AROUND THE WORLD

Doing the cryomodule shuffle

Fermilab completes CM1 run, soon to install CM2

by Leah Hesla

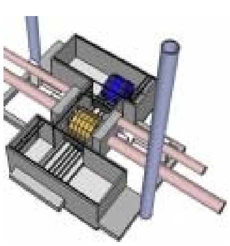
Out with the old, in with the new! Having completed a successful run of tests on Cryomodule 1, Fermilab researchers remove it from its current home and install Cryomodule 2. The new device's components have shown promise, and with the experience from the earlier cryomodule brought to bear on the next, the team hopes to realise the ILC gradient goals at Fermilab before long.

RESEARCH DIRECTOR'S REPORT

Building a home for the ILC detectors

This month's Research Director's Report was written by Karsten Büßer (DESY), Convener of the Machine-Detector Interface Common Task Group

by Karsten Büßer



The ILC detectors have found a home - at least on paper and if they are not to be built in a mountainous region. The process of designing the caverns for the ILC's future detectors centres on optimising space usage and making the system as efficient as possible.

DIRECTOR'S CORNER

The role of professional societies

by Barry Barish

Most of us belong to a professional society that serves many of our professional needs throughout our career as practicing scientists. I have belonged to the American Physical Society since I was a graduate student in Berkeley, and last year I had the privilege of serving as APS President for 2011. It has become customary for each outgoing President to summarise his or her presidential year for APS, and I repeat my summary in order to give a picture of the activities of such a professional society.

IMAGE OF THE WEEK

New bison at Fermilab

Image: Cindy Arnold

Two new male bison, or bulls, were delivered to Fermilab earlier this month. New bulls are rotated into the Fermilab herd every few years. Read more about it in *Fermilab Today*.

IN THE NEWS

from ***Nature News Blog***
18 April 2012
IceCube chills cosmic ray theories
IceCube, an ice-bound telescope that looks for neutrinos rather than photons, has cast doubt on the long-held assumption that gamma-ray bursts are responsible for the highest-energy cosmic rays that rocket around the Universe.

from ***Nature***
18 April 2012
Particle physics: A matter of detail
Yet neutrino speed is still a prime focus for the MINOS physicists, who are carrying out their own high-precision measurement — not least because they did not do this when they saw hints of a faster-than-light neutrino in their own data some years ago.

from ***The Daily Yomiuri***
16 April 2012
REVITALIZING JAPAN–Creative use of land / Universities key to regional growth
Meanwhile, Kyushu and Saga universities, along with the Fukuoka and Saga prefectural governments and others, are developing the idea of attracting a huge experimental facility and establishing an international research town to lure several thousand researchers to come and live from around the world. What they are trying to attract is the International Linear Collider.

from ***BBC News***
13 April 2012
Majorana particle glimpsed in lab
The Majorana fermion was first predicted 75 years ago – a particle that could be its own anti-particle. Now Dutch researchers, who have devised some exotic and minute circuitry to test for the Majorana's existence, believe their results show the fermion to be real.

from ***Interactions***
12 April 2012
"Cosmic Mirages" Confirm Accelerated Cosmic Expansion
An international team of researchers led by Masamune Oguri at Kavli IPMU and Naohisa Inada at Nara National College of Technology conduced an unprecedented survey of gravitationally lensed quasars, and used it to measure the expansion history of the universe. The result provides strong evidence that the expansion of the universe is accelerating.

from ***Physics World***
12 April 2012
Linear-collider teams join in rivalry
Two teams developing rival designs for an international linear collider will continue with their own separate blueprints – even though both teams are joining forces at the organizational level.

from ***symmetry breaking***
11 April 2012
Two proposed linear collider programs to be joined under new governance
The world's two most mature proposals for a collider complementary to the Large Hadron Collider are joining collaborative forces.

CALENDAR

UPCOMING EVENTS

Joint ACFA Physics and Detector Workshop and GDE meeting on Linear Collider (KILC12)
Daegu, Korea
23- 26 April 2012

FCAL Workshop
DESY, Zeuthen
07- 09 May 2012

ILD Workshop 2012
Kyushu University, Fukuoka, Japan
23- 25 May 2012

15th International Conference on Calorimetry in High Energy Physics (CALOR 2012)
Santa Fe, New Mexico
04- 08 June 2012

UPCOMING SCHOOLS

The 2012 European School of High-Energy Physics
Anjou, France
06- 19 June 2012

View complete calendar

PREPRINTS

ARXIV PREPRINTS

1204.4001
Heavy Scalar Tau Decays in the Complex MSSM: A Full One-Loop Analysis

1204.2910
Studies of Vertex Tracking with SOI Pixel Sensors for Future Lepton Colliders

NIMA ARTICLE

679 (2012) 67-81
Design of an 18 MW vortex flow water beam dump for 500 GeV electrons/positrons of an international linear collider
(Subscription required)

AROUND THE WORLD

Doing the cryomodule shuffle

Fermilab completes CM1 run, soon to install CM2

Leah Hesla | 19 April 2012

Cryomodule 2 in the Fermilab Industrial Center Building. Image: Reidar Hahn

Fermilab researchers will soon take a quantum step towards the realisation of an ILC-type cryomodule.

Next week the newly assembled cryomodule RFCA002, familiarly referred to as CM2, will replace CM1 in the Advanced Superconducting Test Accelerator at the laboratory's NML test facility. The change-out is a rung up on the R&D ladder, and not only because it is the second eight-cavity cryomodule to come out of the laboratory. Far more than the first, CM2 resembles an ILC-type cryomodule in its components and cavity test performance.

"The hope for CM2 is that it will be the first cryomodule to reach the average ILC specification gradient at Fermilab," said lead engineer Tug Arkan. The so-called S1 goal of the ILC programme is to achieve an average gradient of 31.5 megavolts per metre over eight metre-long cavities. "That's the goal to demonstrate. We haven't yet proved it at Fermilab."

But they came teasingly close to a different goal. Prior to their being installed in CM2, six of its cavities individually reached or exceeded the ILC specification of 35 MV/m in their horizontal tests. Two fell just shy of the mark, achieving 33 MV/m. (One of these did not receive a final horizontal test after it achieved 36 MV/m in a vertical test, a result of additional surface processing conducted after an earlier poor horizontal test.) Practically speaking, CM2 components are up to ILC standards so far.

"That's the vital thing," said Elvin Harms, who leads the cryomodule commissioning and testing programme. "This is an ILC cryomodule."

The high cavity performance brings the S1 goal that much more within reach. And with 15 months of lessons learned from operating CM1, the CM2 team has plenty of accumulated expertise to draw from.

"Running CM1 was a great opportunity to cut our teeth on operating a multi-cavity cryomodule," Harms said. "The run was satisfying and very instructive for the whole team. We did all the measurements we set out to do, and have done a lot not just with the device itself, but also commissioned all the subsystems that are necessary for safe and reliable operation."

Although demonstrating its operability and measuring its performance parameters have been the prime goals since CM1 was installed in 2010, Lorentz force detuning compensation has been demonstrated to a level considered by many to be the world standard. And, in a nice case of one R&D programme helping to support another, the team used CM1 to provide proof of principle that the nine-millisecond beam pulse required by the proposed Project X proton accelerator was feasible. Further, as an unscheduled activity, the team even nailed down and fixed a nitrogen leak without having to pull out the cryomodule, which itself proved to be a valuable learning experience.

Once CM1 is uninstalled, the Fermilab team will conduct a post-mortem to identify weak points in its operation. Three of the cavities underperformed, and one of the tuners stopped working almost before it started.

Researchers hope to be able to more readily assess CM2's performance, as they'll enjoy the advantage of having all of its data at their fingertips. Unlike CM1, which was assembled from a DESY kit and with the help of DESY and INFN staff, CM2 is home-grown. Though many of its components were purchased from Europe, US personnel put it together. Moreover, all eight of its cavities were processed and tested at Fermilab and Jefferson Lab.

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These recordings were made as part of CM1 Lorentz force detuning compensation work. When radiofrequency power is applied to CM1, cavity 4, it begins to vibrate because of pressure from the electromagnetic field. The vibration waveform is captured by a piezoelectric sensor connected to the beam flange of the cavity.

Download mp3

Cavity 5 is not powered, but is mechanically in contact with cavity 4 (sound file above), so it still vibrates. Files courtesy of Warren Schappert and Yuriy Pischalnikov.

The high-gradient cavities aren't the only components that nudge CM2 towards being an ILC type. Its tuners, designed by INFN in Italy, will replace the kind used in CM1. They will be moved from the ends of the cavities, where they sat in CM1, to the cavities' centres.

CM2 will first undergo warm tests. It will then be cooled down, at which point it will be put through cold tests and, with some good fortune, by early 2013, tests with beam.

For the RF systems, beam opens up a whole new dynamic. Beams consume power and the low-level system has to compensate while remaining stable.

"Let's hope the average gradient of this cryomodule runs at 31.5. Is it a realistic hope?" Arkan asked. "It's not an easy task, but we're trying everything in our power to do it. Now we test and see what's going to happen."

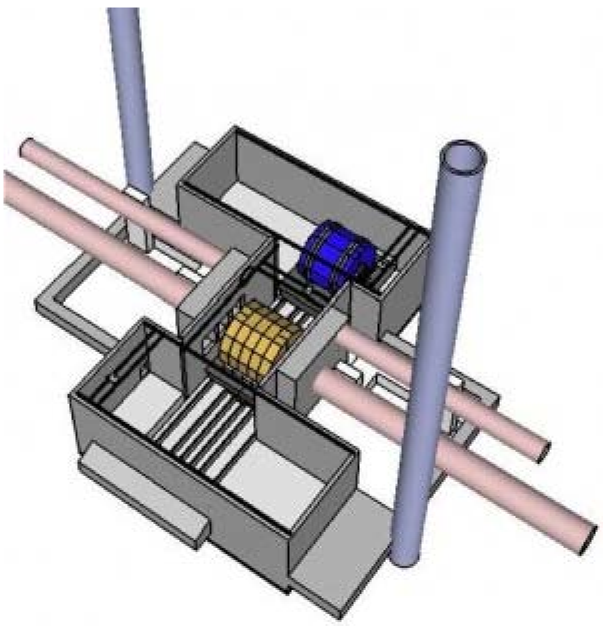
CM1 | CM2 | CRYOMODULE | FERMILAB | SRF CRYOMODULE

RESEARCH DIRECTOR'S REPORT

Building a home for the ILC detectors

This month's Research Director's Report was written by Karsten Büßer (DESY), Convener of the Machine-Detector Interface Common Task Group

Karsten Büßer | 19 April 2012



Layout of the ILC detector cavern for the American region. The detectors push and pull into the common interaction region on platforms. The parking areas need to offer sufficient space to open and service the detectors. (Source: T. Lackowski)

If you are planning to build a home for your family, there is an important ingredient that you will need: translucent paper. Sooner or later in the planning stage, you will have the first blueprints from your architect, and if you are lucky, they already represent to a large fraction what you imagined your new home would be. But then you start to have a closer look and you start to optimise. What would happen if this wall would be shifted somewhat? Or will your new cupboard really fit into that niche? Then the translucent paper comes into play. You put it over the original drawings and you copy them. On the copies you do all the changes that you think are needed. In addition you would probably cut out forms out of an additional sheet of paper that represent scaled versions of your furniture and you test how you would arrange that in the new rooms. OK, you might have noticed that I used to do these things the old-fashioned way. Nowadays I am sure there is an app that would help you with this process.

But in the end, it is an optimisation process that you need to do. You have to check your requirements and you have to take the hard boundary conditions into account: maybe geological reasons forbid you to build a house with a cellar. Or maybe official regulations tell you what shape the roof of your new house has to have. And in the end comes the decisive boundary: your budget. In addition, it is a collaborative process – at least in most cases. Surely your family has a word to say in the creation of the new home.

Designing an experimental environment for the ILC detectors is in certain points rather similar. The underground and surface buildings at the interaction point need to be optimised to accommodate the detectors so that they can be assembled, operated, and maintained with highest efficiency. The requirement for efficiency is probably one of the biggest differences between the design of an underground experimental hall and a family home. Building the ILC binds so many resources that we cannot afford to waste money, time or integrated luminosity.

The underground experimental halls are in the focus of the collaborative efforts between both ILC detector concepts, SiD and ILD, the Machine-Detector Interface Common Task Group, the Beam Delivery System Group and the Conventional Facilities Group. These halls are the most complex underground buildings in the ILC and therefore need to be scrutinised for efficiency. The design of the experimental hall shown in the *Reference Design Report* was simplified and not optimised to the operation of the two detectors in the push-pull system. The basic functional requirements of the interaction region had been agreed upon in 2009, but only the following R&D studies on all relevant issues of the push-pull system, the evolving detector design and the better understanding of the requirements triggered an optimisation process that has been discussed at many real and virtual meetings. A major milestone was the agreement in early 2011 that for the push-pull system the detectors should be placed on big concrete movable platforms. Experience from existing high-energy physics experiments, for example DESY's HERA detectors, and detectors at SLAC, KEK and of course CERN's LHC, was very helpful. Joint CLIC-ILC studies on geological issues and on a detailed design for the platform based push-pull system have been exploited.

The design of the underground hall for the non-mountain sites of the ILC, such as the American or the European sites, is now rather advanced. A common layout of the cavern has been agreed upon and should be part of the ILC baseline in the *Technical Design Report* (see figure above). This design relies on the fact that the detectors would be mainly assembled in surface buildings, similar to what was done for CMS at the LHC. The big pre-assembled detector parts would then be lowered through a big vertical shaft into the experimental cavern (see photo below).

The focus of the work is now on the specifications of the mountain sites for the ILC that are under study in Japan. These sites would not allow for vertical access via shafts, but the experimental hall would be reached by horizontal access tunnels of about 1 kilometre in length. A modified detector assembly scheme needs to be followed under these conditions as the transport capacity in the access tunnel limits the mass and size of the parts. In consequence, enough underground space needs to be provided to allow for the assembly of the detectors out of these smaller parts.

Lowering of the CMS parts into the experimental cavern. The ILC detectors are of similar size. Image: CERN

It is clear that this kind of design work cannot be done with translucent paper anymore. The bases of these evaluations are the 3-D CAD models of the detectors and the underground halls that are organised in the ILC engineering document management system. But the basic principles are the same: how does the equipment fit into the available space and how do we keep the requirements while optimising the system to high efficiency? The upcoming KILC12 workshop will be an important step on the way to find the final underground hall design for the TDR.

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DIRECTOR'S CORNER

The role of professional societies

Barry Barish | 19 April 2012

The American Physical Society can look back on a good 2011.

The breadth of activities carried out by professional societies is truly impressive, from publishing and organising conferences to affecting physics education, science policy and public outreach. Most of us belong to a professional society that serves as a professional home in our county. I have belonged to the American Physical Society since I was a graduate student in Berkeley, and last year I had the privilege of serving as APS President for 2011. It has become customary for each outgoing APS President to summarise his or her presidential year for APS and I repeat my summary below.

APS President, 2011

Last year was a very good one for the APS. Our core activities have continued at a high level; our journals continue to be the leading journals in the world and our major meetings are well attended and have exciting scientific programs. The APS finances and membership are stable and growing; our programs in outreach, education, government relations and science policy are thriving. Overall, we can be proud that the APS is serving physics and the physics community very well.

Nevertheless, the future presents us with new challenges, and to meet them we are in the process of developing a new strategic plan for the APS. This plan will be brought to the broader membership in the coming months and will serve as a roadmap for the coming few years.

New programs or changes in emphasis for a large organization like the APS generally take longer than one presidential year. Therefore, an absolutely crucial aspect of successfully evolving the APS for the future is for the entire presidential-line and APS operating officers to work together on a set of common goals, and over a period of years. The strategic plan will formalize our goals for the next few years, but in fact, some important new initiatives are already under way.

Expansion of APS Ridge publishing headquarters. Image: APS.

Publishing is the largest APS activity, and, despite the rapid conversion to electronic publishing, we have outgrown the current editorial offices in Ridge, New York, as the journals have continued to expand. Based on projections of future space needs and after investigating possible options, we have decided to add a second story to the Ridge facility. The Executive Board and Council approved this expansion. We have developed an attractive design, employed an experienced contractor, and are now completing the last formalities, before beginning construction. The new Ridge facility should be completed by summer of 2013.

Another long-term issue that faces scientific publishing is how to approach the movement toward "open-access" journals. This is a very fluid situation and one where we must take the lead in order to ensure that whatever changes are instituted, we maintain the high quality of our journals and that they remain financially viable. We have taken an important step during the past year by introducing Physical Review X, a new online-only, open-access, author-pays interdisciplinary physics journal. We have appointed *an outstanding editorial board for PRX and have established high standards for accepted articles. We are also in discussion with funding agencies, universities and other publishers about possibly carrying out a joint pilot program in open access, in order to gain more experience.*

The second largest APS activity is our very successful set of scientific meetings. Again, looking toward the future, we plan to reevaluate the entire suite of meetings, as well as to modernize them by employing modern tools to post and/or live stream talks. We performed a pilot test program at the April meeting last spring, electronically posting talks from plenary sessions. The number of hits and downloads of those talks impressively demonstrated how this will extend the reach and importance of our meetings.

We are responding to the realization that we have a growing membership living outside the US, now over 20 percent. One step to serve this constituency better has been to increase non-US resident membership serving on the APS Council. Now we are working to increase the number of non-US resident participation serving on our standing APS committees. We are considering a variety of other ways to serve international members, for example in forming partnerships with foreign physical societies and holding meetings outside the US.

There is much more that I could report on the activities from last year, but I will end on a personal note. As a young physics graduate student I joined the APS and gave my first oral presentation at what was then the New York meeting. Throughout my career in physics, the APS served as my professional home and, in addition to presenting and publishing my research, it has provided me with opportunities to grow by participating in its broader activities. APS has served me well, and I am very happy to have had the opportunity to contribute to APS by serving as its President for 2011.

APS | EDUCATION | OUTREACH | PHYSICAL SOCIETY | SCIENCE POLICY