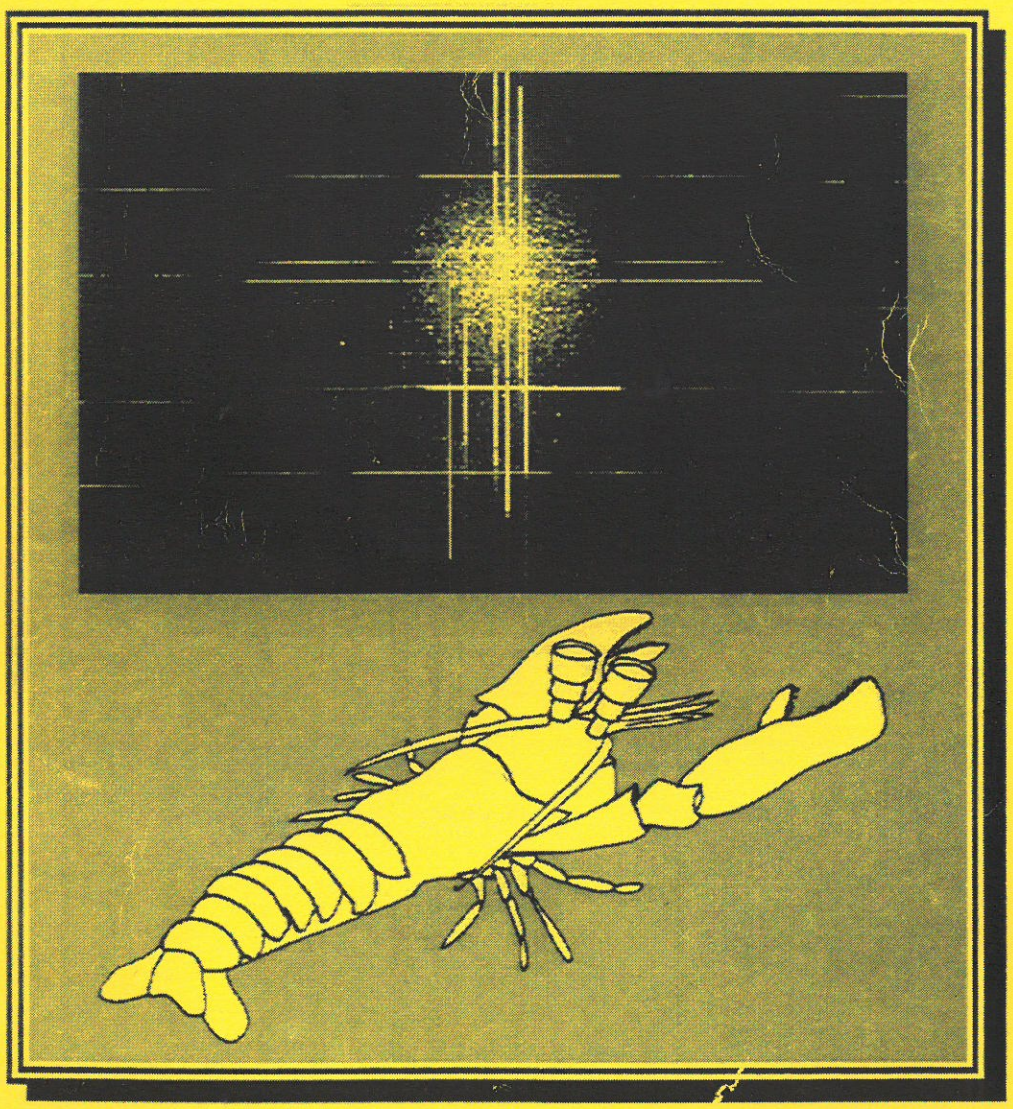
J. Dawes

Australian Optical Society

NEWS



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AOS NEWS

COVER :
Simulated view of the Large Magallenic Cloud as seen by an X-ray telescope (see article p23). X-ray sources are imaged as crosses by an array of square channel capillaries. The telescope has the potential to image the whole sky and will be small enough to fly on a satellite. One of the few creatures on earth to make use of this principle of imaging, the lobster, is also depicted gazing upon the distant galaxy. (Drawing by Miguel Alonso).

SUBMISSION OF COPY:
Contributions on any topic of interest to the Australian optics community are solicited, and should be sent to the Editor or one of the Associate Editors. Use of electronic mail is encouraged, or else submission of hard copy together with an ASCII text file on floppy disk.

Accepted word processor formats include Microsoft Word (for Windows and Mac), WordPerfect and Latex. Where possible, diagrams should be contained within the document or sent as separate encapsulated postscript files. Figures on A4 paper will also be accepted.

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DEADLINE FOR NEXT ISSUE :
7th November, 1996

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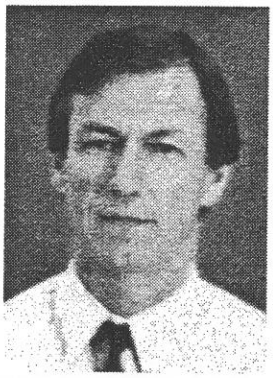
President's Report

by Chris Walsh

(As reported to the Annual General Meeting of the Australian Optical Society on 19 July 1996. A summary of the proceedings of that meeting are presented on page 10 of this issue).



The Australian Optical Society celebrated its tenth birthday some years ago and during the nineties has been a very stable organisation. Our Conferences are held regularly, either as stand-alone meetings or as part of the biennial ACOLS meeting. Our membership fluctuates, but has been around the 300 mark for at least the last five years. Our Newsletter under a series of dedicated hard-working editors has achieved a consistently high standard in both technical articles as well as reader services such as membership and company lists and information on companion societies such as the OSA and SPIE.

There are no down-sides to such stability. On the other hand, there is no reason why a stable organisation such as ours should not periodically examine ways in which we can better fulfil our charter. This charter is multi-faceted and includes objectives relating to providing a forum for discussion of optics, assisting in education in optics at teaching institutions in Australia, promoting 'research and other activities in optics in all its diversity', and fostering international collaboration in optics through society links, etc.

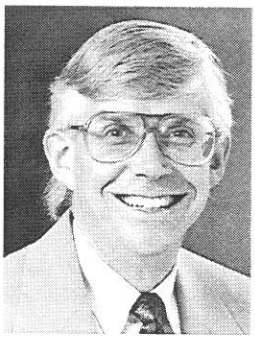
This issue was discussed at the most recent Council meeting and a number of relevant issues were identified. First, we felt that our interaction with the 'photonics' part of the Australian optical community could be improved, and we will be investigating ways in which this could be done, for example through inviting key speakers from that community to AOS Conferences, maybe even holding the AOS meeting in tandem with photonics-related meetings. We also identified the area of medical optics, particularly in non-optometry areas, as one where workers in the field could benefit through interaction with the AOS. It is worth noting in this context that a number of our corporate sponsors do substantial business in the medical sector. I hope that these issues will be pursued vigorously by the new Council, in which I will have the position of Past President.

Chairing this meeting is my last official duty as President. I have enjoyed the duties (which have not been onerous) that I have undertaken over the past two years. I was lucky to be President during the Tenth AOS meeting in Brisbane last year, definitely the largest and most successful meeting we have had as a Society. I have particularly enjoyed the interactions with my fellow councillors; our discussions, whether at a round table meeting or via email, are always robust, interesting and constructive. I greatly appreciate the efforts of the Newsletter editors during my term, first Martin de Sterke and Judith Dawes, then Duncan Butler. Duncan has also given me tremendous assistance with the Society accounts during the overseas absence of our Treasurer.

I conclude this report by thanking all my colleagues for the efforts they have made on behalf of the Society, whether as Councillors, Newsletter Editors or Conference organisers. I wish the incoming President and Council all the very best for the future.

From the incoming president

It is both a privilege and a challenge to have the Presidency of the Society handed on to me from a predecessor as dedicated and resourceful as Chris Walsh. Chris's thoughtful messages as outgoing President deserve our careful attention, because the next few moves that the Society makes could well determine its future impact. (This is not a new situation, of course: such sentiments have probably occurred to every incoming President since the Society got started!) I look forward to getting to know many more people in the Society, doing my best to cope with our far-flung geography and wide range of professional and scientific interests. For the time being, however, I want this message to brief and to emphasise my appreciation of the excellent job that Chris has done during his term as President.



- Brian Orr

AOS MEDAL

AUSTRALIAN OPTICAL SOCIETY

The Australian Optical Society is seeking nominations for the third award of this medal, which is for an outstanding contribution or contributions to the field of optics in Australia by a member of the Australian Optical Society.

The inaugural winner of this Medal, in 1995, was the late Bill James of James Optics, Melbourne, cited for his numerous contributions to the design, production and testing of aspheric and other high precision optics. The second medal was presented in July of this year to Dr Parameswaran Hariharan, Visiting Professor at the University of Sydney and Honorary Fellow at CSIRO Division of Applied Physics, for his extensive achievements in interferometry, holography, and other areas of optics.

This Medal is the most prestigious award of the Australian Optical Society. It would normally be presented only to a nominee at an advanced stage of his or her professional career and with a strong and sustained record of authority, enterprise and innovation in the field of optics in Australia.

Nominations for the 1997 AOS Medal Winner should include brief personal details and a curriculum vitae emphasising the main contributions made by the nominee to Australian optics. Two letters of recommendation should also be provided. Nominations may be made either by or on behalf of any eligible candidate. The selection panel reserves the option to seek additional information about candidates for the award.

It is hoped that the person selected to receive the medal will be able to do so at the Australian Optical Society Conference to be held in Adelaide in December 1997.

The closing date for nominations is 31 January 1997. Nominations should be sent to the Secretary:

Dr Clyde Mitchell
CSIRO DMST
Private Bag 33
Clayton South
Victoria 3169

Fax: (03) 9544-1128
E-mail: mitchell@mst.csiro.au

Editorial

The diversity of our membership is reflected in the submissions to *AOS News*. In the previous issue we had articles about optical computing, biomedical optics and astronomical optics. This issue we have an article featuring crustaceans! An international flavour has been added with articles from Ray Smartt (USA) and John Dudley (New Zealand). Many thanks to the authors for the time and effort they have put into their work.

This year has seen Australia host IQEC, one of the premier international optics conferences. Reviews of this and its satellite meetings can be found in this issue.

Please take note of the advertisments for the AOS Prizes contained in these pages. The guidelines for these prizes (the medal, student prize and technical worker prize) have been revised. Several deadlines for applications are in 1996, so this is most likely the last reminder you will receive.

Don't forget to visit the new AOS web site (see p19 for the address). Any feedback would be welcomed.

Finally, another reminder that any views, reviews, announcements or articles you have are welcome submissions to the *AOS News*!

Duncan Butler

PS: I regret that a few typographical errors have managed to escape my detection in the *AOS News*. There have also been problems with aliasing in some of the images (this only arises if the originals are from a laser printer). I will try to overcome this problem in future but I am somewhat limited by the printing process we use.

OPTICS GRAPEVINE

News from the World of Optics

OPTICAL TESTING DIGEST

WHAT IS IT?

An electronic periodical sent via e-mail to provide information, updates and a discussion forum for the community working in related aspects of optical testing. It is supported and adminstered by SPIE - The International Society for Optical Engineering.

ARE THERE RELEVANT KEYWORDS?

Interferometry: holography: moire: speckle: photoelasticity: gratings: fringe analysis: phase, displacement, curvature, profile, roughness measurement: optical fiber sensors: NDT: inspection.

WILL THERE BE ANY CHARGES FOR SUBSCRIBERS?

It is e-mailed free-of-charge to all subscribers monthly.

HOW CAN I SUBSCRIBE?

E-mail to optical-test@mail.spie.org with "subscribe" as subject. To unsubscribe use "unsubscribe" as subject. To change address, unsubscribe and resubscribe using new address.

WHEN IS THE FIRST ISSUE APPEARING?

1st July 1996. Back issues can be found at the SPIE web-site: http://www.spie.org/otd

WHAT ARE THE CONTENTS?

Announcements:

Upcoming journal titles, Courses, Conferences / Symposiums, Books, Thesis, Software, Hardware, Jobs, Scholarships, Awards, Preprints.

Forum:

Questions, Answers / Comments / Critiques, Interviews, Personality Profiles, Book Reviews.

HOW CAN I SUBMIT MY ARTICLE?

E-mail to mpengtw@leonis.nus.sg with "submit" as subject. Please keep the articles as brief as possible. The editor reserves the right to amend contents or reject submission.

- WWW -

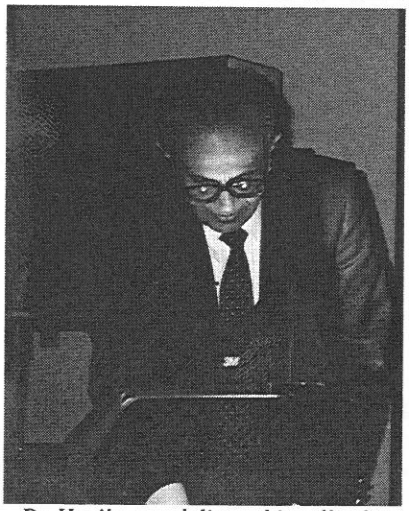
Visit the AOS web site

(see p19 for details)

The AOS Prizes are announcened in this issue. This is the first and final call for applications for the Postgraduate Student Prize (p13) and the Technical Optics Award (p11). Nominations for the AOS Medal (p5) are due in January, next year.

Please note that Sydney phone numbers have gained an extra digit: a 9 at the beginning.

More information about the LIGO gravity wave interferometer (mentioned in the last issue of *AOS News*) can be found in electronic form at http://www.ligo.caltech.edu/



Dr Hariharan delivers his talk after receiving the AOS Medal at IQEC

AOS Medal presentation

~ Dr P. Hariharan ~

Dr Parmeswaran 'Hari' Hariharan was presented with the 1996 Medal of the Australian Optical Society at a ceremony held during the recent IQEC meeting at Darling Harbour. Hari was cited for his extensive research in interferometry and holography which has resulted in a host of awards, including the Fraunhofer Medal from the Optical Society of America, the Henderson Medal of the Royal Photographic Society, the Walter Boas Medal of the Australian Institute of Physics, the Denis Gabor Award of the SPIE and the Thomas Young Award of the Institute of Physics London.

Following the award Hari gave a presentation on some of his most recent work involving the theory and application of the geometric phase. Using a Poincare sphere approach, Hari demonstrated how phase shifts in an interferometer could be produced without physical variation of the optical path, and discussed potential applications of this effect in interferometery and optical profilometry. Hari will present a more detailed article on this work in a subsequent issue of AOS News.

The Australian Optical Society is grateful to the organisers of the IQEC '96 Conference for providing us with the venue for the presentation, and for permitting us to advertise the talk to the conference delegates. It was pleasing to see a range of attendees, from students to senior international invited delegates, in the audience for the presentation and Hari's talk.

Notes from Council

The AOS Council met in Sydney on Sunday 14 July 1996, the eve of IQEC '96. Those attending were Chris Walsh (Chair), Ken Baldwin, Peter Farrell, Clyde Mitchell, Jesper Munch, Brian Orr, Anne Roberts, Halina Rubinsztein-Dunlop, and Lew Whitbourn. (Apologies were received from the three absent Councillors).

A highlight of the meeting was a brief visit by David Hennage, the Executive Director of the Optical Society of America, and Tom McIlrath, the Chair of the Joint Council for Quantum Electronics, both in Sydney for IQEC '96. The President invited the guests to provide an OSA perspective on the relationship between the two associations. One concern that we had was a proposal that OSA would reduce its membership fee and discontinue its discounted membership rates for AOS members, with possible deleterious effects on AOS membership.

David Hennage said that no action was yet being taken on the proposal, which would be formally considered in February. The OSA already had a similar reciprocal agreement with Mexico and were trying to establish one with China, so it was not a foregone conclusion that the proposed fee reduction and loss of discounted membership would proceed. He noted AOS concerns about the matter.

He went on explain that the OSA wanted to enhance optics worldwide, and was trying to help overseas optical societies, with a view to maintaining strong international journals, communications and literature. The OSA would have an on-line journal by the end of 1996.

There was discussion about the merits of continuing to invite the past-president of the OSA to address AOS meetings. David Hennage thought it was better and less expensive to have specific individuals from OSA taking on particular geographics areas, but some Councillors pointed out the value of having a good turnover of speakers. Tom McIlrath observed that the formal structure suggested by the OSA was good in cases where there was difficulty in building up personal relationships, but since this was not the case with Australia, the present arrangement should probably be continued to maintain this diversity. The present arrangement, with Ken Baldwin visiting the US regularly and maintaining the links with OSA, seems to work well.

Some councillors observed that policy changes within OSA and IQEC could have detrimental effects on our conference planning, and asked for as much notice as possible about plans which might impinge upon AOS. Tom McIlrath remarked that OSA had itself been surprised by the CLEO Pacific Rim Conference.

It was agreed that Ken Baldwin, Brian Orr and Chris Walsh would attempt to renegotiate the bilateral agreement between AOS and OSA, which is soon to expire. Council would also seek ways of strengthening ties with SPIE.

One other thing that came about as a result of talking with the visitors was that Council decided to make the AOS membership database available on the World Wide Web. The OSA already has this in place.

[As an aside, some members may not even be aware yet that the AOS has a home page! It has been recently set up by Duncan Butler, and Council recorded a vote of thanks to Duncan for this work. It can be accessed at

http://www.dap.csiro.au/OPTECH/Optics-Radiometry/aoshome.htm

and contains lots of useful information].

In his President's Report to Council, Chris Walsh raised the matter of the Society's membership "stability" and asked whether this was considered a good or bad thing. Regarding the Society's future, he commented that while we had the academic side of optics well covered, we did not have many members in the semi-professional area who were USERS of optics, lasers and so forth. Do we want to attract these members, with the accompanying change of membership profile and possible loss of stability? The President left this as a question for Council to consider. Initiatives in medical optics and education might be worth considering.

In the discussion which followed, the merits of back-to-back conferences with other organisations were strongly supported, and Council decided to investigate possibilities in this area. It was also observed that the medical field would benefit from more help from workers in optics. Possible new corporate members or even corporate sponsorship by big companies in this area was noted. It was suggested that there might also be opportunities for the AOS to expand in the area of education.

The Treasurer's Report was presented by Chris Walsh (Esa Jaatinen being overseas). Council expressed some concern over the continuing very high audit fees. It also agreed to accept $1500 from the dormant Australian Millimetre Wave Symposium, on the informal understanding that the AOS would consider favourably an initiative from the Australian Millimetre Wave Symposium (such as a nominated invited speaker) at future AOS conferences.

Council spent considerable time discussing the conditions and guidelines for the AOS's three awards -

the AOS Medal, the AOS Postgraduate Travel Award, and the AOS Technical Optics Award (formerly the Young Optical Worker of the Year Award). Notices about all three of these appear in this issue of AOS News, so you can see the outcome of Council's deliberations by reading these. Among the issues Council was concerned to address were the desirability of getting a stronger field of high-quality candidates for the Medal; clearer and fairer guidelines for the travel award; and more nominations for the Technical Optics Award (hence the change of name, although young technical workers in optics are still strongly encouraged to apply).

The last major item to be discussed by Council at the Sydney meeting was the state of planning for the AOS's next conference. It has now been decided that this will be held at the University of Adelaide, and the dates will be 10 - 12 December 1997. (While this information may be of use to those of you who like to plan well in advance, be warned that it is not yet set in concrete!) The Chair of the Organising Committee is Jesper Munch, whose contact details appear among those of the other Councillors at the front of AOS News.

Among other issues discussed at the meeting were the arrangements for Council Meetings. (How many face-to-face meetings needed per year? How many teleconferences? Should we consider video conferencing? How useful is email?) It was decided to have a Council Meeting along with a lecture at the time of the next AGM, which will be in April or May 1997. The likely location will be Sydney.

A few other matters were discussed briefly, and one agenda item (Promoting the AOS / Recruitment) was deferred for later discussion (probably by email) due to the pressure of time.

I hope that this summary of the proceedings at the latest Council meeting will prove more useful to members than a formal presentation of the draft minutes (still unratified, and with their numerous back references to previous business and so forth). I welcome feedback from members.

Clyde Mitchell
Secretary.

Annual General Meeting

of the Australian Optical Society held on Friday July 19, 1996 at the Darling Harbour Convention Centre

SUMMARY OF PROCEEDINGS

After accepting apologies and verifying the agenda, the meeting accepted the minutes of the previous meeting.

Under Business Arising, The President advised the meeting that the AOS Council was considering the possibility of holding AOS XI in Adelaide back-to-back with ACOFT. This will be explored informally with key organisers of the ACOFT meeting.

Also, the World Wide Web page has been established by Duncan Butler [see Notes from Council in this issue of AOS News for more information about this].

The President presented his report, which is reprinted separately.

The Treasurer's Report (also reprinted separately) was accepted by the meeting, as was the re-appointment of the Auditor, Mr Evan Philip Groombridge, practising as E P Groombridge and Co.

The meeting then proceeded to the election of Office-Bearers and Councillors, under the temporary Chair of P. Browne. The following nominees were declared elected:

President:	Brian Orr
Vice President:	Halina Rubinsztein-Dunlop
Past President:	Chris Walsh
Secretary:	Clyde Mitchell
Treasurer:	Esa Jaatinen
Councillors:	Kieran Larkin Jesper Munch Chris Chantler Ken Baldwin Peter Farrell Ann Roberts Lewis Whitbourn

Brian Orr took over the Chair as incoming President and thanked the previous Council for its efforts. He advised the meeting that the next AGM would probably be in Sydney in May 1997.

AOS Technical Optics Award

1996/7

This award (which replaces the Young Optical Worker of the Year Award) recognises those who have made a significant achievement in technical optics, not necessarily in a manner manifested by an extensive academic record or a traditional academic reputation. The work for which the award is made must have been carried out principally in Australia.

Applications are encouraged from, but not restricted to, young optical workers.

The winner will receive a prize consisting of $300 cash, one year's free membership of AOS, and an invitation to attend the AOS conference and make an oral presentation of his or her work.

Nominations are now invited from (or on behalf of) suitable candidates for the 1996/7 award, which will be presented at the next AOS Conference (planned for Adelaide in early December 1997).

Details of the applicant's or nominee's activities and achievements should be sent to the Secretary:

Dr Clyde Mitchell
CSIRO DMST
Private Bag 33
Clayton South
Vic. 3169
Fax: (03) 9544-1128

to be **received by 30 November 1996**.

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AUSTRALIAN OPTICAL SOCIETY

POSTGRADUATE STUDENT PRIZE

A. Preamble

The Australian Optical Society wishes to encourage participation in national and international conferences by high-quality postgraduate students. To this end, the Society has instituted an award, the Australian Optical Society Postgraduate Student Prize. This will take the form of a grant to assist the grantee to attend a conference in optics or a related field. For 1997, the award will be valued at up to $1500. The Society now invites applications from suitably qualified people for this prize for 1997.

B. Prerequisites

An applicant must be: (1) a citizen or permanent resident of Australia, (2) a member of the Australian Optical Society, (3) enrolled in a postgraduate research degree in Australia at 31 October 1996, with a project in an optically related area. Non-members of the AOS may join the Society concurrently with their application for the prize. (Application forms are available in *AOS News*, or may be obtained from the Treasurer or Secretary). The prize cannot be awarded more than once to any individual.

C. Selection criteria

An applicant must be sufficiently advanced in the research project to have obtained significant results in optics or a related area, such that those results are suitable for presentation at a proposed conference that falls in the twelve month period commencing 1 December 1996. It is expected that the presentation at the proposed conference would take the form of a research paper, invited or contributed, oral or poster. The successful applicant will be expected to write a summary of the conference for AOS News.

Preference will be given in the selection procedures to applicants who intend to use the prize to attend and present their research results at a major conference outside Australia or New Zealand.

It is not essential that the results to be presented should already have been accepted for presentation at the proposed conference at the time of application, but no payment of the prize will be made until evidence of such acceptance is provided to the Society. Applicants are encouraged to provide tangible evidence of the results likely to be presented at the proposed conference (for example, in the form of an outline of a paper that has been accepted or submitted or is being prepared for that conference) and to make clear the benefits that would arise from their attendance at that conference.

The AOS award is not intended to cover the full cost of the applicant's attendance at the proposed conference. Wherever possible, applicants should identify means by which their research group and/or institution is likely to make a substantial contribution to their travel costs. Evidence of any such supplementary support should be provided (for example, by an undertaking in the supervisor's letter of recommendation). However, students with no identifiable supplementary travel support will not be disadvantaged in the selection process.

Since the research supervisor's report is a major factor in the assessment process, supervisors should be prepared to rank their students against the selection criteria if contacted by the selection committee.

D. Application Details

1. Curriculum vitae;
2. List of publications, conference papers, theses, reports, etc.;
3. Details of postgraduate research project;
4. Details of proposed conference (including its status and relevance to optics);
5. Details of participation in the conference (nature of contribution as specified above);
6. Details of predicted expenses, as well as other (probable or confirmed) sources of funding for attendance at the conference;
7. Reports from the candidate's research supervisor and one other referee;
8. Statement that the candidate is a citizen or permanent resident of Australia;
9. Statement of agreement to write a summary of the conference for AOS News.

Applications should be sent to the Secretary:

Dr Clyde Mitchell
CSIRO DMST
Private Bag 33
Clayton South
Victoria 3169

and **must be received by 31 October 1996**. (Please note earlier closing date for applications than in previous years). The winner will be announced early in 1997.

From Quantum Noise to Semiclassical Chaos in a Modelocked Ion Laser

John M. Dudley and John D. Harvey
Department of Physics, University of Auckland
Private Bag 92019, Auckland, NEW ZEALAND

Despite being a 25 year old technology, the actively modelocked argon ion laser can still be used as a testbed for the study of fundamental ideas about pulse propagation in the presence of coherent interactions and superfluorescent effects. Recent work studying the stability characteristics of such a laser has demonstrated features characteristic of both macroscopic quantum fluctuations and semiclassical chaos, both of which are currently active research fields in physics.

1. Introduction

A laser is a device which produces coherent radiation at optical frequencies. It consists of an atomic gain medium capable of generating and amplifying optical radiation, enclosed by some type of optical resonator or cavity. The output radiation from a laser depends on the combination of the amplification provided by the gain medium with the constraint that laser oscillation can only be sustained at the resonant frequencies corresponding to the standing-wave modes of the laser cavity. In most lasers, oscillation occurs at more than one of these longitudinal modes, but the phases of individual modes are randomly related, leading to a continuous output. When the phases of the individual modes can be locked together in some way, then the laser output changes from a continuous output to a regular train of pulses. This process is called "modelocking", and is routinely used to generate ultrashort light pulses for a variety of applications in pure and applied physics.

In ionic gas lasers, mode-locking is usually achieved using some form of amplitude modulation on the cavity loss to synchronise the phases of adjacent cavity modes. Modelocking in this way is a very old technology, and in the argon ion laser, for example, was first reported in 1965. Since then, the modelocked argon ion laser has evolved to a commercially available product routinely used in a wide variety of applications such as holography and in time resolved spectroscopy. In the last eight years, however, the physics of the modelocked argon ion laser has come under renewed scrutiny as the result of experimental and theoretical research by the authors at the University of Auckland in New Zealand, and by Professor Peter Drummond at the University of Queensland in Australia. This research has uncovered a rich variety of previously unreported behaviour in the laser, embracing the physics of coherent atom-field interactions, the physics of macroscopic quantum noise, and recently, the physics of chaotic laser dynamics. Because the atomic transitions in argon are well understood, this type of laser allows a first-principles test of the quantum theory of the laser in a high-Q regime that was never previously investigated, either in theory or in experiment. In this article, we review these results and discuss the wider implications of this work for other laser sources.

2. Coherent Pulse Phenomena and Superfluorescence

In the late 1980's, workers from the University of Auckland [1] reported unusual operating behaviour from the modelocked argon laser when operated in a high-Q cavity. Most commercial argon laser systems are not operated in high-Q cavities, since this generally results in reduced average laser output power. The experimental results at Auckland, however, showed that despite reduced average output power, the laser in this regime actually produced modelocked pulses of greatly increased peak power, and temporal durations significantly shorter than had previously been reported. Indeed, these pulses had a temporal width of around 30 ps, only about one third of the duration of the so-called "gain-bandwidth limited" pulses from modelocked argon ion lasers. This rather surprising result led to several years of further experimental investigation, and the development of a detailed model for the laser based on a semiclassical description of the atom-field interactions within the laser using the fully coherent Maxwell-Bloch equations [2].

The physics behind this high-Q operating regime was found to derive from coherent atom-field coupling in the laser, which contrasts with the usual rate-equation coupling present in most lasers. Of particular importance to future research was the realisation that the coherent pulse propagation in the modelocked argon laser was equivalent to the pulse propagation in a near-infinite swept gain superfluorescent amplifier. A swept gain amplifier is an amplifying medium where, as a pulse propagates, it always encounters a fully inverted gain medium. Extensive theoretical research into pulse

propagation in swept gain media was carried out in the 1960's and 1970's, but little experimental work was carried out because of the practical difficulties in constructing swept-gain amplifiers.

In the modelocked argon laser, however, the combination of an active modelocking element and an inversion recovery time shorter than the cavity round-trip time led to an equivalent experimental configuration. In the high-Q limit, pulse propagation in the modelocked argon laser could be interpreted as superfluorescent, fulfilling the promise of a "coherence-brightened" laser first proposed by Dicke in 1954 [3]. Direct confirmation of this interpretation was provided by experimental measurements of coherent Rabi oscillations on the laser pulses [4,5]. In addition, the results from a more detailed series of experiments studying the pulse characteristics [6] were found to be in good agreement with the results of numerical simulations based on the semiclassical superfluorescent pulse propagation model.

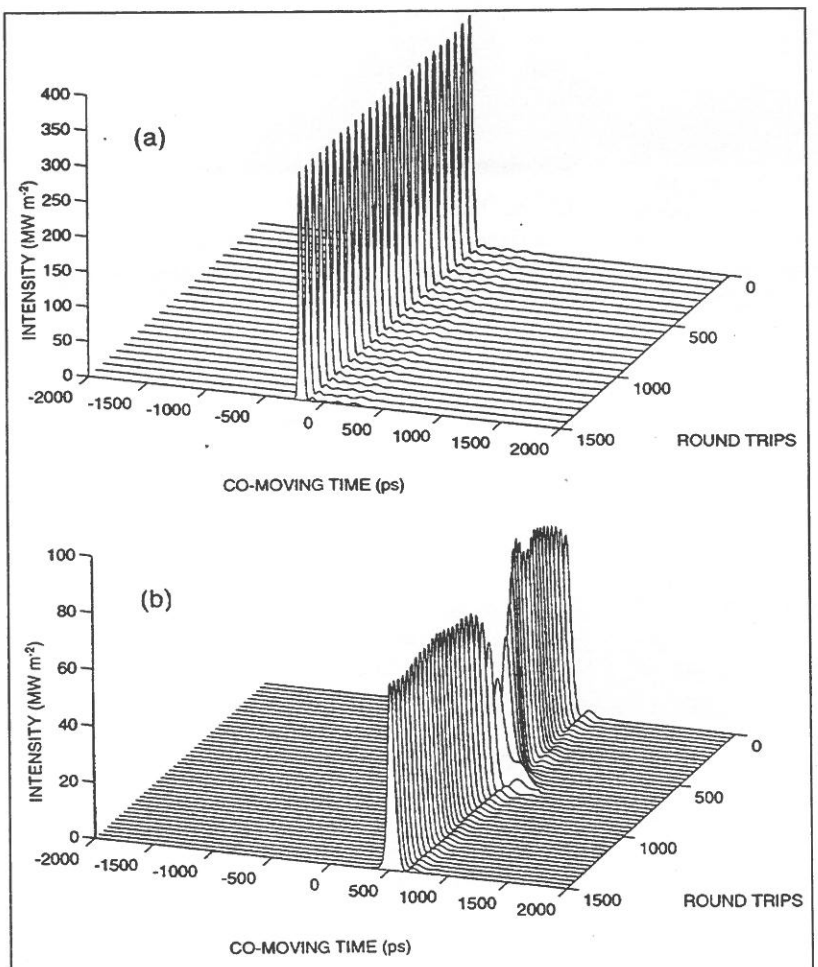

Figure 1: *Results from numerical simulations of the modelocked argon ion laser showing the intracavity pulse intensity (measured in a co-moving time frame) as a function of the number of cavity roundtrips. Fig. 1(a) shows a stable single pulse in the laser cavity, while for a slightly longer cavity, Fig. 1(b) shows the appearance of a dramatic macroscopic intensity fluctuation initiated by quantum noise. The cavity length difference between these two simulations is around 150 μm.*

3. Quantum Phase Waves

Despite the successes of the semiclassical model, further theoretical work at the University of Queensland was carried out so that the numerical simulations could investigate not just the steady-state pulse characteristics, but also the noise characteristics of the modelocked superfluorescent laser (MSL). Theoretical work by Hopf and Overman in 1979 [7] had predicted that pulse propagation in a superfluorescent amplifier should display signatures of the amplification of microscopic quantum fluctuations to the macroscopic domain in the form of large amplitude "phase waves" on the laser pulse train. These phase waves have their physical origin in the extreme sensitivity of a coherently propagating pulse to spontaneous emission ahead of it in the amplifier, and lead to episodic large amplitude fluctuations in the pulse energy. The theoretical developments were based on a fully quantum-mechanical description of the coherent atom-field interaction [8], and in addition, included other features such as the radial structure of the transverse laser mode, accurate modelling of inhomogeneous broadening in the laser, and the inclusion of the multilevel nature of the laser transition. The increased complexity was required so that experimental studies of the noise characteristics MSL could be realistically compared with the predictions of the theory to look for unambiguous signatures of the macroscopic phase wave fluctuations.

The first results from Queensland using the modified theory of the MSL confirmed what the Auckland experimentalists had known for five years – namely that the noise characteristics of the MSL were an extremely sensitive function of the laser cavity length. The theoretical results, however, went a step further with the prediction of a distinct phase transition in the noise characteristics – from a noisy regime where macroscopic quantum phase waves caused large amplitude broadband energy fluctuations, to a quiet regime at shorter cavity lengths where the position of the pulse in the modelocker loss window resulted in their suppression [9]. In this quiet regime, the laser was found to be shot-noise limited at frequencies above 1 MHz. Fig. 1 shows plots of the pulse propagation inside the laser cavity for two different cavity lengths on either side of the phase transition in the noise characteristics.

In Fig 1(a) the laser is operated in the short-cavity regime where the pulse position relative to the time-varying loss of the modelocker results in the pulse leading edge seeing an increased loss relative to the trailing edge. In this case the phase waves are suppressed and quiet laser operation is observed. Fig. 1(b) shows the effect of a slight increase in the laser cavity length so that the loss on the pulse trailing edge is reduced. In this case the phase waves are able to propagate into the main pulse, and the dramatic amplitude fluctuations generated on the pulse train are clear from the figure. A careful set of experiments measuring the laser noise as a function of cavity length detuning was performed, and the experimental characteristics of the predicted transition were found to be in agreement with theoretical predictions [10], allowing these results to be interpreted as the first laboratory observation of phase waves, and providing a successful test of the underlying quantum theory of the atom-field interaction.

4. Multiple Pulse Behaviour

Continuing studies of the modelocked argon laser have concentrated on testing the predictions of the numerical simulations in other regimes. In particular, recent research has studied the MSL noise characteristics for large negative cavity length detunings (cavity shortening), where early experimental studies had identified another regime of instability accompanied by multiple-pulse operation of the laser [11]. Experiments at Auckland showed that as the laser cavity length was decreased further from the regime of phase-wave operation, a satellite pulse appeared on the trailing edge of the primary pulse, an effect well-known to workers with experience in modelocking ion lasers. Initially the appearance of the satellite was accompanied by quiet laser operation, but as the satellite increased in amplitude with further detuning, discrete structure appeared in the noise spectrum with fluctuations at particular characteristic frequencies. Even larger detunings resulted in the evolution of the noise spectrum in a manner reminiscent of deterministically chaotic systems.

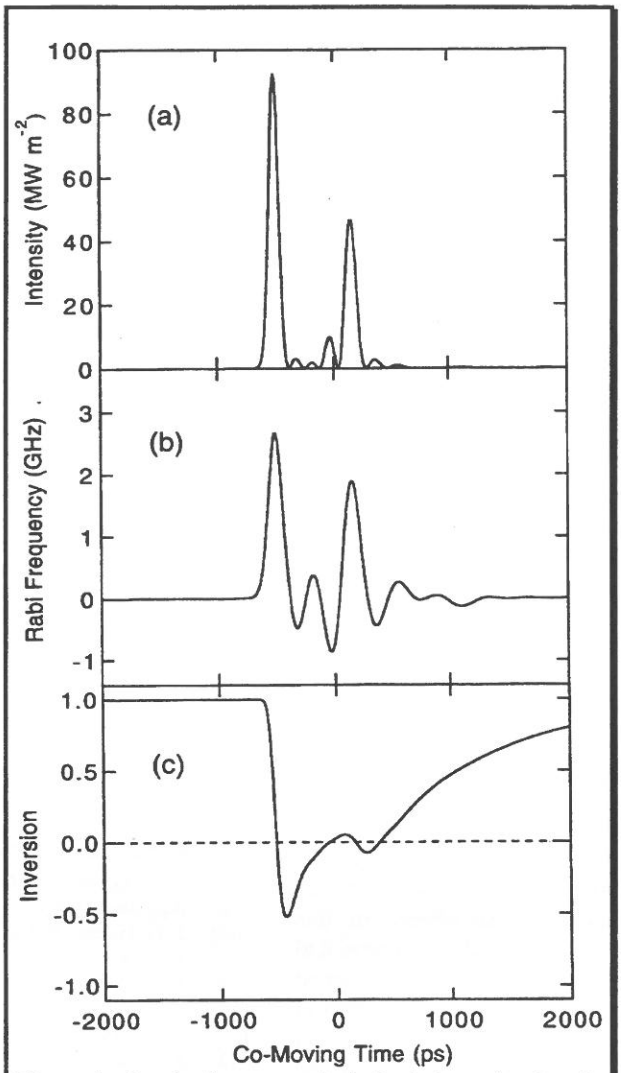

Figure 2: Results from numerical simulations showing the modelocked laser characteristics for a cavity shortened from modelocker resonance by around 100 μm. In this case, the presence of a satellite pulse can be seen on the intensity distribution (a), while its origin in amplified coherent oscillations on the pulse trailing edge is clear from the electric field amplitude shown in (b) and the plot of inversion recovery in the gain medium (c).

Numerical simulations of the MSL in this large short-cavity detuning regime have again provided further insight into the laser's operation. The simulations have shown that the appearance of the satellite is also a consequence of the coherent atom-field interaction, but that the stability behaviour in this regime can be explained well by the semiclassical model, in contrast to the long-cavity detuning regime where the fully quantum-mechanical model is required.

Fig. 2 shows results from numerical simulations which illustrate how the satellite forms from the amplification of coherent ringing on the trailing edge of the primary pulse. The amplification derives from the recovery of the inversion after the passage of the primary pulse through the gain medium, and stability is determined by the interplay between the cavity detuning, the inversion recovery, and the time-varying loss of the modelocker. The simulations also indicate that the stability of the satellite pulse can only be sustained over a small range of negative cavity detunings, and larger values of detuning result in cyclic variations in the satellite pulse energy and position. Fig. 3 shows further simulation results illustrating the pulse propagation in the laser, with Fig. 3(a) illustrating the situation where a stable satellite pulse is formed, and Fig. 3(b) the situation at larger detuning where the satellite undergoes regular fluctuations in amplitude and position.

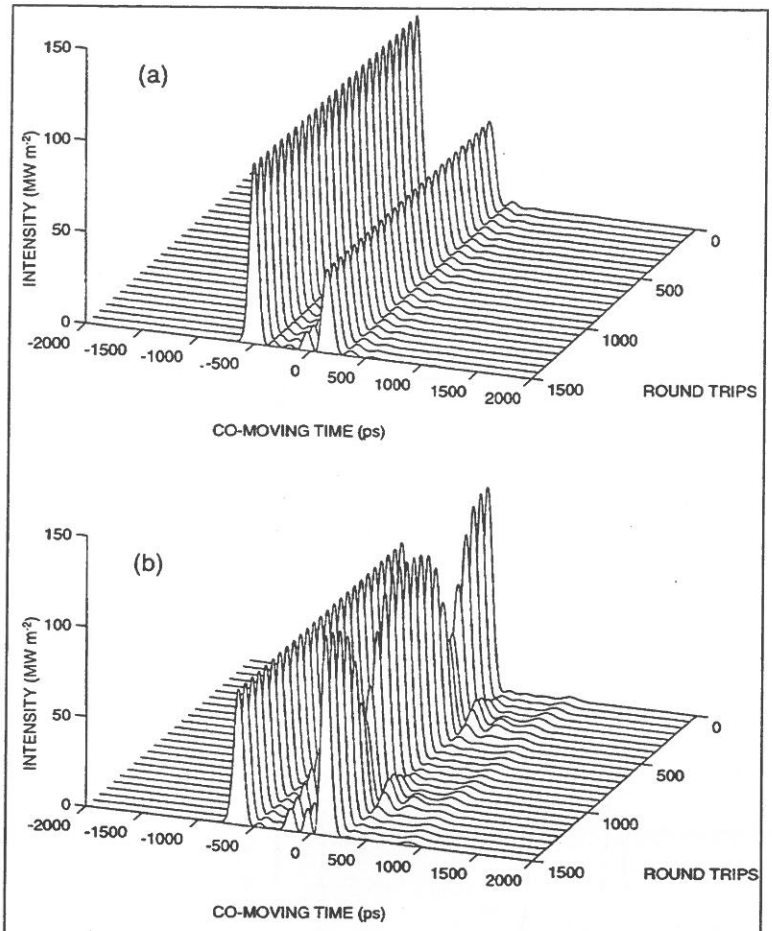

Figure 3: Simulation results showing the transition from the stable double-pulse regime into the unstable regime where the satellite pulse is observed to undergo regular fluctuations in amplitude and position. Fig. 3(a) corresponds to the stable double pulse position of Fig. 2, while Fig. 3(b) corresponds to a cavity which has been shortened by 50 μm.

Significantly, these satellite instabilities appear to arise from the macroscopic dynamic interplay between the various gain and loss shaping elements in the laser, and the effect of quantum noise is insignificant in this regime. The instabilities are found in numerical simulations where the effect of quantum noise is turned off, and the results are interpreted as a manifestation of a chaotic instability present in the purely semiclassical description of the modelocked laser. The comparison with numerical simulations is presently only at an early stage, but initial agreement is very encouraging, with the simulations qualitatively reproducing both the development of the pulse structure and the evolution of the noise characteristics as a function of cavity detuning [12].

5. Conclusions

These studies have shown that the modelocked argon ion laser exhibits a rich range of behaviour which can be fully explained only by a fully quantum-mechanical model of the interaction between the gain medium and the circulating pulse. Additionally, we have also found qualitatively similar behaviour in a modelocked krypton laser. When the pulse characteristics are investigated in detail, we have found that there is no regime where the widely applied rate equations provide an adequate description of its operation. Even in the low-Q limit, differences appear between the predictions of the full theoretical description and the rate-equation model which have their origin in the inhomogeneous nature of the ion laser gain medium.

We conclude that the argon laser is not a unique pathological case, and that in all laser systems operated with sufficiently large intracavity power similar differences will occur between the observed laser operation and the predictions of simple rate-equation theories. The most promising laser class in which the signatures of resonant coherent interactions may be observed is that of self-modelocked solid state lasers, but we note that in these condensed matter systems, strong dispersive effects, not present in gas lasers, can mask the effects of coherent interactions. We anticipate, however, that with increasing advances in the performance of modelocked laser systems the fully coherent Maxwell-Bloch equations, augmented by the addition of quantum noise terms if necessary, will need to be used increasingly for a full understanding of the operation of modelocked lasers.

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SPIE Annual Symposium a Success in New Location

More than 5000 attended SPIE's International Symposium on Optical Science, Engineering, and Instrumentation, held the week of 4-9 August in Denver, Colorado.

Relocated from San Diego for the first time in more than 25 years due to the Republican National Convention taking over the San Diego Convention Center, the symposium, attracted an enthusiastic audience in its new, temporary home. The technical registration numbers were up over last year, and exhibitors were pleased with the turnout.

SPIE Technical Director Terry Montonye said interest was high in the technical sessions, and pointed out several highlights: A conference entitled "GOES-8 and Beyond" (SPIE Volume 2812) dealt with technical issues associated with the GOES weather satellites. Also well attended were "Hyperspectral Remote Sensing and Applications" (Vol. 2821) and "Photonics and Radio Frequency" (Vol. 2844). A Critical Review conference of invited papers on "Polymers in Optics: Physics, Chemistry, and Applications" also attracted a large audience.

Special presentations included a forum on "CORONA: The World's First Optical Reconnaissance Satellite," and a "town meeting" on optics, conducted by the Committe on Optical Science and Engineering of the U.S. National Research Council.

SPIE's 41st Annual Awards Banquet included the following presentations:

Gold Medal of the Society:
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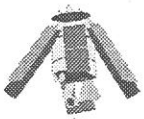

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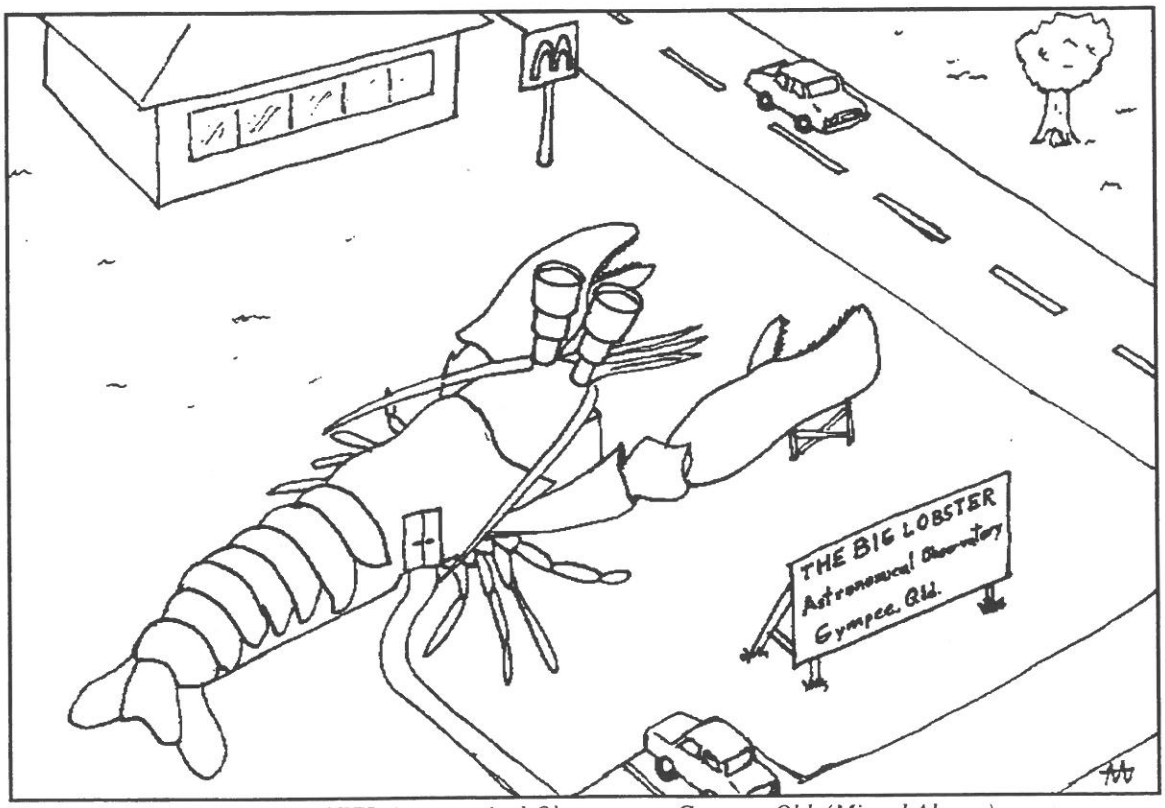

The BIG LOBSTER Astronomical Observatory, Gympee, Qld. (Miguel Alonso)

Lobster-Eye Optics at the University of Melbourne

Andrew Peele
Optics Group, School of Physics
University of Melbourne, Parkville VIC 3052

Evolution and the epicurean adventures of optical researchers combined to show the way for x-ray astronomers. Now advances in the microelectronics industry are making possible the construction of artificial lobster eyes which may one day gaze upon the Crab nebula in an all-crustacean space encounter.

1. Introduction

The development of lobster-eye optics is a fine example of how different threads of research can eventually be woven into an entirely different story. That story involves the use of devices based upon the lobster eye design which may be used to focus x-rays and is the subject of ongoing research at the School of Physics at the University of Melbourne.

A brief disclaimer: this article is intended to impart the flavour of some of the work we have done in this area. Please feel free to contact us at the Optics Group for more information.

Independent research by Vogt [1] and Land [2] in the 1970's identified and explained the fascinating optical system employed by the macruran crustaceans, which includes the lobster and the shrimp. The lens of these animals, rather than being based on refraction, is a mirror system. The mirrors in this case are arranged as a regular grid of square tubes Fig. 1 shows the eye of a local prawn, kindly donated by a local restaurateur, which has been somewhat distorted after cooking. The entrance to the, essentially, square tubes can be seen.

The focusing action is readily deduced from Fig. 2 which shows a side view of the channels. Rays from one direction will be brought to a line focus (in and out of the page in Fig. 2) after a single reflection. A second line focus is formed by reflections from the orthogonal set of channel walls. Rays which reflect once from each of the pairs of orthogonal walls in a channel are brought to a central focus at the intersection of the two line foci. Rays which do not reflect form a chequered shadow pattern over the whole image. The analysis also works for higher numbers of reflections - odd numbers of reflections focus and even numbers don't.

The matter may have remained there as an optical curiosity were it not for a paper in 1979 by Angel [3]. The construction of x-ray mirrors is complicated by the fact that small grazing angles of incidence are required. If the angle is too high the x-rays will be absorbed by the mirror. A lobster eye with a large radius of curvature will present many grazing angle mirrors to rays from a given direction thus reflecting a large amount of the incident flux into the focal cross. Additionally, the spherical shape of the lens means that rays from all directions will be accepted thus providing a focusing system with full sky coverage.

2. Australia Picks up the Threads

At about the same time the opto-electronics industry was developing the microchannel plate ('MCP') for use as an electron multiplier. An MCP is an array of precisely aligned capillaries of small, usually circular, cross section. MCP's are commonly made with millions of channels with diameters of 10 μm or so.

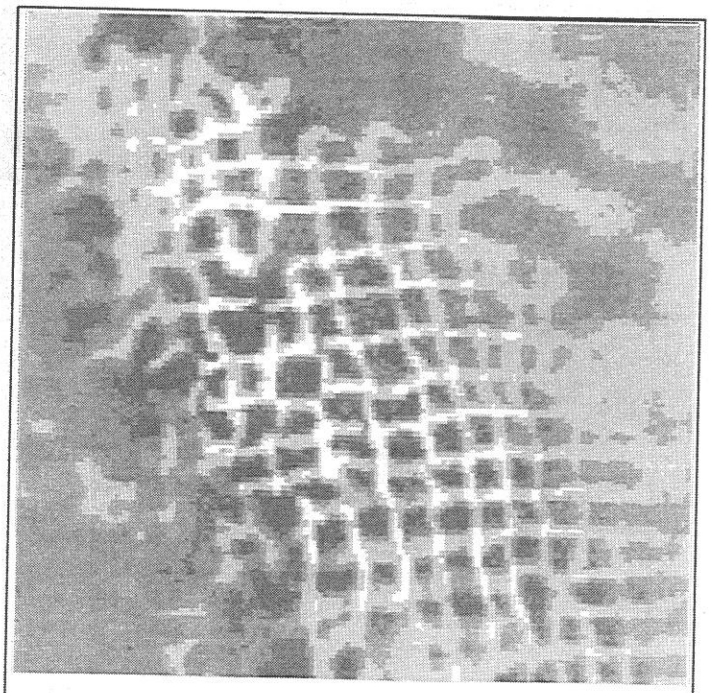

Figure 1: *Prawn's eye - cooked and magnified*

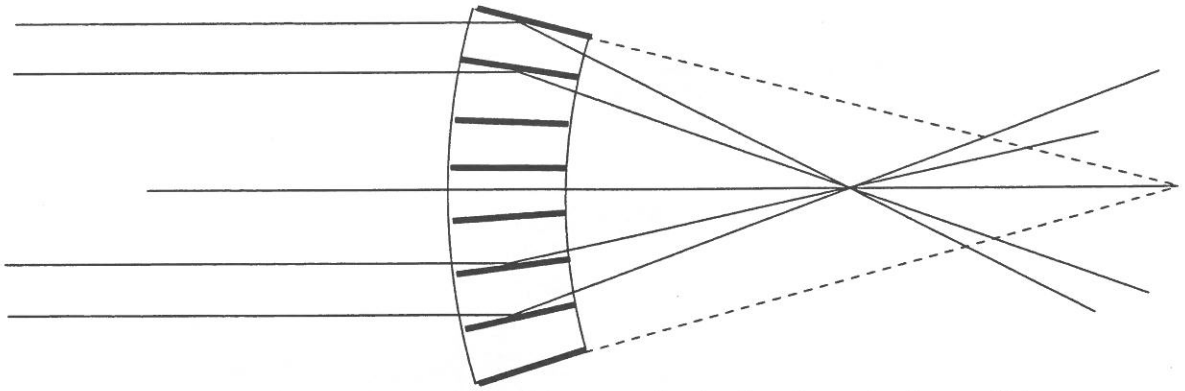

Figure 2: *Side view of channels in a lobster eye showing focusing action for parallel rays.*

The threads began to be drawn together in 1989 when Steve Wilkins of the Division of Materials Science and Technology, CSIRO, suggested the use of MCP's for x-ray focusing [4]. Keith Nugent of the University of Melbourne pointed out that square channels should be by far the most effective configuration. With Steve Wilkins, Keith enlisted Henry Chapman as a graduate student to develop these ideas. Henry was quickly able to demonstrate the efficacy of square cross section channels over circular channels [5]. In theory square channels can focus more than two orders of magnitude more efficiently than circular under the right conditions. It was only after this stage that the connection to lobsters and Angel's paper was revealed and the picture completed.

The initial period of research in the early 90's concentrated on the theoretical potential of square channel MCP's. The relationship between the proportion of flux being focused into each of the focal arms, the central focus and the background and the thickness of the array was derived [5]. The resulting curves for hard x-rays have a pleasing form and, importantly, has a clear maximum for flux into the central focus at a particular array thickness for a given channel size (see Fig. 3). The shape of the curves varies as the energy of the x-rays decreases but there is still an optimum value for the array thickness for a given channel size.

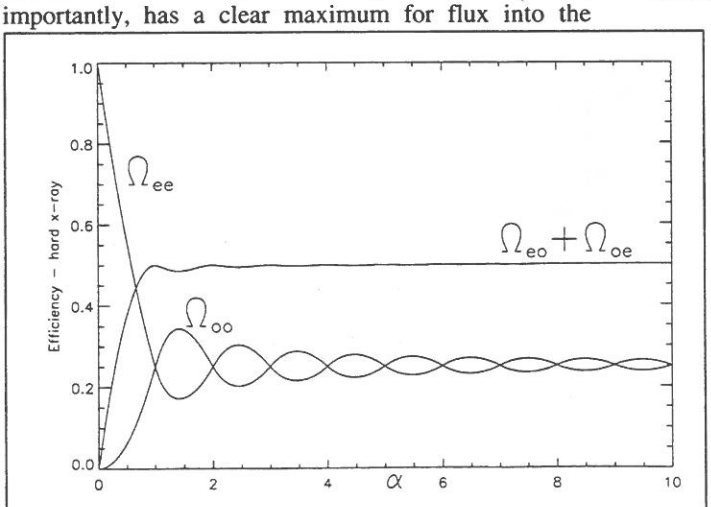

Figure 3: *Efficiency for hard x-rays for focal arm reflections(oe+eo), central focus reflections (oo), and non-focusing reflections (ee). The horizontal axis here is* $\alpha = t\theta_{crit}/d$, *where* θ_{crit} *is the critical angle of reflection, t is the array thickness and d is the channel width.*

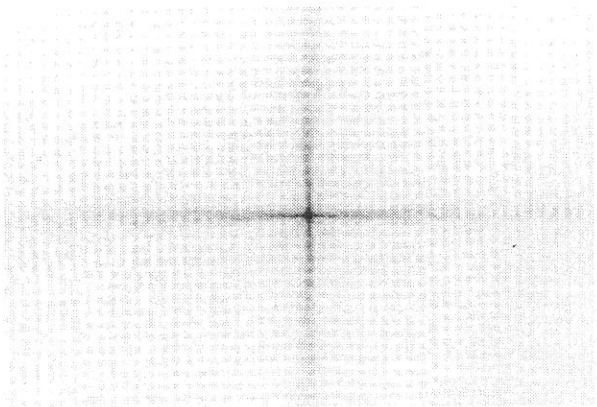

Figure 4: *Focal cross formed by an MCP.*

Experimental work was initially less successful as results from square channel MCP's deviated markedly from theory due to defects in the MCP's. Work with circular MCP's showed that these MCP's performed much more closely to theoretical expectations [6]. This is perhaps not surprising. The opto-electronics industry had, for various reasons, concentrated almost exclusively on circular MCP's. Twenty years of practice had produced MCP's which were very close to perfect. However, a small number of MCP manufacturers then began to improve their techniques for making square channel MCP's with spectacular results. In 1993 the first cross focus from an MCP was reported [7] and more recently we have demonstrated extremely high quality focusing from a square MCP [8] (see Fig. 4).

3. Lobster-eye telescopes

In the meantime, we (the author, K. Nugent, W.C. Priedhorsky and C.T. Chantler) undertook research pursuing Angel's suggestion for a lobster-eye telescope. The impetus for this

approach lies in the realisation that traditional designs for non-focusing x-ray all-sky monitors have reached a practical limit. An instrument which demonstrates an order of magnitude increase in sensitivity over existing designs would need to be of the order of ten tonnes in mass - a fairly large satellite project. Our design targets the NASA small to medium explorer funding category and, with a total instrument mass under two hundred kilograms, is suitably diminutive. Using computer modelling we simulated the performance of a lobster-eye telescope. Rather than use a hemispherical lens and detector, which would be difficult to construct, the telescope is made up of a number of smaller segments which spin to provide full sky coverage. Other features included in the modelling are the size of the Nickel coated MCP channels, 200 μm, the effect of a detector window and finite detector resolution and duty cycles due to lens coverage, radiation belts and earth and sun occultation.

The thickness of the array was set at the optimum thickness for flux into the central part of the cross focus. In this optimising process the incident spectrum was, appropriately enough, assumed to be that of the Crab nebula between 0.5 and 3.5 kV. Using the model it is possible to calculate the expected number of source and background counts in each pixel of the detector for various sources. Fig. 5 shows an example of a simulated image of the LMC (Large Magallenic Cloud). The expected detection sensitivity is an order of magnitude better than for existing instruments for comparable integration times.

The implications of this increase in sensitivity for an all-sky monitor are exciting both in the new avenues of astrophysics research which may be followed as well as what it means for developing existing fields of astrophysics. Not only will it be possible to build up an x-ray all-sky catalogue in unprecedented detail but studies of time variability for large numbers of sources will be possible.

We have discussed the makeup of the model, the simulation results and the astrophysical implications in detail elsewhere [9]. A partial catalogue of the expected survey capabilities of the telescope modelled by us is shown in Table 1. However, at present the real question is can such a lobster-eye telescope be made.

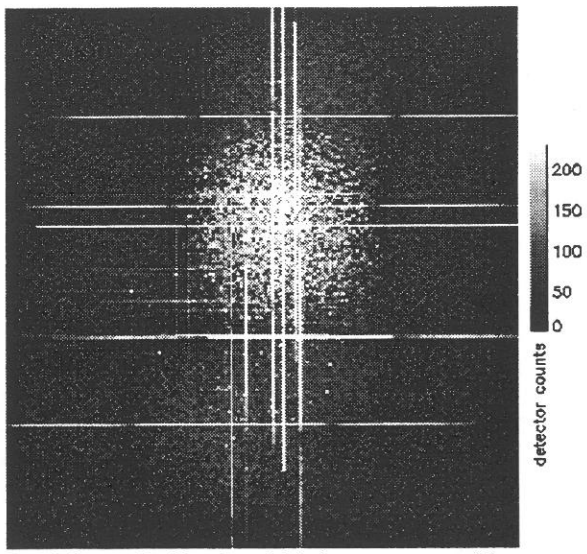

***Figure 5** : Simulated 10 day exposure of Large Magallenic Cloud as seen by a lobster-eye telescope.*

4. Soft x-ray testing facility

To help answer this question we have constructed an experimental facility at the School of Physics which allows for testing of MCP samples. The facility consists of a standard electron bombardment laboratory x-ray source, a sample chamber with sample stages and a ccd

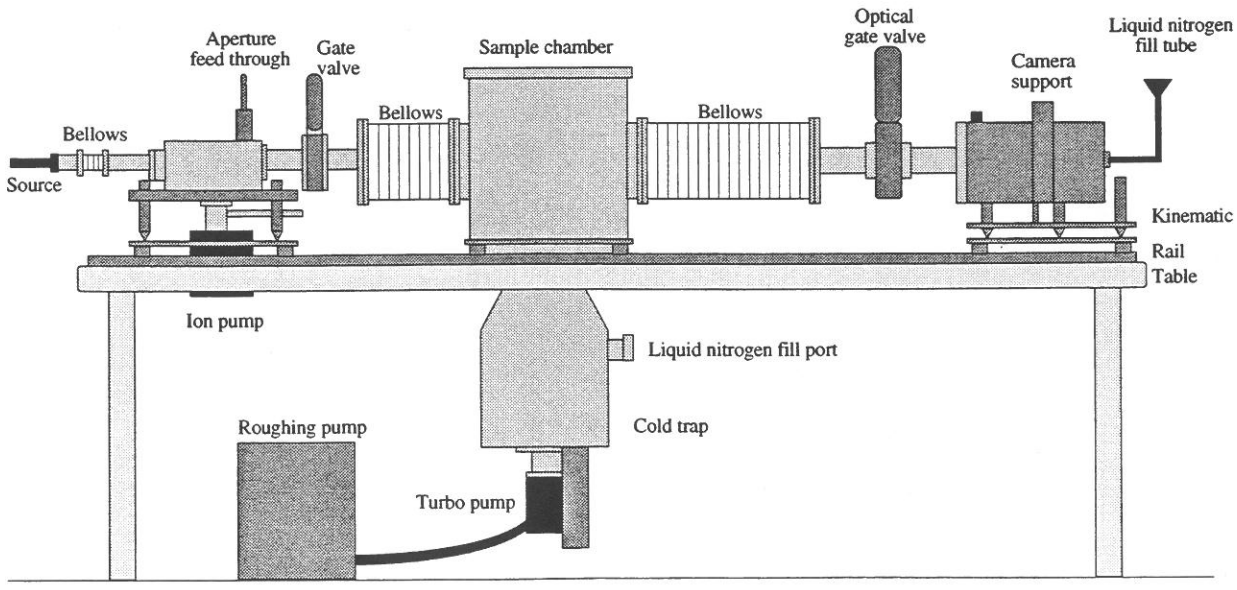

***Figure 6:** Schematic of our soft X-ray testing facility*

camera for a detector (see Fig. 6). The source is currently equipped with an Aluminium and a Magnesium target (characteristic Kα energies are 1.49 and 1.25 keV respectively) which allows us to test samples at two different energies within our bandwidth of interest; 0.5 - 3.5 keV. The entire system is evacuated to avoid the problem of excessive absorption at our low operating energies. To date we have successfully verified our earlier MCP results obtained from overseas and have undertaken some further testing with new MCP samples.

Table 1: A partial census of LOBSTER source measurements.

Class of Object	Number Monitored
Targets monitored daily to 20%	
Galactic x-ray binaries	~ all
LMC x-ray binaries	20
Cataclysmic variables	120 - 400
Coronal sources	1000
AGN	1000
Fast transients	
"HEAO A-2" transients, t = 60 - 2000 s	1000 - 10,000 yr^{-1}
"Ariel 5" transients, t = 0.1 - 2 d	7000 yr^{-1}
Gamma ray bursts*	160 yr^{-1}
Type II supernovas*	25 yr^{-1}
Surveys	
Weekly (Rosat limit)	50,000
Deep (6 months)	1,000,000

* Detection limit

5. Fabrication Facility

In addition to the above testing facility, there has been considerable effort in a different direction to fabricate multi-channel plates locally in the School of Physics for thermal neutron and X-ray optical applications, particularly involving Dr Cimmino and Shaun Griffin [10].

Issues which we hope to address in future experiments include the following. Can MCP's, which are produced flat, be curved as required for a telescope without damaging the regular channel structure which is so important to high quality focusing? Can Nickel or some other material be coated on the inside surfaces of MCP's to improve reflectivity without degrading quality? (A. Cimmino and A. Nikulin have helped to address this question). Can MCP's be assembled into the large area needed for a telescope with sufficient accuracy? Can MCP's of sufficient quality to match the predicted results of our modelling be made? Other interesting matters such as what is the optimal tiling layout for the MCP's in the telescope segments should also be investigated. The direction of rays after reflection from the MCP, and therefore the quality of the focus, is governed in part by the physical orientation of the array surfaces. Another matter to come to grips with is how much of the focal blur is due to the misorientation of channel surfaces and how much is due to diffuse scatter caused by surface roughness. It is necessary to know this information so that improvements to MCP's can be made.

6. More Information

Apart from the published papers more information on lobster-eye optics may be found at our web sites

http://optics.ph.unimelb.edu.au/~peele/lobopt.html
http://optics.ph.unimelb.edu.au/~peele/lobsat.html

we have also developed an educational package of pages suitable for overhead transparencies which may be downloaded.

http://optics.ph.unimelb.edu.au/~peele/lobdocs/lobdocs.html

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Sign seen on laser lab wall : "Do not look into laser with good eye"!

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XX International Quantum Electronics Conference (IQEC'96)

Jim Piper (Chair, IQEC'96)
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A report on the 20th International Quantum Electronics Conference held at Darling Harbour, Sydney, 14-19 July 1996.

Nearly 800 registrants, exhibitors and accompanying persons made the 20th International Quantum Electronics Conference, held at the Sydney Convention and Exhibition Centre last month, a great success.

IQEC is the premier international conference in quantum electronics, including laser physics and spectroscopy, atom and quantum optics, optical materials, nonlinear optics, ultrafast phenomena, photonics and applications. IQEC'96 represented the first time the conference had been held in the southern hemisphere. It was a unique opportunity for quantum electronics researchers in Australia and New Zealand to participate in this top international conference in large numbers. Of the 600 papers presented at the conference, 125 reported results of groups and individuals from Australia, and 20 from New Zealand. Registrations from Australia and New Zealand topped 250, over 100 of these being students.

The registration list read like a who's who of the top international researchers in the field, and the extremely high standard of papers delivered was the subject of much comment (as indeed was the superb Sydney weather all week!). The Plenary Sessions commenced with a superb talk by Eric Cornell (JILA-NIST, University of Colorado), which set the scene for outstanding sessions in Bose-Einstein condensation, atom optics and squeezing which followed over the next few days. Nobel Laureate, John Polanyi (University of Toronto) spoke about the photochemistry of absorbates and clusters, and David Miller (formerly of Bell Labs and now at Stanford University) gave an excellent talk reviewing the physics and applications of semiconductor quantum well devices. The latter talk prefaced a number of excellent sessions covering advanced photonics and optical communication, a thrust in quantum electronics which will be very evident in subsequent IQECs.

Besides the plenaries, another highlight of the conference was the AM Prokhorov 80th Birthday Symposium. Professor Prokhorov could not be present due to ill health but sent a personal message and was well represented by Professors Bagayev and Manenkov of the Russian Academy of Science. Dr Bill Krupke (Lawrence Livermore National Laboratories) and Professors Bob Byer (Stanford University) and Herbert Walther (Max Plank Institute) gave outstanding reviews of progress in solid-state lasers, nonlinear materials and quantum optics respectively. The five tutorials were also very popular, representing a convenient way to catch up

Plenary speakers at the conference were Nobel Laureate in Chemistry, Professor John Polanyi (centre) and Dr David Miller (right), pictured with Professor Jim Piper

on developments in diverse areas of quantum electronics in lectures delivered by experts: Waveguide lasers (David Hanna, University of Southampton); Ultrashort pulse sources (Ursula Keller, Swiss Federal Institute of Technology); Quantum computation (Artur Eckert, University of Oxford); Semiconductor light emitters (Claude Weisbuch, Ecole Polytechnique Palaiseau); and Optical pattern formation (Luigi Lugiato, University of Milan).

There were 10 invited papers from Australian labs., one from CSIRO Division of Materials Science and Technology and University of Melbourne, four from the Laser Physics Centre RSPE and Physics Department, ANU, one from the University of Queensland, one each from the University of Sydney, the Australian Photonics CRC, University of Melbourne and Macquarie University. The latter given by graduate student Antonio Lauto on laser-solder repair of nerves, had standing-room-only available in the meeting room. As well as the oral presentations, there were over 250 papers presented as posters, the latter proving very popular for informal discussion which lasted well beyond the formal session times.

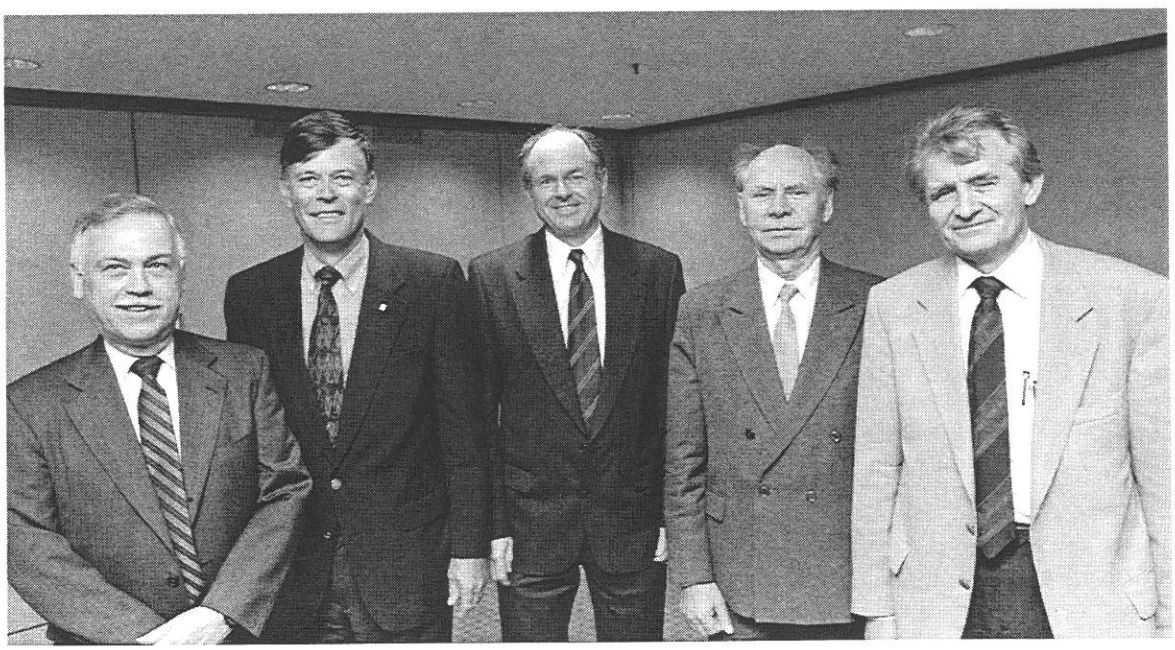
The Technical Exhibition had 28 booths, all of which had a high standard of presentation. Pretty well every Australian distributor of components and equipment for experimental quantum electronics were at the exhibition plus several overseas suppliers. The exhibitors were certainly pleased with the exposure and sales leads that they got at the conference and registrants enjoyed the leisurely atmosphere for their discussions with suppliers.

The IQEC'96 social functions also proved to be very popular, with over 800 people cramming into the Harbourside Room of the Convention Centre for the Conference Reception. The postdeadline function helped about 600 attendees to unwind later in the week. The lucky "red-spot" attendees had a great night cruising and dining on Sydney Harbour in a special function to thank invited speakers, committee members and sponsors.

In all, and despite the various crises and problems which seem to be inevitable in running such meetings, IQEC'96 seemed to be highly successful as an international scientific meeting, as an advertisement for ANZAC science, and as a window on Sydney and Australia.

The Organising Committee would like to thank again the various sponsors and guarantors, without which the conference would not have been financially viable. These were: the Australian Academy of Science, the Australian Optical Society, the Australian Photonics CRC, the BHP Co., the International Conference Support Scheme (Commonwealth Government), the International Union of Pure and Applied Physics, Coherent Scientific Pty. Ltd. and Coherent Inc. (USA), Lastek Pty. Ltd. and Spectra-Physics (USA), Laser Resource Management Pty. Ltd. and Rofin-Sinar, the Commonwealth Special Research Centre for Lasers and Applications and Macquarie University.

Copies of the IQEC'96 Technical Digest containing summaries of all papers including postdeadline papers are available at a per item cost of A$60 plus postage from Chair IQEC'96, Centre for Lasers and Applications, Macquarie University, NSW 2109, Australia, or the Optical Society of America, Washington DC. Copies of the IQEC'96 Technical Exhibition Guide containing all exhibitor addresses and product information are also available at $5 each.



General Chair of the IQEC'96, Professor Jim Piper (Director Macquarie Centre for Lasers and Applications) with (from left) Bill Krupke (Head, Laser Directorate, Lawrence Livermore National Laboratory), Professor Bob Byer (Stanford University), Professor Alexander Manenkov (Russian Academy of Science, Moscow) and Professor Sergie Bagayev (Russian Academy of Science, Siberia).

Tropical Quantum Optics

David T. Pegg
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A report on the Quantum Optics conference which was held at the Novotel Palm Cove Resort, Cairns, North Queensland on the 8th and 9th July 1996 as a satellite meeting to IQEC'96.

Introduction

A quantum optics conference was held at Palm Cove, Cairns, as a satellite meeting to IQEC'96 in Sydney in July 1996. The conference was held in conjunction with, and preceded, a satellite Atom Optics meeting. As the first international quantum optics conference of its type to be held in Australia, the response was very pleasing, with about eighty participants from eighteen different countries. The conference itself was also very pleasing and instructive provided, of course one could manage to concentrate on physics in absolutely delightful weather in idyllic surroundings. Masking some of the memory of the conference is also the memory of a trip to the Great Barrier Reef where we found that snorkelling in crystal clear water at a perfect temperature among fantastic fish and coral, followed by a visit to a small picture-postcard tropical island, could also turn the conversation away from squeezed states and cavity quantum electrodynamics. In this article I shall try to put aside such memories and recall some of the topics and talks which, to me at least, made the physics at the conference also memorable.

The programme

The conference was divided into sessions on cavity quantum electrodynamics; lasers and quantum fluctuations; spatial effects; information, computing and solitons. A combined session on Bose-Einstein condensation was held with the Atom Optics conference.

The conference opened with a talk by P. Knight of Imperial College describing how the radiative dynamics of atomic transitions can be modified, quite severely at times, when the atom is confined in a structure with at least one dimension of the order of the wavelength of the light from the transition. Such effects have been known for quite some time, but Professor Knight brought us up to date rapidly in the area and discussed some interesting new effects, for example in planar cavities where the output radiation can be engineered as a Bessel beam which does not undergo diffraction as it travels [1]. This was followed by a talk by S. Barnett of Strathclyde University expanding on his work with Huttner [2] and other collaborators in formulating a fully canonical theory of light in a dielectric, with particular reference to light inside a dielectric cavity. The third talk was by R. Knops of Eindhoven University of technology. He spoke about progress made so far towards conducting a quantum non-demolition experiment to measure directly the photon number in an optical cavity by the deflection of atoms. One of the motivations of this work is to obtain direct proof of the quantisation of the field as other tests, such as photon antibunching were considered to be too indirect. I must confess that I was not absolutely convinced about this point.

H. Carmichael of the University of Oregon, began with a statement that he had not actually published anything on the subject of lasing without inversion, and then proceeded to give an admirably lucid exposition of the topic. The concept of lasing without inversion, or perhaps more appropriately gain without inversion has been with us for some time since it was first raised by M. Scully. Indeed it now seems to have become something of an industry. In the early proposals it was argued that although inversion was not apparent it was indeed present but hidden by the particular basis set used to express the atomic states. For example population trapping of some of the atoms in a superposition of the ground states was evident in the first proposals. While these atoms could be considered to have been taken out of the process, if their numbers were still counted, then there was no inversion. Later proposals involved more subtle mechanisms. Professor Carmichael used the quantum trajectory approach to make more transparent what was actually going on in the process. He found that in a recent experiment [3] demonstrating gain without inversion there was actually a hidden inversion, though not of the inappropriate basis type. The hiding place this time is actually the time average, with the inversion of each atom turning on and off stochastically. P. Mandel of the Université Libre de Bruxelles also spoke about gain without inversion, in a three-level V scheme. He showed that the origin of the gain can be ascribed to destructive interference that reduces the absorption process but which does not affect the amplification. I have always wondered if there was anything to be gained from this industry which appears to be built solely on a paradoxical sounding title. However if it leads to a better understanding of the processes involved then I guess it has achieved something.

In his talk F. Haake of the University of Essen examined the way an atomic beam interacts with a microcavity field when the average number of atoms in the field is less than unity. Because of random statistics there is a significant probability that there will be two atoms in the field sometimes which can lead to cooperative effects. D. Welsch of the Friedrich Schiller University of Jena spoke about

obtaining quantum input-output relations which are valid in the whole frequency domain for dispersive and absorbing multilayer dielectric barriers. As with the work described in S. Barnett's talk, the importance of the Kramers-Kronig relation was emphasised on the basis of conforming with causality.

The Monday evening session began with a vivid description by L. Lugiato of INFM, Milan, of a new quantum effect which is manifest as spatial correlations in nonlinear optical patterns formed by a degenerate optical parametric oscillator. This was followed by two short talks by M. Babiker of the University of Essex and M. Yamanishi of Hiroshima University. The former described polariton quantisation and cavity quantum electrodynamics in low dimensional systems and the latter described how sub-Poissonian photon fluxes are generated by Stark-effect blockade of emissions in semiconductor diodes driven by constant voltage sources. M. Reid of the University of Queensland gave a very interesting talk introducing a new Einstein-Podolsky-Rosen type concept which she called macroscopic local realism. This is a weaker premise than the usual locality postulate and leads to a new version of the EPR argument, which provides a stronger test than the now experimentally disproved version based on local realism at the microscopic level. A question was asked on how to define macroscopic changes for the individual momentum and position factors of the action product. The Bell inequality theme was continued with a talk by A. Zeilinger of the University of Innsbruck on experimentation involving two-photon Bell states.

Tuesday's session began with N. Imoto of NTT Basic Research Laboratories discussing the principles and problems of quantum information processing, that is, quantum cryptography and quantum computing, which was followed by J. Cirac of the University of Innsbruck speaking on engineering the coupling of a quantum system to an environment to control the type of damping. The talk by H. Wiseman of the University of Auckland partially resolved for me the controversy between the Auckland and Garching groups over whether complementarity or uncertainty is more fundamental in some Welcher Weg experiments.

The session on Bose-Einstein condensates, which was shared with the Atom Optics meeting, was opened with an overview given by K. Burnett of Oxford University, who emphasised the problem associated with the phase of the condensates. C. Gardiner of the Victoria University of Wellington showed how mathematical techniques used in quantum optics could be applied to Bose condensation and the work of C. Cesar of EFTCE - NIT concerned the progress towards BE condensation in Hydrogen. The final talk in this session was by D. Walls of the University of Auckland who gave a talk following on from the recent work of Javanainen and Yoo [4] on the interference of two BE condensates and the implications for the occurrence of a quantum phase.

The final oral session opened with A. Imamoglu of the University of California, Santa Barbara, speaking on microcavity exciton polariton lasers followed by S. Friberg of NTT Basic Research Laboratories describing some experiments with quantum solitons which included quadrature amplitude soliton squeezing, quantum nondemolition measurements and soliton photon-number squeezing. The final talk was by A. Sizman of the Universität Erlangen-Nürnberg who discussed quantum nondemolition measurements using sub-picosecond solitons in optical fibres.

Conclusion

In addition to the oral sessions there were two poster sessions where posters of a consistently high quality were displayed. I shall not attempt to discuss these posters here, as I would not have space to mention them all, and the ones which I would describe would only be those which were of most interest to me personally. I often feel that I gain more from the poster sessions at conferences than from the talks in that I can proceed through the work at my own pace, obtain help from the authors as I need it and, importantly, meet the authors and talk to them on an informal basis. Often a stimulating small discussion group gathers about a particular poster. The poster sessions at the Quantum Optics meeting were no exception to this and seemed to be widely appreciated. I was interested and pleased to see from the posters that research is still active in some of the quantum optics areas which were are no longer regarded as hot topics and further, that this research is still as interesting as it was when these areas were very much in vogue. Another thing one often does at conferences is to try to predict future bandwagons. I decided that it was too hard even to try at this conference.

In conclusion, although as part of the local organising committee I am probably not impartial, I felt that the conference was very successful and enjoyable.

Acknowledgment

On behalf of the remainder of the local organising committee, I would like to thank Bryan Dalton of the University of Queensland for the tremendous ongoing effort he put into the organisation of the conference and for keeping the committee so well informed of developments.

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Workshop on Atom Optics

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A report on the Atom Optics workshop which was held immediately after the Quantum Optics conference at the Novotel Palm Cove Resort, Cairns, North Queensland, June 9 - 11, 1996

The field of Atom Optics - the manipulation of the atomic de Broglie wave in analagous fashion to light optics - has grown rapidly in recent years. The strength of interest in the field was apparent at this international workshop held in Cairns from 9 - 11 June as a satellite meeting to the major International Quantum Electronics Conference (IQEC '96) in Sydney from 14 - 19 June. Nearly 160 scientists from 20 countries attended the Cairns workshop, which was run back-to-back with a meeting on Quantum Optics at the same venue (June 8 - 9). Together these workshops provided the backbone for the attendance at IQEC '96 (with around 700 registrants).

The attendance is even more remarkable given that a major European workshop on Atom Optics was held in Italy just one month beforehand, attracting over 100 registrants of whom 30 or so later attended the Australian meeting. The Australasian contingent reflected the strength of the field in this part of the world, contributing over 50 of the delegates in Cairns. In all, 6 papers by invited speakers, 15 contributed talks and 55 contributed posters were presented over the 3 days of the workshop.

This high level of interest reflects the rapid progress and diversification in the field. A highlight of achievement in physics in recent times has been the laser cooling of atoms to nanokelvin temperatures to produce the first Bose-Einstein Condensate (BEC). This was a major theme of the conference which was attendedby Eric Cornell from the first group to achieve BEC in Boulder, Colorado. The first experiments on the physics of the condensate have now been performed, with the measurement of vibrational modes of this macroscopic quantum state.

Significant advances have also been made in atom interferometry which has been used to very sensitively measure fundamental quantites. For example, Steven Chu of Stanford University reported on precision measurements of the fractional change in little g which has the potential to surpass conventional gravimeters in sensitivity. Still others reported progress on other atom optical components, such as mirrors based on magnetic fields (Maclean from Melbourne and Wynands from Bonn) and evanescent light waves (Aspect from Paris). Hollow optical fibres which use evanescent light fields to guide the atoms through the fibre were also reported by the Boulder group (Cornell) and the Seoul/Tokyo collaboration (Jhe).

Applications of atom optics are now being actively pursued, particularly in atom lithography. Using a hologram made from coded apertures in a SiN membrane, the interference pattern produced by the de Broglie waves of cold neon atoms was used to write structures with sub - 100 micron resolution (Shimizu, Tokyo). Even greater resolution can be obtained using mask lithography of photoresists which are exposed to energetic metastable rare gas atoms, with edge structures as small as 30 nm being reported in Konstanz (Mlynek) and Harvard (Johnson).

A special session was devoted to the comparison of other matter wave optics techniques. The state of the art in neutron interferometry was reported from a number of perspectives (Klein, Melbourne; Werner, Missouri; and Zeilinger, Innsbruck). Comparisons were also made with interferometry using charged particles (Hasselbach, Tubingen). There was clearly something to be learnt from all forms of particle optics, with the maturer fields pointing the way to future directions for the unique properties of atom optics, with its ability to control both the internal state and momentum of the atom.

The future of atom optics was also the subject of a panel discussion for the final session of the conference. There was a sense that although atom optics was a fascinating field with some beautiful demonstration of principles through the ability to directly reproduce and extend light optics, there was a need for the field to put something back into the rest of science through useful applications. Many ideas were put forward, including lithography for nanostructure fabrication, interferometry for the measurement of gravity fields for mineral exploration, and atom tweezers for biological applications. However, recent progress in BEC might indicate that perhaps the most potent tool may be the equivalent of the laser which was given to science by optics - the production of a coherent source of amplified atomic de Broglie waves - or an atom "laser".

******

A Special Issue on Atom Optics including many of the advances presented at the Elba and Cairns conferences has been published in "Quantum and Semiclassical Optics" (Journal of the European Optical Society Vol. 8, No.3). Copies of the Special Issue may be obtained from Prof. Hans Bachor, Physics Department, Faculty of Science, The Australian National University, Canberra ACT 0200: Tel (61) 6 249 2747, Fax (61) 6 249 0741; email: hans.bachor@anu.edu.au

Meetings Calendar at a Glance

Date	Meeting	Contact	Location
Oct 1	9th Symposium on Optical Fiber Measurements	OSA	Boulder, Colorado
Oct 7	EUROPTO Series: Imaging Sciences and Information Services	OSA	Berlin, Germany.
Oct 14	Micromachining and Microfabrication	SPIE	Austin, Texas
Oct 15	Optoroute'96-Photon'96 (Information highways)	OSA	Grenoble, France
Oct 16	AIPR Workshop	SPIE	Washington, DC
Oct 20	OSA `96 Annual Meeting	OSA	Rochester, N.Y.
Oct 20	Optics and Imaging in the Information Age	OSA	Rochester, NY
Oct 20	Optical Fiber Communication (OFC '97)	OSA	Dallas, Texas
Oct 20	Interdisciplinary Laser Science (ILS-XII)	OSA	Rochester, N.Y.
Oct 22	Ocean Optics XIII	SPIE	Nova Scotia, Canada
Oct 22	5th Int. Conference on Plastic Optical Fibres and Applications	EOS	Paris, France
Oct 27	High Speed Photography, Videography, and Photonics	SPIE	Santa Fe, New Mexico
Oct 27	Massively Parallel Processing Using Optical Interconnections	OSA	Maui, Hawaii
Nov 4	Photonics China '96	SPIE	Beijing, China
Nov 4	Automated Optical Inspection for Industry (AOII)	SPIE	Beijing, China
Nov 18	Photonics East	SPIE	Boston, Massachusetts
Dec 1	ACOFT'96 Australian Conference on Optical Fibre Technology	-	Gold Coast, Queensland
Dec 3	Nondestructive Evaluation Techniques for Aging Infrastructure	SPIE	Phoenix, Arizona
Dec 10	Photonics and Fibre Optics (Photonics India 96)	SPIE	Madras, India
	1997		
Jan	International Conference on Quantum Optics and Laser Physics	OSA	Hong Kong
Jan 26	Advanced Solid-state Lasers Topical Meeting	OSA	Orlando, Florida
Feb 8	Photonics West '97 (Inc. Optoelectronics,LASE '97,BiOS'97,EI'97)	SPIE	San Jose, California
or 14?	- Optoelectronics, High-Power Lasers (LASE '97) - International Biomedical Optics (BiOS '97) - Electronic Imaging Science and Technology (EI '97)		
Feb 9	Winter Topical Meetings - Optical Remote Sensing of the Atmosphere - Light and Color in the Open Air - Fourier Transform Spectroscopy - Chemistry and Physics of Small-Scale Structures - Vision Science and Its Applications (Jan 30)	OSA	Santa Fe, New Mexico
Feb 16	Optical Fiber Communication (OFC '97)	OSA	Dallas, Texas
Feb 22	Medical Imaging '97	SPIE	Newport Beach, California
Mar 2	The 10th meeting on Optical Engineering in Israel	EOS	Jerusalem, Israel
Mar 2	Smart Structures and Materials	SPIE	San Diego, California
Mar 3	EUROPTO : Optics and Optoelectronics for Environmental Safety	SPIE	Wiesbaden, Germany
Mar 10	Microlithography	SPIE	Santa Clara, California
Mar 18	Spring Topical Meetings - Spatial Light Modulators - Ultrafast Electronics and Optoelectronics - Quantum Optoelectronics	OSA	Lake Tahoe, Nevada
Mar 19	Applications of High Field and Short Wavelength Sources	OSA	Santa Fe, New Mexico
April 2	8th European Conference on Integrated Optics	OSA	Stockholm, Sweden
April 20	AeroSense : Aerospace/defence sensing and controls	SPIE	Orlando, Florida
April	3rd Int. Conf. on Optical Fiber Submarine Telecomm. Systems	OSA	t.b.a
April	European Symposium on Space Optics II	EOS	t.b.a.
April	Photomask Japan	SPIE	Kawasaki City, Japan
May 18	Lasers and Electro-Optics (CLEO '97)	OSA	Baltimore, Maryland
May 18	Quantum Electronics and Laser Science (QELS'97)	OSA	Baltimore, Maryland
June 4	Pattern Recognition in Practice V	IAPR	Vlieland, Netherlands
June 16	LASER MUNICH'97 - European Symposium on Environmental Sensing III - European Symposium on Lasers and Optics for Research and Man. III - European Symposium on Microelectronics Manufacturing I	EOS	Munich,Germany
July	Materials for Nonlinear Optics	EOS	Capri, Italy
July 7	Topical Meeting on Diffractive Optics	EOS	Savonlinna, Finland
July 20	Optical Amplifiers and their Applications	OSA	Victoria, Canada
July 27	SPIE Annual Symposium	SPIE	San Diego, California
Aug 26	OIST'97	EOS	Moscow, Russia
Sept 9	EUROPTO Series: BiOS Europe V (Biomedical optics)	SPIE	Italy
Sept 17	Photomask Technology and Management	SPIE	Santa Clara, California
Sept 22	EUROPTO Series: Satellite remote sensing IV	SPIE	France
Sept 22	11th Int. Conf. on Integrated Optics and Optical Fiber Comm.	OSA	Edinburgh, UK

Sept 22	**23rd European Conference on Optical Communication**	OSA	Edinburgh, UK
Sept 28	**Photonics East**	SPIE	Philadelphia, Pennsylvania
Oct	**Micromachining and microfabrication**	SPIE	Austin, Texas
Oct	**Microelectronic Manufacturing**	SPIE	Austin, Texas
Oct	**Applied Imagery Pattern Recognition Workshop**	SPIE	Washington, DC
Oct 11	**OSA'97 Annual Meeting** **- Interdisciplinary Laser Science Conference (ILS-XIII)** **- Organic Thin Films for Photonics Applications**	OSA	Long Beach, California.
Oct 18	**Fall Topical Meetings** **- 12th International Conference on Optical Fiber Sensors** **- Photosensitivity and Nonlinearities in Guided Wave Optics** **- Glass and Optical Materials Division (GOMD) Meeting**	OSA	Williamsburg, Virginia
Dec	**AOS Bi-Annual Conference**	AOS	Adelaide, SA
	1998		
Feb 22	**Optical Fiber Communication Conference (OFC'98)**	OSA	San Jose, C
Mar 23	**European Symposium on Advanced Networks and Imaging Technologies II**	EOS	United Kingdom
May 3	**CLEO**	OSA	San Francisco, CA
June 8	**European Symposium on Environmental Sensing IV**	EOS	Lyon, France
Sept 11	**Biomedical Optics Europe VI**	EOS	t.b.a.
Sept 21	**European Symposium on Satellite Remote Sensing V**	EOS	Florence, Italy
Oct ?	**Photonics Europe'98**	EOS	Paris, France
Oct 3	**OSA Annual Meeting**	OSA	Baltimore, MD
	1999		
May 16	**CLEO**	OSA	Baltimore, MD
Feb 21	**Optical Fiber Communication Conference (OFC'99)**	OSA	San Diego, CA

This list of optics related conferences is compiled from several sources and should be used as a guide only. Further information can be obtained from :

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All the wrong signals

(Press release from FASTS regarding university budget cuts).

Moves to cut science university funding by millions of dollars will jeopardise Australia's future as an innovative and technologically advanced nation.

"The impacts will be felt a decade from now, "said Dr Joe Baker, President of the Federation of Australian Scientific and Technological Societies (FASTS). Science is being hit by a double whammy. HEC fees for undergraduate courses will nearly double, from $2442 to $4700; and long-delayed salary increases for university staff are being denied yet again.

"This is sending all the wrong signals to students contemplating a career through university training," Dr Baker said. "Australia is trying to built a future as a 21st century leader in the Asia-Pacific region - a place where Asian nations can find solutions to their pressing problems. This particularly relates to natural resources, to the production of clean green food, and its value-added products."

"What's the logic in making science a less attractive career to our best and brightest students?" The Minister has justified big increases on the courses that attract high remuneration for graduates. This is not true of science. Too many young research scientists face underpaid, uncertain careers on short term funding.

"Australia is not being fair to its young scientists and technologists. We already expect these people to go through a rigorous and lengthy training process, and then reward them with poor salaries and a precarious career structure," Dr Baker said.

"Young scientists spend six to ten years completing undergraduate and post-graduate degrees and gaining on the job experience, and then face the prospect of having to live on short-term grants. Higher HEC fees will just add to the burden."

Dr Baker applauded moves by the Government to meet their pre-election commitments in boosting funding for university infrastructure, for post-graduate scholarships, and for collaborative research.

FASTS May circular

The revised FASTS Policy Document will be launched at Parliament House on Tuesday June 18 at 11 am, with formal presentation to Minister Peter McGauran. An invitation will shortly be sent to all Member Societies as well as relevant MPs and prominent representatives of science and technology organisations.

1. Working with the new Government
There is a war of rumour and speculation in government circles in Canberra, and it will continue right up to Budget Day on August 20. It is a time when kites are being flown and waters tested, to gauge just what reaction unpopular policies are likely to get.

The Government is walking a thin line. It came to office promising new standards of honesty and probity, and saying that all election promises would be honoured. Now there are strong messages coming out that these promises are being reviewed, in light of the $8 billion "black hole". It is in danger of being tagged "just another Government."

Ministers are confirming nothing and denying nothing, using the standard line of all Governments that things will be made clear on Budget night. And in some cases it seems that Ministers are trying to cause the maximum disturbance and uncertainty in their portfolio areas - the University sector is one such case.

Minister for Science Peter McGauran has charted a safer path. FASTS has found him open to suggestions and ideas, even if he is not able to give pre-Budget commitments. Other science groups have also been impressed with his handling of the portfolio to date.

But as FASTS said to Minister McGauran last week, the real judgement will have to be reserved until Budget night, when the S&T community finds out how successful he has been in protecting his portfolio against the economic rationalists in Treasury and Finance.

2. Protests and actions
The FASTS media conference at Parliament House on Friday May 31 brought together science groups and the National Farmers Federation to ward off rumoured cuts to S&T funding. This sort of "third-party endorsement" by the NFF of the value of S&T is particularly important in Budget discussions, and avoids the charge that science and technology are self-serving.

The event was a major news item on television news that night, featuring on ABC and Channel 9 and 10 news through the evening. It was on radio news, and gained some print media coverage.

Spokespersons were:
Dr Joe Baker (FASTS), Dr Wendy Craik (National Farmers' Federation), Dr Ray Akhurst (Aust Soc of Microbiology), Professor Derek Robinson (Aust Mathematical Society and AMSC), Professor Bob Crompton (Aust Institute for Physics), Dr Keith Boardman (Academy of Science), Dr Mark Sceats (CRCs Association), Mr Robin Groves (Aust Science Teachers Assoc), Dr Graeme Mann (Aust Soc for Medical Research)

3. University Challenge
The University sector also held a highly successful media event in Parliament House on Monday May 27, with FASTS playing a prominent role in putting the event together. The creation of an historic Alliance of students, staff and administrators was announced, with all groups joining to protest threatened cuts to the University sector.

The event captured a colour photo on the front page of the Sydney Morning Herald, and coverage in other major papers. My advice to the Minister to heal the rift between herself and the University sector was carried in the Canberra Times and the Age. Further actions are planned by the Alliance, including a Press Club lunch, close lobbying of MPs, and other media events.

4. Revised Policy Document
Thanks all the Members who commented on the draft Policy Document circulated last month. It is in its final stages of preparation, and I hope to see as many as possible of you at the launch on June 18 in Canberra.

It will be a good opportunity to indicate the strength of the S&T community to our new Minister, and to meet others with a strong interest in science and technology.

5. FASTS on the Web
The FASTS Web page contains all the basic information, including a list of Member Societies, contact points, the Policy Document, relevant speeches by politicians, and copies of our media releases.

It also indicates links to the Web sites of our Members Societies. If your Society has a Web site and it is not listed, let Graham Johnston know! He has generously volunteered to look after the FASTS site, and his address is: grahamj@extro.ucc.su.oz.au. The Web address is:
http://bimbo.pharmacol.su.oz.au/fasts/fastshome.html

6. ANZAAS Congress in Canberra
I have been asked to Chair the final plenary session, to bring together a day-long discussion on science policy. A range of prominent speakers is offering their thoughts on how S&T can best be utilised by Australia.

Minister McGauran will be there, and the aim of the discussion is to suggest policy directions for the Government to consider.

7. Parliamentary Standing Committee on Industry, Science & Technology
Membership of this Parliamentary Committee was announced on Friday, and is: Hon B. Reid (Lib, Bendigo) Chair, Mrs F Bailey (Lib, McEwan); Mr R Baldwin (Lib, Paterson); Hon D Beddall, (ALP, Rankin) Deputy Chair; Mr R Broadbent (Lib, McMillan); Hon M Evans, (ALP, Bonython); Mr R Evans, (Lib, Cowan); Mr J Forrest (Nat, Vic); Ms T Gambaro (Lib, Qld); Mr H Jenkins (ALP, Scullin), Mr A Morris (ALP, Newcastle); Mr P Nugent (Lib, Vic); Mr G O'Connor (ALP, Corio); and Mr P Zammit (Lib, NSW)

8. Meeting our Members
I have had good meetings this month with members of the Australian Institute for Mining and Metallurgy, the Australian Society for Medical Research, and other groups involved in the media conference at Parliament House.

Joe Baker, President

FASTS June circular

The position of funding for science has not become any clearer over the last month. Minister for Science and Technology Peter McGauran seems confident that he can stave off most of the threatened cuts. This does not sit very happily with announced cuts of 24 per cent to the Department of Industry, Science and Tourism.

I am meeting him next week, and will take the opportunity to raise some of the more persistent rumours of funding cuts with him. These relate to the universities, to CSIRO, to the 150% tax deduction for industry R&D, and to the flow-on effect to CRCs of cuts to associated research organisations. They also relate to the position of Chief Scientist. Will there be a full-time position with adequate support? When will an appointment be made. Despite the Minister's confidence - and his assurances (see item 4) - the alarming rumours persist.

1. Launch of new Policy
The revised FASTS' Policy Document was launched in the Main Committee Room at Parliament House on June 18, and a copy formally presented to the Minister Peter McGauran.

It is a significant revision of the original policy, with new sections reflecting input from Member Societies, Board discussions, and from changing circumstances. Several of the new ideas were picked up in media coverage of the launch.

The launch was attended by about 60 people, including representatives of Member Societies, senior figures in science policy and administration from universities, CSIRO and bureaucracy, and the media.

2. New office
FASTS has moved to a new office in the Academy of Science dome. It is sited close to Parliament House, major Commonwealth Departments, the ANU and CSIRO headquarters, and to the Academy.

Physical address: Becker House, Gordon St, Canberra City (the Academy dome). Postal Address: PO Box 218, DEAKIN WEST ACT 2600 (unchanged). Phone: (06) 257 2891 Fax: (06) 257 2897. Email: fasts@anu.edu.au (unchanged)

3. November Council
The FASTS Council meeting on November 21 will be held in the Jaeger Room in the Academy dome building. All Member Societies are entitled to send representatives, and I hope you will take this opportunity to inspect our new premises as well as be involved in FASTS policy.

4. Letter from Minister
Minister McGauran has written to FASTS to inform me that he is preparing a proposal to Government to implement coalition policy on Chief Scientist and ASTEC; that preparations for next meeting of PMSEC have commenced, and he is writing to the PM about membership of PMSEC, "including the membership of your Federation."

5. EPAC submission
The FASTS' submission to the Economic Planning and Advisory Commission will be circulated by EPAC to all relevant Departments plus Treasury and Finance. It covers five topics:

a. career paths for younger scientists
b. measures to rectify looming shortage of maths and science teachers
c. proposal to fund a calendar of scientific events
d. an approach to tackle the chemical deficit issue
e. a new way of funding industrial R&D

The full submission is up on the FASTS' web (as is the policy Document).

6. Accounts mailed
Accounts have now been mailed to all FASTS Corporate, Associate and Observer Members, to cover subscriptions to FASTS for 1996-97.

7. Joint statement on Higher Education
FASTS was one of 7 signatories to a joint statement on the threatened cuts in university funding. This was prepared by the Higher Education Alliance (including the AV-CC and the National Tertiary Education Union), and sent to the Prime Minister and all MPs.

8. Democrat spokesperson for S&T
From July 1, Senator Natasha Stott-Despoya will take over this role from Robert Bell.

9. Media
FASTS is gaining increasing coverage in the media, either as the main point of a story or mentioned in reference to general funding or policy issues.

The Age June 11 p5 "Top science job may be downgraded". The Australian June 15-16 p47 "Budget cut brain drain pure sci-fi: McGauran". The Courier-Mail May 28 "University staff, students plan 24 hour strike". Campus Review end May p1 "Time running out for VCs". The Australian June 19 p 38 "Science on the cheap could cost us". The Age June 19 p 6 "Scientists seek competition in tax breaks for research". Canberra Times June 19 p4 "Maths lacking: report". Nature vol 381 June 6 p456, "Cuts strike at Australian Universities". New Scientist 22 June p49, on launch of new policy document. Canberra Times Sunday June 30 "Sums done, maths doesn't add up" (editorial)

Joe Baker, President

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Australian Astronomers

by Ragbir Bhathal
National Library of Australia, 1996
248 pp, paperback, $24.95 RRP

Astronomy is without doubt the scientific field in which Australia has achieved the greatest international prominence. Our extraordinary success is due to several factors, not least of which have been the outstanding Australians who have devoted their lives to astronomical research. Bhathal's "Australian Astronomers" represents an important record of the thoughts, recollections and predictions of some of these people.

The book consists of 18 separate interviews of a sample of Australian astronomers. Like any good astronomer, Bhathal states his selection criteria carefully: each person interviewed is either a Fellow of the Australian Academy of Science (or has achieved equivalent status overseas), or is the head of a major astronomical institute or department. There can therefore be no crying foul by those not included. Nevertheless, it is unfortunate that some great astronomers who have profoundly altered the course of Australian astronomy are excluded by these criteria - everyone will be able to create their own list of favourites.

The book makes fascinating reading for any astronomer or physicist, the more so for those familiar with some of the events and individuals concerned. The men are very different. Some go to extraordinary lengths to avoid mention or acknowledgment of their colleagues' contributions to the success of the work described; most, however, are generous in sharing the credit. One is left with the overwhelming impression that astronomers are, after all, human. This, of course, adds greatly to the book's appeal! A purely objective "time-line" of facts, devoid of the personalities involved, would make much less interesting reading.

Bhathal is careful to keep his own analysis to an absolute minimum. The introduction (which is the only place where he ventures any opinions at all) intersperses facts about the progress of astronomy in Australia with quotations from his interviewees. The illusion that this creates of a completely unbiased record must, however, be treated with caution - the choice of questions will inevitably bias the responses in the direction of the interviewer's preconceptions.

Nevertheless, "Australian Astronomers" is an invaluable resource for future historians who will attempt to piece together an analysis of the events. In addition, people are already lifting quotations from the book to embellish their own lectures and after-dinner speeches.

Paul Wild's insight into the nature of fame is one of the most interesting:
"I believe that most scientific discoveries, had they not been made by the originator, would have been made by somebody else within a year or so or even less."

He goes on to say:
"To my mind the most significant discoveries or projects are those which would have eluded other researchers for decades or more."

The message is clear - truly great scientists are those who do things no-one else has thought of, not those who scrabble for telescope time to make observations some-one else would soon make anyway.

Some interesting facts emerge that are clear even to a non-historian. Only five of the 18 astronomers interviewed actually did significant work at a "state" university, and of these only one (Melrose) is still employed. Partly this is a selection effect, but perhaps it also reveals a frightening decline in the capacity of our universities to conduct front-line research after the demands of undergraduate teaching are met.

It is also striking that not a single woman is included. Bhathal draws attention to this himself, mentioning Ruby Payne-Scott as an individual who may have risen to prominence had past CSIRO policy been more enlightened. Australian astronomy also lost a great champion with Louise Webster's untimely death. Even so, Australia's record on equal opportunity does not appear to have been a good one.

To broaden the appeal of the book beyond the professional astronomy community (which, after all, consists of only about 200 people in Australia), Bhathal includes side bars to explain the relevant science in lay terms. These explanations are, for the most part, clear and well written. In some cases, however, the need to oversimplify the profound concepts under discussions creates an awkward contrast to the main text. Not all are entirely accurate - for example on page 120 it is stated that no interstellar molecules have been discovered in the infrared; in fact both acetylene and methane were detected first at ten microns. This is, however, a minor quibble.

This is a fascinating and important book, and one which I recommend highly. Every Australian astronomer - and many physicists from other fields - will want a copy of "Australian Astronomers" on their book shelves. In addition, the book will be read with great enjoyment by anyone with an interest in the history of science, and by all those with a curiosity about the human side of science. Yet another group who will find the book appealing are our students, who will want to know what it takes to become a successful astronomer. For them, Don Mathewson's advice is particularly relevant:

"Go for it. I think it's the most wonderful career you could ever have. And if you really want to do it, if you're really interested and you know inside yourself, then just go for it. It's a wonderful career."

John W.V. Storey
School of Physics
University of New South Wales

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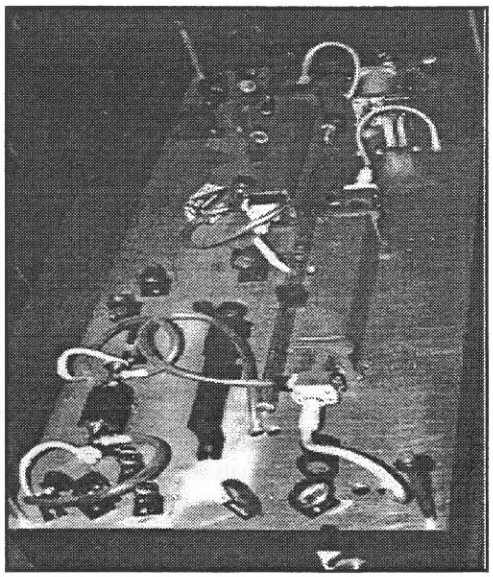

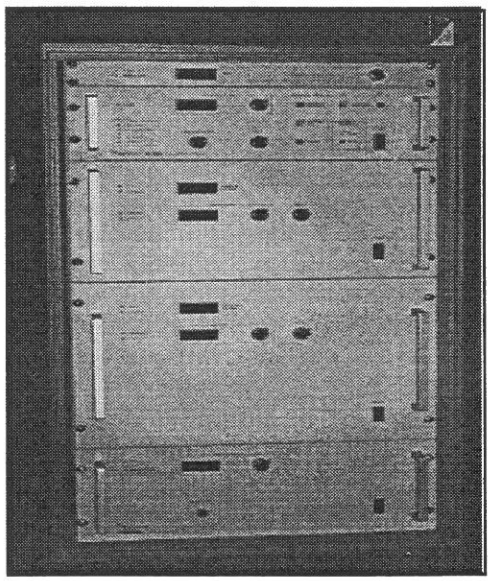

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For more information see the AOS web page (the address is on p19) or email the editor (p1).

R&D Tax Breaks
FASTS: there's a better way

A new method of funding research and development by Australian industry has been put to the Government by the Federation of Australian Scientific and Technological Societies (FASTS). This would eliminate the suggestions of tax-rorting which have plagued the Syndication Scheme abandoned last night (Tuesday) by the Government.

It would also improve research quality, increase returns to the Australian tax payer, and be monitored by industry itself.

"We're looking at a completely new approach, where industry puts forward research proposals with the best ones qualifying for government assistance," said Dr Joe Baker, President of FASTS.

"The process of selection would be carried out by panels drawn from industry. This peer-group selection is the way all proposals for scientific and medical research in the public sector are chosen for government assistance, and it ensures the taxpayer quality and value for money.

"We have offered to assist the Government to develop the details of this new approach."

Dr Baker said that although the Syndication Scheme was exploited to gain large tax benefits, it had also been a useful vehicle to bridge a crucial gap in Australian innovation.

"It brought financial groups into the equation, and at its best was an effective vehicle for bringing industry, research and financial organisations together."

Australia has a real problem with industrial research and development. Government contributions to R&D have ranked among the world's best, but Australia's overall private sector R&D performance is abysmal by any international comparison.

The latest figures for business expenditure on R&D (BERD) as a ration of Gross Domestic Product (GDP) put Australia ahead of only Italy, Spain and Iceland.

In 1994-95, Australia spent about half as much as France, Finland, the UK and Germany, and only 40 per cent as much as Japan and the USA.

"Unless we can find a new mechanism for encouraging industry to get more involved in R&D, Australia is always going to struggle to realise the full benefits of its scientists and technologists," Dr Baker said.

"Science has great potential to generate wealth as well as provide solutions to economic and social problems, and we need industry actively involved to bring these benefits to fruition."

Treasurers Comments to the 1996 Audit

Its that time of year again, when we all must justify the few pennies we receive for countless hours of work to the government. The same applies to the AOS and its finances, which has recently undergone the scrutiny of the auditor - who found everything to be in order. From the balance sheet, which is reprinted in the following pages, the important figures are our annual income and expenditure. Over the last year we earned $10 380 while our total expenditure was $12 914, which means a deficit of $2289. Now you, like I was, may be a little annoyed to see that we are still running in the red despite last years fee increase and wonder how this could happen. The balance sheet shows that we have cut down our annual expenditure by over $1000 from last year so our subscriptions should be enough to cover costs. Well, the simple answer to this puzzle is found in point three, "membership subscriptions" , of the auditors notes. This point shows our subscription for 1996 to be 261 members which looks like a drop of 100 from last year. In fact what it really means is that only 261 of our total membership of approximately 370 have paid their fees for 1996. This leaves 109 members (not far off one-third of the total) who have not, leaving us $2990 short in income.

I know that it may appear that I harp on incessantly about payment of AOS subscription fees, but without its full annual income the society cannot perform to its full potential - which is to the detriment of all members. The AOS is not out to make a profit. Every cent received is put back in the system by encouraging and supporting the optics community in Australia, through initiatives like the Newsletter and the series of AOS prizes that are offered annually. But all this costs money and, usually, the bills have to be paid before the end of the year. This requires the society receiving its income early in the year as we don't have the reserves to cover these expenses. So please, help get the best out of your society by ensuring that all subscription fees are paid on time.

- Esa Jaatinen

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Tel: (03) 558 0344
Fax: (03) 558 0252

Spectra-Physics Pty Ltd
25 Research Drive
Croyden, VIC, 3136
Tel: (03) 761 5200
Fax: (03) 761 5600

Warsash Pty Ltd
PO Box 1685
Strawberry Hills, NSW, 2012
Tel: (02) 9319 0122
Fax: (02) 9318 2192

AUSTRALIAN OPTICAL SOCIETY
(Incorporated in Tasmania)
A.C.N. 009 548 387

BALANCE SHEET
AS AT 30TH JUNE 1996

1995 $		$	$	1996 $
	CURRENT ASSETS			
121	Cash on Hand		121	
31651	Cash at Bank		29362	
31772				29483
	Represented by:-			
	ACCUMULATED FUNDS			
47689	Balance at 1st September 1995		31772	
8105	Surplus/(Deficit)Income over Expenditure for period ended 30th June 1996		(2289)	
24022	Transfer to ACOL Funds		-	
31772	**BALANCE AT 30TH JUNE 1996**			29483

INCOME AND EXPENDITURE STATEMENT
FOR THE PERIOD FROM
TO 1ST SEPTEMBER 1995 TO 30TH JUNE 1996

	INCOME			
6445	Subscriptions		10380	
3340	Interest Received		1395	
33865	Conference Fees	(700)		
21262	Less: Conference Expenditure	450		
12603			(1150)	
22388				10625
	EXPENDITURE			
1600	AOS Medals		-	
1197	AOS Committee Travel Expenses		503	
1476	Accounting and Audit Fees		1490	
633	Bank Fees		280	
30	Filing Fees		292	
6758	Newsletter Expenditures		5761	
233	Postages		1166	
1500	Postgraduate Award		1500	
866	Printing and Stationery		469	
-	Subscription - FAST/ANCI		1453	
14283				12914
8105	**SURPLUS/(DEFICIT) INCOME OVER EXPENDITURE FOR PERIOD ENDED 30TH JUNE 1996**			(2289)

AUSTRALIAN OPTICAL SOCIETY
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NOTES TO AND FORMING PART OF THE ACCOUNTS
FOR THE PERIOD ENDED 30TH JUNE 1996

1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

The Accounts have been prepared in accordance with Statements of Accounting Concepts, applicable Accounting Standards and the Corporations Law, including the disclosure requirements of Schedule 5. The Accounts have been prepared on the basis of historical costs and do not take into account changing money values or, except where stated current valuations on non current assets. The accounting policies have been consistently applied, unless otherwise stated.

The Income and Expenditure Statement has been prepared on a cash basis.

2. INCORPORATION

The Society was formed on the 17th September 1984.

3. MEMBERSHIP SUBSCRIPTIONS

At the 30th June 1996 the Society has members whose subscriptions status was as follows:-

	Number	
	01/09/95	30/06/96
Current	362	261
Non current	59	-
Total membership	421	261

4. FUNDS HELD IN TRUST

In addition to Cash at Bank of $29362, the Australian Optical Society held in trust $22379 (1995: $36530) for Australian Conference on Optics Lasers and Spectroscopy. Interest earned by these trust funds, up to $1000, will be income of the Australian Optical Society. Interest income earned on these funds for the 1992 - 1995 period up to the 1st November 1995 of $2436 was transferred to the Australian Optical Society and taken up in the 1995 Accounts. A further amount of interest income earned up to the aforementioned date of $53 will be transferred in the subsequent period. On the 21st August 1995 $15000 of the trust funds of $36530 was loaned to the organising committee for the 20th International Quantum Electronics Conference. The loan is to be repaid together with interest of $1500 on or before the 31st July 1996. A further amount of interest earned from 1st November 1995 to 30th June 1996 of $859 will be transferred to the Australian Optical Society in due course.

5. INCOME TAX

The Society is limited by guarantee and has obtained exemption from income taxation.

6. LIABILITIES OF MEMBERS

In the event of the Society being wound up and not being able to pay its debts in full, every member will become liable to contribute an amount not exceeding $100.

AUSTRALIAN OPTICAL SOCIETY
(Incorporated in Tasmania)
A.C.N. 009 548 387

INDEPENDANT AUDITOR'S REPORT TO THE MEMBERS OF THE AUSTRALIAN OPTICAL SOCIETY

SCOPE

We have audited the attached Financial Statements comprising Income and Expenditure Statement, Balance Sheet, Notes to the Accounts and Statement by Directors. The Directors of Australian Optical Society are responsible for the preparation and presentation of the accounts and the information they contain. We have conducted an independant audit of these accounts in order to express an opinion on them to the members of Australian Optical Society.

Our audit has been conducted in accordance with Australian Auditing Standards to provide reasonable assurance as to whether the accounts are free of material misstatement. Our procedures included examination, on a test basis, of evidence supporting the amounts and other disclosures in the Accounts, and the evaluation of accountong policies. These procedures have been undertaken to form an opinion as to whether, in all material aspects, the accounts are presented fairly in accordance with Australian accounting concepts and standards and statutory requirements so as to present a view of the Company which is consistent with our understanding of its financial position and the results of its operations.

The audit opinion expressed in this report has been formed on the above basis.

AUDIT OPINION

In our opinion the Financial Statements of the Australian Optical Society are properly drawn up:

(a) so as to give a true and fair view of:
(i) the Company's state of affairs as at 30th June 1996 and the Company's profit for Company for the period ended on that date so far as they concern the members of the Company; and
(ii) the other matters required by Division 4.4A and 4B of Part 3.6 of the Corporations Law to be dealt with in the accounts; and

(b) are in accordance with the provisions of the Corpations Law; and

(c) are in accordance with Statements of Accounting Concepts and applicable Accounting Standards.

E.P. GROOMBRIDGE & CO
E.P. GROOMBRIDGE

Chartered Accountants.

DATED at Lindfield, this 12th day of July 1996

Australian Optical Society 1996 Subscription

Dr Esa Jaatinen,
Hon. Treasurer AOS,
CSIRO,
Division of Applied Physics,
PO Box 218,
Lindfield 2070, AUSTRALIA
Tel: 02 413 7269 Fax: 02 413 7200
EMAIL: esaj@swifty.dap.csiro.au

Please complete form and send with payment to the address shown above

Address

Title *Initials*

First Name(s)

Surname

Employer / Institute /Company

Telephone Number

Fax Number

Email Address

Other Affiliation (please tick) *AIP* *OSA* *SPIE*

Main Activities (number up to three in order of importance)

First *Second* *Third*

1	astronomical optics	11	spectroscopy
2	atmospheric optics	12	thin films
3	communications and fibres	13	vision
4	electro-optics	14	quantum optics
5	fabrication and testing	15	nonlinear optics
6	information processing	16	teaching
7	lasers	17	holography
8	optical design	18	(.....)
9	optical physics	19	(.....)
10	radiometry, photometry & colour	20	(.....)

SUBSCRIPTION RATES (per calendar year)

Corporate Member :	*A$ 250 p.a.*	*Member :*	*A$ 30 p.a.*
Associate Member :	*A$ 125 p.a.*	*Student:*	*A$ 10 p.a.*

*PAYMENT : by cheque ** *money order* *Bankcard* *Mastercard* *VISA*

Please tick box. *Cheques payable to "THE AUSTRALIAN OPTICAL SOCIETY"*

If paying by credit card please complete ALL boxes in this authorization. Incomplete forms cannot be processed.

EXPIRY DATE /

CARD NUMBER

AMOUNT A$ *SIGNATURE* *DATE*

* Please do not staple cheques onto this form, use a paperclip instead.