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## PROFILE

# Mark Palmer brings CesrTA research to the ILC

Taking on white papers and electron clouds, Mark Palmer brings his own energy to the CesrTA programme.

by Leah Hesla




With his feet firmly planted on Cornell university ground and certain clouds permanently in his head, Mark Palmer is a key figure in the ILC's battle against an unwanted phenomenon called electron cloud. Learn more about him and his work in this profile.

## AROUND THE WORLD

# A niobium company visit in Ningxia, China

by Min Zhang



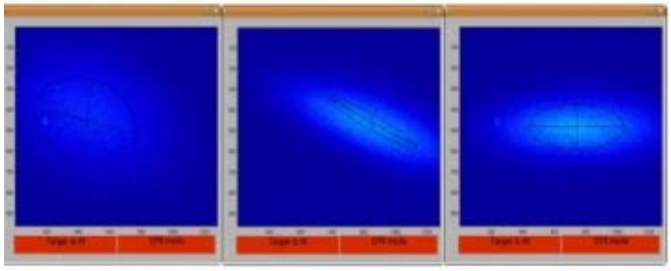
On 18 February 2011, a delegation of Global Design Effort representatives visited the Orient Tantalum Industry Co. Ltd (OTIC), Ningxia, a leading niobium company in China. The group consisted of ILC project managers Akira Yamamoto and Marc Ross, together with Robert Rimmer of Thomas Jefferson Laboratory in the US, accompanied by Asian Linear

## DIRECTOR'S CORNER

# Progress in the nanometre world

Today's issue features a Director's Corner from Toshiaki Tauchi, a member of the EC.

by Toshiaki Tauchi

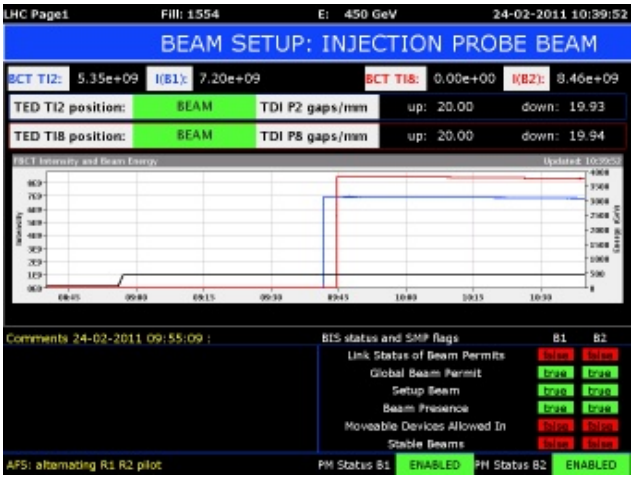


Two periods dedicated to beam tuning and beam size studies at KEK's Accelerator Test Facility ATF2, built to test the ILC's final focus system, have brought researchers a step closer to

Collider Steering Committee Chairman Jie Gao and ILC group member Jiyuan Zhai of the Institute of High Energy Physics (IHEP) in Beijing.

achieving the ILC's demanding beam parameters. Executive Committee member Toshiaki Tauchi reports on the studies.

## IMAGE OF THE WEEK




# LHC back after winter break

Image: CERN

The operators of the Large Hadron Collider LHC at CERN switched their machine back on last weekend. First low-energy beams circulated on Sunday morning, and the team is now working on a series of tests for various systems of the accelerator before they can send high-energy beams into collision in the detectors.

## IN THE NEWS

From Wired
22 February
'God particle' may not exist if no evidence found before 2013
If the Large Hadron Collider does not prove the existence of the Higgs boson in the next two years, physicists say the entire Standard Model theory of subatomic structure must be reassessed.

From Physics World
22 February
Will the LHC find supersymmetry?
The first results on supersymmetry from the Large Hadron Collider (LHC) have been analysed by physicists and some are suggesting that the theory may be in trouble.

From Scientific American
21 February
Budget crunch could prematurely shutter Tevatron
Now things are looking even bleaker for Fermilab and the Tevatron. The Fermilab Neighborhood blog reports that lab director Pier Oddone said at an all-hands meeting February 15 that budget cuts proposed in the House of Representatives would force a number of drastic measures at Fermilab.

From Physics Today
18 February
House, White House spending plans are poles apart on energy and other R&D programs
Just as President Obama sent a budget request for fiscal year 2012 to Capitol Hill that includes big increases for energy R&D and other federal basic research programs, House Republicans tacked in the opposite direction, submitting a bill that would chop billions of dollars in spending from R&D programs in the current year.

## CALENDAR

### UPCOMING EVENTS

End Station Test Beam (ESTB) Workshop 2011
SLAC

## BLOGLINE

21 February
*Fermilab*
Proposed funding cuts continue to draw attention

17 March 2011

2011 Linear Collider Workshop of the Americas (ALCPG11)
University of Oregon, Eugene, Oregon, USA
19- 23 March 2011

2011 Particle Accelerator Conference (PAC'11)
New York Marriott Marquis Hotel, New York, NY, USA
28 March- 01 April 2011

### UPCOMING SCHOOLS

Joint US-CERN-Japan-Russia School on Particle Accelerators
Course on Synchrotron Radiation and Free Electron Lasers
Ettore Majorana Foundation and Center for Scientific Culture, Erice, Sicily, Italy
06- 15 April 2011

View complete calendar

## PREPRINTS

### ILC REPORT

2011-028
CLIC-ILC General Issues Working Group Interim Report

### ARXIV PREPRINTS

1102.3454
Effects of high-energy particle showers on the embedded front-end electronics of an electromagnetic calorimeter for a future lepton collider

1102.3361
Effective Yukawa couplings and flavor-changing Higgs boson decays at linear colliders

1102.1892
Charged Higgs Boson Physics at Future Linear Colliders

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PROFILE

# Mark Palmer brings CesrTA research to the ILC

Taking on white papers and electron clouds, Mark Palmer brings his own energy to the CesrTA programme.

Leah Hesla | 24 February 2011

For many involved with the ILC, Mark Palmer exemplifies what it means to be a nexus.



*Mark Palmer is the CesrTA project manager at Cornell University's Wilson Laboratory.*

Palmer is the connection between the Cornell Electron-Positron Storage Ring Test Accelerator (CesrTA) programme – a prototyping project for the ILC damping ring – and the larger ILC community. Working with his team at home and taking their findings to the Global Design Effort, Palmer devotes as much diligence to writing reports as he does to analysing particle beam data, fitting test results into the framework of collaboration.

"Mark has been a tireless advocate for the CesrTA scientific programme, and is almost singlehandedly responsible for establishing Cornell as the centre of ILC damping ring expertise," said CesrTA Principal Investigator David Rubin, also leader of the low-emittance tuning group.

A man of many well spoken words, Palmer brings in physicists from outside Cornell for input on CESR data. As an ambassador for CesrTA to the linear collider community, he's turned many scientists' attention to Ithaca, New York.

One of the many tasks of CesrTA is to subdue derailing effects known as electron clouds in the accelerator. The electron cloud is not yet fully understood, and modelling it is crucial for the success of future electron-positron colliders. By many accounts, Palmer's persistence in ploughing through various physics scenarios is responsible for bringing researchers that much closer to handling the problem.

"The CesrTA programme led by Mark Palmer represents a huge step forward by actually measuring and quantifying the effects, as well as comparing mitigation techniques," said GDE Director Barry Barish. "Mark has led the project by example, being on top of all issues from technical matters to project management."

Palmer's dedication to CesrTA springs in part from his regard for CESR as a treasure in the field of accelerator technology.

"In accelerator physics, it is rare to be able to take an operating high-energy physics machine and utilise it for an extensive accelerator physics experimental programme," Palmer said. "Here at Wilson Lab, we have the combination of a university environment, an operational machine, and very few restrictions on people conducting basic accelerator research. Unique research opportunities have a chance of coming to fruition in an environment like this."

With such opportunities so close at hand, one can hardly keep them to himself.

"Asked to participate in a review, teach a class, or to consider a test of yet another mitigation, he – almost – never says no," Rubin said.

That may be because there's little about physics that doesn't engage him.

During his final year as a Princeton University undergraduate and under the guidance of Nobel laureate Val Fitch, Palmer set himself to building a torsion balance that would be sensitive to a short-term component of gravity (discussed in a paper by Ephraim Fischbach). After completing a yearlong Fulbright fellowship at Rijksuniversiteit Groningen in the Netherlands, he

returned to Princeton for graduate school. He researched so-called fifth force measurements for his doctoral dissertation, also supervised by Fitch.



“I essentially got a gravity-related degree while I was there,” he said. Then, while at the University of Illinois, stronger, shorter-range forces lured him to particle physics. He worked on the CLEO silicon detector project for his post-doctoral research.

“I enjoy the technical, engineering-intensive things,” he said. “There are folks in high-energy physics who enjoy using computers, but I have always tended to be fairly hardware-oriented.”

He became a member of the CLEO Collaboration in 1994, where plenty of hardware and particle puzzles awaited him. In 2000, he joined the accelerator operations group at Cornell and since 2005, has been actively participating in the ILC collaboration, which has allowed him join the study of fundamental physics with the machinery that reveals it.

“It’s been a nice balance of things these last ten years,” he said.

Working at Cornell also allows him to be close to relatives in upstate New York, where his wife, a choir director and elementary school music teacher, grew up and has family. They and their two teen-aged sons maintain a full life of year-round sports, music, and enjoyment of the outdoors, especially with Ithaca’s beloved waterfalls, wild game and sledding slopes.

Though Palmer is meticulous in managing CesrTA, he is not strictly business.

“He’s got a wry sense of humor,” said GDE Americas Regional Director Mike Harrison. And using that sharp tool, he said, “Mark’s able to keep a steady hand on the tiller during the inevitable stormy weather.”

CESRTA | CORNELL UNIVERSITY | ELECTRON CLOUD

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AROUND THE WORLD

# A niobium company visit in Ningxia, China

Min Zhang | 24 February 2011



*ILC project managers visit the titanium branch of OTIC. Image: OTIC*

On 18 February 2011, a delegation of Global Design Effort representatives visited the Orient Tantalum Industry Co. Ltd (OTIC), Ningxia, a leading niobium company in China. The group consisted of ILC project managers Akira Yamamoto and Marc Ross, together with Robert Rimmer of Thomas Jefferson Laboratory in the US, accompanied by Asian Linear Collider Steering Committee Chairman Jie Gao and ILC group member Jiyuan Zhai of the Institute of High Energy Physics (IHEP) in Beijing.

With the aim of preparing for ILC superconducting radiofrequency (SCRF) cavity and cryomodule industrialisation, and to seek cost-effective mass-production scenarios for the SCRF cavity and cryomodule systems, the ILC project managers set up a plan for industrial communication. They decided to pay visits to twelve companies between early February and late April 2011 to discuss technical specifications and industrial models. The companies, based in America, Asia and Europe, are manufacturers of niobium material or cavities and cryomodules.



*Visitors and OTIC managers stand in front of a 600-kilowatt electron beam furnace, which is used for electron beam melting. Image: OTIC*

OTIC, located in the Ningxia Hui autonomous region of China, is the last company in Asia that ILC project managers visited. “As a very close collaborator with IHEP (see 22 July 2010 and 2 September 2010) and with Peking University (see 9 September 2010) on superconducting technology for many years, OTIC is one of the most important niobium production companies in Asia,” said Gao. OTIC, established in April 1999, is a controlled subsidiary company under China Nonferrous Metal Ningxia Orient Group Co., Ltd (CNMNC). Due to a combination of core prime assets and achievements in scientific research contributed by CNMNC as the main originator, OTIC is a large sized enterprise specialising in scientific research, development and production of rare metals, is the biggest manufacturer of tantalum and niobium in China and is one of the world’s three top tantalum processors. It is also the only Asian member of the executive committee of Tantalum-Niobium International Study Center. OTIC is an important supply base for new materials of such rare metals as tantalum, niobium and beryllium for high-tech applications and an export-oriented high-tech enterprise in China. “I have been much impressed with the promising configuration and scale of the company, which has a highly motivated spirit for advanced technology,” said Yamamoto.

OTIC contains all fabrication plants of niobium sheets including pressing, out-gassing and sintering, electron beam welding, cutting, forging, mechanical grinding, rolling, polishing, cutting and annealing. “We learned a lot about this company and enjoyed very much the tour of very active factories and laboratories of OTIC,” said Yamamoto after the guided visit tour of fabrication plants of OTIC. The detailed discussions between ILC project managers and OTIC experts established a mutual understanding both on ILC requirements and OTIC capacity and its future planning. “It would be nicest for me to understand that OTIC may cover most of our technical requirement of niobium material as well as niobium-titanium alloy production,” said Yamamoto.

As a forward-looking action, a new sub-company dedicated to superconducting materials and components supply called Ningxia Orient Superconductor Technology Co., Ltd., run jointly by OTIC and Peking University, is to be established on 28 February. “It shall be a unique feature of OTIC to be realised soon, and it will open a new door for the company. It will handle everything, including all processes from materials to cavity integration,” said Yamamoto. “I hope to extend our cooperation,



*Attendees listen to the introductory report by OTIC. Image: OTIC*

especially with a company that demonstrates a pioneering spirit for advancing superconductivity technologies."

In early March, ILC project managers will extend their industrial communication to companies in Europe. Stay tuned for more news from the industry world.

CHINA | GDE PROJECT MANAGERS | INDUSTRIALISATION | INDUSTRY | NIOBIUM | SUPERCONDUCTING CAVITY

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DIRECTOR'S CORNER

# Progress in the nanometre world

Today's issue features a Director's Corner from Toshiaki Tauchi, a member of the EC.

Toshiaki Tauchi | 24 February 2011

This is the second time I contribute an article for this column. Last April, I reported that we have entered the nanometre world by tuning the beam size just below one micrometre at ATF2, a test facility for the final focus system at KEK, Japan. Since then, there have been two experimental runs for one week each in May and December 2010, which were dedicated to the ATF2 beam tuning. I would like to briefly describe the achievements and our efforts until now.

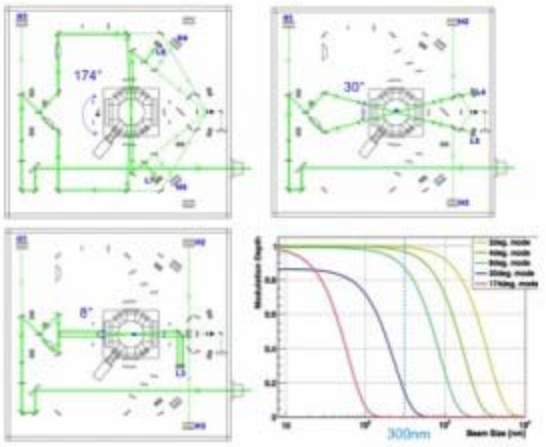


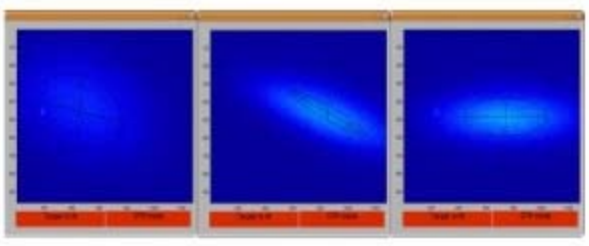

*Figure 1. Configuration of angular modes in the interaction point beam size monitor and the range of beam size measurements.*

The minimum beam size of 313±31 nanometres, was achieved in May last year. The beam tuning began with the initial setup of 850 nanometres and was brought down to 313 nanometres during a 16-hour experiment. The beam sizes were measured by the Shintake monitor or the interaction point beam size monitor (IPBSM). In the May run, we switched to a different mode when the beam size was successfully reduced to 313 nanometres for the lower limit in the eight-degree mode. However, we could not reduce the beam size further, since there is also another limit, the upper limit at the 30-degree mode. During the beam tuning, we observed that the minimisation of beam size required large rotations of the two final doublet magnets called QD0 and QF1 in several milliradians.

The figures show the laser crossing configurations for 174-, 30- and 8-degree modes and the modulation depth as a function of beam size. Wavelength, pulse duration and power of the IPBSM laser are 532 nanometres, eight nanoseconds and 1.4 joules per pulse, respectively. A laser beam comes from the bottom right corner, and is split into two beams at a mirror in the left centre. The crossing angle can be changed continuously from two- to eight-degree mode by fine adjustment of mirrors. The eight-degree mode can measure the beam size from 1,500 to 300 nanometres.

The ATF hardware is maintained and upgraded in every shutdown, especially the long summer shutdown that lasts about three months. In summer 2010, two old modulators at the 1.3-GeV injection linear accelerator were replaced with new compact ones. The beam lines from the radiofrequency gun to the damping ring were realigned. We realigned the final doublet magnets. One major improvement of the instrumentation is the installation of multiple Optical Transition Radiation (OTR) monitors with new targets at the diagnostic section just in front of the final focus system. The multi-OTR can measure the beam transverse profile by one pulse, whereas the present wire scanners measure it by scanning with many pulses. This significantly speeds up the beam tuning. One demonstration is shown in the bottom image, which has been taken during this autumn run from November to December 2010. The beam profiles clearly visualise individual corrections of dispersion and coupling.

The ATF is operated with one-week cycle, concluding operations and starting again the following Monday evening. Two weeks in October were dedicated to the fast kicker study. Thirty bunches were successfully extracted with a spacing of 308 nanoseconds by the fast kicker from the damping ring where three trains of ten bunched beams at 5.6 nanoseconds were accumulated. It is a basic experimental verification of the beam extraction at the ILC.



*Beam profiles at the OTR0X, one of four multi-OTRs; images before (left) and after dispersion (centre) and coupling (right) corrections. The multi-OTR system was made by colleagues*

The ATF2 beam tuning was conducted for five weeks from November to December 2010. The beam size was reduced to 2-3 micrometres in the vertical direction by tuning with a five-micrometre-

diameter carbon wire (C-wire) at the interaction point. Improving the timing system with digital control, the IPBSM signals were tuned in two-degree mode in the fourth week. Also, the coupling correction and emittance measurement were done with the multi-OTR system for the first time.

*at Valencia University and SLAC.*

During the last week dedicated to ATF2 beam tuning the beam was reduced to less than two micrometres with the C-wire. The beam size tuning brought the beam size down to about 370 nanometres. During the tuning with the six-degree mode, the modulation frequently reached to the maximum that indicated that the beam size became even less than 300 nanometres.

From 13 to 14 January 2011, the 11th ATF2 project meeting was held at SLAC, which was a week before the second Baseline Assessment Workshop. There were about 50 participants, and the whole meeting was operated with WebEx for remote participation. We reviewed the commissioning status of hardware and software and the continuous run with the nominal optics. We also discussed strategies for achieving a 37-nanometre beam size by 31 March 2011, the end of Japanese fiscal year 2010. We confirmed that the beam position monitor and multi-OTR systems were well calibrated and the ATF2 beam line was well modeled. Major issues are the large background in the IPBSM and the insufficient commissioning at the 30-degree mode.

Resuming the ATF2 beam tuning in February 2011, the beam operation became very stable with improvement of timing control system at the injection. Optical elements of the IPBSM were realigned in the most sensitive region for laser focus at the 30-degree mode, and the temperature control of the laser system was also improved for the stable laser beam generation. UUnfortunately a fire accident at the LINAC modulator stopped ATF operation on 16 February, but it will resume its operation this March with huge effort by the ATF staff and international support and encouragement of the KEK directorate.

I hope that I will report the achievement of a 37-nanometre beam size in the near future.

ATF2 | BEAM MONITOR | BEAM SIZE | BEAM TUNING | KEK

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