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This month's cover picture is of the Cone Nebula which is part of an enormous cloud of hydrogen and tiny solid particles in the constellation of Monoceros. Within and around this cloud are many recently formed stars, some completely hidden within the dense interstellar matter. They can be detected by special infrared techniques which are able to penetrate the obscuration. The largest of the dust clouds is the curious straight-sided feature which gives this object its name. The photograph was taken and submitted by Dr. David Malin of the Anglo-Australian Observatory.

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Optimistic Millenium?

The review of ASTEC which is currently underway seems particularly timely. I know that many members of the Institute were very disturbed by the comments attributed to the Institute of Physics in the Australian Senate's report on the chair of ASTEC, Professor Birt, concerning the role of research in the modern Australian university. Along with others I have been upset by the emphasis on social science in what used to be the government's key source of advice on policy in the hard sciences.

Nevertheless ASTEC still has powerful potential for good. On the positive side Professor Birt has acknowledged the need for ASTEC's advice to result in action. Too many past reports have simply been filed unheeded. In addition, there has been no other body which could deal with the question of major facilities. Agriculture and astronomy aside, over the past thirty years science in Australia has been characterised by an almost total lack of investment in major facilities. No other country with our level of development is as poverty stricken in this area. Since physics on the international scene is a major user of large facilities, this is one of the reasons why our discipline has struggled.

The DFG, Germany's main source of funding for basic research, has a regular budget line for major facilities - this year almost a billion marks. To the best of my knowledge we have never had such a line as a recurrent item in any budget! In this light the recent ASTEC report on major facilities breaks new ground. It suggests that for the next 10 years Australia should commit 20 to 30 million dollars per annum for new major facilities. Inadequate though the figure may seem in comparison with European, Japanese or North American models, it is a step in the right direction. The coincidence with one of the major recommendations in our Strategic Plan is extremely important and must be strenuously pursued.

Science policy in this country will have no claim to maturity until: at least $1.5 million (1992) is committed to building major national facilities as a recurrent budget item; the choice of which facilities to build is based on considerations of national interest together with international peer review of all proposals. I am enough of an optimist to expect to see this happen in this millennium.

A. W. Thomas
Newcastle Mater Misericordiae Hospital

CHIEF PHYSICIST

Department of Radiation Oncology

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Enquiries to: Dr. J. W. Denham
Director, Department of Radiation Oncology
Newcastle Mater Misericordiae Hospital
Telephone (049) 21 1177

or

Dr. R. K. Porter
Director of Medical Services
Newcastle Mater Misericordiae Hospital
Telephone (049) 21 1266

Applications should be forwarded to:
The Chief Executive Officer
Newcastle Mater Misericordiae Hospital
Edith Street, Waratah NSW 2298 Australia

before closing date of 24th July 1992

Please mark application “Chief Physicist”

EDITORIAL

Aspects of Deep Depression

I spent a very depressing week in Canberra recently going through ARC applications prior to setting out on the interview round for 1992. The depression has its usual cause - a large number of very highly rated projects, a budget which has not grown in 1992 and the prospect of a success rate for initial applicants of less than 20%. Last year the overall success rate for initial applications was close to 25%. This year it is less than 20%, but the budget is the same. What is the reason for the difference?

There are actually two reasons. In general terms the success rate in 1991 was probably more like 23% until the Government did its supplementation exercise and found about $4M which it gave to the Large Grant Scheme and which in turn raised the success rate to 29%. Thus a major contribution in 1991 was an unexpected windfall. This windfall will not occur in 1992 because interest rates and inflation, both of which contribute to the supplementation, are very low. Indeed it may well be that the supplementation for 1992 will be zero.

Secondly, for 1992 there has been an 18% increase in the number of initial applications and that figure translates to a decrease in the success rate of about 5% ie. we are down very quickly to a 20% likely success rate. Taking account of the ongoing commitments arising from the increased number of three year contracts, one-line, indicatively funded grants and the ARC policy of maintaining the average grant one has a success rate likely to be a little under 20%.

In physics, in particular, and also in mathematics, the increase in initial applications has not been as high as in other disciplines such as biological sciences or the social sciences. The quality of the applications as assessed by the referees’ reports is very high, so the net result is likely to be a lot of very good proposals will go unfunded for 1993. The fact that the physics, mathematics and chemistry proposals are almost all very highly rated is probably also indicative of a problem in our discipline. The physics, mathematics and chemistry proposals have the highest proportion of rankings in the top 5% or top 10% categories of all disciplines.

Some of our colleagues in other disciplines suggest that this might be due to a worldwide collective thought which rates our proposals more easily (and hence higher) than in other areas. I do not accept this. I believe that what we are seeing is a discipline in which those whose proposals were good, have time after time not reached assessor-levels which provide funding, are becoming disheartened and withdrawing from the competition.

In a discipline where student numbers are not growing as fast as in others, there is little in the way of new staff, those who withdraw leave behind a group of very good researchers who have obtained funding. Thus, by elimination we arrive at a set of highly ranked proposals.

Unfortunately, the withdrawal of those good, but unfunded researchers, affects the total funding to the discipline panel. Currently, the algorithm for distributing funding between panels includes a factor relating to the proportion of initial applications submitted to the panel. A smaller growth for physics means a lesser proportion of the funds. This will show up more obviously in a situation of constant funding.

What can we do to rescue the situation? Certainly we must continue to submit proposals whether we are successful for 1993 or not. We must continue to seek increased funding to the ARC and hence, the discipline panel. We must continue to seek grants to tide our unfortunate colleagues over a hard time if they miss funding in any one year. We must work hard to encourage growth in our student numbers. We must provide the maximum support for our younger and newer colleagues joining our staff, to allow them to establish their research identity. And I guess we have to hope.

R. J. MacDonald
Accreditation and all that: a message from the Registrar

Dear Editor,

Council of the Institute at its February meeting, decided to implement a scheme of accreditation of courses. All Departments in Tertiary Institutions offering a course which could lead to a qualification which could satisfy the requirements for Graduate Membership of the Institute are to be asked if they wish to nominate such courses for accreditation (or re-accreditation) by the Institute. Graduates of courses granted accreditation would be automatically eligible for Graduate Membership.

The rationale for this decision is related to the establishment of the Unified National System and also to the development of Competency Based Assessment by bodies such as the National Training Board and the National Office for Overseas Skills Recognition. Many other Professional Societies have accreditation procedures of the type now envisaged for the Institute: without such procedures, the Institute is in danger of being unable to claim justifiably to be the peak society for the discipline of Physics in Australia. Failure to implement our own procedures could lead to other bodies establishing competency criteria for our subject.

It is not anticipated that difficulties with granting accreditation will often occur as it is the Institute’s impression that most, if not all, Physics courses are entirely adequate. Nevertheless, it may be that the accreditation procedure will serve a useful purpose in ensuring a degree of comparability between Physics courses in Australia and may be valuable in establishing areas where facilities are not being adequately financed by the parent University.

Following the decision of Council, State Branches were invited to nominate representatives on the Accreditation Committee. The members of this committee, which includes the existing membership committee as a nucleus, are listed here. It is intended to establish the criteria for accreditation at the first full meeting of the Accreditation Committee and to determine the detailed procedures for examining a proposal from a department. It is anticipated that the procedure will involve the assessment of documentation from the department followed by a site visit, usually by three members of the committee. A report would then be prepared for the Institute and the department by the Accreditation Committee.

Accreditation Committee 1992
Registrar: R. Leckey (La Trobe)

Membership committee members
A. Moodie (CSIRO I RMIT)
D. Booth (VUT-Footscray)
J. Cashion (Monash)

NSW J. Bell (UTS)
ACT H. Bacher (ANU)
SA I. Prescott
WA S. Crisp UWA
Qld D.T. Peggs (Griffith)
Tas M. Duldig (CSIRO)
(alt L.E. Humble (U. Tas))

Fee Structure 1992

Members are particularly asked to notice the large reduction in fees for student members set by Council for 1992 and are asked to redouble their recruiting efforts.

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<td>Member</td>
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Membership Certificates

New members have recently been issued with redesigned membership certificates in a style similar to that now adopted for the information brochure/application form. The new certificates are of A4 size, and are suitable for framing. Members who may have mislaid their original certificates or who would like one in the new style, are asked to contact the secretariat (Clunies Ross House, 191 Royal Parade, Parkville 3052). A sample certificate has been sent to all Branch Secretaries with a request that it be displayed at the next appropriate meeting of the Branch.

Robert Leckey
La Trobe University

Global Warming

Dear Editor,

As a graduate student in Stuart Butler's department at Sydney University twenty years ago, I got my first introduction to the dangers of a little knowledge. Stuart regularly received manuscripts from well-meaning citizens on everything from perpetual motion to unified field theories. These were passed on to the graduate students for their edification and/or amusement. Having since switched my research interests to atmospheric radiation, I now find the wheel turning full circle.

The greenhouse effect - or more correctly global warming - is indeed a

Women in Physics

Dear Editor,

The cover photograph of the May issue of the Australian and New Zealand Physicist (coffee break at congress) was charming, except for one thing: it was a stark reminder of how few women are active in physics in Australia.

To help reduce this gender imbalance and to provide support and encouragement for women and girls interested in physics we have recently formed a group called Women In Physics, South Australia (though our members are as far flung as Jabiru, NT). The group is associated with the SA branch of the AIP.

Our primary aims are to increase the number of female physics students (secondary, tertiary and post-graduate), to have an input into physics and education policies, to maintain a database of women who will talk at schools and promote physics as an attractive career option for girls, and to encourage contact between women already in the field.

We currently have thirty members and a subcommittee is organising school holiday science excursions for Year 10 girls.

We would be glad to hear from interstate women physicists who wish to be informed of our activities, or who have already set up or intend to set up similar groups in their own states. For more information write to Anna Ralston, Department of Medical Physics, Royal Adelaide Hospital, North Terrace, Adelaide 5000.

Let's get more women into the picture!

Anna Ralston
Department of Medical Physics
Royal Adelaide Hospital

Judith Pollard
Department of Physics and Maths Physics
University of Adelaide

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Australian & New Zealand Physicist Volume 29, Number 7, July 1992
burning issue. Many people find it hard to believe that a gas which makes up only 350 parts per million of our atmosphere, and is essential for life, could at the same time constitute such a threat. This situation even extends to the scientifically literate, as the letter from Vivian Robinson attests. It would take several pages of the Physicist to properly address all his/her misconceptions, so I must confine myself to the most important.

Let’s start with the basics. Visible light covers the wavelength range 0.4 to 0.7 μm. Solar radiation actually covers a range from around 0.25 μm to 4.0μm. About 50% of this reaches the earth’s surface, with another 15% absorbed in the lower troposphere. The earth and its atmosphere re-radiate between wavelengths of 4.0 and 100 μm, with a peak around 10.0 μm.

The vast majority of this (terrestrial) radiation is absorbed in the lower layers of the atmosphere, by water vapour in its 6.3 μm vibration rotation band (between 5 and 8 μm) and its rotational band at around 20 μm and longer, plus the 15 μm band of CO₂. Water vapour is, in fact, the major absorber, although without the CO₂ the seas would be too cold for any evaporation.

An increase in atmospheric CO₂ leads to more absorption, and more radiation back to the surface. This will lead to increased evaporation, and hence a positive feedback due to increased absorption by water vapour. Some of this increased water vapour may condense onto the ice caps, it would then have been trapped under layers of falling snow. Centuries later, when scientists analysed the ice cores, they would have measured (much) higher CO₂ levels than normal, not lower.

Carbon dioxide is only one of the inputs required for plant growth, and is rarely the limiting factor. Some of the experiments which have been performed in Australian conditions in a doubled CO₂ atmosphere show that after an initial growth spurt, plants then struggle to achieve healthy growth. The so-called heat island effect is well appreciated by climatologists, and efforts are made to allow for it as best as possible. Unfortunately, most of the temperature records we have going back over the longest periods fall into this category. Nevertheless, other proxy data, such as that recently extracted from trees in Tasmania (Science, Vol. 253, page 1266) tend to support the notion of gradual warming in recent decades.

Recently, a spokesman for our engineering cousins claimed that the Government’s intention of achieving a 20% reduction in greenhouse gas emissions by 2005 was unattainable – probably because the answers were not in any of their textbooks. Here is the chance Physics has been looking for. We should tell the public, and the government, that we can meet this challenge; all they have to do is provide sufficient funding.

Michael Box
School of Physics
University of New South Wales

Sceptics Out-think Crays

Dear Editor,

Your correspondent, Vivian Robinson has cut through the complexity of climate change to give us an analysis that a child could understand. Unfortunately a child may also believe it. One wonders why climatologists spend millions of dollars on supercomputer time and monitoring, if reality is not only contrary to their results but also very easily arrived at.

So let’s examine the arguments that lead to the conclusion that an increase in CO₂ concentration is good for us.

Water vapour for a start, is not “lighter than air”, it is less dense, and it doesn’t just “rise until it cools and condenses producing clouds”. It is part of a non-linear dynamic system, and so acts in an unpredictable manner. In the process, clouds of various types are formed. The relationship between the planet’s albedo and the amount of water in the atmosphere is certainly not linear, and Polya’s expectation of increasing CO₂ leading to more clouds and subsequent cooling must owe more to a wish to burn fossil fuels than it does to scientific evidence.

While cumulus-type clouds produce the above mentioned negative feedback, cirrus and other high altitude clouds increase the greenhouse effect by producing a net reflection of radiation towards the planet. It is not currently known how increased temperature will affect either type of cloud. Are researchers wasting their time in attempting to determine relationships between temperature and cloud infrared emittances, or the dependence of cloud depth and ice liquid water paths on cloud microphysics? I think not.

While Robinson states that water is a “very effective greenhouse gas” she goes no further. I would have thought a positive feedback was suggested. Moreover, in proposing that the possible increase in CO₂ concentration is less than the natural variation of atmospheric water content, Robinson displays a apparent lack of appreciation of (a) the effects of small changes within nonlinear systems; and (b) the fact that the variations in water content are regional and temperature dependent, whereas the increase in CO₂ is global and currently accelerating.

A scenario is offered wherein past increase in CO₂ concentration is contingent upon temperature, rather than vice versa. This may be true. It may not. We are dealing with an extremely complicated interdependence, not a controlled experiment with two variables. Surely if it is true then we could be offered some other explanation of temperature variations. Perhaps the congruence of atmospheric methane and temperature found in the Vostok ice cores may be a clue.

There is not space here to consider the additive, synergistic, and counteractive physical and chemical atmospheric processes currently being investigated. Suffice it to say however, that Robinson’s analysis fails to even mention methane and other greenhouse gases (at least partly derived from fossil fuels) such as N₂O, CO₂ and tropospheric O₃. Also worthy of mention are: the stratospheric cooling and consequent tropospheric warming caused by CFCs (also greenhouse gases); disruption of the phytoplankton carbon sink due to increased UV radiation; and overloading of the troposphere’s - the hydroxyl radical.

Your correspondent’s faith in the stability of the “existing equilibrium” is...
Argumentum ad verecundium

Dear Editor,

Argumentum ad verecundium (the appeal to reverence), I am sad to report, is becoming ever more prevalent in today's society. The article by Duncan Steel, "Physics and the Assassination of JFK" (April 1992), is a classic example of such tactics. In order to sell Alvarez's conclusions about the Kennedy assassination we are subjected to an extensive list of Luis Alvarez's virtues and achievements in an attempt to establish an unquestionable reputation. I will grant that tales of Alvarez's inquiring mind and range of interests are of themselves fascinating, but they do not lend any support to the verity of the stated "head recoil theory". We are being asked to believe Alvarez's conclusions simply because he is Alvarez not because of well reasoned arguments. Unfortunately much of the article is devoted to reputation not to physics.

Albeit, we are offered some very good advice with respect to questions physicists should ask when attempting to arrive at the truth. First, "Do I know this? How do I know this? and is this still true?" Unfortunately, one of the most fundamental questions that should be asked and be stated explicitly is missing - that is, what assumptions have I made? When Alvarez's (Steel's) conclusions are subject to this line of inquiry, the "head recoil theory" may not be quite as scientific as it purports to be. For instance, let's consider some of the statements/conclusions made in the article and the assumptions which are made.

1 "... three masses are of consequence here - the bullet, Kennedy's head and an observed jet of brain matter." Are these really the only masses of consequence? Can we safely ignore the fact that Kennedy's head is attached to a much larger mass, his body, even if it is coupled through a somewhat flexible neck? Can we continue to ignore body mass, especially if we accept a later statement in the article which indicates that the "president's car decelerated just before the final (fatal) shot", presumably the chauffeur's response to the first two shots. This of course would cause the president's body to be projected forward relative to the car and presumably cause neck muscles to tighten, which would in all likelihood couple the head to the body in a much more rigid fashion. As well, it introduces a component of angular momentum to the whole equation.

2 "Alvarez tested his theoretical result by having bullets fired from a rifle (presumably the same as the murder weapon) at watermelons which had been tightly bound with glass fibre reinforced stick tape". Does the taped watermelon accurately model a human head? A skull is constructed of a roughly spherical shaped mass of dense bone. It is an extremely strong structure resisting shock, penetration and deformation. Evolution has seen it necessary to provide such a structure to protect the most vital organ - the brain. We are being asked to believe that the watermelon model would emulate this structure and exhibit similar behaviour with respect to the transfer of energy and momentum. I seriously doubt that it can be assumed that this is an appropriate head phantom for ballistic testing purposes, even without regard to a discussion of the comparability of their internal structures, i.e. the mass, contents and dynamics of a watermelon's interior relative to a human brain. The assumption that they are comparable is, of course, central to the "observed jet of brain matter" postulate.

3 What about the experimental conditions for the "watermelon" tests? Can we assume that the experimental conditions for these tests accurately emulated the conditions at the time of the assassination? That is, were the watermelons appropriately attached to a body to closely simulate human anatomy, were they travelling at an equivalent velocity to Kennedy's head, were they fired at a position that duplicated the actual geometry (above and behind), etc.? Were these factors even considered? This speaks to the difficulty and expensive to reproduce. The use of a "sticky taped watermelon" is suggestive of an experiment conducted at an elementary level, i.e. on the cheap. Even if we assume that a watermelon accurately models a human head there is still doubt about the faithfulness of the testing conditions.

4 "Six out of seven (p=0.857) melons recoiled towards the gun". Even if we accepted that this experiment could be used as a reliable model its outcome is still statistical in nature. Are the confidence levels high enough to use its outcome to so readily reject evidence which could support Kennedy being shot from the front? In fact, the nature of the findings suggests a reasonable probability that the opposite is the case. The common sense expectation for head direction can occur, hence allowing that being shot from either the front or the back could be consistent with experimental observations.

Without belabouring the point any further I think it can be seen from the >
above examples that if good physics is to be practised, then a thorough examination of the nature of the assumptions made is necessary.

Additionally, does the weight of a reputation necessarily mean that the expert will always be right when passing judgement on any given issue? Personally, I do not think that scientists (or any other expert for that matter), no matter how decorated, radiate truth only. I.e. in each and every instance truth must be established by a rigorous process of logic. Furthermore, as physicists, we cannot afford to use argumentation processes that bypass reasoned discussion (such as appeal to reverence) or preempt logical analysis by making assertions that pronounce sentences before the evidence has been heard, e.g. "half-baked conspiracy theories". The degree of rigour we use to establish the validity of our laboratory experiments should be used whenever we pass judgement on any issue, otherwise our credibility as objective observers is at stake.

Terry Coulter
Varian Australia Pty Ltd

TAFE and Technical Assistance

Dear Editor,

I was very pleased to read your thoughts on technical help in April's Australian and New Zealand Physicist. As far as I can recall this is the first time that TAFE and technical assistance have been mentioned in our journal.

Unfortunately your comments reveal a common misunderstanding of the present scope of TAFE activity. This is perhaps an indictment of those of us who work in TAFE and have not spread the message about TAFE and its products.

TAFE is not just about apprenticeships and trade training. While trade training remains an important function for TAFE, training of para-professional technicians has become as important, if not more important, in many of Australia's TAFE systems. These technicians, graduates of TAFE's associate diploma and advanced certificate courses, carry out functions which go well beyond the role of the skilled tradesperson. These technicians are found assisting professional scientists and engineers in all aspects of their work, including the important role of technical manager in the laboratory and in the field.

It is important that scientists recognize that these are not second-rate university graduates - instead they are people who have made a conscious decision to become first-rate technicians. If scientists do value the contributions of their technicians they should respond by employing more TAFE graduates rather than using technical positions for the training of young scientists. It is only in this way that we will change our culture to recognize the important role of sub-professional staff in science and technology.

Another way that we can recognize the importance of technicians in physics is to create an AIP membership category for technicians. Many other professional associations have already taken this forward-looking step.

Thank you for an interesting and stimulating journal.

Aidan O'Leary
Head, School of Applied Science
ACT Institute of TAFE

Commercial Reality

Dear Editor,

I have read with interest articles, one of which was by Dr Scott Butcher, ANZPP, February, 1992, dealing with Australia's inability to convert our wealth of inventive talent into commercial reality. As a physicist who invented a piece of equipment, formed an organisation to manufacture it in Australia and is now making a living from my own invention and commercial knowhow, I believe I know a little about the problems faced and offer the following by way of comment.

There is a lack of understanding by scientists of commercial reality, which will not be overcome by our current policy of telling our scientists to become more commercial. All that happens is that they go out and play the money game harder, without any greater knowledge of the rules. Scientists need to learn a little commercial reality. As an example, I use Dr Butcher's question of 'Are salesmen or economists expected to do the work of scientists?' A salesman selling science based equipment, is expected to answer most of the scientific type questions his potential customer may ask. If he can't, the customer will probably chuckle about him behind his back, or tell him to 'Come back when you know what you are talking about and don't waste my time'. A salesman does not have to know enough science to invent it, or even to service it, but he does have to know enough to sell it. If a salesman can learn a little science, a scientist can learn a little about sales. Dr Butcher's article, which I believe summarises scientists thinking indicates the nature of the problem. Scientists do not even know there is another side to the story and believe the commercial world should alter it's rules to fit their ideas.

A Government scientist once told me that "...was sick and tired of supporting Australian Industry," blissfully unaware that Australian Industry was responsible for the taxes which were necessary to pay his salary. Australian Industry, whilst not always the most efficient in the world, is never-the-less sufficiently profitable that it can pay it's way, with sufficient left over to support large government expenditure. By comparison, in a world of ever increasing technological innovations, most Australian scientists can't commercialise their research and are heavily dependent on government funding. Commercial reality is that industry must be doing a lot right and scientists something wrong. A common mistake made by scientists is to become too closely entangled in their science to appreciate commercial reality, seeing it as obeying some complex set of rules beyond their comprehension. But the rules are quite simple. For a product to have any chance of commercial reality, it needs to fulfill two criteria. It must do something that people want and it must do it in a better/cheaper combination than any alternative. Commercial reality is such that there are very few salesmen who can sell something that people don't want. (After all, would you buy something you didn't want? Also, would you buy anything if you knew you could get it for what you perceive to be a better/cheaper elsewhere?) They are the rules of commercial reality by which most industries flourish.

Commercialising research is 5% inspiration and 95% perspiration. For a project to come to fruition, someone must champion it through the 95% perspiration and the best person is the inventor. It would be fair to say that very few scientists are prepared to put in the large effort that is required to get a project from laboratory prototype to commercial reality, for a 33% share of royalties, which are only about 3% of sales. It is not much of a reward, when you consider that a scientist putting a similar effort into papers can obtain promotion and recognition. However, offering a scientist a more realistic share of the profits from his invention would give a great incentive. After all, if you have the choice of a career path which leads to a remuneration package of $75,000, or $200,000 plus, which would you choose? To help achieve that end, I would like to propose the following.

Australian & New Zealand Physicist Volume 29, Number 7, July 1992
LETTERS

1 Scientists be encouraged by their research organisation, to exchange their technical skills for equity in a joint venture between themselves and an appropriate commercial organisation. That way, a scientist knows he will receive a good financial reward if the project is successful, and none if it fails. When faced with such a loss, learning commercial reality becomes easy. But, if you will still receive a salary, even if you are unsuccessful, there is no reason to learn the intricacies of the commercial world.

2 In the absence of another suitable commercial partner, organisations such as Unisearch (UNSW) or Sirotech (CSIRO), should give thought to entering into a joint venture with the inventor, perhaps on a fifty-fifty basis. They receive considerable funds from consulting ventures undertaken by their staff and could use those to start a joint manufacturing venture. Once one venture has been successful, the money and skills raised would be useful for others. Both parties would receive shareholders dividends as and when the ventures are successful. That would give their staff considerable experience in the commercial world. For larger projects, the organisation could take a interest in the company working on the project, in return for work done by its staff, with the reward coming later, after it has been successful. (Demanding large up front fees, because you think a project is worth a fortune, will win a few good payments, but never as much as will be made from the continuing success of a project. It is the death knell of many projects and is not a good commercial practice.)

3 To allow time for that to be done, permanently tenured scientists in Commonwealth and State research organisations, should be given an allowance of say two years full time salary to exploit their commercial talents. That could be a Commonwealth entitlement concurrent to Sabbatical leave, but would not be available again once a scientist had used up his entitlement, even if he changed employment. During that time, he could work on the commercial exploitation of his idea, with an approved joint venture partner, receiving full salary. If he decided the project would not succeed, he could give a final report and revert to conventional duties, with no loss of seniority. If the project took off, he could leave the research organisation and work full time for the company of which he was a shareholder. It could be done part time as well, slowly changing from one employer to another.

4 If an organisation did not like the idea of allowing a scientist to do it on full salary, at least let them do it after hours. The scientist has the opportunity of making his own choice as to whether or not he wants to risk his own time, knowing that it will cost him nothing but a few hundred hours, yet could reward him with a large increase in income. Most people will opt for the extra work in return for a promise of extra money.

With just one successful project per year, the organisation would soon be shareholder in enterprises turning over millions of dollars per year, with profits ranging from 10% up. At some stage down the track, the joint venturers - the scientist and his organisation - can either keep their respective shareholdings, or buy the other out using normal commercial considerations. It would not be unrealistic to receive a return within a decade, of well over ten times the initial investment.

Such a system has a number of advantages:

a Researchers would be directly exposed to the commercial world, wherein if they were successful, they could make a lot of money. Top matriculation students are much more likely to apply for science careers, knowing they can earn big money if they are good enough, instead of trying for medicine, law, etc., which are already over subscribed with graduates. After all, remuneration packages of over $200,000 p.a., are quite achievable for even a minor success. That would be of benefit to the industrial base of the country.

b After a few successes, there will be a few people in industry who have commercial experience and would be able to give the correct advice to the younger scientists as to how to commercialise their research. Even those who had been unsuccessful, would be able to pass some of their experiences across to others and increase the commercial skills of the scientific community.

The problems associated with commercialising research are not all due to failures on the part of Government or Industry. If you believe you have an invention that is capable of being commercialised, write down what it can do that would make people want it; and why it can do it in a better/cheaper combination than anything else. Then take your scree to a scientist with commercial knowledge, there are a few commercial scientists and scientific entrepreneurs, and get them to read over your presentation. You never know, they may like your suggestion and help out.

If you don't know any, contact me on (02) 899 1444.

They would probably give you a good critique of why your presentation was not interesting and assist you in preparing something better. You should also prepare a realistic cost benefit analysis, giving an indication of the outlay required and the return expected. To do that, you need to know a little economics, but it is no more complicated than budgeting for a project, an experience to which all scientists are subjected. It is here that you have to be careful because many Australian scientists have been overly optimistic about the value of their technology and have "promised the world" in order to get a contract. When they were unable to deliver the goods, the project soured and a lot of money was lost. Companies are now wary about claims made by scientists. If you want your project to be commercialised, prepare that type of presentation and take it to someone with commercial skills. If it succeeds, well and good, if it doesn't, at least you will learn a little more about the commercial world.

In the scientific world, if you undertake a series of say 10 projects, getting 100% for 9 of them and nothing for the remaining one, you must be assessed as 90%. Commercial reality is that your commercial success would be zero. There is a skill to commercialising research, which is different from, but not inferior to scientific skills. After all, just look at the number of projects which have been well researched, but which have gone nowhere commercially because nobody knew how. The activities of the AIP and NZIP, and the contents of the ANZP, are almost exclusively devoted to pure science. There are no articles about how "so-and-so or such-and-such tried to commercialise their research", and an evaluation of why it did or didn't succeed. If you want to learn a little about the commercial world, you should at least make some effort to undertake some commercially oriented activities, and not just point the finger at others and say they need to change.

Vivian Robinson
ETP Semra Pty Ltd

FIX-on-PHYSICS
The Editorial Board requires short, illustrated articles for publication in our education supplement Fix-on-Physics. Articles may be ideas for experiments and discussion of material relevant to teachers and students of Year 11 and 12 Physics. Articles and ideas may be sent to the Honorary Editor (see address on Contents page).

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Australian & New Zealand Physicist Volume 29, Number 7, July 1992
OPPORTUNITIES for POST-GRADUATE STUDIES and RESEARCH in PHYSICS

David Whitehead

ACT

RESEARCH SCHOOL OF PHYSICAL SCIENCES AND ENGINEERING
Australian National University
GPO Box 4, Canberra City ACT 2601
Director: Professor E. Weigold

The School consists of a General Physics Division (applied mathematics, atomic and molecular physics, laser physics, optical sciences, plasma research), an Engineering Division (computer sciences, electronic materials engineering, systems engineering) and Departments of Nuclear Physics and Theoretical Physics.

Scholarships
Australian National University Scholarships and (Australian) Postgraduate Research Awards are available for applicants with first class Honours or good second class Honours, division A and a capacity for research. The School offers assistance to PhD students in the form of Graduate Scholar Assistantships. Some assistance is also available from sources such as grants.

GENERAL PHYSICS DIVISION
Department of Applied Mathematics
Head: Professor B.W. Ninham

This Department is devoted to research at the interfaces of sciences where physics, chemistry, mathematics and biology all join. It is not an Applied Mathematics department in any conventional sense. Nor is it one of Physical Chemistry, Chemical and Condensed Matter Physics, Colloid, Surface or Membrane Science or Immunotoxicology. But the groups that form this conglomerate grouping carry out research in all these areas, pure and applied, experimental and theoretical.

ATOMIC AND MOLECULAR PHYSICS LABORATORIES
Head: Dr. M.T. Elford
Electron Physics
The Group is engaged in experimental studies of low energy (less than 20eV) electron and ion scattering by atoms and molecules with particular emphasis on the study of interactions of relevance to a wide variety of physical phenomena and technological applications. There is also a substantial interest in several aspects of high resolution electron spectroscopy. Close collaboration with theorists engaged in electron and ion scattering problems and transport theory is a feature of the Group’s work.

Diffusion Research
The Unit studies the interactions between particles in liquids, liquid mixtures and solutions by experimental measurements of diffusion, viscosity, conductance and p-V-T properties at pressures ranging from atmospheric to 400 MPa. Theoretical models, some based on computer simulations, are used and developed to complement the experimental work. There is extensive collaboration with overseas laboratories.

Ultraviolet Physics
The Unit undertakes experimental and numerical modelling studies of problems of atmospheric, aeronomic and astrophysical significance relating to the interaction of vacuum ultraviolet (VUV) radiation with matter.

Optical Sciences Centre
Head: Professor A.W. Snyder FRS

The Centre works at the forefront of pure and applied theoretical research into photonics, as well as in vision research. There is strong interdisciplinary teamwork comprising physicists, electrical engineers and applied mathematicians.

Research in photonics concentrates on nonlinear propagation, covering light-guiding-light, optical switching, active devices, solitons and chaos, and on miniaturised optical circuitry for the photonic chip. There are extensive collaborative links with other university groups and the Australian telecommunications industry, primarily through the $100 million Australian Photonics Cooperative Research Centre.

In vision, the emphasis is on unravelling the strategies of visual information processing of the brain for application to robotic vision and understanding parallel-processing in visual systems. There is also strong interest in colour vision. The Centre has a highly sophisticated visual biophysics laboratory, and closely collaborates with the Centre for Visual Sciences.

Plasma Research Laboratory
Head: Professor S.M. Hamberger

The Plasma Research Laboratory investigates plasma phenomena of relevance to a wide variety of applications, including thermonuclear thermonuclear
fusion, space physics, and industrial processes. Its experimental and computational research is conducted jointly with the plasma physics group in the Department of Theoretical Physics, and in collaboration with other Australian and overseas groups. The Laboratory is well provided with facilities for plasma diagnostics, data acquisition and handling and computing.

ENGINEERING DIVISION

Computer Sciences Laboratory

Head: Professor R.P. Brent

Computer Sciences Laboratory research is concentrated in: parallel computation, including parallel algorithms and parallel computer architectures; man-machine systems, including computer speech and image processing.

The Laboratory collaborates with the Department of Computer Science (Faculty of Science) and is affiliated with the Centre for Information Science Research.

Electronic Materials Engineering

Head: Professor J.S. Williams

Research programs in the department are concentrated on MeV ion beam processing of semiconductors, III-V semiconductor layer growth, property modification and characterisation of the near-surface of materials and mechanical alloying. Silicon and gallium arsenide structures underlying the fabrication of optoelectronic devices are of major interest. Major facilities include MeV ion beam processes (both for material modification and analysis), metal organic vapour phase epitaxial growth of III-V semiconductor films; SIMS and electrical characterisation of devices. The department interacts strongly with the Microelectronics and Materials Technology Centre at RMIT and with CSIRO.

Systems Engineering

Head: Professor J. B. Moore

The Department of Systems Engineering is a high profile but small department concerned with conducting state-of-the-art research and sponsored work into control systems, signal processing and telecommunications, and involves faculty members, postgraduate students, contract support staff and visiting academics.

DEPARTMENT OF NUCLEAR PHYSICS

Head: Professor T.R. Ophel

Study of nuclear structures and dynamics and of ion-solid interactions with beams of heavy ion provided by the 14UD tandem accelerator. Current topics are: investigations of rapidly rotating nuclei at low temperature through gamma-ray spectroscopy, and at high temperature through fission and particle decay; study of hyperfine interactions and applications to measurements of nuclear moments; masses and properties of nuclei far from stability; resonant heavy-ion reactions; accelerator mass spectrometry dating with $^{14}C$, $^{18}O$ and development of applications with other radio-isotopes.

DEPARTMENT OF THEORETICAL PHYSICS

Head: Dr B.A. Robson

The Department is engaged in research into theoretical aspects of several branches of physics: atomic and molecular physics, condensed matter physics, nonlinear dynamics, nuclear physics, particles and fields, plasma physics, quantum mechanics and statistical mechanics. A substantial part of the work relates to the experimental interests of the Research School.

The research groups listed below conduct research based primarily upon the application of the principles and techniques of physics to challenging problems in the Earth Sciences.

Scholarships

In addition to Commonwealth Postgraduate Research Awards and ANU Ph.D Scholarships, a limited number of endowed scholarships are available for Honours Year and Ph.D. study.

Seismology and Geomagnetism

Leader: Professor B.I.N. Kennett

Investigation of the Earth's internal structure via theoretical and observational studies of seismic wave propagation and electromagnetic induction in the Australasian region.

Geodynamics

Leader: Professor K. Lambeck

Investigation by continuum-mechanical modelling of the processes responsible for deformation of the Earth's crust and mantle leading to an understanding of phenomena such as the formation of sedimentary basins, and the loading of the lithosphere by seamounts and ice sheets.

Geophysical Fluid Dynamics

Leader: Professor J.S. Turner

Study of a variety of mixing, convection, and flow problems in fluids via laboratory experimental investigations and theoretical modelling of dynamical processes in the oceans and the Earth's interior. Particular interests: multicomponent convection, crystallisation, dynamics of density-stratified flow, effects of rotation on ocean currents, mantle convection and its effects at and near the Earth's surface.

Petrophysics

Leader: Dr I. Jackson

Experimental investigations of the elastic, inelastic and rheological properties of geologic and ceramic materials under conditions of high pressure and temperature, with applications to seismology, structural geology and materials science; transmission electron microscope studies of crystal defects in rock-forming minerals and related materials, and their role in geophysical and geochemical processes.
Hypervelocity Aerodynamics and Shock Wave Physics

Laser Physics and Spectroscopy
Experimental Quantum Optics: in particular experiments to suppress quantum noise and generate squeezed states of light. Development of quantum noise limited sensors. Design of optical components for a gravitational wave detector. Manipulation of atoms by laser light: such as laser cooling, trapping and atomic interferometry.

Structure of Atomic Nuclei
Study of structure of excited states of nuclei by gamma-ray spectroscopy. Study of light nuclei using a low-energy Van de Graaff; also applied physics.

Theoretical Physics
Quantum theory. Quantum optics. Quantum measurement theory.

Scholarships
Australian National University Scholarships for the degree of Doctor of Philosophy, Master Degree Scholarships, Postgraduate Research Award Scheme (Commonwealth Government) are all available.

Astrophysics
Infrared spectrophotometric and spectro-polarimetric observations out to 22 μm using a unique instrument on large telescopes; composition and physical properties of the interstellar medium and “starburst” galaxies.
Infrared studies of star formation regions, interstellar and circumstellar dust and the Galactic Centre including observations and theoretical modelling; laboratory studies of dust particles characteristic of those in the interstellar medium.
Balloon-borne X-ray and γ-ray observations of southern sources and Supernova 1987a; development of improved detectors leading into space operations.

Scientific Ballooning
Maintenance and operation of the Australian Balloon Launching facilities for flying large scientific payloads at high altitudes.

Atmospheric Physics
Remote sensing of the first kilometre of the atmosphere using Doppler acoustic radar; wind profiles and turbulence parameters of importance in pollution control and aircraft operations.

Hyperfine Interactions
NMR studies of oriented nuclei at milliKelvin temperatures and with high magnetic field; measurement of electric field gradients in ferromagnets; observation of spin-spin interactions; search for superradiance at ultra short wavelengths and gamma ray switching.
Pulsed NMR studies of transition element ferromagnetic alloys.
Specific heat measurements of ferromagnetic and antiferromagnetic alloys over a temperature range of 0.25-4.2 K.
Mossbauer spectroscopic studies of magnetic and structural properties of amorphous alloys and hydrogen storage systems.
OPPORTUNITIES FOR POST-GRADUATE STUDIES AND RESEARCH IN PHYSICS

Solid State Physics
Temperature modulation methods are used to investigate critical phenomena of elemental metals and amorphous magnetic alloys. Susceptibility measurements of magnetic materials and high $T_c$ superconductors.

X-ray research includes fundamental X-ray dispersion and attenuation coefficients, X-ray topography studying domain structures, X-ray diffraction observation of transition metal compounds and the effects of storage, and compositional analysis of minerals and alloys.

Electron microscope research using scanning transmission electron microscopy and scanning electron microscopy is conducted on a wide range of materials including high temperature superconductors and objects from museum collections.

The areas of physics research within the School are as follows:

Astronomy
Observations of variable stars, radio observations of active stars, computer control of data acquisition and telescope movement.

Laser Physics
(including the Commonwealth Special Research Centre for Lasers and Applications).

Metal-vapour lasers (gold, copper, barium, strontium, calcium), excimer lasers, dye lasers, frequency shifting of laser outputs, soft-X-ray-excited lasers, tunable solid state lasers, infrared and waveguide lasers, nonlinear optics, optical design, laser-light scattering, industrial and medical applications of lasers.

Magnetism
Applications of magnetic materials in solid-state high-speed pulse circuits.

Materials Physics
High temperature superconductors, ceramic/polymer composites; electronic optical mechanical and thermal properties of conducting polymers; dielectric, electro-optic and piezoelectric properties of ferroelectric polymers, laser ablation of polymers, dielectric behaviour of oils.

Quantum Optics
The theory of the spectrum of a quantised light field, correlation properties of frequency-filtered light, studies of joint correlations between photons and photoelectrons in multihit photon ionisation, microscopic model of a maser.

Solid State Physics
Graded AlGaAs heterostructures, liquid-phase epitaxial growth, radiofrequency reactive sputtering, photodissociatively deposited nitride dielectrics, high-mobility semiconductors, cryogenic measurements, quantum theory and transport theory for electrons and phonons in imperfect crystals.

Theoretical Physics
Quantum theory and quantum electrodynamic effects of enclosed flux, scattering theory and group representations.

Scholarships
Commonwealth Postgraduate Research Awards, Macquarie University Postgraduate Research Awards.

NSW

SCHOOL OF PHYSICS
University of Sydney, NSW 2006
Head: Professor L. Cram

Applied Physics
Optical, electrical and structural properties of thin films and applications to photothermal and photovoltaic devices; heat transfer, molecular dynamics; transducers and instrumentation; solar collectors and systems; evacuated insulation.

Astronomy
Stellar photometry and very high angular resolution stellar interferometry; fundamental stellar properties and astrophysics.

Astrophysics
Studies of radio emission from the Sun, stars, pulsars, supernovae, galaxies and quasars with the Molonglo Synthesis Telescope and the Australia Telescope; optical spectroscopy using the Anglo-Australian Telescope.

High Energy Physics
Current activities involve an underground physics laboratory, an accelerator experiment on neutrino oscillations, a program to investigate heavy ion collisions and development of particle detectors.

Modern Optics
Optical instrumentation, Fourier optics, development and applications of scanning optical microscopy; adaptive optics; image processing and 3-D reconstruction.

Optical Fibres
Research into the use of special optical fibres in devices for sensing and for telecommunication and design and fabrication of such fibres, in association with the University of Sydney's Optical Fibre Technology Centre.

Plasma Physics
Tokamak studies of wave-plasma interactions, development of plasma diagnostics, gyrotron and laser development and applications, laser and spectroscopic studies of processing plasma discharges, including magnetron sputtering discharges, microwave discharges and vacuum arc discharges.

Theoretical Astrophysics
Studies in theoretical astrophysics, particularly plasma astrophysics, high energy astrophysics and solar physics.
OPPORTUNITIES FOR POST-GRADUATE STUDIES AND RESEARCH IN PHYSICS

Theoretical Physics
Optical properties of surfaces, electromagnetic scattering theory, optical fibre theory, transport properties of composite materials, nonlinear plasma theory, processes in laboratory plasmas, quantum electrodynamics.

Scholarships and Support
APRA and University Postgraduate Research Scholarships (the latter being restricted to candidates ineligible for the former). The School of Physics provides excellent research facilities and support from academic and technical staff.

NSW

SCHOOL OF PHYSICS
University of New South Wales
Kensington NSW 2033
Head: Professor J.W.V. Storey
Postgraduate Director: Associate Professor D. Miller

The School has about 50 academic staff and 70 research students and offers supervision in a wide range of fields. A detailed brochure is available.

Advanced Electronic Materials
High temperature superconductors, optical and optoelectronic ceramics, rare earth compounds and glasses, magnetic films, synthetic superlattice structures.

The First Australian Conference on
COMPUTERS IN UNIVERSITY PHYSICS EDUCATION
14 - 16 APRIL 1993
University of Sydney
Sydney, Australia

Further details can be found in the first circular obtainable from Dr. I. D. Johnson
School of Physics, University of Sydney
NSW 2006 Australia
Phone (02) 692 2637, 2537, fax (02) 660 2903
Email: idj@physics.usyd.edu.au

8th Conference of the
AUSTRALIAN OPTICAL SOCIETY
University of Sydney, Australia
1 - 5 FEBRUARY 1993
For details and provisional registration forms please contact:
Dr. Brian James, School of Physics
University of Sydney NSW 2006
Phone (02) 692 2599, fax (02) 660 2903
Email: idj@physics.usyd.edu.au

Applied Physics
Acoustics, mechanical properties of materials, polymers.

Astrophysics and Optics
Optical infra-red and radio astronomy, observational cosmology, quasars, planetary nebulae, photodissociation regions, astronomical instrumentation, infra-red detector arrays.

Atmospheric and Space Physics
Atmospheric radiation, remote sensing, ionospheric modelling.

Biophysics
Structure and properties of biological membranes; cryobiology; in-vivo NMR spectroscopy and imaging; x-ray diffraction, electrical cell fusion, molecular biology; musical acoustics.

Condensed Matter
Surface and thin film physics, solar cells, semiconductors, optical and magnetic resonance techniques, materials.

Theoretical Physics
Atomic, nuclear, condensed matter theory and statistical mechanics, solid surfaces, particles and fields.

Scholarships and Support
University of New South Wales Postgraduate Scholarships, similar to Australian Postgraduate Research Awards. Supplementary scholarships include those offered by the Faculty of Science and Gordon Godfrey Scholarship in Theoretical Physics. Contact the School for application forms. Most postgraduate students undertake some part-time teaching in the School.

NSW

DEPARTMENT OF APPLIED PHYSICS
University of Technology, Sydney
PO Box 123, Broadway NSW 2007
Head: Associate Professor R. W. Cheary
Postgraduate Coordinator: Professor A. R. Moon

Applied Physics
The major research interests of the Department are in the areas of materials technology, electron microscopy, physics education, theoretical physics and computational physics. There are several major funded research projects currently underway in all these areas, and several of the projects link closely with industry. There is also significant interaction between members of the Department and other research organisations such as CSIRO, ANSTO and other Australian universities. Extensive experimental facilities and computing facilities are available within the University and through external collaboration.

Some of the research projects underway are:
Materials Technology and Electron Microscopy
Inclusions, defects and optical properties of high temperature ceramic materials; optical and electronic thin films; x-ray and neutron diffraction studies of materials; high temperature superconductors; structural studies of the stability of SYNROC; electrochromic and angular selective window coatings; solar energy technology and photovoltaics.
OPPORTUNITIES FOR POST-GRADUATE STUDIES AND RESEARCH IN PHYSICS

Theoretical Physics and Computational Physics
Electromagnetic methods in geophysical exploration; satellite data retrieval; climate modelling; fractals and chaos in solid state physics; Monte Carlo simulation of high Tc superconductors; defects and impurity states in semiconductors and insulators and image analysis.

Physics Education
Computers in science education; cross-cultural science education; diagnostic testing of science students as a guide to teaching strategies.

Scholarships
Candidates for postgraduate degrees are eligible to apply for Commonwealth Postgraduate Awards and University awards. Part-time study is available to all postgraduate courses, and some positions may be available from time to time through funded research projects.

NSW
DEPARTMENT OF PHYSICS
University of New England
Armidale NSW 2351
Head: Associate Professor G. A. Wodsey

Gaseous electronics, including gas discharges, plasmas and lasers; optoelectronics; solid state physics; ionospheric physics. Specific current interests include:

- Nanosecond time-resolved optical studies of ionised gases; laser-induced opto-galvanic studies, the role of metastable excited states in conduction through gases; discharges in highly electronegative gases and vapours; energy transfer in corona discharges; development of optical measuring techniques for discharges and plasmas; the role of rotating magnetic field current-drive in high temperature confined plasmas.

- Optical fibre sensing of gas discharges. Theoretical studies of hydrogen in metals, diffusion of atoms in crystals and nuclear spin relaxation in solids; ultrasonic wave propagation in powders and aerogels.

- Total electron content using satellite radio signals; F-region dynamics, analysis and theory of geomagnetic variations.

Scholarships
In common with other Australian universities, the University of New England offers Commonwealth Postgraduate Research Awards. Also available are University of New England Research Scholarships. Applications for both normally close on 31 October in the year preceding the year in which candidature commences. The opportunity for research students to undertake paid casual teaching also exists.

NSW
DEPARTMENT OF PHYSICS
University of Wollongong
PO Box 1144, Wollongong NSW 2500
Head: Professor P. Fisher

Astronomy and Astrophysics
Infrared mapping and spectroscopy of star forming regions; applications of image digitising and analysis systems to the measurement of astronomical, survey plate material and archival storage; industrial applications of image analysis; photometric and spectroscopic studies of long period variable stars in the Magellanic Clouds; observational studies of extragalactic dynamics and gas dynamics.

Nuclear Physics
Neutron capture cross-sections, aspects of nuclear fission and reactor physics.

Solid State Physics
Piezo- and magneto-optical studies of the electronic states of impurities in semiconductors by far infrared spectroscopy; laser induced photoluminescence of compound semiconductors, superlattices and quantum wells and the effects of hydrogen passivation on these materials.

Theoretical Physics
Theoretical studies of extragalactic dynamics and gas dynamics; computation of fundamental quantities of atomic systems; group Δ.
OPPORTUNITIES FOR POST-GRADUATE STUDIES AND RESEARCH IN PHYSICS

Theoretical analyses of the effects of perturbations on energy states and optical transition probabilities of various solid state phenomena; calculation of the band structure and properties of associated spectral features for semiconductors superlattices.

NT

FACULTY OF SCIENCE
Northern Territory University
PO Box 40146, Casuarina NT 0811
Contact: Dr J. Singh

Theoretical Physics
Solid state physics: excitonic processes in crystalline solids, amorphous materials and quantum well structures, and solar cells; structure of atoms, interactions of electrons and photons with atoms, and computational methods.

Laser Physics
Opto-acoustic and pump-probe modulation spectroscopy, CO₂ and SMM lasers.

QLD

DEPARTMENT OF PHYSICS
The University of Queensland
St. Lucia QLD 4072
Head: Associate Professor J.S. Mainstone

Astrophysics
Transfer of radiation through outer layers of the sun and stars; cosmic abundance, experimental determination of relevant atomic properties.

Geophysics
Gravity: improved methods for terrain corrections; instrumentation for measurement of coal dust at working faces underground; earthquake prediction, rock physics and magnetotelluric studies.

IR and Sub-mm Laser Physics
Nonlinear optical effects in semiconductors using a pulsed CO₂ laser; discharge and optically pumped sub-mm lasers; non-linear dynamics in lasers; propagation of radiation in waveguides; microwave studies of fluidised beds.

Marine Physics
Water flow in rivers and estuaries, hydraulic models; studies of dispersion coefficients; generation and propagation of waves in bounded seas.

Solid State Physics
X-ray and thermal neutron crystallography: structural phase transformations, molecular orientations, order-disorder, computing techniques.

Space Physics
E and F region disturbances using an advanced ionosonde, a large HF steerable radar and a computerised phase ionosonde; physics of sporadic E clouds and their stability; generation of travelling disturbances in the auroral zone. Remote sensing of sea waves.

Theoretical Quantum Optics
Interaction of light with atomic and molecular systems; multi-photon processes, non-classical radiation fields, squeezed states; theory of quantum non-equilibrium structures, quantum solitons.

Materials and Solid State
Microstructural and physico-chemical studies of ceramics, oxides, semiconductors, sulphides and glassy metals using analytical electron and tunneling microscopy and surface analytical techniques; electronic structure of high temperature superconductors, solid-state near surface and surface reactions practice and theory; STEM applications to near surface physics and ultra-fine line lithography; novel semiconductor devices and device structures; metal hydrides for hydrogen storage; small-angle neutron scattering; neutron and x-ray diffraction; magnetic materials.

Radio Physics
Low frequency electromagnetic techniques in geophysics; antennas and communications.

Laser/Atomic Physics/Collision Physics
The Laser Atomic Physics Laboratory undertakes research into electron-atom collision processes and laser-atom interactions.

Electron-atom collision processes with emphasis placed on the application of laser techniques to collision studies; stepwise electron-phonon coincidence methods using laser techniques; super-elastic electron scattering studies from laser-excited atoms and electron-Auger electron coincidence experiments on atoms.

Laser-atom interactions; theory of atom-laser light interactions; laser beam manipulation of atoms and light traps; experimental tests of theory, laser spectroscopy and applications to atomic collision studies.

Theoretical Physics
Vibration theory and acoustics; solid-state and surface theory; theoretical quantum optics, interaction of radiation with atoms.

Scholarships and Support
As well as Commonwealth Postgraduate Research Awards, competitive Griffith University Postgraduate Research Awards are available.

QLD

DEPARTMENT OF PHYSICS
Queensland University of Technology
GPO Box 2434, Brisbane, QLD. 4001
Head: Associate Professor B.W. Thomas

Medical Physics
Medical imaging; physiological measurements; occupational assessment of toxic heavy metals through in-vivo analysis; nutritional status analysis studies in children and animals utilising total body...
Opportunities for Post-Graduate Studies and Research in Physics

Potassium measurements; biochemical techniques and thermal neutron capture gamma ray analysis; evaluation of radiological hazard from radiological dust associated with airborne dust in mines; low level radiation determination; environmental modelling and monitoring studies relating to daylighting, air and pollution dispersion etc.

Note: A Medical and Health Physics Centre located within the Department provides a focus for fostering through education, research and development, the application of physics to clinical and occupational health areas of our society.

Materials Studies

Utilising XRF, XRD and neutron activation analysis and other techniques; such studies are undertaken in both laboratory and industrial settings; studies involved in characteristics of modern materials, e.g., characterisation of shock wave formed materials from powders.

Imaging Studies

Being developed with the co-operative participation of a range of other professionals, engineers, computer scientists, medical scientists, etc., with application to medical physics and materials performance.

Post Graduate Programs

Master Degree - in addition to a program involving research and a thesis, programs involving course work and research project lead to the award of M.App.Sc. (Medical Science) with specific strands in Medical Physics and Medical Ultrasound. A candidate who exists after satisfactory completion of Stage I of these programs can be awarded a Graduate Diploma. Ph.D programs are available in the areas cited above.

Scholarships and Support

Financial support during the period of the above studies is available on a competitive basis via the Australian Government Scholarships, the Owen J. Wordsworth Memorial Scholarship, and those funded by research grants. Some additional support can be obtained through the candidate undertaking a limited amount of tutoring in the Department.

The Department of Applied Physics at the University of Central Queensland offers a Graduate Diploma in Information Technology (by external study only). This course of two years duration (part-time) is concerned with the acquisition, transfer, storage and processing of information and the application of this information. The course provides a formal and structured way for present and intending professionals to update or extend their knowledge base.

The Department also offers the degrees of MSc and PhD by research and thesis. Areas of interest include Seismology, Image Processing and Analysis, Plasma Physics, and Materials Science.

Scholarships

Australian Postgraduate Research Awards; James Cook University Scholarships (set annually to be of similar value to APRA); Physics Department Scholarship. Some projects in the Physics Department are attracting financial support from industry and government agencies.

Oceanography and marine meteorology involving HF radar backscatter; coastal sediment dynamics; boundary layer meteorology; line broadening of atomic spectral lines due to temperature and pressure effects; low energy elastic and inelastic gamma ray scattering measurements and studies of theoretical models; theoretical physics of ion mobility in gas discharges; elementary particles.

Optics and Lasers

This is a recently established group with research interests in basic laser physics and optics as well as applications of optics in sensing and industrial measurements. The experimental facilities of the group are expanding rapidly, and present efforts include optical phase conjugation, real time and conventional holography, diode laser pumping, remote sensing, laser frequency stabilization, studies of laser noise, and quantum optics.

High Energy Astrophysics and Cosmic Rays

This group has experimental and theoretical interests in the highest energy processes involving particles and photons in the Universe. With this aim an International Astrophysical Observatory has been established at Woomera with several Japanese Universities. Two large telescopes are used for TeV Gamma ray astronomy. The installation of a southern hemisphere Fly's Eye to study particles with
energies near a joule is expected shortly. A high energy neutrino experiment is undergoing a pilot study and a long-running scintillator experiment has operated at Buckland Park at intermediate energies.

Mathematical Physics

Research within the group covers a wide range of interests in mathematical physics. Particular areas of current interest are field theoretical models of hadron and nuclear structure, algebraic methods in statistical mechanics and quantum field theory, general relativity cosmology, quantum gravity and superstring theory.

Theoretical Nuclear and Particle Physics

Our concern is with the structure of matter at its deepest levels. Particular areas of interest include supersymmetry, chiral symmetry, chiral quark models (including chiral solitons), deep-inelastic scattering and structure functions as well as intermediate energy physics.

We have very close contact with overseas centres, notably CERN, Los Alamos, Saclay and TRIUMF. Approximately a dozen overseas scientists spend at least a month each year working in this group.

Ultra-Violet Physics

This group studies atomic and molecular quantum states by experimental measurement and theoretical modelling of the absorption of ultraviolet radiation by atoms and small molecules. The experimental program is based on vacuum ultra-violet monochromators and laser facilities. These instruments are equipped for high precision absorption measurements, photo electron spectroscopy and molecular beam studies. Related theoretical modelling work is concerned with resonant processes such as predissociation and autoionisation, and is related closely to the experimental program.

Physical Archaeometry

The physics of thermoluminescence, and its application to archaeological and geological dating, are the main activities of this group.

Medical Physics

Research into medical physics is carried out as a joint activity with the Department of Medical Physics at the Royal Adelaide Hospital and with physicists at other hospitals. A course-work Masters program in Medical and Health Physics is also offered.

Scholarships

Students within Australia are, of course, encouraged to use a Commonwealth Postgraduate Award to study at the University of Adelaide. In addition the university offers a number of postgraduate scholarships each year. The stipend is presently under review, but is generally very close to the value of the Commonwealth Scholarship.

Experimental

Atomic and molecular reactions with electron beams; electron momentum spectroscopy involving the measurement in coincidence of the momenta and energies of all continuum electrons in a high-

energy symmetric ionisation experiment; electron swarm physics using a technique of measuring electron distributions by observing the photons produced in reactions; gas discharge tomography and analogue imaging devices; plasma physics research which is concerned with an investigation of a method of driving plasma currents by use of the Hall term; the application of this technique to the generation and sustainment of compact torus and tokamak configurations.

Theoretical

Atomic scattering theory; few body nuclear theory; quantum field theory; the application of functional integral techniques to quantum chromodynamics; theoretical plasma physics focusing on the stability of resistive plasmas and the generation of plasma currents by means of the non-linear Hall term.

Electronic Structure of Materials Centre

This is a Centre of Excellence specially funded by the Australian Government. Its purpose is to develop the instrumentation and computer programs for investigating the electron spectroscopy of solids and to use them to discover the electron motion and correlations in semiconductors, superconductors, metals, magnetic materials and surface-adsorbed molecules.

Scholarships

The closing date for applications for Commonwealth and Flinders University scholarships is October 31 in each year. Initial enquiries to the Co-ordinator of Physics are welcomed.

SA

SCHOOL OF APPLIED PHYSICS

University of South Australia

The Levels SA 5095

Head: Professor J. C. Thomas

The School offers an M.App.Sc and a Ph.D. programme. In addition, the School operates an M.Sc. in Medical and Health Physics programme jointly with the University of Adelaide.

There are three main groups active within the School. These are:

Optical Techniques and Instrumentation Group

This group contains the Centre for Lasers and Opto-electronics and the Laser Light Scattering and Materials Science Group. Activities include development of laser systems for hazardous environments, development of metal vapour laser systems, visible laser diode applications, development of lasers for medical applications, development of miniature all solid-state light scattering systems, industrial application of laser light scattering (eg. particle size measurement) and the design and development of novel digital correlation systems. There is a substantial interest in colloid and materials physics.

Radiation and Health Physics

Work underway includes radiation control and dosimetry, and radiation protection from both nuclear and x-radiation. Collaboration is ongoing with the Schools of Electronic and Mechanical Engineering and with the Royal Adelaide Hospital.

Geophysics and Instrumentation for Agriculture

Activities include studies of physics of the atmosphere and the ionosphere with emphasis on meteorology, radio communications

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and applications to agriculture. Particular interests relate to GPS satellite observations (with La Trobe University) and irrigation sprinkler technology.

TAS

DEPARTMENT OF PHYSICS
University of Tasmania
GPO Box 252C, Hobart TAS 7001
Head: Dr. J. E. Humble

Astrophysics Groups
Optical astronomy and optics, radio astronomy and radiophysics, cosmic rays, X-ray and γ-ray astronomy. Projects range from techniques and instrumentation through to theoretical studies of the astronomical objects concerned. Available instruments include a 1-metre optical telescope, 26-metre and 14-metre radio telescopes, a 0.25 m² X-ray telescope and a range of cosmic ray detectors and telescopes. Current projects concern variable stars, X-ray and radio pulsars and collapsed objects, active radio sources using VLBI techniques, interstellar masers, cosmic ray anisotropies and high energy particles from astronomical sources.

Theory Group
Gauge theory and supersymmetry, including electrodynamics, chromodynamics, flavour dynamics and gravitation. Topics of current interest include the realisation of the quantum versions through dimensional reduction and non-perturbative solutions of gauge models. Supersymmetric aspects of these theories are under study as well as more formal group theoretical aspects of superlie algebras and their applications. Universal features of chaos are also being studied.

Biophysics Group
Electric characteristics of plant cells and tissues and individual cells are studies using microelectrode, tracer and modelling techniques. Current studies include mechanisms of nutrient uptake, of hormone-induced growth and the morphogenetic effects of light.

Scholarships
Details of courses, scholarships and other assistance are available from the Head of Department.

VIC

DEPARTMENT OF PHYSICS
La Trobe University
Bundoora VIC 3083

Electron Physics Group
Head: Dr J.G. Jenkin
Much of the work of the group centres on the investigation of the electronic properties of materials, including:
- Photoelectron spectroscopy of semiconductors, heterostructures and superlattices based on both silicon and gallium arsenide. Extensive use is made of the synchrotron radiation facility in Berlin. Facilities are available for the preparation of crystalline materials by the technique of molecular beam epitaxy.
- The use of a wide variety of surface science techniques for the study of surfaces and interfaces; for example, the adsorption of chemical species on clean well-defined surfaces, bonding in newly-synthesised materials (piezoelectrics & ferromagnetics), and surface properties of samples relevant to industry.
- Electron-atom interactions, and particularly studies related to resonance effects in scattering processes; the history of science, and especially of Australian physics.

Theoretical and Space Physics Group
Head: Professor K.D. Cole
The theory of the earth's upper atmosphere, ionosphere and magnetosphere; general relativity, statistical mechanics, theory of liquids, atomic physics, musical acoustics.

Studies relating to the properties of the ionosphere and magnetosphere using radio and optical techniques, auroral physics, solar-terrestrial relations. The Theoretical and Space Physics Group operates a field station in Kilmore Shire and encourages collaborative projects with outside agencies, especially the Antarctic Division. Studies of atom-ion interactions are conducted in the group's laboratories.

Scholarships
La Trobe University postgraduate scholarships are available.

BEMAL: Bendigo Electron Microscopy and Analytical Laboratories
Current projects include imaging techniques in the scanning electron microscope, automatic analysis in electron microprobe, and image analysis applications.

Centre for Instrumentation
Current projects include application of microcomputers and PLCs in vacuum systems, measurement of total available soil moisture content and other soil characterisation parameters, automatic measurement and recording of rainfall and evaporation rates, information transfer techniques in the agricultural environment, and direct field measurement for sheep classing.

Physics Education
The learning process and misconceptions in elementary physics are being investigated to enable definition of areas in which special care must be taken in the presentation of courses. The use of PCs in the laboratory to simulate experimental apparatus is beginning.

Scholarships
Candidates for graduate degrees are eligible to apply for Commonwealth Postgraduate Awards and for a limited number of College awards available to research centres. BEMAL supports one position which is half technical/half research. Enquiries to the Head of the Physics Department.
OPPORTUNITIES FOR POST-GRADUATE STUDIES AND RESEARCH IN PHYSICS

VIC

SCHOOL OF PHYSICS
University of Melbourne
Parkville VIC 3052
Head: Professor A.G. Klein

Theoretical Physics
Studies of elementary particle interactions (both strong and weak), nuclear reaction theory, nuclear structure theory, atomic collision theory, plasma theory, statistical mechanics, scattering of electromagnetic waves and astrophysics.

Experimental Particle Physics
Including participation in experiments at CERN (Geneva), TRIUMF (Vancouver) and in-house activities.

Fundamental Experiments

Solid State Physics
Including the study of crystal structures, crystal defects and their interactions and quasi-crystalline solids by the diffraction of x-rays, neutrons and electrons and by high resolution electron microscopy and spectroscopy.

Optics
Including x-ray optics, near-field scanning optical microscopy, high aspect ratio micro-fabrication (in collaboration with MARC) and optical coherence.

Astrophysics
Observational Astrophysics, including observational studies using the facilities at the Anglo-Australian Observatory, and related theoretical studies.

Nuclear Science
Studies of intermediate-energy photnuclear physics and applied nuclear physics including interdisciplinary studies.

Micro-Analytical Research Centre (MARC)
This research is based on a Proton Microprobe, a high spatial resolution analytical microscope which uses a beam of protons or other ions from a 5 MeV Pellettron accelerator. MARC undertakes applied research in biology, medicine, geology, solid state and many other areas of technology. This work has been strengthened by the addition of a Raman microprobe to the Centre.

VICT

DEPARTMENT OF MATERIALS ENGINEERING
Monash University
Clayton VIC 3168
Research Coordinator: Dr. B. C. Muddle

The Department of Materials Engineering offers, to suitably qualified students, the opportunity to undertake full-time supervised research leading to the award of the degrees of Master of Engineering Science and Doctor of Philosophy in one of six research programmes: ceramics engineering, corrosion engineering, metal forming, physical metallurgy, polymer engineering and surface engineering.

In each of these programmes, research focuses on aspects of materials processing, the influence of processing variables on microstructure, and on microstructure-property relationships in engineering materials. Consequently there is interest in fundamental aspects of phase equilibria in metals, ceramics and polymers, the role of microstructure in determining mechanical, electrical, magnetic and optical properties, and the resistance of materials to degradation in service. Studies of the effects of processing include work on the solidification processing of materials, metal forming, and solid state extrusion of oriented polymers. The importance of surface engineering is recognised with projects in the fields of electrochemistry and corrosion, coatings and adhesion. Developing research areas include composite materials, telecommunications materials, biomaterials, liquid crystalline polymers and polymer blends, degradation of polymers and numerical process modelling.

The major current research activities in the Department include:
- properties of engineering plastics, composites, rubbers and adhesives; polymer alloys and blends; ageing of polymers; optical fibres; damage and remanent life in engineering materials; electrical and magnetic properties of alloys; phase transformations and theory of alloy phase equilibria; ultra-high strength aluminium alloys; thermo-mechanical processing of steels; yield and fracture of metals and alloys; metal forming; modelling of metal deformation processes; metal-matrix composites; solidification processing; corrosion and corrosion protection; biomaterials; thermally sprayed coatings; properties of sur-

Digital image processing and applications (characterisation of discrete objects); electronic states in metals; electron paramagnetic resonance (lineshapes, enzymes, geology, laser materials, spectrometer development, food irradiation, radiation dosimetry; pulsed electron paramagnetic resonance (from late 1992); general relativity and quantum electrodynamics; impulse acoustics (atmospheric propagation); instabilities in solids (High Tc and conventional superconductors, zirconia based ceramics, Raman scattering, diffraction); Metal vapour laser development; magnetic & Mossbauer spectroscopy (magnetic particles, 2D magnetism, industrial applications, disordered systems); magnetism and neutron scattering (atomically disordered systems); metal-semiconductor interfaces; Mossbauer spectroscopy and Mossbauer imaging (gold mining and activated carbon, coals, minerals, surface studies); musical acoustics; optical astronomy; polymer physics; Raman spectroscopy and lattice vibrations; renewable energy studies; solid state physics and field theory; surface diffraction; theoretical biophysics (muscle behaviour, surface motion in cells); theoretical condensed matter physics and computational physics; computed tomography; ultrastructure and growth mechanisms of hard tissues, waves in random media.

Full details of the above programs are described in Physics Monash available for no charge on request. Enquiries should be directed to the Head of the Department.
face coatings and films; ceramic powder processing; superconducting ceramic oxides; mechanical properties of ceramics; analytical electron microscopy.

The Department maintains excellent research facilities for vacuum melting and casting, strip casting, plasma and flame spraying, heat treatment, metal working, polymer and ceramics processing, mechanical and corrosion testing. It also provides access to a wide range of materials characterisation techniques including optical microscopy, x-ray diffraction, differential scanning calorimetry, differential thermal analysis, thermogravimetric analysis, dilatometry, particle size analysis, dynamic mechanical analysis and ultrasonic flaw detection. All major items of equipment are interfaced to personal computers and there is ready access to mainframe and personal computers, a well-equipped workshop and photographic facilities.

VIC

DIVISION OF CHEMICAL AND PHYSICAL SCIENCES

Section of Physics and Electronics
Deakin University
Waurn Ponds VIC 3217

Chairman of Division: Mr H. Hudson

Investigation of sampling techniques for occupational hygiene. Quantitative analysis using X-ray diffraction; electron spin resonance applications to electrochemistry; development of microprocessor based instrumentation; electrical methods for determining body composition; development of computer simulation techniques for electrochemistry; underwater mapping by acoustical positioning; development of a micro-computer controlled theatre lantern; investigation of techniques for real-time moisture content of grain; feasibility studies of millimetre wave radio systems for digital and wide band services applications.

VIC

VICTORIAN UNIVERSITY OF TECHNOLOGY
GPO Box 2476V, Melbourne VIC 3001

Head: Dr H. K. Wagenfeld

Phase transformations in Al2O3 amorphised by ion implantation; acoustic absorption of various materials in high pressure nitrogen by the rapid impedance tube method; optical waveguides fabricated in polymers by ion implantation; ion beam induced epitaxial crystallisation; corrosion of protected metal films; investigation of fluorescence microspectrophotometry to classify dark wool fibres; computer modelling of the interaction of electrons with thin solid films; electron emission from surfaces; design of infrared imaging spectrometer; ultrasonic Doppler flow measurement; application of electron energy loss spectroscopy (EELS) to the study of magnesia partially stabilised zirconia; dynamical scattering; warm superconductors; ion beam modification of metal surfaces; secondary ion mass spectroscopy (SIMS); superconducting thin films; a study of modification of ceramic surfaces by ion beams; phase stability and impurity diffusion in ion-implemented amorphous and crystalline silicon; toughening of diamond using ion beam irradiation; synthesis of thin film diamond; the analysis of ion beam irradiated grey carbon; OPTRANS - an optical transform computer package; porosity and small angle X-ray scattering in coal and sintered ceramics; studies of materials for electronics; observation of the lower tropospheric state using a Michelson interferometer; Fourier optical analysis of micrographs of biological specimens; enhanced adhesion of metal films to ceramics; computer modelling of interfaces; computer simulation of superdense colloids; phase transformations in ion-implanted silicon; particle dynamics in concentrated dispersions; comparative RBS/AES studies on radiation induced surface alloy formation; surface modification of metals by ion beam mixing; a mineralogical analysis system for in-plant real time application; computer-generated holography; electronic speckle pattern interferometry; optical non-destructive testing and embossed holograms.

WA

DEPARTMENT OF PHYSICS
University of Western Australia
Nedlands WA 6009

Head: Associate Professor R. S. Crisp

There are two major research groups: atomic and surface physics and gravitational physics, as well as groups in solid state, surface physics magnetic materials, high Tc ceramic superconductors and nuclear (γ,n) reactions.

Experimental

Atomic and Surface Physics includes electron, atom and ion beam spectroscopies and scattering, laser and X-ray spectroscopy, the production and detection of spin polarised electrons, optical position-sensitive detectors, studies of the electronic and surface properties of materials, as well as crystallography and structural studies.

Gravitational Physics research includes gravitational radiation detection, gravity radiometry and the development of ultra-sensitive
OPPORTUNITIES FOR POST-GRADUATE STUDIES AND RESEARCH IN PHYSICS

measurement techniques including ultra-stable oscillators for time measurement. The associated research includes astronomy in both the visible and radio regions including VLBI.

Research groups collaborate actively with the Crystallography Centre and the Centre for Electron Microscopy, which are housed in the Physics building, as well as with departments in Engineering (particularly in the study of magnetic materials). The major areas include high vacuum, microwave and cryogenic technology as well as state-of-the-art computer and electronic technology.

Theoretical

Research includes phase transitions and critical point phenomena, cosmic electrodynamics, astrophysical plasma physics, high energy physics, atomic physics and chaos in non-linear systems.

Scholarships

University Research Scholarships may be available to Australian as well as overseas students who hold, or expect to obtain, a good honours degree or equivalent. These awards are presently valued at $12,250 pa (tax exempt) with allowances for dependents, travel and thesis preparation and are normally tenable for 3 years (PhD) or 2 years (MSc). Full details of these and other more specialised awards can be obtained from the Registrar, University of Western Australia. Most applications close in mid October each year.

WA

DEPARTMENT OF APPLIED PHYSICS
Curtin University of Technology
Bentley WA 6102
Head: Associate Professor B.H. O’Connor

Scholarships

Commonwealth Postgraduate Research Awards and Murdoch University Research Studentships are available to full-time students.

Applied Optics


Atmospheric Research

Air quality monitoring; laser (LIDAR) remote sensing of the troposphere and stratosphere; satellite meteorology; coastal meteorology; numerical modelling; atmospheric retrievals from satellite radiances; space science. Activities include co-operative research with the Western Australia Satellite Technology and Applications Centre (WASTAC).

Isotope Studies

Thermal ionisation mass spectrometry including application to astrophysics, meteorics, fossil products, environmental monitoring, geochronology, isotope geochemistry and medical research.

Marine Research

Coastal oceanography; numerical modelling; satellite oceanography; sea surface temperature and sea state; marine acoustics and marine technology. Collaborative research is undertaken with the Centre for Marine Science and Technology.

Materials Research

X-ray analytical science (diffraction and fluorescence), scanning electron microscopy and radiation physics; electrical, thermal and optical properties, abrasion resistance, deterioration due to ultraviolet and to other factors of a range of materials (metals, ceramics, polymers, rubbers, minerals); development of alumina-based toughened ceramic materials; high temperature superconducting ceramics and non-oxide rare earth ceramics.

Scientific Data Acquisition and Analysis

Digital image processing of scientific data including image enhancement procedures, feature/pattern recognition, frequency and spatial domain transforms; use of low-cost image processing systems and associated video digitising facilities; system software for image arrays.

Scholarships and Support

Students are eligible for Commonwealth Postgraduate Award (CPGA) Scholarships. Supplementary loadings may be paid to CPGA recipients. Industry and public-sector scholarships, other than CPGA, are offered from time to time. Part-time teaching is also available. Some students...
undertake thesis studies part-time while working as research or teaching assistants within the Department.

Analytical Ultracentrifugation and Electrophoresis
Molecular transport studies using centrifugation and electrophoresis for the separation and characterization of macromolecules in solution; electrical conductivity and dielectrophoresis as methods for investigating biological particulate systems.

Biomechanics
Computational simulation of expiratory airflow from human lungs and prediction of common clinical respiratory function tests in normal subjects along with simulation of pathological conditions; investigation of some aspects of the physics of the merging of unequal flows in a bronchial junction, as well as the relationship between tube properties and flow limitation mechanisms; investigation of osteoarthritis in the knee using real-time spectral analysis of joint sounds. Spectra, waveform, sound and knee angle are monitored and recorded on videotape. The important features of the spectra are being correlated with radiographic and clinical data.

Phonoangiography is intended to be used in epidemiological and drug efficiency studies in addition to clinical practice. The method promises a relatively cheap, non-invasive and safe diagnostic technique.

Electronics
There is a continuing programme involving the development of instrumentation for use in teaching and research. Recent projects include the development of a real-time digital correlator for use in studying the movement of a VLSCI correlator chip.

Nuclear Magnetic Resonance/New Techniques
An NMR imaging system has been developed to provide proton spin density maps of microscopic systems. Various pulse techniques enable relaxation contrast and the imaging of spin echoes under the influence of intense field gradient pulses. This latter experiment reveals molecular dynamics at specific locations in disperse phases. The system is being used to investigate plant tissue, food materials and polymers.

Polymer Physics
Diffusion of large molecules in solution studied by observing the scattering of laser light; ternary solutions of two polymers in a low molar mass solvent are being investigated; dynamical properties of synthetic and biological polymer systems studied by various NMR techniques including pulsed field gradient spin echo NMR, proton density imaging and relaxation measurements. The work on synthetic polymers seeks to elucidate reptation motion and internal modes in high (10^9 dalton) molar mass semi-dilute solutions and in gels using molecules labelled with both protons and deuterium; rheology of polymer solutions and melts.

Structural Biophysics
Developmental studies of connective tissues using electron microscopy as the major technique; relationships between the mechanical properties of a tissue and its collagen fibril diameter distribution; structural and functional roles of other components in connective tissues; image analysis techniques used to enhance the signal/noise ratio in electron micrographs and to deduce structural information from assemblies of biological macromolecules; computational analyses of the main acid sequences of fibrous proteins.

Theoretical Particle Physics
The relationship between low energy quark models of nucleons and the high energy scattering data.

Scholarship and Support
As well as New Zealand Commonwealth Scholarships and NZ Vice Chancellors' Committee Postgraduate Scholarships, competitive Massey University PhD Scholarships and Graduate Assistantships are available.

Astrophysics
High energy gamma ray astronomy using a 76 scintillator cosmic ray shower recorder.

Cloud Physics/Applied Meteorology
Physical properties and behaviour of liquid drop collisions, optical scattering, depolarization; electrical charge transfer between hydrometeors; field studies on the mesoscale and microscale of the characteristics of raindrops, rainfall, and orographic influences; optical scattering in rainfall; development of instrumentation for microphysical studies of precipitation and radar studies of clouds and precipitation.

Ionosphere
F-region morphology and its relation to atmospheric and solar changes.

Laser Physics Optoelectronics
Research in the laser physics laboratory is concentrated on the construction of new lasers, modeling of lasers and the application of short optical pulses; high peak powers generated by novel techniques are used to investigate a variety of nonlinear optical processes, notably optical parametric amplification, frequency doubling stimulated laser scattering in optical fibres and modulation instabilities in optical fibres.

Nuclear Physics
Nuclear physics using 4MV vertical tandem accelerator AURA2. High accuracy, (100 ppm), measurements of proton energies relative to one-volt standard; experimental parameters of pure Fermi beta decays; surface elemental analysis by PIXE, (proton induced X-ray mission), of Polynesian obsidian artefacts and medical samples of muscle tissue.

In collaboration with ANU, Canberra; high spin studies of heavy ions using the tandem accelerator at ANU. P:
Quantum Optics
The Quantum Optics group undertakes theoretical research into the interaction of light with atoms; topics include photon statistics, squeezed states of light, laser theory and nonlinear optics; laser manipulation of light by atoms, laser cooling of atoms, and atomic interferometry. Quantum measurement theory and quantum non-demolition measurements.

Signal Processing
Signal design for underwater acoustics applications; high gain signal processing using pulse compression of pseudo random sequences; optimal finite band signals.

Solid Earth Geophysics
Thermoluminescence and electron spin resonance dating; oscillations of the Earth's core; monitoring and theory of geothermal systems.

Underwater Acoustics
Theoretical studies of sound propagation. Topics include shallow water bottom interactions and complex ray and saddle point analysis of the acoustic field; long range, deep water propagation studies to monitor ocean temperature; ocean wave generation of seismic noise; fisheries SONAR.

Scholarships and Support
As well as New Zealand Commonwealth Scholarships and New Zealand Vice Chancellors' Committee Postgraduate Scholarships, competitive Auckland University Physics Department Postgraduate Scholarships are available.

Condensed Matter Physics
Contact: Dr G. D. Jones
Several projects are offered in spectroscopic studies of the fundamental electronic and magnetic properties of ions doped into single crystals. Facilities include those for growing and treating doped single crystals and probing them through FTIR, laser selective, optical, EPR and Mössbauer spectroscopy. The group has cooperative programmes, particularly in holeburning and the development of up-conversion lasers, with ANU, Cornell (USA), Los Alamos (USA) and Regensburg (Germany).

Atmospheric Physics
Contact: Dr G. Fraser
Radar techniques are used to study upper atmosphere winds and temperatures, the orbits of meteorites striking the atmosphere and the nature of the ionosphere above Christchurch and the Antarctic. Current meteorological projects include the study of soaring conditions for gliders above the MacKenzie Basin.

Astronomy
Contact: Dr J. Hearnshaw
The group operate the University observatory at Mt John which houses the 1m Telescope. Current projects include the study of pulsations and abundances in Cepheids and hydrogen deficient stars, the measurement of high precision stellar radial velocities and the use of remotely operated CCD cameras in astrophysical research.

Theory
Contact: Professor Siedman
Research interests include quantum field theory, solitons, fluid dynamics, the development of group theory for use in physics (solids and particles), Lagrangian wavefunctions, tests of Bell's inequalities and gyrotropic optical effects.

Ring Laser
Contact: Professor Siedman
A 1m ring laser is being built to test various predictions of quantum electrodynamics. (See The Australian and New Zealand Physicist Jan 1991)

Medical Applications of Lasers
Contact: Dr Bulter
A yellow copper vapour laser is used to treat port wine birthmarks. The guidance of this beam is being developed and its interaction with human blood vessels and tissue is being studied.

Atomic and Laser Physics
The group carries out theoretical and experimental research in the field of interaction of light with atoms. Topics under current study include dynamical switching in optical systems, four wave mixing with fluctuating background fields, spatial reorganisation for interacting laser beams, the photorefractive effect, and a variety of photonics applications.

Thin Films and Optics
The anisotropic properties of optical coatings caused by thin film microstructure are being investigated by experiment and by computer modelling. Currently, particular emphasis is placed on in situ measurements of optical anisotropies during the early stages of growth of evaporated metals and dielectrics, during post-deposition ion etching. A cooperative medical optics project, with the Department of Ophthalmology, involves the development and testing of instruments for detecting defects in the vision of infants.

Radio and Space Physics
This group is concerned with plasma waves and aeronomy of the earth's magnetosphere. Propagation, amplification and generation of plasma waves as well as wave particle interactions are investigated over the frequency range of millihertz to tens of kilohertz. Radio and plasma waves are also used for remote sensing of the constituents and plasma distribution of the magnetosphere.

Research involves both analysis of passive observations of the effects of natural events such as whistlers produced by lightning as well as active experiments for which the causes are artificially produced by the experimenter in the laboratory.

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Sea Ice

Laboratory experiments on acoustic emission generated in artificial sea ice subjected to load are being carried out with the aim of identifying the source of the emissions. Field work on natural sea ice is planned in 1991/92. Facilities: Experiments are performed in the walk-in freezer at Portobello Marine Laboratory. Loading gear, acoustic emission transducers and a data acquisition system controlled by PC are available.

Energy Utilisation

The principal interest of this group is in the efficiency of energy processes, in particular in the study of dissipative mechanisms, and their effect on process efficiency. Current projects include practical investigations of heat pump applications, thermal power station loss mechanisms, and product drying. The group is increasingly involved in the numerical simulation of energy processes for the analysis of losses by second law methods. This work, which includes Rankine and Brayton cycle heat pump driers and Stirling cycle cryogenic refrigeration, is based on real plant operation data. The thermal power plant study utilises real time data from Huntly power station. The group is closely involved with a commercial facility for rating heat pumps and air conditioners at Unigold Energy Ltd, Dunedin. Two 90m$^3$ insulated chambers, each equipped with precision air conditioning (25kW) for use in the range 20 to 50C have been set up as an independent standard rating laboratory and for contract development work. This facility is available to the group. Other facilities include data acquisition equipment for field studies and extensive software exists for thermodynamic property calculations.

Wind Energy and Acoustics

Studies in meteorology relevant to wind energy utilisation; atmospheric turbulence using optical and anemometer measurements; applied acoustics relating to meteorology, buildings and music.

Theoretical Physics

All of the above groups maintain theoretical programs. Independent fields of interests are those of classical electrodynamics, quantum field theory including gravitational field theory, aspects of elementary particle physics. Currently work is in progress: difficulties confronting relativistic wave equations for particles of higher spin; supersymmetric theories.

Interaction of light with condensed matter systems: ellipsometry studies of gas adsorption on solids; theory of reflection of electromagnetic, acoustic and particle waves from interfaces, with applications to ellipsometric studies; statistical mechanics of dielectric functions; study of gas adsorption on the surface of ice.

Accelerator physics, ion implantation and electron microscopy in the study of materials: the development of a technique for the energy calibration of Tandem accelerators using nuclear resonance reactions induced by heavy ion beams; research into accelerator and nuclear techniques for the study of materials of relevance to NZ science and the development of new technologies for industry; the application of computer based processing techniques to the electron microscopy of materials; a theoretical study of electron diffraction from ordered defect structures in metals.

Antarctic Physics

Physics in the Antarctic: the measurement and interpretation of the optical, thermal and microstructural properties of sea ice; properties of ultraviolet light in the Antarctic and interaction with algae.

Astronomy

Photometry and Spectroscopy: photometric and spectroscopic observations on a range of cataclysmic variable stars; observations of selected southern hemisphere stars using the Vilnius photometry system and expansion of the observational base to include the two-channel photometer and CCD system at Mt John; photometric and spectroscopic observation and analysis of binary stars to derive meaningful parameters for such systems; hardware and software development of the two-channel photometric computer-based system located at Mt John Observatory, Lake Tekapo.

Biotechnology and Medical Physics

Physics in Biology: continuation and development of the application of radiation physics, nuclear and allied techniques including electron microscopy in the area of biotechnology and medical physics.

Scholarships and Support

NZ Universities Post Graduate Scholarships and VUW Post Graduate Scholarships.

Materials Science

Electronic properties of materials: high temperature superconductors - the preparation of a series of perovskite superconductors and ruthenate perovskites, measurement and modelling of their vibrational and transport properties and magnetic susceptibility, microstructural studies using electron microscopy; conducting polymers - measurement and interpretation of electronic transport properties; superlattices - the preparation of superlattices of Ta/Ge, Ge/Ge:H and Ge/Si with layers as thin as 5 atomic layers and the study of their structure, electrical properties and stability.

Plasma Physics and Kinetic Theory

Moment equations and application to transport in high temperature plasma; theoretical studies on anomalous transport in magnetically closed systems; plasma torch.

Theoretical Quantum Optics

Squeezed light and quantum noise; anti-bunched light; intensity correlations; fundamentals of quantum theory and proposed experimental tests.
The annual joint meeting of the SA Branch of the AIP and the Astronomical Society of South Australia was held this year on the 1st of April at the University of Adelaide. The meeting opened with one hundred years of “time travel” for the Astronomical Society and so it was fitting that the meeting be addressed by Professor Paul Davies on the topic “Wormholes and Time Machines”. In the two years since his arrival in Adelaide, Professor Davies has done much to enliven public interest in modern physical ideas and an eager and expectant audience of about 350 people were present to hear his masterly and entertaining presentation on space-time wormholes and their possible utilization to realize faster-than-light travel i.e., the creation of a “time machine”.

The meeting began with a welcome from the Chair of the SA Branch of the AIP (Graham Sorell) and the announcement of the 1991 winners of AIP Merit Certificates. These are presented by the SA Branch of the AIP to students who obtain the maximum possible mark in the Year 12 Physics examination. This announcement was followed by the presentation of the AIP Bronze Bragg Medal, for the best performance in 1991 Year 12 Physics examination, to Jason Harper by Professor Davies. Professor Davies expressed the hope that in future years a greater number of women would be receiving merit certificates, a wish warmly received by the audience.

Professor Davies commenced his talk with details of a stop-press communication from the Bulgarian Physicist, Loof Lirpa, who had recently announced on ABC radio, the ability to travel in time. After discussing the “result”, and some of its peculiarities in detail, Professor Davies explained, to those members of the audience who could not spell backwards, that his announcement was merely an April Fool’s joke designed to whet their appetite for what was to come. The lecturer then began his talk in earnest.

Following an historical summary of ideas and proposed methods of time travel, Professor Davies outlined physicists’ picture of a “black hole”, a region around a space-time singularity in which gravity is so strong that not even light, let alone objects with rest mass, can escape. Professor Davies then reminded his audience that an Adelaide Mathematical Physicist, George Szekeres, had been among those to show that black holes should appear in pairs, one on top of the other and “pointing” in opposite directions. These pairs of black holes have been christened “wormholes” and, theoretically, allow the passage of objects from one region of space-time to another. An object entering one end of the wormhole would emerge from the other end in a different space-time region. However, the neck of the wormhole pinches off very rapidly - so rapidly in fact that not even light can pass through it. Thus if one is to pass through a wormhole without encountering a naked singularity, a way must be found to keep the “throat” of the wormhole open.

A number of proposals for keeping the throat open have been proposed, including rotation, electric repulsion and the use of negative pressure arising from the Casimir effect. The Casimir effect is a QED effect in which two metallic plates produce negative energy and hence negative pressure between each other. Professor Davies indicated that the use of a Casimir “device” to keep the throat open was widely regarded as possible, though not, at this stage, feasible. Even if a theoretical means is found to keep the throat open, problems, particularly those associated with passing very close to a naked singularity, would remain. If all these problems can be overcome a path by which faster-than-light travel (time travel) between two regions of space-time would be provided by a wormhole. This possibility leads naturally to the question of whether time travel introduces paradoxes, such as the famous “Grandfather Paradox”, into physics. However, it is hoped that the “Many-Worlds Interpretation” of quantum mechanics, wherein individual wave functions split into many separate branches, thus allowing the existence of many different futures from one past, can be used to overcome such paradoxes. An attempt to deal with such paradoxes is to postulate that nature will not tolerate them and so there will always be a definite past, a supposition known as the Chronological Protection Hypothesis (CPH), suggested by Stephen Hawking.

This supposition (CPH) lead to the final section of Professor Davies’ talk in which he discussed the use of postulates such as CPH to "filter" physical theories. Any "Theory of Anything" (TOE) must have certain properties considered essential to any physical theory, e.g., it must obey the CPH. Using these desirable properties of physical theories we can "filter" our putative TOEs and arrive at only one TOE. Thus, gedanken experiments on black holes can help physicists determine which TOEs are realistic. Only time will tell if the ideas discussed in the talk will turn out to be merely gedanken experiments or whether time travel will one day be possible.

At the invitation of Mr. Sorell, Associate Professor Charles Pearce, of the Astronomical Society, thanked the speaker for his lively and entertaining lecture and, more importantly for his public relations work for the University of Adelaide and Physics in particular and Academia and Science in general. The audience showed their approval of these sentiments and Professor Davies’ talk with a rousing round of applause.

Bill Boundy, Daniel Phillips ☞

Australian & New Zealand Physicist Volume 29, Number 7, July 1992 165
Fighters, Fatigue Cracks and Faraday's Law

Dr Stephen Burke of the DSTO Aeronautical Research Laboratory was Guest speaker at the April meeting of the Victorian Branch. Dr Burke presented an entertaining lecture with the enticing title, "Fighters, Fatigue Cracks and Faraday’s Law".

We were left in no doubt that an in-depth knowledge of classical Physics is of economic importance to the world of Aeronautics. Dr Burke described the Aloha Airlines incident in Hawaii as an illustration of the dramatic outcome of fatigue crack growth. He also showed examples of fatigue failures in both military and civilian aircraft. It became clear to the audience that the early detection and monitoring of crack growth was not only important to aircraft safety but was of economic importance. Dr Burke drew data from a Department of Defence report which demonstrated that the relative benefit to cost of R and D in Non-Destructive Evaluation was measured in factors of ten, a statistic which should appeal to the world of business.

When Dr Burke commenced his research in eddy-current nondestructive evaluation just seven years ago, he expected that the foundation laid by Faraday and Maxwell and a century of scientific effort would leave little room for further breakthroughs. He was surprised to find that there was more known about subatomic particles than the response of eddy-currents to cracks in thin conducting plates.

In the eddy-current technique for nondestructive evaluation an alternating magnetic field is excited by an alternating current in a coil. When the coil is placed adjacent to a conducting plate, the field excites eddy-currents. These currents in turn generate an opposed field and induce a back EMF in the coil. The coil impedance reflects the magnitude of the eddy-currents in the plate. A crack in the conducting plate will interrupt the eddy-currents streamlines and will be observed as a change in the coil impedance. Dr Burke explained that a change in the separation of the coil from the conducting plate (lift-off) also caused a change in coil impedance. Fortunately the phase of the impedance can be used to distinguish between a crack and coil lift-off.

Instrumentation for eddy-current nondestructive evaluation is well advanced, but the data is qualitative. Dr Burke explained that when he started his research, there was a clear need for mathematical models to predict coil response and to optimise inspection parameters. He called this the forward problem. In the development of models, mathematical difficulties were caused by the lack of axial symmetry. To address these symmetry problems, the current in the cracked plate was treated as the sum of (i) the current in the uncracked plate and (ii) a distribution of current vortices along the crack. The models led to parameter free solutions for the impedance change of a coil above a thin plate with a through crack and a double plate with a hidden second-layer crack.

Dr Burke also described his benchmark problem where the coil diameter and skin depth have similar dimensions to a finite crack in a halfspace conductor. In this work he is involved in an international collaboration.

Mr Burke also described recent work toward predicting crack size from eddy-current test data. He called this the inverse problem. The geometry tested was an infinite crack of uniform depth and crack opening in a conducting half space. Using a high frequency approximation, thin skin boundary conditions were described and fields inside the crack determined. In Dr Burke’s words, “calculation of $\Delta Z$ requires the solution of a 2D boundary value problem for the Laplace equation”. He demonstrated that the solution of this forward problem revealed the crack depth and the crack opening with good agreement with actual measurements. The $\Delta R$ and $\Delta L$ calculations led to self consistent results.

An appeal to "StarTrek" placed the present into the context of the future. The goal is to non-destructively examine a structure and to confidently predict the life to within a few minutes. Neither nondestructive evaluation, nor fracture mechanics have achieved this capability. Clearly there is work to be done.

The evening concluded with lively discussion. The quote of the month from Professor Klein: - "People know more about nuclear problems then they know about cracks - this is amazing!". The ground is fertile for meaningful contributions from Physicists to the world of engineering, particularly if one is prepared to revisit the world of Classical Physics.

David Arnott
Bureau of Meteorology Research Centre

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Australian Journal of Physics

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Tuneable Diode Laser Spectrometer System

The Model LS000 tuneable diode laser spectrometer system is part of a complete line of tuneable diode laser sources and accessories manufactured by Laser Photonics Analytic Division and supplied by Coherent Scientific. The Model LS000 is a new generation, liquid nitrogen dewar based, ultrahigh resolution tuneable infrared laser spectrometer system suitable for basic research, monitoring, analytical, and diagnostic applications. The system utilises LS521 series tuneable diode lasers, (TDL), which provide narrow band radiation (3 x 10^-4 cm^-1) throughout the mid to long infrared wavelength range (1800 to 3050cm^-1). Each TDL is a unique laser source specifically manufactured for your specialised application. An individual TDL is semi-continuously tuneable over typically 50cm^-1 by means of a precise temperature and injection current control, provided by the LS830 tuneable diode laser controller.

For more information, please contact Narrelle Murphy at Coherent Scientific.

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Coherent Scientific is the Australasian distributor for Edinburgh Instruments, a UK based manufacturer of infrared gas lasers and spectrometers. They have recently released a new range of luminescence spectrometers known as the 900 series which consists of three standard instruments, Models FL900, FS900 and TL900. The fluorescence lifetime spectrometer, Model FL900, uses time correlated single photon counting (TCSPC) and measures fluorescence lifetimes typically in the range 100 picoseconds to 10's of microseconds based on a nanosecond flashlamp. The lifetime range can be easily extended to cover phosphorescence measurements by changing the nanosecond flashlamp to a microsecond excitation source. The Model FS900 measures steady state excitation and emission spectra over the UV-visible region and, optionally, the infrared region using the TCSPC technique. The transient luminescence spectrometer, Model TL900 uses pulsed laser excitation and directly measures the luminescence decay, pulse by pulse, using a transient digitiser.

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For more information, please contact Narrelle Murphy at Coherent Scientific Pty Ltd. 138 Greenhill Road, Unley SA 5061. Phone (08) 271 4755 Fax (08) 271 1202

Spectra-Physics to represent Klinger/Micro-Controle

Spectra-Physics Pty Ltd are pleased to announce their appointment as the exclusive distributors in Australia for Klinger/Micro-Controle, the French-based company who last year were acquired by Newport Corp.

The announcement coincides with the release of the 1992 Klinger catalogue of precision opto-mechanical instruments, including an extensive selection of some of the finest motion control & optical mounting equipment available.

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thoughtfully designed & cost-effective hardware for operation of laser diodes including drivers, temperature controllers and heatsinks.

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Department of Theoretical Physics
Research School of Physical Sciences and Engineering
The Australian National University

SUMMER SCHOOL ON
MODERN PERSPECTIVES IN
MANY-BODY PHYSICS

11 - 29 January 1993

The Department of Theoretical Physics is organising a Summer School on Modern Perspectives in Many-Body Physics for a period of three weeks beginning 11 January 1993. This School is the sixth in an annual series on various topics in physics intended for postgraduate students of Australian and New Zealand universities. Participation of research workers with interests in this area from universities and research laboratories is also encouraged.

The School will consist of several main courses and lectures on some special topics of current interest. The aim of the School is to expose the participants to the basic concepts and modern developments in the subjects of the lectures in a manner normally not covered in text books. The lectures will start at an introductory level and later build up to a stage where the participants can appreciate the challenges of the current research fields. The courses and lectures have been planned to be suitable for both theorists and experimentalists. A tentative programme of the School follows.

D.J. Thouless (Seattle, USA)  Introductory Many-Body Theory
R. M. Dreizler (Frankfurt, Germany)  Collective Description of Many-Body Systems
D. Pines (Urbana, USA)  Fermi Liquid Theory
A. H. MacDonald (Bloomington, USA)  Theory of Fractional Quantum Hall Effect
D. J. Scalapino (Santa Barbara, USA)  Numerical Methods for Problems of Interacting Many Electron Systems
A. B. Balantekin (Madison, USA)  Supersymmetry in Nuclear and Condensed Matter Physics
K. I. Golden (Vermont, USA)  Strongly Coupled Plasmas
R. G. Clark (NSW)  Fractional Quantum Hall Effect and Electron Solids
P. J. Forrester (La Trobe)  Exactly Solvable Models: Coulomb Systems in 1 and 2D
J. Oitmaa (New South Wales)  Finite Lattice Techniques
M. P. Das (ANU)  Models to Treat Strong Electronic Correlations

There will be about three lectures per day (five days a week). Therefore, plenty of time will be available for individual study, review of lecture notes and informal discussion among the participants and lecturers.

Accommodation for the participants is being arranged in Burgmann College and it is possible that some accommodation could be arranged in Liversidge Court. Tariffs are indicated on the accommodation sheet.

There will be no registration fee. Intending participants in the Summer School are requested to submit the Registration Form before 31 August 1992.

The second circular with more detailed information and the final programme will be sent to those registered for the School by October 1992.

For any queries contact myself Dr. J Mahanty (Convenor), or the Secretary, Department of Theoretical Physics, Research School of Physical Sciences and Engineering, The Australian National University, GPO Box 4, Canberra ACT 2601. Telephone (06) 2492952, fax (06) 249 4676, telex QA62760.
Delayed Critical
The Cold Fusion Delusion

During the past few weeks I have been enjoying "Too Hot to Handle", the story of the race for cold fusion written by nuclear physicist, Frank Close. The book was loaned to me by Professor Paul George, to whom I am most grateful.

It is not so long since that day in March, 1989, when the news media shook the world of physics with the announcement of a breakthrough in fusion power production which would solve all the world's energy problems. Why, with the team leader sporting the elite FRG seal of quality it had to be right, did it not?

Almost from the start something smelt fishy about the whole affair. Four watts of excess power? Let's see, assuming say four MeV per fusion, we are looking at the production of more than one million million energetic protons or neutrons every second. It seemed odd that most of them would remain trapped in the palladium electrodes. Many nuclear physicists said just that, but their objections were overridden in the mad scramble to secure a slice of the action at almost any price. Harvard alone wasted about half a million dollars on the quest. Perhaps not entirely wasted, because they duplicated the apparatus so exactly that their negative results thoroughly disproved the cold fusion claims.

Now, three years down the track, everybody knows that cold fusion is not achievable by playing around with electrochemistry. And the story behind it is a cautionary tale that needs to be kept before us lest we fall into the same trap as Pons and Fleischmann. Yes it can, and has, happened here. There are some institutions in this part of the world where mention of tachyons or unbound quarks may still be somewhat embarrassing.

"Too Hot to Handle", therefore, is a book which needs to be kept readily available for every new generation of researchers to read, enjoy, and darn well take notice of.

No doctoral student in physics or chemistry, or other sciences for that matter, should be sent out into the world without having digested its essential message: stick to the rules of science - or else.

Although "Too Hot to Handle" is for the most part easy and enjoyable reading, it is rather too repetitive and has too many misprints and omitted words to qualify for a literary award. It would have merit for non-physics doctoral candidates in teaching them some useful nuclear physics. Many non-nuclear physicists would gain a better appreciation of nuclear radiation counting equipment from reading it.

While this commentary is rather too late to qualify as a timely review of Frank Close's "Too Hot to Handle", it is more in the way of a recommendation to have a copy of the book on hand in the library of any institution where young future scientists are under training. The story it tells is too important to be forgotten. Similar fiascos are bound to happen again in the future, but far less likely in places where this book is read and understood.


Colin Keay

Knots and Physics
L. H. Kauffman

In 1984 the Auckland born and educated mathematician V. F. R. Jones uncovered a remarkable connection between knot theory and statistical mechanics. In 1990 he was awarded the Fields Medal, the mathematical equivalent of the Nobel Prize. An avid rugby fan, Jones delivered his Fields Lecture wearing an All Black jumper. Significantly, the work of two of the other three Medalists, V. G. Drinfeld (quantum groups) and E. Witten (topological quantum field theory), is also deeply related to knot theory and exactly solved models in statistical mechanics.

The way to systematically study knots is to construct their knot invariants, which are mathematical expressions that depend only on the topology of the knot, rather than any particular picture of it. One such invariant is the Alexander polynomial discovered in 1928. Knots with different Alexander polynomials can be distinguished from each other by various invariants related to it, such as the Jones polynomial, which is constructed from it.

The choice of topics reviewed underlines the relevance of defects to semiconductor technology: the first two chapters deal with the fundamental theory of electronic band structure, followed by six chapters on various aspects of defects, impurities, dislocations and grain boundaries. It may be an oversight of the editors that only relatively little attention is paid to the fundamental physics of layer structures, although an excellent chapter deals with semiconductor interfaces. The technologically increasingly important amorphous silicon is discussed thoroughly in one of the last chapters.

All the chapters are extensively referenced and are up-to-date. In general, this volume gives a detailed and exhaustive discussion of a range of topics. I feel, however, that an overview of semiconductor physics in the 1990's is incomplete without a detailed description of the physics of quantum wells, superlattices, etc. I also feel the price tag on this volume, DM 430 (A$ 350), takes this book out of the reach of many potential customers, including probably universities and students.

M. Gal
School of Physics
University of NSW

Electronic Structure and Properties of Semiconductors
W. Schröter (Ed)

This volume (the 4th) of the impressive 18-volume series 'Materials Science and Technology' aims to review semiconductor physics starting with the perfect crystal, via the study of semiconductor defects, to the modern semiconductor structures, such quantum wires and quantum dots. This major venture is achieved with the help of 20 well known authors from throughout the world, representing major laboratories, industry and academia.

The choice of topics reviewed underlines the relevance of defects to semiconductor technology; the first two chapters deal with the fundamental theory of electronic band structure, followed by six chapters on various aspects of defects, impurities, dislocations and grain boundaries. It may be an oversight of the editors that only relatively little attention is paid to the fundamental physics of layer structures, although an excellent chapter deals with semiconductor interfaces. The technologically increasingly important amorphous silicon is discussed thoroughly in one of the last chapters.

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M. Gal
School of Physics
University of NSW
I find the book to be excellent value for its price. Kauffman manages to take the reader from the most elementary (and physically useful) knots to the most recent developments at the very forefront of a rapidly expanding field. The lecture course flavour, with all the intermediate steps included in the working, is ideal for newcomers to the area. It is particularly suited to those with a background in the Yang-Baxter equation and exactly solved models wishing to learn about knot theory - and vice versa. There are many illustrative pictures (presumably in the author's own hand). Most of the book's pages are seemingly adorned with hieoglyphics, as many of the calculations and proofs are diagrammatical. My three year old daughter became quite excited when she immediately recognised them as 'knots and tangles'. I was excited by this book too. It deserves to be a classic.

Murray T. Batchelor
Department of Applied Mathematics
Australian National University

Processing of Metals and Alloys
R.W. Cahn
VCH, Weinheim 1991
628pp., DM430 (hardcover)

When I first read through the general and the individual lists of contents I felt that this was a book that I would like to have easily available to refer to. After reading, but not fully digesting, the book, I still feel the same way.

This is not a book intended to be read in sequence, one should browse according to interest. This is aided by detailed lists of contents, an index and some cross-referencing including to other volumes in the series.

But what in the book? With the series title 'Materials Science and Technology', I put this volume on the science side, that is it is more concerned with principles than with gadgetry. From the volume title, Processing is to be understood as manipulating whether to form shapes, modify surfaces, produce amorphous phases, produce non-equilibrium phases or control and measure texture.

Powder metallurgy, recrystallization and recovery and solidification sound standard but move into new fields with microgravity and rapid solidification. As well, surface treatment by lasers and electrodeposition turn to non-equilibrium and non-crystalline phases and to alloying by vapour deposition, ion mixing and milling. I see this book with a number of uses. Apart from checking that one's own lecture notes are up-to-date the chapters provide a good starting point for research students starting in these areas. This use is aided by extensive up-to-date references and the provision in many chapters of a general reading list. Each chapter carries its own list of symbols and abbreviations. Many chapters also indicate current problem areas which require further research.

I did not find all the chapters equally readable, with thirteen sets of authors, the wide range of topics and treatment this is not surprising. I thought chapter 1 on solidification processing was clear and concise while I found some other chapters encyclopaedic or finicky. I did not find many typographical errors, the most serious was a graph (5-14) without identification on the lines and an incorrect top line of table 4.9.

With a price of around $A340 I think this will have to be a book for libraries.

J. D. Brown
Department of Mechanical Engineering
University of Newcastle

The Differential Equations of Thermodynamics
(Second Edition, Revised)
V.V. Sychev
viii + 251 pp., UK$61.00 (hardcover)

The aim of this book is to present the reader with the mathematical tools appropriate to thermodynamics. It assumes a prior knowledge of the basics of the subject.

The material covered starts with a resume of thermodynamic principles. It provides the necessary mathematics applied in the book to various thermodynamic systems. Treatment of an extensive list of the characteristic thermodynamic functions and their properties, the discontinuities of thermodynamic quantities, and the mathematics of the critical point are then presented. The important Maxwell equations are included. Phase transitions are covered. Simple (expansive work only) and complex (non-expansive work) thermodynamics systems are also treated.

The presentation is clear and well written, but a minor criticism could be made of some of the notation employed, e.g. in a section on gravitation, G is used to represent mass (and weight becomes g), although the symbol m is not used elsewhere in the book! A Notation Index is given, however, at the end of the book. The mathematical treatment of the systems covered is systematic and extensive. This gives the reader a sense of completeness, but perhaps emphasises that D>
Theoretical Atomic Physics
Harold Friedrich
Springer-Verlag Berlin 1990
ix + 316pp., DM 58 (hardcover)

This excellent book is written for physicists, both theoretical and experimental, who want an introduction to atomic physics of the 1990's. It is suitable as an honours or postgraduate text or as a reference for the professional. The text provides, or gives appropriate references to, the quantum mechanics and theoretical methods needed for practical applications at the forefront of modern atomic physics.

The first two chapters, about one third of the book, present a self-contained account of traditional basic quantum and atomic physics. A notable feature, and a novelty in one of the texts at this level, is the treatment of bound and continuum states on the same footing. This approach leads easily to the inclusion of quantum defect theory which has become a powerful and widely used tool for analysing atomic spectra. This is at the forefront of contemporary interest. The principles are well described. The treatment in these two chapters is well presented and readable, however because of brevity it is probably without sufficient detail for the student. However there are ample and appropriate references, including 1991 reviews, to pursue matters of interest.

The hydrogen atom has always occupied a central place in atomic physics as the standard one-electron system. In this text the central place is expanded because of the intricate detail of the subject which continues to be revealed and which draws theory and observation together; it is used to illustrate autoionization, resonances, elastic scattering by a short range potential, threshold effects and inelastic scattering. An example of the contemporary role of the hydrogen atom is its ionization from an initial state with large principal quantum number n=66, in a microwave field of about 10 GHz (photon energy of 4x10^23 eV) where more than 70 photons would have to be absorbed. The limitations of the standard perturbative approach, which is useful at low photon intensities, are discussed and recent direct solutions involving Floquet and Volkov states are discussed.

The last two chapters will appeal to all readers. The treatment of simple reactions, particularly elastic scattering, spin and polarization is thorough and readable and leads to current review papers. The theoretical and experimental physics principles are well matched and illustrated with recent experimental data. If I had not noticed to the author's treatment earlier I would have in this section since it was a salutary experience to see three diagrams from my own experimental papers appearing as textbook examples.

The last chapter (five) deals with multiphoton absorption, chaos with examples including ionization of the hydrogen atom in microwave and magnetic fields and finally coherent wave packets in real systems. The quasi-Landau modulations, in the wonderful example of the photoabsorption spectra for barium atoms in magnetic fields of the order of 10 Tesla, are a very instructive example of how unstable periodic classical orbits in a classically chaotic system manifest themselves in quantum mechanical spectra. Such coverage of current atomic physics is excellent and includes coherent states, the 'periodically kicked rotor' is given as a simple example of a system in which chaos can occur, i.e. a system with one spatial degree of freedom with the Hamiltonian depending explicitly on time. But these chapters contain many more wonderful examples which convey the spirit of excitement permeating throughout modern atomic physics. The book is worth reading for these sections alone.

The text is commendable because of the good physical description and insight offered throughout, particularly in recent advances. This is a good pedagogical approach because it helps the student to formulate the correct basic model for theoretical prescriptions, which is well illustrated in the treatment of atoms in external fields, for topics of contemporary interest. There is also good interaction between the descriptions of theory and experiment to indicate the successes and limitations of each. Each chapter concludes with a number of well chosen problems, which would be more helpful as a learning aid if worked solutions were provided.

B. W. Lucas
Physics Department
The University of Queensland

Introduction to Renormalization Group Methods in Physics
John Wiley & Sons, Inc. 1992
xvi+409pp., £52 (hardcover)

This is essentially a text on the topic of classical field theory, mainly for fluids as applied to dielectric tensors, optical activity, dispersion, Cerenkov radiation, nonlinear wave interaction, fluid dynamics with viscosity and turbulence, shock waves, solitons and finally liquid crystals. It is presented as a set of problems, each fully worked. The style is somewhat disjointed and uneven (some problems being isolated or trivial) The problems are about 70% helpful and 30% frustrating, the explanations at times very skeletal, and the translation at times a little rough, but on the whole it is a useful compendium of exercises which will be valuable to any, undergraduate or graduate with an interest in such topics, touching on a wide variety of applications.

R. Delbourgo
Physics Department
University of Tasmania

Book Notice

Physics of Continuous Media
G. E. Vekstein
Adam Hilger, Bristol, 1992
vii + 194pp., £15 (paperback)
UK£45 (hardcover)

This is essentially a text on the topic of classical electrodynamics mainly for fluids as applied to dielectric tensors, optical activity, dispersion, Cerenkov radiation, nonlinear wave interaction, fluid dynamics with viscosity and turbulence, shock waves, solitons and finally liquid crystals. It is presented as a set of problems, each fully worked. The style is somewhat disjointed and uneven (some problems being isolated or trivial) The problems are about 70% helpful and 30% frustrating, the explanations at times very skeletal, and the translation at times a little rough, but on the whole it is a useful compendium of exercises which will be valuable to any, undergraduate or graduate with an interest in such topics, touching on a wide variety of applications.
1992

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Recent Advances in Two-Dimensional and Nanostructure Electron Systems
School of Physics, University of New South Wales, Sydney, Australia
Contact: D. Neilson, University of New South Wales, Kensington, NSW 2033
Phone (02) 697 4564, Fax (02) 663 3420
or Internet neilson@newi.phys.unsw.oz.au

August 17 - 20
The 14th Triennial URSI International Symposium on
Electromagnetic Theory, Sydney, Australia
Dr G. L. James, Chairman of the Organising Committee, CSIRO Division of
Radiophysics, Phone (02) 868 0222 or (02) 868 0290, Fax (02) 868-0400

August 26 - 28
Fifth New Zealand National Physics Conference, University of Auckland
Dr. G. D. Putt, Department of Physics, University of Auckland, Private Bag
92019, Auckland, NZ. Phone NZ (09) 373 7999/XXX828, fax NZ (09) 373 7443

September 8 - 11
ASPIN Symposium - Introductory Physics Education in University, Japan
ct - Prof. Yasuhiko Tsuruoka, Dept. of Physics, Tokai University,
1117 Kuwanakura Hiratsuka City, Kanagawa 259-12, Japan.
Phone 81-463-58-1211, Fax 81-463-58-812

September 14 - 18
APSEM/BECON’92 Physical Sciences in Medicine and Biomedical
Engineering Conference,
Contact: A/Prof. B.J. Thomas, School of Physics, Queensland University of
Technology, GPO Box 2434, Brisbane QLD 4001, Australia
Phone (07) 864 2586 or Fax (07) 864 1321, OR Mr. M. McCarthy, Department
of Physical Sciences, Royal Brisbane Hospital, Bowen Bridge Road, Herston
QLD 4029, Australia. Phone (07) 253 8520 or Fax (07) 253 1389

September 28
Workshop - Materials Engineering in a Hazardous Environment
Lucas Heights Research Laboratories, Sydney, Australia
Enquiries: Conference Business Manager, Ms. Joan Watson Australian
Institute of Nuclear Science & Engineering, Private Mail Bag No.1
Menai NSW 2234, Australia. Phone (02) 717 3411, Fax (02) 717 9268

November 12 -14
16th Scientific Meeting of the Australian Society for Biophysics,
University of NSW, Sydney
Prof. Hans Coster, Department of Biophysics, University of NSW
PO Box 1, Kensington, NSW 2033, Phone (02) 6974583, Fax (02) 6633420

November 25 - 27
Australian Acoustical Society Annual Conference 1992, Ballarat, Victoria
John Upton (Convener), Phone (03) 370 7666 or (03) 370 7196,
Fax (03) 370 0332. Geoff Barnes, Phone (03) 720 1266, Fax (03) 720 6952

December 1 - 5
ICPE Conference on Physics Education for Development, Philippines
Prof. Geoffrey I. Opat, School of Physics, The University of Melbourne
Parkville, Victoria, 3052, Australia. Phone (03) 344 5121, Fax (03) 347 4783

December 11
Dr. Geoffrey Fletcher’s Festschrift Symposium on
"Electrons in Solids - The 1990s and Beyond"
The Department of Physics, Monash University, Clayton, VIC 3168
Phone 61-3-565 3630, Fax 61-3-565 3637

1993

January 11 - 29
6th Physics Summer School: Modern Perspectives of Many Body Physics
Canberra, Australia
J. Mahanty, Dept. of Theoretical Physics, R.S. Phys.S.E., ANU
GPO Box 4, Canberra ACT 2601 Australia
Phone (06) 249 2952, Fax (06) 249 4676

February 1 - 5
8th Conference of the Australian Optical Society
University of Sydney, NSW 2006 Australia
Chair of the Organising Committee: Dr Brian James, School of Physics,
University of Sydney, NSW 2006. Tel (02) 692 2599, Fax (02) 660 2903
email: james@physics.su.oz.au.
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