{jlAPS} Summer 2013

Editor's Note

by Norbert Bonnici

First of all I would like to thank all the contributors and proof readers as we had a really good year and loads of articles. Secondly I would like to thank whoever is reading this. This year we decided to colour code the articles. Green articles indicate that the article is about an event or one of the many committees which make up {iaps}. Magenta indicates scientific articles and purple ones are fun or science fiction articles.

All our articles are available on http://jiaps.org well before the print edition is produced, so make sure to check it out frequently.

Are you enjoying this year's ICPS? Would you like to read more about next year's one? Go to page 6 for more information.

If you are really excited about ICPS read about one of the bids by NC Croatia on page 8.

Have you been to our CERN trip or are you interested on what happened? A cool article by Anton Dudko on page 12 gives an out-of-the-box approach on the trip.

Are you a good physicist? Really? There's a competition in the Netherlands to make sure you are, read about it on page 16.

Do you have a bunch of computer lying around? Do you have a bunch of simulations to do and your local super computer is busy all the time? Then go to page 18 and read about how to make your own computer cluster.

Interested about signal processing and earthquakes? Then go to page 21.

On page 24 you can read about Claytronics and the world of reconfigurable matter.

And if you like the number 42, 26 is the page for you.

Hope you have a nice conference.

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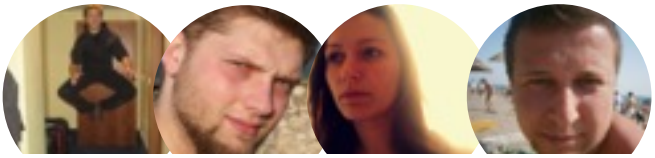
LC Novi Sad



by Strahinja Ilic, Vujadin Mrkajic, Sonja Cuturilo & Drazan Jaros

3rd August, 2012. Gathering in front of the University of Novi Sad. For most of us, this was the longest trip ever. 28 passengers, 2 drivers, smiley faces; everything was ready for some good and quality time. The number of students from Serbia was not a surprise, because our young people yearn for travelling, meeting new cultures, but we are limited by the economic situation in our country. We have all heard of tulips, windmills, and specific Dutch architecture which is very different from ours, and those in our surrounding. All of this has temped us to visit Netherlands. Aside from that, students in Novi Sad wish to improve their knowledge and to keep up with modern physics, meet other physics students, and of course to have a good time, in which we are well known for. ICPS was a unique opportunity.

We organised this trip so we could pick up our dear colleagues from Zagreb on our way, even though it was not the shortest path. There was a great atmosphere in our bus during our travels, so the 36 hour long journey was not a problem. During this trip we also had a chance to visit Munich, which was also an advantage of travelling by bus.

All the time in Utrecht was accompanied by the hospitality of our hosts, and we were very satisfied with lectures as with University and laboratory visits, with whole new points of education, further specialisation and possibilities of employment. The goal of ICPS was accomplished, and we returned home tired from the trip, but happy, full of new experiences, knowledge, nice memories and new friendships.

NC France

by Aloïs Dubois

The Association Fédérative Nationale des Étudiants Universitaire Scientifiques (AFNEUS) is an association governed by the law of July 1st, 1901. It aims at representing the science students in the various national and university bodies by means of its associations' members in the respect for their personal freedoms, so extending their values of citizenship, help and solidarity between science students. To reach its purposes, the AFNEUS proposes training to the leaders of associations and to the associative student elected representatives in the various authorities. It continues to develop by participating in many reflections revolving about sciences. Thus since 1999, AFNEUS has been struggling against the disaffection of the scientific studies by participating and by organising national meetings to exchange the reflections. This gave rise to the publication of a first report in 2001 and a second in 2005.

Defending students

Thanks to its direct or indirect presence in various authorities and its representativeness to the eyes of institutions, the AFNEUS defends the material and moral interests of student associations and science students. Each member association of the AFNEUS can request the help and the support of AFNEUS when itself or the students whom it represents meet a problem. AFNEUS also seeks to promote and support the development of life and associative values in the sciences. It is an arrangement of all the students who look for information or advice, as well as to create an association or to develop an existing association.

Representing students

This is one of the most important interests of AFNEUS vis-à-vis its members and students in science in general. Through its participation in the elections CNESER and CNOUS since 1994, as well as its adherence to the FAGE (Federation of General Students Associations), AFNEUS enjoys the status of representative organisation under of the article 13 of the law of July 10th, 1989.

The member associations of the AFNEUS also benefit from the criterion of representativeness. This one can bring in certain cases an advantage to associations as regards the obtaining of premises, of subsidies or to be represented in certain local bodies such as the CSE (social Commission of establishment). Directly or indirectly, the AFNEUS is present or represented in more than twenty bodies and national governmental organisations.

Scientific thinking

Current events concerning the scientific courses evolve very fast. Nobody except AFNEUS has for its mission to present the vision and the proposals of the representative students of this disciplinary sector. Through its meetings and its work, AFNEUS arouses and organises the reflection of the science students. It expresses then at the national level the position of the science students concerning their rights, their homework and their future. By its work, the AFNEUS participates actively, as repeatedly in past, at the elaboration of the reforms concerning the science students. It is particularly true at present with the application of the European harmonisation of diplomas (Licence-Master-Doctorat reform).

Federate the student associations

AFNEUS unites associations of science students. As such, its primary role as a federation, is to allow the representatives of its

associations to communicate between them and to share their skills. By being an element of sustainability, AFNEUS allows that the ideas, the projects, the experiences are transmitted of city in town to remain finally permanently available.

The federative will of AFNEUS relies mainly on meetings of the board that occur several times a year and at the annual congress. By these, AFNEUS seeks to establish links of solidarity between its members and contributes to the esprit de corps between the science students, in other words develop its network. Finally, federate associations of science students answer a logic of structuring of the scientific associative movement to allow it to assure its sustainability by compensating for the problems bound to the fast renewal of managers.

Inform and train the representatives

One of the most visible actions of AFNEUS is probably the broadcasting of information and the realisation of trainings as well as with the associative persons as the science students elected representatives. The training is intended for the associative personnel which allows them to better fulfil their responsibilities.

These formations play an important role in the sustainability of associations. The provided training by AFNEUS corresponds to demand scientific association leaders. The training is intended for the student elected representatives of the councils of UFR and the central advice (CA, CEVU and CS) allow them to better understand and more quickly, the functioning of institutions, councils, and thus provides greater credibility vis-à-vis their interlocutors.

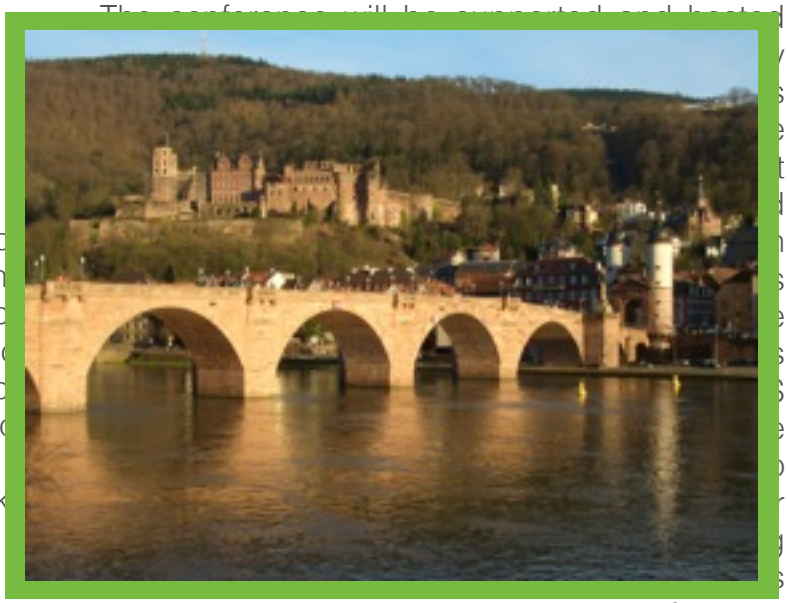
These trainings thus allow the scientific students elected representatives to represent better and to defend better the students. AFNEUS will continue its work of representation of the science students, with the ministry and various bodies of reflection and representation regarding training and regarding occupational integration of the science students.

It will lead an overall policy of training of the associative executives, the student elected representatives and the development of associations to give them the means to establish themselves as major actors of animation of the campus academics and of representation of the students.

AFNEUS

LA fédération des étudiants en Sciences


by Simon Schröder and Anna Bakenecker



Every year in August up to 450 physic students from all over the world meet to atten the International Conference of Physic Students (ICPS). The ICPS is the main event the International Association of Physic Students. It is a conference organised f students by students and is hosted in different country every year. In 2014 it will tak place in Heidelberg, Germany.

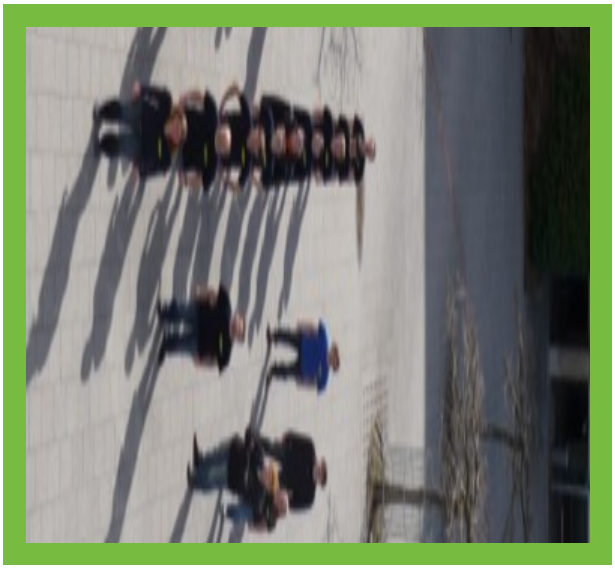
"The main purpose of this event is to offer participants from all over the globe an opportunity to come together, talk about science, studying and academic life, as well as to give them the chance to practice giving presentations", states Peter Micke, chair of the program organising committee. All in all this event is meant for all those Physics students who also have a genuine interest in foreign cultures, meeting new people, building scientific contacts and international friendships as well as developing their professional skills and of course learning from other students.

but also with its unique research facilities covering all major research areas". Thus, the area provides great opportunities to experience culture and science at the same time.

The participants of the ICPS 2014 will be able to visit research centres and companies in the vicinity of Heidelberg, such as the Max-Planck-Institutes for Nuclear Physics or Astronomy, the Fraunhofer Institutes in Stuttgart, the GSI Helmholtz Centre for Heavy Ion Research in Darmstadt, the German aerospace centre (DLR) or the chemical company BASF. They also will visit the prestigious research centre Karlsruhe Institute of Technology (KIT) and …

25 members of the Young German Physical Society (jDPG) put heads together to organise the ICPS 2014. The jDPG is a section of the German Physical Society (DPG) which has about 62,000 members and represents Germany's physical community. It consists of 30 regional groups spread throughout the whole country. This nationwide network allows organisers from twelve different cities to cooperate.

Apart from the planning of the next ICPS the active members of the jDPG have experience in organising congresses, workshops, seminars, excursions, networking



explore the research facilities. In this way, they can get an impression of various fields of work for physicists.

"The participants' input is the main focus of the conference. They are encouraged to take ICPS as a unique opportunity to practice giving a talk in front of an international audience or presenting their research during the poster sessions. Furthermore, we are planning workshops, which allow our participants to improve their professional skills", says Peter Micke. The scientific program is complemented by invited talks given by world's leading scientists and tours of the University's laboratories.

The aspect of mixing cultures and bringing students together will be at leas
as the professional excha
scientific excursions. There
numerous social events such a
and different kinds of celebratio
will be plenty of opportunities t
each other and have inspiring
In this way, up to 450 students w
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participate in the ICPS 2014
from August 10th to Augus
organisers are looking forward t

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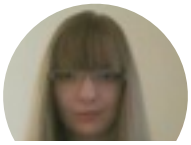
The Organisers

Another task of the jDPG is to represent Germany's physics students in academic political aspects. It has a representative in DPG's executive board and council, which gives recommendations concerning the physics high school curriculum and decides about national and international cooperation partners.

Furthermore, the jDPG closely works together with the national organisation of student councils. They send a representative to the conference of all physics departments in Germany, which decides about

ICPS 2014
Heidelberg

NC Croatia



by Ivana Kurečić

I am sure you have all become well acquainted with the Croats in your ICPS experience so far. They are the friendly and loud part of the ICPS parties. They migrate to the host countries in larger numbers with each passing year. They have brought to you student lectures ranging from the physical explanations of curve balls to the summaries of their published research papers, as well as encouraged the development of your experimental instincts with suspicious food and drinks at the National parties. And now they would like to invite you to visit them on their home ground.

This year, NC Croatia is putting forward a bid for the position of host of the ICPS 2015 at the Annual General Meeting of IAPS. The first Croatian ICPS was held in 2000 in Zadar, and we had decided to call it a test run. We may come from a small country, but the students who had found their way to the ICPS 2009 in Split would certainly assure you that we are capable of making a big ICPS. It lasted for nine days and it was the first ICPS to accept the large number of participants we are accustomed to seeing these past years, as well as cause an international incident (to the best of our knowledge). We believe it is time to up the stakes by inviting you to our capital, Zagreb.

A laser harp made by the physics students of the University of Split.

Croatia is the banana (shaped) republic located at the border of Central Europe and the Balkans, that takes pride in its beautiful geographical diversities, ranging from the warm Adriatic sea with thousands of islands, the rich plains of Slavonia, the karstified Dinaric Alps, and the hilly region of Hrvatsko Zagorje, reminiscent of the Shire in both its geographical features and the characteristic behaviour of its inhabitants, next to which Zagreb is situated. You can also find many national parks, with more than a thousand endemic forms of life. But nature isn't the only thing to observe. More than two millennia of human activity on Croatian soil have left a plethora of architectural monuments dating from as early as ancient Greece to the modern day. Historically a region of conflict, and finally claiming its independence from Yugoslavia around 20 years ago, Croatia has celebrated entering the European Union in July 2013.

There are several hundred companies and institutions pursuing scientific research and development of technology in Croatia, and their areas of work differ greatly even looking only at physics related fields. Most of the profits of Croatian technological companies come from the export of their products, which range from nuts and bolts to machine guns. The scientific institutes have highly developed friendly relations with other institutes around the world, and the work coming out of those collaborations tends to be of high standard. The number and quality of Croatian scientific centres is constantly growing, with new, specialised laboratories being founded every year.

The physics students' community is small, but quite lively – there are several hundred university level physics students, with most studying at the University of Zagreb and the University of Split, the two most populated cities in the country, geographically separated, but united under the NC Croatia. In Split, there is the Student Section of the Physical Society Split, well known for the

Student Section has with PRIMUS is potentiated by the fact that all the members of its Executive Committee study physics. The dean of the Faculty of Sciences and Mathematics is a , as well as the rector of the y of Zagreb. **Who wouldn't hysicists in charge of ng?**

A demonstration using liquid nitrogen and a copper pipe, by Physics Express

re different events organised ut the academic year – the n party, the Open Air, an event front of the Faculty, with e, live music played by bands of and tournaments in disciplines th a spherical chicken and arm omen, informal lectures on their are given to the students by the he Department of Physics on a nd with snacks donated by the ere are movie projections, visits and organised discussions on ar topics related to science that y few weeks, a yearly Christmas singing and dancing by both the students and the professors, as well as post-exam mental-health-care board game afternoons.

Croatian physics students are very

of interesting experime "astroparties" they organise ea Split Festival of Science, while is the Student Section of the C Society, with its popular project (Physics Express), through w students present the explosively entertaining part of physics to schoolchildren.

The Department of Physics in Zagreb has permitted the use of one of their office rooms to the students of the department – some years ago it was furnished and decorated by the friendly Club of Ma and it is now a c over by the Stude Physical Society Students of Natura (PRIMUS). It is divi couches, a mo refrigerator, a micro table tennis set, a textbooks and note – everything a stu skip classes, an blackboard, a whi and several comp multiple sources. the first wireless in accessible to stud STUDNet, mai administrator grou

A balloon in vacuum shown at a Physics Express demonstration

very active on the front of popularisation of science, with some highly successful projects.

A physics student of the University of Split demonstrating the properties of a lemon in an electrical circuit to schoolchildren

The project Physics Express was founded by the Student Section of the Croatian Physical Society during the World Year of Physics in 2005, with its main goal being the promotion of physics and science among schoolchildren and in society in general. The primary activities of Physics Express consist of visiting elementary and high schools with a set of experiments, presenting scientific inquiries on everyday phenomena, all through interesting lectures and audio-visual effects. Some experiments included in Physics Express' presentations are experiments with liquid nitrogen, a Rubens' tube, experiments with vacuum and microwaves, a Tesla coil and others. It is a students' project, with little to no intervention from the side of the Croatian Physical Society and even with the race for outside funding, it is the perfect grounds where future scientists and physics teachers can practice their communication skills and performance in front of an audience. In addition to visiting schools, Physics Express has taken part at events such as the Zagreb Festival of Science, the Science Picnic, the Open Days at CERN, the EPF Conference on Show Physics, at various events of scientific institutes in Croatia, the Summer School of Science, and others.

Another notable project is the Summer Science Factory (SSF). The SSF is an educational programme for youth from 9 to 18 years old, founded by a former student, and now a graduated physics teacher. It is based on one week long workshops over the summer in which the participants work on small scale scientific projects. University students work as mentors – they formulate the problems and activities, and lead a group of participants. Physics students mostly work as mentors, with a great number of them in the organization team of the SSF, and with workshops ranging from the experimental exploration of the physics found in cartoons, for younger children, to the practical construction of electric guitars, Tesla coils, as well as solar and mice-powered energy sources. The project has recently been given the Google RISE award.

The physics students of the University of Split have recently visited an elementary school in a small town near Split, where they held 2-hour workshops for the children – in one they provided them with the tools necessary to make a battery using a lemon and thereby learn the basics of electricity and acidity, while in another they crafted an up to scale model of the Solar system. The children who participated in the project have shown amazing interest and deduction skills, especially considering that they had never before had that kind of access to science, which is one of the main reasons why Croatian physics students continue to work hard in an effort to excite both children and adults about all the different things physics can and can't show us about the world we live in, and to engrain the essence of scientific curiosity in their minds, in fun and inventive ways. That, and because it's cool.

In the name of all of the Croatian physics students and the NC Croatia, we hope that you will extend us the privilege of hosting the ICPS 2015 in **Zagreb**.

A survival guide to Geneva

by Anton Dudko

This year I helped organise the **iaps2cern** trip: on 2 – 5 April 2013, 46 students of IAPS gathered in Geneva, Switzerland to see for themselves what all the fuss about this research centre is for. It is already for several consecutive years that IAPS takes a group of students for a 2-3 days study visit to the CERN, and most of us know about this project and the trip has already been on the pages of jIAPS before. But this time I will give a view on it from a bit different angle.

For me, the trip was something different also because I saw it as both as a first-time participant and as an organiser. Just upon becoming a "fresh" IAPS EC member, I gladly got my hands on helping with the technical jobs, recording applications, tweaking Google spreadsheets and even calling some lucky people on Skype.

In my article you will not read a lot about the micro-particles colliding, about the Higgs Boson, and the Physics Mecca of Europe, because it's better to visit once than to read a dozen times. But instead I will gladly give you my account of this trip – rather a travelogue of the entourage – of what this visit was for me. A number of snippets in mind that glue together in a weird way – this is how my brain stored these memories. Here they go.

The visa

"A visa is a large stamp that you get onto your passport from an embassy of a different country and it allows you to go to that country" – these are the words that Sahra had to write back to one German applicant, because he didn't know what he was being asked about. It's nice to realise that in some countries people are not even aware of what a visa is. But not in Ukraine. For some, going on a trip to Switzerland is only a question of buying a ticket, but for others, it might be a major event in life and a chance to get out abroad.

For me, in managing the iaps2cern project, preparing visa invitation letters was one of the most fun parts, because I could do something that I myself can appreciate so much. And for me, the trip did not begin on 2 April in Geneva airport or something, but rather in February, in the Swiss Embassy in Kyiv. Not that I'm complaining here, I just found it amusing that in order to facilitate this visit to CERN and to go to one of the most fancy cities in the world, I had to spend a couple of hours outdoors on a snowy below-zero morning waiting in line on the porch of the Ambassade de Suisse.

Morality: Some applicants dropped out only because they couldn't get their visas on time. Apply early!

The French language

I like vagabonding. Although the visit was to start on Tuesday, I flew in on Sunday, and spent a couple more days to vagabond around Geneva and, like I often do, I stayed via CouchSurfing. My host Connor, an American who moved to Geneva to study, told me that he speaks decent French, but "if your French is not perfect, people will answer you back in English. The Genovese will speak among themselves in French, but it's not a place to

letters that I opened a Google map and found Geneva on it. I tried to find the address of our youth hostel, a LIDL store, a post office, and roam around the Lake with the tip of my cursor and the street-view. Only then did I realise that Geneva is surrounded by France just as badly as my body is surrounded with mosquitoes on any summer night I choose to spend near a lake in Ukraine. So, for example. Connor, with whom I spent the weekend, in fact studies in Geneva, but lives in France: he commutes using "le bus F", where "F" actually stands (or not) for Ferney-Voltaire, France. For a Ukrainian, for whom the concept of a state border is something to do with passport check, an emotionless officer staring into your mug and going through your backpack, it can be a shock. "Only your ticket is no longer valid" – he pointed at my black-and-white slip from the bus machine – "once we cross the Swiss-French customs, it's another transport zone. That's why I usually get out here and just walk the remaining 5 minutes home". Oh OK.

Morality: people from Geneva go to France to shop, because groceries cost about half the price found in the city. The same is true about the rent.

The Belarusian woman

My first day, as I was again boarding a bus "from France to Geneva", I heard some Russian ng spoken on the bus stop – somewhere in rney-Voltaire, the middle of nowhere. ments like these I always look on myself, my thes and stuff to see if there is anything that uld give away that I speak Russian too. parently, I was OK wearing the eutschland" scarf that day, because the two ssian-speaking ladies who entered the bus n me addressed me in English, when I was sent-mindedly messing with the ticket chine. I changed my mind and confessed (in ssian) that I understand them and I'm from v, and voilà – I already held another shiny 0 CHF ticket in my hand for free from their lets, still absent-mindedly. I soon learned t they are from Belarus and Moldova, as well as a decent chunk of their life stories in an expat land. When we got to the Gare Cornavin, the Belarusian lady Viktoria (in her late thirties) told me that "Well, I need to go back to my boyfriend in Lausanne, and there is a train in half an hour, but it's such a rush… and I don't like rush… I like to take things easy. Hey, are you busy now?". That was very challenging for me to understand why she would prefer taking another train (which was two hours later) instead, and filling her time by taking me to a

but it's such a rush… and I don't like rush… I like to take things easy. Hey, are you busy now?". That was very challenging for me to understand why she would prefer taking another train (which was two hours later) instead, and filling her time by taking me to a Rue de Mont-Blanc cafe to treat me to a two glasses of vin rosé and talk about life. To me with my impetus and the feeling that I'm being useless if I've been sitting on my butt for another 10 minutes, it was strange, but I didn't mind, wondering if this is the true Geneva lifestyle, and how I should try to go with the flow and take it easy. Although totally random, the Belarusian woman with her wine will always remain "my first day in Geneva" memory.

Morality: I heard Russian being spoken in Geneva too often. Couple weeks later, on my 21st birthday, I gave up drinking.

The hostel

In the Auberge de Jeunesse Genève, they had our booking of 46 people under the name of "International Association of Physics Students", but probably there is a char limit on a string in their computer, so it showed as just "International Association". For some reason, that boosted self-esteem and respectability of a usual student like me so much. "Yes, International Association? That's me".

Also, there is a cooking-dining-hangout area in the hostel – downstairs from the conference rooms. And don't worry that it says on the door that it closes at 22:00.

Morality: the Wi-Fi in the hostel is OK.

The pizza

The fact that we at iaps2cern don't organise group meals for lunch and dinner, urged everybody to go out hunting for their own food in the afternoon. In this trade, Couchsurfing is very valuable in getting information as well. I'm wondering at this point, to which extent I'm appearing to fellow Europeans as a poor Ukrainian student dirtbag whose monthly scholarship is 90 EUR, but I thought that this piece of advice might be useful for some readers.

"Man, Geneva is expensive. In downtown Geneva, you can find some cheap kebab places, of course. But by saying "cheap" I mean "be ready to pay at least 10 CHF for a kebab". But I'll show you one life-hack" – Connor told us on the second day. There, in that orange shop on the corner, where the "PIZZA" sign lights up at about 6 PM, they start serving pizza that costs 10 CHF. They put whatever you want on it and as much as you want, but it will always cost exactly 10 CHF. Even though they are not allowed to serve it late, they do, and after midnight – even from the backyard of their shop. And yeah, they're super-friendly. If I'm wasted and I'm eating pizza – I know where I am."

So that pizza place was where we got our dinners for three days in a row – and they were extra generous with olive oil and cheese on it. The pizza, I will remember as a symbol of surviving in the night city.

Morality: hunger is a bitch. You better find those

Apart from the nonsense described in this article, the iaps2cern trip is also highlighted by visits to the United Nations office, to the Natural History Museum, the Botanical Gardens of Geneva, and plenty of exploration of the Old Town. They were just too perfect and trash-free to be interesting to describe in this travelogue.

Yes, CERN was still there if you did not forget what the article is about. "The feeling of being a small, stupid student, in the middle of this big Dome of Physics" is how my friend Anatolii described it to me when the first visited the CERN with IAPS in 2012. Obviously, it is a very decent chance to learn why the magnets are so big and why there are so many computers in their labs. Just hear what some of our participant say:

"iaps2cern 2013 was just great. The best moment? Going 100 m below the surface to see the CMS detector. This huge construction consisting of so much technology was definitely one of the most impressive things I've seen in my life!"

Lukas Jablonka, *University of Kassel*, Germany

"The CERN trip has allowed me to discover the world of IAPS and the existence of a network of Physics students around the world. Not only this journey gave me the opportunity to see with my own eyes one of the greatest technological and scientific achievements of the human kind, it also allowed me to meet fantastic people with similar interests and different backgrounds. It was great to be part of it and, since then, I am following the activities of IAPS with much more attention. I also hope to spread knowledge about these at Imperial, hoping that they will benefit others as they did to me."

Francesco Sciortino, *Imperial College London*, UK

The hat

It was our last day of the visit at CERN, just after lunch, when my friend Stas went, rummaging in his pockets, "Shit! I lost my hat". That bright olive-green hat with red and yellow stripes, once purchased on a Flohmarkt in Kehl for 7 EUR, it meant much more to him than the Higgs Boson and all the other particles on that particular day. We went to the reception, to the gift shop, then sneaked our way again to the cafeteria, asking everybody in the best of our English and French about the "chapeau perdu", but it was not there to be found. We didn't even mind going for another extra tram trip to CERN the next day – to walk up to the reception and check once more, but alas. The sir at the desk told us, though, that one day Stas' hat would turn up for sure. He said: "We're at the LHC, you know: everything is going in circles here".

PLANCKS

by Casper van Schuppen

Did you ever hear of the name PLANCKS. Assuming you're a physicist, sure you have. Most likely you'll refer to the famous German physicist Max Planck, which delivered great work on black body radiation. PLANCKS however is also the abbreviation for "Physics League Across Numerous Countries for Kick-ass Students". Good chance you haven't heard of that before. It is an international competition for university students, both undergraduates and graduates, with a focus on theoretical physics. The first of what will hopefully become a long lasting series of high-level international physics olympiads.

PLANCKS is a three day event, taking place from the 23rd till the 25th of May. Core activity: a contest providing a wide range of exercises in the field of theoretical physics. From every country across the world, three teams of the finest physics students can enter the competition to show what they're capable off. Teams can be up to four contestants. As a competitor, you will not only be part of the first PLANCKS competition ever to be organised, but also visit the majestic city of Utrecht, enjoy lectures of famous Physicists and join in many social activities to meet your foreign fellow students.

The three day program will kick-off on Friday with an opening in the city centre of Utrecht followed by a nice dinner during which the participants can get to know their fellow contestants. Saturday morning we'll start straight away with the first round of exercises. By then the competition has truly begun. During the break, a rich lunch will be offered and everyone will get a chance to catch their breath. Shortly after, the second round commences and the teams will struggle over the last set of problems. The exercises will be very challenging and will cover all aspects of physics. An example can be found below and some more are provided on our website. In both sessions combined between 10 and 20 problems will be issued.

After the competition the teams will be able to enjoy a drink, join in for the barbecue and recover from the intense sessions of hard work. Later that night there will be an international party for a rousing conclusion of the day. The third and last day will be dedicated to the award ceremony. Of course eternal glory will be granted to the winning team, but also a prize of no less than $€\triangleq 10^{37} J^{-1} s^{-1}$ (we'll leave the calculation to the reader). After the ceremony the official part of the program has come to an end. However, subsequently we'll offer all participants the possibility to explore Holland during a typical Dutch excursion.

Since the start of 2013 the organising committee has been working hard to expand their network and make preparations for the contest. We've been in contact with many student organisations worldwide, including IAPS and EPS. We're still on the lookout for any kind of contributions to the event. If you're a member of an association that could expand our network of potential participants or if you're interested in participating yourself, please don't hesitate to contact us. Since we are unable to accommodate for the participant's travel expenses, we hope that teams will be able turn to their university for financial support. However, we will be able to cover all the expenses during the event, including meals, lecturers and social activities, for a symbolic price of 25 euros per team. All participants will be provided an official certificate signed by an internationally recognised panel of judges (to be announced).

Like we mentioned before, the main stage of PLANCKS is the city of Utrecht. With more than 300,000 inhabitants, Utrecht is the fourth largest city of the Netherlands. It is located right in country's centre, approximately 40 km

in country's centre, approximately 40 km from Amsterdam. The city gets its unique charm from the old city centre, its canals, canal-side cellars, old churches and of course the famous Dom Tower. The University Utrecht (UU) is the country's largest university, which has made Utrecht a true student-friendly city where one in every five people is a student. On request contestants could be recommended residences to spend the weekend where they can enjoy the city's cultural diversity and vibrant nightlife. Contact the PLANCKS organisation if you have any questions about accommodation.

Can't wait for the contest to begin?

We know you've probably been waiting over 20 years now. You'll only have to wait a few more months! In any case, make sure you'll take a look on www.plancks.info, which we'll use to keep you informed about the latest news and developments. On this website you can also subscribe to the contest and to our newsletter.

Disclaimer: information in this article is the current prospect. However, since this competition is organised for the first time and parts of the program can still change, we cannot guarantee any of the information in this article.

Fluorescence from a Single Molecule

G.A. Blab, Utrecht University

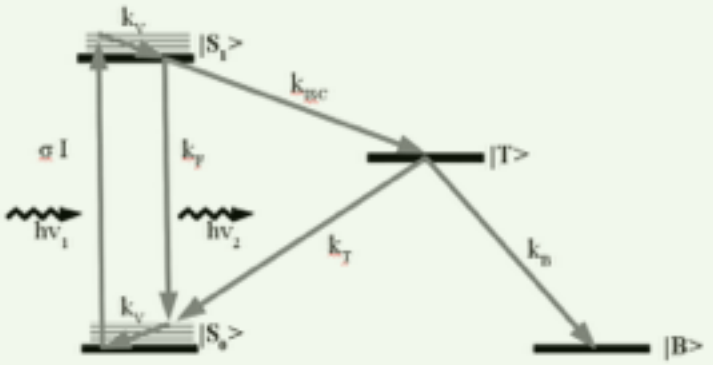


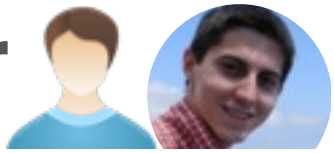
Figure 1: Simplified Jabłoński diagram of a fluorescent molecule. A photon $h\nu_1$ can excite the molecule from its ground state $|S_0\rangle$ to a excited state $|S_1\rangle$. From there, the molecule can emit a photon with lower energy $h\nu_2$ and go back to the ground state, or transition through a triplet (dark) state $|T\rangle$ back to the ground state, or bleach to become a photo product $|B\rangle$.
When asked for a numerical answer, use the following rate constants: radiative $k_F = 3 \times 10^8\,s^{-1}$; non-radiative $k_V = 1 \times 10^{12}\,s^{-1}$, $k_{ISC} = 1 \times 10^7\,s^{-1}$, $k_T = 2 \times 10^5\,s^{-1}$, $k_{bl} = 1 \times 10^4\,s^{-1}$.

1 Find an analytical expression for the measured fluorescence life time τ_F, that is the life time of the excited state $|S_1\rangle$ after absorption of a photon $h\nu_1$. From the general expression, make the assumption $k_V \gg k_F, k_{ISC}$. How does this effective fluorescence life time $\tau_F$differ from $(k_F)^{-1}$?

2 Ignoring for the moment the irreversible bleaching, what is the expected time constant for one excitation emission cycle τ_{cycle}? What does this mean for the number of photons a molecule can emit per unit time? You may use the approximation $k_{ISC} \gg k_T$ in your calculations.

3 Find the excitation intensity (expressed in Wcm^{-2}) needed for a photon emission(!) rate of $5 \times 10^4\,s^{-1}$ from a single molecule. To find the absorption cross section σ, you may assume that the condition are such that the Beer-Lambert law is valid and that the molar extinction coefficient of the fluorophore is $\epsilon = 80\,000\,M^{-1}\,cm^{-1}$ at the excitation wavelength $\lambda_{exc} = 488\,nm$.

Building the "Winnie-the-Pooh" computer cluster



by Maciej Lucky and Michał Naskręt

One of the main difficulties faced by modern physics is a barrier associated with finding analytic solutions to, sometimes seemingly easy, problems. Some of these problems can be analysed numerically with a good accuracy – using computers. Recent rapid development of technology, which allows us to explore more and with better precision, is described best by the Moore's law. The law describes exponential increase in time of number of transistors used in integrated circuits [1]. Unfortunately, benefits of using computers in physics interfere with high cost of building and maintaining supercomputers. Cheaper, but less professional solution is building Beowulf clusters [2].

Computer clusters

Beowulf cluster is a multi computer architecture, which is capable of performing parallel computations [3]. Usually, this type of cluster consists of one computer, which is a server node and a number of computers, which are client nodes. All computers are connected into a Local Area Network (LAN) using a switch. Such a system can also be connected to the Internet, which allows users to have remote access to the cluster. The main node is a server for a group of programs controlling the work of the client nodes, while client nodes have the minimum number of software needed to connect to main node and to solve problems. This type of solution is beneficial, because all the nodes used in the architecture can be ordinary PCs. Nowadays PCs are so popular, that building a Beowulf cluster is relatively inexpensive. The cost of maintenance is also low and if one of the nodes is damaged it can be easily replaced with another PC. Expensive supercomputer components are not required. Beowulf uses Linux as an Operating System. All the necessary software is free, which makes such a solution more affordable and feasible. Of course, Beowulf cluster has also a few negative aspects. Because we are operating a number of fully valuable computers, they consume a lot of energy. Moreover, since Beowulf is built with many nodes, it will also need plenty of space. Nevertheless, it is a perfect solution to satisfy needs and financial limitations of a group of students.

To build our cluster we used secondhand computers donated by a local company. We were given 5 PCs, which unfortunately had

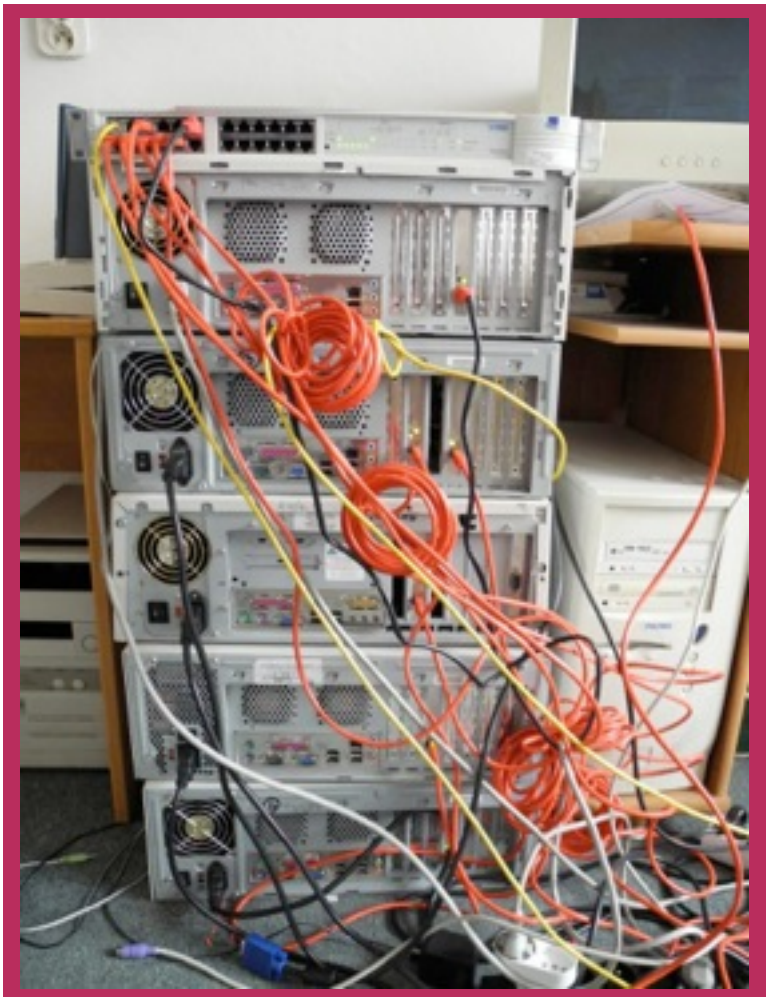


Figure 1: Winnie-the-Pooh cluster

Table 1: List of hardware used

Nº	Name	Producer	Type	Resources
1.a	Processor	AMD	1 core	1600 Mhz
1.b	Processor	AMD	1 core	1500 Mhz
1.c	Processor	AMD	1 core	1300 Mhz
2.a	Hard drive	Wester Digital	ATA	40 GB
2.b	Hard drive	Maxtor	ATA	41 GB
3.	RAM memory	n/a	DIMM	256 MB

Table 2: Hardware configuration of each node

Nº	Name	Processor	Hard drive	RAM memory
1.	Kanga	1.a	2.a	3.
2.	Owl	1.c	2.b	3.
3.	Piglet	1.b	2.b	3.
4.	Rabbit	1.c	2.a	3.
5.	Tigger	1.a	2.b	3.

We were also given a 24-port switch from the resources of our university. On each node we installed Ubuntu Server 2.6.32 and following software.

Table 3: Software configuration

Name	Version	Description
G++	4.4	c++ compiler
OpenLDAP	2.4.21	user authentication
NFS	3	distributed file system
MPICH2	1.5	message passing interface
Torque	4.1.3	resource manager

Performance tests

In order to test the "Winnie-the-Pooh" cluster efficiency we run a program that uses capabilities of parallel programming. We used the Message Passing Interface (MPI) communication protocol. The program is an implementation of the Ising model. All measurements were taken using UNIX time program(user value), 10 times per each number of nodes and taking the average value.

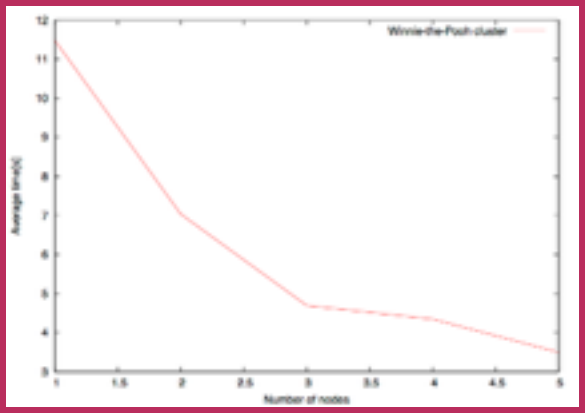


Figure 2: "Winnie-the-Pooh" cluster efficiency

The second test we performed on the cluster was designed to verify its node-to-node communication abilities. To serve such purpose we used program generating Mandelbrot fractals [4]. Given desired coordinates, zoom and definition the output gives us a bitmap with a fractal. The default definition of 1280×720 pixels. Graphical effect is presented below.

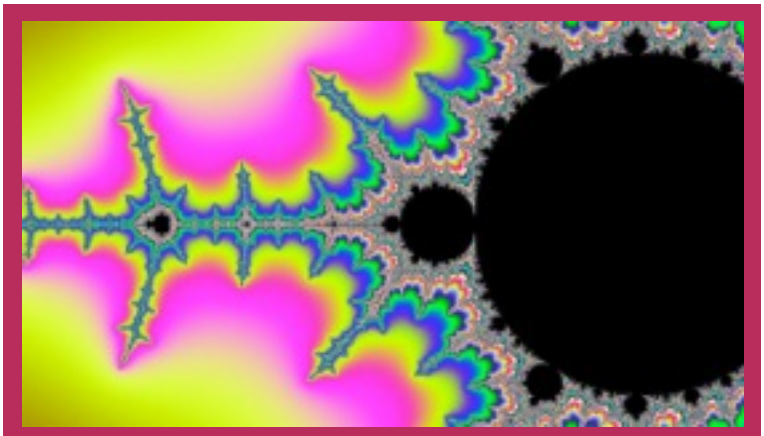


Figure 3: Mandelbrot fractal

The algorithm computes iterations of complex sequence, given by the equation: , where c is a $z_{i+1} = z_i + c$complex constant. The program generates proper colour by analysing the radius of convergence for given point and number of iterations. Each node computes these values for separate parts of the image and saves it to a file. Then, once again using MPI protocol, each node sends the data to the master node, where proper colours in RGB scale are fitted.

The transferred files weigh only about 2 MB and using the time utility we are hardly able to observe any decrease in efficiency, comparing to the earlier graph:

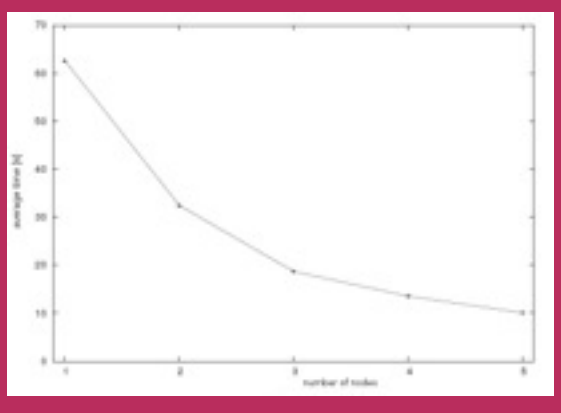


Figure 4: "Winnie-the-Pooh" cluster efficiency

However the further analysis with *gprof* program let us observe, that communication functions take from 4% of time (2 nodes active) up to 11% (all nodes active). It is certainly satisfying efficiency for this simple type of computing cluster.

Application

The purpose of constructing such a device was purely educational. Everyone involved in the process had a good chance of gaining a lot of knowledge from general linux environment usage, through hardware know-how and finally to real parallel programming. As the project got completed our interest in Beowulf clusters grew. It is a cheap and efficient way of obtaining your own mini-supercomputer. Even though the "Winnie-the-Pooh" does not provide with extraordinary computational power it has inspired us to undertake more innovative plan and build another Beowulf cluster. This time using much cheaper and more efficient single-board computers.

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Predicting earthquakes! VLF signals

by Suresh Pant

Earth's surface is under slow but continuous movement of tectonic plates due to which collisions, rupturing and micro-fracturing of rocks in the crust occurs. Huge amounts of strain energy is developed as a result of such contraction and stretching of the tectonic plates. This huge stored energy produces tremendous disturbances affecting the earth's crust that are balanced by attaining equilibrium through reactions we call earthquakes.

Earthquakes have been creating lots of misery almost everywhere. It is one of the natural disasters that cannot be predicted until it happens. More often than not, earthquakes have devastating effects upon property and life so the prediction of earthquakes is very important. Since quakes cannot be prevented, perhaps, the best way to face their attack is to mitigate their adverse effect. The use of quake-resistant structures, that use shockers or lightweight construction materials can be effective, but they are not always affordable for the public at large and many not be able to withstand seismic over 6.5 on the Richter scale. Although this is a proactive approach to the present impossibility of prevention, Greeks, earlier on, used to study the anomalous behaviours of animals like dogs, rats and reptiles to predict earthquakes. Also, scientists in China suggested that there was deviation in the voice bandwidth of parrots just before an earthquake. The presence of radioactivity in the atmosphere due to changes in the level of radon gas due to seismic activity was first monitored in Russia as a possible method of prediction. However, none of these methods could predict earthquake for sure and minimise the loss because of it.

Nowadays, the Very Low Frequency (VLF) techniques seem to be promising, and reliable for the prediction of earthquakes. In fact, physicists and seismologists, all over the world are now actively engaged in monitoring, formulating, and characterising the consequences of the changes in the signal strengths of long waves that are related to earthquakes. Electromagnetic radiation in the frequency range of 3 kHz – 30 kHz is known as Very Low Frequency (VLF) waves. They are being continuously propagated in the earth's atmosphere from transmitters and get reflected from the ionosphere. This frequency range has been used by military everywhere for encoded communication. Due to less attenuation, VLF waves have been used for military communication especially by Navy. A couple of stations for my region, Nepal, include VTX (18.2 KHz) and NWC (19.8 KHz) of the Indian and Australian navies respectively.

Propagation of VLF signal

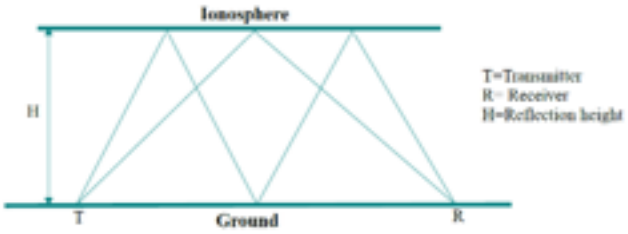


Fig 1. the mode of propagation of the VLF signal

The straight propagation along the surface of the ground is known as a ground wave. The propagation due to the reflections from the D-region of the ionosphere is know as a sky wave. It is clear that a receiver gets the resultant wave formed by the superposition of a ground wave and a sky wave. Therefore, change, if any, in the propagation path alters the path difference which causes the variation in the intensity of the signal at R.

Receiver and Technique

VLF signals can be easily captured using a simple loop antenna and a resonance circuit (for research purposes). The signal is then fed into a

computer where the variation in the intensity can be monitored using appropriate software like SpectrumLab on a PC.

The D-region of the Ionosphere

The ionosphere at 50 – 90 km from the earth's surface is known as the D-region. During daytime, the region extends down to 50 km from the earth's surface due to significant ionisation of the air by sunlight (UV rays and X-rays form Sun). During nighttime, the recombination rate is very high and this layer shifts up to 90 km from the earth's surface. Thus, the reflection height of VLF signals keeps on changing due to photoionisation and the recombination process. This change in the reflection height alters the path difference and phase difference at the point of reception (R). This leads to the variation of the signal intensity on the software.

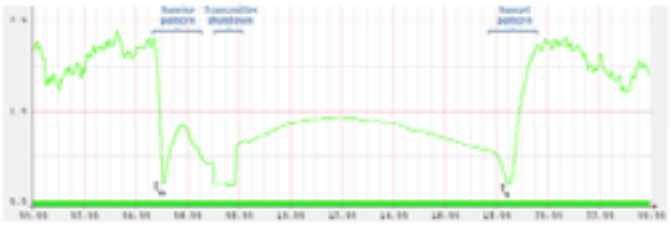


Fig 2. A typical graph for a normal quiet day

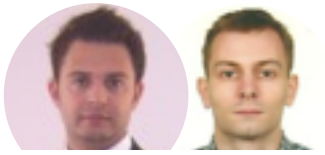
The first minimum intensity in the morning is known as a morning terminator ™. There is an evening terminator (te) as well. These terminators are noticed due to variations in the height of the D-layer (reflecting boundary) in the morning and evening because of fast ionisation and recombination process. The time interval between these morning and evening terminator is know as "VLF day".

Indication of an Earthquake

The ionosphere, thus, is a great detector in itself. Any change in the ion density in the D-region of the ionosphere would definitely cause a change in the reflection height of the sky wave. This would cause a significant variation in the intensity of the received VLF data at Receiver (R). However, beside earthquake, some astrophysical phenomena like solar flares, Gamma Ray Bursts (GRB), X-Ray Bursts (XRB) and meteor showers have been studied by the analysis of VLF data. M. Hayakawa first noticed a change in the terminator time in the VLF signature while analysing the data of the Kobe earthquake in Japan.

During the earthquake, preparation time within the earth, fragmentation and micro-fracturing of the rocks take place which releases ion gas into the rocks and then into the atmosphere a few days before the earthquake happens. Moreover, the production of radioactive gas from within the earth increases the conductivity of the atmosphere causing huge fluctuations in the ionisation level. This event gradually increases the "VLF day". Experimentally, it has been noticed (in most of the cases) that the "VLF day" becomes longer just for four days before an earthquake occurs. During that time, a maximum number of anomalies have also been noticed. These observations have now encouraged scientists to predict earthquakes with more confidence. Nevertheless, continuous monitoring of the freely available VLF signals is needed to ascertain the standard model forms of the variations of the signals. Only then, any further deviation from the standard model forms can be taken as an anomaly. This tool is now becoming a trustworthy technique for the earthquake and many scientists from Japan, India, Brazil, Nepal, Russia and Germany are now publishing their valuable works in this emerging area of earth science.

Summing up, this method of monitoring VLF signals can be one of the important tools not only to study and predict earthquakes but also to research astrophysical events such as GRB, XRB, lightening in the thunder-belt of atmosphere, or solar flares. Also, this method is cheap as VLF signals are free and can be received using a simple loop antenna. So, it can even be done as a high school project by keen, innovative students or researchers for deep

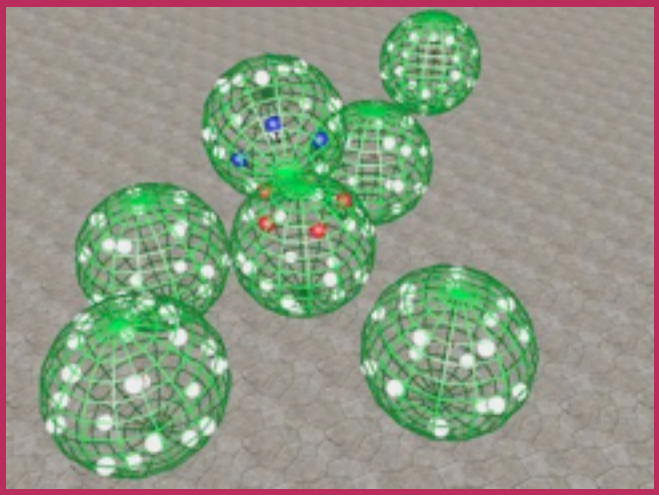


by Ajmal Faizi and Deividas Sabonis

Abstract: Billions of microscopic robots working together in a vast network to build 3D objects that can change colour, feel solid to the touch, can be moulded and changed into almost anything. Claytronics i.e. programmable matter could change the world as we know it.

You are probably thinking what is Claytronics? The aim of this article is to give a short introduction to this new and exciting field. It is probably the first time that you have heard the two words clay and electronics mentioned together as one term. But by the time you finish reading this article you will be probably thinking that the term *claytronics* is very well suited.

Coined at Carnegie Mellon University by Seth Goldstein and Todd C. Mowry during the last decade now it is becoming one of the most exciting research areas. It has immediately drawn attention of the industry along with the curiosity of the scientific community. This is not hard to grasp because it could have a big impact on everything that surrounds us in our daily life: from the way we use things and manufacture them to how we communicate. Most of us know how easily clay can change shapes and combining it with electronics could



Catoms can be programmed to form interesting dynamic shapes and configurations. They also can be used as a system for exploring the computer science of programmable matter.

Instead of having to buy a pre-manufactured object we would just download the design and with the help claytronics it would form into different things. One of the key challenges is figuring out how to program millions or billions of processors that are all working together. To find out how catoms can work together, researchers have created computer simulation so the catoms can interact with the forces of physics in a virtual environment.

This is something Intel Corporation is interested in. Intel researchers are working on how to program catoms to assemble themselves. This research project has set its goals on two principal pathways. Firstly to engineer, design, and test of modular robotic catoms prototypes that will be suitable for manufacturing in larger quantities. Secondly on creation of programming languages, and software tools to control ensembles of millions of catoms. Under

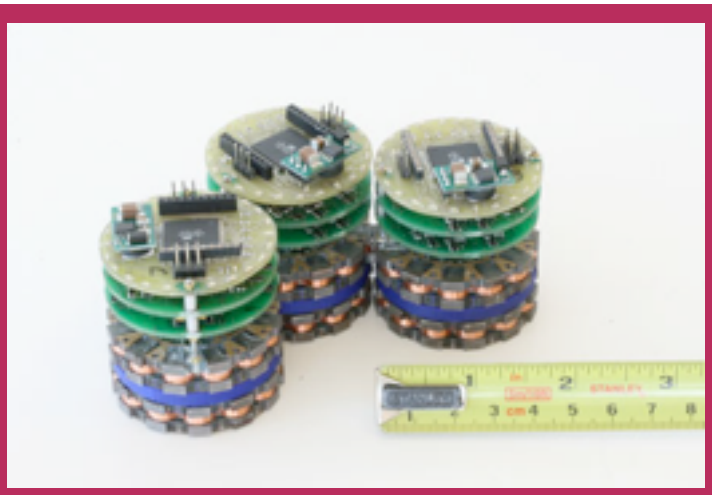


Figure 2: Prototypes of claytronical units.

simulated force of gravity catoms arrange themselves in a shape where they stick together. They have built experimental catoms that work

research project has set its goals on two principal pathways. Firstly to engineer, design, and test of modular robotic catoms prototypes that will be suitable for manufacturing in larger quantities. Secondly on creation of programming languages, and software tools to control ensembles of millions of catoms. Under simulated force of gravity catoms arrange themselves in a shape where they stick together. They have built experimental catoms that work on a flat plane, to conquer the challenges moving in a 2D world, before they move into third dimension. The aim was to build larger units that would verify some of the main principles behind claytronics that are essential to create fully functioning devices. The initial step was to put electromagnets around cylinders Figure 1. When the right magnets are activated due to mutual attraction different units communicate with each other by for example moving around. This might sound as a simple task but it took 3 years of research to achieve this. These small units move without any moving parts without no self-contained power source. Other achievements of course is creating a new programming paradigm. The magnets will probably not work very well on a microscopic scale. That is why other methods are needed for the catoms to stick together and move (e.g. via electrostatic attraction). In order for claytronics to work, the catoms have to be much smaller than the available models today (sub millimetre size in fact). There are several ways to shrink them. Tiny spherical machines can be printed like integrated circuits forming themselves into spheres. It sounds complicated but at the end of a day there is some sort of a natural simplicity to it. The units are small, all very similar to each other, they are doing the same thing. That is the system is made of simple parts.

Making these tiny spheres has already happened at the Airforce Research Lab in the US. Claytronical objects will be able to form complex structures and perform elaborate tasks that may seem impossible with today's technologies. In order to construct complex structures these mini-robots are needed in large numbers and tiny scale. With this ability your furniture will be able to do double duty adapting to your needs. With claytronics the art on your walls or for example statues could be changed depending on your mood and needs. Cellphone could turn into laptop and when the work is done, back into cellphone. But its most amazing application is how claytronics could revolutionise human to human communication even if people are in the same room. To build a moving, sensing, and at the same time colour changing copy of human out of claytronical units would make every chat a face-to-face meeting. This is the the future 3D Video conferencing.

Many fields, and robotics is not an exception. managed to make their way out from science fiction in last 4 to 5 decades. Claytronics is an exception as it never existed in science fiction as a science or technology until recent years.

Figure 3: One of the many possible applications of claytronics

Real products are still years away but researchers have been looking at ways to make an object of any imaginable shape, and changes in the technology trends prepares everybody for tomorrow. While investigating claytronics the Carnegie Mellon-Intel researchers have created two new programming languages, namely *Meld* and *Locally Distributed Predicates* (LDP). Meld is a logic programming language originally designed for programming overlay networks. By using logic programming, the code for an ensemble of robots can be written from a global perspective, enabling the programmer to concentrate on the overall performance of the claytronics rather than writing individual instructions for every one of the thousands to millions of catoms in the ensemble. This dramatically simplifies the thought process for programming the movement of a claytronics. On the other hand LDP is a reactive programming language which has been used to trigger debugging in the earlier research. With the addition of language that enables the programmer to build operations in the development of the shape of the claytronic object, it can be used to analyse the distributed local conditions. Claytronics will revolutionise the design and engineering of computing, telecommunication, human-computer interfaces, entertainment, hardware systems etc. It will offer a more realistic sense to communication over long distance. Similar to how audio and video provide aural and visual stimulation, this provides an aural, visual and physical sensation. Hence an idea of the creation of a new media-type, which is called pario is proposed. Seth Goldstein expressed this in the following way: "*We are neither transporting the original object nor creating an exact replica: instead, the idea is to create a physical artefact that is a "good enough" reproduction of the shape, appearance, and motion of the original object – one that our senses will accept as being real.*" A user will be able to hear, see and touch the one communicating with them in a realistic manner. So the countdown for the next tech revolution has started and we all are witnesses.

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Encyclopædia Galactica – foreword to the first terrestrial edition

by Vanja Blazinic

Every social change is met with resistance, to a greater or lesser extent. The history of mankind is full of such examples: the spread of the early Christian Church, the acceptance of the idea of a heliocentric planetary system, the rise of Isaac Newton's axiom of classical mechanics as a new theory which could explain a large number of natural phenomena, humanism and the renaissance… An eternal optimist, such as the likeable coyote chasing the Road Runner, might even say that people have learned something from their rich history. Therefore we were very surprised by the wave of dissatisfaction which swept over Mankind not long after the announcement that everything except "the third rock from the Sun" would be included in the Encyclopædia Galactica. Malevolent people, among whom there was a large – fortunately, not large enough – number of my fellow Encyclopædists, claimed it was "the final proof that Mankind is a lost case, despite all accomplishments, because it is still trying to place itself into an imaginary privileged, central position".

Personally, I think that the Milky Way, as Mankind calls it, and the entire Cosmos are large enough to allow every civilisation and species that much vanity, as long as it causes no harm to others. The globalisation on Earth began, at least symbolically, with the foundation of the League of Nations after the First Terrestrial War, and continued through the work of the United Nations. The fear of globalisation, which gained greatest momentum in the computer era of humanity, was marked by treason, greed, and hopelessness. The wars were just the consequence of these human conditions. Many individuals, nations and their leaders feared that globalisation would sweep away their cultural, ideological, and any other identity. The globalisation of Earth did, in a way, erase the differences between the Earth's nations and cultures, but if it were not for those differences, there would be no globalisation. As positive and negative electric charges or opposite magnetic fields attract, as a key fits into a lock, so these differences helped the nations of the Earth complement one another and created a unique entity – a real human civilisation, the one and only.

Everyone is privileged, and yet, everyone is equal.

Apart from diplomacy and art, science also made a great contribution to globalisation. Mankind's ability to stabilise and control the process of cold fusion supplanted the use of fossil fuels and greatly reduced the possibility of electric energy shortage, the decline of industrial and agricultural production, environmental pollution, those symptoms that forebode war. There is no need for the individual to be greedy, with all the abundance there is. The only potential threat left is disregard for oneself and one's fellow man.

On a much greater, but not so conceivable scale, Mankind has taken a step into, if you'll excuse the pun, the process of galactization. The Encyclopædia was created with the purpose of bridging the cosmic gap, in the spatial, cultural, and scientific sense, between a civilisation which is just getting ready to set off among the distant stars and the rest of the galactic society. And those who can go among the stars are certainly responsible enough to take care of their heritage. That is why, in this terrestrial edition of the Encyclopædia, you will find everything except Earth itself.

If we were to compose a detailed list of individuals who are to be thanked for this accomplishment, it would be large in number and reach far into the past, all the way to the first workers of the ancient Library of Alexandria. However, let us emphasise those from the last stage of globalisation.

We would like to posthumously thank Mr. Isaac Asimov and Mr. Carl Sagan for bringing the idea of the Encyclopædia Galactica closer to Mankind through their works, as well as Mr. Douglas Adams whose Guide to the Galaxy served as a model for the terrestrial edition. In his honor, there is a separate article on the number **42**. Furthermore, we thank the volunteers of Wikipedia and the qualified personnel of Encyclopædia Britannica, Inc., who selflessly took over all the work of updating and language editing from the Committee for the Encyclopædia on Terminus.

Lastly, I personally thank the Committee for approving the publication of the Encyclopædia on Earth, despite initial skepticism. The Encyclopædia is not the end. It is but the beginning of a new epoch in the progress of Mankind.

In my own name and the name of the entire Galactic community, welcome. May the flame of the good star shine upon your “third rock from the Sun” for many generations.

Before the Committee for the Encyclopædia and the publishing house “Ursa Major”, R. Daneel Olivaw

checked for grammatical errors by: Maša Dvornik