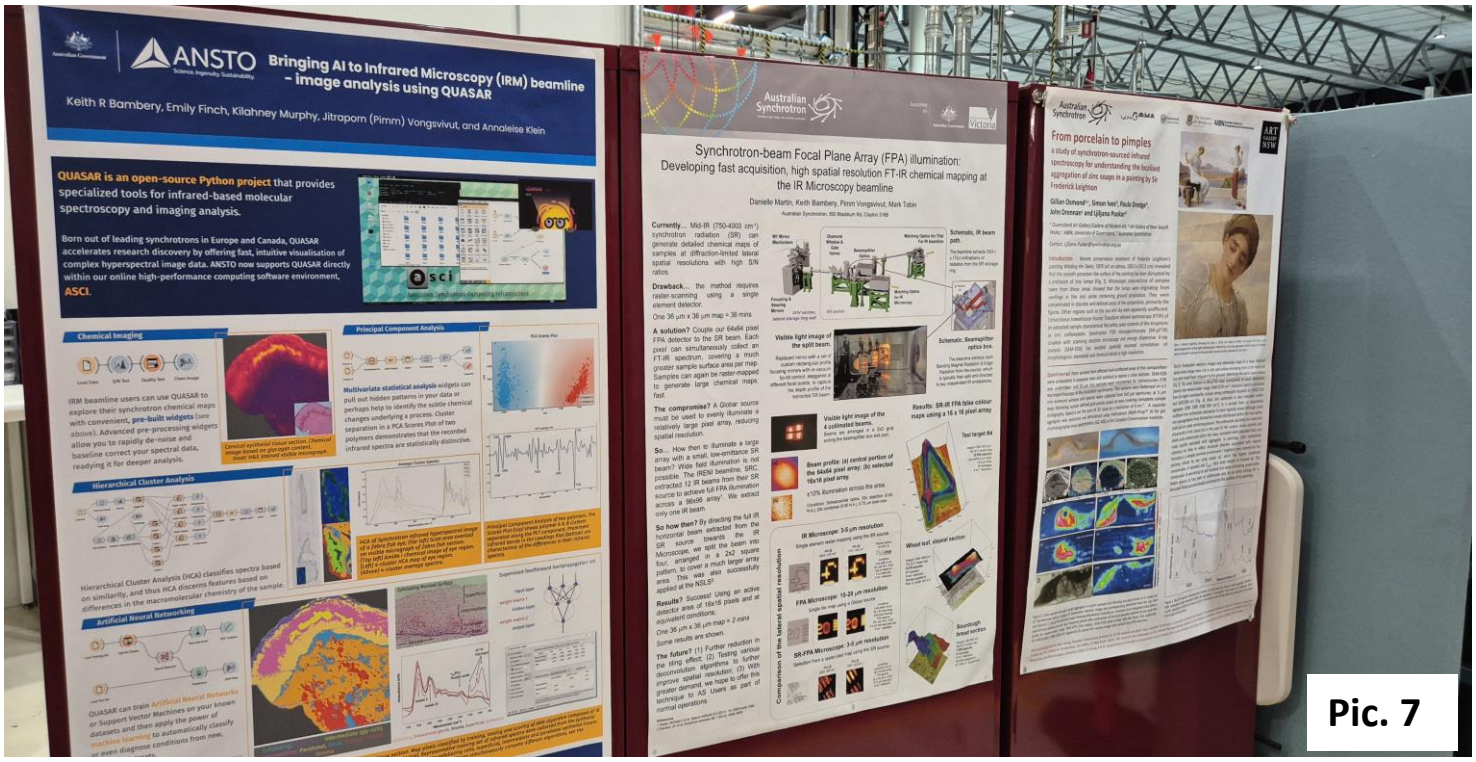
Pic. 6

Fragment-based drug discovery (FBDD) is a technique for identifying low molecular weight chemical starting points for drug discovery. Fragment-based screening using X-ray crystallography is an efficient method for identifying binding hotspots on proteins, which can then be exploited by chemists and biologists for the discovery of new drugs.

The drug which triggers a signal in cancer cells causing them to die has been shown to be effective in treating chronic lymphocytic Leukaemia patients successfully.

(Pic 6.) Showing a two closely related protein (**green** and **yellow** coloured) that keep healthy cells alive and many cancers make a lot of one or the other to grow and spread. Scientists were able to find a fragment in the protein molecule where an effective drug can fit in and act like being part of it what stops the protein to be able to grow and eventually kills it.

Infrared Microspectroscopy (IRM) Beamline



Pic. 7

Infrared Microspectroscopy (IRM) Beamline

The device of Macro ATR-FTIR microspectroscopy was developed to the **(Pic.7)** Infrared Microspectroscopy (IRM) beamline allowing high-resolution chemical imaging analysis. With this technique scientist are able to do high-resolution chemical imaging analysis in archaeology, electrochemistry (battery), biomedical and forensic sciences. Apart from these, it can be used in additional applications in the fields of food and pharmaceutical science.

X-ray Fluorescence Elemental Mapping

X-ray Fluorescence Elemental Mapping

Degas' painting **(Pic 8.)** from the late 1870s has hung in the National Gallery of Victoria since 1937.

Scientists used a high-definition scanning technique to establish the nature of the paint lying beneath the finished work **(Pic.9)**.

Just like an ink-jet printer moving back and forth over paper, the synchrotron's scanner moved across the painting, firing intense X-rays into the canvas.

The were able to reconstruct the colours by examining the metals e.g. cobalt means blue, mercury means vermillion. Every metal and components were represented by a certain radiation wavelength what had to be calculated to find the right corresponding colour.

Portrait of a woman (Portrait de femme)
Edgar DEGAS (c. 1876-1880)

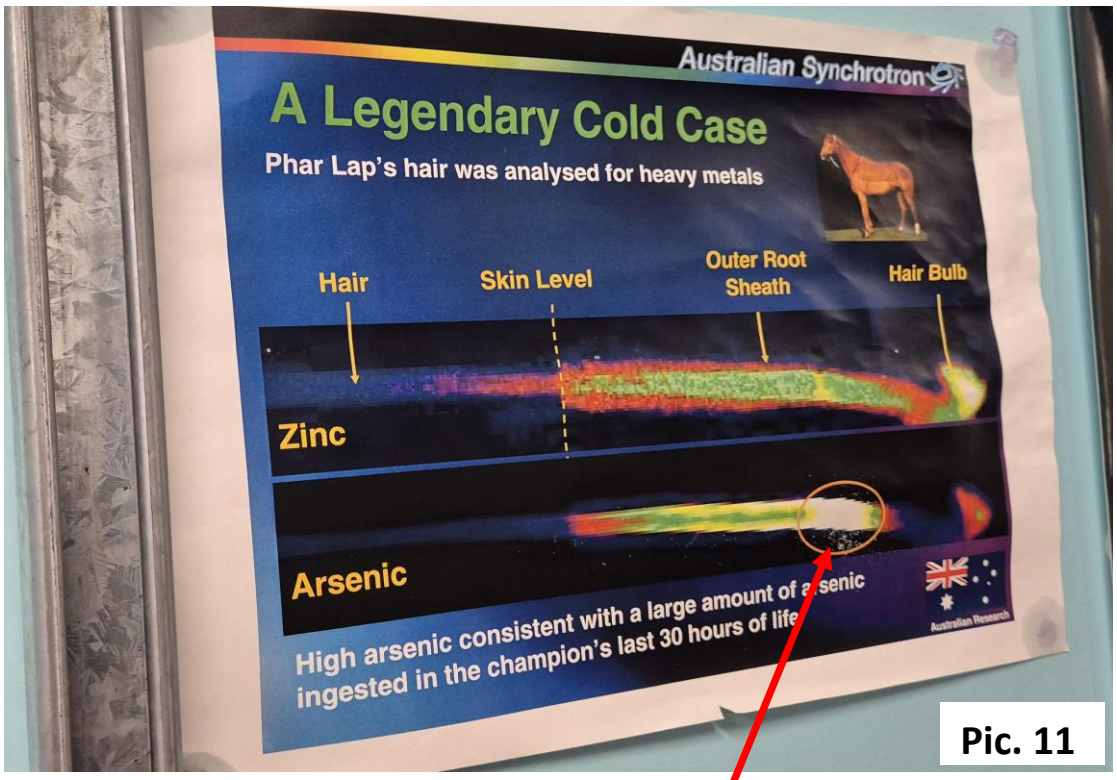
The reconstructed hidden painting.

Phar Lap died from a lethal dose of Arsenic.

Old documents have revealed the galloper's trainer, Harry Telford, routinely used arsenic as part of a tonic for Phar Lap. Arsenic has historically been used as an appetite stimulant and it also promotes the shedding of old dead hair and the regrowth of a shiny new coat.

In 2006 at the Synchrotron a microprobe was used, which is a mapping scanning spectrometer for cells, showing the 3-D distribution and chemical properties of arsenic in his hair sample. The analysis showed **(Pic.11)** that Phar Lap had ingested a large dose of arsenic in the last 30 to 40 hours of his life while he was in America **(Pic.10)** on April 5, 1932.

Phar Lap in America, 1932



Evidence that Phar Lap had ingested a large dose of arsenic in the last 30 to 40 hours of his life while he was in America in April 1932.