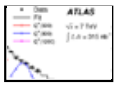
ATLAS e-News

7 September 2010

NEWS

ATLAS sets world's best limits on q*



Something to get excited over

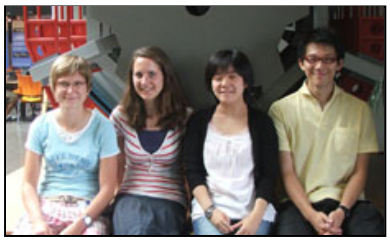
ATLAS helps plant learning tree in South Africa

The first African HEP school took place in Johannesburg in August

New CERN - Morocco student programme

First arrival: Mohamed Gouighri

FEATURES



Another successful CERN summer school

Four participants from the CERN Summer School talk about their experience working on ATLAS

PHOTO GALLERY

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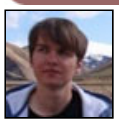
PROFILE



"I've always been interested in questions about the universe and what makes it tick," says summer student Elvar Karl Bjarkason

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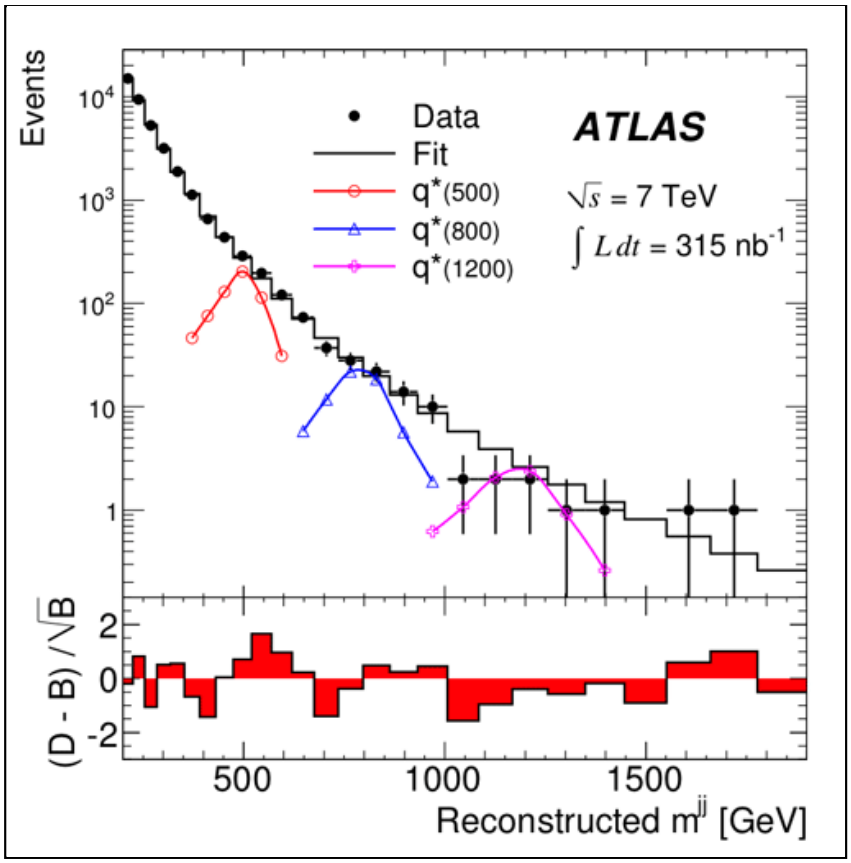


Reconstructed dijet mass (filled points) fitted to a smooth background distribution, with predicted q* signal indicated at three different masses.

The ATLAS Experiment has recently set the world's best known limits for the mass of a hypothetical particle, q*. The analysis, which was undertaken by the Exotics group and accepted for publication by Physics Review Letters last week, represents ATLAS's first exclusion of physics outside the Standard Model and extends the scientific reach of previous experiments.

The original search, performed on a 315 nb^{-1} sample of 7 TeV centre-of-mass energy proton-proton collisions, scoured the data for new physics. Looking at the mass distribution of measured dijet events, analysts used six different model-independent statistical tests to hunt for telltale features – bumps, tails, or overall shape discrepancy in the plotted data – which would indicate something new and unexpected.

“Unfortunately we didn't find anything new,” reports analyst, Georgios Choudalakis, so the team went on to focus on one of the popular theories – that a dijet event could denote a decaying q* particle – and investigate what the mass of that theoretical particle might be (or, more correctly, what it might not be).

The q*, an 'excited quark', is both excited and exciting. For a quark to be able to be in an excited state infers that it is a composite particle as opposed to an elementary one.

“Observations so far indicate quarks to be point-like, with no visible inner structure. But with the energy we have today, we may be able to see if there is anything to excite 'inside' quarks,” explains Georgios.

They chose to scrutinise the q* rather than any of the other possible sources of dijet

events because it has the highest probability of being produced at low integrated luminosity. In other words, it was the object that they could say the most about with the limited amount of data available to them. More importantly, q* is a 'benchmark' model, representative of a whole family of theories that predict similar signatures, described as 'narrow resonances'.

The maximum numbers of q* events that could have slipped through without being visible to the analysis were calculated for a range of q* masses by comparing with Monte Carlo production simulations. The thought process runs something like: “For this particular mass, at most there can be 10 events. If there were more than 10 events, then I would have seen [a signal]. It would be very unlikely to not have seen it.” Comparing these calculated maxima to theoretical predictions for q* production, the Exotics group were able to say at which mass the theories began to be incompatible with observation.

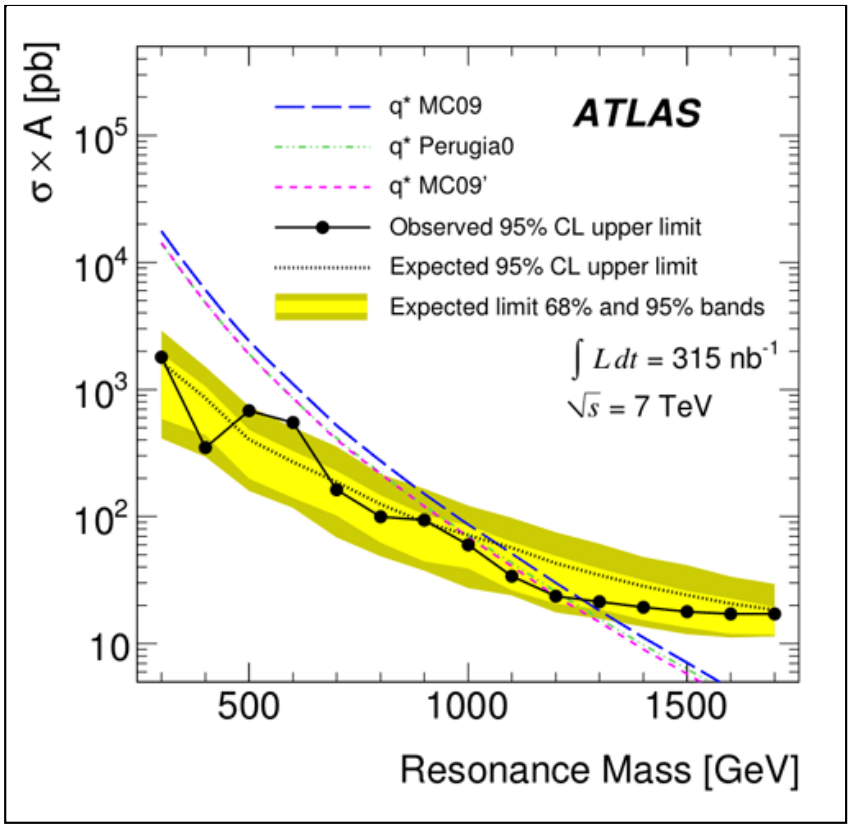
“Above this mass, theory starts predicting numbers which are allowed. But below this mass point, theory predicts [production] numbers which are too big,” explains Georgios, adding: “Beyond reasonable doubt – a 95 per cent confidence level – if excited quarks of this mass existed, they would have been seen. The fact that they were not seen means that the mass has to be different.”

According to ATLAS data, the mass of the q*, should it exist, will be outside of the range 0.30 TeV – 1.26 TeV. The lower limit denotes the edge of ATLAS's sensitivity, but the upper limit is the more interesting. The q* is expected to have a high mass since it will need to absorb energy (and therefore gain mass) to shift into an excited state.

The question of whether the quark is composite, whether there is anything inside it, has a long tradition. “That has been a paradigm in physics for millennia, reducing things to smaller and smaller building blocks,” says Georgios, “so there is no strong reason to believe that we have reached the bottom. If there is a bottom.”

A discovery of the quarks innards, 'preons', might provide insight on how quarks and leptons are interrelated – by elementary particles whose different combinations produce what science has observed to date – and if so, could offer a step towards a **Grand Unified Theory** .

For now though, ATLAS is able to say a little more about what the q* mass *isn't*, and has provided theorists with data in a new energy range, which they can use to test the limits of their own new models for any dijet final state narrow resonance.



The expected and observed upper limits of q* production as a function of dijet resonance mass. The intersection of the theoretical q* model curves (coloured dashed lines) with the measured values (black line with dots) determines new limits for each model.

Ceri Perkins
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ATLAS Helps Plant Learning Tree in South Africa

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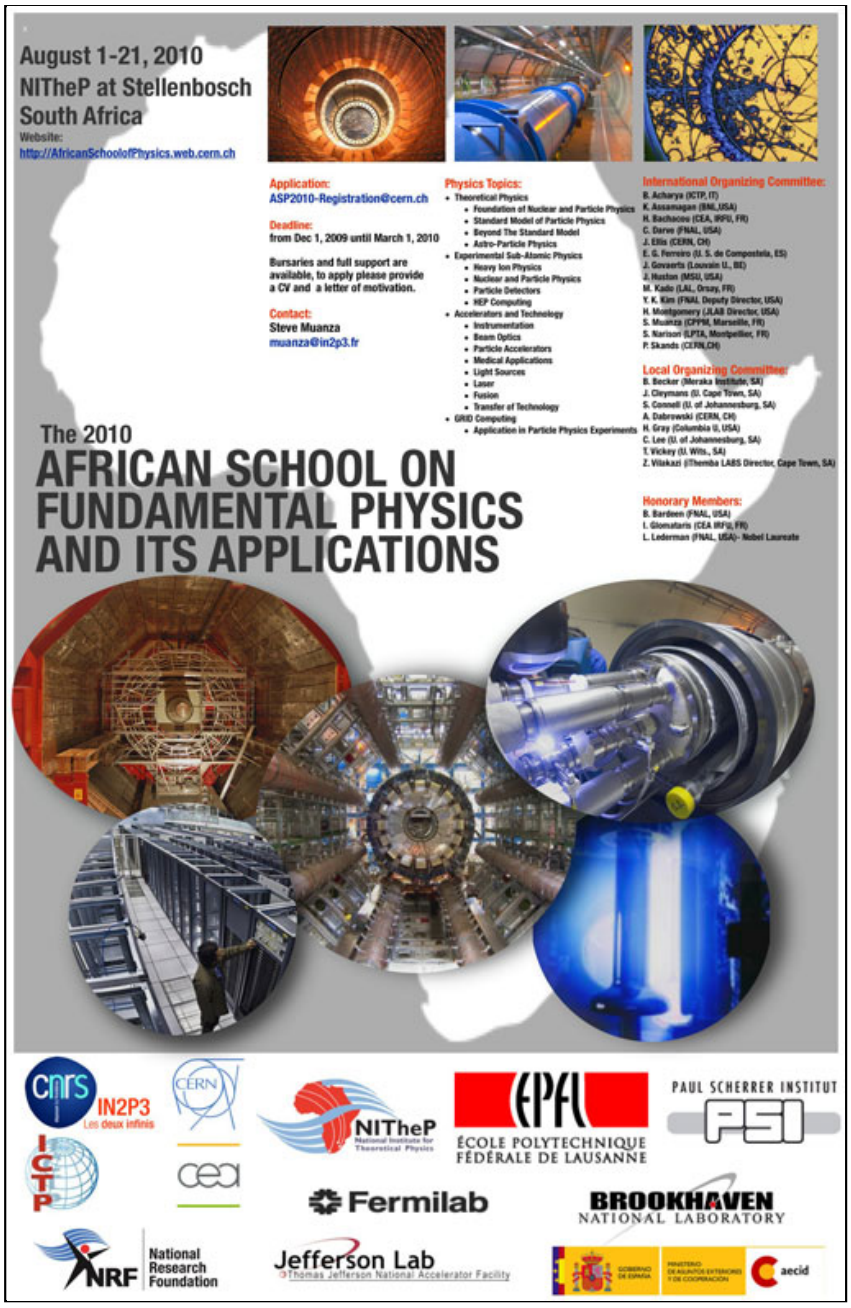

The new African biennial summer school was brought to life with diverse efforts, many from ATLAS colleagues.

ATLAS colleagues have played a large role in the formation and administration of the first Biennial African School on Fundamental Physics and its Applications which was held August 1-21 in South Africa. In addition, many current and former ATLAS members such as Ketevi Assamagan, Simon Connell, Andrea Dotti, Daniel Froidevaux, Heather Gray, Peter Jenni and Steve Muanza gave lectures at the school.

The purpose of the school was to increase the capacity in Africa for fundamental physics and its applications, as well as to establish a path to the benefits associated

with such development. The pedagogical approach of the school was central to its success because it took into account both the general and specialized education needs of the students.

Building on the strong scientific foundation in South Africa, the school reached out to students and scientists from neighboring sub-Saharan countries and beyond as well. It was the general opinion of the school organising committee that this approach would best contribute to the development of fundamental physics knowledge in Africa. The 65 participants were selected out of over 200 applicants, and were primarily doctoral students, master's students and young researchers coming from 17 African and four other countries. Heather Gray, of the local organising committee said that, “Because people in Africa don't really have so much money, the idea with this school is to fund every single student. This is wonderful because it just meant that [all they had to do was] apply and be accepted, and they didn't have to worry about [financial] stuff.”

Smiling participants of the first Biennal African HEP School

Last Feremenga from the University of Chicago, whose home country is Zimbabwe puts it that way: “The school as a whole was humbling and yet motivating. The complexities of the basic principles in theoretical physics made me realize how big a hole I have in physics; at the same time, the wit and expertise with which everything was presented strengthened my motivation to get involved in further pursuing research in physics, especially high energy.”

“[This school] has been a wonderful and unique experience,” said Michael Kagan an ATLAS graduate student from Harvard, and one of the handful of international participants. “Being able to meet students from all over the African continent and to connect with them through our mutual passion for physics has been an engrossing experience. During this program, I have learned a great deal not only about particle physics but also about the role of physics in many different African nations. More generally, this experience has opened my eyes to prospects of using physics as a means of education, communication, and development."

The first week of the school's three-week duration was dedicated to the review of the theory underlying some of the central HEP concepts. This was done to ensure that each student could review this theoretical foundation that they may have only had slight exposure to before. Then, the main topics covered were experimental subatomic physics, detector techniques, accelerators and technologies, and information technology with an emphasis on GRID technology. Each topic was subdivided into an initial set of recaps of essential background knowledge, followed by four main lecture themes, and finally a dedicated theme on computing-related aspects of the topic, including Monte Carlo generators, GRID, and high-performance computing. Aside from the core curriculum, three special ‘star’ lectures highlighted the cutting-edge aspects of current research presented at the school.

Heather also commented on the curriculum saying, “I think the amount of application involved with this school is quite unusual. It's something different that they chose to do, which makes sense because in Africa there isn't so much money to build enormous accelerators and just do high energy [physics], and so they're doing both things. They're seeing if people are interested in [accelerators], but also giving people ideas of something they can [more easily implement] in Africa as well. The other thing about the school is that there is quite a focus on computing. There are computer labs every

week, and they're teaching skills that can be used."

The idea for the school was initially posited 10 years ago by John Ellis, but it was Steve Muanza, an ATLAS physicist at France's CNRS/IN2P3 and the co-founder and director of the school, who gathered the group of people that finally passed the 'critical mass' to start and run the project. Steve's parents are from the Democratic Republic of Congo and, although he was brought up as a French citizen, he is strongly influenced by African culture and has always had the vision for such a school. He had tried various avenues for support and found many people at CERN, Brookhaven, Fermilab, and other institutions who were interested in an African school too. As Anne Dabrowski, another member of the school's local organising committee and working at CERN on the CLIC project, put it, "In the end we all just joined forces towards one common goal."

The African school is a project which the supporting group of individuals and institutions hope will have an impact. Anne noted that, "CERN has, in recent years, provided scholarships for a few African students to come to CERN as summer students. In addition, through the teachers program, CERN has also supported a few high school teachers from Africa, with the philosophy that exposing one good teacher to the program will then mean that through them, many more students are better informed about fundamental research and the research engaged in at CERN. So, the main thing with this [school] is that we're doing the same thing, but on African soil." Both Anne and Heather also agreed that in place of the aforementioned attempts to send seeds to plant for student learning, this school was akin to planting a full grown tree on African soil, ready to give fruit to the students and apt to grow on its own.

ATLAS has been involved in the formation of the school, with collaboration members participating actively in administrative panels and lecturing at the school. Christine Darve, Steve Muanza and Ketevi Assamagan played important roles in the overall organisation. This school is something to look forward to watching evolve and blossom in the future.

Sarah McGovern
ATLAS e-News

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New CERN - Morocco student programme

7 September 2010

New ATLAS doctoral students Mohammed Gouighri and Sara Boutouil at a welcome ceremony with CERN Director General Rolf Heuer and the Hassan II Academy of Science and Technology's Secrétaire Perpétuel, Omar Fassi Fihri.

The first Moroccan doctoral student to benefit from a new funding programme, Mohamed Gouighri, is six weeks into a one-year stint at ATLAS. Moroccan groups, clustered into the 'Réseau Universitaire de Physique des Hautes Energies' have been members of the ATLAS Collaboration for over 10 years, and several PhD students have undertaken thesis work here, Mohammed is the first to be given the opportunity to study at CERN full-time.

He arrived at the start of August to work under Guillaume Unal on an extension of a project he began on a two-month trip here back in 2008. On the hardware side, he is involved with the Liquid Argon cross talk correction and Trigger, and for his analysis he will work with B-physics, investigating the B_d meson to J/Ψ plus K_d data channel.

“This channel is one of the most important at the start,” Mohamed smiles. Indeed, the B_d peak started to appear in data just two weeks after his arrival in August.

This year at CERN will mark Mohamed's seventh year of studying physics (the previous six being spent at the Faculty of Science in Casablanca), and the final year of his PhD. “Normally I should be finishing now, but since I had this opportunity I decided to add one year,” he smiles.

Mohamed is the first student to benefit from a new multi-party agreement between CERN, the **Sharing Knowledge Foundation** the Moroccan universities participating in the LHC programme and the Hassan II Academy of Science and Technology, an agreement which ATLAS's Patrick Fassnacht was involved in orchestrating. Mohamed has been awarded a scholarship, funded by the Hassan II Academy of Science and Technology, in order to take up his post here.

He arrives two months ahead of ATLAS's second Moroccan student, Sara Boutouil, who will begin a four-month placement with ATLAS in October as part of her top quark PhD studies. The placement, part-funded by ATLAS, is facilitated by an exchange programme between France, Morocco and Sweden.

Mohamed is already throwing himself into CERN life, and vows to get as much as possible from his year here. “It's really something very important, to have all this; to meet people, to have help from other people,” he says, adding: “It's very easy to work

here too, rather than for example in Morocco. It's like you're constantly in update frequency."

Ceri Perkins
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2010 ATLAS Summer Students Succeed!

7 September 2010

From left to right: Magdalena Kusz, Elina Fuchs, Sumire Shimojima and Jiayin Wang

As the first summer student lectures began, one could feel electricity filling the globe. Students from all over the world gathered and began soaking in their new reality – their summer internship working at CERN. As anticipation subsided, the magnitude of this opportunity was not difficult to appreciate. Even toward the end of the summer, the euphoric gratitude remained. For the most part, the students working on ATLAS were so impressed with it that they would have chained themselves to a detector so that they would never have to go back home. Their enthusiasm and appreciation were also apparent in their words.…

One of those declarations of gratitude to ATLAS came from Sumire Shimojima, a Japanese student who was analyzing ATLAS pixel detector data. Sumire said, “It's just so exciting. We're looking at new data that was just taken yesterday. It's not on the books. It's just so new and so exciting. It is amazing!” Sumire also discussed her experience at the hostel with her new friends. There she heard ideas and saw new ways to relate that she'd never known existed before.

The range of experience was broad though. Many students I talked to had a different perspective and approach to their time here. For example, Jiayin Wang, a Japanese student knew he deliberately wanted to make this a trip reserved for introspection about his future professional goals. Jiayin wanted to explore the reality of being a particle physicist juxtaposed to the reality he already knew as a young teacher working with students. Jiayin was working on a research and development project for the ATLAS MicroMEGAS detector and said, “I appreciate that I was given a chance to touch the professional work of researchers and get a picture of it, which was really useful for me to make a good decision for the rest of my life.” He came to realize that he wanted to be nearer to people, actively helping them to “…realize their dreams.” While here, he made the very important decision to pursue this specific path.

Elina Fuchs, a German student who worked with the ATLAS photon reconstruction group, thought she would surely go into theoretical physics as a postgraduate student, but being here might have changed that opinion. “Now I realize that with real data, rather than with simulations, it's much more interesting, so now I'm considering going back to experimental physics,” Elina explained, happy that she had the opportunity to learn this. She was clear, focused, and ready to take-on the world of particle physics.

Magdalena Kusz, a Polish student, felt similarly to Elina in that her interests were also peaked by the inclusion of actual data, though with an entirely different emphasis because she is a young computer scientist. Magdalena expected to be programming in C++ for ATLAS, but she, "...didn't expect [to be] dealing with the KDE KIOSK framework," nor did she expect to enjoy the incorporation of physics as much as she did. Learning many new things during her time here led Magdalena to admit the whole ATLAS experience very much outgrew her expectations. "Meeting new very interesting people among other summer students and workers, and also living in the center of CERN... was a great experience." She liked listening to people in the cafeteria while they discussed physics problems, and she said, "It is inspiring that everyone is really passionate about projects; it creates a great atmosphere."

It was fun to hear each student talk about their favorite moments. Not surprisingly, they very much liked being with each other. It seems that the experience of staying at the hostel and sharing a common area in the evenings really touched them and left an indelible mark on their time here. All were obviously impressed with these experiences.

Jiayin also had some advice for future summer students. He noted the difficulty of studying in a second language saying, "Summer students coming from non-English-speaking countries should prepare hard before they arrive. Also, those who tend to hesitate at asking questions should overcome it before they arrive." Surprising to hear from someone who's English was nearly perfect…

Additionally, according to a few students, administrative aspects of the summer program could also use a bit of fine tuning. Some lecture material was repeated several times, and one mentioned that perhaps there was a need for the speakers to crosscheck their lecture content while in the planning phase as to avoid this from happening.

It should also be mentioned that this year again, thanks to financial support from Akbank, and from the CAST and ATLAS collaborations, three additional Turkish students were admitted to the program as Engin Arik Fellows. This foundation was established in the memory of Prof. Engin Arik and her colleagues who perished in a plane crash in December 2007. This year's fellows were Doga Can Gulhan, Deniz Gunceler and Duygu Tarhan. This foundation aims to continue Engin's tireless efforts to bring great Turkish students to CERN.

Overall, the ATLAS students were fairly ecstatic to be here. They were exposed to many career and life-changing ideas and opportunities that they had never encountered before. Definitively, the CERN summer student program has impacted many students' long-term goals.

Sarah McGovern
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Elvar Karl Bjarkason

Nationality: Icelandic

Elvar paragliding with a friend

“I've always been interested in science, and questions about the universe and what makes it tick.” says Elvar Bjarkason. Like many physicists he began by being interested in general science, so still in primary school he liked mathematics, chemistry and physics, while learning about the structure of atoms. But that was just a start. Later, in his last three semesters at high school, he was much encouraged by three young and very enthusiastic teachers, teaching physics, astronomy/astrophysics and philosophy. “I liked the thought aspect in philosophy, as mentioned by Thomas Kuhn in the “The Structure of Scientific Revolutions” and in “The Scientific method” by Sir Karl Raimund Popper;” recalls Elvar. “I could very easily relate to them (my teachers) and they were in many ways a big factor in thinking I could have a future in physics,” he continues.

As he had good marks in all subjects, choosing which subject to study was still difficult. His Icelandic teacher suggested that he should study Icelandic literature. With both parents being geologists, geology would have been another option. Iceland's knowledge in geothermal energy is in high demand today and Elvar's father, working in geothermal exploration, travels to Indonesia, Turkey and New Mexico. Travelling as part of a career was a tempting prospect to Elvar as well, and so he wondered if perhaps geophysics was in his future.

Finally he made up his mind and started to study physics at the University of Iceland in Reykjavik, where he has finished his second year of undergraduate study. “I found out about the summer student program when I saw it advertised by the student council for physics and math at my University.” Actually, he found out about it last year, but when he was in the process of applying for it, his professor suggested that he should wait another year and learn about quantum mechanics first, to really take benefit. Luckily he did, not just to follow the seminars at the CERN summer schools more easily, but also as this year the LHC is running and CERN is even more the place to be as a physicist...

Since Iceland is not a CERN member state, his summer-studentship is just 8 weeks long, with 6 weeks of lectures. “I do learn a lot, as most information is new to me. Most summer students have already finished their third year of undergraduate or have started their masters. Some seminars are too basic for me, but some are too advanced,” he explains and continues, “Next year I'm [going to take] more quantum mechanics, not just math.”

But he is not just learning a lot in the lectures. For his project, the offline display for histograms of ATLAS, he has to use ROOT, Python XML/HTML and Java. He learned these programming languages by using them. “I had a course in Matlab at the university and knowing one programming languages, it is easy to learn another one. I like the challenge of programming,” Elvar explains.

Unfortunately programming means a lot of desktop work - something that Elvar is not so fond of. “I like sports a lot - actually any sport with a racquet, like squash and tennis, Basketball and my favourite is floorball.” The game of floorball is also known by many other names, such as salibandy (in Finland), innebandy (in Sweden and Norway), and unihockey (in Switzerland and Germany). The game is believed to have originated in Gothenburg, Sweden, where it was played for fun as a pastime at schools. Floorball is played indoors with players, except for the goalkeeper, using a floorball stick that is short, (as compared with ice hockey), to get a plastic whiffle ball into a net past a goalkeeper “It is still a small sport in Iceland compared to Finland, Sweden or Norway” Elvar mentions and adds proudly, “The team I am playing on as winger is right now national champion and cup champion as well.”

Elvar's plans for the future are to finish his undergraduate studies in Iceland and then change to a Scandinavian university - maybe to Copenhagen, as he already knows Danish. It is still undecided, if it would be Astrophysics, Particle physics or Geophysics. Although the experience as summer student at CERN was meant to help him with his choice, he is still not totally sure. What he is definitely taking back home from Geneva and CERN is the experience of working in a big place dedicated to physics. “But for CERN being the high-end place of physics worldwide the environment and the building are rather odd,” he smiles. “Most of us summer students did expect a much more modern architecture. But obviously all the money goes into the experiment,” he adds with a grin and continues, “I appreciated a lot meeting other students from all over the world and discuss[ing] with them their plans for their further studies.” And he concludes: “I hope to keep in contact and have the opportunity to work together with some of them in the future.” And maybe come back to CERN as a fellow, once he finishes his studies…

Birgit Ewert
ATLAS e-News

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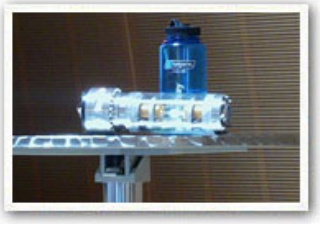
CERN Summer Students 2010



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