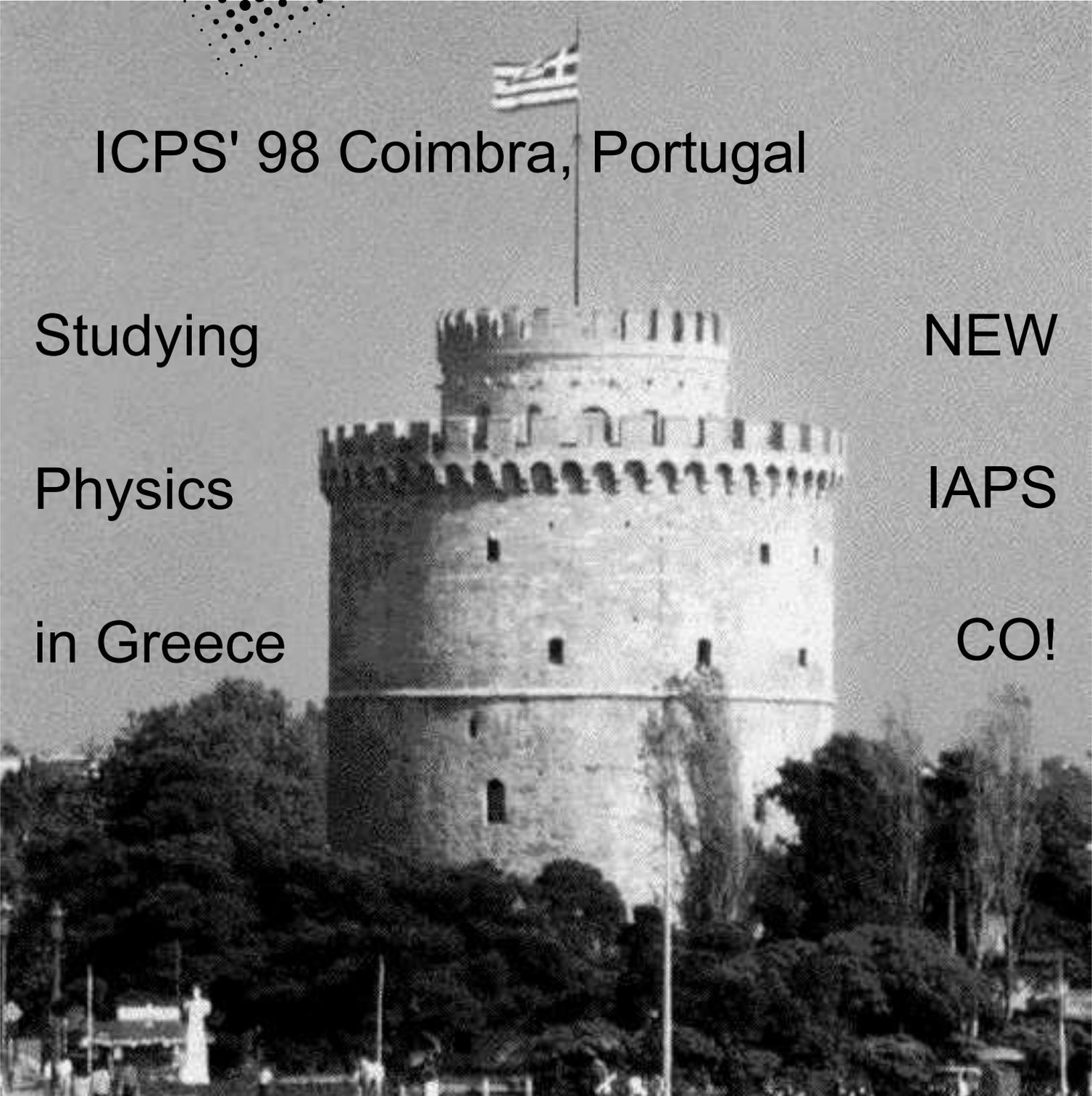




JiAPS

The Journal of
the international
Association of
Physics Students

The New JiAPS. Issue 4, December 1997



ICPS' 98 Coimbra, Portugal

Studying

NEW

Physics

IAPS

in Greece

CO!

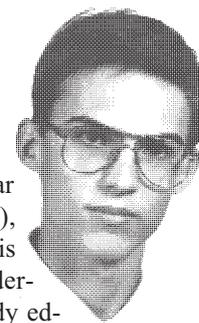
The White Tower of Thessaloniki



ICPS '97 Vienna

JiAPS is the Journal of IAPS

(the International Association of Physics Students)



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The Editor

My name is Márton Major (IV. year physics student at ELTE, Hungary), and I am the editor of the issues of this year. I was asked by Miguel to undertake this job at the ICPS '97. I already edited some of the HAPS' Journal: Mafigyelő.

Before starting this work, I could not believe, that how hard could it be. It is a big work for one person, and without the help of the others (you for example) it simply does not work. The Idea of the Journal is marvellous, but without **YOUR** co-operation, editing it is only a waste of time. The journal needs articles (see back cover page for details) and readers too. So, if you read this issue, then please give it to your friends, other physics students and faculty members also. It is a good idea, to place a few copy in your university library too.

Finally I would like to say thanks to Miguel for his great help in proofreading, and for his ideas and of course for running the Journal for one year. I also thank for every author (see at the Summary) and special thanks to Zsófia József and Edit József for collecting the article from Tom.

Márton Major, JiAPS Editor
(mano@ludens.elte.hu)

The Bank Account of IAPS in 1997-98:

You should pay the membership fee here:

Lloyds Bank Plc
Knightsbridge Branch
79 Brompton Road
London SW3 1DD
Account number: 0253575
Sortcode: 30-94-81

All cheques, etc., will need to be made payable to 'The Institute of Physics'.

Sue

IAPS Central Office 97-98

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IAPS President addresses the Martian Ambassador...

This organism began as a *Homo Sapiens* zygote in a uterus around Christmas Eve, 1974. Sixty or so mitoses later it left, forming scar tissue around a severed umbilical cord, at 20:45 on 24 September 1975. The mother named it Nigel James Harris. Its position has so far been confined to Earth's crust and atmosphere, recently 5,000 feet upside-down flying a Scottish Aviation Bulldog, above Cambridge's Trinity College; where, amidst programming and a multifarious social life, it has been reading *Theoretical Physics*. Employing principally neural tissue, it has formed an Integrated Global Representation of something it calls "The Universe", and an altruistic philosophy towards this Universe, from which it derives contentment. This organism often wonders what it would be like to join itself by high speed data link directly to another organism or an Internet of organisms. Would the joint organism feel itself to have an identity, the way this organism feels an identity?

Greetings from Cambridge! IAPS Central Office has invaded England, drawing on the gracious hospitality of Trinity College and the Department of Applied Mathematics and Theoretical Physics, where excellent computing facilities have kindly been allocated by Professor David Crighton, the Head of Department. We enjoy also the financial wisdom of the Institute of Physics, in London, where we have fine banking terms, and the processing of membership applications, in St. Catherine's College and the Clarendon Laboratory, in Oxford.

From this strong base, we aim this year to expand the International Association of Physics Students worldwide. We are establishing links with East Asia, initially China, and shall present ourselves, our views and our aims to the International Physics Olympiad and the United Nations at the World Youth Forum (Lisbon) and the Global Youth Forum (Seoul). Our fresh ideas were welcomed at the European General Forum '97 of the European Physics Education Network, and IAPS is happily set to contribute to EuroPhysics News and the International Circular of Physics Education. JiAPS, our ICPS'97 Proceedings and our brochures will reach people directly. We shall also fully exploit the Internet, much improving our service to student physicists. We shall provide this fully scaleable with the technology available to the individual student, be (s)he undergraduate or doctoral.

Students with access solely to e-mail will naturally be able to discuss physics on our mailing lists, yet can still be published on our Web pages and receive logs of teleconferencing sessions, constantly available using the Internet Relay Chat "IAPS" channel on IRCnet (e.g. ircnet.demon.co.uk). Those with the latest hardware and software technology will most fully experience physics modelling web applets, encryption-secured time-stamping of their contributions, and Internet animation, video and sound, applied also to our "Netscape Conference" physics teleconferencing.

Towards the 21st Century, we aim to become a true World Physics Collaboratory, bonded with artificially intelligent networks and universally accessible experimental apparatus and results databases... building on vital personal contact through the annual trip to CERN and through our flagship, the week-long International Conference for Physics Students, next August to be held in the historic city of Coimbra, in Portugal.

Our global co-operation will make Planet Earth a Physicist of cosmic standing in the Universal Physics Olympiad!

Nigel Harris, President

The Treasurer

My name is **Sue Jackson** and I am the treasurer of IAPS this year (I am also the 'coffee & biscuit' provider at our CO meetings!). You will probably remember me as being part of the UK entry at the National Party at ICPS '97 in Vienna...



I did my Physics degree at the University of Birmingham, and enjoyed it so much that I stayed there for another 3 years to do a PhD. My research was in Condensed Matter Physics, investigating a highly-ordered phase of ice, known as Ice XI. It was great fun, being a mixture of challenging experiments, and even more challenging theory!

I finished my PhD studies last year and headed for the bright lights of London, where I am now the Student Liaison Officer for the Institute of Physics. This makes me responsible for undergraduate and postgraduate students in Physics across Britain & Ireland. I really like my job, because I get to visit Physics departments nation-wide to see all of the exciting Physics happening there, and talk to enthusiastic lecturers and students who share my love of Physics. And, of course, it allows me to attend ICPS!

Nexus is the name of the student section of the Institute. We currently have about 5,000 members (from many countries, not just the UK), and when I travel around the universities this autumn I will be encouraging the new first year students to join us. Nexus is very proud that IAPS has chosen us as this year's CO. I have excellent team members in Nigel and Jan, and I am confident that we will do a good job for you as your new CO.

I am grateful to the Institute for providing a 'home' for the IAPS bank account for this year. I have been given much support and advice, particularly from the Institute and past-CO members, on what makes a good treasurer, and I promise that I will try my best to serve you well. I am very happy to receive suggestions on how I can improve what I do for you as IAPS Treasurer. Please help me by cooperating promptly when I ask for your membership fees!

Sue Jackson, Treasurer

The Past President



Being part of an international organisation like IAPS is a great experience; you can share your ideas with people from across your continent and you also have the chance to meet them at a big conference at the end of the summer.

But, if you also work inside of the Organisation (being part of the Executive Committee), the experience is amazing. It is a wonderful thing to know that the work you are doing is being done not only for the people of your university but also for a wider group of people. In fact, at the end of the last conference (ICPS '97), IAPS was present in 37 countries, mainly in Europe, but also in America and Asia.

Therefore, one of the main activities IAPS could start doing is to cooperate with the EMSpS programme (European Mobility Scheme for Physics Students), helping those students who want to study physics for a year in a foreign country through the Local Committees. To this end, we could work with those who still have not decided the place they want to go to and once they have decided where they are going to study, providing them with the kind of information that you'll never find on the official reports, or on the official sites of our Faculties or Universities. So, I would like to highlight that we have the Network, we mostly know each other but, in my opinion, we have not made the most of it.

On the other hand, it is important to spread the name of IAPS to those places and institutions that still do not know us. This little world is crowded with organisations and foundations with pretty big budgets. Some of them know exactly what to do with their money, but there are lots of them who have a big problem: they have the money, they have to spend it, but they need the right people to spend it on. I think we are the right people. All we have to do is find them and knock at their doors saying hello with a big smile, an attractive project and as many things as possible to demonstrate to them that we are, in fact, the right people.

The foundations for a future consolidation of IAPS have already been laid. All we have to do is take the next step.

*Oscar Pleguezuelos García
Past President of IAPS*

The Past JiAPS Editor



My name is **Miguel Carrión** and most of you know me already as last year's JiAPS Editor. Just when you thought you had got rid of me, I come back to haunt you at the new Editor's request—such is life—.

First off, a summary of last year's accomplishments. I am supposed to also give you a taste of 'what it is like' to be JiAPS Editor (what Philosophers call 'the qualia'—sorry, bad joke). Let's see...

First you have to pester everyone to get them to write articles, at the risk of losing your IAPS friends in the process. Then you have to compose the issue before the (self-inflicted) deadline for publication. When you get articles after this deadline not even Einstein can come to the rescue. This involves a lot of stress, at the risk of burning your eyebrows in the process. Then you copy and mail the issue, and you want to get it done as soon as possible. In my case it was the CO who did that, and since they were not very fast at it (not their fault) I run the risk of alienating them in the process. Then everyone gets the issue and just ignores it—frustration!—or say it's great—you know that already, and you're too tired anyway—. So you just go to sleep for a weekend and start pestering everyone again on Monday. Then you go to the next ICPS, are acclaimed at the Opening Ceremony, and do your best not to be re-elected. **The End.**

All that follows is excerpted from the 1996-97 JiAPS Report, which the past CO should be making available soon. Hopefully it will also be on the IAPS web page.

Read and enjoy,

*Miguel Carrión Álvarez,
JiAPS Editor 1996-97*

Excerpts from the 96-97 Report

[...] During the ICPS '96 it was decided that IAPS still needed a printed journal, despite the negative experiences in the past. However enthusiastic I may have been during the Szeged ICPS, it still strikes me as unusual that a newcomer should be appointed to such an important position. [Note: not any more: in Vienna we appointed a newcomer as nothing less than President! It was a good choice, by the way.] I have to say that had I not considered myself capable of handling it I would not have accepted in the first place. I was confident because I had some experience of editing [...]. I hope I lived up to the expectations of those who voted for me. [...]

With the conclusions of the ICPS '96 workshop "JiAPS: Quality is better than quantity!" in mind, and after a little discussion with other members, I devised the following plan for 1996-97:

- The Journal would be published 3 times per year, every 3 months since in the summer there is the ICPS. The dates of publication would be November- February- May.
- Having three issues per year, and considering the importance of the ICPS, the November issue should contain a review of the past ICPS, the February issue a review of the coming ICPS, and

the May issue a presentation of candidates for the following ICPS. This would also provide a trend in the contents of the Journal, and a sense of continuity.

- The first issue of the year should contain an introduction to the newly-elected Executive Committee, to encourage the participation of the members in the projects of the CO and EC.
- The discussion in the IAPS mailing list over each period of 3 months would be summarised in a review article.
- The rest of the Journal should be made up of contributions from the members. The editor might coordinate a problem section, to which members would still be the main contributors.
- There should be a ‘JiAPS Distribution List’ where active members could subscribe. This procedure would provide the EC with a way to keep track of active members of the association. [...]

Despite the many difficulties to meet the above goals, there were a number of encouraging accomplishments during last year:

- We have (just) managed to produce 3 issues of JiAPS.
- The reactions to the successive issues of JiAPS have invariably been enthusiastic. It may be that those who disliked it did not bother to voice their criticism, but I think that is unlikely (call me optimistic).
- We have a Distribution List includ-

ing all National Committees, Local Committees and Individual Members, as well as other interested members of committees, and a fair number of outside addresses. JiAPS regularly reaches about 100 readers directly. One can never be sure about indirect diffusion, but the LCs and NCs can do a lot to increase this number. All of them say they cannot afford to copy and distribute the journal further, though. Those committees with a Journal try to reproduce parts of JiAPS; this is the case of SPS and HAPS. In this way, the 6,000 members of SPS (the USA NC) got to see most of issue 1. If this were to continue, then most of our readers would be American!

- JiAPS 1 and 2 are now available online in PostScript format under <http://www.nikhof.nl/pub/iaps/jindex.html>. The credit goes to Kjetil Kjernsmo of NoFFo, for getting us disk space at <ftp://ftp.fys.uio.no/jiaps/>. JiAPS 3 will have to wait a little longer, since I have to figure out how to join the parts I did with TeX and those I did with PageMaker in a single PS file.
- JiAPS is taken really seriously by professional organisations like EUPEN. This should increase IAPS’ credibility.
- A ‘JiAPS Workshop’ was established and gave rise to a lively discussion of the problems of JiAPS. Its conclusions are summarised in the JiAPS Report. [...]

An important thing that members

should understand is that the only sensible way to work is that articles other than news (that is, every article except those of Executive Committee members) should be submitted for publication not in the next issue, but in the one after that. It is a sound editorial policy to have more material available than fits in one issue. Then one can publish the best material, and not just what happens to be there. Contributions for an issue should be sent before the previous issue is out. **People, please, write as much as you can!**

One more thing: if you think a journal is a one-man thing, you are wrong.

Acknowledgements

The following people have contributed to JiAPS during the year, be it through articles or through the JiAPS Workshop:

Daniel Aguirre Molina, Hendrik Ferdinande, Pedro Castelo Ferreira, Olav Frijns, Bent Grøver, Remco Hammen, Bente Hansen, Jorg Janssen, Kjetil Kjernsmo, Damir Kovacic, Merete Lillemark, Márton Major, Filipe Moura, Dwight Ed Neuenschwander, Yasser Omar, Anne Petit, Óscar Pleguezuelos García, Ravi Vakil, Ramón de Vries, Stefan Witoszynskij.

I apologise for any omissions in the above list. None of this would have been possible without their help.

Miguel Carrión Álvarez
JiAPS Editor 1996-97

The President Designate

My name is **Michal Zawada** and I am the current president designate. The Scientific Association for Physic Students of the Jagiellonian University is my Local Committee. I have been chairman of our Association for a year and a half, the new chairman will be elected in November. This person will probably be our candidate for IAPS president next year. I think he will say more than me about the future Central Office in <N|K|F> in the next issue of JiAPS. My job is to create a new Central Office, his (her) job will be much harder. Firstly, we would like to show you next year that IAPS is not only the ICPS. We know that many LCs are organising some summer school, or workshops. Why couldn’t IAPS help them?

Secondly, there are still some countries without IAPS even in Europe. We will do our best so that the number of this countries will decrease. There is a number of things we can do. Anyway, we are open for any suggestions from you about the future of IAPS. Please mail to us at nkf@druid.if.uj.edu.pl, we need your help.

Michal Zawada, President Designate

IRC communication

As a way of communication between IAPS members and supporters, there will be IRC meetings once/twice a month on #IAPS channel (IRCnet). Dates and agenda will be announced (at least a week in advance) on the mailing list of IAPS and on www pages of IAPS (<http://www.nikhof.nl/iaps>).

Questions regarding IRC should be sent to me (Damir.Kovacic@public.srce.hr). FAQ about IRC can be found at <http://www.irchelp.org>.

Hope to hear you on IRC,

Damir Kovacic,
IRC coordinator

The IAPS Network of Contact Persons

I wrote this article right after an exam, with my head still not ready for any other task. The reason is that I was informed that I should write an article while I was very busy preparing for the exam last week and the deadline was today. Well, let's see what I can get out of my head.

Because of these circumstances I would like to ask you to excuse my mistakes. In order to get my brain working, let me introduce myself first. My name is **Stephan Witoszynskyj**, I am studying physics – I guess this is no surprise – at the Vienna University of Technology. During the IAPS General Meeting the IAPS-representatives elected me as the IAPS Network Coordinator (that is why I have to write this article). I guess many of the readers know me from various ICPSes I have attended and most of those probably remember me as Chairman of the Organising Committee of ICPS '97 (if you would like to read something about the ICPS '97, you had better read Olav's article, because I don't know anything about the conference except accommodation troubles, visa troubles and so on and that is not very interesting).



What is the IAPS Network?

In my opinion 'what is' is not the correct question. I think you should better ask 'what was' or 'what should be' the IAPS Network of Contact Persons (or simply the Network). I am going to elaborate briefly on following topics the idea of the Network, some reason why I think it ceased to exist and my plans.

The ideas behind the Network

The Network was brought into existence during ICPS '91. The idea of the Network was to help students who would like to study abroad by having a fellow student at another university who could help them getting information, contacting university officials etc. Those people who agreed to pass on information and to help colleagues were called Contact Persons. Because in 1991 only a few people could use e-mail and Internet, a hierarchical structure was established.

Why doesn't it exist anymore

That it doesn't exist anymore is not quite true, but I want to put it a little bit more drastic. There are probably many reasons for it, but I will provide my own interpretation, which, of course, could be wrong, because I couldn't talk to those who originally were in the Network. My explanation is derived from my experience with communication, from organising ICPS '97 and what I have seen and heard of the Network. During organising ICPS '97 I experienced that most of the people didn't tell you if they wanted to cancel their registration. I guess something similar happened to the Network. The Contact Persons graduated and left university, but they didn't

inform the Network Coordinator. So the address list became inaccurate, because the people on it didn't exist anymore. In the end the list was deleted and it was tried to set-up a new one. There is one at the moment, but it can't be compared to the one I saw years ago.

What are my plans

The tree main aims are of course:

- getting Contact Persons, because there can't be a Network without them;
- keeping this list up-to-date;
- spreading information about the network.

Although I started doing some preparations – especially on programming the perfect web page – I'm not yet ready to go into public, because I had a lot to do with the leftovers of ICPS '97 and to make the exams for which I had no time because of the ICPS '97 preparations. I think I will finish everything during the Christmas holidays. In my opinion keeping the list up-to-date is the most simple task. According to my experience you can't rely that people tell you address changes and if they don't want to be Contact people anymore. So I thought of contacting the Contact People regularly – monthly – and after a certain number of tries stayed without response the person will drop of the list. Spreading the information will be more difficult. Of course there will be a web page – which hopefully will be linked from pages that are being visited by students – and postings in newsgroups, but the spreading of the information also relies on you, the members of IAPS and readers of this magazine. The most difficult task will be to get Contact Persons. You can/should be one of them.

Becoming a Contact Person

The Contact Person is the most important part of the Network. The Contact Person should be a student. Your only task would be to answer a few mails (among them will be my "Are you still alive?" mails) and pass on requested information (doesn't sound very difficult, does it?). But of course you can do more like setting up a web page with useful information like addresses of physics departments (and the according links) at your university, pointers to information scholarships, etc. You can also stay in contact with the people if they really come to your university. There are no limits. So, if you want to meet physics students from other countries, becoming a Contact Person might be an opportunity.

What to do if you want more information

I will send out information to the IAPS mailing list as soon as the web pages are ready. But of course you can –and I encourage you to – contact me directly. My e-mail address is iaps-network@nikhef.nl .

My postal address is

Stephan Witoszynskyj
 Fachschaft Physik
 Technische Universitaet Wien,
 A-1040 Vienna, AUSTRIA

ICPS '97 in Vienna

by Olav Frijs (a-very-past secretary of IAPS)

It was a warm day in August, when our car took off for Vienna, where the ICPS '97 was held. Full of memories of the very successful ICPS conference in Szeged in 1996 we were very eagerly looking forward to this meeting of physics students from all over the world. Our Dutch delegation was very small this year, with only Ramon de Vries and me coming from Delft. Fortunately we were joined by the a-very-past president of IAPS, Bent Grøver (Norway), who was too late to arrange a cheap flight and therefore had to travel by boat to Holland and further together with us in what used to be last year's IAPS staff car. It must have been a great disappointment for him to find out that a mountain 1200 m high does not necessarily have to be rocky, barren and covered with snow. His demand of a lake or a fjord seemed equally hard to fulfil in the Bavarian Forest, where we camped.

As we drove into Vienna it started to rain, but this did not worry us at all. It was the same in Copenhagen and in Szeged and both weeks turned out to be successful and sunny. After some struggling with one-way streets we finally managed to locate the colourful building of the TU of Vienna, which seemed very quiet at first sight. Inside the ICPS-quarters it resembled more a hen house, with the organisers completely overworked and running



A moment of the National Party

around everywhere. Fortunately they had prepared well and with the help of the small maps we quickly found our hostel. In contrast with the one large concrete housing in Szeged, this year the participants were hosted in no less than 12 student and youth hostels spread over the whole Vienna area. It seemed that we were very lucky, being located quite close to the centre and within a reasonable distance of the university, only once to 'Bitte Umsteigen'. Some participants were less fortunate and had to change train two or three times before reaching their countryside hostel.

The first evening immediately faced us with the problem of finding a cheap place to eat, not such an easy task

in a city well-known to be horrendously expensive. We finally ended up in Artur and Artur, which seemed to be a fine and inexpensive place at first sight, but somehow it lacked one thing, namely a proper, large enough kitchen. When the size of our group started to grow exponentially, because all the participants who arrived were sent to this place, the waiting time for food quickly increased to more than two hours. This restaurant and its menu left us with one intriguing question, what are Preiselbeeren?

The next morning the conference started with a very interesting opening lecture and a presentation by Oscar, the president of IAPS. This presentation was absolutely the glossiest an IAPS president has ever given. The lectures given by the participants were as usual very varied. The subjects ranged from the very theoretical to 'humour in physics'. As varied as the subjects was also the number of the students attending the lectures, though a trend was very easily discovered. The lectures on Monday were well attended, the three lecture halls were filled, but on Wednesday I attended a lecture with only three more people. The reason for this shameful quietness was most probably Vienna.

The proximity of the centre of Vienna, combined with the hot sunny weather outside, worked like a magnet on most participants. Of course Vienna had something to offer, as the capital of the former Austrian-Hungarian Empire. Filled with monuments, palaces, museums, small squares and streets and a huge 'Dom', the city breathes a kind of special atmosphere, also because of the penetrating smell of horse urine, which makes you feel you are walking in the 19th century again. Of course the presence of many shops, terraces and green meadows in the parks and in the 'Prater' exerted a magnetic force on many participants.

The first evening is traditionally the moment for the opening party, which was held in a maze-like bar, called the 'Manchester Club'. Some parts of this club were more like a Finnish Sauna. The dance floor in the cellar was fine, providing you could find your way to it. After a very good party it became painfully clear just how far away the hostels could be and also how efficient the Vienna night bus system could be. I still wonder whether those two Russians ever made it to their hostel.

On Tuesday a 'National Party' was scheduled. This event, which was born as a funny song contest during the closing dinner of the ICPS '95 in Copenhagen, had become a tradition in Szeged. The idea is plain and simple: every country gets the chance to present itself by means of food and a performance, usually a song or an act.

The location was quite special this time, namely the canteen of the Österreichische Bundesbahn, somewhere in a questionable neighbourhood far out of the centre of Vienna. This canteen proved to be perfect for the large bazaar-like mess which was quickly created by all the

delegations. This evening skipping dinner was rewarded, because there was so much food and liquor available on all the tables that you could easily explode.

We, the Dutch delegation, decided to bring some food this year too, so before we left we took Bent Grøver into a Dutch supermarket. He pointed out all the stuff he did not know and which seemed very awful to him, so we ended up with real 'beschuit met muisjes' and 'advocaat',

a kind of an egg-liquor. To flush it all away we brought some real 'elfstedendrank' or Beerenburg, a Frysian herb liquor. We did not see anyone vomiting and we even got some positive reactions about the 'muisjes' or mice, though I fear that the hostel's cleaning lady must have been shocked by all the "rat poison" and "mice shit" on the carpet of our room.

Besides loads of food and liquor the national performances were the highlights of the evening.

Of course the attention paid to the songs was a bit meagre at the beginning due to all the food distraction. Kjetil almost blew out the speakers with Grieg's Peer Gynt suite before he got some attention and the small delegations were completely helpless against the eating and drinking crowd.

This situation demanded experts on mass celebrations and the British were happy to fulfil this difficult task. With their small dancing course, which ended up in everyone dancing a Viennese Waltz, they certainly got the attention back.

The whole evening carried on in a rather messy but enjoyable way with some people singing something unintelligible up front and people walking and talking all over the large hall. This evening was concluded with a disco for the people who could still walk, which lasted till sunrise. I guess it is no surprise that there were only very very few people attending breakfast the next morning.

Wednesday certainly showed a historical dip in the attendance of lectures and especially the poster session in the afternoon had better been given in the centre of Vienna. Those who did dare to defy the pull of Vienna were rewarded with some very

interesting lectures and posters, though the one completely in Cyrillic characters was a bit too far out. During the afternoon it was also possible to visit some laboratories.

Dinner this evening was more like a working dinner. Enjoying good Viennese food and fine beer in a beer restaurant just around the corner, the IAPS Executive Committee discussed its strategy to find new people to run IAPS. The diplomatic hunting season was opened. When this meeting was finished Stephan, the main organiser of the conference,

took us on a guided tour around Vienna by night. I didn't realise that there were so many corners, so many squares, so many buildings with a story and so many stories in Vienna. Even though half the group walked on its last feet and only kept standing by leaning on each other or the wall, Stephan always happily announced 'something very interesting' around the corner, on our ever-lasting tour to the always close-by terrace with beer. Fortunately the tour was very interesting, otherwise a lynching was not to be excluded when the promised terraces with cold drinks appeared to be closed already. It is still a mystery to us how Stephan could still be running around so lively, though he had probably not slept more than three hours per night. He could earn a lot of money with his secret recipe.

The next day was one full of IAPS diplomacy for some people, for others it was the day of the excursion to



A memorable moment of the GM: Oscar receives a tie for his work in IAPS



Multinational dinner

the nuclear reactor. The organisers discovered that it is not easy to handle a group that big in one Viennese bus. That evening the film 'The Third Man' was shown, which featured in Vienna just after the Second World War. In this film we could recognise all the places we had seen in Vienna.

Friday was IAPS day, the day of the general meeting. For the Central Office this was stressing. A lot of things still had to be finished and sorted out, so they locked themselves in the most secret place of the university, the headquarters of the organising committee, called the 'Fachschaftsraum' in German. Here Oscar started his fight with a German version of MS Word and it was here that IAPS really seemed a professionally managed organisation.

The General Meeting was as usual a very long event and for some people very tedious event, but it's part of the game. IAPS has to be run somehow and this is the only occasion to get some things sorted out, like the elec-



It is difficult, isn't it?

tion of new IAPS representatives. This may seem a minor point on the agenda, but days of heavy diplomacy have preceded this simple election. The old CO and EC members had to spend quite some time in bars, cafeterias, corridors, youth hostels and (not to be forgotten) restaurants and discos, to find and persuade new candidates. It is probably one of the greatest miracles of the 20th century how each year new candidates are found.

After this long meeting it was again party time. We set off for the Manchester Club again to enjoy the closing party. The organisation provided some food, which was eagerly consumed before the party really took off. During this party the Danes did their best to confirm all prejudices. They could be found sitting at a long table behind large glasses always filled with beer, singing their songs. Their repertoire had been adapted to the International audience, though a lot of Danish songs were still in it.

The dance floor was again heavily used. A closing party is always a bit of a good-bye evening, which gives it a minor sad undertone, a goodbye to all those new and nice friends, who you will probably not meet again or only in one year's time. An evening with mixed feelings, but an evening to forget all the rest of the world. On such an evening it seems that physicists can always get along.



The ICPS Organisers' meeting

The next morning, Saturday, was the last breakfast and for most people this meant the end of the conference and the start of a free day in Vienna. At the same time a meeting was called for the ICPS organisers. During this four-hour meeting a lot of advice was exchanged and given to the new organisers. With this advice and their enthusiasm the next ICPS in Coimbra Portugal, can't be anything short of a big success. Also at the same time the transfer of the Central Office took place in the Fachschaftsraum. Here the old CO spent hours explaining to the new CO what to do the next year. Considering the fairly short time for this vital task, it is an absolute miracle that each new CO seems to be able to keep the organisation running.

After all these meetings and hard work it was finally time to relax for them too. Stephan knew a nice place, a village near Vienna, where a wine festival took place. This festival, which could be described as a fair with silly musicians running around, was at the honour of the fresh grape harvest. The idea was to visit a 'heurigen', a kind of wine restaurant, and to enjoy one or more good glasses of wine out there. What was intended to be a small-scale operation turned out to be one of the largest events of the conference. All the participants followed Stephan as meek sheep, though the conference was officially over. Of course this was no problem at all and I think everyone enjoyed the wine and the food.

Afterwards a small group went to an area in the first district of Vienna, which many participants had visited before: the so-called 'Bermuda Triangle', a kind of bar and disco stronghold, in which people tend to get lost. Next year I will probably find out who, among the people present there, managed to escape from it unharmed.

The next day we had to drive back to Holland, but only after a long good-bye session at the university and a small detour. Bent, who drove with us to Vienna, had been visiting an old study friend of his the day before and he had to be picked up first. This friend was a real aristocrat and lived in a not-too-small castle north of Vienna. This gave us the opportunity to see some of the Austrian countryside and to have coffee in the courtyard of a real castle. At 6 o'clock we finally left Austria to start with our long ride over dark 'Autobahne' back to Delft, looking back on a perfect week and promising ourselves to come to Coimbra next summer...

ICPS '98

In the ICPS '97 in Vienna we submitted our proposal to organise the **ICPS '98 in Coimbra, Portugal, from 9 to 16 of August**.

It all began when a group of physics students from the University of Coimbra realised the importance of a conference like this and decided to go ahead with it. So, here we are. We are aware of the problems that a conference like this will bring. However we wish to do so, because the ICPS '98 is a very important event to the university scientific community and will bring to our country physics students from all over the world giving a new impetus to our university and to all the people involved. You may ask why we think that ICPS '98 should take place in Portugal and specially in Coimbra city. Well, Portugal is not only an interesting country to visit with its warm weather and friendly people, but also because in 1998 Portugal will be the centre of the world due to the universal exposition in Lisbon, Expo '98. The Expo '98 will be the last universal exposition of the 20th century and there are expected more than 8 million visitors with the participation of more than 100 countries. The main theme of this exposition is "The Oceans, A Heritage For The Future", and the Expo '98 will be the international Forum for the exchange of all essential information for decision making concerning the management of our common ocean heritage. The Expo '98 Oceanarium will be the largest in Europe and second largest in the world. We plan to book for the participants a full day visit to the Expo '98. Coimbra holds centuries of history (more than 2000 years) that lie under a fine mantle of huddled white houses intersected by endless winding streets, steppers, arches and lanes which decorate its beautiful centuries-old upper town. This town has the oldest university of Portugal, more than 700 years old. Over the centuries, the university has been the seat of the passionate pursuit of beauty and wisdom. The surrounding white houses serve as its throne. The Mondego river is the royal mirror and Coimbra, renowned and ancient as always had, the university so dear to its heart.



Entering by the "Férrea" gateway, the participants will feel the emotion as well admiration for the magnificent sequence of architectural splendour. The high reaching tower stands as a symbol of the university and of the city itself. You can also visit the old and the new cathedrals and admire their different styles that were a characteristic of the times of their construction. Besides the beautiful monuments and architecture of the ancient buildings, Coimbra is a town turned to the students that are more than 20000, and has a unique academic life that can be shown by the traditional suits, the parties made when the freshmen arrive, the unforgettable academic weeks in November and May, the bars and cafés that are open until late at night and many other night amusements. The Physics Department of the University of Coimbra has 14 research groups organised in 4 centres. The centres and the respective groups are: Study of Materials by X-Ray Diffraction Centre, Radiation and Material Physics Centre, Instrumentation Centre and Theoretical Physics Centre. The Physics Department of the University of Coimbra has a very large prestige in Europe due to the scientific interchange with the most famous European scientific centres. We have already prepared a preliminary programme that includes scientific and cultural visits, lectures given by the students and by invited scientists. In the scientific lectures we will try to aboard recent subjects such as Nuclear Fusion, Microelectronics, Biomedicine, and other interesting themes. The first contacts to different sponsors have already been made and the answers have been quite encouraging. To participate in the conference the participants have to pay a fee that will cost 100 US Dollars. The conference fee includes meals, lodging, trips to all visits, and all conference materials. We hope you will come and we will do the best we can to make that week amusing and useful for your future as physics students or scientists.

The Organizing Committee

You can find the pre-registration form and up-to-date information at the ICPS '98 homepage:

<http://www.fis.uc.pt/~icps98/>, or you can write to the organisers at icps98@nautilus.fis.uc.pt

Pre-registration deadline: May 29, 1998

Learning Physics in Greece

In this article one can read how students learn physics in Greece: the topics that are covered on each educational level, the priorities that teachers usually give when teaching at different classes and how students feel about physics throughout their academic route. Some supplementary information is given about the structure of the Greek educational system so as to help the readers to construct a more thorough picture of the way the things work in Greece.

Greek students have their first academic contact with physics at the last two classes of **primary school**—around the age of 10. The course at this stage is not pure physics, but an introduction to the natural sciences. For that reason apart from physics, chemistry and biology are being taught as well in the same class. These subjects are of course presented in the simplest possible way, so as to be easily grasped by the young students and as one may easily guess, do not involve mathematical or any other numerical calculations. The book, therefore, covers qualitatively the most important natural phenomena and explains roughly the rules and the laws that govern our world. I think that the heavy illustration and the interesting topics that the book covers, catches the children's attention from the very beginning, and very soon this introductory in physical science lesson becomes one of their favourite among all others!

Things, though, get more serious when students enter the **high school**: physics is now presented as a separate subject in a more systematic way. During this term students must become familiar with using the scalar as well as the vector quantities, which are introduced for the first time at school. Teachers at this point are also very conscious of showing how important it is in physics to use the proper units and convert all physical values from one measuring system to another when necessary. Also, to be descriptive and catch the classroom's attention, they sometimes perform simple experiments in the classroom and at the same time encourage the students to do some experimental work at home too.

The topics covered in the second and third class of high school (in the first year no physics is taught) have to do with mechanics, hydrodynamics, thermodynamics, reaction of materials under temperature change, some basic principles of geometric optics, oscillations, waves, electricity and electromagnetism, conductivity of materials and a few things about nuclear physics, all of them of course at an elementary level. The students have to deal for the first time with some problems as well, which involve only simple calculations and help them to put theory into practice.

When somebody reaches this point successfully is free either to stop attending school or go on with his studies for another three years, at lyceum. In Greece the lyceum may be the so-called "general" or a technical one. Those who have in mind to go to the university prefer the first one while the later is preferred by those who just want to be technicians.

In the general **lyceum** physics is approached in a more scientific way and mathematics begin to play a significant role. Students realise, maybe for the first time, that mathematics is a very useful tool in problems dealing with physics. The problems they are asked to face during this term are evidently more complicated and abstract (not plain applications of mathematical formulas) and aim at making students think critically. Theory covers the same topics as in high school, but is given, as I said before, from a different point of view. This first serious approach in physics is considered apparently the most difficult and demanding. Usually the students that cope successfully with this course at this stage have great prospects of becoming the future physicists.



Up to this point, as one may see priority, is given to theoretical work rather than to experimental and this basic concept, up to a point, will guide university studies, as well. In that way, Greek students, who have practised a lot in dealing with quite a wide range of theoretical problems, are stronger in thinking than in practising in the laboratory.

In the third class of lyceum, only those students that decide to study in university the natural sciences—or medicine—attend lessons in physics. By the end of this year those students that have decided to become physicists have to take the Panhellenic exams. This means that they will be examined on Physics, Mathematics, Chemistry and on writing an essay. The problems that they will be asked to face during this examination are totally unknown and within three hours they have to cope with it successfully! If they do fine, then they can enter one of the five universities in Greece with a department of physics: Capodistrian University of Athens, Aristotle University of Thessaloniki, University of Patras, of Ioannina or of Crete.

University studies on physics take four years in Greece. Of course this is the typical duration of studies, as it's indicated by the university curriculum. Practically, there are no limits to attendance. During the first two academic years great emphasis is put on mathematical courses which will be needed to a great extent in the next two years. Analysis of one and several variables, simple and multiple integrals, geometry, algebra, differential equations and functions of complex variables are the compulsory topics to be taught. Those who are interested of course in working on some more mathematical applications can simply choose some of the other optional subjects available (vector and tensor analysis, differential geometry, supplementary topics on complex functions, etc.).

The courses on physics during the first year are just the introduction to mechanics and thermodynamics. In the years that follow, some completely new topics are

introduced, while some others that are already familiar to every student are presented in a more sophisticated way (mechanics, electricity and magnetism, electromagnetism). For example, in the course of theoretical mechanics Newton's laws do not appear anywhere! Problems are dealt with using the Hamiltonian and Lagrangian principles. As the academic years pass the schedule undoubtedly becomes heavier and the topics turn out to be more complicated and advanced in level. Atomic and molecular physics, optics, quantum mechanics, electronics, astronomy-astrophysics, statistical physics, crystal structure-crystallography and environmental physics are some of the mandatory courses that must be attended by all students. As the semesters follow one another and the undergraduates gain more experience and knowledge, they can pick up some optional courses according to the field of specialisation they have chosen.

Fields of specialisation differ from university to university all over Greece but there are mainly five branches on physics over which one can work:

- Astronomy and astrophysics
- Atomic and radiation physics & elementary particle physics
- Solid state physics
- Electronics
- Environmental physics & applications of physics

Besides there are some extra lectures on chemistry, biology, medical physics and teaching of physics for those who do not want to get a specific orientation. Additional work in laboratories is done every semester over a different field: atomic-molecular physics, optics, electric circuits, electronics, structure of materials and radiation.

When students attend a sufficient number of lectures that is determined by the university curriculum they are ready to graduate and take their diploma. What follows next? It really depends on each student personally! One can go on with his studies for free (at no educational level is anybody forced to pay any fees) and even try to get a scholarship to earn money while studying. Every university in Greece with a department of physics has postgraduate courses on a M.Sc. or Ph.D. level in the five fields referred to above. It is also possible for a physicist to cooperate at the postgraduate level with another department (medicine, geology, school of engineering) according to his choice of field of specialisation. Besides all Greek universities collaborate with many foreign ones and if somebody so wishes then he has the opportunity to continue his studies abroad!

So this is the way the Greek students learn physics in Greece. We sincerely hope that the methods of teaching and the subjects of our science will continue to improve as the years go by and keep up with the international progress.

Eleni Katragkou
Aristotle University of Thessaloniki
Dept. of Physics IV



Editor's Note: The following article is written by Tom, who was a summer IAESTE-HAPS trainee this year. Eleni, the author of the previous article also spent her summer in Hungary via IAESTE-HAPS exchange.

The people mentioned in Tom's article are:

Zsófi: *Zsófia József* (sister of HAPS exchange coordinator); **Imre:** *Imre Major* (brother of the HAPS President); **Barbara:** *Barbara Fehér* (you know her from ICPS '97); **'... and their family and friends':** the other IAESTE-HAPS trainees and *Edit József* (HAPS exchange coordinator), her mother and brother and the HAPS President).

A summer's research experience in Budapest

In the summer of 1997 I was fortunate to be nominated by IAESTE, the International Association for the Exchange of Students for Technical Experience, for an eight-week work placement in Hungary. I am now in my fourth and final year at the University of Durham, UK, where I am studying for a Master of Science degree in physics. From mid-July to the end of September 1997, I worked at the Research Institute for Materials Science (ATKI) in Budapest.

I chose to travel to Hungary by Eurolines coach, as I wanted to see the different countries en route. On arrival at the Erzsébet tér bus station in Budapest, I was met by two Hungarian students associated with IAESTE (they were the relatives of the HAPS organisers – *the Editor*), Zsófi and Imre; and Heiko Hasckhe, a German IAESTE student. They all spoke very good English, and I was glad because I only knew a few words in Hungarian! To help me find them, Imre was holding up a sign with my name on. I was very pleased to be met by somebody, because before leaving home I did not know where I would be living in Budapest. Another time, I think it would be a good idea to have the address of my accommodation, and a contact telephone number.

After a short walk by the Danube, we went to Déli pályaudvar to meet Hrvoje Mestric, a Croatian IAESTE student. We were then shown to our accommodation by Zsófi and Imre.

Whilst I was in Budapest I lived in the Kőrösi Csoma Sándor Kollégium on Dayka Gábor street in the eleventh district. From mid-July to the end of August, I had a room on the 10th floor in building A. For the first four weeks I shared this room with Hrvoje. In September the students returned for the semester, and I moved to a room in building B, which was slightly more luxurious than the first one as it had a balcony and en suite bathroom! The accommodation was quite basic, especially the first room, but very cheap. It soon got to feel like home. I think the main thing which would have improved the accommodation would have been a refrigerator; as it was there was nowhere to store perishable food.

On the morning after I arrived, I was introduced to Barbara, who spoke excellent English and German, and together we went into Budapest to arrange student identity cards, money and travel passes. Hrvoje was introduced to his supervisor, then in the afternoon Zsófi showed me the way to my workplace, the Central Research Institute for Physics (KFKI).

Travelling from my accommodation to my workplace involved three separate bus journeys, and took nearly an hour. KFKI is situated in the hills in the western outskirts of Budapest. It is a large site, comprising several different research institutes, one of which is ATKI. In spite of the long journey to work, I think I was very lucky with the position of my accommodation in relation to my workplace. Given the size of Budapest, I could not have expected to live much closer to both KFKI and the centre of town, and at such a low cost!

On my first day at work, my supervisor, Dr. Gábor Pető, showed me around the Institute, including the library and restaurants, and gave me a list of possible tasks to keep me occupied during my stay. We discussed the sort of work I might do; the main area of study was to be the pulsed laser deposition of thin films. To begin with, the work was a little daunting, as I did not know exactly what was required of me. However, as I read more about the subject, I began to get some ideas for an experimental

project. My supervisor was very keen that I should decide for myself what work to do; it was his philosophy to allow the members of his research group to do what they wanted, and if they had any good ideas, to develop them. This was for me a very good introduction to scientific research.

On weekday evenings I met up with the other IAESTE physics students, Heiko, Hrvoje and Gabrijela Zakarias, and we either went to the restaurant bar in our hostel, or went to a pub in the town. At the weekends we explored Budapest, visiting the Castle Hill, and walking in the hills between the TV tower and the Erzsébet kilátó. On one occasion we met up with Zsófi and Barbara and their family and friends, and we travelled on the HÉV to Szentendre. Another time we went to the caves at Aggtelek, a trip which was organised by Ádám, a PhD student who studies at the ELTE university.

After four weeks Hrvoje's placement ended. I had a two week holiday from work. On the first weekend, Heiko and I went to the Hungarian Grand Prix. I visited Bratislava, then a friend came over from England and together we travelled to Kosice in eastern Slovakia. On August 20th I watched the fireworks on the Gellért Hill with Zsófi and her family.

After my holiday I was able to start some experimental work. With assistance from Zoltán, a PhD student working at ATKI, I made some thin nickel and tungsten films using the method of pulsed laser deposition, and investigated their thickness profiles. Towards the end of my placement, I gave a seminar to other members of the Institute, and wrote a report which will be used as the basis for a publication.

At the weekends in the second half of my placement I did quite a lot of travelling. On one occasion a Syrian IAESTE student, Hassan Houssan, came up to Budapest from Szeged, and I was able to show him around. On other occasions I visited Hrvoje in Zagreb, Hassan in Szeged, and Gabrijela in Belgrade. I was impressed by how cheap and easy it was to travel around in Eastern Europe.

While I was in Budapest, I earned

8000 HUF per week. This would have been enough to live on had I stayed in the city the whole time. As it was I travelled around and visited places, and spent much more than this!

One of the strangest things about spending the summer in Hungary was that I only spoke to one native English speaker in twelve weeks. When I first arrived, I knew hardly any Hungarian, and it was quite bewildering not being able to read or to understand what people were saying. I was quite dependent on Zsófi and Barbara to interpret for me. However, I found that many people could speak a little English or German, and I soon learnt enough in Hungarian to be able to ask for food and train tickets! At work I spoke either English or German. Most of the research workers and PhD students at ATKI were quite good at English, and communicating was easy.

After twelve weeks I felt quite secure in my life and work in Budapest. I had made many new friends, learnt some physics, and was having a good time. Much of this was due to the expert guidance of my supervisor and the excellent hospitality of the people I met. I enjoyed my time in Hungary very much.

From an academic point of view, the placement at ATKI was extremely useful. It gave me a feel for scientific research, was good practice for the fourth year of my degree, and confirmed that for me a postgraduate degree is the next step. Living and working in Hungary elevated the placement onto a higher plane. To get to know another country – its people, culture and history, simply by being a part of it for twelve weeks is a very exciting and rewarding experience.

I would like to thank IAESTE UK for helping me to obtain this placement, my supervisor and co-workers at ATKI, and everyone from the Hungarian Physics Students' Association (HAPS) who did so much to make my stay enjoyable. I would recommend an IAESTE placement to any penultimate-year science or engineering student, as it is the ideal way to combine work experience with getting to know another country.

*Thomas Moore, Durham,
November 1997*

Houston, we have a problem!

by Miguel Carrión

Problems worthy of attack
 Prove their worth by hitting back
 —Piet Hein

This is the third instalment of JiAPS' problem section, and we are yet to receive a contribution from the readers. A problem section is for the readers to send in solutions and more problems, so without your participation there's no point in me going on with it.

The layout of this section is simple: first a list of proposed problems is given, and then come the solutions (hopefully yours!) to some of the problems from previous issues. No problem is ever closed. Even after a solution has been published, if a different solution, an extension, or a comment is received, it will of course be published. You will notice I have removed problem #2 without giving a solution, as it didn't seem to have one. But let us get to the point.

The Problems

Problem #5: It is well known that an electric dipole in a uniform electric field experiences a torque tending to orient the dipole parallel to the field. For a neutral object without a permanent dipole moment, a non-uniform field gives rise to a net force. Prove or disprove the conjecture that a neutral conducting object in a uniform electric field will in general experience a torque. [Hint: a spherical object obviously experiences no torque]

Problem #6: Christiaan Huygens, the inventor of the pendulum clock, first observed the phenomenon known as 'entrainment' or 'phase locking', which can be described as follows. Two different clocks, having minute differences in length and mass of their bobs, would oscillate freely at slightly different frequencies and therefore develop a phase difference even if they started oscillating in phase. However, if those two clocks were mounted on the same wall, they would end up oscillating synchronously despite the difference in natural frequencies. Modelling the penduli by harmonic oscillators, though, this behaviour is not recovered. There are two fundamental modes and the general motion shows beats in the amplitude of oscillation but no phase locking. It seems that non-linearity in the pendulum equation (and possibly damping as well) is essential to Huygens' discovery. What may or may not be essential is the fact that a clock is maintained by an escarpment, i.e. that it is a forced oscillator. After all, the escarpment is only necessary to compensate for damping.

Now for the problem: write a simple model of two weakly-coupled non-linear oscillators (e.g. obeying the simple pendulum equation) and explain how Huygens' 'phase locking' arises, possibly giving conditions the natural frequencies must satisfy for the phenomenon to arise. [Note: this should be an exceedingly difficult problem to solve with more than 'hand-waving' arguments, but that's precisely the point]

Problem #7: Consider a shallow canal filled with water to height h_0 . A step-shaped wave front of height Δh moves with constant velocity. How does the velocity depend on the heights? What happens if a second step of height δh moves on top of the first?

Problem #8: A simple model for a quantum dot —see the article 'Artificial Atoms' by Jorg Jansen in issue 3— is a pillbox-shaped potential well of 'depth' V_0 (the ionisation energy). Does this 'artificial atom' possess infinitely many bound states? What conditions need to be imposed on the dot dimensions (diameter and thickness) for all the bound states to be two-dimensional?

Problem #9: A solid limited by a paraboloid of revolution and a plane normal to its axis is dropped on a denser fluid. Find the equilibrium position(s) and study their stability for all possible height-to-diameter ratios. [Note: this problem was completely solved by Archimedes (287-212 BC) using geometrical methods and without calculus! Think about *that* when you solve it.]

Problem #10: Consider the following simple model of a 1D atom with two electrons:

$$\hat{H} = -\frac{1}{2} \left(\frac{\partial^2}{\partial x_1^2} + \frac{\partial^2}{\partial x_2^2} \right) - Z (\delta(x_1) + \delta(x_2)) + \delta(x_2 - x_1),$$

with $Z > 0$. Find a stronger condition on Z so that there are bound states.

The Solutions

Problem #3: A disc of radius R moves in a perfect, incompressible, irrotational fluid with velocity v_0 . Calculate the lift force perpendicular to the direction of motion. This is a two-dimensional problem; if you wish, you can picture a very long cylinder moving in the fluid perpendicularly to its axis, and calculate the lift force per unit length. [Hint: that the fluid is irrotational does not mean that the circulation of the fluid around the disc vanishes]

Solution

Since the disc moves at constant velocity, we can solve the problem in the frame in which the disc is at rest. In that frame, the fluid moves with velocity $-v_0$ at large distances.

The lift force is due to pressure: the force on the disc is given by $\vec{F} = - \int_{\Gamma} d\vec{n} p$, where the integral is taken over the perimeter of the disc, \vec{n} is the outward-pointing normal and p is the pressure. To find the pressure, we just use the equation of motion $\partial_t \vec{v} + (1/2)\nabla v^2 + (\nabla \wedge \vec{v}) \wedge \vec{v} = -(1/\rho)\nabla p$ (if this is new to you, try to prove that it is equivalent to $\frac{d(\rho\vec{v})}{dt} = -\nabla p + f_{ext}$ if the fluid is incompressible). For stationary, irrotational flow, this reduces to $p = p_0 - (1/2)\rho v^2$. Thus, all we have to do is find the velocity field around the disc.

The equation of continuity (which expresses fluid conservation) is $\partial_t \rho + \nabla(\rho\vec{v}) = 0$. Since the fluid is incompressible, ρ is constant and the equation reduces to $\nabla\vec{v} = 0$. The fluid being irrotational, $\nabla \wedge \vec{v} = 0$. Together, these equations imply that \vec{v} can be derived from a harmonic potential: $v = \nabla\phi$ and $\nabla^2\phi = 0$. The boundary conditions are: that $\vec{v} \rightarrow -\vec{v}_0$ at large distances; and that the normal component of the velocity at the perimeter of the disc vanishes: $\partial_r\phi|_{r=R} = 0$, which suggests the use of polar coordinates centered at the centre of the disc. We will find the most general \vec{v} satisfying these conditions.

We can choose the OX axis parallel to \vec{v}_0 , in which case $\phi \rightarrow -v_0x = -v_0r \cos\theta$ at large distances. Since we have a constraint on $\partial_r\phi$, we try a solution of the form $\phi = -v_0f(r) \cos\theta$. In polar coordinates $\nabla^2\phi = \partial_r^2 + (1/r)\partial_r + (1/r^2)\partial_\theta^2$, so $\nabla^2\phi$ implies

$$-v_0 \cos\theta \left[f''(r) + \frac{1}{r}f'(r) - \frac{1}{r^2}f(r) \right] = 0.$$

Trying $f(r) \propto r^n$ as a solution yields $n = \pm 1$, so we have $\phi = -v_0(ar + (b/r)) \cos\theta$. The boundary conditions are satisfied by $a = 1$ and $b = R^2$. The resulting velocity field is

$$\vec{v} = -v_0 \left(1 - \frac{R^2}{r^2} \right) \cos\theta \vec{e}_r + v_0 \left(1 + \frac{R^2}{r^2} \right) \sin\theta \vec{e}_\theta.$$

By the linearity of the equations we can still add a solution in which the velocity field circles around the disc and decays to zero at infinity, since it does not contribute to the boundary conditions. We use $\vec{v} = g(r)\vec{e}_\theta$ as a trial solution. Using $\nabla = (\partial_r + (1/r))\vec{e}_r + (1/r)\partial_\theta\vec{e}_\theta$, we see that this solution trivially satisfies $\nabla\vec{v} = 0$. On the other hand, $\nabla \wedge \vec{v} = (\partial_r + (1/r))g(r) = 0$ implies $g(r) \propto 1/r$. It's then possible to have a solution with non-vanishing circulation (the solution with $g(r) = a/r$ has circulation equal to $2\pi a$) even though the fluid is irrotational. We now make $g(r) = C/2\pi r$, and add the resulting velocity field to the one we found before. This yields

$$\vec{v} = -v_0 \left(1 - \frac{R^2}{r^2} \right) \cos\theta \vec{e}_r + \left[v_0 \left(1 + \frac{R^2}{r^2} \right) \sin\theta + \frac{C}{2\pi r} \right] \vec{e}_\theta$$

for the velocity field.

We now recall the formulae $\vec{F} = - \int_{\Gamma} d\vec{n} p$, and $p = p_0 - (1/2)\rho v^2$. The integral must be calculated at $r = R$, with $\vec{n} = \vec{e}_r$ and, since $\vec{v}(R, \theta) = [2v_0 \sin\theta + (C/2\pi R)]\vec{e}_\theta$, we have

$$\vec{F} = \frac{\rho}{2} \int_{-\pi}^{\pi} d\theta (\cos\theta \vec{e}_x + \sin\theta \vec{e}_y) \left[4v_0^2 \sin^2\theta + \frac{2Cv_0}{\pi R} \sin\theta + \left(\frac{C}{2\pi R} \right)^2 \right].$$

Taking into account the symmetries of the integrand, the only surviving term is

$$\vec{F} = (\rho C v_0 / \pi R) \vec{e}_y \int_{-\pi}^{\pi} \pi \sin^2\theta = \frac{\rho C v_0}{2R} \vec{e}_y.$$

[Note: this problem can be hacked to death using the theory of functions of a complex variable using a complex velocity potential, and that is precisely what aeronautical engineers do to calculate the lift force produced by a wing. They then use a suitable conformal transformation to take the disc into the profile of a wing, the circulation being fixed by the requirement that the field be continuous.]

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