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AROUND THE WORLD

From CERN Bulletin: From calorimetry to medical imaging: a shining example of successful transfer!

A team at CERN has drawn inspiration from calorimetry methods developed for high-energy physics to create a new positron-emission tomography system for use in medical imaging, which they've dubbed AX-PET. With support from European and American laboratories, the project is reaching fruition, as initial tests confirm its promise.

DIRECTOR'S CORNER

The US programme reduction

This week's issue features a Director's Corner from Mike Harrison, Americas Regional Director for the Global Design Effort

by Mike Harrison

Americas Regional Director Mike Harrison reinterprets the dramatic reduction of the US ILC budget starting in the next financial year. Find out about US R&D plans and what all this has to do with sausages.

IMAGE OF THE WEEK

Cavities at your fingertips

Image: ILC, Heiner Müller-Elsner

Are you giving a talk about the ILC, cavities, S(C)RF or linac design and are looking for images that haven't been used a million times? A 17-image series following the life of a cavity from niobium ingot to finished cryomodule is now available on the Interactions image bank.

IN THE NEWS

from ***Nature***
29 August 2012
After the Higgs: The new particle landscape
Physicists hope and expect that the LHC will give them some answers over the next few years. But they are already honing their sales pitches for a machine to follow the LHC — a 'Higgs factory' that would illuminate such a theory with measurements far more precise than the LHC can provide.

from ***SLAC Today***
28 August 2012
A Celebration 50 Years in the Making
In a two-day event commemorating the 50th anniversary of SLAC National Accelerator Laboratory, about 1,000 employees, former employees and university, government and scientific leaders celebrated the lab's successes and looked ahead to the next great challenges.

from ***tiede.fi***
28 August 2012
MAAILMANKAIKKEUTTA ETSIMÄSSÄ
Kilpailevat lineaarikiihdytinehdotukset ovat International Linear Collider (ILC) ja Compact Linear Collider (CLIC). ILC on nimensä mukaisesti kansainvälinen projekti, eikä sen sijoituspaikkaa ole päätetty: se saattaisi tulla Eurooppaan, Yhdysvaltoihin tai Japaniin. (google translation)

CALENDAR

UPCOMING EVENTS

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

ANNOUNCEMENTS

Steven Weinberg lecture at LCWS: title announced

Steven Weiberg's public lecture on 24 October at 7:30 pm during the LCWS12 workshop will be "The Standard Model, Higgs Boson, Who cares?"

LCWS12 early registration deadline: tomorrow!

The early registration of the International Workshop on Future Linear Colliders 2012, LCWS12, is 31 August. The registration fee will be increased from $425 to $490 starting on 1 September. You must make the payment by 31 August to take advantage of the reduced early registration fee.

In addition, the conference special rates for hotels begin to expire as early as 1 September due to the great possibility of American baseball World Series championship games near the conference dates, so we strongly encourage you to make a reservation as soon as possible.

The hotel information and the registration can be done on the conference web site, LCWS12.org.

We look forward to welcoming you all in Arlington, Texas!

Jae Yu and Andy White,
Co-Chairs LCWS12 Local Organization Committee

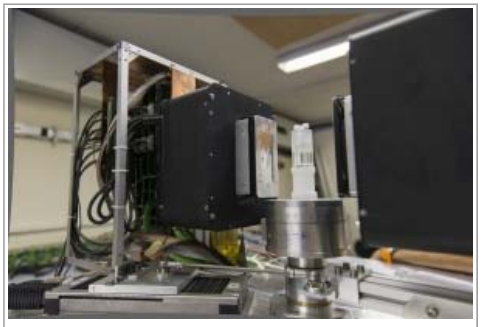
PREPRINTS

ARXIV PREPRINTS

1208.4106
Neutralino Decays in the Complex MSSM at One-Loop: a Comparison of On-Shell Renormalization Schemes

From calorimetry to medical imaging: a shining example of successful transfer!

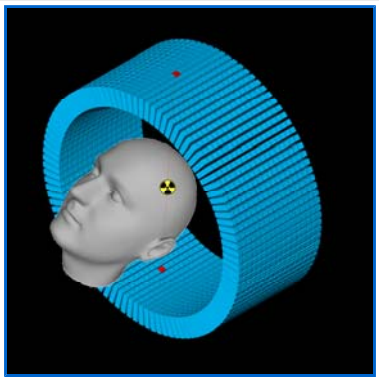
A team at CERN has drawn inspiration from calorimetry methods developed for high-energy physics to create a new positron-emission tomography system for use in medical imaging, which they've dubbed AX-PET. With support from European and American laboratories*, the project is reaching fruition, as initial tests confirm its promise.



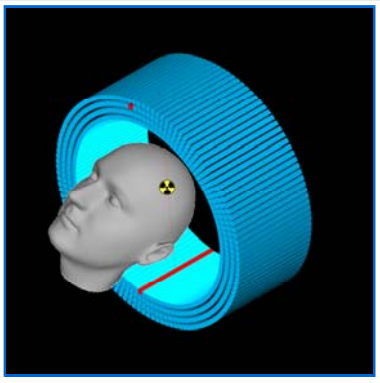
Snapshot of a "phantom", a test object, surrounded by the AX-PET photon detectors.

Positron-emission tomography (PET) is a medical imaging technique based on the matter-antimatter interaction that can provide a three-dimensional representation of the metabolic activity of an organ. To do so, radioactive marker molecules are first injected into the subject. As the marker decays, it emits positrons (antimatter particles), which are annihilated upon encountering electrons in the surrounding environment. The resulting flash, consisting of two photons, is detected by the PET machine. In conventional PET systems, it is impossible to improve spatial resolution without losing sensitivity. AX-PET offers a way around this trade-off, improving the quality of the imaging. Thus, AX-PET can achieve millimetre-scale resolution, while conventional PET resolution is limited to 4 to 6 millimetres.

The AX-PET technique, whose development began in 2007, relies on calorimetry methods commonly used in particle physics: a lattice of crystals transforms the incoming photons into scintillating light. Each crystal is connected to a photodetector, which transmits analog information. The innovation in AX-PET compared to older technologies lies in the positioning of the crystals with respect to the photon source (see figure below). "Unlike the traditional layout, where the photosensitive crystals are positioned radially to the subject being examined, AX-PET uses elongated crystals, 100 mm in length, that are aligned parallel to the machine's bore axis," explains Matthieu Heller, a Marie Curie fellow in CERN's PH Department who is one of the names behind the project. "In this way, if you want to improve sensitivity, all you have to do is add more layers of crystals." Behind each row of crystals there is a perpendicular row of plastic strips, which is used to record the position at which a photon has impinged on the crystal. The resulting three-dimensional lattice can be used to measure the precise point of impact of a photon.



A traditional PET scanner showing the crystal layout.

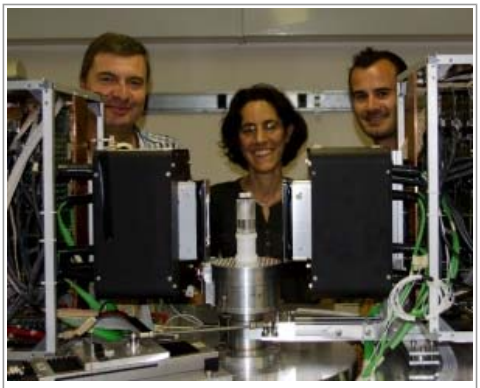


The axial orientation of elongated crystals in AX-PET.

In June the project team performed initial tests with small animals at the ETH Zurich laboratories that are specialised in small-animal imaging. "The results showed us that our demonstrator has reached the stage of maturity," notes Christian Joram, the leader of the PH Department's Detector Technology Group and the person in charge of the AX-PET project. "There are now several possibilities. One of them would be

to couple the PET machine with an MRI machine so as to give a combined snapshot of the metabolic and structural aspects of the subject. This would require some further work, because MRI—magnetic resonance imaging—relies on very strong magnetic fields, which must be protected against any interference from our detector."

Other avenues of research are aimed at improving the performance achieved by AX-PET, now that the demonstrator, which was manufactured at CERN, has shown that the new PET principle works and is feasible for bigger-scale application. These research ideas include simulations (using different crystals and geometries) and tests with new Digital SiPM photodetectors, which convert light directly into digital data. Coupled with the crystals, such detectors could be used to distinguish the time-of-flight of photons emitted by the source. This temporal information would improve the detection sensitivity and reduce the background noise, providing a much sharper image.



Some members of the project team: Christian Joram (CERN), Chiara Casella (ETH Zürich) and Matthieu Heller (CERN) pose behind AX-PET.

"As CERN researchers, our role isn't to build a complete scanner, but to transfer the technology," concludes Christian Joram. "We have demonstrated the performance that is possible with our principle, and now we are helping our partners to develop suitable applications. Recently we have also started working with manufacturers and medical imaging experts on a detector that would incorporate both MRI and PET functionalities." From calorimetry to medical imaging, there is an unmistakable drive to move ahead!

**Laboratories involved in AX-PET project : INFN Bari, INFN Cagliari, INFN Roma, CERN, University of Michigan, Ohio State University, University of Oslo, Tampere University of Technology, IFIC Valencia, ETH Zürich.*

by Caroline Duc

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DIRECTOR'S CORNER

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Mike Harrison | 30 August 2012

Traditional sausage making. Its connection to high-energy physics is explained in the Director's Corner.

The 19th-century German statesman Otto von Bismarck said that laws are like sausages – it's better not to see them being made. The US budget, when it finally appears, eventually becomes law. With the GDE mandate and the associated R&D programme for the ILC coming to an end with the final handover of the *Technical Design Report* (TDR) in summer 2013, this year's budget process was awaited with a more than normal degree of trepidation by those of us strongly influenced by the end product. This unease proved justified, for when the presidential budget was released in February 2012, it dramatically reduced the ILC funding for FY13. Commentary on this move was provided at the subsequent High Energy Physics Advisory Panel (HEPAP) meeting when Jim Siegrist, Head of the DOE Office of High Physics, reported that the five-year GDE R&D plan was successfully completed but that they could see no project on the near horizon. He also pledged that the US would continue to be involved in the international planning at a low level.

So what does this mean in a practical sense? Well, to first order, I suspect it means what it says: further significant US investment in the ILC R&D programme will require (among other things) serious movement towards a construction project by the global community. Implicit in the statement, however, is the recognition that the maturity of the technical developments under the GDE programme are good enough to support such a project proposal by the high-energy physics community. Thus in one move the ball has been squarely hit back on our side of the court – where is the project?

There are several elements needed to achieve approval of a project of this size and complexity: science, a design, a host and willing participants. The science case must be compelling. In this regard the recent announcement of the Higgs-like particle at the LHC is a major boost. The nominal 500-GeV centre-of-mass energy on which the TDR design is based could be higher than necessary if a Higgs-factory approach is favoured. Physics beyond the Standard Model represents a known unknown, to quote a recent US cabinet secretary. Physics beyond the Standard Model could also affect the desired energy of a future collider. The flexibility of the linear collider approach is a great virtue in this regard as a phased approach to the ultimate machine energy is feasible. These issues are under active consideration in the various regional strategy analyses, which will report within the next year (the EU strategy, the Asian roadmap, and the US Snowmass conference on the Mississippi). Ultimately I believe an ICFA endorsement of whatever emerges will be necessary to proceed.

Besides a solid science case, we need a reliable accelerator design and cost estimate. In this regard the GDE programme has been pivotal, and with the impending release of the TDR, a great deal of uncertainty has been removed. As mentioned earlier, the

US funding reduction can be viewed as a sign that we are ready to go (among other interpretations!).

The linear collider must be sited somewhere and this step requires a host. Of necessity the host entity assumes the major project responsibility, both technical and financial. The as yet site-unspecific TDR will need to become a site-specific engineering design, much of which can only be done by the host. In addition to the linear collider itself, some form of central laboratory complex will be necessary, adding to the host investment. High-energy physics is a fascinating and compelling endeavour, but it does not come cheap. Encouragingly, these issues are starting to be considered in Japan as part of the siting studies currently in progress.

The final requirement is the establishment of a global collaboration to execute the project. The GDE has provided a strong technical collaboration, but the resources for a major construction project will need several countries to show a significant political willingness to participate. The political climate for international science is worthy of a column in itself. Suffice to say that this will be a major challenge over the next few years.

So where does this leave the US programme? Two-thirds of the US effort during the GDE era was related to superconducting radiofrequency technology development. We are fortunate that there are several other projects under consideration in the US that are also interested in 1.3-GHz ILC-like components, and the generic General Accelerator Development programme will continue to offer support in this area. Fermilab will continue to fabricate and test cryomodules in the NML facility, albeit at lower priority than before. The ultimate goal of a three-cryomodule string test with beam is in doubt, though.

The US's Thomas Jefferson National Accelerator Facility will also continue to work on higher gradients, though again with reduced priority. R&D in other systems areas, principally aimed at hardware development, will wind down over the next several months in a coherent way. Collaboration within the various technical working groups will continue with reduced resources allocated to these efforts. Although the details of this evolution of the US programme are still being worked out, with the baseline design work and the R&D goals of the GDE largely completed, a reduced US effort will hopefully be sufficient to carry the project forward for the foreseeable future while bigger issues are decided.

Besides pondering the mysteries of sausages, Otto von Bismarck was responsible for the unification of modern Germany. High-energy physics needs to follow his lead in pursuit of the next major facility. Progress in science is inexorable but a united approach generally helps. The new, broader, linear collider collaboration under Lyn Evans, the director for the new linear collider organisation, is an important step in this direction.

BUDGET | GLOBAL COLLABORATION | SCRF | US | US BUDGET