Synchrotron Puts People under the Beam

When the Australian Synchrotron's Imaging and Medical Therapy beamline opens next year, researchers will be able to follow the movements of individual stem cells. They will be able to follow cancer cell movement and tumour development to eventually develop better treatment.

Already new synchrotron-based radiotherapy techniques are being developed, and will be implemented at the Australian facility to enable clinical research into cancer treatment.

The beam will be 10 million times more intense than a hospital X-ray but will be delivered in tight, sharply tuned beams. It will expose patients to X-ray doses similar to and in some cases lower than those from conventional machines.

Golden Stem Cells

Monash researcher Chris Hall hopes to be one of the first users of the imaging beamline. He's developing techniques for tracking individual stem cells and cancer cells in the body using 3D computer tomography (CT).

"We have developed a way of labelling cells with protein-coated particles of gold just 50 nm across," he says. "Then we inject the gold-tagged cells into a live animal and watch how the cells move through the body."

One of his first targets is the autoimmune disease multiple sclerosis (MS). His colleague, Claude Bernard, is successfully using stem cells to repair damaged nerve cells in the spines of people with MS, but he wants to make sure he knows where the stem cells are going.

Hall hopes that by using gold-labelled stem cells he will be able to track the path of the cells and see whether they are working locally or moving to parts of the body where they are not wanted.

Assessing Airway Quality

At the Women's and Children's Hospital in Adelaide, a research team led by David Parsons is developing a new gene therapy for cystic fibrosis airway disease. The correcting genes are delivered to the cells lining the airways using viral particles.

They are using X-rays from the SPring-8 synchrotron in Japan to develop techniques to assess the improvement of the airways in living, anaesthetised mice. Using phase contrast X-ray imaging, they can see the airways in remarkable detail.

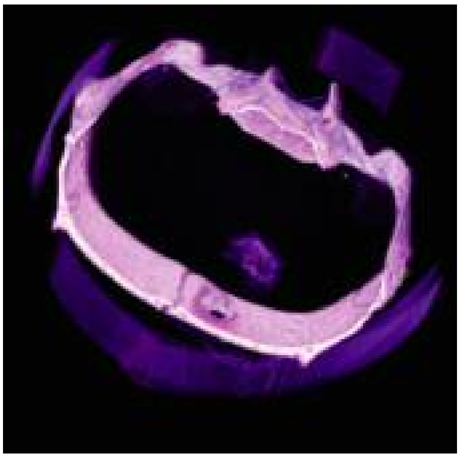
"The technique allows us to see what is happening inside the airways without having to open the animals up surgically," Parsons says. "Once an animal has been treated we can look at changes to the airways over time."

Better Radiotherapy

The imaging beamline will also be used for medical therapy, according to Peter Rogers from the Monash Institute of Medical Research. "More than half of cancer patients are treated using radiotherapy – a technique that has been largely unchanged for 100 years," he says.

A new technique, microradiation therapy, is attracting attention around the world. "If a tumour is irradiated with a comb pattern of X-rays with gaps in between the beams, the cancer cells still die but the normal cells around them seem less affected." Rogers is using synchrotron light at the SPring-8 facility in Japan to working to understand why this is the case.

"When the Australian beamline is completed, we will commence studies here at Monash, which we hope will ultimately lead to clinical trials with cancer patients. If it can be made to work, then a new generation of X-ray machines will be needed."



A rat cranium observed using computer tomography. The blue "cloud" in the centre is a brain tumour labelled with gold nanoparticles. Photo: Chris Hall, Monash University

Swiss Guides Synchrotron

Swiss scientist Daniel Häusermann is leading the team building the Imaging and Therapy Beamline. He is excited about the potential of this beamline.

Häusermann comes to the Australian Synchrotron with huge experience designing high power X-ray research tools, but this is the first time he has brought his know-how to the world of medicine. Previously he has worked in the field of high pressure physics, designing beamlines firstly at the European Synchrotron Radiation Facility in Grenoble, France, and more recently at the Advanced Photon Source in Chicago.

The beamline is the longest at the Australian Synchrotron – it is 150 metres long, leading to a satellite building that will include a patient reception area, animal holding and preparation facility and near-beam surgery facilities, as well as complementary imaging technologies.

"The facility will also be one of only a couple worldwide capable of online image reconstruction, thanks to a high performance computing facility that will be linked to the beamline facility, allowing rapid data analysis," Häusermann says.

Visit www.synchrotron.org.au for more information.