The Journal of
the International Association of Physics Students

{ jiaps }

Summer edition, 2005

Pink Power!

It is now time for this year's long awaited ICPS. It is also where we (the Norwegians) say goodbye to you as the Central Office of IAPS. Our little journey started in Novi Sad, Serbia & Montenegro August 2004. During this amazing week of sun, shopping, lectures and parties we ended up with being the central office of IAPS. Not quite sure of what to expect and with a mix of a nervous and excited feelings we entered what was to become the Pink-Year of IAPS.

We had a lot of ideas and visions as we started as the CO. Some of them were realised and many not, but I guess that's how life is, we can not get everything we want. But we can certainly try! I guess what has been the most fun has been to travel and to get to know a lot of different and interesting people.

And now, after one year, we have done our part. It has been a fun year and we have learned a lot, about ourselves, about an international association and about a number of possible crises…hehe. So this is where we say goodbye from the CO and pass the torch on to Davide & co in Italy, the next CO. Good luck and most importantly……have fun!

For the Central Office
Annett Thogersen
IAPS president 2004/2005

As Annett use to say: "Ohhh, it is so cute!"

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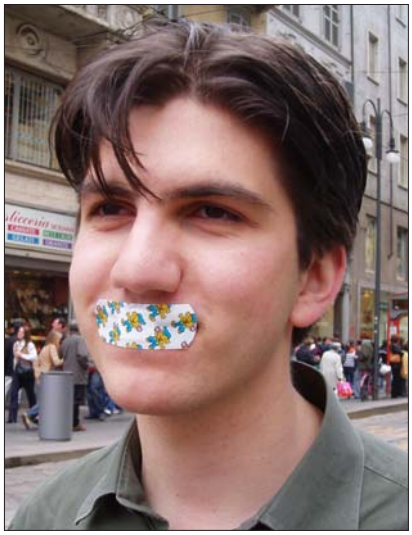

Finally he will be allowed to speak!

IAPSing Italy

Hard discussions on IAPS and the future of Italy

After Germany, now it's Italy's time to know about IAPS. Saturday 30 April 2005, more or less 50 figures coming from 10 different universities were attending the very first "MISF" (Italian Meeting of Physics Students) held in Modena (the town where Ferraris are built ;-)), in the north of Italy, just where the EC meeting took place.

The purpose of the meeting was to introduce the Italian students to the international community of associations and of course to light-up their wish to participate in the scene.

The meeting was rather informal, as was planned, nevertheless important institutional representatives gave a good kick-start to the working day, with presentations in English (for the IAPS EC) and in Italian on the local and national research environment and on the Italian reform of university education. Immediately after the rich coffee-and-sweets break offered by Modena's INFM S3 (NanoStructures BioSystems at Surfaces) laboratory, our fellow professional representatives of Mafihe (Hungary), NEXUS (UK), Physis (Portugal), FAPS (Finland), IAPS-Norway described to the Italian students their national experience in building an association, and the result achieved so far. The charming speech of our President Annett ended the morning, leaving the guys with many ideas, doubts and thoughts about the Italian perspectives.

Although people started to socialise on Friday evening (there were "delegations" from south Italy that took more than 10 hours travel to come) the sense of brotherhood and friendship was really established on Saturday afternoon (and without the need for alcohol! incredible!).

At 3 p.m. the participants started a fruitful debate about the possibility of building an Italian association of physics students or just simply setting up a network and organising events. During the four hours of work more or less everybody contributed to the establishing of some working groups where people committed to the organisation of a website, to the setting up of a second MISF, and to the drafting of a charter (gulp!). And finally, a party was organised in the evening to let the people taste the work-enjoy paradigm of IAPS-Lifestyle (pictures are self-explaining). Ultimately, the first "Meeting Italiano degli Studenti di Fisica" was a great success, and I can support this sentence by some evident consequences. First of all, as many of the readers will be able to verify, for the first time a delegation of more than 18 Italians will be present at the ICPS this year. What's more, the Italian newborn association has already an active website, forum and mailing list, already produced two suggestions for an official charter, established contact with the Italian Physical Society, and planned a meeting in Catania (south Italy) for the end of September. We finally have the demonstration that there's more than pizza, spaghetti and latin-lovers in Italy, there are also very motivated physics students (the males of which, of course, are definetely latin lovers... but that's another story)!

Norwegians appriciate italian charm (?)

References:

http://www.madtrip.org/MISF/

Davide Venturelli

One day of my life

The date is 9th of June. I'm quite close to getting out of my bed and starting a not ordinary day, but something keeps me back. It's raining... I hope it is just a bad dream, but it IS raining without doubt. Let's see what do I have to do during the day:

Have a shower, have breakfast, meet the tv guys at the square, build up some tents if we don't want to be watered, bring the t-shirts to the square, make a report with a physicist about physics (how astonishing in the year of physics... :-)), wait for the children to come, make the children behave like small particles, say goodbye to the children and everyone, go back home, eat something, go to the pub to drink something after this day and finally sleeeeep.

If you didn't figure it out yet, this is the day of the Flash Mob.

To understand why it is so important for me (and hopefully for the children too), I have to talk a bit about our association's part in Hungarian education.

I've heard that associations organise Physics Circuses and some other shows for example in Denmark. I think it is a really good thing, because after the show hopefully children will be interested in physics. More of them will decide to be physicists in the future and they will not choose some other departments like economics (as they do in Hungary).

Unfortunately it was not originally part of our association's remit to organise events where we could encourage high school students to be physicists. Everyone kept saying that so few people (and not the best ones) choose this field of science, but no-one had a good idea to change this. Now, the idea is given, all we have to do is a little work.

Well, I have to correct this statement. We have a Palace of Magic – a special kind of playground. One can see some funny experiments there, it is really entertaining, but this is the only place in Budapest where you can find "funny physics" for children. But now our association, Mafihe, has decided to make a Flash Mob, which is the first open-air, physics-related programme for youngsters in Hungary. And it is still raining...

I go outside, it is cold too. The temperature is a bit above 10 Celsius. I have a raincoat and a warm sweater, but we planned that the children would wear flash mob t-shirts! What will they do? Wear them outside their raincoats?

Who thought a half year ago, when I started to organise the event, that this day would be the coldest and rainiest in June and I should have ordered not t-shirts but umbrellas.

I've called the tv out, some journalists and nearly 500 high school students. The biggest (or at least the longest) square in Budapest is ours for a whole day, I've ordered a sound system, electricity (it is not coming by itself), a small stage for me to speak, so everything is well-planned. But who ordered this rain?!

No problem, I start my day as I planned until I get a phone call. It is the director from the tv. They will be in late because of the rain. Great! - I say to myself. No problem, now I and the other organisers have more time to build up the tent. It is not that easy, you know!

Funny neutrons

The professor whom I should make the report with is here, but the tv guys are nowhere. Another phonecall. The director says they were waiting in the office till now, but when I say that we have the tents ready, the professor is here, they really should leave now, he says, okay,okay, we are coming. Thank god! - I think.

T-shirts have arrived, soundsystem will be a bit late, some 20 minutes. I think, hehe - if it was my greatest problem during the day, I would be really happy. Tv arrive, I make that interview with the professor, it is quite good. But where are the children? They should be here too. I said to the teachers to arrive around 2pm. It is 2pm, but no-one here... After some stressful minutes the first class is arriving! Whoaaaa! And another one, two... When we reach 300, I think, now, we can make this experiment even if no-one else is coming. I planned 60 children to be detectors (white t-shirt), 20 to be protons (red t-shirt) and neutrons (blue t-shirt), the others should be alpha-particles (purple t-shirts), but to make the experiment look good at least 200 alpha-particles are necessary. And we reach that number, not just reach, but we are above that. When we start the experiment at 3 pm nearly 400 students are on the square!

Protons and neutrons are standing in the middle of a circle (radius is 20 meters) surrounded by detectors, we collect alpha-particles and make 4-5 children to run towards the nucleus in every second. One can see some students in yellow t-shirts, they are the collimators, my dear organisers.

You can see in the pics that the children are happy to be there, they are wearing the t-shirts on their jackets – problem solved.

I hope you, dear reader, excuse me for saying that I'm really proud of this event. I hope this was just the beginning of something bigger in Hungary. I hope next year I can organise something even bigger for high school students and not let talented youngsters choose other departments than physics. And I also hope that I will be able to find someone in Hungary who will organise events like this after me.

Andras Zsom
Hungary

... Meanwhile, in Nigeria:

On June 9, 1905, Albert Einstein published his ground breaking research papers. IAPS set aside June 9, 2005 as an historic day to celebrate the centenary of this great man, at the same date and time in major cities across the globe. It is indeed a good way of making physics fun for young pupils and society.

The Physics Students Association of Nigeria is a nexus of students who have an interest in physics and in promoting the subject in Nigeria. One of its adopted strategies for the World Year of Physics is enthusing young people to take physics as their future career. Past events have included: seminars, competitions, public lectures and career talks. The association is looking for a way to collaborate with some organisations to provide Scholarships for students who want a career in physics.

The venue for the day was Nickdel Private School, Idi ape, Ibadan, Nigeria. The programmes were designed to suit the target audience: graduating pupils from primary schools to high school between 10 – 14 years old.

Activities included:

Opening remarks/Keynote address on World Year of Physics

Introducing Albert Einstein

Career talk on the prospect of Physics

Exhibitions of projects

Experiments

Songs and rhymes

Inauguration of the Young Physicist Club Nigeria.

Drama and Play on Physics.

The play, entitled 'Physics the Heart of Science', was performed by the Drama troupe of Nickdel Private School. The play centred on various factors that influence a pupil's interest in studying physics as a future career. The main character, Aliero, explains the importance of physics to her colleagues; eventually she is able to convince her parents and her mates that studying physics makes you somebody in society. The play stimulates the pupils and arouses their interest in the subject. With the belief she has in physics, Aliero trains as a Medical Physicist, has many achievements and contributes to the development of science in her society. Finally she is named as the winner of the prestigious Nobel Prize in Physics. The play ended on a fine note amidst cheers.

The major experiments included: Rutherford Scattering Experiments, surface tension, Rectilinear propagation of light, Archimedes principle, Brownian motion etc.

The kids were totally preoccupied with all the situations and solutions in physics being explained. This showed when so many questions were asked after the career talk. It was so interesting that nearly all the pupils have their own definition of the phenomenon called PHYSICS.

Immediately after the career talk, twelve years old master John Roland asked " What is Physics?" Ten minutes later, he said " Physics is knowing how the world works".

The event was taken to the grassroots where it belongs. All the participants including pupils and invited guests were fully enthused about how Nigeria can benefit from Physics.

A few minutes before the closing remarks, the moderator asked the pupils: "Now who wants to become a Physicist ?" The organisers' faces wore beautiful smiles when all the pupils raised their hands. The mission was accomplished because the future Physicists were born on June 9, 2005. Who knows if Nigeria can produce another great physicist like Albert Einstein?

Akintola Abayomi
Secretary Flash Mob Project Committee
A Sub-committee of Nigeria WYP Organizing Committee.

Participants' comments:

" *I'll have to explain to my mum at home why pressure cooker cook beans faster than stove*" – Rebeca Ladi, eleven years old.

" *Physics is more interesting than literatures!*" Supoju, twelve years old (who also played the role of Aliero in the play).

According to ten years old Ahmed Sulaiman, Physics is more like magic and he said he will have to proffer solutions himself.

"*The event should be an annual event, my pupils loved it so much*", Mr. Steven, the head of science from Nickdel Private School.

JET - Get it while you can!

The world fusion community recently agreed to site the next major fusion project, ITER (International Thermonuclear Experimental Reactor) at Cadarache in southern France, after an 18 month stalemate. Resources will now be concentrated on the new project, which will produce 500MW of fusion power and pave the way towards a commercial power plant; at the same time, the current world-leader, JET (Joint European Torus), based at Culham in Oxfordshire, UK, will be gradually scaled down. If you want to see JET while it is still in its prime, sign up for the IAPS visit on October 21st 2005!

We will have an introductory talk followed by tours of JET and MAST (another fusion project); we will also visit the nearby Rutherford Appleton Laboratory, where we will see ISIS, the neutron and muon source.

The event will run from Thursday 20th to Sunday 23rd, with the Culham and RAL visits on the Friday and a free day on Saturday. Accommodation will be at the modern Youth Hostel in central Oxford. Thanks to generous donations by Nexus and the European Physical Society, we have managed to get the overall price down to just 90 euros. This covers three nights (bed + breakfast) at the youth hostel, plus one evening meal, and transport between Oxford, Culham and RAL. There will be plenty of time to explore the ancient university town of Oxford, and we are hoping to organise city tours and tours of the university physics department.

Places are strictly limited, so book now to avoid disappointment!

Contact Maren Isachsen NOW:

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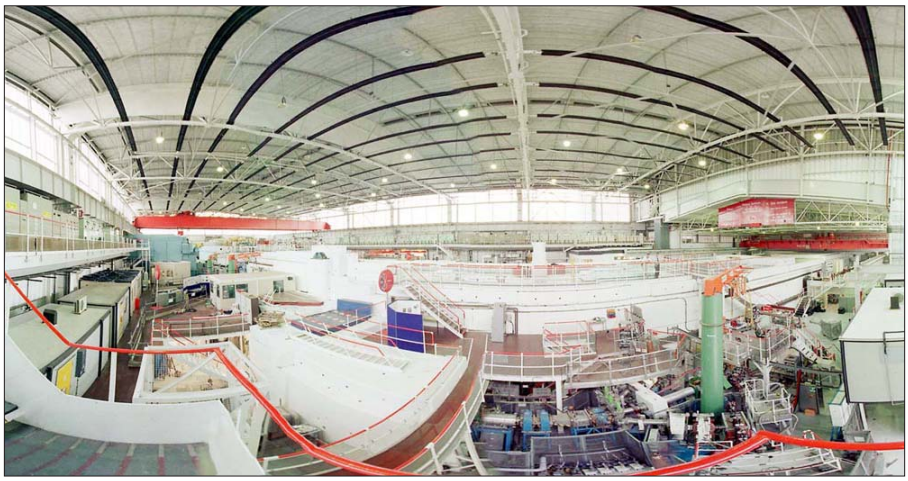

ISIS Experimental Hall

The Long Road to Fusion

Ever since the detonation of the first hydrogen bomb in 1952 showed that manmade fusion was possible, physicists have been working to tame the huge energy release so that it can be used to provide cheap, clean electricity. Even before the H-bomb, the theory of fusion as the power source of stars had already been firmly established; now the task was to find some way of creating a small "star" in a terrestrial laboratory. It was always going to be a long haul; early predictions were that a commercial fusion reactor was at least 50 years away, and cynics often argue that it will always be 50 years away; however, huge advances have been made, many of them by JET.

JET (Joint European Torus) began operation in 1983 after a 10 year design and construction phase. It is a magnetic confinement experiment, which means that magnetic fields are used to contain the hot plasma, and, as its name suggests, it is in the shape of a torus or doughnut, the plasma particles circulating around the central "core". In stars like the Sun, the dominant fusion reaction is the pp chain, which is a three-stage process in which protons fuse together to form deuterons, which then combine with more protons to make helium-3, and finally two helium-3 nuclei fuse to produce helium-4 and two protons. JET, however, uses deuterium-tritium fusion:

$$^{2}_{1}H + ^{2}_{1}H \Rightarrow ^{4}_{2}He + n^{0}$$

This reaction is chosen because it is more easily achievable than the pp chain; in the latter, the last stage requires a high enough temperature for two doublycharged helium nuclei to get close enough to fuse, but in D-T fusion both the fuel components are singly charged. It does, of course, require a supply of tritium, which is not found in nature (which is just as well since it is radioactive!) although it is a by-product of nuclear fission. The neat thing about the D-T reaction is that the outgoing neutrons can be made to react with lithium (an abundant element) in a "jacket" surrounding the vessel (which is known as a tokamak) to produce more tritium:

$$^{6}_{3}Li + n^{0} \Rightarrow ^{4}_{2}He + ^{3}_{1}H$$

Fusion is extremely safe - it is not a chain reaction like fission, and so cannot run out of control; if the magnetic containment fails, the plasma simply collapses. There is also far less radioactive waste than is produced by a fission reactor, and it is shorter-lived, with half-lives of the order of decades rather than millennia. This makes fusion power more sustainable in the sense that the waste products resulting from the energy

needs of one generation are not left as a legacy for future generations to deal with (well, almost). And, of course, there is no greenhouse gas emission!

JET - A Record Breaking Project

JET has already set the world record for fusion power generated using the DT process (16MW) and was also the first experiment to achieve a "break-even" reaction in which the fusion power generated equalled the input power. At the same time, the United Kingdom Atomic Energy Authority (UKAEA), which runs the Culham site, is also looking into alternative geometries for fusion projects, and has developed the MAST (Mega Amp Spherical Tokamak) experiment in which, as its name suggests, the plasma has more of a spherical shape. It is thought that this design has a number of advantages over the conventional toroidal plasma used in experiments like JET. JET will recommence operation in November after a year-long shutdown for upgrade work, and will now focus on testing concepts and technologies directly relevant to ITER. All work on the tokamak itself is done by robots, as the interior is a "no-go" area for humans due to induced radioactivity. However, there is a replica of the interior which is used to train the robot operators, so that we will see what it is like inside without getting a lethal dose!

Neutrons For All

The Rutherford Appleton Laboratory is a central laboratory facility serving all UK universities as well as some private companies. It is a multidisciplinary laboratory covering the fields of particle physics, lasers, space science, IT, computational science, engineering, instrumentation and radio communications. And it will soon be home to DIAMOND, the UK's new synchrotron radiation source, the shell of which already dominates the local skyline. ISIS is the world's leading pulsed neutron and muon source. It is a spallation source in which the neutrons are produced by bombarding a target with high energy protons, and are then used in a plethora of neutron scattering experiments in all sorts of diverse fields - everything from archaeology to cell structure, and superconductors to aeronautical engineering. Neutron scattering complements the use of X-rays to probe the structure of matter, with the advantage that neutrons can "see" all nuclei equally well, whereas many light materials are transparent to X-rays. ISIS is set to expand soon, with the addition of a second target station and a number of additional experimental areas. Some time in the next two years, a third target will be inserted into the proton beam, but only for a few milliseconds at a time - for this is the target that will "parasitically" produce the muon beam for MICE (Muon Ionisation Cooling Experiment), an exciting new development which will be the first major particle physics experiment to be based in the UK for many years, and may pave the way for a "neutrino factory" if it is successful.

Further information:

JET and MAST: **http://www.ukaea.org.uk/culham/index.htm**

ISIS: **http://www.isis.rl.ac.uk/**

MICE: **www.mice.iit.edu**

Acknowledgements: "Nuclear Fusion: Energy of the Future?", Khee Gan Lee, Nexus News, March 2005; UKAEA promotional literature; ChrisWarrick (UKAEA),personal communication; ISIS Annual Report.

Jim Grozier
University of Sussex, UK

AFRICAN CONFERENCE OF PHYSICS STUDENTS, 2005

The African Conference of Physics Students, 2005 is the first of its kind. It will be held in Abuja, Nigeria on 15th-18th November, 2005 and is expected to gather together 300 students (undergraduate, postgraduate) studying Physics and related courses around the world. The conference is the result of an initiative by Oke, Olumuyiwa Oladunni, a student of Pure and Applied Physics at Ladoke Akintola University of Technology, Nigeria, with the aim of improving the development of his course of study in Africa.

The theme for the conference is "The Development of Physics in Africa" having the following as Keynote Speakers: Associate Professor Peter Dunshy (University of Cape Town, South Africa), Professor Norbert H. Hounkonnou (International Chair in Mathematical Physics and Application, Benin Republic), Fred Jerome (Science Writer and Journalist, U.S. A.), Professor Samuel Yeboah Mensah (University of Cape Coast Ghana) and Professor Emeritus John Stachel , Director of the Center for Einstein Studies of the Boston University U. S. A.

The conference events include: Opening and Closing Ceremony; Invited Presentations; Panel Discussions; Contributed Paper/ Poster Presentations; Workshops; Special Lecture on Einstein; Technical Visit; Awards; Book Fair; Social and Cultural Programme; and the Annual General Meeting of the African Association of Physics Students (AAPS).

The success of the conference will be evaluated on a number of parameters and the expected outcomes include the formation of the African Association of Physics Students, publication of the conference proceedings, summary of conference discussions, a website for AAPS, etc.

Members of the Organising Committee are: Oke, Olumuyiwa Oladuni (Chair & Initiator), Markus Kartsen (Vice-Chair, Webmaster), Latinwo Olugbenga Olasunbo (Secretary), and Aquah Paul (Member).

Detailed information about the conference can be viewed at the conference

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How to set up a Science Circus

First of all, one might ask "What is a Science Circus?", "What purposes should it fulfil?", and "Who would be interested in its existence?" If you are able to answer these questions, even just vaguely, you have a strong foundation for a Science Circus. In this article we, a Danish Science Circus, will give our answers to these questions and many more practical issues.

"What is a Science Circus?" and "What purposes should it fulfil?"

These are the fundamental questions that every member of a Science Circus must be able to answer. The answers are provided by the vision that the Science Circus is built on. In our Science Circus, we define ourselves as an organisation that brings the physics of everyday life to the elementary- and highschool-students. And we do it in an interesting way. As a part of this vision, we have set one goal above all others. We want the students to be amazed by the world they live in, and think twice when they see something new, not just discard it as being outside their immediate field of interest. We are not trying to make a whole world of physicists, but just raise the awareness. From this comes our measure of success — do they now think physics is interesting? When you have answered these questions, and answered them well, the answer to the third question in the introduction should arise directly.

We have a vision! Now what???

At this point you should be a small group (we started out with five members) and a concept of what your Science Circus should be. It is now time to make yourselves operational. Let us not fool ourselves here, the first thing you need is money. You need money to buy equipment and you need money for salary. In addition you will also need some money for the day-to-day operation. It is possible to borrow, or even get, some old equipment from your physics department, but it is always best to have your own. This way you can have full control and you are free to make any necessary alterations to the equipment. So how does one get the money? This all depends on your home country, but as a general rule the physics department is always interested in promoting itself. Therefore ask the head of your department for some financial support, and maybe some advice on how to get more money. We have made the arrangement that the department pays our salary and transportation (we travel around the country). Just remember one thing, it might be all right at first to do it for free, but it is a job that require a huge amount of work and should be treated as such. The amount needed for running a Science Circus differs from country to country, but as an example, we in Denmark have a year-budget of around 10,000 euros.

So what do we do with our money?

The heart and centre of a Science Circus is of course the equipment. Always keep it in prime condition. The question now remains what type of equipment you should buy. This all depends on what kind of experiments you would like to show, but in general you shouldn't spend a lot of money on a piece of equipment you can only use for one experiment. In our Science Circus we have tried to make the equipment as recognisable as possible. We have built a great part of our show around a microwave oven and a ghettoblaster. To this we add some experiments that it is impossible for them to do in class (like superconductors and liquid nitrogen experiments). The general rule is that any experiment can be made interesting. It is only a matter of having ingenuity, providing a good, understandable explanation, and searching the internet (the words "dangerous" and "experiment" give some interesting results on GoogleTM). As a final remark, it is not always a good idea to go out and buy a ton of equipment from day one. Start with a narrow field of subjects, learn them well and expand from there on.

Getting the word on the street

Once the Science Circus has been brought to life, it is vital that you start advertising. Here again the physics department is a helping hand. Have them advertise you on their website and help you set up a website of your own. Furthermore contact your old schools (if you are aiming your Science Circus at schools) and make an arrangement with them. We have found that once you have started making shows, the word spreads slowly. Also get the media to come to one of your shows, when you think you are ready. And remember that you are never too big to advertise!

Beyond the first six months

Since a Science Circus is fuelled by the ideas and the constant development from within, it is important to always have new ideas. Because of this, it is important to have a working "recruitment-programme". You will soon need to add new blood to the Science Circus as your number of shows increases and the founders start to graduate. There are basically only three things that can kill a living Science Circus: Lack of new ideas, lack of advertising and lack of people willing to do the work. All of them can be prevented by having a constant mixture of experienced people and newcomers. So get the Circus started and remember

PHYSICS IS FUN!!!

Fysikshow - Odense
University of Southern Denmark

A big thanks to EuroPhysicsFun (**http://www.europhysicsfun.org**) for proofreading.

IAPS ANNUAL REPORT 2004/2005

Director's cut….

After a fun and exciting year with IAPS we thought we should summarise it with an unofficial annual report. This year the executive committee (EC) consisted of Annett Thogersen (President, Norway), Ingvild Thue Jensen (secretary, Norway), Filip Nicolaisen (treasurer, Norway), Milla Karvonen (Past president, Finland), Davide Venturelli (President elect, Italy), Philip Jarnhus (Communications, Denmark), Laszlo Oroszlany (Development, Hungary) and Maria Joao Benquerenca (icps-organiser, Portugal). And of course you all know our jIAPS editor, András Zsom from Hungary.

France

We had altogether 3 Executive Committee meetings. The first one was held in Mulhouse, France, at the headquarters of the European Physics Society (EPS). Here we received lots of useful information from the omnipotent David Lee, EPS secretary general. The meeting was also used for male and female bonding and to set up a strategy for the rest of the year. We also spent quite a lot of time and energy to find the student pub in Mulhouse. It turned out to be a wild goose chase, since there *is* no student pub in Mulhouse. Instead we sent the entire Central Office into a normal French pub to try to water it down to a student pub. This resulted in us getting to know the agreeable French public, as well as a dog named Sergio (when we met the dog named Sergio the following morning, we were more than freaked out!).

First EC meeting, EPS

We also tried to follow up on the Executive Committee's "Pink Strategy" by visiting a bar frequented mostly by males who like Gloria Estefan. For some reason our treasurer Filip turned out to be the most popular of the entire committee, even though he seemed a bit desperate…

Male bonding!

Norway

The next meeting was held in Oslo, Norway at New Years. At this meeting we had our first follow-up and got even friendlier. The meeting was mostly concerned about ICPS and IAPS finances, setting up a strategy for how to acquire the funds needed for running an organisation of thousands of members spread around the world. . Among other things we finalised what was later to be the disastrous EU-financing proposal (see below).

The meeting coincidentally coincided with New Year's eve, where parts of the Central Office had arranged a big party with hundreds of people. Needless to say, the EC made a lasting impression, both on the stock of the bar, the dancefloor and on the innocent Norwegians.

Maria and Philip kissing Andras, New Years Eve

It should be mentioned in passing that people who are not from Norway should be warned about Norwegian climate, gender equality and beer prices before coming.

Jose & Maria imitating "Angry boy"

Italy

Our last meeting was in Modena, Italy at Davide's place. Some of us also combined this with a vacation at Davide's summerhouse in Riva del Garda.
The Italy meeting was used to hammer down many of the final details of ICPS. We also tried out a new process that we called "Work Meeting", in which we all sat down one day, created a working office and got a lot of work done.
After the meeting we also attended the first ever Italian Physics Students' Conference. We gave presentations about IAPS and ICPS, and later joined the Italians for dinner. This turned out to be a rather hilarious event since the treasurer again turned out to be a rather unpopular guest, which resulted in him being denied food for the majority of the evening. Maybe the Norwegians should also have investigated the finer points of Italian culture before ordering food...

Dinner with Italian physics students

Annett & Ingvild in Riva del Garda

Annual report 2004/2005

CERN

After some minor troubles with the CERN-trip, we decided to alternate each year between going to CERN and going somewhere else. And this year we will have a trip to Culham/JET outside Oxford in October, so sign up…it will be fun! See the article in this issue of jIAPS.

Trip to Germany

We also organised a trip to Germany, which again you can read all about in next issue of jIAPS.

Summer School

We had a summer school in Budapest Hungary in July about Quantum Information. This is a good tradition of IAPS we were proud to continue, in which physics students from different nations have a chance to meet socially and professionally.

After a hard lecture and a football match

World Year of Physics and the Flash Mobs

To celebrate the World Year of Physics (WYP) we decided to have "flash mobs". These are stunts where lots of people do something big and spontaneous in a public place, for us it was to do an experiment using people. This project was performed in Hungary, Romania, Portugal and Croatia on the 9th of June. This is the date when Einstein first published one of his most famous papers.

Hungarian Flash Mob, also at page 4

From EPS we were granted money for WYP projects. The idea is to encourage our members to organise popular physics shows for the general public. The Physics on the Beach-event at ICPS is one such activity.

We also had a WYP T-shirt design competition, sponsored by CERN and the Institute of Physics. This t-shirt will be released at ICPS and used during the Physics on the Beach-event.

EU first encounter

This year IAPS made a proud attempt to bamboozle some money out of the EU. Unfortunately we greatly underestimated the hardheartedness of multinational bureaucracy. Our 75 page application was brutally dismissed over Filip's handwriting on one of them… Next year we'll double our forces against the evil empire!

Representing IAPS

We also tried to travel around to get more committees and to present IAPS on events around Europe. We went to Hamburg, Germany to their national meeting for physics students, to Paris, France for the World Year of Physics Launch and to Zurich, Switzerland to meet up with their local physics committee.

Zurich

Hamburg

DESY, Hamburg

Paris

So now we come to the part where you say: "Hey, IAPS seems like a lot of fun!" Because that's what IAPS is all about, having fun, meeting people and learning new things. All at once…

Want to be a part of it? Just talk to us at the ICPS or mail us at **iaps@iaps.info**, and we will hook you up!

Physical Centres of Excellence

In 2000, the Norwegian Parliament decided to give an extra 17.5 million Euros to a new fund for so called Centres of Scientific Excellence. This was part of a growing European trend to build up smaller and more streamlined research centres, instead of the broad and heavy department-based research of the past. Recent international and national evaluations had shown that although there was much good research being done in Norway, the organisational structures were too flat and there weren't enough measures of goals and success.

The extra funds were "fresh" money inserted straight into thin-worn budgets of departments and institutes, so naturally many were eager to apply. At the end of the deadline in 2001, more than 131 centres had applied. Out of these, very few were to receive the now coveted "Centre of Excellence" status, along with the extra funding. The money, around 1-2 million Euros, was supposed to be funded over a period of 10 years, with an evaluation period after 5 years.

The criteria for determining which centres were to be chosen were the following:

- Scientific quality: Originality, solidity, scientific relevance
- Scientific level and environment
- Researcher education
- Scientific leadership
- Research environment and infrastructure

Then, in October 2001, 40 were chosen by the board of the Norwegian Research Council to continue to a second round of deliberations. More interviews were done, more international experts were called in, and more applications were written. In June 2002, the board was ready to make their decision. They found that out of the 40 candidates, chosen from the 130 applications, 13 were in a condition to more than satisfy the criteria. Of these 13, three went to the University of Oslo. Of these three, one was awarded to the Centre for Molecular

Biology and Neuroscience, one was given to the Centre of Mathematics for Applications, and one was given to the Centre of Physics of Geological Processes. To much surprise (and celebration), two of these are heavily involved in physics.

Mathematics for Applications is basically about solving large systems of equations, as well as finding these equations for complex physical problems. Their four main areas of interest are computational geometry, stochastic analysis, non-linear differential equations and computational physics. There are many students and researchers working there, mainly people with backgrounds from computational physics. Other people involved are mainly computer scientists and mathematicians.

Physics of Geological Processes is exactly that; the study of the physics of geological processes. It is based on a cooperation of physics, geology, mathematics and computer science. It also has four main areas of interest:

1) Geodynamics, which concerns the processes behind earthquakes, volcanoes and the formation of mountains.

2) Deformations in the earths crust.

3) Fluid transport, as in oil and gas, and

4) Processes in contact areas.

The centres have now been active for 4 years, and are getting ready for the half time evaluation next year. The two centres connected to the physics department have had big success in their programmes, with much published research in their respective fields. There is therefore good reason to believe that they will get continued funding for the next 5 years to come. In any case, their expanded contact with external interests, such as research programmes, business and other institutions, have generated so much funds for the centre that the funds from the research council covers less than 30 % of their annual budget. On all accounts, it looks like the centres are to live on for many years to come.

Filip Nicolaisen

The Nigerian Educational System

Education in Nigeria emerged from the ancient informal education which involved acquiring basic technical skills to become employers of labours. The inflow of missionaries, and the employment by the British of clerks for the smooth running of their various offices, gave Nigerians the taste of white collar jobs and encouraged them to learn to write. Many continued the schooling and graduated with great honours to become professionals in their various fields.

The western region self-government in the 1950s, piloted by Chief Obafemi Awolowo, was able to design a well structured, qualitative educational system for Nigeria with the objective of education for all . Many from this region were educated to fight the injustice of colonialism and imperialism through collective agitation.

In the 1950s and 60s, the Nigerian educational system was based on the British design. Primary education spanned 6 years of intensive and extensive learning, with the products moving to modern schools. The products of modern schools could take up elementary teaching jobs in primary schools or later graduate to teacher training colleges. Holders of teacher training colleges' certificates could proceed to university for strengthening and re-strengthening of their certificates in their chosen fields; graduates from tertiary institutions could then pursue Masters and Doctorate degrees at post-tertiary institutions.

English language is the language of instruction in the educational system, due to the heterogeneous nature of the nation, with many ethnic groups.

Modifications to the System

In the mid-1980s Nigeria adopted new educational systems to foster the development of science and technology, based on a new formula known as "6-3-3-4" after the number of years spent at each stage.

The 6 stage in the formula is based on the need for well designed and guided primary education for six years with intensive learning in all aspects of life. After the sixth year, pupils take the Common Entrance examinations and Primary School Leaving Certificate examinations which aid admission into Junior Secondary Schools. These provide three years of intensive learning, with business and technical knowledge imparted. This stage is terminated with the Junior Secondary Certificate examination which is the prerequisite in selecting the categorised classes, viz. Science, Arts, Commercial and Social Science, the divisions of the Senior Secondary School system.

The Senior Secondary School is designed to last for three years, with theoretical and practical training that will equip the students for their final West African Secondary School Certificate Examinations (WASSCE) and the National Examinations Council Senior Secondary Examinations (NECO SSCE) which are needed for admission into tertiary education in polytechnics, monotechnics, colleges of education and universities.

Structure of Nigerian Tertiary Institutions

Nigerian tertiary institutions were structured to compete with world educational standards. The polytechnics and monotechnics are designed to cater for the materials needed for science and technology. Monotechnics cover a specific academic field(s), which include Agriculture, Science and Technology, Engineering, Commerce and management and lead to the awards of National Diploma (ND) and Higher National Diploma (HND). Polytechnic education was designed to provide foundations for the development of Science and Technology, maintaining sound and active technicians and technologists. Through the intervention of the Federal Government, State Government and private bodies and individuals, more functional polytechnics were built to meet the challenges of 21st century technological advancement.

The adoption of colleges of education started in the early years of educational development through the teacher training colleges, training and retraining teachers for the task of teaching students in primary and secondary schools. Colleges of education were proportioned according to the task given to them, giving rise to Colleges of Education (Technical), Colleges of Education (Special),and Colleges of Education (Regular). There are over 61 colleges of education in Nigeria.

The chains of monotechnics, polytechnics, and colleges of education provide over 468 study programmes in over 160 campuses, with some awarding degrees in Education and Technical Studies.

University education is based on a minimum of four years for the award of first degree honours (five years in universities of technology). There are eleven faculties in Nigerian universities, viz. Education, Sciences, Health Sciences, Agriculture, Environmental, Law, Arts, Social Sciences, Business and Management, Engineering and Technology. Nigerian Universities have been designed to meet the challenges of the modern world, with integration of staff and students into other world universities. The monopoly of state ownership of education was broken by the establishment of private universities to train graduates in their respective fields.

The Nigerian universities have increased over the years with numbers over sixty. The quality of graduates from the universities has been tested, recognised and recommended by many world educational bodies like UNESCO etc.

Curricula

Every nation's educational system has its curricula in which courses are taught. Right from primary education, science is at the root of teaching, with courses like mathematics and elementary sciences which arouse the interest of pupils towards science. The Junior Secondary curriculum includes integrated sciences modules embodying elementary physics, biology and chemistry which are essential for targeting science development.

Educational regulations and control

The educational system is regulated, so as to maintain standards, by the National University Commission (for universities), the National Board for Technical Education (Polytechnics and Monotechnics) and the National Commission for Colleges of Education. Recently the National Polytechnic Commission was established to oversee the affairs of the polytechnics so as to upgrade into a more effective institution. Many professional bodies also regulate and are duly involved in the accreditation exercises of some study programmes. These include the Institute of Chartered Accountants (ICAN) and the Nigeria Institute of Science Laboratory Technology (NISLT) which embodies professionals like microbiologists, chemists, physicists, geologists and astronomers. NISLT is the only recognised professional body that is tasked in regulating the activities of science professionals and technologists in Nigeria.

The importance of professional bodies like the Council of Registered Engineers (COREN), Nigerian Institute of Medical Laboratory Scientist (NIMLTS), Nigerian Medical Association (NMA), Nigerian Institute of Physics (NIP) and Nigeria Chemical Society (NCS) cannot be overemphasised in influencing government decisions. The activities of these professional bodies have refocused the need to empower our economy through an enhanced scientific basis.

Challenges ahead for the Physics Students Association of Nigeria (PSAN)

PSAN was formed to protect the interests of physics students in all levels of tertiary institutions, coupled with the development and integration of all members of the association; also to foster and enhance interest in physics and science in children and students. Promoting and developing physics in society is important, in order to have a nation that will be scientifically developed. The students association is essential to this effort because youths are the future of the nation. Another challenge is the state of physics in Nigerian society, where its importance is rarely known due to the past negligence on the part of the authorities. The attitude of society, students and young children towards physics needs urgent intervention to provide a remedy.

PSAN has started its crusade by creating awareness in its project to 'catch them from the root', with interesting programmes to promote an interest in physics in youths and young children. The programme, aimed at school children, stresses the need to study physics at higher institutions, making them aware of the uses and significance of the subject.

PSAN is involved in the United Nations 'World Year of Physics' and the celebration of Albert Einstein's annus mirabilis, with many interesting programmes to promote the objectives of the association. And in 2009, Nigeria will be celebrating a decade of civilian rule, under which the science world has witnessed tremendous achievements.

A nation blessed with over 120 million talented people with little or no interest in science and physics needs the impact of a strong and well funded association to change its focus. PSAN has taken up this task and intends to make its impact felt in the nooks and crannies of the nation.

Oyedokun Kehinde
Secretary PSAN,
Nigeria.

What you never wanted to know about the Hydrogen Atom

How many times have you been told that the Schroedinger equation can be solved analytically only for simple systems like the Hydrogen Atom?

Didn't you feel powerful looking at the mathematical form of the H eigenfunctions, knowing that with paper and pencil you could really derive average values of any operator just integrating by the techniques you've been told in your mathematical methods course?

That period now is over. This article is to remind you something that in basic quantum mechanics courses is usually just mentioned with nonchalance: "ah... yes... however by using this Hamiltonian we are actually neglecting relativistic effects and other quantum details..."

Even if your atomic physics course may have treated some of what I am going to review, I am confident that many students end their bachelor's exams without having ever seen **the monster**.

However I must warn you and tell you that I have been cheating, since in order to well understand these effects it would be good to use the right theory, i.e. Quantum Electrodynamics, and directly solve the Dirac equation instead of the Schroedinger equation. However, for the people that, like me, don't really know a lot about quantum field theory, the physical significance of the additional terms can be understood nevertheless.

The Monster

Now the (1) terms are the usual parts we are friends with. We are studying a quantum system composed of a proton and an electron, so we need to take into account their kinetic energy and their mutual coulomb attraction.

But wait! The kinetic energy is not such a simple concept when we look relativistically. The (2) terms derive in fact from the Taylor expansion of the energy. Of course you could go beyond and calculate the fourth, fifth terms but usually nobody is masochistic enough.

Let us meet some tougher parts: spin-orbit interaction. Yes, it turns out that the intrinsic magnetic moment (spin) couples with the magnetic field generated by the orbital motion of the particle giving rise to a corrective term of the energy.

The relativistic analysis shows that we can treat the field generated by the orbital motion of the electron with speed v as one generated with linear motion with speed v (Thomas' precession). So the correction is straightforward and its effect takes the name of fine structure of hydrogen.

Quantum Field Theory give us term (3) as well, called the Darwin term, saying that the electron is not a point particle, but it is represented by a spread out wavefunction. This means that it doesn't have only a local pointlike sensitivity to the coulomb field: the Taylor expansion of the coulomb interaction around the electron's location gives a second-order term which is precisely the Darwin term (the delta function is the laplacian of the coulomb potential).

If you thought we would have forgotten the proton's role, well you're too naïve for the typical jIAPS reader. Terms (4),(5),(6) are what we call the hyperfine structure of hydrogen. The proton has a spin as well, so it is somehow bothered by magnetic fields, like the one produced by the tiny electron orbiting around it. The magnetic field in the centre of the atom is simple to derive by magnetostatics, and we have term (4):

Hey there's something else which is magnetic here, apart from the current generated by the electron. It's the electron himself, that is, his spin! From the vector potential of the nuclear spin we can get the magnetic field generated by the proton and thus calculate the magnetic energy of the second spin, term (5). But since the proton has a finite size we can use Maxwell's equations to derive the magnetic field inside *the proton as well. When the electron-nucleon wavefunctions overlap (see the role of the delta function), we have such an interaction, given by term (6), called term of Fermi's point of contact.*

It is not the end, since the orbiting radius of the electron is perturbed by void energy fluctuations. This perturbation can be somehow included in term (1) by writing r + dr. This provokes an energy shift which is detectable and depends on all quantum numbers, called Lamb Shift.

I've had enough fun with this useless stuff. I know that now that we have revealed these secrets you may probably feel a sense of superiority among all the others that forgot about the real face of our H. The reason we usually just mention these terms in basic courses is that their effects are very small compared to the energy eigenvalue separation.

However we should note that their existence and measurement allowed mankind to develop new theories and exploit them for new research. Just to name a few: Quantum Electrodynamics credits its origin to the Lamb-Rutherford experiment, Spin-Orbit coupling is central in many new mesoscopic technologies and the 21 cm radiative transition between hyperfine levels of H is a key-breakthrough in the long-range study of the universe.

Now that you have faced the monstrous identity of the most trivial atomic system, don't dare to forget approximations in the future, attacking monsters can be worth a Nobel prize!

$$\hat{H} = \underbrace{\left(\frac{\hbar}{2M}\hat{P}_{\mathbf{R}}^2 + \frac{\hbar}{2m}\hat{P}_{\mathbf{r}}^2 + \frac{e}{4\pi\epsilon_0}\frac{1}{r^*}\right)}_{(1)} + \underbrace{\left(\frac{\hbar^4}{8m^3c^2}\hat{P}_{\mathbf{r}}^4\right)}_{(2)} + \underbrace{\left(\frac{1}{2m^2c^2}\frac{1}{r}\frac{dV}{dr}\hat{L}\cdot\hat{S}\right)}_{(3)} + \underbrace{\left(\frac{\pi\hbar^2e^2}{2m^2c^2 4\pi\epsilon_0}\delta(\mathbf{r})\right)}_{(4)} +$$

$$\underbrace{-\frac{\mu_0}{4\pi}\frac{2\mu_B\mu_N}{\hbar^2}\left(\frac{\hat{I}\cdot\hat{L}}{r^3}\right)}_{(5)} + \underbrace{\frac{\mu_0}{4\pi}\frac{2\mu_B\mu_N}{\hbar^2}\left(\frac{\hat{I}\cdot\hat{S}}{r^3} - 3\frac{\left(\hat{I}\cdot\hat{r}\right)\left(\hat{S}\cdot\hat{r}\right)}{r^5}\right)}_{(6)} - \underbrace{\frac{\mu_0}{4\pi}\frac{2\mu_B\mu_N}{\hbar^2}\frac{8\pi}{3}\left(\hat{I}\cdot\hat{S}\delta(\mathbf{r})\right)}_{(7)} + \ldots$$

The monster

Davide Venturelli

The Physicists' March of Mafihe - ICPS edition

To the tune of *John Brown's body lies a-mouldering in the grave*

Hear Ye! Hear Ye! Come hither and hear of our great exploits!

We're the most beautiful out of all the multitudes
We're the most cheerful guys out of all the multitudes
We're the most enlightened out of all the multitudes
And the most humble of all!

You can go through the needle's eye seven times,
Can be as important as a condom on the night-
But still you can't come close to the good old physicist!
'couse physics is the BEST , the BEST, the BEST!

Canst thou integrate a P.D.E whenst it aproacheth a great singularity ?

Don't know how to integrate, so only perturbate[1]
And assuming of convergence might be a mistake.
But we create a new world with our every word and line.
So I'd say we're doing fine!

Should I be a particle or should I be a wave?
And if I were a dead cat then just how should I behave?
I need to find the answers and I need to find them now
But I really don't know how!

And thou shalt knoweth the simplest of physical systems!

Harmonic oscillator, hydrogen atom[2]
Whether there is anythin else, oh how could I know?
But if there's anything else, I don't give a sh*t -
That's a perturbation hit!

Should I be...

Hast thou heard of the might of Schrödinger's Equation?

Whether you take ICPS[3], beer or anything,
The Schrödinger's Equation will clarify everything!
Though, Feynman says we're missing the Moral and the Pig[4]...
(It's) just a perturbation hit!

Should I be...

What knowest thou of the connection of physics and engineering, the expansion of the universe, the might and beauty of this lyrics, and generally, this whole [...] lot?

From the table of my knowledge all engineers are fed,
Space expands to make room for the thoughts inside my head!
At my command the world turns 'round and nuclei decay,
So, only one thing's left to say:
Should I be a particle or should I be a wave?
And if I were a dead cat then just how should I behave?
I need to find the answers and I need to find them now
But I really don't know how!

[1] The pornographic version cannot be regarded as authentic!

[2] To tell the truth, the H atom can also be viewed as a 4 dimensional harmonic oscillator...

[3] May be replaced by other events, eg. Nation's Party, trip to Belgrade, etc.

[4] See Feynman, R.P.:The Feynman Lectures on Physics.

Published by Dávid Gyula et al.

Translated by James T O'Connor (NC UK), Bruck József, Kövesárki Péter, Patay Gergely, Serényi Tamás (ICPS2002 OC). Further thanks to Emily Cook, and, for the last verse, to Jim Grozier (ICPS2004).

Summary

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The Trouser Transformation Operator

jIAPS is taking its part in physics recruitment. The wise have long agreed that physics has an image-problem, mostly because she has a problematic image. With this in mind, we went straight for the jugular of the problem, the notorious "those-pants-aint-long-enough" problem. Many will nod in recognition of this fiend, this destroyer of pickup-lines and wrecker of style. What can be done, you might say, about this nigh indestructible foe? jIAPS has a proposition for a knight in charming armour; He is rough, he is hard, he is cruel, he is ... the trouser transformation operator!

The "those-pants-aint-long-enough"-problem, also known as "Kurze-Knickers" or "Theorist-Trousers"-problem has caused havoc for many years in the physics community. There are rumours that Faraday started losing audiences because of it, and that this was the cause of the suicides of both Bolzmann and Ehrenfest.

In modern-day physics, it is an unfortunate fashion-climate gas that requires more than a Kyoto-agreement to control. It is a problem that many know about, but fewer know the cause or the cure for. We will attack both with scientific vigour!

The Cause

What is it that makes our people in general choose the shorter pant, and, as if that was not bad enough, pull it even further up? It is a many-faceted problem, so let's get right at those facets:

Facet 1:

Physicists often wear white, thick, tennis socks. These, it can be argued, are cheap, durable and look cool in neon-lights. These, it can be further argued, make the foot of the user very hot when used in conjunction with non-breathable shoes, which will cause said user to withdraw pant upwards.

Facet 2:

Physicists are often near-sighted, a result of overzealous computer-use and a willingness to read. This being a natural state of the human eye will cause the use of glasses to make trousers appear unnaturally close to the foot. This results in an urge in the habitual spectacles user to pull his pants away from his feet.

Facet 3:

It is windy in the physics-world, very windy. A physicist, knowing all too well the enormous forces waiting to be unleashed in the Earth's climate system, will be ever vigilant wearing a so called "All Weather Jacket". However, these jackets, hermetically sealing the top of the user to the outside climate, will result in a potentially deadly gas pressure buildup. In order to release pressure it is important to have a valve system, in which the opening between foot and trouser comes into play. Hoisting up ones pants is simply a way of forming a vent.

Facet 4:

We all, at some point, wish we were Einstein. There is no escaping that. In recognition of the fact that we are not indeed Einstein, we might try to emulate him in some manner. Some adopt a German slur, others a healthy moustache, but the easiest way to pay homage to the hero is to acquire the Albert-hairstyle. Having such a hairstyle, unfortunately, results in a terribly high friction coefficient when moving through fluids, like, say, the air. In order to reduce this retarding force, one has to improve ones own aerodynamics. And thus, up they go again!

We have above summed up the four most likely candidates for physicists' endless need to elevate their pants. Alas, no rest for the wicked, we continue on to ... the Cure!

The Cure

The Cure is a British rock band widely seen as one of the leading pioneers of the British alternative rock and post-punk scenes of the 1980s. The band is often considered as being part of the Gothic genre, possibly because of lead singer Robert Smith's image, but Smith rejects this, saying that he considers the band to be mainstream. (From **www.wikipedia.com**)

After some thought, this might not be the cure to our problems, but to someone else's. We try again

The Cure (to our problem)

So, we have identified four elements which together are causing a stir of fashion problems. What we need is some kind of object that will simultaneously:

- Switch white tennis socks into thin, black socks
- Remove glasses
- Exchange all-weather jacket with garment which is permeable to most gases
- Flatten hair

No easy task, but fortunately, our most ardent mathematicians have been able to create an object which does just that.

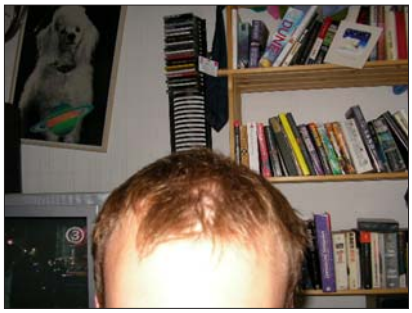
Enter ... The Trouser Transformation Operator! (if you did not hear a small fanfare and the sound of chimes at this point, you should return this magazine for a new one, bring a few extra for your friends' benefit, and quickly recall why you started this education in the first place).

Define a 4-dimensional vector space, which we will call Trouser-space.

Define then a basis which is orthogonal.

White socks...

black socks.



Flatten hair...

cool hair.

All weather jacket...

trendy jacket.

And finally, the trouser transformation!

We then have four vectors in trouser-space that represent the socks, glasses, jacket and hair. We will call these vectors |S>ock, |G>lass, |J>ack and |H>air.

We then need an operator T, so that

*T |**v**>* = a *|**v**>* , *where | **v** > is one of the vectors mentioned above, and* a *is an eigenvalue for the vector T.*

We further demand that the four vectors above should span a basis in a 4-dimensional Hilbert-Space, and that when the operator T is applied to a vector-product of the basis, we will get

T (|S>ock, |G>lass, |J>ack and |H>air) = b *(|S>ock, |G>lass, |J>ack and |H>air), where* b *is an eigenvalue of the vector-product.*

We now demand that this eigenvalue should be the value of a shiatsu, a Jack Daniels's with ice, a Marlboro cigarette and some un-intelligible note with what looks like a hotel room-number scribbled on it, combined with the sound of some East-German sounding voices approaching what looks like a rapidly declining healthy lifestyle. You should at this point look around you, nervously, to see if anyone is watching you. If they are not watching you, you will know that something is seriously wrong. Do not act alarmed, this will only make the inevitable happen a lot quicker! At some point we must all come into close contact with the fact that we are all, after all, just small windmills in a big wind, constantly churning out flour for the big bread.

The rest of the details of the calculation are trivial, and are suggested as an exercise to the reader. It will turn out, however, that the eigenvalues a *of the Trouser Transformation Operator are exactly what we require them to be, namely:*

T |S>ock = b *|S>ock*
T |G>lass = n *|G>lass*
T |J>ack = t *|J>ack*
T|H>air = c *|H>air* ,

where the eigenvalues are black, no, trendy and cool.

We can make a projection of this lunacy into what we all perceive as the real world, but is really just a loaf of bread.

The result can be seen on the illustrations!

That was that, we are now taxiing down the runway of this article, and will shortly be taking off towards the next. At this point I would like to point out the emergency exits of this article, which are:

One at the very top of the article, before you knew anything was wrong.

One where you seriously suspected this had nothing to do with operators as such.

We hope you have enjoyed the ride, and would like to point out that if you in any way feel offended by this article, I would like you to tell me at **f.f.nicolaisen@fys.uio.no**, because it makes me sleep better.

Filip

african conference for physics students

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15th - 18th november 2005

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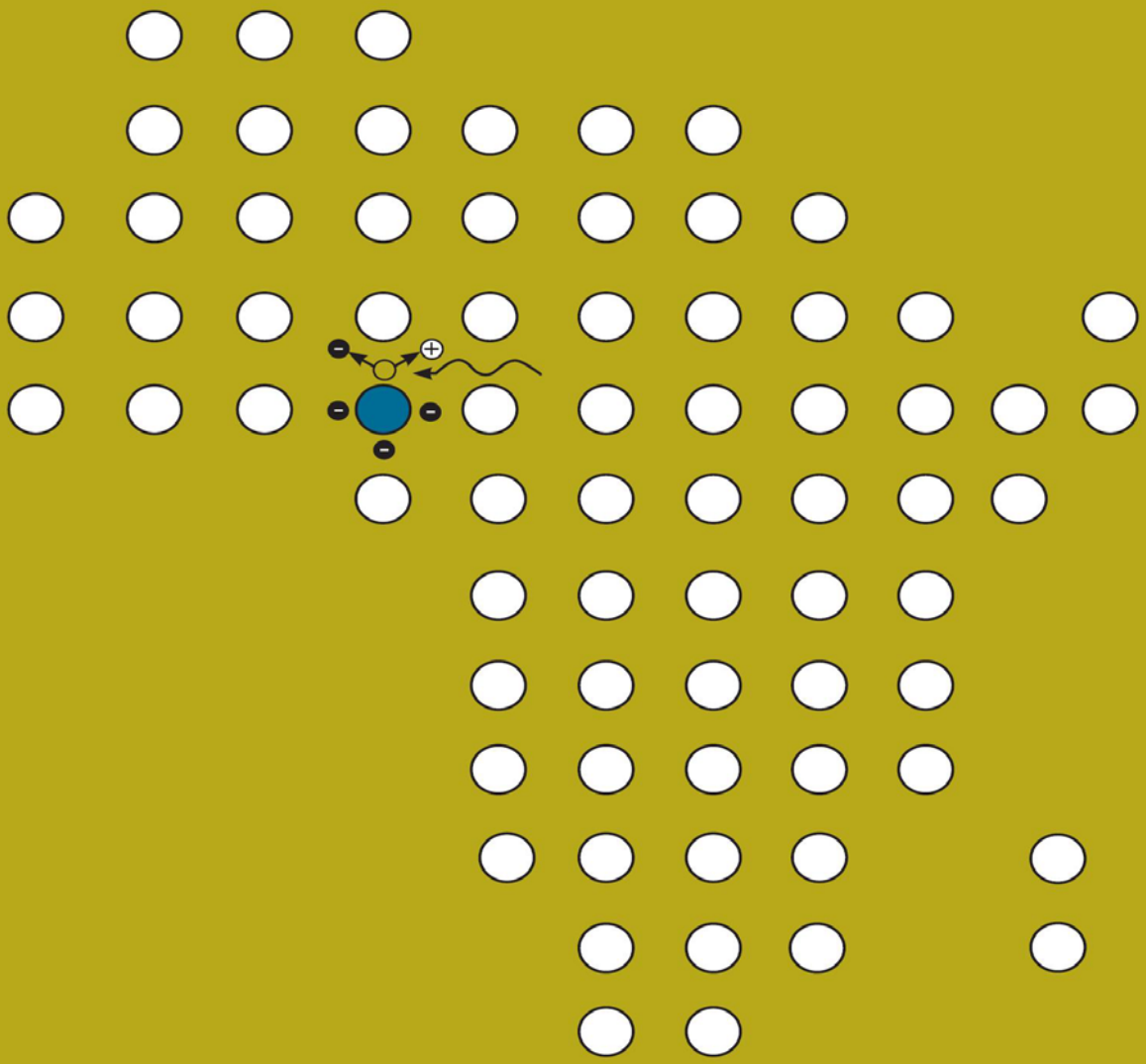

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