TOP 2017

TOP - Share Knowledge with Young scientists

Universidade do Minho
Escola de Ciências

UNIVERSIDADE DE COIMBRA

ISEL
INSTITUTO SUPERIOR DE ENGENHARIA DE LISBOA

LIP

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Introduction

The series of International Workshops on Top Quark Physics started in 2006, in Coimbra, with the main goal of establishing a close collaboration between experimentalists and theorists working on the field of top quark physics and its connection to new physics. The workshop gathers contributions from experts from around the world that meet, now, once a year and typically in September, to discuss the latest developments achieved by the community.

The *top* quark, also named as *t* quark, is the heaviest of the six fundamental building blocks of nature know as *quarks* (*u*, *d*, *c*, *s*, *b* and *t*) which, together with the six *leptons* (*e*, ν_e, μ, ν_μ, τ, ν_τ) discovered so far, constitute the know matter in the Universe. It is a very massive fundamental particle, with a mass similar to a tungsten atom, roughly 173 times the mass of a proton. Like all quarks, the top quark is an elementary fermion with spin 1/2, and experiences all four fundamental interactions: gravitation, electromagnetism, weak interactions, and strong interactions. Because it is so massive it is believed to play an important role in the understanding of the stability of our Universe together with the Higgs boson that was discovered in 2012 at the Large Hadron Collider (LHC), the European Organization for Nuclear Research (CERN), in Geneva, Switzerland. The existence of the *top* quark was, for the first time, proposed by Makoto Kobayashi and Toshihide Maskawa in 1973, and was discovered more than 20 years, in 1995 by the CDF and D0 at Fermilab, USA.

Top Quark Workshops

The main underlying motivation for the series of workshops is pure curiosity to learn more and more about the top quark and its role in our Universe. The international meetings have been held in many cities and countries, Coimbra in Portugal (2006), Isola d'Elba in Italy (2008), Bruges in Belgium (2010), Sant Feliu de Guíxols in Spain (2011), Winchester in England (2012), Durbach in Germany (2013), Cannes in France (2014), Ischia in Italy (2015), Olomouc in Check Republic (2016) and returns back to Portugal to commemorate the 10th Edition in Braga. The participants in the series of workshops come from all over the world i.e., Australia, Belgium, Brazil, Canada, China, Czech Republic, Denmark, Finland, France, Germany, Italy, India, Iran, Israel, Japan, Norway, Portugal, Republic of Korea, Romania, Slovakia, Spain, Sweden, Switzerland, United Kingdom, United States of America, etc. and are renowned experts in particle physics.

Figure 1. Photos of the first edition of the workshop.

The 1st Edition of the workshop (Figure 1), in Coimbra, was the starting point before data was collected in Europe by the LHC experiments at CERN, ATLAS and CMS. By that time only results on top quark physics from the Tevatron experiments, CDF and D0, were available at Fermilab (US) following the discovery of the top quark in 1995.

Figure 2. Editions of the workshop from 2008 to 2012.

Every two years, for the following editions, until 2012 (Figure 2), the conference used basically a

model similar to that of the first edition. In 2010 the Constitution of the International Workshops on Top Quark Physics was written in Bruges, with an International Advisory Committee (IAC) and a Local Organizing Committee (LOC). A symbolic document that establishes the aim of the workshop i.e., bringing together theorists and experimentalists to review the status and future prospects of top quark physics.

Figure 3. Editions of the workshop from 2013 to 2016.

Since 2012 (Figure 3), the workshop has been extended to include Q&A sessions (specially dedicated to Questions and Answers from young scientists), a Young Scientist Forum and a theoretical mini-workshop were outstanding open questions are discussed.

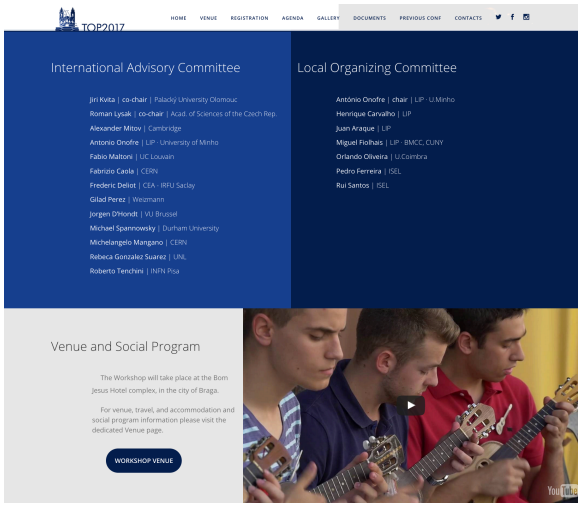
The 10th Edition of the Workshop

This year's edition will happen in Hotels of Bom Jesus Sanctuary in Braga, from September 17th to 22nd, 2017 (http://top2017.lip.pt/, Figure 4).

Figure 4. Edition of the workshop in 2017.

The Sanctuary is an important tourist attraction and notable example of pilgrimage site with a monumental Baroque stairway that climbs 116 meters (381 feet). In the hill top there is the XVIII century sanctuary surrounded by a large park with several gardens, artificial lakes, and other infrastructures.

The Committees



The City of Braga

Braga is a lively city, one of the oldest in the country, and is teeming with young people who study at its universities. Built more than 2,000 years ago, "Bracara Augusta" was, as the name indicates, founded by Augustus; it was located on one of the main Roman roads in the Iberian Peninsula, since it was the administrative seat of the Empire, and later given the status of capital of the Roman province of Gallaecia, present-day Galicia, by Emperor Caracalla. The Braga Diocese is the oldest in Portugal and, in the Middle Ages, the city even competed with Santiago de Compostela in power and importance. One of the Camiños de Santiago passed through here, when this pilgrimage cult grew with the Christian reconquest and the foundation of Portugal.

Figure 5. The city of Braga.

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During the conference, visits are planned to cities around Braga as part of the social program. These include the guided visit to Guimarães (Senhora da Penha sanctuary, with a panoramic view over the city castel of Guimarães, Paço dos Duques, historic center, UNESCO world heritage) and Porto (panoramic tour, visiting the main spots, walking tour around Clérigos, Sé do Porto and S. Bento train station, panoramic view over the city from the Morro garden).

Figure 6. TOP2017 conference poster.

TOP-SKY Scientist Initiative

CERN

CERN (Figure 7) has been, since its creation, an outstanding laboratory for knowledge and science development where LIP together with other Institutes and Research Centers have been working for the last decades. In addition to the daily life of building accelerators and detectors, to take data that is analyzed with dedicated software tools developed by the research teams, and publish scientific results that can change our understanding of the world, there is a deep conviction that everything matters more if the scientific knowledge is spread out through society.

This crucial aspect of the research activity is taken more and more importance as time goes by.

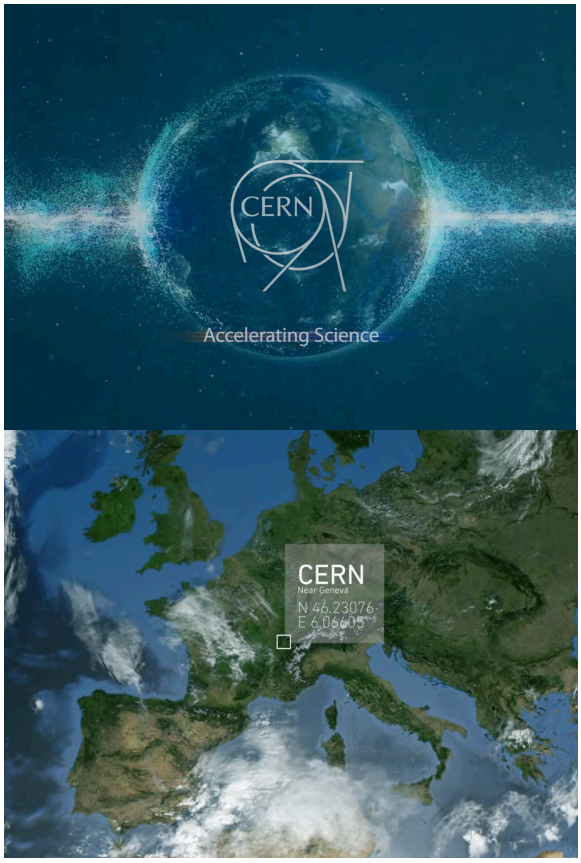

Figure 7. CERN, Geneva, Switzerland.

The LHC at CERN

The Large Hadron Collider (LHC) is the world's largest and most powerful particle accelerator. It first started up on 10 September 2008, and remains the latest addition to CERN's accelerator complex. The LHC consists of a 27-kilometre ring of superconducting magnets with a number of accelerating structures to boost the energy of the particles along the way.

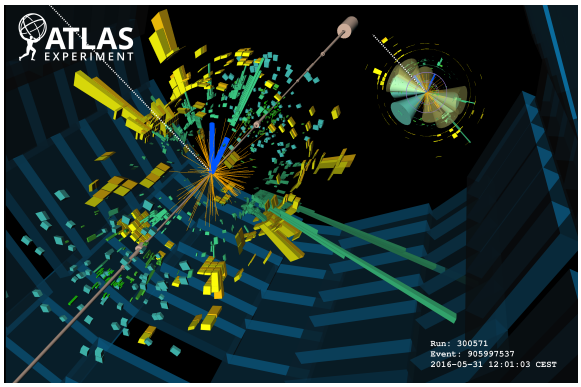

Figure 8. Collisions at the ATLAS experiment at the LHC.

Inside the accelerator, two high-energy particle beams of protons travel at close to the speed of light before they are made to collide (Figure 8). The beams travel in opposite directions in separate beam pipes – two tubes kept at ultrahigh vacuum. They are guided around the accelerator ring by a strong magnetic field maintained by superconducting electromagnets.

The CERN Interactive Tunnel

The CERN Media Lab group has developed an interactive tunnel where students (and senior researchers!) can enjoy themselves with collisions by playing proton football games (Figure 9-11) or understanding how the Higgs field work (Figure 12). The Higgs boson was discovered in 2012 at CERN and the reason why it is so important, relates to the fact that the interactions of the known fundamental particles with the Higgs field, gives masses to the particles.

Figure 9. The CERN Media Lab interactive tunnel.

Figure 10. Playing football in the tunnel (angry-birds!).

Figure 11. Not only the youngsters have fun in the tunnel.

The Higgs field simulator shows the effect of particles acquiring mass by the simple fact they interact with the Higgs field.

Figure 12. The Higgs field simulator.

Other Interactive Devices

Interactivity can also be achieved by using touch sensitive devices like LCD touch screens (Figure 13). Interactive LCD & LED Touch Screens are changing our way of learning and having access to information. Their applications can range from simple presentations, education, access to conference rooms or being used as an interactive device to communicate with scientists around the world.

Figure 13. Interactive LCD touch screen.

The Proposal

The TOP-SKY Scientist Initiative intends to set up a pilot project with the duration of 1 year, to allow students from high schools in the Northern Region of the country (Braga, Barcelos, Famalicão e Guimarães) to have access to information, forums of discussion and scientists that can fulfill the true expectations of our youngest (and future) scientists at high schools and, at the same time, provide good advise and guidance for the years and choices ahead. The initiative intends to build an outreach pilot project on Particle, Astroparticle Physics and Advanced Computing with High Schools with a specific protocol.

Given the fact, the TOP2017 Conference will bring more than 100 experts from all over the world, it will be a huge opportunity for the high school students to have contact with participants at the conference, discuss with them, ask them scientific questions and get answers. Following this event, the bridge between the high schools, the University of Minho and Research Centers around the world LIP works with (CERN, ESO, ESA, etc.) will be established by means of use of Interactive LCD & LED Touch Screens. The proposal presented here is divided into few main tasks, proposed in the following.

Task 1

For this task an outreach session is foreseen: **September 22nd at 15h30** at the **University of Minho**, with invited TOP2017 experts to discuss with students, present potential projects and answer questions. After a presentation of 1h00 about what is the Universe made of, the session will be open for discussion. Requested financial support is asked for the TOP2017 speakers (2000€) as well as transportation of students from the high schools to the university. A High School Committee already in place, will take care of making the first selection of students which are expected to be, at most 200. The team has a long tradition of organizing these type of events (Masterclasses at the University of Minho) with very good feedback from the students.

Justification: The funds requested cover part of the expenses with speakers the conference has at the moment and allows to spread knowledge through high schools by renowned names in physics with very important connections with excellent Centers of Research (CERN, etc.).

Task 2

This task involves the acquisition of equipment, namely:

1) One Interactive LCD & LED Touch Screen, to be located at one high school chosen for the pilot project (Requested fund: 2500€)
2) One Laptop and Minimum Video Conference System (Requested Fund: 2500€)

Justification: The purpose of the system to be located at a pilot High School is to allow, during the outreach session at the University of Minho to transmit directly to the schools via Video-Conference the outreach session itself, and allow the high schools students to have a direct contact with researchers at the University of Minho and Research Centers around the world.

Task 3

Content development and software tools during the full duration time of the pilot project. Requested funds: 3000€.

Justification: A minimum amount of work on contents development, software applications and interactive tools are required for the project. The requested funds cover the expenses related to this.