



27 JULY, 2009

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Editorial

Dear friends,

Despite it being holiday season, there is still plenty of CMS news happening at CERN and around the world.

The breaking news from Point 5 is that on Tuesday 28 July at 15:30 the CMS solenoid magnet reached 3.8 Tesla. With that CMS is ready for CRAFT.

There will be lots of physics news during the forthcoming months and this issue looks at identifying top quarks traveling at very high velocities. This is motivated for example by considering theories of extra dimensions.

Congratulations to everyone in the new CMS Remote Operating Centre in Beijing which was established in time for LHC turn on. This is a big step forward in improving distributed collaboration in CMS / HEP. CMS can now cover the third time zone for some of the CMS remote shifts (e.g. Computing, Data Quality Monitoring). More news in the next issue.

This month CMS has welcomed top young scientists and engineers to visit and work on the experiment. ISEF winners received their prize of exploring CERN for three days which included seeing the detector with Jim Virdee. And Summer Students have enjoyed attending lecturers with top physicists including Steven Weinberg, taking tours and working with CMS teams in the labs and control rooms.

With best regards,

Bob Cousins
Rebecca Leam
Marzena Lapka

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CMS Musicians Entertain at Hardronic Festival

Paul Aspell with band RISE

The CERN Hardronic Festival traditionally opens with a bang, but this year's was even more highly charged as four CMS musicians' bands helped entertain around 200 people on the Prevezin site on Saturday 27 July.

Eleven bands with musicians from all over the world took to the stage for this MusiClub festival which started in 1989.

"The festival is about music of course. And to get to know fellow musicians working at CERN - their music and style. It was lots of fun and I enjoyed the atmosphere," says Yi Ling from Malaysia who played the keyboard for Miss Proper & the Moving Targets during the afternoon.

CMS Outreach, Visits and MediaFrom *symmetrybreaking*, 20 July 2009:

European Physical Society honors young physicists for work at Fermilab, SLAC



Maurizio Pierini and Niki Saoulidou Receive Awards at EPS Conference, Krakow

CMS physicists Maurizio Pierini and Niki Saoulidou received the Young Physicist Prize from the European Physical Society during the EPS Conference in Krakow this July. They were both awarded for their work done on previous experiments; Maurizio for his contributions to the study and analysis of B mesons on BaBar at SLAC; and Niki for her outstanding neutrino research at Fermilab. But they have both since joined CMS.

During the past two years of working at CERN, Maurizio has worked on event generation, trigger validation for SUSY/Exotica, HLT commissioning and analysis study in preparation of the first CMS data; and Niki, who very recently joined CMS as a Fermilab Wilson Fellow, is working on the HCAL sub-system and planning to get involved with the data analysis. They both feel very happy and honoured to have received this award.

[Read the full article here](#)

News from Point 5

Because access to Underground Service Cavern (USC) at any time is mandatory for CMS operation, any LHC high power magnet commissioning in sectors 4-5 or 5-6 can only take place after USC has been sealed against any overpressure gas from the tunnel. An additional sealing of CMS Experimental Cavern (UXC) is of large value for CMS as it makes us completely independent of any LHC commissioning work.

To ensure that UXC is sealed before the LHC magnet tests start in sectors 4-5 or 5-6, last week was dedicated to the installation of overpressure resistant doors in the survey galleries of UXC and to seal the Fixed Iron Nose (FIN) area against the head wall of the hall and the tunnel. In parallel the installation of overpressure resistant doors in the USC started. The design of the FIN sealing comes from the integration office and the pieces have been produced and installed by



Installation of side part of FIN sealing

A small incompatibility of the HV connectors at the 13.5m vacuum pump with T2 has been found and needs to be solved before beam operation will start. On the positive end the so called "Cheese Wedges" and all shims between collar and Rotating Shield were installed, closing all large gaps between the HF and the Rotating Shield. To be able to observe TOTEM during the ramp up of the magnetic field, these shielding was left off at the negative end. Also the magnet was tested successfully up to 1.5T. However, at about 1.5T large forces were observed on the positive end that this time pulled the CASTOR table away from the IP by about 2cm.

The interruption last week to install the overpressure doors was used to re-align the positive end and to install massive z-stops on the CASTOR tables of both ends. To break the magnetic flux on the positive end the shims and the Cheese Wedges in front of the Rotating Shield have been removed. For the



Installation of pressure resistant door in the survey gallery

From NOVOSTI, 17 July 2009:

Grand collisionneur de hadrons la remise en service repoussée à novembre (CERN)

MOSCOU, 17 juillet - RIA Novosti. Le redémarrage du Grand collisionneur de hadrons (LHC), un immense accélérateur de particules tombé en panne en septembre 2008, a été repoussé de fin septembre à la mi-novembre, a annoncé jeudi l'Organisation européenne pour la recherche nucléaire (CERN) sur son site internet.

[Read the full article here](#)

From *International Science Grid This Week*, 8 July 2009:

Feature - A solid production demonstration of the CMS role in WLCG

...For the first two weeks of June, instead of flooding the grid with data from actual particle collisions, experiment collaborators at CERN and remote computing sites in Europe, Asia, and North America joined up to test the ability of the collider's Worldwide LHC Computing Grid (WLCG) to record, transfer and analyze simulated data in a step-by-step "production demonstration."

[Read the full article here](#)

"It's a great chance to perform on stage and to provide entertainment for CERN people, friends and families," agreed fellow band member and drummer, Piotr Traczyk from Poland.

American graduate student Seth Cooper played bass for the band, What's Next, who performed classic and modern rock to get the Summer Students and their professors up and dancing.

CMS Preshower group member and bass player for RISE, Paul Aspell reflects: "It was a great event. Different levels of musicians played all kinds of music including country and light acoustic in the afternoon and then pop and rock in the evening, which is what RISE plays. The audience were enthusiastic and everyone enjoyed themselves."

Submitted by:



Rebecca Leam

People

University of Notre Dame, (US) in CMS



The Notre Dame CMS group

Notre Dame has been a member of CMS since 1993. Our current group consists of 22 members, including faculty, students, engineers & technicians. The group is involved in several areas of the experiment.

The group has been involved in the development and construction of the optical readout system for the HCAL. The system converts the optical signals from scintillator tiles into electrical signals for digitization and data acquisition. ND continues its involvement with the HCAL through participation in the detector commissioning and the HCAL test beam program.

Notre Dame is also active in the ECAL project. Our activities include monitoring the performance of the ECAL DAQ electronics, commissioning of the trigger system, ECAL test beams, and prompt feedback analysis of the detector performance. Members of the group are also responsible for developing and maintaining the offline reconstruction software for photons, including track information for photons converting in the tracker material.

The ND group contributes to two parts of the data quality monitoring (DQM system). For photons, we track the performance of the photon reconstruction in real and simulated data to ensure that the algorithms are working correctly. For muons, we monitor the muon HLT performance by comparing it against reconstructed muons, and contribute some specialized DQM for muon performance in top quark candidate events.

Our group is also active in several areas of CMS physics analysis. Our physics interests include tau leptons and electroweak tau production, photons and photon analyses, and top quark physics. We plan to use these and other tools to search for the Higgs boson and for physics beyond the Standard Model.

Notre Dame is also extremely active in outreach. We have helped to establish a number of important HEP oriented outreach programs,

our hall crew, Field Support Unit (FSU) and the transport group. At a later stage the TAS collimator inside the FIN will also be sealed and blocked against movements due to overpressure from the tunnel. Week 29 was used to finish the alignment of all components on both Forward HCAL (HF) towers and to close the HF, T2, TOTEM, BCM, Collar Shield and the Rotating Shielding.



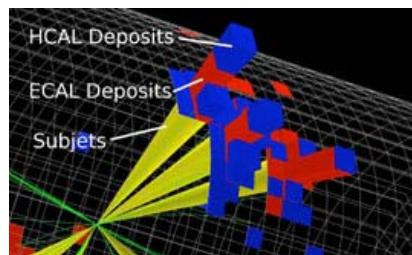
Installation of top part of the FIN sealing

Submitted by:



Wolfram Zeuner

CMS Physics: Boosted Top Tagging



Event display of boosted top jet

Top quarks play an important role in theoretical scenarios of Higgs boson physics (more generally electroweak symmetry breaking) because of their large coupling to the Higgs field (as evidenced by the large mass of the top quark) compared to other quarks. Moreover, many theoretical extensions of the Standard Model contain new particles that decay into top quarks with a large branching fraction, including gluons in models with extra dimensions such as that of Randall and Sundrum. If these new particles are sufficiently massive, the resulting top quarks are highly boosted (moving very fast), and may collapse into a single jet. It is therefore useful to develop reconstruction algorithms that attempt to distinguish these boosted top quarks from those produced in the generic QCD background from proton-proton collisions.

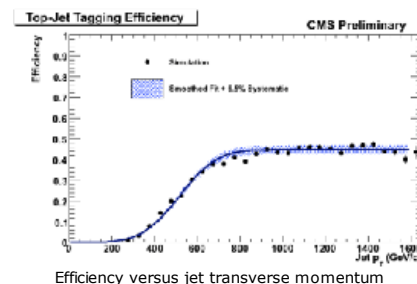
At the LHC, top quarks are usually identified ("tagged") with their semi-leptonic decays. The W from the top cascade decay, however, most often decays hadronically (68% of the time). Addressing this difficult channel can thus benefit from the pertaining increased statistics.

The general strategy for tagging boosted top quarks decaying hadronically is to identify jet substructure in top-quark jets, and to use this substructure to impose kinematic selection criteria ("cuts") that discriminate against non-top jets of the same transverse momentum. In particular, the masses involved in the process (the top mass and the W mass) provide powerful discrimination. This approach is possible because, while the top quark jet is highly boosted such that all of the resultant particles end up within one jet, the individual components of the top cascade decay may be still discernible (i.e. the b quark as well as the quarks from the W decay).

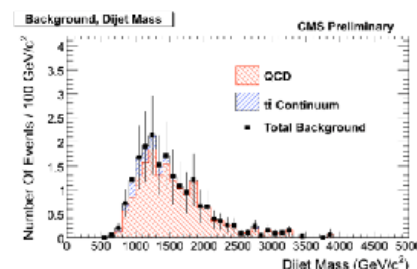
Many possible methods exist to reconstruct hadronic jets. In the CMS detector, jet energies are collected by two calorimeters, the electromagnetic calorimeter (ECAL) and the hadron calorimeter (HCAL) in towers of size (0.087, 0.087) in the (rapidity-azimuth) coordinates in the central barrel region. These energy deposits are clustered in jets. Figure 1 shows a typical top quark jet as seen by the CMS calorimeter towers. The substructure of this jet is clearly visible.

final configuration the shims between Rotating Shield and Cheese Wedge will be produced of non magnetic material. The magnet tests resumed on July 24 and on Tuesday July 28 at 15:30 the magnet reached 3.8 Tesla. With that CMS is ready for CRAFT.

To construct boosted top jets, the Cambridge-Aachen jet clustering algorithm is used. This is a sequential jet clustering algorithm that relies only on distance weighting. The hierarchical clustering sequence of the construction of this jet is used to extract the substructure of the jets. The backgrounds from non-top jets are estimated using a data-driven measurement. An efficiency of 46% for top-jets with $p_T = 600$ GeV/c is obtained, together with a rejection of 98.5% for non-top jets with $p_T = 600$ GeV/c. Figure 2 shows the efficiency versus transverse momentum. Using this new algorithm, a search for resonances decaying into top-antitop pairs is estimated, assuming a sample corresponding to an integrated luminosity of 100 pb^{-1} of pp collisions at 10 TeV. The dominant backgrounds are generic QCD dijets that are mis-identified by the algorithm, as well as continuum top-antitop production. Figure 3 shows the backgrounds expected in 100 pb^{-1} . With this data sample, a 2 TeV narrow resonance with a cross section larger than 1.5 pb can be excluded at 95% confidence level, and a resonance with a cross section larger than 4.0 pb can be discovered with a discovery significance of 5σ .



Efficiency versus jet transverse momentum



Total background for 100 pb^{-1} of 10 TeV collisions

D. Kaplan, K. Rehermann, M. Schwartz, and B. Tweedie, "Top-tagging: A Method for Identifying Boosted Hadronic Tops," *Phys.Rev.Lett* 101: 142001 (2008)

Submitted by:

including QuarkNet, Interactions in Understanding the Universe (IU2), and Notre Dame extended Research Community (NDeRC). CMS plans to make a small amount of trigger bandwidth available for outreach use and Notre Dame is developing the initial trigger that will be used and developing web-based learning activities to use the data in QuarkNet.



Ted Kolberg PhD student, helps to commission the CMS ECAL & physics analysis using photons

My name is **Ted Kolberg**, and I am a fifth year PhD student at Notre Dame. I was born in 1983 in Milwaukee, Wisconsin, and did my undergraduate work at Stanford University in California. My main activities on the experiment are helping to commission the CMS ECAL, and physics analysis using photons. Outside of work, I enjoy cooking and live music.

Watch the interview with Ted on You Tube:



Links

- [LHC](#)
- [ATLAS](#)
- [ALICE](#)
- [LHCb](#)
- [TOTEM](#)
- [CERN](#)
- [CERN Bulletin](#)
- [US LHC](#)
- [UK LHC](#)
- [LHC France](#)

Chilled to Perfection - Summer 2009 at CMS



2009 CERN Summer Students

Ever since the immense media attention for the LHC start-up in 2008, a career in particle physics has been seen with a newfound glamour in the eyes of students worldwide; hence an internship at CERN is like living the dream – that is the Summer Student Programme.

Working here and for a big experiment like CMS is rewarding for many students pursuing careers in particle physics, engineering, computing and high tech instrumentation simply because one gets to be amidst the combined results of all theories, previous experiments and technical ingenuity pushed beyond its limits. What's special about CERN and CMS is that students are listened to and treated as equal collaborators and their fresh ideas can contribute to the project.

The excitement is contagious as one navigates through animated discussions in the cafeteria and corridors, workshops, and large underground caverns. And as one student, Prince Joachim de Belgique, put it after attending an exciting lecture on neutrinos: "it goes through you."

It was in this spirit that some of the summer students shared the highlights of their experiences.

Santiago Folgueras says that he started working a few months ago with the high energy physics group at Universidad de Oviedo, Spain, which is part of the CMS collaboration and that his professor encouraged him to apply to the Summer Student Programme at CERN. He says: "Fortunately, I am here now! It has been the most exciting experience of my life; there are hundreds of people from all over the world working together to achieve the same goal. Being able to participate in this common effort is great."

Santiago's dream certainly does not end this summer: "Since I started in university one of my dreams has been to come to CERN and to obtain my PhD here. This opportunity is unique and I think that all the things I will learn here might allow me to join the CERN community in the future."

Flavia A. Dias agrees that: "The great highlight is to know how people really work here and to integrate into the day-by-day working of important scientists in such a huge project. It's good having lectures with the professors and being completely involved with the subject that they are talking about. I would like to have a career as a high energy physicist, and for this, my stay at CERN is completely complementary to my current studies in Brazil. It will improve my knowledge in theoretical and experimental physics because it mixes the series of lectures with hands-on work in the project."



Salvatore Rappoccio



Petar Maksimovic

and

Akira Miyazaki is part of the ATLAS experiment at home, but is spending her summer with CMS because she wants "to know another point of view." She is happily working on reconstruction of Z mass with CMS MC Data.

Several summer students visited the CMS experiment and were simply amazed at the sheer grandeur and scale of it all. Few of them fully appreciated the scale and complexity of the experiment before actually seeing it. Attending Steven Weinberg's lecture and other detectors were also unique opportunities for them.

Aurelijus Rinkevicius chose to come to CMS because his "local professor had been doing some work with it and it seemed very challenging." He says that the highlight of his summer has been "my supervisor's team who is willing to participate and help me - it is the people who are working here. This internship is a new window to physics - particle physics is precise. It is good to gain new knowledge; it creates shivers in the spine."

Ruth Pearson is thrilled to be a part of the installation team of the Beam Radiation Monitor "which involved climbing on one end of CMS." She finds that "being surrounded by scientists and like-minded people as well as being in an international lab which hopes to tackle the big questions of the universe" is an experience of a lifetime. She is aiming to do a PhD and "being at CERN makes me want to do a PhD even more!"



Some of the summer students on a visit to CMS

Bibhudutta Mishra and Amol Kulkarni have been working on the CO2 based cooling system for the trackers on CMS in the future: "Our work was to correlate the recent theoretical models with the results from the experiment set up at building 187 under the supervision of Hans Postema. Following a small accident caused by overheating, we were able to take part in the reassembly of the set-up, and this allowed us to get a clear idea of the instrumentation involved. The CERN Summer Student Programme has broadened our overall outlook and further strengthened our motivation for exploring new frontiers of science and technology."

Hopefully most of the students will continue a career in particle physics or at least in science and technology. We hope that their rich summer experience at CERN will offer them the sense of excitement of scientific discovery and the paramount importance of technological returns as well as creating "shivers in the spine" – all chilled to perfection.

All the best for Summer Students CMS – 2009!

For the full story and photos visit:

http://www.facebook.com/note.php?created&&suggest¬e_id=110446680998#/note.php?note_id=110446680998&ref=nf

Submitted by:



Archana Sharma

Top Science Students Win Visit To CERN

Last February the Chairman of the Board of Intel, Craig Barrett, visited CERN on his way to the Davos World Economic Forum. Over dinner, hosted by Wolfgang von Ruden, it was suggested that someone from CERN should give the keynote speech on the Large Hadron Collider project at the opening of the renowned International Science and Engineering Fair (ISEF*) in May. Jim Virdee was invited to give this keynote speech to around 1600 student-finalists plus their teachers and parents and half a dozen Nobel-prize winners.



INTEL ISEF Winners with Jim Virdee & Wolfgang von Ruden

In addition to scholarships and many prizes for their groundbreaking work Wolfgang von Ruden suggested that Intel send the "Best of Category" winners to visit CERN. This created a lot of excitement when Jim announced this during his keynote speech.

Visiting CERN was just a dream for most of the 1'500 students showcasing their independent research at the 2009 Intel International Science and Engineering Fair (Intel ISEF), the world's largest international precollege science competition; but for 13 of the 23 'best in category' winners, their dreams became a reality on 30 June.

Their busy three-day programme at CERN included presentations and tours around the different faculties as well as Geneva. Before seeing CMS, the students from different science backgrounds enjoyed 'An Introduction Particle Physics, by Dave Barney. They then visited a CMS Detector Lab with Archana Sharma. But nothing could have prepared them for seeing the real thing.

Jim Virdee welcomed the group of 13 pre-college "Best of Category" winners to CMS at Point 5. Then, the winners, with their hard helmets firmly on their heads, digital cameras in hand, were finally taken 100 m underground. These bright students asked many scientific questions, made numerous comments about the early universe and were more than impressed when they set their eyes on the CMS detector.

"It's incredible," said Marley Iredale, the winner of the earth and planetary science category, Washington. "I've been really looking forward to seeing CMS since Prof. Virdee talked about it during the opening ceremony of the Fair in Reno. We've seen lots of photos of it but I hadn't realised how big it is. I feel like a little kid in a candy shop. It's my favourite experiment of them all because it focuses on muons and the Higgs Boson which looks at the earliest moments after the creation of the universe. Also it is compact and neat and tidy and its accuracy is within a micron."

Nilesh Tripuraneni of Fresno, California, was particularly excited to have won the trip to CERN - he came first in the physics and astronomy category for his studies of quark-gluon plasma; the superhot material created after the Big Bang. He hopes to return to CERN one day as an intern or work on the experiment and study quark-gluon plasma. He agreed with the group: "I'm amazed by the sheer power and size. It's a dramatic change from the theoretical physics I've been studying that only involves my professor and me. It's incredible how much people care about the problems of fundamental physics; so many countries and people are collaborating and spending enormous amounts of time and money on the experiment. It's kind of ironic how such a big experiment is looking for the smallest particles."

These students already show the qualities of becoming some of the world's future influential scientists and in accordance they met for discussions with the CERN Director General, Intel directors, the international media and members of the local Geneva government.

Environmental management category winner Eliza McNitt was also working on making them TV stars as she recorded footage for a documentary about CERN. Her primary objective is to help people to understand science through documentaries and to make them appreciate the importance of such experiments.

The trip was made possible by CERN and Intel. Amongst other contributions to CERN-IT, Intel is also a corporate partner in CERN's OpenLab studying and developing data-intensive solutions to be used by the worldwide community of scientists working at the LHC.

Watch the keynote speech made by Jim Virdee on YouTube at http://www.youtube.com/watch?v=071f_tU_nzQ

For more information about the winners and Fair visit:

www.societyforscience.org/ISEF

www.sciencenews.org/view/generic/id/43870/title/Intel_ISEF_winners_announced

Submitted by:



Jim Virdee



and Rebecca Leam

Web-cam latest images (click picture to enlarge)

