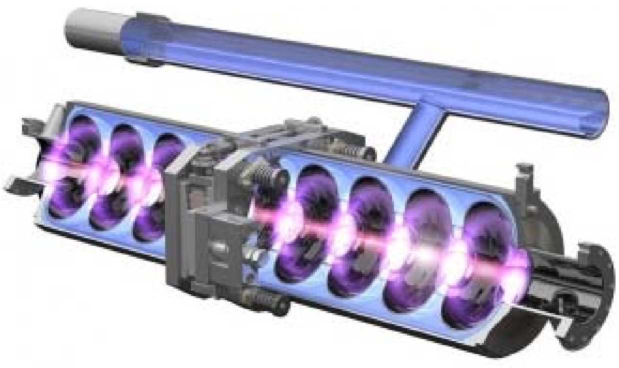
ilc newsline

9 AUGUST 2012

LCPEDIA



Superconducting radio-frequency

by Daisy Yuhas

In our new series LCpedia, *ILC NewsLine* deconstructs the ILC – with words. The technical terms that float around on slides, in conversations and the future *Technical Design Report* are explained here, short and sweet. We start the series with superconducting radio-frequency, or SCRF.

AROUND THE WORLD

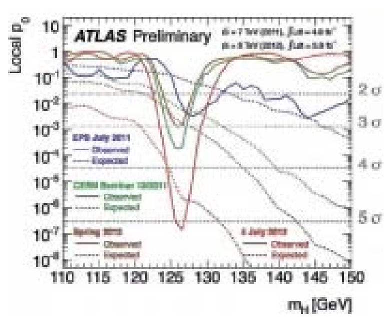
Update on SRF and NML

The development of the superconducting 1.3-GHz radio-frequency test facility at NML, which would comprise three cryomodules and an electron beam to test them, suffered a setback earlier this year with the zeroing out of funds for the International Linear Collider. NML will continue to operate as a cryomodule test facility despite the zeroing out of ILC funds, explains Fermilab Director Pier Oddone in his 31-July Director's Corner.

DIRECTOR'S CORNER

Higgs search presentations at ICHEP 2012

by Barry Barish



Last month, both LHC experiments at CERN announced the discovery of a new particle with mass of 125.5 GeV, which is likely the long-sought Higgs boson. It made headlines worldwide. This is indeed an exciting moment for particle physicists and it came just prior to our largest scientific meeting, the biannual International Conference on High Energy Physics ICHEP held in Melbourne, Australia. In Melbourne, the detailed and impressive scientific evidence was presented to the worldwide particle physics community.

IN THE NEWS

from ***The New York Times***
6 August 2012
After Particle Search, Some Wallets May Lose Mass
When physicists at CERN reported on July 4 that they had discovered a new particle resembling the long-sought Higgs boson, it prompted a worldwide celebration of pride and mystification.

from ***physicsworld.com***
6 August 2012
Physicists unveil plans for 'LEP3' collider at CERN
LEP3 is designed to be installed in the LHC tunnel and serve the two LHC's general-purpose detectors – ATLAS and CMS. If LEP3 is to be built, it will have to fight off two rival proposals for a future collider to study the Higgs – the International Linear Collider (ILC) and the Compact Linear Collider (CLIC).

from ***The Beacon-News***
2 August 2012
Fermilab director Oddone announces plan to retire next year
BATAVIA — Pier Oddone will retire next year after eight years as executive director of Fermi National Accelerator Laboratory, the lab announced Thursday.

from ***DESY***
31 July 2012
A century of discoveries – Physicists celebrate centenary of the discovery of cosmic rays
Anniversary conference looks at future experiments

CALENDAR

UPCOMING EVENTS

SiD Workshop
SLAC
21- 23 August 2012

6th International Workshop on Semiconductor Pixel Detectors for Particles and Imaging (PIXEL2012)
Inawashiro, Japan
03- 07 September 2012

POSIPOL 2012
DESY, Zeuthen
04- 06 September 2012

XXVI International Linear Accelerator Conference (LINAC 12)

Tel-Aviv, Israel
09- 14 September 2012

CERN Council Open Symposium on European Strategy for Particle Physics
Crakow, Poland
10- 13 September 2012

12th International Workshop on Accelerator Alignment (IWAA 2012)
Fermilab
10- 14 September 2012

CALICE collaboration meeting
Emmanuel College, Cambridge, UK
16- 19 September 2012

5th International Workshop on Top Quark Physics (TOP 2012)
Winchester, UK
16- 21 September 2012

52nd ICFA Advanced Beam Dynamics Workshop on High-Intensity and High-Brightness Hadron Beams
Beijing, China
17- 21 September 2012

View complete calendar

PREPRINTS

ARXIV PREPRINTS

1208.1018
High-energy suppression of the Higgsstrahlung cross-section in the Minimal Composite Higgs Model

1208.0504
LEP3: A High Luminosity e+e- Collider to study the Higgs Boson

1208.0251
R&D Paths of Pixel Detectors for Vertex Tracking and Radiation Imaging

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Superconducting radio-frequency

Daisy Yuhas | 9 August 2012

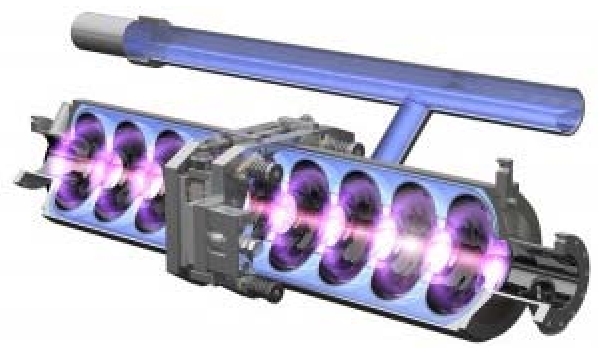

Image: Rey.Hori

How do you accelerate particles in a particle collider? One answer is superconducting radio-frequency (SCRF) cavities. To give particles energy as they move through an accelerator, physicists use cavities containing electric fields that oscillate. The changes in electric field help push the particles from one cavity to the next. These oscillations occur with the same frequency as radio waves, which is why this form of acceleration is called radio-frequency.

Superconducting refers to the way in which electric current is carried through these accelerating cavities. Electric current in a cavity may create friction—unless the cavity is created using special metals called superconductors. “Some metals have no resistance below a critical temperature,” says Fermilab scientist Camille Ginsburg. This means that these metals conduct electricity perfectly. Even in a superconductor, if electric current passing through a cavity encounters any bumps or impurities, the flow of electricity is interrupted and energy can be lost as heat. This is why cavities must be very clean and polished to a smooth finish. In proposed accelerators such as the ILC, the metal used is niobium, which becomes superconducting at temperatures below 9.2 Kelvin (-264°C). Keeping cool isn’t easy, however. To do this, each cavity is kept in a large thermos structure holding frigid liquid helium, typically at 2 Kelvin (-271°C).

There are a number of benefits to SCRF, explains Ginsburg. Among the most important are energy-efficient operation and a shorter accelerator than is achievable with conventional room temperature cavities.

SCRF

Update on SRF and NML

Fermilab Director
Pier Oddone

The development of the superconducting 1.3-GHz radio-frequency test facility at NML, which would comprise three cryomodules and an electron beam to test them, suffered a setback earlier this year with the zeroing out of funds for the International Linear Collider. The U.S. ILC R&D program will end in June 2013 when the worldwide Global Design Effort completes their technical design report and thus its mission. As I explain in more detail below, while NML will continue to operate as a cryomodule test facility despite the zeroing out of ILC funds, it can also support a broader program in advanced accelerator R&D. The laboratory is committed to pursuing all avenues that will allow us to complete this program.

While the ILC was the principal motivation to create a test facility at NML it was quickly recognized that the facility could provide enduring value for a much broader scope of accelerator R&D that would benefit our laboratory, other national and international laboratories and broader society. NML will continue to operate as a test facility for Project X pulsed linac cryomodules and will increase our ability to be of service across the national laboratory system by developing superconducting linacs such as the one required by the proposed Next Generation Light Source at Lawrence Berkeley National Laboratory.

NML can also support a very strong program of advanced accelerator R&D for scientific research purposes and industrial and medical applications. Fermilab is actively pursuing avenues of support for this broader program. The test facility at NML will be an important element of Fermilab's ability to contribute to the use of accelerator technology in industrial applications once we open the Illinois Accelerator Research Center, which will be a portal into Fermilab facilities for our collaborators.

The superconducting radio-frequency technology and advanced accelerator R&D programs at Fermilab are, of course, much broader than the activities at NML. The development of SRF components for Project X in collaboration with Indian institutions remains a high priority. We want to be fully ready for Project X later in the decade, with all components prototyped before the start of construction. Furthermore, if a global facility such as the International Linear Collider develops to study the Higgs boson, we want to be ready to make important contributions. The efforts of Fermilab in the last few years have brought us to a leading position in the world of SRF. We are committed to continue the development of the technology both for particle physics research and in support of the broader DOE mission.

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DIRECTOR'S CORNER

Higgs search presentations at ICHEP 2012

Barry Barish | 9 August 2012

Richard Hawkings and Joseph Incandela presenting evidence at Melbourne from ATLAS and CMS for the discovery of a Higgs-like particle at LHC

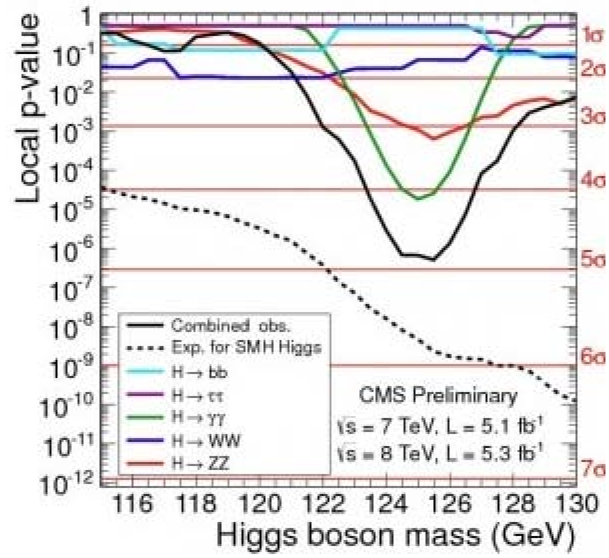
One of the most rewarding features of physics research is the constant interplay between theory and experiment. The job of a physicist is to describe the physical world, and to advance our understanding of the laws of nature. Our science moves forward by the combination of experimentalists making observations that must be explained by theory, and theorists putting forward theoretical predictions that must be tested by experiment. The Standard Model of particle physics has been the centerpiece of our field for nearly 50 years. It has proven to be remarkably successful in describing the very large array of new measurements that have been carried out over the subsequent decades. Nevertheless, one feature of the Standard Model, the mechanism for generating mass, has yet to be confirmed and consequently has become the primary initial goal of the LHC. Peter Higgs first put forward the most accepted explanation for the generation of mass, based on electroweak symmetry breaking. Last month, we were presented with possible confirmation of this idea through evidence for what appears likely to be the first observation of the Higgs boson!

The searches for the Higgs, first at Fermilab, and then more sensitively at CERN's LHC have systematically ruled out wide ranges of mass. Low masses up to a little more than a 100 GeV were ruled out early, and more recently LHC results have ruled out much of the region up to 500 GeV. The non-excluded regions are at relatively low Higgs mass, and therefore those energies have become the primary focus of the search. Results presented in December 2011 from both LHC experiments showing interesting hints of a signal near 125 GeV. However, they did not yet have the statistical significance to declare a discovery. The signature being sought was an excess of events that would result from the presence of a Higgs boson. Although both experiments saw indications, more data was required to reduce the probability of a statistical fluctuation to a very small probability. To declare a discovery, it has become customary in physics and astronomy to require observations having at least a "five-sigma signal," which is where the probability of being fooled by a statistical fluctuation becomes less than one chance in two million.

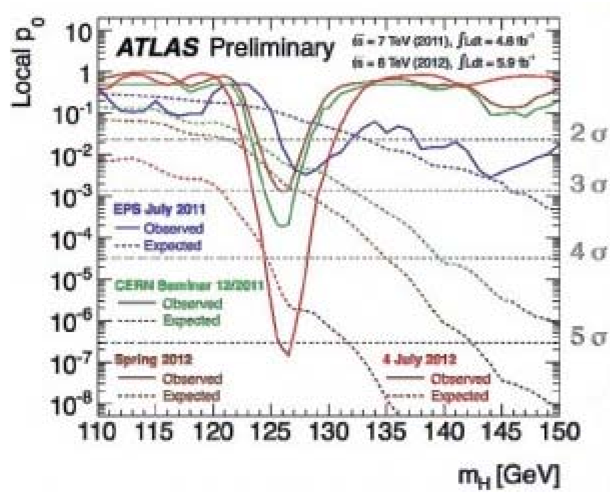
In addition to the statistical significance of the result, confidence that a real signal has been observed is greatly increased because it is reported from two independent experiments, having complementary technical capabilities, different teams of physicists, and separate and independent data analyses. Finally, care has been taken in both experiments to eliminate human bias by performing what is called a 'blind' analysis, where the answer is only revealed after the analysis has been completed and finalised. The presentations at Melbourne make a very convincing case that a Higgs-like particle has been discovered. The whole process, from the operation of the accelerator, the technical understanding of the detectors, and the detailed data analysis leave little question that it is a new particle!

The Higgs-like particle discovery is tremendously exciting for particle physicists, but it is only the first step in what will undoubtedly become a major thrust of the field. The first objective is to determine whether what has been observed is actually a Higgs boson. For example, does this new particle have the unique characteristics of a Higgs boson, for example having no spin and coupling strength proportional to mass? These and other characteristics will be tested as more data is accumulated at the LHC, or perhaps at a future lepton collider.

If it is established that what has been observed is a Higgs particle, the next set of questions will focus on whether it is a simple Standard-Model Higgs particle, or possibly a part of a more complex Higgs phenomenon. There are a number of variants of the Higgs phenomena that have been proposed theoretically. The future will be very interesting!



The CMS narrow resonance signal evidence, broken up by decay mode and the combined five-sigma probability



The development of evidence for a Higgs-like signal from the combined decay modes to five-sigma over time from ATLAS

HIGGS BOSON | ICHEP | STANDARD MODEL