Reactors for R&D

by Heather Catchpole

Australia's newest research reactor – called OPAL — ranks among the world's most advanced.

Two events are creating waves in Australian science in 2007. The opening of the Australia Synchrotron at Clayton, a laser-equipped device capable of seeing into the structure of the tiniest molecules, and the official opening of the OPAL reactor, a nuclear device operated by the Australian Nuclear Science and Technology Organisation (ANSTO). This allows researchers to understand atomic structures using neutrons at a scale not previously available in Australia. The two facilities place Australia at the forefront of research into the structure of matter at small scales.

Avenues of research at the two facilities are extremely broad, ranging from forensic science to drug design and disease diagnosis.

The OPAL reactor is based on pre-eminent research reactors like those at France's Institut Laue-Langevin (ILL) in Grenoble or the Centre for Neutron Research in Maryland, USA. ANSTO expects OPAL will become one of the top three research reactors in the world.

There are alternatives to reactors when it comes to churning out neutrons. Japan and the USA are among those investing in advanced particle accelerators. Japan has 18 research reactors but is also building

the Japanese Spallation Neutron Source, an accelerator. In terms of science, particle accelerators with spallation sources offer similar capabilities to research reactors, as well as a few extra features. The USA's Oak Ridge facility is hedging bets both ways, building the Spallation Neutron Source while upgrading its old 85 MW High Flux Isotope Reactor (HFIR).

However one of the main jobs of OPAL — irradiating material to create radioisotopes or doped silicon — is a reactor job and cannot be done with a spallation source.

Another good reason to go ahead with the construction of a new research reactor in Australia was political. One of the key issues for Australia is the ability to participate in world discussions on nuclear non-proliferation while promoting uranium supplies, says ANSTO's Chief of Operations Ron Cameron.

"For our standing in the world, we have to have an advanced reactor in terms of nuclear research and technology," he says.

Australian scientists are excited by the opportunities offered by OPAL with hopes that it will revolutionise biology in particular.

In particular, having an advanced reactor helps Australia maintain a permanent seat on the Governing Board of the IAEA; it also picks up influence in the Regional Cooperative Agreement and Forum for Nuclear Cooperation in Asia.

Cameron hopes OPAL will instigate other opportunities to collaborate with Asian science research and gain funds for the development of more advanced instruments for OPAL. Taiwan has already invested in the triple-axis spectrometer, one of the nine instruments starting up this year at ANSTO.

Australian scientists are excited by the opportunities offered by OPAL with hopes that it will revolutionise biology in particular. President of the Pacific Nuclear Council and Australian Nuclear Association secretary, Clarence Hardy, says OPAL is the best in the world for multi-purpose use.

"It's really a great opportunity for Australia and Australian science. There aren't many of these facilities in the world and I think Australia has the opportunity to be at the forefront of molecular biology and biotechnology," says Jill Trewhella of the University of Sydney.

OPAL is a 20 MW reactor with twice the thermal capacity of its predecessor, HIFAR. It uses light water for cooling and low-enriched uranium to operate, keeping it safer and less wasteful than a reactor using highly-enriched uranium. However, its neutron beam consequently lacks the punch of some other facilities.

A look inside the Opal reactor hall. Photo: ANSTO

JOINING FORCES

In April 2007, IAEA Deputy Director General Werner Burkart joined Australian Prime Minister John Howard in attending the opening ceremony for Australia's $380 million OPAL research reactor in Sydney. It was the same day that ANSTO became a Collaborating Centre. Following is an extract from Dr Burkart's remarks:

"ANSTO and the IAEA have enjoyed many years of cooperation. Indeed, our areas of mutual interest confirm the importance that both organisations place on the value of nuclear technology in the modern world. ANSTO's role as a leading research organization is fully complementary to the promotional role of the IAEA's work in nuclear sciences, which is primarily to bring the benefits of nuclear sciences and applications to developing countries.

"For this we rely on support and cooperation with the world's leading nuclear institutions. IAEA and ANSTO are both, for example, active in the development of new radiopharmaceuticals for better diagnosis and treatments of disease; we both have interests in understanding environmental processes and the effects of pollutants in the marine and terrestrial environments, and in understanding climate change.

"The Agency strongly promotes sustainable industrial development in developing countries, and it is also in this area that ANSTO's cutting-edge research capabilities are vital. The OPAL research reactor will open new horizons in physics, chemistry, materials science, medicine and engineering, and in many other important fields of nuclear technology. The IAEA looks forward to enhanced and even more fruitful collaboration.

"In recognition of the long standing cooperation between ANSTO and the Agency, the IAEA has proposed and the Australian Government has agreed that ANSTO may be designated as an IAEA Collaborating Centre for Neutron Scattering Applications, ensuring greater value for both of our programmes in this special area.

"We have jointly developed a three year plan to enhance our collaboration in this field, which, among others, will provide information and tools to understand the behaviour and composition of a variety of materials

What it lacks in neutron flux — the volume of neutrons generated by the reactor — OPAL plans to make up for in instruments, with aims to have 17 commissioned. The reactor has a cold neutron source and planned hot source, opening up a wide range of experimental possibilities, and its long neutron guide hall and bank of detectors adds to its capacity for precision and quality of final data.

OPAL has significantly increased the attractiveness of Australia as a research destination. The Bragg Institute's Mohana Yethiraj defected from Oak Ridge to OPAL recently and can confirm its appeal to international researchers.

"It runs as it is supposed to, nearly every day," says Yethiraj of OPAL , which can operate 340 days of the year. "It's a brand new facility, so there's a lot going in that's state-of-the-art."

"If you decide you are going to have a nuclear reactor, it's good to gave one that's leading edge," says OPAL Operations Manager Greg Storr.

"I firmly believe it's important for countries to have access to and knowledge of peaceful nuclear capacity, so you can have a better understanding [of the technology]. If you don't, it breeds ignorance.

"There is the possibility [with OPAL] for really good science in this country and to attract people here. You just end up bettering human kind by your understanding of things," he says.

Heather Catchpole is a freelance science writer based in Sydney. This article was first published in a supplement to Cosmos magazine.
Visit: www.cosmosmagazine.com

Australia's nuclear research and development organisation — ANSTO — has been designated as an IAEA Collaborating Centre.

and develop new materials for both nuclear and non-nuclear applications.

"With the IAEA Collaborating Centre scheme, as partners we can strengthen and better promote the values of nuclear technologies for improving the quality of life and standards of living. ANSTO has made many important contributions to nuclear sciences, and as an IAEA Collaborating Centre, I am sure that its work will become even more widely acclaimed."

A Collaborating Centre is an institution which assists the IAEA in the implementation of its regular budget programme through research and development, as well as training in a relevant nuclear technology.

UN Agencies such as the World Health Organisation (WHO) and the Food and Agriculture Organization (FAO) have operated Collaborating Centre schemes for years, involving over 1,400 participating institutions worldwide.

Over the course of the last three years, IAEA Collaborating Centres have been designated in the Philippines, the Republic of Korea, Brazil, Malaysia, Syria, Hungary, Italy, Belgium, and China.

For more information, visit the IAEA website at www.iaea.org

Werner Burkart at the opening of Australia's new research reactor, OPAL .

Photo: Getty Images