Australian Government | ANSTO

Australian Synchrotron

BRIGHT Program

Presented by: Alan Ng - Control Systems Manager

Date: 30/10/2020

Science. Ingenuity. Sustainability.

What is a synchrotron?

Australian Synchrotron

- A synchrotron is a large machine (about the size of a football field) that accelerates electrons to almost the speed of light.
- As the electrons are deflected through magnetic fields they create extremely bright light.
- The light is channelled down beamlines to experimental workstations where it is used for research.

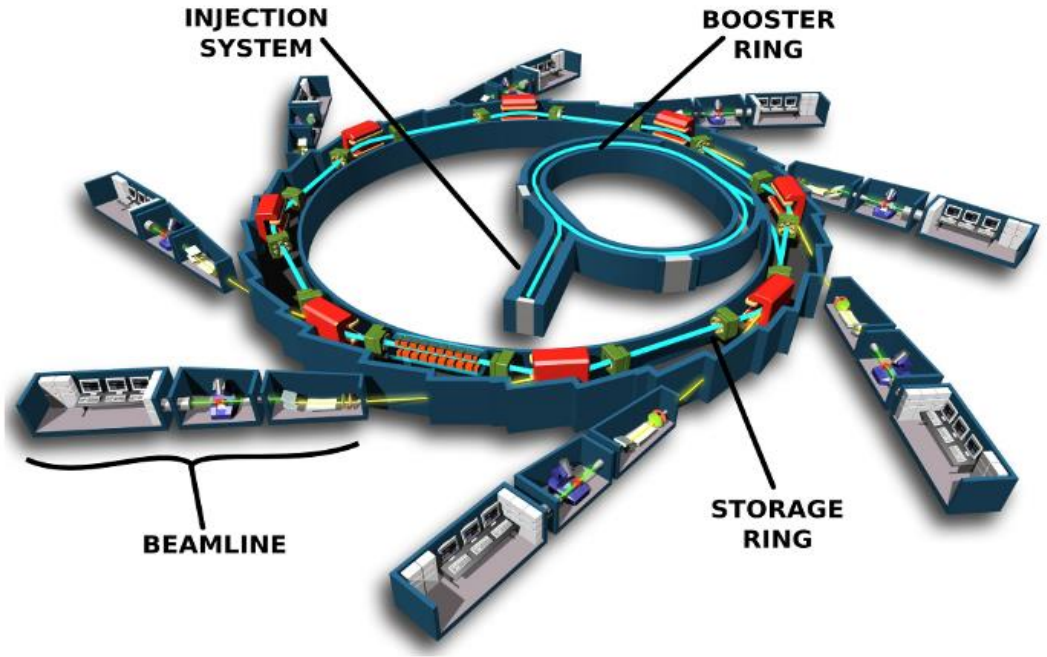


Illustration of the Australian Synchrotron

ANSTO

Synchrotron applications

Synchrotron light is advancing research and development in fields as diverse as:

- biosciences (macromolecular/protein crystallography and cell biology)
- medical research (microbiology, disease mechanisms, high resolution imaging and cancer radiation therapy)
- environmental sciences (toxicology, atmospheric research, clean combustion and cleaner industrial production technologies)
- agriculture (plant genomics, soil studies, animal and plant imaging)
- minerals exploration (rapid analysis of drill core samples, comprehensive characterization of ores for ease of mineral processing)
- advanced materials (nanostructured materials, intelligent polymers, ceramics, light metals and alloys, electronic and magnetic materials)
- engineering (imaging of industrial processes in real time, high resolution imaging of cracks and defects in structures, the operation of catalysts in large chemical engineering processes)
- forensics (identification of suspects from extremely small and dilute samples).

Current Active Beamlines

The Imaging and Medical beamline (IMBL)

The Imaging and Medical beamline (IMBL) is a flagship beamline of the Australian Synchrotron built with considerable support from the NHMRC. It is one of only a few of its type, and delivers the world's widest synchrotron x-ray 'beam'.

The Infrared Microspectroscopy beamline

The Infrared Microspectroscopy beamline combines the high brilliance and collimation of the synchrotron beam through a Bruker V80v Fourier Transform Infrared (FTIR) spectrometer and into a Hyperion 3000 IR microscope to reach high signal-to-noise ratios at diffraction limited spatial resolutions between 3-8 µm.

The THz/Far-IR Beamline

The THz/Far-IR Beamline couples the high brightness and collimation of a bend-magnet synchrotron radiation to a Bruker IFS125HR spectrometer providing high-resolution spectra (0.00096 cm-1) with signal to noise ratio superior to that of thermal sources up to 1350 cm-1 for gas-phase applications; the beamline also delivers signal to noise ratio superior to that of thermal sources up to 350 cm-1 for condensed phase samples.

Current Active Beamlines

Macromolecular and Microfocus Crystallography

The Macromolecular Crystallography beamlines at the Australian Synchrotron (MX1 and MX2) are general purpose crystallography instruments for determining chemical and biological structures.

Powder Diffraction

The Powder Diffraction beamline at the Australian Synchrotron is optimised for carrying out structural investigation under non ambient conditions and as a function of time.

SAXS / WAXS

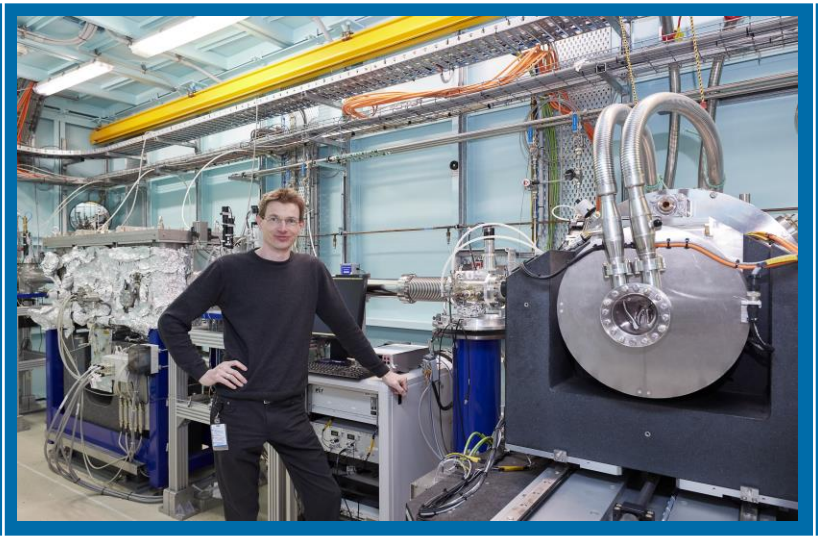
The SAXS / WAXS beamline at the Australian Synchrotron is a highly flexible x-ray scattering facility with purpose-built optics and a very flexible endstation and SAXS camera enable multiple types of experiments.

ANSTO

Current Active Beamlines

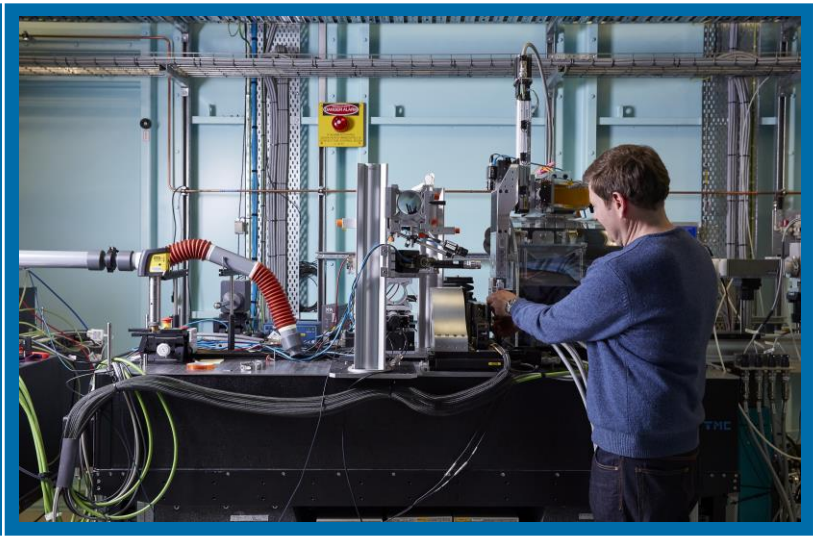
Soft x-ray spectroscopy

Soft x-rays are generally understood to be x-rays in the energy range 100-3,000 eV. They have insufficient energy to penetrate the beryllium window of a hard x-ray beamline but have energies higher than that of extreme ultraviolet light.



X-ray absorption spectroscopy

X-ray absorption spectroscopy (XAS) is a versatile tool for chemistry, biology, and materials science. By probing how x rays are absorbed from core electrons of atoms in a sample, the technique can reveal the local structure around selected atoms.



X-ray fluorescence microscopy

The X-ray fluorescence microspectroscopy beamline offers a range of x-ray absorption and fluorescence spectroscopy techniques at submicron length-scales. The beamline has two microscopes optimised for complementary studies.

ANSTO

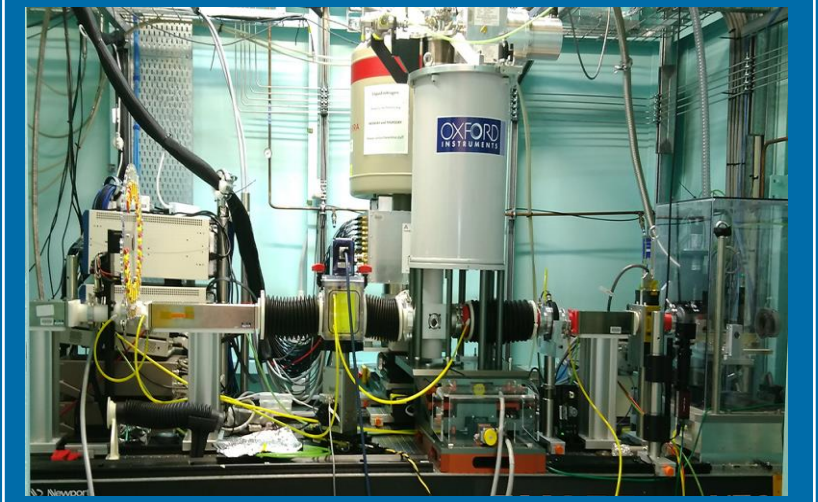
BRIGHT Program

ANSTO

New BRIGHT Beamlines

Micro-Computed Tomography beamline (MCT)

With enhanced submicron spatial resolution, speed and contrast, the Micro-Computed Tomography beamline opens a window on the micron-scale 3D structure of a wide range of samples relevant to many areas of science including life sciences, materials engineering, anthropology, palaeontology and geology. MCT will be able to undertake high-speed and high-throughput studies, as well as provide a range of phase-contrast imaging modalities.



Medium Energy X-ray Absorption Spectroscopy Beamline (MEX-1 and MEX-2)

The Medium Energy- X-ray Absorption Spectroscopy beamlines will provide access to XANES and EXAFS data from a bending magnet source, optimised for cutting-edge applications in biological, agricultural and environmental science in an energy range that is not currently available at the Australia Synchrotron.

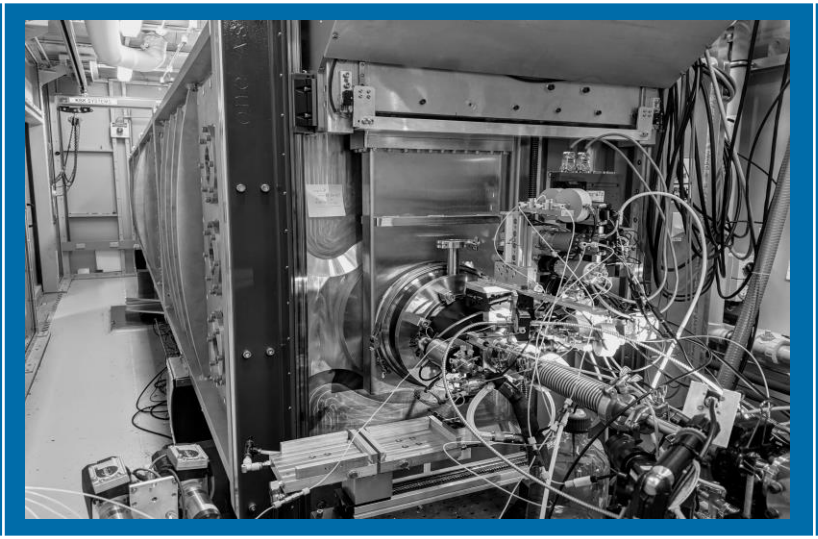
X-ray Fluorescence Nanoprobe beamline (Nanoprobe)

The X-ray Fluorescence Nanoprobe beamline undertakes high-resolution X-ray microspectroscopy, elemental mapping and coherent diffraction imaging – providing a unique facility capable of spectroscopic and full-field imaging. Elemental mapping and XANES studies will be possible at sub-100 nm resolution, with structural features able to be studied down to 15 nm using scanning X-ray diffraction microscopy.

New BRIGHT Beamlines

High Performance Macromolecular Crystallography Beamline (MX3)

The MX3 beamline will enable the study of very small (sub-5 micrometre) or weakly diffracting crystals, providing a state-of-the-art high-throughput facility for researchers. MX3 will be able to study the structures of large proteins and protein complexes for virology, drug design and industrial applications via goniometer mounted crystals, in-tray screening, or via serial crystallography methods.



Biological small angle X-ray scattering beamline (BioSAXS)

The Biological Small Angle X-ray Scattering beamline will be optimised for measuring small angle scattering of surfactants, nanoparticles, polymers, lipids, proteins and other biological macromolecules in solution. BioSAXS combines combine a state-of-the-art high-flux small angle scattering beamline with specialised in-line protein purification and preparation techniques for high-throughput protein analysis.

Advanced Diffraction & Scattering Beamlines (ADS-1 and ADS-2)

The Advanced Diffraction and Scattering beamlines (ADS-1 and ADS-2) are two independently operating, experimentally flexible beamlines that will use high-energy X-ray diffraction and imaging to characterise the structures of new materials and minerals.

Q&A

Thank you