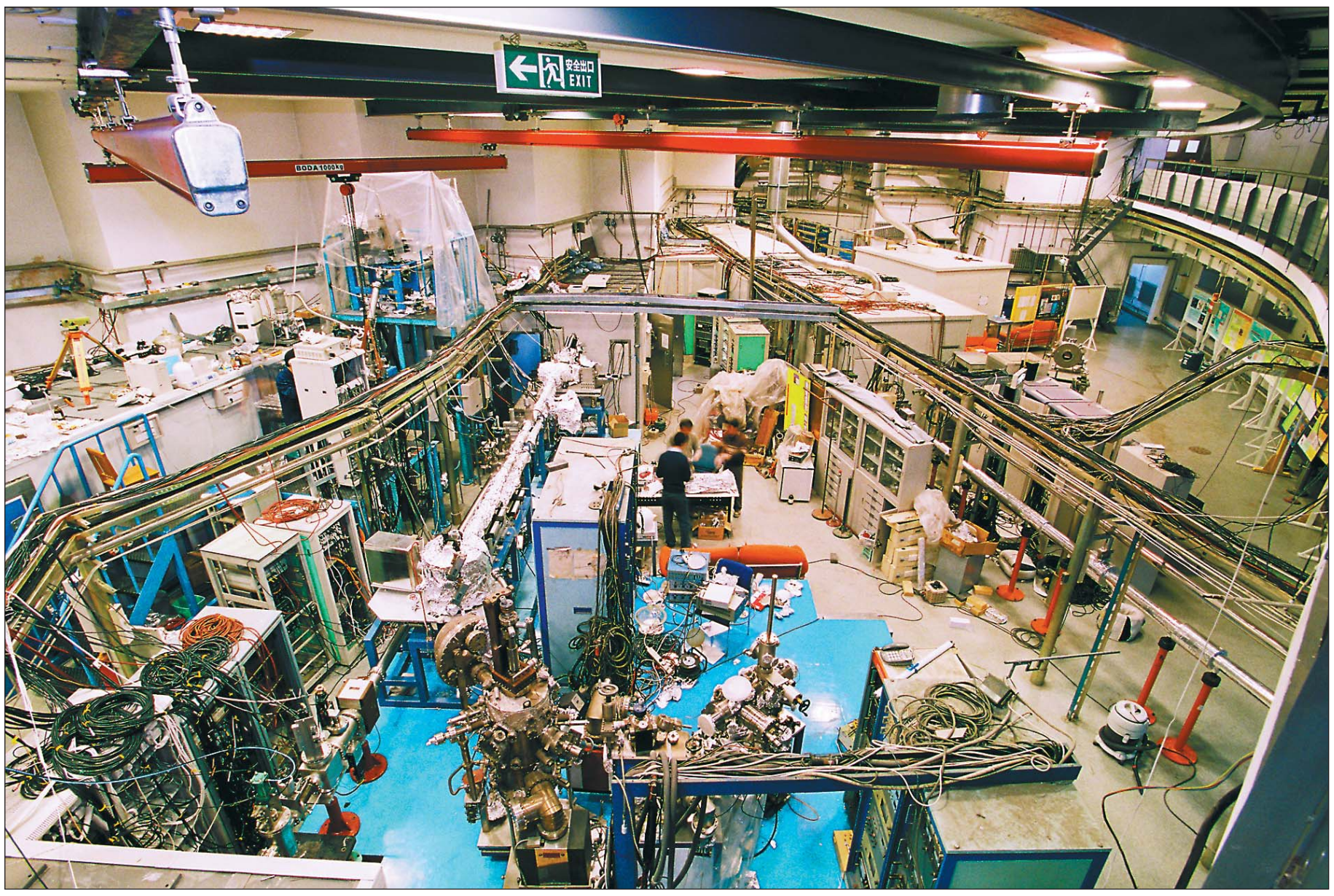

PHOTOS PROVIDED TO CHINA DAILY

Scientists test devices at Beijing Synchrotron Radiation Facility, part of the Beijing Electron Positron Collider (BEPC) project, at the Institute of High Energy Physics in Beijing.

Works like a charm

The Beijing Electron Positron Collider has been quietly leading research in charm physics for decades, reports **Cheng Yingqi** in Beijing.

The European Organization for Nuclear Research (CERN) recently announced the possibility that it had discovered the long sought-after Higgs boson.

Buried 100 meters underground and spanning the border between Switzerland and France, CERN's Large Hadron Collider (LHC) produces an energy concentration high enough to re-create the environment within 0.0000000001 second after the beginning of the universe.

Consisting of a 27-km-long accelerator chain, it is both the largest collider — and machine — on Earth.

China also planned to build a similar scale machine, but instead built a much smaller collider that is running under Beijing and has been contributing to physics research and education for decades.

The collider is housed at the Institute of High-Energy Physics, under the Chinese Academy of Sciences.

"LHC's maximum beam energy is about 3,000 times that of Beijing's collider," Zhang Chuang, a researcher with the institute, says.

The Beijing Electron Positron Collider (BEPC) has a circumference of 240 meters, and a maximum energy of 2.3 GeV, while the maximum energy of LHC is 7 TeV.

"Both GeV and TeV are very small units of energy. When one particle has energy as high as 7 TeV, its energy is equal to a mosquito beating its wings," Zhang says.

"But when you try to accelerate the protons to 7 TeV, it requires a huge machine that consumes a lot of power, and the total energy of 300 trillions protons for the LHC can be compared to that of a 40-ton train running at 150 km/h."

Zhang reveals that Chinese scientists had planned to build a collider like CERN's.

In 1972, 18 scientists wrote a letter to the late premier Zhou Enlai, urging the country to start its own high-energy physics studies.

Although it was during the "cultural revolution" (1966-76) when almost all scientific research was suspended, Zhou responded by saying it "cannot be delayed".

In the following year, the Institute of High Energy Physics was established and scientists started to design a 50 GeV proton synchrotron complex, which is when Zhang Chuang started work at the institute.

"In the late 1970s, when we designed the high energy accelerator, the 'cultural revolution' had just ended and everyone was overconfident about the country's economy," Zhang says.

The storage ring at BEPC, in Beijing.

The initial plan was to build a high-energy accelerator like CERN's, but this proved too expensive and the idea was shelved in 1980.

Then, China's former leader Deng Xiaoping allocated 240 million yuan ($37.5 million) in 1980 to build BEPC.

"It doesn't sound like a huge amount today, but in the early 1980s my monthly salary was only about 100 yuan," Zhang says.

When deciding to build BEPC, Deng explained that he wanted China to "have a place in high technology research".

But China's particle physics development is better than that.

"We are actually leading international research in the special energy region of BEPC — charm physics," Zhang says.

"BEPC is very unique," says Qian Jianming, a professor of physics at the University of Michigan.

"To pursue higher energy is one direction of research, but to pursue higher precision at lower energy levels is also important.

"Colliders at different energy levels can survey different particles, and the energy region of BEPC is rich in charm physics. BEPC has performed measurements with greater precision than any other collider in the world."

Elementary particle physicist Samuel Chao Chung Ting was awarded the Nobel Prize in 1976 for the discovery of the J-particle, which consists of a charm quark and an anti-charm quark, and is in the energy region of BEPC.

"The collider that led to Ting's discovery was closed after BEPC was built because of its lower luminosity, a measure of the particle event production rate," Zhang says.

China invested 640 million yuan to upgrade BEPC in 2009, and invests a further 90 million yuan every year on maintenance.

Cultivating talent is another benefit of the collider, Qian says.

"Undergraduate students can learn a lot from working on the collider, and they will find the skills very useful when they step out of university."

In May 2009, when BEPC started upgrading, a magazine published by Fermi National Accelerator Laboratory in the United States claimed that American scientists were flocking to BEPC to study charm quarks and their kin.

"Like migratory creatures, researchers circle the globe in search of the best data, working on one experiment for several years and then moving on to the next, all in the hope of answering fundamental questions about the way the world works … China's accelerator offers just such an opportunity," the report says.

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The 'fashion front' of high energy physics

Extreme science comes at a cost. CERN's Large Hadron Collider (LHC) was built for about 5 billion Swiss francs ($5 billion).

"LHC is the fashion front of high energy physics and a mission impossible for any single country to accomplish, given the funding, technology and talent it requires," says Zhao Zhengguo, a leading high-energy physicist in China, who has participated in the CERN ATLAS Experiment since 2001.

ATLAS is one of two general-purpose detectors at the LHC, the other is CMS.

"For example, the end cap muon spectrometer, which composes just a small part of ATLAS, converged the efforts of more than 10 countries," Zhao says.

"Some countries are in charge of making the chambers, some produce precision machinery, alignment, microelectronics, etcetera. This project sets a high demand on participating country's industrial technology and the expertise of experts."

Between 1994 and 2008, more than 7,000 scientists from over 80 countries and regions took part in the construction of LHC.

Before LHC was switched on, the Tevatron in the United States was the most powerful collider in the world and in its final years of operation, it raced to catch a first glimpse of the Higgs boson.

Although Tevatron was closed in 2011 due to budget constraints, the scientists involved in that project announced in March they had found evidence of a new fundamental particle that had a mass that fits in with predictions for the Higgs boson and was similar to experimental evidence announced by the Swiss-based scientists in December.

But the role of LHC is likely to be challenged soon. Some 2,000 accelerator and particle physicists, engineers, theorists, technicians, students, software experts and others, from all corners of the world, are working on the design and technologies for the next-generation particle accelerator International Linear Collider.

The project aims to complement LHC and shed more light on the secrets of the universe.

— CHINA DAILY

Equal rights for cyborgs and Mann's new reality

A week ago, the "world's first cyborg" claims he went to McDonald's in Paris for a chicken ranch wrap and was assaulted because the franchise's employees objected to his digital glasses.

Steve Mann, the University of Toronto professor, has been wearing augmented vision computers for the best part of 35 years as part of his research on melding mind and machine.

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While McDonald's insists he was not attacked, photographs taken by his glasses appear to show that they did destroy documentation explaining why he was wearing them and manhandled the glasses, which are fixed to his head and were damaged. No one disputes the fact he was metaphorically kicked out of the restaurant.

While lawyers are no doubt chewing over the facts of the case, the real news is possibly the first case of cyborg bullying and Mann's belief that, "A person should be their own master of their own sensory perception. It's not up to McDonald's to prescribe eyewear in a mandatory fashion" — or, presumably, any other modification that any one of us decides on in the future.

The future has arrived because cybernetic organisms are part of the present. You could argue that Carl "Blade Runner" Pistorius is not really a cyborg and that's why he's allowed to compete in the upcoming Olympics. He certainly does. But what about pacemakers, insulin pumps and hearing aids? C-legs and second generation implants that enable the blind to see?

Or looked at another way: If smart phones enhance our abilities, then if they are part of us, ergo we are enhanced beings, or cyborgs.

Sergey Brin is another forward thinker who has regularly been wearing augmented glasses. In June, the Google co-founder introduced at a developer's conference in San Francisco eyewear that can stream video and sync to the Web wirelessly. The glasses will go on general sale in 2013 and he's hoping the technology will replace smart phones in three or four years.

That's if Internet contact lenses don't arrive first. Imagine, says Michio Kaku in his book *Physics of the Future*, all the information on the Web flowing before your eyes in real time. You meet someone, facial recognition software identifies them, their Wiki entry displays, and if they speak a language you don't understand voice recognition software provides subtitles.

There is a theory that in the long run of evolution the machine is humanity's inheritor, a bit like Arnold Schwarzenegger's *Terminator*. Certainly we are already using augmented reality in war. When Osama bin Laden was shot down in his house in Pakistan, the White House was watching, practically taking part in the action, directing, like a video game.

But there's more to it than that. Not only will we become part of the video game. We will also become part of the environment — through logging on to the Web.

This relates to a newish field of thinking and research called the Internet of Things, a kind of mirrored virtual world, governed by computers and guiding real world services like ordering goods and providing real-time feedback.

At a recent talk hosted by XinDanWei in Shanghai and reported by flamingoshanghai.com, IOT "Council" founder Rob van Kranenberg opined that China is one of the leaders in the field and behind the idea of a "sensing planet".

This means that many more billions of objects in the future will have IPs (Internet Protocols), like computers now. They are already in your smart phone, possibly in your fridge and will become part of your clothing and even your toothbrush, along with sensors, allowing the Net to monitor the environment and your health, among other things.

Search engines based on algorithms like Google are a childlike but massively powerful artificial intelligence, identifying IPs and sorting information, evolving daily and becoming more powerful. This really isn't science fiction, it's science fact.

Once we are modified and linked in with this, we become part of a new reality. More machine than man perhaps.

Not incidentally, another of Steve Mann's areas of expertise is controlling computers with brainwaves. Naturally, this also means computers could control brains.

It looks like McDonald's isn't the only one that will have to deal with Mann's new reality.

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