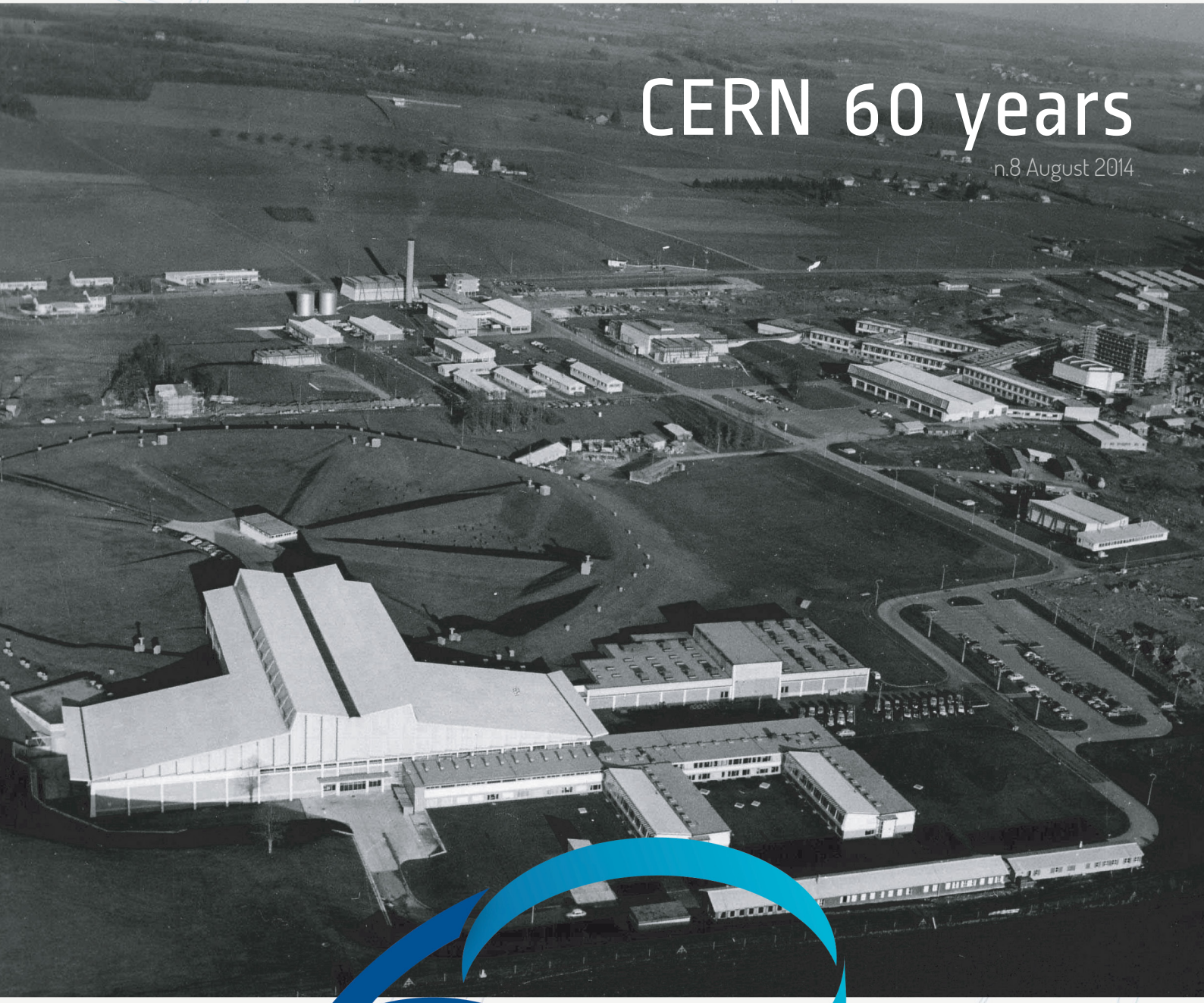
LIP NEWS



CERN 60 years

n.8 August 2014

YEARS/ANS CERN

EDITORIAL

Every organization has multiple histories – oral and written, formal and informal, official and personal, factual and mythic. Each provides a particular point of view and a special way of understanding the organization, its origins and development, its polices and activities, and of understanding also the various roles played by those who have influenced it and who have been influenced by it.

Len Jossen, in ICPE (Physics Education), 1988

This newsletter modestly tries to contribute towards documenting the evolution of CERN, by highlighting several chosen aspects of the relation of Portugal with CERN during the 60 years of CERN existence.

For the past 60 years CERN scientists have been breaking the mysteries presented by nature and living up to the challenging process of trying to complete the Standard Model of Particle Physics. The achievements of the international scientific community at CERN have undeniably changed the point from which we see the world today: from the consolidation of the standard model of Fundamental Particle Physics, which provides us with a deeper understanding of how the Universe "works" to the invention of the World Wide Web, which provided us with a new paradigm in communication...

In this edition we highlight important scientific breakthroughs in CERN history and along with them, some milestones for the Portuguese path towards CERN and within CERN. In this line, accounts given by some of our senior colleagues enrich this edition with firsthand accounts of their experience with CERN.

The history of institutions is also the story of how they have changed their surrounding environment, a particular aspect for which CERN has much to account for!

Portugal accession to CERN had a crucial role in the constitution and development of today´s Portuguese community of theoretical and experimental particle physicists. LIP, in particular, was founded in 1986 when Portugal joined CERN as a Member State.

CERN has also had a major contribution to the formation of a new generation of researchers in Particle Physics, being a unique source of internationalization for young students, whose integration in large teams with members from many different countries is an invaluable experience for their future careers, independently on whether they will stay in or leave the field of research. This is the case of colleagues that, having left research, give us their testimony in this edition.

The influence of CERN in Portugal has spread beyond the scientific community to the society. Such is the example of LIP organized CERN schools for Portuguese Speaking Teachers, which have been helping Science in general, and Particle Physics in particular, to reach high school teachers and young students since 2007.

This is a commemorative newsletter focused on the history of CERN, but it is always a good exercise to think about the present and the future, while reviewing the past. Regarding the present activities we chose to stress Physics, in particular the physics of the top quark, and its very important role in the Standard Model and in the searches for Physics beyond it. As for the future, we highlight a question likely to be present in the thoughts of many: "LHC: what next?".

We wrap up the edition with a back cover picture of Les Horribles Cernettes, "the one and only High Energy Rock Band", founded by employees of CERN and the band whose picture was the first ever to be clicked on in a web browser!

Patrícia Gonçalves and Filipe Veloso

CONTENTS

In between newsletters the LIP bloguetim (news blog) allows us to have a more regular flow of news that will be later selected and published in the next issue of the newsletter. Hopefully some news will motivate lively discussions...

The bloguetim is available at

www.bloguetim-lip.blogspot.pt

This is an interactive bulletin.

This kind of codes allows to easily access content from the internet.

When you see this kind of code, simply scan it with your phone to follow the related page.

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LIP NEWS

issue n.8 august 2014

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HIGHLIGHT

CERN's 60th Birthday

adapted from history of CERN in home.web.cern.ch/about by

Ricardo Gonçalo

CERN, the European Organization for Nuclear Research, is celebrating its 60th anniversary this year. Over these six decades it has been the stage of many of the most striking episodes in the history of nuclear and particle physics, which changed dramatically the way we understand the Universe in which we live. Its impact goes beyond its 20 European member states and also beyond nuclear and particle physics, with programmes dedicated to technology development and transfer, scientific and technical training and the arts, with the creation of the World Wide Web, and by fostering international collaboration. Here are a few highlights of the first 60 years of CERN's history.

In the boxes we highlight some of the experiments where LIP physicists participated.

The first decade

After the destruction caused by the Second World War, European science was depleted of its scientists and means, and was no longer world-class. Following the example of international organizations, a handful of visionary scientists, including Pierre Auger and Niels Bohr, imagined a nuclear physics laboratory uniting European scientists and allowing them to share the increasing costs of physics facilities. With support from Louis de Broglie and Isidor Rabi, the idea coalesced in a provisional Conseil Européen pour la Recherche Nucléaire (CERN) created by 12 european countries. The European Organization for Nuclear Research officially came into being on 29 September 1954, with a laboratory in Geneva, and kept the acronym of the provisional organisation.

The 600 MeV Synchrocyclotron (SC), built in 1957, was CERN's first accelerator. It provided beams for CERN's first experiments in particle and nuclear physics. In 1964, this machine started to concentrate on nuclear physics, leaving particle physics to the newer and much more powerful Proton Synchrotron (PS).

The Proton Synchrotron (PS) accelerated protons for the first time on 24 November 1959, with a beam energy of 28 GeV. One of the major achievements it allowed was the discovery of weak neutral currents, explained by the exchange of a Z boson, using the Gargamelle bubble chamber in 1973. When CERN built new accelerators in the 1970s, the PS's principal role became to supply particles to the new machines.

Antimatter

By 1965, each particle was known to have an antiparticle. But are matter and antimatter exactly symmetric, as Dirac had predicted? Would an antiproton and an antineutron stick together to form an antinucleus? The answer to the question was found in 1965 with the observation of the antideuteron, achieved simultaneously by two teams led by Antonino Zichichi, using the PS at CERN, and by Leon Lederman, Brookhaven National Laboratory, New York. Much later, in 1995, a team led by Walter Oelert created atoms of antihydrogen for the first time at CERN's Low Energy Antiproton Ring facility. In 2011, the ALPHA experiment at the Antiproton Decelerator achieved a milestone result by trapping anti-hydrogen for 1000 seconds.

A revolution in detectors

In the 1960s, detection in particle physics involved examining millions of photographs from bubble or spark chambers. This was slow and unsuitable for studies of rare phenomena. Then came a revolution in transistor amplifiers, which allowed Georges Charpak to develop the multiwire proportional chamber in 1968. Linked to a computer, this detector achieved a counting rate a thousand times better than existing detectors. The invention revolutionized

Figure: Aerial view of CERN in 1960. The PS tunnel can be seen as a circular structure behind the experimental hall.

HIGHLIGHT CERN's 60th Birthday

particle detection, which passed from the manual to the electronic era, and gave Charpak the 1992 Nobel prize in physics.

LIP-Coimbra inherited a long tradition in detector gaseous development and, since the early years, participated in several CERN projects including Multiwire Chambers, RD51, PS195/CP-Lear, Liquid Xenon and n-TOF.

Of W's and Z's

With seven kilometres in circumference, the Super Proton Synchrotron (SPS) was the first of CERN's giant underground rings and the first to cross the Franco-Swiss border. It started operation in 17 June 1976 and in 1979 was converted into a proton–antiproton collider. The stochastic cooling technique, invented by Simon van der Meer, allowed enough antiprotons to be collected to make a beam. The first collisions happened in 1981, allowing the search for signs of W and Z particles, carriers of the weak interaction. Their discovery was announced in 1983, and gave the Nobel Prize to Carlo Rubbia and van der Meer in 1984.

Little Bangs

In 1986 CERN began to accelerate heavy ions in the SPS to confirm the existence of quark gluon-plasma, which existed shortly after the Big Bang. The aim was to "deconfine" quarks – set them free from their confinement within nucleons – by smashing the heavy ions into appropriate targets. The first experiments used relatively light nuclei, and produced results consistent with the quark-gluon plasma theory, but no real proof. In 1994 a second generation of experiments began with lead ions, and by 2000 there was compelling evidence that a new state of matter had been seen. This was recently confirmed without doubt at CERN's new flagship machine, the Large Hadron Collider (LHC).

LIP participated in the NA38, NA50 and NA60 experiments at the SPS and was deeply involved in the discovery of the guark-gluon plasma.

The LEP era

The excavation of the tunnel for the Large Electron-Positron Collider (LEP) – Europe's largest civil-engineering project prior to the Channel Tunnel – was completed on 8 February 1988. For seven years, the accelerator operated at 100 GeV centre of mass energy, producing 17 million Z particles. It was then upgraded for a second operation phase, doubling the energy to produce W boson pairs. During 11 years of research, the LEP experiments provided a detailed study of the electroweak interaction. These also proved that there are three – and only three – generations of particles of matter. LEP was closed down on 2 November 2000 to make way for the construction of the LHC in the same tunnel.

LIP participated in the DEPLHI experiment through the entire lifetime of LEP - from before the exciting arrival of the first Z boson in the summer of 1989 to the shutdown in the fall of the year 2000.

World Wide Web

Tim Berners-Lee defined the Web's concept and wrote the first browser and server software in 1990. The world's first web page contained information regarding the WWW project (info.cern.ch/hypertext/WWW/TheProject.html). The original computer hosting the server can be seen at the Microcosm exhibition at CERN, still bearing the label, hand-written in red ink: *"This machine is a server. DO NOT POWER DOWN!!"*

SNAPSHOTS

Since the beginning of CERN several Portuguese visited or enjoyed CERN programmes and the Portuguese physicists organized events in Portugal to develop research in High Energy Physics. We review some events.

1969

In August 18 1969, the first students graduating in Physics at the University of Lisbon visited CERN. Among them were Augusto Barroso, Carvalho Soares, Amélia Maio and Conceição Abreu.

1971

In January 1971, the minister of education Veiga Simão organized a meeting to evaluate the interest of the Academy in opening research to high energy nuclear physics. The participants were the president of IAC - Instituto de Alta Cultura, Dr. Abreu Faro and professors from the universities of Lisbon, Coimbra and Porto.

In March 1971 professors Armando Policarpo and Carlos Conde traveled to CERN to evaluate the possibility of a Portugal/CERN collaboration. The project did not go forward due mainly to the lack of interest of the Academy of those days.

1973/1976

Maria Adelaide Moreira Brandão **in 1973** by the University of Paris VI and José Mariano Gago **in 1976** by the École Polytechnique are the first to obtain a PhD in Experimental high energy physics. Their stays at CERN started in 1969 and 1971, respectively.

1975

In Abril, at the Physics Laboratory of the University of Coimbra, George Charpak gave a seminar on multi-wire chambers, the work for which we would be awarded the Nobel prize in 1992.

1977

In the 1977-1978 academic year, starts at IST the free course "Introduction to the experimental methods of quantum Physics", lectured by Professor Mariano Gago.

1978

From 24 to 28 September, the first Automn school "Elementary particles and the structure of matter" in held in Lisbon, in the ex-IFM. The last and number XXVII edition of this school took place in 1999.

The present

The LHC began operation on 10 September 2008. After a serious problem causing much damage it was put back into operation around a year later, with a beam energy that reached 4 TeV in 2012. The LHC is currently undergoing a shutdown, to restart operation in early 2015 with higher beam energy of up to 7 TeV.

At a seminar held at CERN on 4 July 2012, the LHC experiments ATLAS and CMS announced the observation of a Higgs boson candidate with a mass around 125 GeV. This immediately brought CERN and particle physics to media channels around the world. Since then, the existence of this Higgs boson, the last missing prediction of the Standard Model theories of particle physics, has been confirmed, and the LHC experiments continue to study its properties.

Other important milestones have been achieved, in particular, those related to the Heavy Ion Program. Unprecedented energy density regimes allowed more detailed characterization of the quark-gluon plasma. New phenomena, as jet quenching, has been observed.

CERN's physics programme encompasses many areas, both in the LHC and in many other experiments. These range in focus from unstable nuclei to neutrino physics, antimatter, cloud formation, the search for hypothetical particles such as axions and magnetic monopoles, the proton's spin, and much more.

Today CERN is truly a world laboratory, concentrating the work of around 10,000 scientists from 110 countries, training the scientists and engineers of tomorrow, pushing the limits of technology, and seeking answers to our fundamental questions about the Universe.

Today, LIP is strongly engaged in the LHC experiments ATLAS and CMS, as well as in the COMPASS experiment, in GRID computing projects, in detector development, including calorimetry, RPC and many others. LIP has grown to include particle astrophysics and medical physics projects, but CERN experiments remain at its core. Advanced training and education and outreach are today another priority for the laboratory.

Figure: The first Web server, with the hand written sign saying "Do not power down!!".

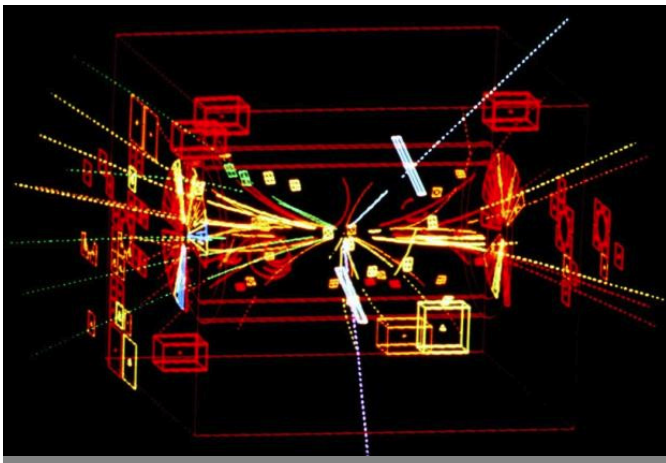


Figure: first detection of a Z boson as seen by the UA1 experiment on 30 April 1983.

1981

In June 1981 The international Conference in High Energy Physics takes places in Lisbon.
In parallel, a general public exhibition "What are things made of" is held.

In the Summer of 1981 the first Portuguese students participate in the CERN summer student programme:
João Varela, Sérgio Ramos and Paula Bordalo.

1985

The agreement for the Portuguese accession to CERN is signed in **April 26 1985** by the Portuguese minister of foreign affairs, Jaime Gama, and by the Director General of CERN, Herwig Schopper. Also present was José Mariano Gago.

1986

LIP, Laboratório de Instrumentação e Física Experimental de Partículas, was created in **May 9 1986**.

In 1986, the first Portuguese Technical Students are selected for a one-year internship at CERN. They were Fernando Barão, Rui Ferreira, Paulo Fonte, Luís Melo, Rui Pires and Pedro Resende, graduating in Physics Engineering at IST. The first fellows Mário Pimenta and Rui Dilão are selected in the same year.

1981-1986

In these years several students were preparing their PhD: P. Bordalo and J. Varela in NA10, S. Ramos in NA14 and M. Pimenta in NA74.
Members of the experimental nuclear physics community were joining high energy physics: R. Marques, A. Policarpo, G. Barreira, A. Maio, C. Abreu and others.

LIP becomes a member of the PS195/CPLEAR and NA38 collaborations and participates in these experiments.

HIGHLIGHT

Portugal@CERN

José Mariano Gago

The accession of Portugal to CERN in 1985 represents a landmark for the history of modern Portuguese science. CERN was the first international scientific intergovernmental organisation to be joined by Portugal, followed by ESO, ESA, ESRF and EMBL more than one decade later. The Portuguese participation at CERN contributed decisively to the progress of Portuguese science and technology, to the development of modern science policies in Portugal and to new R&D and technological capabilities by Portuguese industry.

CERN, April 26th 1985

Signature of the Agreement for the Accession of Portugal to CERN as a member state, by the Portuguese Ministry of Foreign Affairs (Jaime Gama), and by CERN Director-General (Herwig Schopper).Seated, from left to right, W. Kummer (President of CERN Council), Jaime Gama, Herwig Schopper. Standing, from left to right, Castro Brandão, Pinto Lemos, Favila Vieira, José Mariano Gago and Jean-Marie Dufour (Head of CERN Legal Services).

CERN, January 1st 1986

First hoisting of the Portuguese flag at CERN, with Herwig Schopper (CERN Director-General), Eduardo Arantes e Oliveira (Secretary of State for Science and Technology), António Costa Lobo (Portuguese Ambassador), as well as CERN staff and Portuguese physicists: Peter Sonderegger, Sérgio Ramos, Gustavo Castelo Branco, Mário Pimenta, Margarida Nesbitt, João Varela, Gaspar Barreira and José Mariano Gago (with Karin Wall Gago and their baby daughter Catarina).

Lisbon, October 16th 1985

Charter for the accession of Portugal to the CERN Convention, signed by the President of the Portuguese Republic António Ramalho Eanes, and countersigned by the Ministry of Foreign Affairs, Jaime Gama.

António dos Santos Ramalho Eanes

Presidente da República Portuguesa

Faço saber aos que a presente Carta de Confirmação e Adesão virem que foi adoptada a Convenção para o Estabelecimento de uma Organização Europeia para a Pesquisa Nuclear, bem como o seu Protocolo Financeiro, anexo à mesma Convenção

Visto, examinado e considerado tudo quanto se contém na referida Convenção e Protocolo Financeiro, anexo à mesma Convenção, aprovados para Adesão pelo Decreto do Governo número trinta/oitenta e cinco, publicado no «Diário da República», primeira série, número cento e oitenta e quatro, de doze de Agosto de mil novecentos e oitenta e cinco, são pela presente Carta a mesma Convenção e Protocolo Financeiro confirmados e dados por firmes e válidos para produzirem os seus efeitos e serem inviolavelmente cumpridos e observados.

Em testemunho do que a presente Carta vai por mim assinada e selada com o selo da República Portuguesa.

Dada nos Paços do Governo da República, aos dezasseis *dias do mês de* Outubro *de mil novecentos e oitenta e cinco.*

HIGHLIGHT

Since Portugal became a member of CERN in 1986, not only experimental particle physics projects have been developed. We chatted via email with colleagues in ISOLDE and in the Theory.

30 years of Portugal at ISOLDE-CERN

an unimaginable success, but still not official

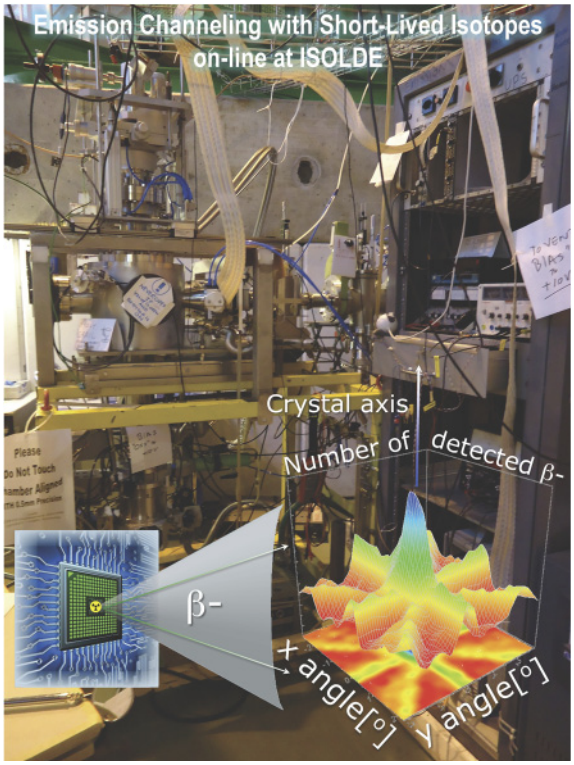
José Carvalho Soares and João Guilherme Correia

In 1986, no one could have foreseen when one of us was first invited to apply for funding projects at CERN – in a field outside high energy physics and dedicated to the applications of nuclear physics to the study of materials at the ISOLDE laboratory – that 25 years later, instead of a *"scientific fairy tale"*, a lively infrastructure would have been built.

CERN is a very special place to foster ideas especially when these are original and backed up with a commitment to planning in the medium to long term by the country of origin, i.e., Portugal. At this time – to our advantage – there was the Solid State Nuclear Physics Group (GFESN), established at the Nuclear Physics Centre of the University of Lisbon (CFNUL), which brought together professors, researchers and students from the Faculdade de Ciências de Lisboa and from the Physics Department of the former Instituto Tecnológico e Nuclear (ITN). Today these are integrated into the Instituto Superior Técnico (IST) as the Campus Tecnológico e Nuclear (CTN). The group was already well recognized internationally in the areas of materials modification and characterization with ion beams and hyperfine interactions. Being at the time the responsible group for the use, coordination and development of the ITN accelerators, with resources from national and international projects, it settled a laboratory of excellence in the field of ion beams in Portugal. On the other hand, profiting from the existence of the ITN Portuguese Research Reactor, radioactive sources were produced and used to probe the materials with hyperfine interactions, a special method with nanoscale and ns time resolution that allows spying the electronic and atomic behaviour of single atoms merged into materials.

How then came the idea of ISOLDE – CERN, in this context ?

The answer is due to the uniqueness and complementarity of the ISOLDE laboratory (Isotope Separator On-Line DEvice). This is a centre of excellence worldwide and is unique in its ability to produce a large variety of elements and isotopes, which are delivered as highly pure radioactive beams. Combining GFESN expertise with the ISOLDE environment – which could produce isotopes and elements unavailable elsewhere – in 1989 we revived and reconfigured a K.-Siegbahn e-gamma Perturbed Angular Correlation spectrometer, a unique machine from the 1950's previously stored at the University of Bonn. With such a unique tool we could enlarge the number of suitable hyperfine interaction probe elements (working with both gammas and electrons as nuclei messengers) with senior researchers and students evolving in a 1st class world laboratory. A research proposal had by then been approved by the CERN-ISOLDE scientific committee, planting a seed that was to bear fruit in the coming years.



Evolution: Since 2000, ITN has taken responsibility for the coordination of Portuguese activities at ISOLDE, including the maintaining of a coordinating researcher on-site. The combined support from CFNUL-ITN has been sustained and been crucial in all R&D achievements, as well as being the driving force for extending the collaboration to other materials research oriented universities, such as the Universities of Porto, Aveiro, and Trás-os-Montes. From the early years to 2011 funding support for the scientific work, R&D and maintenance of the Portuguese infrastructure has been provided exclusively by the Portuguese funding agency, FCT. The CERN projects have been evaluated annually and achieved the maximum grade over for the last 10 years. The number of research subjects and infrastructure has also grown considerably. Since 1997 the group has embraced a new technique *"Emission Channelling"* – a powerful method to determine the lattice site location of diluted dopant-impurities in, e.g., semiconductors for almost every (radioactive) element of the periodic table. By using fast electron position sensitive Si-pad detectors – primarily developed at CERN for high-energy physics – we have developed and commissioned in 2007 a new experimental infrastructure (EC-SLI – Emission Channelling with Short Lived Isotopes). This has been installed on a dedicated ISOLDE beam line and has greatly enlarged the number of available probes to determine the properties of semiconductor dopant elements such as Be, Mg, Mn, Co, and Ni.

Today four active proposals exist which utilise the initial hyperfine interaction methods covering subjects such as ad-atoms on graphene, cleaning water with magnetic nanoparticles, superconductors and giant magneto-resistance materials, and studying the doping of new transparent semiconducting nano-particles. In parallel, using the emission channelling technique, there are two active proposals studying the lattice location of transition metals examining their relevance for doping, and the particularly hot subject of magnetic doping in semiconductors.

Last year – 2013 – three Portuguese (one post-doc and two PhD students) won prestigious prizes at international conferences with data produced at the EC-SLI setup. This was even mentioned by one of our famous Sunday political commentators, who didn't realise that the most relevant point was that this was the fruition of continuous Portuguese investment (in terms of initiative and infrastructure) at a foreign laboratory – ISOLDE CERN.

In fact this leads us to the only sad fact in this adventure: Portugal has worked at ISOLDE for almost 30 years, produced relevant results, with many high grade scientific publications and theses; it has established a permanent experimental infrastructure and yet has never entered the ISOLDE collaboration as a partner, having been refused several times by the funding agencies and politicians. There, at ISOLDE (and FCT), we are always mentioned as being one of the strongest groups, an example of quality and professionalism. However paradoxically, at the same Laboratory we are excluded from the decision-making and management committees and – with bitterness we must say – that many times we are singled out as being the unfortunate Portuguese spongers who can't even pay such a low cost fee/subscription.

To end on a positive note: this is a success story from the strategy of Portuguese groups and funding – which has attracted high-quality national and foreign researchers and collaborations to our laboratories both in Portugal and at ISOLDE. We have the leadership of a unique facility which is based abroad, due to the specifics of the techniques and of the ISOLDE laboratory itself, embracing the endless world of materials research, while also training students in such complementary areas as nuclear and materials physics.

more info at:
c2tn.tecnico.ulisboa.pt/grupos-de-investigacao/engenharia-e-tecnicas--nucleares/caracterizacao-de-materiais-com-tecnicas-nucleares-radioac-tivas

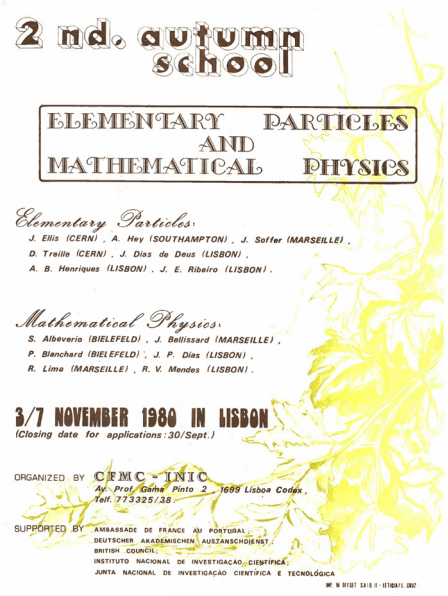
isolde.web.cern.ch

Theory

Jorge Romão, Gustavo Castelo Branco

Portugal's accession to CERN in the mid 1980s had a crucial role in the development of theoretical particle physics in Portugal.

After the revolution of the 25th of April 1974, several physicists returned to Portugal who, for a variety of unplanned circumstances, had done a PhD in Theoretical Particle Physics. They created a small initial nucleus to which belonged Jorge Dias de Deus, Rui Vilela Mendes, Gustavo Castelo Branco, Alfredo Barbosa Henriques and Augusto Barroso. Portugal's accession to CERN provided a framework for financing, throught the so called Fundo CERN. This allowed for the developed of the group which attracted excellent students and grew to a community of about three tens of physicists with a PhD in Theoretical Particle Physics working in Portugal.



This growth was also boosted by the modernization of Universities and the introduction of the Teaching Career Statute, where the requirement of a PhD took, in some schools, to an exponential growth, as was the case at the Instituto Superior Técnico (IST). IST eventually attracted most of the initial nucleus, as well as the majority of the students, and a third generation of excellent physicists is today already starting its activity. Due to the lack of opportunities, many of these young scientists are pursuing their career outside Portugal.

If nothing is done, the necessary renewal may be compromised, overturning much of what has been achieved.

It it worth noting that the field of Particle Physics was pioneer in Portugal, three decades ago, in introducing instruments of action and development, having the international best practices as a reference. Among these stand out the contracts for post-doctoral positions, workshops on specific subjects associated with the latest developments in various areas of expertise (the Automn school series) and the pioneer use of electronic mail and of scientific computing. We can say with some pride that much of the current research infrastructure in Portugal in several areas ows to the organization and practices that this field of knowledge was able to build and enforce in the national scene over the years.

In addition to the funding structure that membership created, CERN has also played a central role as an attractor and a place for sharing of ideas. In fact, with the LHC, CERN increasingly became the global reference in Particle Physics, not only for experimental physicists but also for theorists. These have been able to obtain Fellow positions at CERN's Theory Division and CERN has welcomed as short and medium term visitors a large number of theoretical physicists and PhD students in this area.

HIGHLIGHT

Ex CERN Physicists now in Enterprises

CERN played a central role in the development of a strong particle physics community in Portugal.

LIP was created shortly after Portugal became a member of CERN and proved to be a solid ground for advanced training and for the participation in international scientific projects.

For all of us working in research, CERN is an unavoidable reference. CERN experiments are still at the core of the institute. Several former LIP students and researchers are today CERN staff members. Even today, with LIP teams working in cosmic ray and dark matter experiments elsewhere in the world, few are those who were never connected to CERN. But what is the view of those who left research?

How do they see CERN and its role in their career? Via email, we chatted with 2 former LIP/CERN members.

Rui Ferreira, 49 years old

Living in Zurich, Switzerland.

During my business professional career, I have worked in the financial services industry (banking, insurance, asset management).

In the current job, as Risk and Capital Data Manager at Zurich Insurance Company and previous job with IBM, I have managed the development and implementation of strategic information management solutions with the objective of improving business performance and risk management, and reducing complexity.

After completing the Physics Engineering Degree at IST, I joined the LIP applied research programme in 1987/88 as a PhD student in the context of the CERN-SPS NA38 Collaboration, focusing on the search of quark gluon plasma in high-energy heavy ion collisions.

LIP was a new international research institution with plenty of young talent, combining experienced scientists returning to Portuguese universities from PhD and Post-doc studies abroad with a new generation of Physics and Computer Science graduates from IST, Faculdade de Ciências and Universidade de Coimbra.

At the time, LIP could be considered a "start-up" in experimental high--energy physics. There was a strong entrepreneurial spirit, and drive to compete and succeed in the international scientific arena. Growth and expansion depended critically on significant investments from the European Commissions and Portuguese government funding.

After completing my PhD in 1992, I started working as a CERN Research Fellow in the CERN-SPS CHORUS Collaboration looking for the experimental evidence of neutrino oscillations.

The ability to design, develop and implement complex computer programs for data analysis, data modelling, and statistical treatment of large data sets is a unique asset in today's Big Data world. To be a Data Scientist is one of the most exciting professions in any industry of the 21st century.

Because I have worked in a truly international collaborative environment, I am an excellent team player with proven ability to drive and lead in cross-functional, multi-cultural teams.

Scientific and business research has always been a key aspect of my work. We can't compete in this rapidly changing world of knowledge and information, if we can't keep up with the newest industry trends, technology novelties and business best-practices. Continuous learning is not just a necessity, it is a survival strategy.

In the end of 1997, after 10 years of research in particle physics, I decided to make a major career change. I embarked on an Executive MBA programme to facilitate the move to the business world, and started working as Risk Analyst for Fortis Asset Management in Belgium.

Teresa Monteiro, 42 years old

Living in Paço de Arcos, Portugal.

I work at Coriant, a global company developing advanced end-to-end solutions – equipment and Software- for optical telecommunication operators. At the moment, I am the Line Manager of a team of 15 System Architects, who work in the identification of customer needs and in the definition of the required functionality for Coriant's products. I am also the coordinator, both at technical and project level, of the functional specification for an innovative optical network planning and operation solution that Coriant expects to introduce soon to the market.

I joined LIP as an undergrad student, working on my Physical Engineering degree thesis for about 1 year. I left for a few years, but kept in touch while doing my PhD, in High-Energy Physics. I later worked again directly with LIP for another 3 years, in a post-doc position at CERN.

I left LIP when my post-doc position at CERN ended and I decided to look for a job outside the academic world.

High-Energy Physics introduced me to Sofware Engineering and it was via Software Engineering that I walked into the Telecommunication arena. My current responsibilities and business area have little to do with the specific topics I studied while at LIP/CERN; however, it was at LIP that I first worked in multi-cultural, multi-national environments, where large teams, spread over different locations, address and find solutions to complex technical problems in a cooperative way, with a common goal - and that is undoubtedly one of the cornerstone of what I do today.

I quite like what I do and would not go back to high energy physics or to pure research. I like the fact that I work in a very demanding, high--paced, technological field, where I need to keep in touch with the latest scientific developments in optical transmission and telecommunication networks. However, I also like the business and marketing part of it all, and I find it very gratifying that the products I help developing are used every day by millions of users all-over the world!

It happened 40 years ago

From the diary of Carlos Conde

In May 1975, at the Physics Laboratory of the University of Coimbra, George Charpak gave a seminar on multi-wire chambers, the work for which he would be awarded the Nobel prize in 1992.

This visit coincided with the elections for the Assembleia Constituinte, the first elections after the revolution of the 25th of April 1974. Charpak was very impressed by the high turnout of voters in these elections (see foto).

This visit is vaguely related to the visit of professors Armando Policarpo and Carlos Conde to CERN in 1971 to evaluate the possibility of Portugal becoming a CERN member.

Thus, the first accession attempt was conducted by the then minister of education Veiga Simão, who met with all the professors/researchers in experimental and theoretical nuclear physics and all the universities with the aim of evaluating the interest in high energy physics research.

The first meeting between the minister and the researchers took place at the ministery in January 1971, at 17h. The participants where the minister Veiga Simão, the president of IAC - Instituto de Alta Cultura, Dr. Abreu Faro and Professors Almeida Santos (Coimbra), Joaquim Araújo (Porto), Lídia Salgueiro (Lisboa), Gomes Ferreira (Lisboa) Bragança Gil (Lisboa), Providência e Costa (Coimbra), Armando Policarpo (Coimbra) and Carlos Conde (Coimbra). Issues related to research in "High Energy Nuclear Physics" and to the accession to CERN were discussed.

As a result of this meeting, in March Profs. Conde and Policarpo travelled to Paris, where they had a meeting with Prof. Teillac. They also met Adelaide Brandão, who was preparing a doctorate in High Energy Physics. From Paris they went to Geneva where they visited CERN.
As a curiosity, we give the detailed programme of the trip:

8 de Março de 1971
10h Reunião em Lisboa com o Ministro e o Presidente do IAC
12h 30m Partida de Lisboa
15h Chegada a Paris, encontro com Adelaide Brandão.
16h Reunião com o Prof. Teillac do Inst. du Radium, Paris.
17h Reunião com o Mr. Onmes do Inst. de Physique Nucleaire
9 de Março
9h Reunião com Mr. Dubocq
15h 30m Reunião com Mr. Block
11 de Março
9h Partida de Paris
10h Chegada a Geneb seguida de visita ao CERN
12 de Março
7h 30m Partida de Genebra
8h 30m Chegada a Paris
10h 30m Reunião com o Prof. Teillac e Mr. Dubocq
15h Partida de Paris
17h 30m Chegada a Lisboa
18h Reunião com o Ministro e o Presidente do IAC
19h 25m Partida de Lisboa
22h Chegada a Coimbra

After the visit, there was a meeting in Lisbon in March 16 with the minister Veiga Simão where Profs. Abreu Faro, Policarpo, Conde and Providência were present.
The idea did not go forward due mainly to the fact that the participants in these meetings did not show interest in opening their research to this new field.

However, already in those days, several young physicists were preparing their doctorates and post-graduations in several European and American universities.

Around 30 years ago

Catarina Espírito Santo

In the beginning of the 1980's, the Portuguese high energy physics community was showing important signs of growth. In 1981, it was able to attract to Lisbon the International High Energy Physics Conference, which took place at the premises of Fundação Calouste Gulbenkian. In this Conference were present Richard Feynman, Abdus Salam and the CERN Director General of the time, Herwig Schopper.

In parallel with the conference, the public exhibition "De que são feitas as coisas?" (what are things made of?) at the IST attracted a large number of visitors. The poster of this exhibition is shown in the figure.

The organization had the active participation of a number of young physicists who had attended the first free courses on elementary particles lectured by José Mariano Gago, or the recently born Autumn Schools (see "Snapshots" section - pg4), or were in some way getting started on the path of high energy physics.

The exhibition included the organization of public seminars. In particular, a series of seminars was given by Peter Sonderegger, who kept a close and fruitful connection with LIP for the decades to come, and was at the time the head of the WA74 experiment at CERN, where young Portuguese researchers were working. Portuguese PhD students were also present in NA10, led by Louis Kluberg and Roberto Salmeron, and NA14, led by Daniel Treille, as well as in the team of Charpak and Sauli.

The year 1981 was an important milestone that showed the motivation and organization of this community. Portugal would become a member of CERN in 1985, and LIP would be created in 1986.

HIGHLIGHT

LHC: what next ?

Gaspar Barreira

This was a question with a very simple answer some ten years ago. The answer was ILC, the International Linear Collider, a lepton accelerator somewhere in the range 500 GeV to 2 TeV for the more ambitious, an approach of relatively conservative design under the assumption that if we got the money to build the machine we could start now!

In a meeting in Saclay around the end of 2004, a large representation of our community was faced with the request from our American colleagues to take immediately a decision on the site location. Proposal: Fermilab. The community was divided: LHC was yet under construction, why such a hurry, LHC was still clearly a priority, why in the States and not at CERN...There was even a trouble maker arguing why not across the Portuguese Spanish border along the axis Évora Badajoz?

To make things even more complicated CERN had (still has) an alternative to the ILC, the CLIC, a technically ambitions project that could not be installed immediately even if the money existed.

Anyway, in the following year the CERN Council approved in Lisbon the European Strategy for Particle Physics where the LHC was declared the very first priority, and yes the ILC is very interesting, but R&D for CLIC should be poursued, lets install the LHC and look at the data, we will talk then about the next machine...

Not much later the US Secretary of Energy Samuel Bodman declared that the US would not consider ILC before 2015. It was not the end of it but there were no more any hurry for a decision. Eventually the ILC approach and the CLIC approach joined together in mixed committees and work is still going on at a much slower pace, even if *"a five-volume report containing the blueprint for a future particle physics project, the International Linear Collider, was published on 12 June 2013"* (a citation from the ILC web site).

And LHC finally emerged and run! Data was taken and analyzed. And the world became much more complicated (and interesting). Where is the energy wall beyond which we will begin discovering the Dark Universe, the supersymmetry elegance, the New World of Elementary Particles? We are NOT yet there. And again the question: is the ILC the new horizon for experimental particle physics? Nobody is sure. So let's wait for the 13-14 TeV LHC and look at the data. Then decide...

Meanwhile, CERN was preparing the next edition of the European Strategy in Erice, Italy, in January 2013. And boom!, our Japanese colleagues announced that they will install ILC in Japan as a global Facility. This announcement triggered a lot of curiosity and some enthusiasm but the question remained: is this the machine we need after LHC?

The European Strategy was approved by the CERN Council a few months after: lets increase the energy of LHC, lets increase its luminosity and keep going towards HLLHC and SuperLHC . That will keep us busy till 2035. Keep an eye on the Japanese program, keep CLIC R&D going...

In January 2014, the impatient guys at CERN presented a new project: The FCC, Future Circular Collider, a 100 TeV hadron accelerator, 80 to 100 km in perimeter depending on how many Tesla we can put in the supermagnets, and the entire Geneva town will just fit inside...Some would bet that this is the machine that will break the energy wall.

(Astroparticle physicists involved in extreme energies could laugh: they already break the accelerators energy wall. Have you already heard about Auger?)

Coming back to my original question "LHC: what next?", you want my sincere answer?

The next machine after the present LHC will still be LHC. Keep busy guys.

FCC (Future Circular Colliders)
CDR and cost review for the
next ESU (2018) – including injectors

PROJECTS

The top quark:
Why it plays an important role in particle physics

Michele Gallinaro

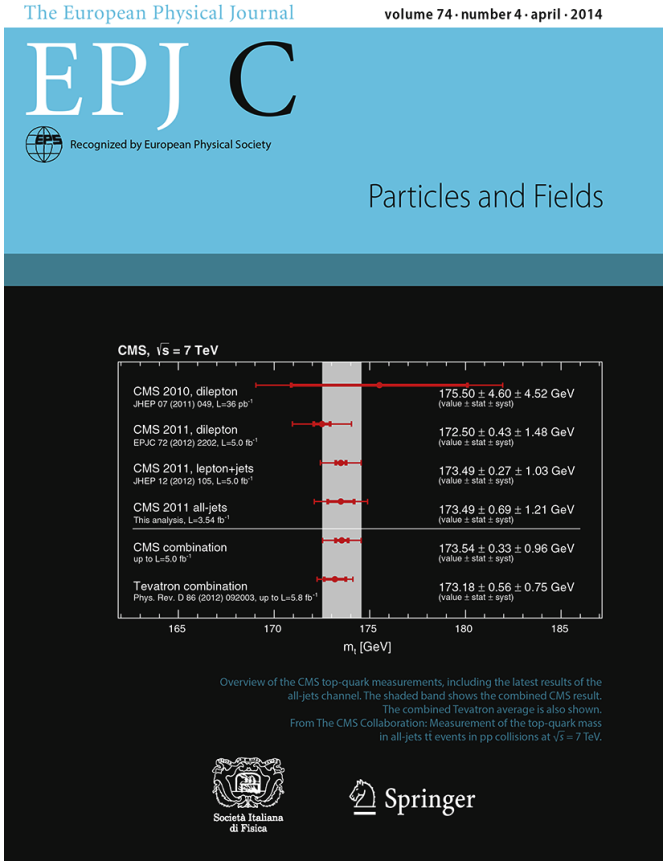
A quark is an elementary particle and a fundamental constituent of matter. After the discovery of the Higgs boson at the CERN LHC, we understand the Universe in terms of quarks and leptons and bosons for approximately 5%. The remaining 95% is unknown.

The quark model, introduced as a part of an ordering scheme for hadrons, was proposed by Murray Gell-Mann and George Zweig in 1964. Quarks are elementary particles that experience all fundamental interactions, and are of fractional charge. Deep inelastic scattering experiments at SLAC gave evidence of their physical existence in 1968. Eventually, accelerator experiments provided evidence for all six flavors. There are no more. The top quark was the last to be discovered at Fermilab in 1995.

The top quark is a fundamental particle, perhaps of a special kind. Researchers at LIP played a leading role in studying its properties during the CERN LHC Run I, both with the ATLAS and CMS experiments. These include the measurement of the top quark cross section and top quark mass in the dilepton channel, and a recent most precise measurement to date of the Cabibbo-Kobayashi-Maskawa matrix-element Vtb.

A summary plot of the CMS top quark mass analyses at 7 TeV made it to the cover of the European Physics Journal C (EPJC) April 2014 issue. In the Figure, there are two measurements directly performed by the LIP/CMS group, labeled as JHEP 07(2011)049 and EPJC 72(2012)2202. These measurements represent the first top quark mass measurement at the LHC, and the most precise single measurement in this decay channel, respectively. EPJC is one of the journals with highest impact factor in our field. This recognition reflects the importance of these results. In fact, the top quark mass is a fundamental parameter of the standard model and an accurate measurement may provide stringent constraints on the electroweak symmetry breaking mechanism and in the search for New Physics, and allow for an improved understanding of the future steps to take. In addition, observations of the relative rates and kinematics of top quark final states may also provide constraints for new physics processes.

This reminds us of the importance of fundamental measurements and about their impact, and it is important to remember that writing a paper in a large international collaboration is not only a matter of numbers of infinitesimal fractions. It is often (wrongly) assumed that large experiments leave no space for individual talents and small groups to excel. This belief is wrong, and one should consider it again. These results would not have been possible without the invaluable support of our funding partner FCT, and we hope its recent instabilities are only temporary.



Big puzzles, such as the understanding of the Universe, can only be addressed by challenging international projects where researchers collaborate in large groups towards a common goal. The top quark still plays a fundamental role in the program of particle physics. The study of its properties may uncover the first hints in answering some of the fundamental questions, towards an improved understanding of our Universe. With the start of Run2 in the dawn of 2015, researchers at LIP will be probing some of the most challenging frontiers of the Unknown.

PROJECTS

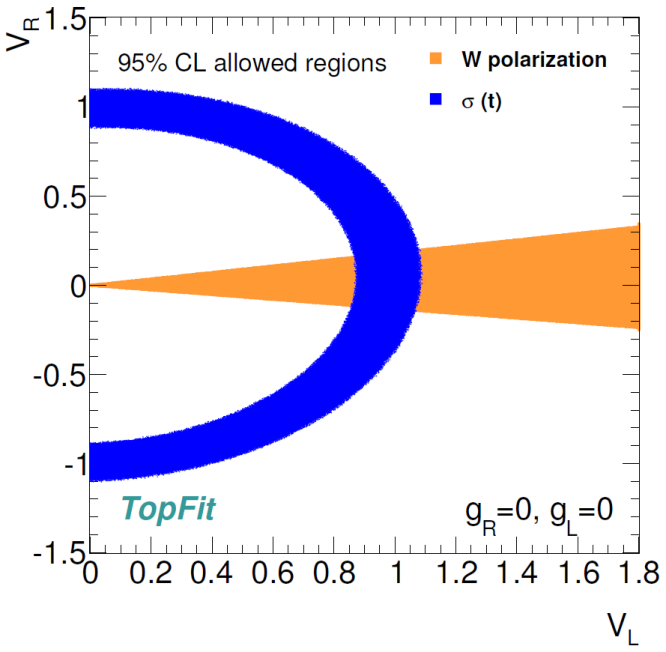
The top quark as a precision test of the Standard Model and as a window to physics beyond it

Nuno Castro

The dataset collected by the Large Hadron Collider (LHC) in 2011 and 2012 at a centre of mass energy of 7 and 8 TeV, respectively, opened a precision era in the study of the top quark's properties.

This quark is the most massive elementary particle known to date, decays almost exclusively through a single decay mode (t->bW) and, due to its extremely short lifetime, decays before the typical hadronization timescale, allowing its spin information to be transferred to the decay products. Such unique characteristics provide not only an excellent way of testing the Standard Model (SM), but also an important window to physics beyond it.

At the LHC, the dominant production mode of top quarks is the pair production, with the corresponding cross-section calculated at next-to-next-to leading order in QCD, including resummation of next-to-next-to-leading logarithmic soft gluon terms. This very significant effort from the theoretical top quark physics community allowed to reduce the theoretical relative uncertainty in the top pairs production cross-section to less than 6%. The experimental results by ATLAS and CMS are in good agreement with this prediction and, amazingly, the ATLAS result in the dilepton channel has an experimental relative uncertainty smaller than the theoretical uncertainty (4%).



Even if the top quark mass is a free parameter in the SM, it can be related, through the electroweak radiative corrections, to the Higgs and W bosons mass. The simultaneous measurements of these masses is, therefore, an important consistency test of the SM, allowing us to test, for instance, the stability of the Brout-Englert-Higgs potential when extrapolated to higher energies.

It is interesting to note that the current measurements point to a meta-stability region of the potential.

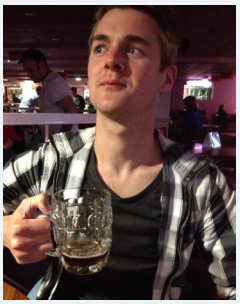
An important milestone in the measurement of the top quark mass was the first world-wide combination (by the ATLAS, CDF, CMS and DO Collaborations in March 2014), which allowed to obtain a measurement with an unprecedented relative uncertainty of 0.4%. Such precision motivates a discussion on the the exact meaning of the observable being measured. In fact, it should be noticed that the top quark mass measured through direct reconstruction of the top decay may differ from the pole mass, corresponding to the definition of the mass of a free particle, by around 1 GeV. The strong dependence of the top/anti-top production cross-section with the top mass offers the possibility of interpreting the cross-section measurements as a measurement of the top quark pole mass. The latest ATLAS result on the top pole mass is in good agreement with the measurements based on kinematic reconstructions, but with a significantly larger relative uncertainty (1.5%).

The top physics programme at ATLAS allowed to perform precision measurements of several properties, both related to the production (charge asymmetry, top polarization, spin correlation, pair production associated with photons, W and Z bosons) and to the decay (W polarization, rare decays) of the top quark. Furthermore, an extensive search program in the top sector was developed: heavy resonances, new heavy quarks, excited quarks, flavour changing neutral currents, anomalous production of same-sign dilepton events, etc. Even if no evidence for new physics was found so far in the top sector, it should be noticed that many Run I analysis are still ongoing and that the huge amount of data expected at the Run II will allow to probe subtle effects which were not tested yet. In fact, most of the current measurements are dominated by modelling and jet measurements systematics, so a significant effort will be required to develop specific analysis which will allow to reduce these uncertainties. In addition, the detailed study of differential distributions will require a significant increase of the available dataset and the measurement of the top quark couplings (to the W, Higgs, Z and photon) will be crucial to fully characterize the top quark. Such studies of the top couplings will require the combination of different channels, as exemplified in the enclosed figure, where is is clear that a combination of the single top production cross-section and the W polarization in top decays observables are required to probe the left- and right-handed vectorial couplings of the Wtb vertex.

In summary, two decades after the top quark discovery, the study of its properties is still a very active field, which has now entered in the precision measurements phase. The completion of the analysis of the Run I data, as well as the significant increase of the available dataset in the Run II of the LHC, are expected to considerably expand our knowledge on this quite intriguing particle.

TRAINING

New Members



Robert Cantrill

I've recently started working at LIP, Lisbon as a postdoc on the ATLAS experiment. My work includes research for the ttH analysis and contributions to the jet trigger.

I am originally from the UK and I studied for my PhD at Royal Holloway, University of London. My PhD could not have been timed more perfectly, I had the opportunity of working with the Higgs to diphoton ATLAS group during the time the Higgs boson was discovered and the privilege to include a first measurement of the Higgs boson in my thesis. The discovery of the Higgs was the most exciting experience in my academic life. It was a triumph for science and an opportunity for me to participate in lots of outreach events, one of which included talking with politicians at the UK Houses of Parliament.

I am excited to be working at LIP and to continue research on the Higgs. Thank you to everyone for making me feel welcome and persevering with my limited Portuguese - I am learning honest.

I am looking forward to the opportunities that come with this analysis and the restart of the LHC. Lets hope there are more discoveries to come.

IDPASC doctoral programme

Mário Pimenta and Catarina Espírito Santo

The IDPASC-Portugal doctoral programme has recently been approved by FCT, with a total of 24 grants for 4 editions. The programme brings together the main higher education institutions and research units in Portugal with a clear record of expertise in the field of PASC (Particle Physics, Astrophysics and Cosmology), comprising both research of excellence and successful doctoral programmes.

The combination of their expertise, resources and infrastructures is expected to provide students in this programme with unique research and training conditions. The participant institutions are LIP and the Universities of Lisboa, Coimbra, Porto, Minho and Évora. The programme benefits also from the close connection to the IDPASC international network.

The first call for applications is currently open. Researchers can submit thesis proposals from July 3rd to September 1st. Applicants can apply to proposed thesis from 3rd July to 5th September.

find more at: www.idpasc.lip.pt/portugal

Master Thesis

Study of jet trigger in p+Pb collisions with the ATLAS detector

Alexandre Lopes
19 de Maio de 2014

PhD Thesis

Integrated Circuit Design for Time-of-Flight PET

Manuel Rolo
16 de Abril de 2014

Time-of Flight information on PET systems allows for unprecedented sensitivity and spatial resolution, as the signal-to-noise ratio and thus the background rejection is significantly improved. The very high gain of the silicon photomultiplier (SiPM) and its sensitivity to single photon hits makes it a good candidate for highly compact systems. The EndoTOFPET-US project aims at 200 ps FWHM coincidence time resolution, which would allow to confine the positron annihilation coordinate along the line-of-response with a FWHM position uncertainty of u 30 mm.

Scintillation light statistics, which include intrinsic timing characteristics of the crystal and the travel path of the photons, along with the time spread due to the avalanche build-up in the SiPM, introduce a jitter that could ultimately compromise the targeted time resolution.

In fact, the signal shape fluctuation at the output of the photodetector reflects the statistical time distribution of each photon building up the signal. Since the arrival time of these photons is weakly correlated to the time of the decay, the readout system must be able to trigger on the first photo-electrons. Achieving this fine resolution calls for fast and low-noise front-end electronics, capable of extracting the energy and a very precise time stamp of each event.

At the same time, its integration in compact PET detectors with several thousand channels poses strict limits to the maximum power budget.

This thesis describes the design of a novel front-end ASIC for Time-of-Flight applications.

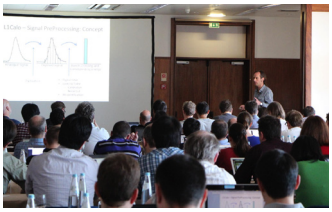
The chip integrates signal conditioning and discrimination circuitry, and high-performance low-power TDCs for each of 64 independent channels, providing a time stamp and time-overthreshold measurement for each event of interest. It targets 25 ps r.m.s. intrinsic resolution and features fully digital output.

IN BRIEF

ATLAS Trigger Workshop 2014 in Sesimbra

Ricardo Gonçalo

After Beatenberg (Swiss Alps), Amsterdam and Athens, the 2014 ATLAS Trigger Workshop was held at the Hotel do Mar in Sesimbra and organized locally by LIP.



The trigger is a crucial part of any experiment. In the case of the LHC experiments these are very complex systems involving the work of hundreds of researchers and PhD students. Every year, the ATLAS Trigger community meets for a few days in a workshop to identify the challenges ahead, estimate future requirements from physics analyses, and plan the work for the coming year. The main goal for this year's workshop was to prepare for the coming LHC Run II, to start in early 2015.

Exceeding our expectations (and almost the hotel capacity) more than 130 colleagues came to Sesimbra. Prof Gaspar Barreira presented LIP during the opening session and several other LIP members were of great assistance during the workshop. Ms Natália Antunes was irreplaceable in the meeting preparation and in the workshop secretariat. Hugo Gomes and Carlos Manuel expertly wrote the meeting webpage. During the workshop we counted on the help of ATLAS students Ademar Delgado, Mário Sousa and Lourenço Lopes. Patricia Conde Muiño and Ricardo Gonçalo were the local committee.

Our colleagues went back after five days of intense work, a huge number of fruitful discussions in the relaxing atmosphere of Sesimbra and during a social evening cruise in the Tagus followed by dinner in Lisbon. This was a very successful workshop, which is showing its fruits in the ATLAS trigger preparation for the upcoming LHC run.

more info at: www.lip.pt/events/2014/atlas_trigger_workshop

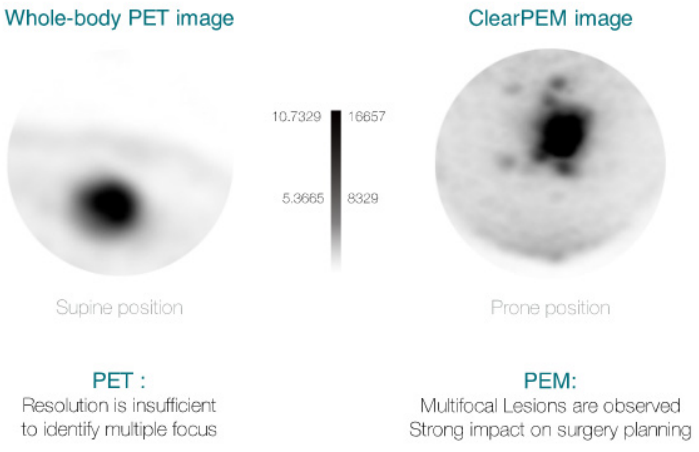
PETSys Electronics – Clinical Trials

João Varela

The validity of PETsys high-resolution technology has been demonstrated in clinical trials in Hospital Marseille and ICNAS, Coimbra, with two machines (prototype and pre-production). Several cases of cancerous tumors were identified which are not visible in the whole-body PET images. Medical doctors conducting the clinical trials have presented the results in international scientific conferences. Our ClearPEM technology (image in the right side) identifies multifocal lesions. Standard whole-body PET (image in the left side) doesn't.

In surgery, it is essential to know that there are multifocal lesions in order to remove them all when extracting the cancer tumor.

more info at http://www.petsyselectronics.com/web/inovate-solutions



CIÊNCIA VIVA NO LABORATÓRIO 18ª EDIÇÃO

OCUPAÇÃO CIENTÍFICA DE JOVENS NAS FÉRIAS
JUNHO A AGOSTO DE 2014

OCJF 2014 – Ocupação Científica de Jovens em Férias

Catarina Espírito Santo

As in previous years, LIP-Lisboa participated in the summer holiday programme of the Ciência Viva agency OCJF - Ocupação Científica de Jovens em Férias 2014.

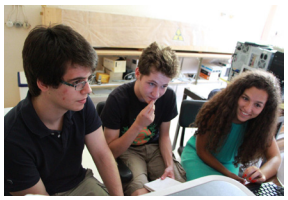
From the 14th to the 25th of July, fourteen students with ages between 15 to 18 worked with us in three different proposed internships:

In ATLAS, the six participants analysed data in search for the W, Z and Higgs bosons, performed laboratory measurements related to the optical fibers and scintillators that constitute the TILECAL, the hadron calorimeter of the experiment. In CMS, two other students also studied pp collisions at the LHC, this time in search for top quark production, understanding how the detector works and what are the challenges of the different final states.

Finally, in the "Particle Hunt" internship, six students learnt about particles, interactions and the research done at LIP, through different proposed activities that included analysing bubble chamber and LHC data, detecting cosmic muons and gamma rays from nuclei, understanding radioactive decay using dice or computing how many neutrinos arrive from the Sun.

In the last day the participants presented their work in a LIP Seminar. Also present in this session and presenting their work were students and teachers from Escola Sá da Bandeira - Santarém, who developed a project on Extreme Energy Cosmic Rays during one schoolar year.

more info at: www.cienciaviva.pt/estagios/jovens/ocjf2014



OUTREACH

Radiation Environment Project

Luis Peralta and Florbela Rego

On May 10, 2014 ended the 7th year of the Radiation Environment Project with the National Meeting of the participating Schools held in "Oficinas de São José" in Lisbon.

The meeting saw the participation of 26 schools of primary and secondary level, and three institutions of higher education, which was attended by 137 students and 33 teachers.

There were several moments involving the meeting, science fair, moments of animation and end with a scientific discussion with the presence of several Portuguese researchers, who responded enthusiastically to questions posed by students and professors.

"Participation on 7th Radiation Environment Project"

26 schools + 3 institutions

=

137 students and 33 teachers

But the most exciting moment was the science fair, where students had the opportunity to show all the activities that were held during the school year. With particular emphasis on the most recent activity in the project, the construction of an infrared detector based on a semiconductor LED. Students had the opportunity during the year to build the detector from scratch and perform activities such as the study of the Stefan-Boltzmann law.

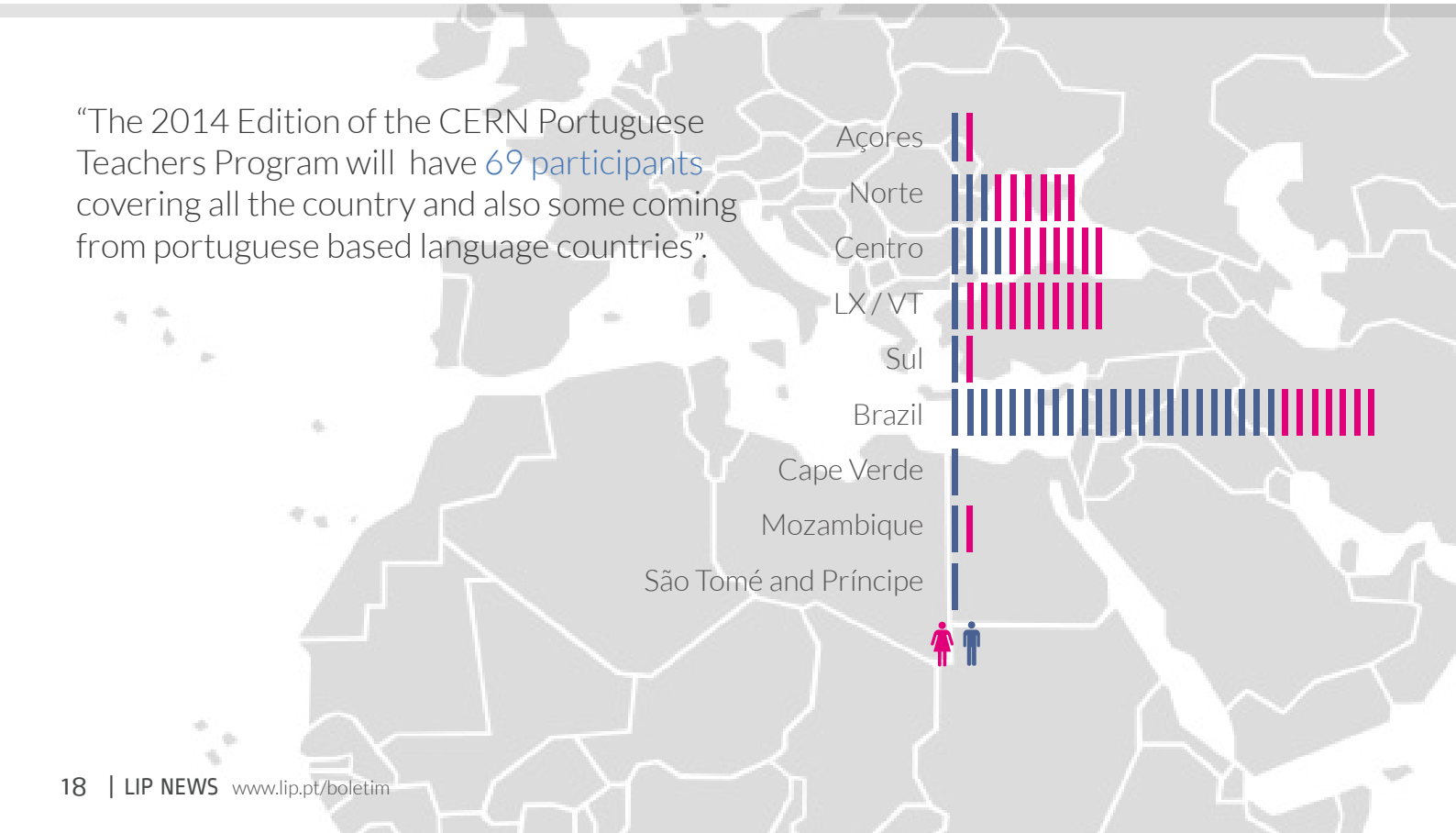
Throughout the meeting the share of experiences among the various schools and institutions supporting the project was undoubtedly of great value for the dissemination of science among students in primary and secondary level.

The project is funded by Program *"Escolher Ciência"* of Agência Nacional para a Cultura Científica e Tecnológica (Ciência Viva) and has the support of Laboratório de Instrumentação e Física Experimental de Partículas, Universidade da Beira Interior, Universidade de Coimbra e Universidade de Lisboa.

This Summer at CERN

Pedro Abreu

"The 2014 Edition of the CERN Portuguese Teachers Program will have 69 participants covering all the country and also some coming from portuguese based language countries".



CERN Teachers Program in Portuguese 2014

24-29 August, CERN

more info www.lip.pt/cern_em_portugues

FÍSICA2014 - 19th National Conference on Physics and the 24th Iberian Meeting for Physics Education

2-4 September, IST Lisboa

more info www.spf.pt/fisica2014

"A Partícula no Fim do Universo"

with a foreword by José Mariano Gago, Amélia Maio e João Varela.

recently RELEASED 19,35 €

IYL 2015 - International Year of Light and Light-based Technologies

International Year of Light and Light-based Technologies (IYL 2015)

more info www.eps.org/?page=event_iyol

sp física SOCIEDADE PORTUGUESA DE FÍSICA

Portuguese Physical Society Membership

In LIP over 75% of us are physicists but very few are members of the Portuguese Physical Society (SPF).

It is always good to live in a country where there is a Society to discuss the interest of physics, how to improve their teaching and research.

The quota is 40 euros, but we will receive at home a good magazine - The "Gazeta de Física" and the "europhysicsnews" from EPS and we will have discounts on all SPF initiatives.

The Membership and quota payment can be done online: http://www.spf.pt/adesao

Les Horribles Cernettes

In a Birthday all songs are welcome

WATCH LIVE CONCERT http://www.youtube.com/watch?v=jQKpB81kB3k

Image by: CERN, Illustrated by Carlos Manuel.