SYNCHROTRON LIGHT SOURCES

International interest

Kobe

AT an international symposium on synchrotrons held in Kobe two weeks ago, scientists from Europe, the Soviet Union and the United States described a variety of next-generation synchrotrons whose purpose is not to accelerate particles but to produce intense beams of radiation ranging from ultraviolet to X-rays.

Synchrotron light sources are finding a wide range of applications in experimental physics and technology, and it is Japan that seems likely to have the most powerful machines by the end of this decade.

The first of the new generation machines to come on line will be the European Synchrotron Radiation Facility (ESRF), now in its third year of construction at Grenoble, France. Ten beam lines from the 6-GeV ESRF are expected to be available in mid-1994, with expansion to 30 lines by 1998, according to Rupprecht Haensel of ESRF. Projects including materials science, protein crystallography (2 lines) and surface diffraction studies have already been selected for the first eight beam lines.

In the United States, the 7-GeV Advanced Photon Source (APS) at Argonne, Illinois, is not expected to be completed until 1995 but the facility already has a mailing list of about 3,500 potential users, according to G.K. Shenoy of APS. One crucial technical hurdle that APS must overcome is the development of well-cooled optics that can handle the tremendous beam power that will be focused on samples. The APS engineers intend to solve this problem by using liquid gallium rather than water as a coolant, and their experience will aid Japan's plans to build the world's most powerful synchrotron, the 8-GeV Super Photon Ring (SPring-8) facility at Harima Science Park City west of Osaka, construction of which begins this month (see *Nature*, **343**, 582; 15 February 1990). SPring-8, which is expected to undergo its first tests in 1997, may be capable of achieving about ten times the beam brilliance of APS, according to calculations presented by the SPring-8 design team.

With such high brilliance, it may be possible to take picosecond snapshots of the reaction kinetics of proteins. And this could open up a "completely new era in crystallography and structural chemistry", according to Janos Hajdu of the University of Oxford in the United Kingdom, who has carried out pioneering work on enzymes and viruses at the Daresbury synchrotron.

But Hajdu warns that there is a need to put more effort into the development of detectors that operate at such speeds if the new synchrotrons are to reach their full potential. Japan has made a contribution on this front with Fuji Film's development of an imaging plate that may be able to take high-quality snapshots at the picosecond level. But there is a need for real-time detectors, Hajdu says.

Soviet scientists have an ambitious plan to build a 10-GeV synchrotron, Siberia-3, perhaps at Dubna near Moscow, G. Kulipanov says. But "we have no money" and "500 million roubles is not so easily obtained at the moment".

Physicists at the High-Energy Physics Laboratory (KEK) in Tsukuba have long had a plan to convert the electron–positron collider TRISTAN into a gigantic 10-GeV synchrotron once the collider outlives its useful life in a few years time. Conversion could be carried out at very low cost — the order of ¥10,000 million ($70 million) or about one tenth the cost of SPring-8 — and this seems "the biggest possibility" for the final fate of TRISTAN according to Seigi Iwata, director of the Physics Department at KEK.

Several Japanese companies have mini-synchrotrons for the development of VLSI (very-large-scale-integrated) circuits and people from industry were at the symposium. **David Swinbanks**

HIGH-ENERGY PHYSICS

Big linear collider proposed

Tokyo

HIGH-ENERGY physicists in Japan are hoping to build a huge linear collider that will compete for results with the United States' Superconducting Super Collider (SSC). But, at the earliest, their proposed collider could not be built before the beginning of the next decade, and in the meantime many Japanese physicists are keen to participate in experiments at the SSC. Whether the Japanese government, however, has a similar enthusiasm to help build the SSC remains far from clear.

The Japanese Linear Collider (JLC), which is being promoted by scientists at the High-Energy Physics Laboratory (KEK) in Tsukuba, would cause positrons and electrons to collide at an energy of 1 TeV. This is less than the combined 40 TeV proton–proton collisions of the SSC, but the lower energy is partly made up for by the 'cleaner' collisions that positrons and electron produce, and the scientific goals of JLC are the same as those of the SSC, according to Seigi Iwata, director of the Physics Department at KEK.

The Ministry of Education, Science and Culture (MESC) has yet to decide whether to go ahead with JLC, but has provided a few hundred thousand dollars for research and development over the past few years. Some funds for JLC have also come from a cooperative US–Japan science and technology agreement between KEK and the Stanford Linear Accelerator Center, California, Iwata says.

The JLC would consist of two linear accelerators, one for electrons and one for positrons, facing each other. With present technology, each 500 GeV linac would have to be about 50 km long, but the developers of JLC plan to keep the total length of the collider down to about 16 km by developing powerful new klystrons to accelerate the particles. Even at this length, Japanese land prices would make JLC's cost prohibitive, an obstacle KEK researchers plan to get around by building the accelerator at a depth of 50 to 100 m.

The Ministry of International Trade and Industry (MITI) is currently drafting new legislation that is expected to limit land-ownership rights to a maximum depth of 50 metres. MITI's legislation is intended to promote the development of underground cities and power stations but, according to Iwata, Japan's high-energy physicists are also waiting for "a good new law from MITI".

For this and budgetary reasons Iwata's "best hope" for the start of construction of JLC is 1995. Construction will take "at least five years". Iwata is not prepared to estimate a total cost for JLC at this stage because he says that will depend very much on what is achieved in research and development over the next few years. But JLC will cost more than KEK's electron–positron collider, TRISTAN.

Without a next-generation collider of their own until the next century, many Japanese physicists are very keen to participate in the experimental phase of SSC, Iwata says. But others, particularly those in the universities, would prefer to collaborate with the European Laboratory for Particle Physics (CERN) in the operation of their proposed LHC (Large Hadron Collider), which might be built in the latter half of the 1990s.

Participation in the LHC is expected to cost less than in the SSC. So far, Japan has made no commitment to contribute to the construction costs of the SSC.

Last year, a US mission visited Japan to explain the project to government officials. But since then, there has been no contact, and Japan has made no decision on SSC, according to Yubun Narita, director of scientific affairs at the Ministry of Foreign Affairs. At present, there seems little incentive for Japan to join the construction phase. "If Japanese companies are not allowed to provide superconducting magnets for SSC, what is the point of Japan contributing to construction costs?" asks one leading Japanese physicist.

David Swinbanks