ATLAS e-News

28 June 2010

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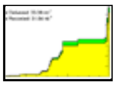
Freeze frame

Pausing to take stock of a frozen Tier0

Ready for rejection!

Tuesday May 25, 4am - the luminosity had reached $2x10^{29}$

LHC leaps ahead



Luminosity jump just in time for ICHEP

FEATURES

Tracking material with the Electromagnetic Calorimeter

EM calorimeter based study reveals the presence of all those bits of material one had forgotten about

PHOTO GALLERY

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PROFILE

"Harmony is everywhere, one must develop one's sense," says Snezana Nektarijevic

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July 17 - 18 CERN **Hardronic Festival**

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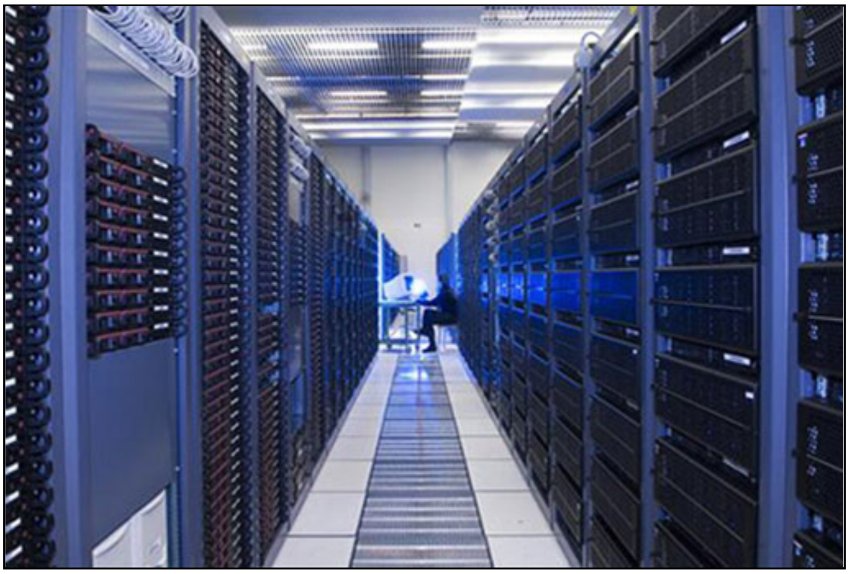

Tier0, CERN Computing Centre

Back in May we reported a new approach being introduced at Tier0: freezing the physics content of the software to ensure that data could be fairly compared from one run to the next and coherent datasets could be built up for the summer conferences. Two months in, the pros and cons of the new strategy are becoming clear…

In a nutshell, the point of freezing the software, for both real and simulated data, is to allow new data to be continuously tacked on to the end of the existing dataset. The big 'pro' of this approach is that new data will be immediately comparable with that which has already been reprocessed.

"From my point of view, it also means that I have fewer requests for [software] updates, because some of them are so obviously incompatible," explains David Côté, who is just coming to the end of an 18-month stint as Prompt Reconstruction Operations Coordinator (PROC). "On the other hand, each update request is more work because we need to understand what it's doing in much more detail."

This is because changes must be validated one-by-one, and where before developers could make change requests themselves, the mechanics of this now falls solely to David and his co-PROC, Walter Lampl. Changes are still filed because, although the physics content of the software is fixed, says David, "We try to push the concept of being frozen to the limit."

"When people ask for an update, it's always for a good reason," he argues, "and psychologically it's difficult to block improvements." Total freezing is both unnecessary – because there are things that can be changed without affecting the reconstruction output – and impossible – because there are things that must be up-to-date for data-taking. Detector monitoring (mapping dead channels, and observing how the tracking and combined reconstruction is working) is a good example.

Elsewhere, updating for improved detector alignment is another change that has been deemed acceptable. "That's like a software change in some sense, in that the reconstruction results will be different from one day to the next," David explains. "But the agreement with Monte Carlo should improve as a result of this, and not decrease. So we accept it."

"It's sort of an art that we have to learn: how to plug in as many updates as possible and still not change the physics!" he smiles.

Up until April, the primary concern was whether or not altered code still functioned. Now, consistency in the reconstruction output is suddenly a factor: “In the mornings, we have to check not only that it runs, but that the results are identical [to those produced by previous versions of the code, on a test sample],” David explains.

Identical results production – or absence thereof – is one area in which the Tier0 freeze has proved to be a bit of a headache though. A couple of ‘irreproducibility bugs’ cause the code to spit out different results each time it is run on the same events, even when no changes are applied in the interim.

One such bug was spotted two weeks before the Tier0 was frozen for the May reprocessing, requiring everyone to go back and scour their code to see if it was the source. But in the absence of an obvious smoking gun, the mystery wasn't solved in time to be fixed before the campaign began in earnest, ahead of ICHEP.

Unfortunately, the culprit was deep in the TRT code, which made it all the harder to spot as it had lain dormant for years. It was only when ATLAS started considering particles with much lower transverse momentum (a key difference in the scope of the April and May reprocessing campaigns), that an incorrect assumption in the TRT code – that all particles would necessarily leave the sub-detector and go on into the next layer of calorimeter – manifested itself as a spanner in the works.

Before May, all the particles under consideration *had* had enough momentum to fulfil this criterion, but with the broader spectrum of momenta studied in May, ‘looper’ particles without enough transverse momentum to escape the TRT were wrongly accounted for in the code. Under the frozen Tier0, even though this problem has now been traced, it can't be fixed until the whole software is updated at the next full reprocessing.

“It's tough for bug-fixers, if you have a known bug and you cannot fix it,” David sympathises. So far though, this is the only un-patchable bug of any consequence that has been found, and the effect on ICHEP data should be negligible: “We have made quite some effort to assess it, and concluded that it's not really a problem, except for specialised things like tracking commissioning itself.”

The Tier0 has been frozen for about five weeks this time around, but the answer to the question of how long it is foreseen to stay so is open ended. “We're discussing it right now, and every other week since a long time,” smiles David.

Bugs and glitches are noted on the **DataMCforAnalysis TWiki** as they are uncovered, and until there is a fatal problem in the data or there is significant benefit in moving to a new software update, things will stay as they are. Ultimately, like a game of **Buckaroo**, when enough niggling problems have mounted up, the time will come for action.

“The problems are generally minor and recoverable. But if you add up a long list, it becomes more and more difficult to manage.” In the short term though, says David, “The goal is to remain frozen until [the] ICHEP [data cut-off date], to provide the maximum possible dataset.”

Collaborators are invited to attend the new ATLAS Reconstruction Meeting on Tuesdays at 16:00, which aims to bring together the physics community and reconstruction experts to discuss the timeframe of new releases. Slides form the last meeting are available **here.**

Ceri Perkins
ATLAS e-News

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Ready for rejection!

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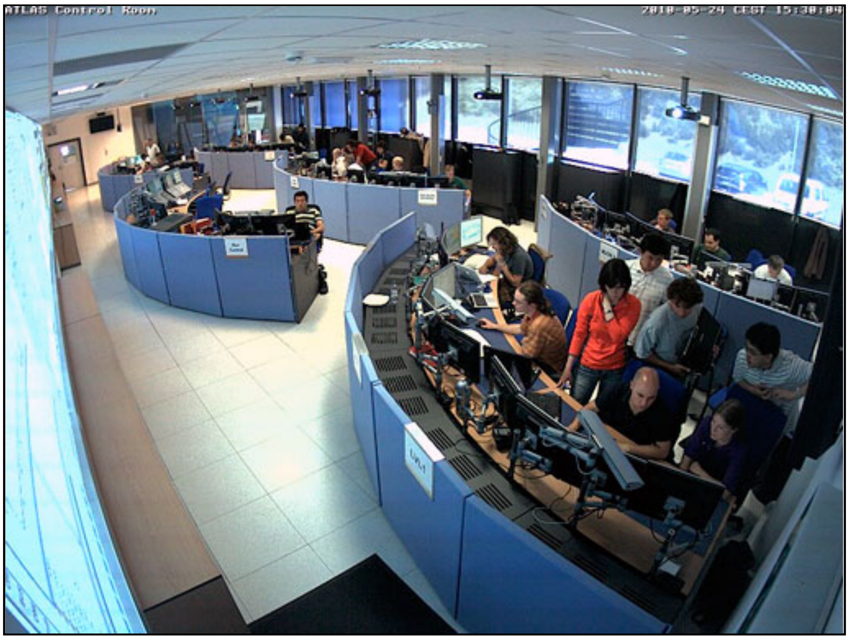


Webcam photo of the control room May 24th

As mentioned in the last e-news issue (link), it was very early on May 25 that the ATLAS High-Level Trigger (HLT) has started to actively select events keeping the more interesting ones and rejecting the uninteresting ones.

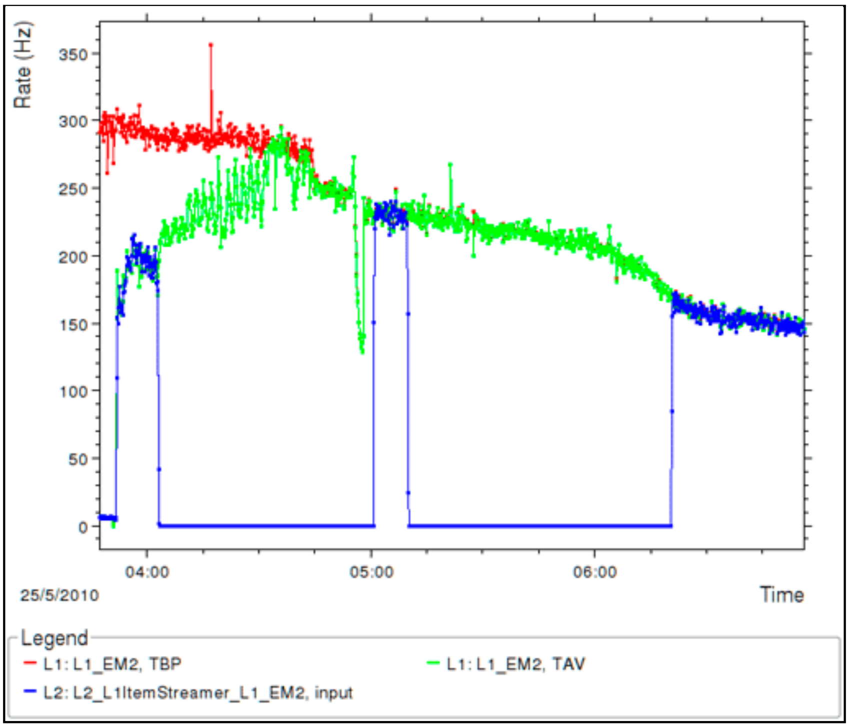
“The trigger is like a big sieve with different levels of granularity.” explains Monika Wielers, the convener of the electron and photon trigger group. “Up to now it had been sufficient to leave it to the hardware-based Level-1 trigger to sieve out the interesting events as the incoming collision rate was low enough. At luminosities above 1 to 2 $x10^{29}cm^{-2}s^{-1}$ this is no longer true as the number of collisions with electron and photon candidates selected by the L1 trigger with the lowest requirement of electromagnetic energy (E_T>2GeV) detected is getting too high. So we decided to switch on the next level of selections: the HLT. One of the main criteria to say we are ready for rejection was that the trigger is very efficiently selecting collisions containing 'good' electron and photon candidates found by the offline reconstruction. It is important to stress that getting ready to enable the HLT in rejection mode involved much work of a considerable number of people (in fact too numerous to all list here), on trigger operation, menus and data analyses". Finally D-day was approaching during the Whit Sunday weekend.”

The weekend started well with a nice long run on Friday night followed by more collisions on Saturday, Sunday and Monday. ”Every time we hoped ’Now, now, the peak luminosity exceeds the critical threshold. Let's switch on the HLT selection‘”, recalls Monika. “but ... no luck.“ Anna Sfyrla, who had just finished her weekly shift as menu expert on call, remembers: “We were 6 to 7 trigger experts in the control room on Monday May 24th, all anxious about what would happen next - we also had bets between us on what the peak luminosity would be - people guessed from 1.2 to1 to 2 $x10^{29}cm^{-2}s^{-1}$ and I think in the end Frank Winklmeier had the closest guess.” The next collision period arrived but again the luminosity was not high enough and no HLT rejection was required. In the evening only the shift crew was left in the control room.

Just before going to bed Frank, the online on-call expert during that weekend, thought: ”It would be ironic if we had to enable the rejection at night without any expert around in the control room...” Ironic or not, just a few hours later Frank was woken up by a phone call from John Morris, the trigger shifter on duty. The luminosity had reached 1 to 2 x10^{29}cm^{-2}s^{-1} and too many collisions flooded the system.

The situation was quickly under control after putting the correct set of triggers including the HLT selections in place. Frank then called Takanori Kono, the e/gamma trigger expert on-call, to check the performance. After having checked all the monitoring plots from home Takanori proclaimed: “Everything behaves as expected!” When asked about the phone call later he remembers: “It was 4:00 am on Tuesday morning May 25th. It was the time when I thought nothing happened. I was soundly asleep and least prepared for it to happen.” John recalls: “It was very busy. I spent a lot of time on the phone with Frank, talking to the run control shifter and the shift leader. It was a very exciting shift, but it wasn't until I was at home relaxing that the significance of what we'd done sunk in.”

All's well that ends well. Let's hope for many more high luminosity runs to come for all of us.



Rate plot as a function of time of the lowest energetic L2 trigger for electrons and photons (L1_EM2) before (red) and after veto (green). The difference between the two lines represents the dead time incurred by the large rate arising from just this one trigger. Once the HLT rejection was activated at 4:05 by disabling the L1 only selection (L1_ItemsStreamer, blue) the system stabilized quickly. Shortly after 6:15 the rate dropped below 200 Hz and the HLT rejection was disabled again.

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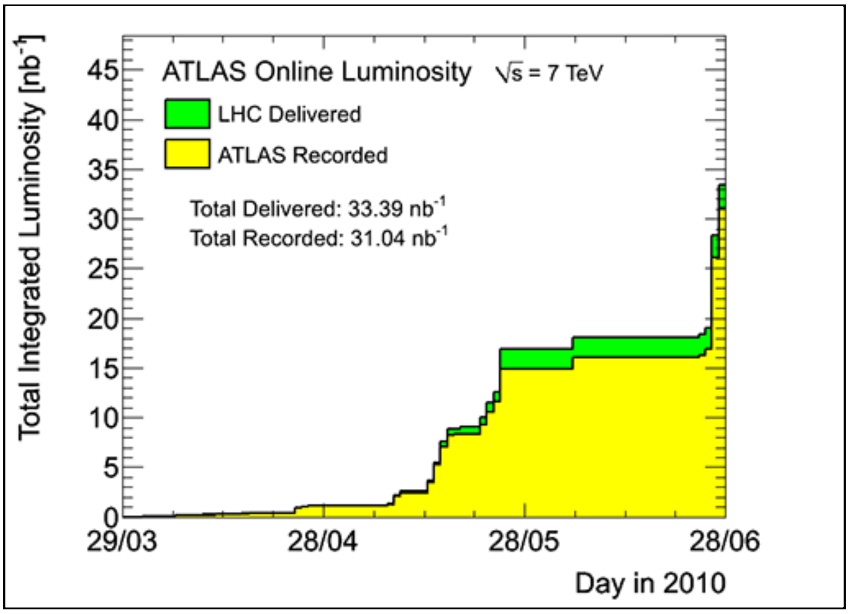

Total integrated luminosity collected by ATLAS

Three weeks ago, the LHC experiments agreed to an extended machine development phase, ending all physics runs for the time being as the LHC worked up to continuous running with nominal bunches containing 1.15 x 10^{11} protons.

As soon as just two of these 'fat bunches' were colliding last Saturday night (June 26th, the total volume of data collected by ATLAS since March 30th) almost doubled, from 16 nb^{-1} to 30 nb^{-1}, delivering some early payoff for adopting this strategy.

"Payoff is a complex concept," considers Run Coordinator Benedetto Gorini, carefully. "We certainly believe that it will pay off for the total luminosity by the end of the year. But it may not pay off at all before ICHEP."

ATLAS's position had to be formulated extremely quickly when the LHC proposed the extended commission. "Martin [Aleksa, Deputy Run Coordinator] and myself had a long discussion over the phone with Fabiola [Gianotti, ATLAS Spokesperson], because she was in DESY at the PLHC conference at the time,"says Benedetto. "She discussed with the machine experts and the other experiments' Spokespeople, who were all there too. It was a very active time."

The alternative, conservative, approach would have been to collect as much data as possible with the tried-and-tested smaller bunches before ICHEP, and commission for nominal bunches later. In the end though, the consensus following a "long and fruitful discussion" with the other experiments was to go for the machine development phase immediately, and then come back with a vengeance at much higher luminosity.

Continuous stable beam physics with nominal bunches began on Friday 25th June. Analyses were due to be completed for approval at the Copenhagen ATLAS week which kicked off on Monday, but according to Spokesperson Fabiola Gianotti, the data collected over the last weekend of record luminosity should be able to be "largely incorporated" into the ICHEP output. Aside from statistical analyses, any physics candidates which are identified in the data being taken now will of course also be fair game for showing at the upcoming conference.

Regardless of the size of the ICHEP dataset, everyone agrees that getting commissioning out of the way in a chunk like this is a big improvement on the old model of interleaving short commissioning phases during the week with short physics runs at the weekends, which had proved to be very inefficient.

“The problem was that before we had two different setups: one for physics, with small bunches – 2 x 10^{10} protons per bunch – and another for commissioning with final bunches – approximately 1 x 10^{11} protons per bunch,” Benedetto explains, adding: “Every time you switch, it takes a non-negligible amount of time. All this is time you lose, and we saw by experience that there was a lot of margin for potential mistakes.”

“Going away from the approach of switching continuously between the physics and commissioning setups is certainly going to pay off,” says Benedetto, and with the beam now ready for continuous running with nominal bunches – hitting a peak luminosity 7 x 10^{29} on Tuesday 29^{th} June – the long-term luminosity goals of the experiments are undoubtedly within easier reach.

Ceri Perkins
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Tracking material with the Electromagnetic Calorimeter

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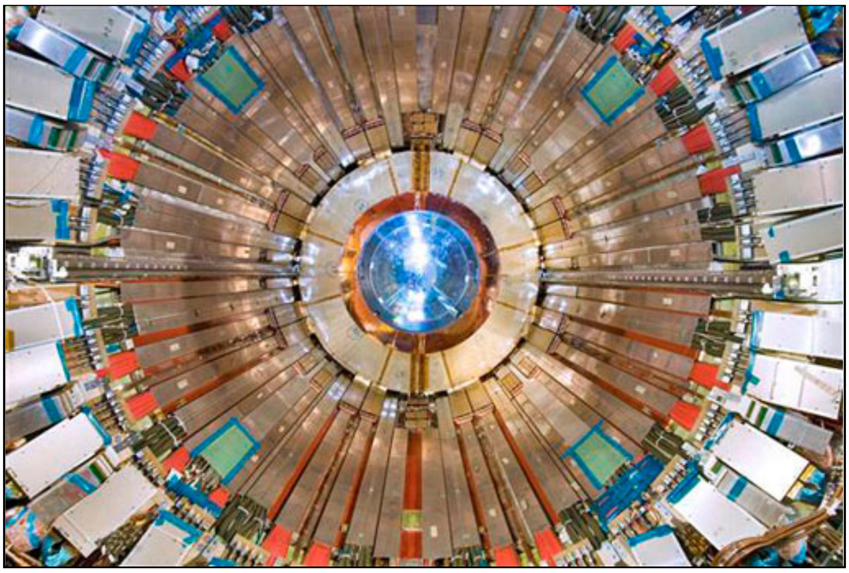
Knowing the position and amount of material in the tracker is a prerequisite to reach nominal performance for electrons and photons. A detailed description of this material (including services), based on information coming from the construction and installation phases, is implemented in the full GEANT4 detector simulation. By measuring the occupancy in the ATLAS electromagnetic calorimeter in 5 million minimum bias events, it is already possible to test to a very good precision level (~0.1 radiation lengths) this implementation of the inner detector services in the simulation. The results show an overall good agreement between data and simulation but also point to some local incorrectness in the present Monte Carlo simulation.



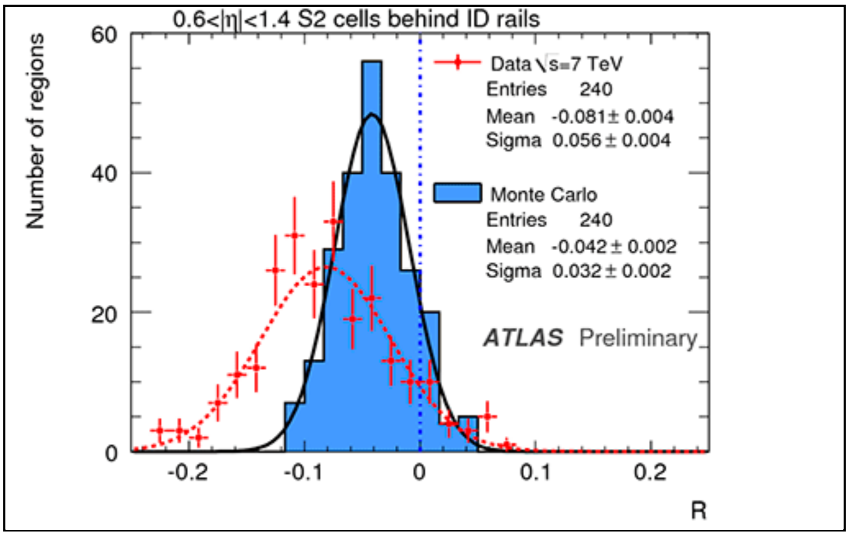
Picture of the inside of the inner wall of the barrel electromagnetic calorimeter after the insertion and cabling of the barrel SCT-TRT. The horizontal rails, supporting the barrel and end-cap SCT-TRT, as well as cables and cooling pipe trays of the barrel SCT-TRT running at constant φ are clearly visible.

ATLAS analyses of the first LHC data have proven that the detector is performing well and that the simulation already reproduces quite accurately many of the detailed features of the data. However, a lot of work remains to be done, for example on the non-uniformity in φ of the tracker material description, mainly caused by the inner detector services and rails running on the inner wall of the barrel electromagnetic cryostat as shown on the above figure. A dedicated study, entirely based on the electromagnetic calorimeter, was developed and applied to first data. Contrary to photon conversions studies, it does not provide the location of the material, but is sensitive to any non-uniformity in φ of the whole material in front of the calorimeter.

This analysis uses a few million minimum bias events recorded in early April 2010 at a centre of mass energy of 7 TeV, triggered and selected with the Minimum Bias Trigger Scintillators. Counting the number of energy deposits above 5 times the measured electronic noise in all electromagnetic calorimeter cells allows a channel-by-channel check of the response to physics. This method allowed us to identify a readout cabling inversion and a high voltage cable swap, affecting 0.4% of the total number of cells in the region $|\eta| < 2.5$ Both problems have been corrected subsequently and will not affect the electron/photon reconstruction in the 2010-2011 run.

The main goal of this analysis is to provide a first check with data of the total amount of material in front of the electromagnetic calorimeter. To a good approximation, the event activity is expected to be symmetric in φ. Any occupancy non-uniformity in φ can therefore be attributed either to the EM calorimeter response, (which was shown in beam tests to be uniform to better than 1%), or to the integrated material in front of it.

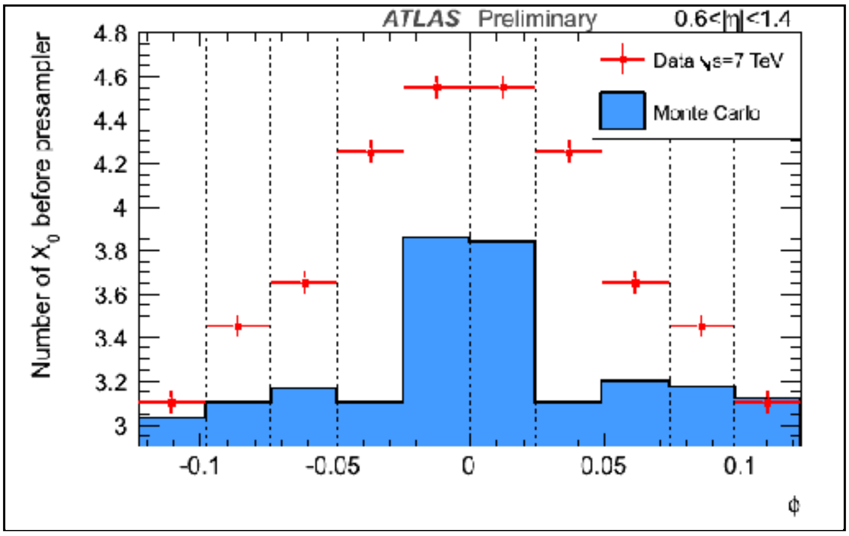
The presence of additional material in front of a geometrical region of the calorimetry lowers the deposited energy and therefore the occupancy in that region. The Inner Detector (ID) services running at specific ϕ on the calorimeter cryostat introduce large non-uniformities in the amount of material, up to 1 radiation length (X_0). This is illustrated in the figure below, where the occupancy measured in the EM calorimeter minus the average found elsewhere is lower than zero for all cells located behind the ID rails.



Occupancy measurement with respect to the average (in %) for cells located behind the ID rails. The negative distribution mean, both for data and Monte Carlo, reveals the presence of additional material in front of the calorimeter. With a shifted mean twice as large in data than Monte Carlo, it is clear that more material is seen in data than was put in the simulation.

The occupancy analysis in cells located behind the ID services allow us to see and probe the material. The SCT heat exchangers and TRT barrel services account for ~0.2 X_0. Their simulation is found to be in good agreement with the data. However, up to one X_0 of material is missing in the ATLAS simulation for the localised regions close to the rails supporting the inner detector. As shown in the figure below, the effect extends along ϕ up to Δϕ = ±0.1 around 0 and π, affecting 2% of the EM barrel coverage. Discussions are ongoing with the experts, and some hints of what pieces could be missing exist. Corrections could be implemented in an updated Monte Carlo geometry.

This study will be further extended to the end-cap regions. All these results have been reported in a **note** recently approved for the Physics at LHC conference.



Average number of X_0 in front of the EM barrel presampler versus φ per bin Δφ = 2 π/256 for 0.6 < |η| < 1.4. The filled histograms are for Monte Carlo, whereas the points are extrapolated from data occupancy in the second EM layer cells located behind the ID rail regions.

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28 June 2010

Snezana Nektarijevic

Nationality: Serbia

Snezana tunes her tamboura

“Everything is composed of harmony, one just needs to refine their senses to perceive it”, says Snezana Nektarijevic. As with many physicists she was torn between Music and Natural Sciences. Since she could not decide whether to give music or science the priority, Snezana took the musical and the science oriented courses in parallel in her school in Kragujevac. After one year of ‘double load’ she finally made up her mind for the natural sciences. What was the determining reason? “I am simply not a born artist. Artists are persons with a subtle sensibility, which brings them an inspiration to express themselves in their unique artistic way, whereas my approach to music was rather scientific. I loved mathematics in music – formulas of chords, development of harmonies, symmetries and asymmetries of forms.” she says. “I loved to analyze pieces I was playing, so I actually liked to do science in music… But finally, one can also find music in physics and mathematics. They have their own harmony as well.”

Snezana's first instrument was guitar, as her father already played it. Later she added the tamboura, a Balkan stringed instrument, which resembles the Greek bouzouki. “Once you have learnt one instrument it is quite straightforward to handle any similar one”. Through classical guitar education she kept her interest for classical music. But music also provides a special connection to Snezana's origins. “I love classical music, especially impressionism. But Balkan music means something special to me. Although it is not very sophisticated, it carries an emotion that makes me feel at home. In it's colorful melodies and playful rhythms it carries the sorrow and joy at the same time. This symbiosis is a kind of definition of Balkan people's mentality - an enormous joy for life despite all difficulties."

Snezana recalls her gymnasium with great enthusiasm. "It was the first Gymnasium in Serbia, that was founded in 1833, just briefly after some autonomy from the Turkish conquest was won.", she proudly explains. The school has a very long and renowned tradition. Beside usual gymnasium classes, the school has also specialized scientific or philological classes for talented students. The specialized mathematical class, in which she was one of seven girls, promoted the talent of the students through participation in diverse competitions and summer school seminars. For those 1-week camps that took place four times per year in the 'Petnica Researching Station' one had to apply with curriculum vitae, recommendation letters and application forms. The camps were held by physics, astronomy or mathematics doctoral candidates "in a very scientific manner – totally informal, but extremely dedicated", as Snezana remembers. She took seminars in astronomy and computer science for three years. It was during these summer schools that Snezana made up her mind to become an astrophysicist. She also showed a large interest for programming, "I was in the team participating in computer science competitions. Every Saturday morning we had classes of preparation for the competition, where we were explaining to each other the fresh solved problems and developed algorithms, similar to the presentations we are doing now at CERN in every day meetings…"

Snezana's father, an electrical engineer, was at first a bit disappointed because he wanted his daughter to follow in his footsteps, but he was supportive of her physics studies in Zurich. Before coming to Zurich she took intensive German classes "with a very strict teacher, who taught not only German language but also the German order", as she recalls.

When Snezana started her studies at the ETH in Zurich, Switzerland, she was confronted with a completely different way of constructing the lessons. Instead of understanding theory through solving lots of problems, usually together with the other students she had to learn how to work the other way around, and mostly on her own. Snezana also had to cope with a kind of culture shock: "I was used to talk to people about things which excite me or bother me, about my personal impressions or problems, but the way the Swiss students interacted was very impersonal." That the Swiss students spoke Schwytzerduetsch - Swiss German - outside the courses did not help very much. When Snezana was in the fifth semester, many German students from the Erasmus studentship started, and she felt less a 'stranger'.

And again the music did help her a lot. A former school friend from Kragujevac studied music at the conservatory and through her she met Serbian musicians and joined a choir. "My choir was kind of my family. There were mainly students and PhD students who happened to study far away from home, in an exciting new country, just like me. They made my students days unforgettable."

Luckily, Snezana attended Physics I and II, and Introduction to Particle Physics under Prof. Günther Dissertori, an enthusiastic teacher. Although she first wanted to become an astrophysicist, after her first small project at CERN "I fell in love with particle physics." she remembers. "I was hardly waiting to finish all my exams and come to CERN for my diploma work, to finally make my fingers dirty with real researching business."

In June 2009, Snezana started her PhD at CERN with the University of Geneva. After completing her Zurich education with a diploma thesis in CMS, the time had come to make another big change. Snezana exchanged Zurich for Geneva, CMS for ATLAS, Swiss-German colleges for completely colorful international environment and German language for English and French. "It sounded like a new challenge. I am very happy to get to know a different detector and other physics topics, but I am also very glad to be surrounded by people from everywhere! We are all foreigners of Switzerland and natives of CERN. People with diverse backgrounds, habits and cultural heritage cannot live in a healthy harmony unless they open themselves towards everybody and learn to accept and appreciate the differences." She is now involved in the ATLAS SCT Operation and, after finishing her involvement in the Minimum Bias analysis through Low Pt Tracking, she is getting ready to start searching for the t'-quark along with her supervisor Alison Lister. "I'm getting really excited about our new analysis! Through Minimum Bias I have learnt the tools of physics analysis. Now I want to use them for making something myself."

Since Snezana's arrival, the ATLAS Geneva group has obtained a couple of summer/master students. She was asked to help them coming on board, which did recall her experiences from the summer schools she was attending in the past. "I like transmitting my know how; it's fun! I think, I would like to go into teaching after I collect enough knowledge by doing physics myself." she says, planning her future. Maybe that way she can transmit one of her major experiences: "To get accustomed to losing solid ground at any moment, to learn to be flexible and open for new experiences."

Today, Snezana is not torn between music and science any more; on the contrary, she found a way to combine them: "To play good music, one must master one's instrument. In particle physics one has the challenge that the instrument is too huge and complex to handle on one's own, but only through an orchestra - and this is our collaboration." she resumes. "ATLAS is a huge orchestra whose music can sound nicely harmonic only when all instruments are well tuned and all players well trained. When the smallest piece fails, the whole performance ends up in dissonance or experimentalism," she smiles.

Birgit Ewert
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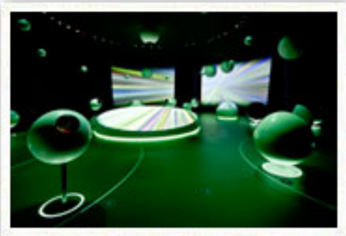



More photos are available **here**