Top 10 CLS Tour Questions

#1 How many synchrotrons are there in Canada? In the world?

The Canadian Light Source is the only synchrotron in Canada. There are about 40 similar facilities worldwide, including eight in the United States.

#2 Does the background noise level change when the synchrotron is on/off?

No, the background noise doesn't change when the synchrotron is on or off. Most of the noise you hear is from the ventilation and cooling equipment.

#3 How much did the CLS cost?

The capital cost of the CLS was $173.5 million (CDN). This cost covers the synchrotron, the facility, and our seven initial beamlines. The Phase II expansion was $55 million, which covered construction of another seven beamlines.

#4 How bright is the light?

Brightness is measured by the number of photons (particles of light) that strike any $1mm^2$ sample per second. The light generated by a synchrotron using Insertion Devices is 1,000,000,000,000 times brighter than a medical x-ray.

#5 How does a synchrotron differ from...?

an MRI - An MRI is used for medical imaging purposes. MRIs use radiofrequency waves to alter the position of hydrogen nuclei within the sample, and magnetic fields to detect the electric signal the hydrogen atoms give off as they return to natural alignment. This signal is measured and helps generate a picture for analysis. Synchrotron imaging techniques use the interaction of light and the sample to produce information that can be used to create an image.

an electron microscope - An electron microscope is used to magnify very small samples. An electron microscope focuses an electron beam onto a sample; the electrons that pass through create a magnified image of the sample on a screen. Synchrotrons use photon beams to gather information about various samples. Most of the information are not images.

a cyclotron - Cyclotrons are actually precursors to synchrotrons. Cyclotrons accelerate charged particles using constant magnetic fields. These particles are then used for many different things, including creation of radioisotopes and therapies for different types of cancers. Synchrotrons use accelerated electrons and manipulate them to release light.

#6 How big is the synchrotron?

While the Canadian Light Source may seem quite large, it is actually one of the smallest synchrotrons in the world. The facility is just over $8000m^2$, about the size of 2 football fields. The linear accelerator is 37m in length, while the circumferences of the Booster and Storage Rings are 103m and 171m respectively.

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#7 Why does tinfoil cover much of the beamline equipment?

The electrons in the synchrotron and the photons in the beamlines are kept in vacuum, similar to that near the International Space Station (about 1x 10^{-10} torr). Our vacuum system allows the particles to travel through the chamber unimpeded by other particles. To help eliminate these extra particles, the vacuum chamber is heated to a high temperature. This process is called 'baking' and the aluminum foil helps to insulate the chamber. The CLS uses approximately 6 km of aluminum foil each year.

#8 How fast do the electrons travel?

The electrons circulate through the Storage Ring at about 99.9999985% the speed of light! This means they are traveling at approximately 300,000 km/s or 360 million km/hr. The electrons travel around the Storage Ring approx. two million times each second. At this speed, it would take the electrons just over one second to get to the moon.

#9 Can I see the light?

Generally, you can't see the light. It is initially enclosed inside the vacuum chamber. Once the light has passed through the monochromator, the wavelengths of light that are visible to the human eye have been filtered out so you wouldn't be able to see the remaining beam that interacts with the sample.

#10 How many beamlines are there at the CLS?

The CLS has seven operational beamlines:

- Far IR - Offers wavelengths of light that are very hard to obtain with other sources to examine gaseous phases of molecules
- Mid IR - Studies the molecular composition of various materials and living tissues
- PGM - Studies where materials meet, such as anti-wear additives in motor oil that coat moving parts and extend engine life
- SGM - Analyses materials containing elements with a low atomic number, such as carbon, nitrogen, and oxygen
- SM - Studies important biological molecules such as amino acids and commercial molecules such as polymers
- CMCF - Determines the shape and structure of molecules such as proteins
- HXMA - Determines molecular level speciation of heavy elements under various sample conditions, such as advanced electronic materials, metallo-organic compounds, and complex chemical speciations in environmental systems

Seven new beamlines are currently under construction:

- CMCF2 - Produces detailed, atomic-scale images of molecules like viral and bacterial proteins
- SXRMB - Determines material structures to nanometer (billionth of a meter) scales
- VESPERS - Determines trace elements and crystal structure in microsamples
- BMIT - Two beamlines that provide medical- based imaging of humans and animals, and radiation therapy techniques
- REIXS - Offers atomic scale microscopy with applications in environmental science and advanced materials development
- SyLMAND - Offers techniques for production of nanostructures

Five new beamlines are currently being designed:

- BXDS - Two beamlines that characterize the structure of a wide variety of materials, such as petroleum products
- BioXAS - Two beamlines that study biological and health-related metals in diseases such as Alzheimer's
- QMCS - Studies electronic properties of novel materials, such as those involved in high-performance computing and energy storage technologies