issues &events

Beijing collider intensifies focus on tau–charm physics

High-energy physics at a Beijing collider is just one of the myriad scientific projects benefiting from China's thriving economy.

A major upgrade of the Beijing Electron–Positron Collider will give it the world's highest luminosity in the collision energy range 2 to 4.2 GeV, a physics-rich niche that, China's high-energy physicists hope, will attract international collaborators. The $77 million BEPC II is scheduled to start up in September 2007.

Not much of the original BEPC, which went on line in 1988, is to be found in the revamped facility. The upgrade uses the same tunnel for collisions and some old magnets and existing infrastructure, but it incorporates superconducting magnets and has separate storage rings, each nearly 240 meters in circumference, for the electrons and positrons. And whereas the original BEPC storage ring held single bunches of electrons and positrons, the new rings will each hold 93 bunches of particles, with a bunch spacing of 8 nanoseconds. Chen Hesheng, director of the Chinese Academy of Sciences' Institute of High Energy Physics, which runs the collider, says that the multiple bunches, plus tighter focusing of the beams, increases the luminosity by a factor of 100.

The enhanced luminosity will also be more than 10 times higher than the present best for the same energy regime at Cornell University's CESR-c. The BEPC II, like its predecessor, creates electron–positron collisions of a few GeV, in the so-called tau–charm region, which produces tau leptons—the heaviest of the leptons—and a variety of charmed mesons and other mesons that carry both a charm and an anti-charm quark (charmonium). Due to space and cost constraints, the maximum collision energy of the new machine will fall somewhat short of the original BEPC's 5 GeV.

In addition to the high-energy physics experiments, parasitic synchrotron light beams will run at the BEPC II starting this fall. The 2.5-GeV synchrotron will provide hard x rays, as did the earlier version of the BEPC. A more sophisticated synchrotron light source is under construction in Shanghai (see the story on page 23).

Increased statistics

Perhaps the best-known advance made with the BEPC was the most precise measurement to date of the tau mass, in 1996. Among the BEPC's other credits, says Chen, are a possible sighting of a new particle and measuring the *R*-value, the ratio of the cross section for hadron production to the cross section for producing muon pairs. That ratio determines vacuum polarization and the effective value of the fine structure constant at the mass of the Z particle and impacts standard model predictions of the Higgs mass.

In addition, says Fred Harris, who leads a group from the University of Hawaii that works on the Beijing Spectrometer, the sole detector on the collider, "We have gathered 58 million J/Ψ events and 14 million Ψ′ events. There is a tremendous amount of physics one can do with such large samples of charmonium events. We can analyze lots of different decay modes." The Hawaii group is contributing a time-of-flight calibration system to the new incarnation of the BEPC II's detector, known as BES 3.

In going to higher luminosity with the BEPC II, physicists hope the greater statistics will lead to a better understanding of previously spied reactions and reveal new particles. Besides going after better measurements of tau properties and decay modes, "One of the hot topics is D mixing, where a D [meson] can turn into an anti-D," says Harris. "If you actually see such a thing, it's an indication of new physics." Other key areas of research with the BEPC II will be looking at the decay of charmed mesons and "seeking states made of gluons or gluons and quarks," says Carnegie Mellon University's Fred Gilman. "Ever since QCD [quantum chromodynamics] was invented, theory has said that gluons should form states by themselves—glueballs—but we haven't found them yet."

Expanding globally

The scientific promise of the BEPC II has veteran users hoping to increase

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Two rings of magnets (above) store particles and crisscross to form interaction areas in the upgraded Beijing Electron–Positron Collider. In June, scientists from China, the US, and elsewhere met in Beijing to discuss collaborations in high-energy physics.

the number of participating foreign physicists. And they're betting that the timing of their machine's startup will be a plus. In the global particle-physics community, the Large Hadron Collider (LHC) will be in the spotlight once it goes on line at CERN next year. But other accelerator experiments, including those at SLAC's BaBar, Fermilab's Tevatron, and Cornell's CESR-c, are winding down.

"It's a very opportune time," says SLAC's Wolfgang Panofsky, a longtime adviser to the Beijing collider, "because there is expected to be quite a gap, in particular for young people, in the time frame between 2008, when most American machines will shut down, and the startup of the International Linear Collider [ILC], at the earliest maybe in 2017. So during this time, opportunities for the younger generation are pretty scarce." Collaborations on the LHC may have 2000 members or so, adds Harris. "They're huge and socially potentially harder to work with. BES 3 is a relatively small collaboration."

Over time, the Beijing Spectrometer team has included scientists from the US, South Korea, Japan, Russia, and Europe, but they made up a small fraction of the collaboration, which remains predominantly Chinese. Joint work in high-energy physics, says Panofsky, "is possibly the oldest collaboration between China and the US in basic science." It goes back, he recalls, to the US–China science and technology cooperation agreement signed in 1979 by President Jimmy Carter and Premier Deng Xiaoping, and "has been enduring and quite productive, and established lots of personal linkages."

At a June workshop in Beijing, scientists and funding-agency representatives gathered to explore expanding US–China collaborations through the BEPC II, a proposed neutrino experiment at Daya Bay in southern China, and astrophysics and astronomy projects. Gilman, who with Chen organized the workshop, says the turnout for the BEPC II was small, "but people from several [US] universities are interested, and we're hoping that the collaboration will start to gel." Discussions with NSF and the Department of Energy are starting, he adds. "We need to get their interest, to see on what level they'll want to support this collaboration." Says Chen, "We should work together to share technology, share the cost, share the manpower, share the experience. That is the intrinsic nature of a particle-physics experiment."

High-energy physicists widely see increased international collaboration

Shanghai builds topflight light source

After several years of the Chinese government's wavering over whether to fund a major upgrade of an electron–positron collider or a new state-of-the-art synchrotron light source, China's scientists are getting both facilities.

In going ahead with both the collider in Beijing (see the story on page 22) and the Shanghai Synchrotron Radiation Facility, the government was helped by China's scientists having convincingly argued that the country has enough scientists to build and use both facilities, says Zhao Zhentang, head of accelerator construction for the SSRF. But perhaps most important is that the local Shanghai government is donating land plus ponying up about a third of the $150 million tab for the SSRF; the Chinese Academy of Sciences and the central government are splitting the balance. The price of the SSRF is "relatively cheap," says Zhao, "because we can build the linac, magnets, vacuum chambers, and power supplies here in China." Other components, such as superconducting RF cavities, klystrons, and some software, are imported.

SHANGHAI INSTITUTE OF ARCHITECTURAL DESIGN

WEICHENG HU, SHANGHAI INSTITUTE OF APPLIED PHYSICS

The synchrotron light source under construction (below) in Shanghai will be housed in a spiral-shaped building. An architect's conception of the completed facility is shown at left.

The SSRF will be a 3.5-GeV machine that, with the help of undulators, will provide x rays spanning 0.1 to 40 keV. Its above-ground storage ring is 432 meters in circumference, and at first will have seven public beamlines plus a few dedicated to universities and industry; eventually it will have as many as 60 beamlines. Expected research areas include biological crystallography, materials science, environmental science, physics, chemistry, and medical imaging. "It's the first third-generation light source in mainland China," says Zhao. "It will play a very important role in the nation's cutting-edge research of fundamental and applied sciences. It is comparable with Diamond [in the UK] and Soleil [in France]."

The building housing the synchrotron "looks like a nautilus shell," says Stanford University's Bob Hettel, an adviser to the SSRF project. "From what I understand, the Shanghai municipal government wants the building to have artistic merit, to be the technical jewel in the crown of the Shanghai region." Located on the east side of Shanghai in Pudong, a technical corridor that only a few years ago consisted of villages, vegetable gardens, and rice paddies, the SSRF will be easily accessible from the airport by magnetically levitated train, and the hope is to attract international users.

The SSRF is scheduled to go on line in spring 2009.

Toni Feder

on the BEPC II as a natural step toward China's playing a significant role in the ILC. "We have joined the discussion," says Chen. "But I can't see any serious commitment to host the linear collider. It will take time. But certainly the Chinese particle-physics community is interested in the linear collider, and we will actively join the collaboration."

Toni Feder

Marburger says communications directive unnecessary

In the wake of a May memorandum in which the National Science Board (NSB) called for the Bush administration to issue a "government-wide directive" to encourage the "open exchange of data and results of research conducted by [government] scientists," a spokesman for presidential science adviser John Marburger said no evidence exists "that the situation requires the development of a mandatory one-size-fits-all government-wide policy."

Benjamin Fallon, Marburger's legislative affairs assistant at the Office of Science and Technology Policy, said that after a January incident in which a NASA official tried to prevent agency scientist James Hansen from publicly discussing climate change research, Marburger "took a hard look at the question of the communication of scientific information." Marburger, director of OSTP, was pleased by the new scientific communication guidelines NASA developed in response to the Hansen incident, Fallon said, "and he issued a letter to every chief scientist government-wide recommending the [NASA] guidelines as a best-practice that they may want to consider." (See PHYSICS TODAY, May 2006, page 27.)

In the letter, which included a copy of the NASA policy, Marburger described the space agency's new approach as "exemplary" and urged the chief scientists to "compare your own current policies with it and strengthen or clarify them if necessary."

The science board memorandum, issued in response to a request in February by Senator John McCain (R-AZ), concluded that "there exists no consistent Federal policy regarding the dissemination of research results by Federal employees. An overarching set of principles for the communication of scientific information by Government scientists, policy makers, and managers should be developed and issued by the Administration to serve as the umbrella under which each agency would develop its specific policies and procedures."

The science board, an independent panel that oversees NSF and advises both Congress and the president on scientific issues, surveyed the communications policies at nine federal agencies and asked NSF's inspector general to poll counterparts at those agencies for any related information. The memorandum, signed by NSB chairman Warren Washington, said, "The American public must have confidence that scientific information they receive from the Federal Government has not been suppressed or distorted."

The Bush administration has repeatedly been accused by members of Congress and some science organizations of suppressing and altering scientific findings that conflict with the administration's policy goals (see PHYSICS TODAY, April 2004, page 30). Marburger, a physicist and the head of Brookhaven National Laboratory before becoming Bush's science adviser, has said in response to those claims that although mistakes have been made, the administration does not manipulate science for political ends.

The science board made four recommendations that the administration should carry out to ensure there is no "loss of confidence by the American public and broader research community regarding the quality and credibility of Government sponsored scientific research results."

- A government-wide directive should be issued that "clearly articulates the requirement for all agencies to develop unambiguous policies . . . to encourage open exchange of data and results" of government research. The policies should also prevent the "intentional or unintentional suppression or distortion of research findings."
- A clear distinction should be made between communicating professional research results and data versus the interpretation of data that reflect the personal views of the researchers. (The new NASA policy does not prevent scientists from expressing their personal views as long as those views are identified as such.) The policies should also be widely communicated to all agency employees and to the public so everyone is aware of them.
- An objective dispute-resolution mechanism for disagreements involving the public dissemination of research findings should be developed.
- A government-wide review of the implementation of the NSB recommendations should be established.

Although Marburger isn't issuing the directive recommended by the NSB or directly responding to the other recommendations, Fallon said the OSTP director "monitors this issue closely, and we look long and hard at reported cases. Where there are problems, it's usually where somebody didn't go through the proper public affairs process," he said, not an attempt to suppress science.

Jim Dawson

World regions in stalemate over particle accelerator conferences

For years, the main particle accelerator conferences have alternated between North America, in odd years, and Europe, in even years. Beginning in 2011, to make room for Asia's PAC to join the rotation, Europe will switch from a two-year to a three-year cycle, but the organizers and sponsors of the North American PAC are resisting such a switch.

In April, Michigan State University's Stanley Schriber, who chairs the NA PAC steering committee, broke a tied vote in the committee, coming down against switching the conference to a three-year cycle.

Arguments for switching include keeping the total number of conferences in the field down and treating North America, Europe, and Asia as equal partners in the field's increasingly global endeavors. Arguments against switching center on the nature of the NA PAC, which includes more engineers and technicians than the other PACs; on the rotation around North America, which gives graduate students and others an opportunity to attend without extensive travel; on the smaller size of the Asian PAC (APAC); and on worries that restrictions by the US Department of Energy (DOE) would limit the number of attendees at foreign conferences.

Albrecht Wagner, chair of the International Committee for Future Accelerators and director of the German Electron Synchrotron (DESY) laboratory in Hamburg, says he is "very disappointed" that the NA PAC is sticking