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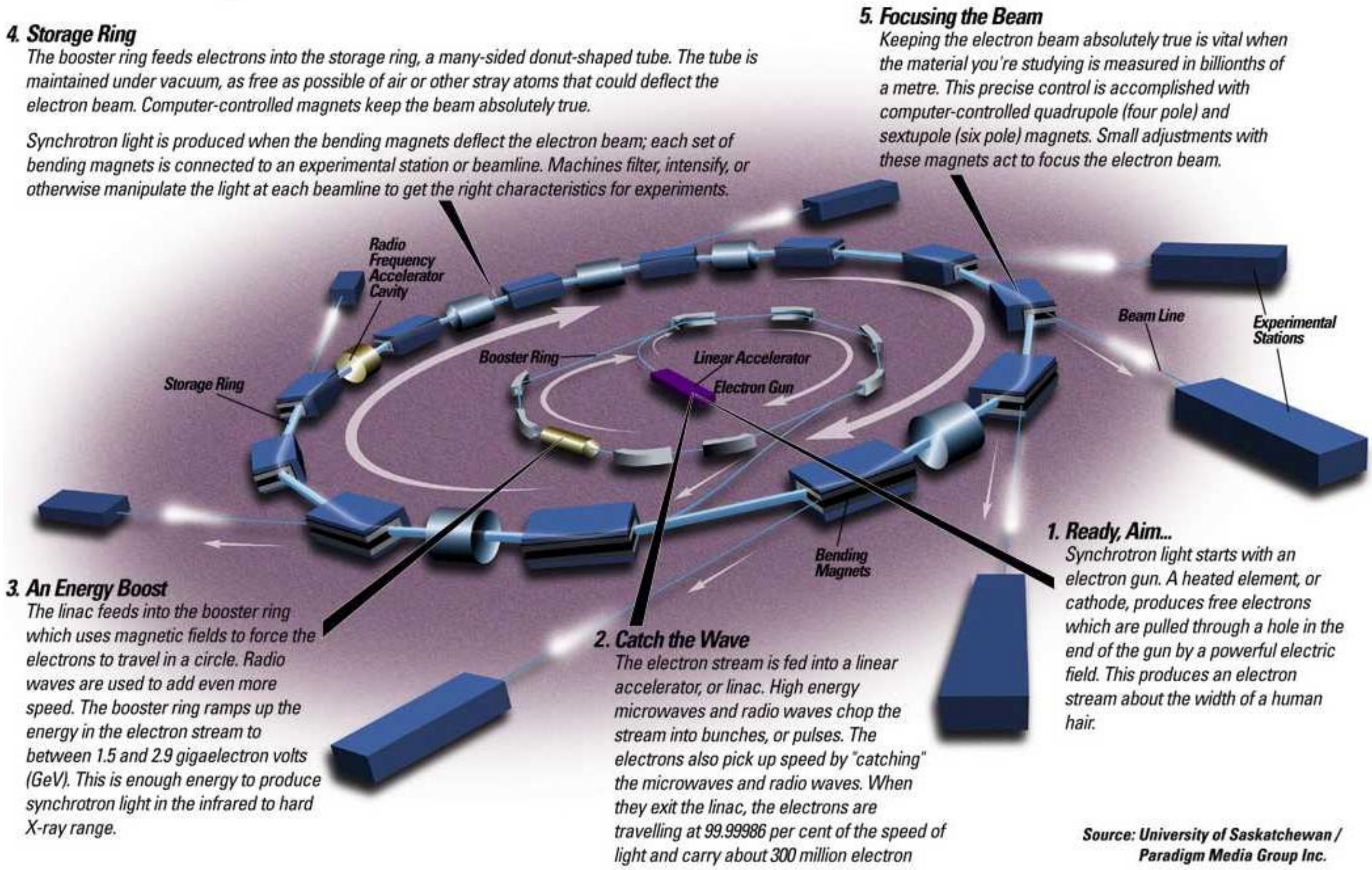
A Bright Light on the Horizon

Canada's biggest science project in more than 30 years is under construction at the University of Saskatchewan. The project is the $174-million Canadian Light Source (CLS). When the U of S-owned national facility opens in January of 2004, the world's fourth most powerful synchrotron light source will be switched on. A ring the size of a football field will accelerate electrons to nearly the speed of light, producing a brilliant but focused light, millions of times brighter than sunlight!

What's a synchrotron?

A synchrotron acts like a gigantic microscope that generates intense beams of brilliant light to view the microstructure of materials. It produces extremely bright light by using powerful magnets and radio frequency waves to accelerate electrons to nearly the speed of light. This infra-red, ultraviolet, X-ray light is shone down beamlines to endstations (small laboratories) where scientists select different parts of the spectrum to "see" the microscopic nature of matter, right down to the level of the atom.

How a Synchrotron Works



Scientists can probe the structure of matter with greater accuracy and precision than has ever before been possible.

Why the need for synchrotron light?

Currently, Canada is the only G7 country without a synchrotron. About 40 synchrotron light sources have been built around the world. Countries with synchrotrons include Brazil, China, India, Korea, and Taiwan. Some scientists have observed that for Canada not to have a synchrotron as it heads into the 21st century would be akin to university labs not having microscopes back at the start of the 20th century. More than 400 Canadian scientists and students now travel to other countries to use this unique light.

One important advantage of synchrotron light is that it covers the full range of the light spectrum from infra-red to X-ray wavelengths. The brilliance of synchrotron light and its tunability (researchers can select the wavelength they need for a particular experiment) are two of the special qualities that permit scientists to explore new research domains that were unimaginable a few years ago. Synchrotron light allows matter to be "seen" at the atomic scale – from the cross-sectional images of a mosquito's knee to the nanosecond-by-nanosecond behavior of protein molecules such as antibodies.

This light can be used in many ways. It lets us see living cells as they react to drugs, or determine the shape of molecules and the structure of surfaces to help us design everything from better plastics to more effective motor oil. Synchrotron light can also be used as an industrial tool to etch microscopic patterns for more powerful computer chips, to machine gears smaller than the width of a human hair, and to weld advanced ceramics that cannot be joined any other way.

Biotechnology & medical uses

Synchrotron light is of particular interest in the biotechnology and medical fields. University researchers and a growing number of pharmaceutical and biotechnology companies use synchrotron radiation to determine the three-dimensional structure of proteins. This can lead to new and better drugs or increase the winter hardiness of wheat. Protein crystal structures can be solved in days versus months or years. The synchrotron has great potential to aid in understanding how plant proteins work. This is especially important to farmers and the agriculture industry. A better understanding of proteins could lead to creation of plants that are more resistant to environmental stresses like drought, cold and salt. Synchrotron light is used to study heart disease, cancer, Alzheimer's, and other diseases, as well as to develop new medicines and vaccines. New synchrotron imaging techniques for medical diagnosis are being developed such as non-invasive angiography. The synchrotron has been used to study the life cycle in red blood cells of the deadliest malaria parasite.

A bright future

Work is now underway to install and test the synchrotron components and related equipment so that the light will shine in 2004. It's taken more than 25 years to realize the dream of scientists across Canada for a homegrown synchrotron facility. The CLS will put Canada on the global map for synchrotron science opportunities in virtually every scientific area including biology, pharmacy, engineering, chemistry, physics, biotechnology, medicine, geological sciences, agriculture, and archeology.

Special thanks to Kathryn Warden, Research Communications Officer, University of Saskatchewan, for the material used in developing this InfoSource.

For more information:

Canadian Light Source Inc.:
http://www.lightsource.ca/
CLS Student's Page:
http://www.lightsource.ca/students/index.shtml
Educational Synchrotron - Related Sites:
http://www.lightsource.ca/students/edlinks.shtml

Synchrotron Light Sources of the World:
http://www-als.lbl.gov/als/synchrotron_sources.html

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