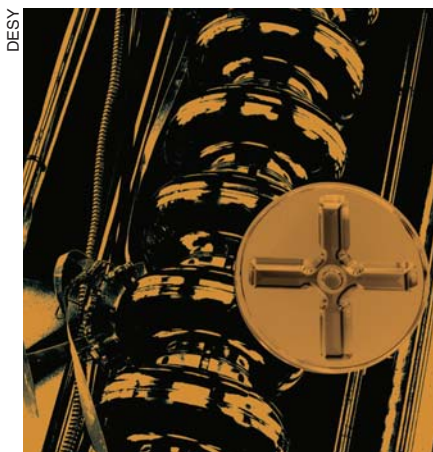


International Linear Collider (ILC); the merged governing body would also be chartered under ICFA.

The ILC, which is distributed among many labs, and the Compact Linear Collider (CLIC), centered at CERN, are both global projects that would smash electrons and positrons into each other at TeV collision energies. The two projects have the same physics goals, says Johns Hopkins University's Jonathan Bagger, who chairs the ICFA steering committee for the ILC. "But they have different technologies, different time scales, different energy extensibility, and different strengths and weaknesses." Ballpark estimates put either machine in the multibillion-dollar range.

For acceleration, the ILC uses high-gradient superconducting RF cavities powered by traditional klystrons, whereas CLIC relies on a novel dual-beam, room-temperature method in which energy is extracted from an intense beam of low-energy electrons to accelerate less-intense, higher-energy parallel beams of electrons and positrons. CLIC has the potential to get to about three times the energy for a given accelerator length, but technical development for the ILC is further along than for CLIC.

Steinar Stapnes, the CERN physicist who heads CLIC, expects some challenges in tightening the collaboration between the two projects. "It's a mixture of personalities, tradition, and work style. There is a long history of people being more committed to one project or the other." Still, he says, "It is hard to agree on a way forward, but it's impossible if we operate as two communities." Says Fermilab director Pier Oddone, "If we have one voice to speak to the world, and we choose one direction rather than have the two projects duke it out, we are much more likely to



**The closer rubbing of shoulders** between the two linear collider collaborations is evidenced by this image from a poster for an upcoming conference. The International Linear Collider is illustrated by a superconducting RF cavity (bulging pipe), while the Compact Linear Collider uses stacks of copper disks (inset) in a novel acceleration mechanism.

succeed and ultimately come up with a proposal that makes sense."

Last year the Large Hadron Collider (LHC) observed hints near 125 GeV of what might be the Higgs boson, the sought-after particle that in the standard model endows mass to the fundamental particles (see *PHYSICS TODAY*, February 2012, page 16). More definitive data from the LHC—expected in the coming months—will be key to choosing between the ILC and CLIC. The question is, says CERN director general Rolf Heuer, "What is needed to get to the desired physics? If you only want to make a Higgs factory, it could well be the ILC today." But to study such things as supersymmetry, he notes, "you may need to wait for the

LHC at full energy to know what ultimate energy and luminosity you want to reach." The LHC is scheduled to start running at its full collision energy of 13–14 TeV in late 2014. "Before we commit to construction of [either future] facility," says Stapnes, "we should make sure that it's an ambitious enough machine and expandable enough to cover the physics that will emerge."

## Acceleration in Japan

European money for high-energy physics is largely tied up in the LHC for the next decade. President Obama's proposed fiscal year 2013 budget zeroes out funding for linear collider R&D. In Japan, meanwhile, efforts are getting started to try to build the ILC as the core of an international "science city" that could be part of rebuilding the northeastern area that was devastated by the tsunami, earthquake, and nuclear meltdown last year. The idea has been around since before the disaster, but now the hope is to fund a linear collider as part of the broader recovery plan.

The science city initiative is driven by scientists and local municipalities. "But the prime minister has announced that he is supportive of accelerator science and supports this project," notes Tohoku University physicist Hitoshi Yamamoto, who chairs an ILC study group that consists of representatives from universities, prefecture governments, and industry. Says Heuer, "If there is a region which wants to carry most of the funding, and there is a good physics case, then we should do it."

"For years we have been saying, 'When we have the LHC results, we will know the next step,'" says Bagger. "That has allowed us great freedom to dream about what to build. The real excitement is what is going on in physics."

**Toni Feder**

## White House seeks to get a handle on "big data"

Scientific enterprise is "drowning in data but starving for understanding."

Five federal science and technology agencies announced plans to spend more than \$200 million in total to develop new tools and techniques to process and analyze huge volumes of digital data. The initial cadre of "big data" R&D participants are the Department of Energy, NSF, the Department of Defense and its Defense Advanced Research Projects Agency (DARPA), the National Institutes of Health, and the

US Geological Survey (USGS).

Presidential science adviser John Holdren said the initiative, announced on 29 March, responds to criticism from the President's Council of Advisors on Science and Technology that the government has been underinvesting in technologies needed to collect, store, preserve, manage, analyze, and share large quantities of data. The world is now generating  $10^{21}$  bytes of data each

year, and the volume is growing rapidly, Holdren said. The data are generated from such diverse sources as remote sensors, online retail transactions, text messages, email, video messages, computers running large-scale simulations, and scientific instruments, including particle accelerators and telescopes. Big data, Holdren said, "are critical to accelerating the pace of discovery in many different domains of science and engineering."

William Brinkman, director of DOE's Office of Science, said experi-



**The evolution of Hurricane Katrina.** This simulation was generated by researchers in the Advanced Visualization Laboratory at the NSF-funded National Center for Supercomputing Applications. The AVL team transformed terabytes of data into an animation of the 36-hour period when the storm gained energy over the warm waters of the Gulf of Mexico and headed toward New Orleans.

ments at the Large Hadron Collider generate terabytes of data each second, and a climate-model simulation produces 10 terabytes a day. As part of the data initiative, DOE announced a \$25 million, four-year award to a national laboratory–university consortium led by Lawrence Berkeley National Laboratory. The goal is to establish a scalable data management, analysis, and visualization institute to assist researchers in using the latest software tools to analyze the data generated by the labs' high-performance computers.

A joint solicitation announced by NSF and NIH is aimed at advancing the core scientific and technological means for managing, analyzing, visualizing, and extracting useful information from large and diverse data sets. Grants will be awarded for research on new algorithms, statistical methods, technologies and tools for improved data collection and management, data analysis, and e-science collaboration environments. NSF also announced a \$10 million grant to the University of California, Berkeley, researchers who are developing novel data-center programming models, improved computational infrastructure, and new scalable machine-learning algorithms and data management tools for handling large-scale heterogeneous data sets. The NSF National Center for Supercomputing Applications, at the University of Illinois at Urbana-Champaign, is home to one of the most powerful supercomputers in the world, and it just granted access to researchers a few weeks ago, noted NSF director Subra Suresh.

The NIH announced that it is making its 1000 Genomes Project, the world's largest collection of data on human genetic variation, available for free on a cloud operated by

Amazon.com. At 200 terabytes, that data printed out would fill 16 million file cabinets, said NIH director Francis Collins. The project has collected a data set so large that few researchers have the computing power needed to make use of it.

The Pentagon "is placing a big bet on big data," said Zachary Lemnios, assistant secretary of defense research and engineering. The \$60 million of new research funding just announced brings DOD spending on big data R&D to \$250 million annually. Some of the funding will be devoted to open prize competitions (see *PHYSICS TODAY*, November 2010, page 21) to be announced in the months ahead, Lemnios said. One DOD goal is to enable "truly autonomous systems that go well beyond tethered joysticks. These systems will be agile, they will maneuver and understand their environment, they will make decisions by themselves, and [they will] also know when to call upon a human," he said. Ken Gabriel, acting director of DARPA, said that agency will devote \$25 million a year for four years to developing computational techniques and software tools to sort through mountains of internet traffic looking for terrorist threats. Gabriel likened the quest to searching for a 55-gallon drum in the Atlantic Ocean.

"We are drowning in data but starving for understanding," said USGS director Marcia McNutt. The agency's John Wesley Powell Center for Analysis and Synthesis announced the award of eight new research projects for transforming big data sets and big ideas about Earth science theories into scientific discoveries.

Holdren promised that other federal agencies would have additional announcements about big data in the



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## issues and events

months ahead. He invited industry and universities to participate and said the effort is “not something the government can or wants to do by itself.”

A White House fact sheet ([http://www.whitehouse.gov/sites/default/files/](http://www.whitehouse.gov/sites/default/files/microsites/ostp/big_data_fact_sheet_final_1.pdf)

[microsites/ostp/big\\_data\\_fact\\_sheet\\_final\\_1.pdf](http://www.whitehouse.gov/sites/default/files/microsites/ostp/big_data_fact_sheet_final_1.pdf)) lists dozens of ongoing federal programs that address challenges and opportunities afforded by big data in support of agency missions and science and innovation. **David Kramer**

## news notes

**Budget squeezes neutrinos.** It's back to the drawing board for the Long-Baseline Neutrino Experiment (LBNE). In March the Department of Energy made clear that under current budget constraints it can't pony up \$1.5 billion for Fermilab's future flagship project.

The LBNE would shoot intense beams of neutrinos from Fermilab to a detector deep in South Dakota's Homestake gold mine. By observing changes in neutrino flavor occurring during the nearly 1300-km journey, scientists want to look for *CP* violation and hope to gain insight into the universe's disparity between matter and antimatter (see page 13 of this issue).

On 19 March William Brinkman, director of DOE's Office of Science, wrote to Fermilab director Pier Oddone asking that the lab “lead the development of an affordable and phased approach that will enable important science results at each phase. Alternative configurations to LBNE should also be considered.”

“Ideally we will preserve the opportunity to do the full-scope experiment in phases,” says Oddone. “But it re-

mains to be seen what we can stitch together.” Although a cost cap “has not yet been discussed,” Oddone says he's aiming to reduce the tab by half or more for the first phase of the project. “We should have a new path forward in June,” he says. **TF**

**Magnetic record.** A pulsed magnet at Los Alamos National Laboratory exceeded the coveted 100-tesla mark on 22 March. “This is our Moon shot. We've worked toward this for a decade and a half,” says Charles Mielke, director of the pulsed branch of the US National High Magnetic Field Laboratory.

Last summer the Los Alamos facility achieved 97.4 T (see *PHYSICS TODAY*, November 2011, page 25). The new high was reached by changing the waveform of the input current, says Mielke.

Higher fields have been reached, but only in magnets that self-destruct in the process. Strong magnetic fields are used to probe, for example, superconducting materials, topological insulators, and the quantum behavior of phase transitions in solids. **TF ■**

## Recently on **physics today** online...

### ► Bookends

Books editor Jerney Matthews interviews Duke University biologist Sönke Johnsen (shown here) about his new book *The Optics of Life: A Biologist's Guide to Light in Nature* (Princeton University Press, 2012).



### ► Singularities

“Capacity building for industrial physics in developing and emerging economies” was the topic of this year's Industrial Physics Forum, which was held over three days last month at the Abdus Salam International Centre for Theoretical Physics in Trieste, Italy. Look in the Singularities department for reports of each day's talks.



### ◀ The Dayside

In his blog, *PHYSICS TODAY's* online editor Charles Day writes about careers in manufacturing, the violent formation of solar systems, the energy cost of barefoot running, and the need for a new social medium to promote science.

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