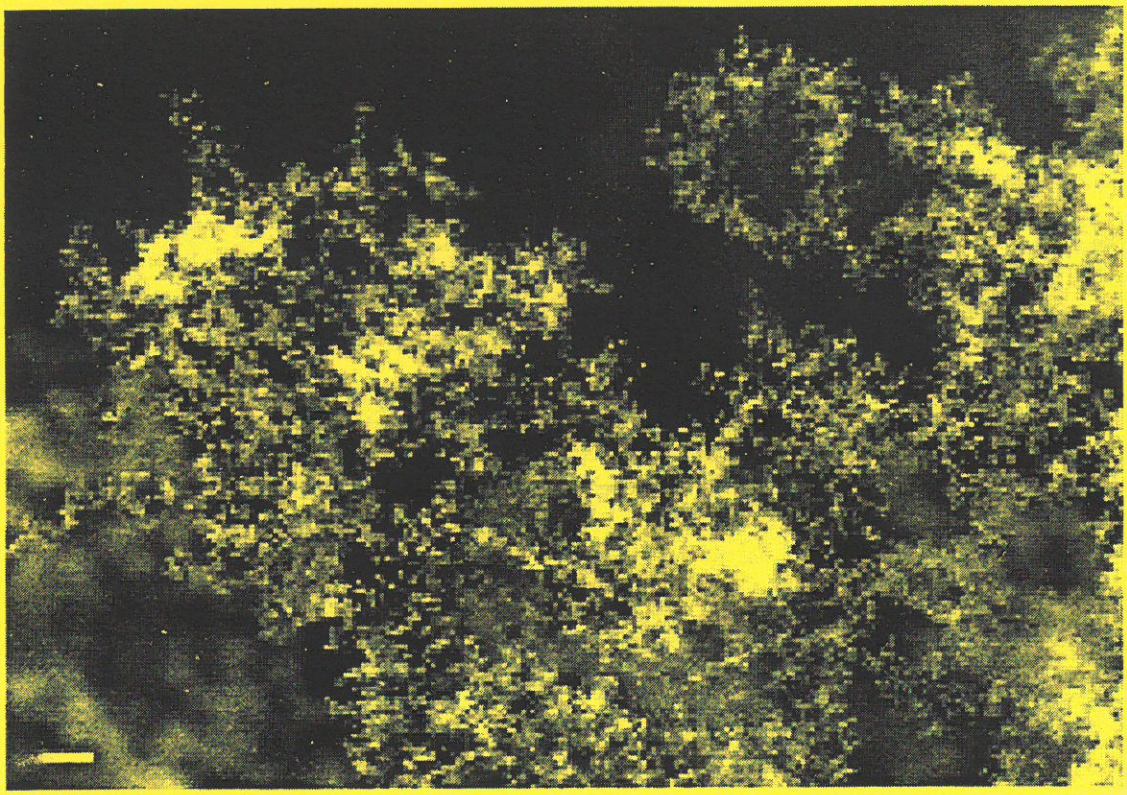
Australian Optical Society

NEWS



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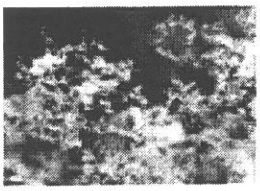

AOS NEWS

COVER :
This issue's cover shows a scanning electron micrograph of a carbon nanofoam produced by pulsed laser deposition at the Australian National University.
The method of continuous evaporation creates a novel diamond-like foam structure. This is one of the applications of ultra-fast laser ablation discussed in the article on page 7.

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Contributions on any topic of interest to the Australian optics community are solicited, and should be sent to the editor, or a member of the editorial board. Use of electronic mail is encouraged, or else submission of hard copy together with an ASCII text file on floppy disk.

Where possible, diagrams should be contained within the document or sent as separate encapsulated post-script files. Figures on A4 paper will also be accepted.

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EDITOR
Wayne Rowlands
Swinburne University of Technology
PO Box 218
Hawthorn Vic. 3122
Tel: (03) 9214 8214
Fax: (03) 9214 5840
wrowlands@swin.edu.au

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ARTICLES

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Retiring President's Report

My term as president of the Australian Optical Society is coming to its end and I would like to express my gratitude and thanks to my colleagues and Council members for their hard work for our Society and their constant support. You are the people who make our Society grow, develop new directions and provide support for the optics community within the country. Without you the Society would not exist.

With this year's Annual General Meeting some Councilors who have played a major role in Society activities are finishing their term as office bearers and others have indicated their desire to stand down from the Council.

In particular I would like to thank Brian Orr from the School of Chemistry, Macquarie University, for the tremendous work he has done for our Society. His enthusiasm and conscientiousness has maintained the Society momentum. Barry Sanders from the School of MPCE, Macquarie University, is retiring from his position as the Society's treasurer. Throughout Barry's term in office he has made sure that our Society stayed financially viable, devising new financial policies for the society. Clyde Mitchell from Optical Systems Engineering, CSIRO Material Science and Technology, is stepping down from his position as our secretary. Clyde – thank you for a job well done. The AOS maintains a wide international outreach. I would like to extend my thanks to Ken Baldwin as AOS International Liaison Officer for coordinating our international portfolio.

I would like to apologize to our members for the hick-ups that we have experienced with the publication of AOS News lately. This is a very important publication for our Society. It helps us to maintain a regular flow of information between Society members and provides us with good scientific articles within a wide range of fields of optics research. I am sure that in the future this publication will arrive on our desks promptly every three months.

Our regular conference series provide us with a very satisfying form of communication within the Society. The most recent AOS XII Conference held in Sydney 1999 was a big success. It was collocated with the ACOFT Conference on Photonics giving us very valuable opportunity of widening the fields presented and establishing dialogues and collaborations in closely related areas of optical science and engineering.

Our next AOS conference is going to be held at the University of Adelaide, 11-15 December 2000. The scientific program of this conference looks very promising with speakers such as Sojeev John, from the University of Toronto, J. Gestner and many others. You can find further details of this meeting under http://www.physics.uq.edu.au/~aos/aos2000.htm.

The preparations for the next ACOLS are in full swing. This conference – ACOLS 2001 will be held in Brisbane in July 2001. This conference incorporates 14th Conference of the Australian Optical Society, !0th Australian Laser Conference, 20st Australian Spectroscopy Conference and 4th Australian Conference on Vibrational Spectroscopy. At the moment the Program Committee chaired by Bill MacGillivray is working on the list of plenary speakers. Very shortly the WEB site for this conference will be available.

The AOS continues to interact closely with the Australian Institute of Physics, to which one third of our members also belong. We also have regular contacts with the Federation of Australian Scientific and Technological Societies (FASTS), a lobby group for Australia's science and technology in local political, social and economic circles.

The 1999 AOS medal was awarded to Professor Dan Walls. Professor Wall's contribution to the field of theoretical quantum optics and atom optics was enormous, with over 300 papers published in major physics journals and a number of books. He was a pioneer of the study of non-classical light. Professor Walls has established both quantum optics and, more recently, atom optics as mature theoretical disciplines. Dan Walls has made a major contribution to optics in Austalasia. He has been very successful in raising the international profile of optics in this part of the world and has put optics in Australia and New Zealand on the world map

This year's AOS Postgraduate student prize was awarded to Ms Soiedeh Soghafi from Macquarie University. Her research towards a PhD is concerned with developing application-specific methods for measuring and characterizing laser beam quality. The prize will enable her to go to Progress in Electromagnetics Research Symposium 2000 in Cambridge, Massachusetts, USA.

This years Technical Optics Award was given to Dr. Alex Boiko from ANU who has made a very substantial contribution to the Australian Optics Community through his innovative work in the field of specialized optical coating technology. His work has involved production of, in many cases, highly specialized thin film optical coating both for research and production purposes. Dr. Boiko had to develop highly innovative techniques in order to be able to produce these coatings. On many occasions he has produced very highly specialized coatings to meet demands of innovative

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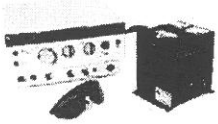

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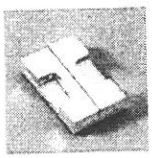

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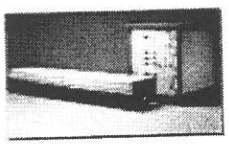

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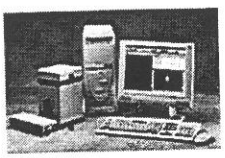

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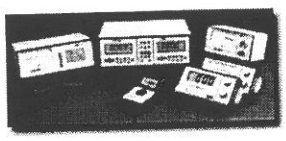

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research. Many of the coatings produced by Dr. Boiko exceed commercially available quality.

Dr. Boiko has provided many non-standard coatings or applied coating to non-standard substrates, which benefited very strongly a number of researchers at the Australian National University. These range antireflection coatings for crystals to dichroic coatings for diode pumping laser crystals. He has also produced broad band output couplers for femtosecond lasers. For many of these tasks Dr. Boiko had to refine and often develop new approaches to making coatings. Very often, he has provided researchers with equipment without which the projects would be severely delayed or even impossible.

On this note I would like to conclude saying "thank you" to all our members for promoting optics in the community and for working hard in many exciting and diverse areas of research and applications of optics.

Halina Rubinsztein-Dunlop
President of Australian Optical Society
June 28, 2000

AOS MEDAL

AUSTRALIAN OPTICAL SOCIETY

The Australian Optical Society is seeking nominations for the fifth 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.

Previous winners of the medal have been:

1995: Mr Bill James, James Optics, Melbourne
1996: Dr Parameswaran Hariharan, University of Sydney and CSIRO
1997: Professor Jim Piper, Macquarie University
1999: Professor Dan Walls, University of Auckland

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 2001 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 next AOS Conference.

The closing date for nominations is **15 February 2001**.

Nominations should be sent to the Secretary:

Dr Peter Farrell
Department of Applied Physics
Victoria University
PO Box 14428, MCMC Melbourne,Vic. 3001
Fax. (03) 9688 4698

Incoming President's Message

It is a great honour to be elected as President of the Australian Optical Society. Halina Rubinzstein-Dunlop (to my knowledge, the first women Professor of Physics in Australia) has done a wonderful job and will be a hard act to follow. Halina's experience and wisdom will be retained through her continued role as Past-President.

The first thing I have done in taking over the Presidency is to review the issues facing the AOS and to identify its basic missions. I think these are fourfold:

1. To provide its members with the capacity to share information and knowledge.
2. To lobby for the professions represented by the AOS with government and to pass on what is learned to its members.
3. To organise conferences to enable its members to meet and discuss their work.
4. To support the younger members of the profession and to assist with their continued membership of the profession - and the AOS.

These four missions require four different forms of activity. I think we have been doing most of them well.

So what does the AOS do with its money?

1. Firstly, it puts out the *AOS News*. We have not managed to do this in a timely manner in the last year and this needs to be rectified. This issue is the first step in getting us back on track.
2. The AOS is a member of FASTS. FASTS is an important body in representing science and technology in Australia. Its impact will be particularly high over the next twelve months as the recommendations in the Batterham Report filter through the government, hopefully with some budgetary impact. Our subscription to FASTS is considerable on the scale of our total budget, but I think it is an imperative. We will be providing feedback from FASTS in the *AOS News* so that our members have some idea of the way the winds are blowing in Canberra (apart from cold and off the mountains!)
3. The AOS will continue to organise conferences, both as stand-alone meetings and as part of other series such as the AIP Congress and ACOLS. Our conferences have often yielded a moderate, but important, profit. It is not our intention to continue to run conferences for profit, and in any case profits are unlikely to be delivered in the next few years. The last conference, run jointly between the AOS and ACOFT, actually ran a loss.
4. The fourth mission is to provide incentives and recognition for bright young optical workers and scientists. The AOS Travel award and Young Optical Worker are therefore important components of our activities. It would be nice to see more demand for these.

All of the above cost money. In fact, if we are not very careful, they cost more money than we receive in subscriptions. Part of my aim as President is to ensure that these services are delivered effectively to our members in such a manner that it is clear what we are doing and why. With the council, I will also review where the expenditures lie and will ensure that all monies are spent in an effective and accountable manner. Of course the AOS has always been very financially responsible. However conference profits are unlikely to be available in the foreseeable future and so some careful planning is needed.

I conclude by mentioning former AOS president Tony Klein. Tony retired recently from an illustrious career at the University of Melbourne and has just been elected a Life Member of the AOS. An article describing his retirement celebrations is included in this edition of *AOS News*. Apart from celebrating Tony's career, poems and songs written by physicists have a curiosity value all of their own. I myself wrote a poem in honour of Tony's retirement. Sadly (or, fortunately), this literary contribution has been lost to posterity due to a computer crash. However the rest is preserved and published here.

Keith Nugent
President of Australian Optical Society
August 2000

Ultra-Fast Laser Ablation and Deposition of Thin Films: Challenges, Solutions, and Applications

A. V. Rode[1], B. Luther-Davies[1], E. G. Gamaly[2], M. J. Lederer[1], V. Z. Kolev[1]
[1]*Laser Physics Centre,* [2]*Department of Applied Mathematics*
Research School of Physical Science and Engineering, Australian National University
Canberra, ACT 0200 Australia

The use of low energy short picosecond pulses at very high, MHz-range, repetition rates in pulsed laser deposition greatly improves the quality of the deposited films by eliminating the generation of particulates from the evaporated plume and also significantly increases the deposition rate.

1. Introduction

Pulsed laser deposition (PLD) can produce diamond-like coatings that make a surface nearly diamond-hard, or high-temperature superconducting films to pave the way for practical superconducting devices [1]. PLD has the highest instantaneous deposition rate among all other known deposition methods like electron-beam deposition, magnetron sputtering, or chemical vapour deposition. A laser beam is a 'clean' tool: it provides direct energy transfer into the ablated vapours. As a result, the PLD process maintains the same stoichiometry in the deposited film as in the target material. The unique ability of the PLD process to operate over a wide range of gas pressures motivated a number of groups to deposit various types of nitrides [2-4], complex multicomponent oxides [5,6] to synthesise nanocrystalline quantum dots [7], ferroelectric thin films [8], planar lasers and nonlinear waveguides [9,10].

Pulsed laser deposition is basically a simple process. A high-intensity pulsed laser beam is focused onto a target in a chamber that is either evacuated or filled with a specific gas such as argon, oxygen or nitrogen (Fig.1). The laser pulse ablates the target material, and the ablated vapour expands into the chamber. When the substrate to be coated is placed in path of the laser-produced plume, the vapour adheres to the surface. A film of a specific thickness of the ablated material is built up using an appropriate number of laser pulses.

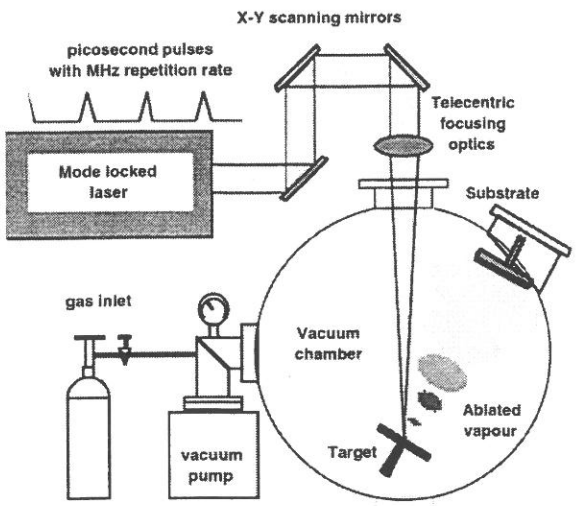

Figure 1. *General scheme of a pulsed laser deposition instalation.*

PLD may be simple, but the deposition process is very sensitive to many laser and target parameters. Several technical obstacles still stand in the way of widespread use of pulsed laser deposition in demanding applications. The main drawback has been the deposition of particulates (or droplets) on the film during the deposition process. The origin of these particles is connected with inhomogeneities in the target, fluctuations in the laser fluence, and other irregularities of the process. The particulate problem severely limits the commercial application of PLD since many applications require the density of micron-sized particles to be less than one per cm^2. Whilst there have been attempts to prevent particles from the target reaching the substrate, using some form of mechanical filtering, there does not appear to have been any satisfactory or universal solution to the problem.

Lasers of various wavelength (from 153 nm to 10.6 μm); pulse duration (from tens of picoseconds to hundreds of nanoseconds); and intensities have been used for PLD. The use of energetic (0.1-1J/pulse) excimer UV lasers has become standard practice simply because most of the materials used for deposition work exhibit strong absorption in the spectral range below 400 nm. The main limitations of powerful excimer lasers producing ~10ns duration pulses are beam quality and repetition rate which is generally in the 10-100Hz range. At these repetition rates, the vapour plume decays away between pulses and, therefore, the film grows in a discontinuous manner from bursts of atoms arriving separately at the substrate. This contrasts with other film growth methods, such as MBE, ion sputtering, etc where high quality films are grown from continuous fluxes of particles.

As a result of a detailed investigation of the current practice in PLD, we recently proposed a new concept for deposition of high quality thin films. The basic principle relies on the use of picosecond or femtosecond laser pulses delivered on a target at a very high repetition rate (100kHz to 100MHz) [11-13]. This modification to the PLD we will call Ultra-Fast PLD due to the combination of short laser pulses with very high repetition rate. The individual short, low energy pulses evaporate only a very small volume of the target per pulse, thereby inhibiting the ablation of particles or droplets whose volume far exceeds that can be evaporated by a single pulse. To

compensate for the reduced ablated mass per pulse, high pulse repetition rates are then used to achieve a high average deposition rate.

The use of high repetition rate lasers also leads to a qualitatively new mode of vapour-substrate interaction. Specifically, the pulses are sufficiently close together that the films grow from a continuous flux of atoms rather than the discontinuous growth characteristic of conventional PLD. In fact the transition from discontinuous to continuous growth occurs at repetition rates around 10kHz and is determined by the spread of thermal velocities of atoms in the laser ablated plume and the target-substrate distance. To maintain a constant ablation rate for successive pulses using ultra-fast PLD the laser beam must be scanned rapidly over the target surface to prevent crater formation. This has an advantage since co-evaporation of different materials becomes straightforward by simply scanning across targets of different composition. Film composition can, thus, be varied continuously by adjusting the dwell time on the different targets. In addition the deposition rate can be adjusted precisely through fine control of the pulse repetition rate. Ultra-fast PLD can, therefore, be applied to the production of films ranging from multilayered films, films with mixed composition, to the production of monolayers of specific atoms.

Thus in summary the key features of Ultra-Fast PLD are:

- elimination of particles by reduction of the single pulse energy to the point where fewer atoms are evaporated per pulse than contained in a micron-sized cluster;
- more efficient evaporation with short picosecond and femtosecond pulses;
- the ability to create films of continuously variable composition;
- close control over the deposition conditions due to deposition with continuous flow of vapours; and
- up to 100 times higher deposition rate than in conventional PLD due to the use of vastly (~ 10^7) higher pulse repetition rates.

2. Progress achieved in Ultra-Fast Laser Deposition

2.1. Optimal regime of evaporation

Any PLD process will be optimised when the whole thermal energy associated with the propagation of a heat wave into the target goes into evaporation (no heat loss) and this leads to a simple relation between the laser and target parameters for optimum evaporation [11,14]:

$$I_a t_p^{1/2} = \left(\frac{\pi}{2}\right)^{1/2} a^{1/2} \rho_0 \Omega \text{; where } a = \frac{\kappa}{C_p \rho_0}. \quad (1)$$

The left-hand side of Eq. 1 represents the absorbed laser intensity I_a and pulse duration t_p, and the right side is the target thermodynamic characteristics: a is the thermal diffusion coefficient in [cm^2/s]; κ is the heat conduction coefficient in [J/(s·cm·K)], C_p is specific heat [J/(g·K)], and ρ_0 is target material density in [g/cm^3]. The above relation fits surprisingly well the range of intensities and pulse duration in laser ablation experiments with laser pulses from milliseconds down to the picosecond-level where the hydrodynamic motion and heat conduction are suppressed. Note that for equation 1 to be valid the target must be strongly absorbing such as can be achieved in metals or in dielectrics irradiated at wavelengths below their band edge.

As the laser intensity is increased above the optimal level, ionisation occurs at solid-vapour boundary leading to plasma formation. The process of optical breakdown is due to avalanche ionisation for long (IR) and visible wavelength lasers along with multiphoton ionisation for short (UV) wavelength lasers. The threshold laser intensity, at which the transition from the atomic vapour to plasma occurs depends on laser wavelength, the intensity, and pulse duration. Above this threshold the vapours became opaque, the laser energy goes into the plasma heating, and the efficiency of evaporation drops significantly. Therefore, in order to keep the vapours transparent and the evaporation and deposition rates at the highest possible level, the laser intensity should be kept below the plasma transition threshold. The relation

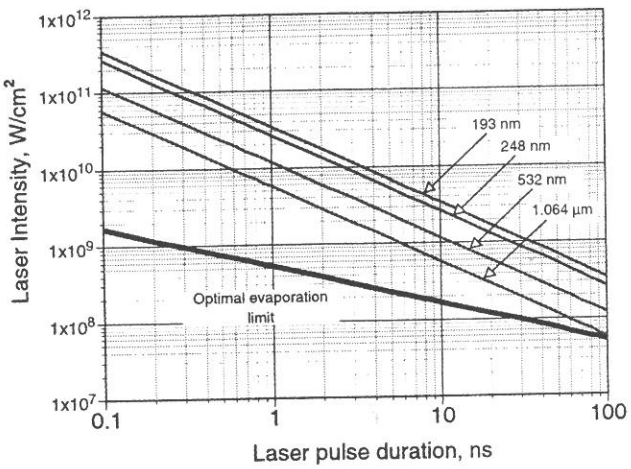

Figure 2. *The range of absorbed laser intensities for ablation of graphite target in the regime of transparent carbon vapours vs laser pulse duration. The lower limit is the optimal evaporation limit (Eq. 1), the upper limits are the transitions to the opaque plasma due to the vapour optical breakdown limts for various laser wavelengths: 1.064 μm – Nd:YAG laser; 532 nm – 2nd harmonic of Nd:YAG laser, 248 nm – KrF laser; 193 nm – ArF laser.*

for optimal evaporation, together with the threshold for optical breakdown [15] enables one to establish the range of laser parameters for the laser evaporation of any target material with various intensity, wavelengths, and pulse duration.

An example for evaporation of a graphite target is presented on Fig. 2. In the intensity range between the two limits the vapour is partially ionised, but the density of free electrons in the plasma is lower than the critical density for the given wavelength and pulse duration, so the vapour is transparent to the laser radiation.

Introducing the evaporation rate during the laser pulse R_{evap} as the number of atoms evaporated per second from a unit area allows the evaporation rate to be related to the laser intensity and surface temperature k_BT. Taking into account the ionisation losses per atom ε_{ion} the evaporation rate is as follows:

$$R_{evap}\left[\frac{atoms}{cm^2 s}\right] = \frac{I_a}{\varepsilon_b + \varepsilon_{ion} + k_B T \frac{\gamma(\gamma+1)}{2(\gamma-1)}}; \qquad (2)$$

where ε_b is the binding energy, $\varepsilon_{ion} = \sum \alpha_i^{ion} J_i$, α^{ion} is the ionisation rate, J_i is the i-th ionisation potential, and $\gamma = 5/3$ as for the ideal gas.

There are two important conclusions from the Eqs. 1 and 2. First, when choosing the laser intensity for evaporation at a fixed pulse duration, one has to favour an intensity close to the lower boundary in order to minimise the energy loss to ionisation and increase the evaporation rate. Second, the shorter the laser pulse, the higher the laser intensity, and thus, the higher the evaporation rate during the laser pulse. Therefore, the transition from a long 10 ns pulse to a short 100 ps pulse results in ten fold increase of the evaporation rate (in [1/cm²s]). These two conclusions form the basis for the Ultra-Fast laser ablation method. However, it is worth pointing out that reducing the pulse duration always reduces the total volume evaporated per pulse ($R_{evap}t_p \propto t_p^{1/2}$). This is important in eliminating particle contamination since with a sufficiently short pulse, too small a volume of material is evaporated per pulse to create a single macroscopic particle.

2.2. *Apparatus for Ultra-Fast Laser Deposition*

For our initial implementation of Ultra-Fast PLD, we used a mode-locked Coherent 'Antares' laser. The average power of this mode-locked or/and Q-switched/mode-locked system, with an additional double-pass amplifier, is up to 45 W at 1064nm, and up to 12 W in the second harmonic at 532nm. The repetition rate is 76 MHz in the mode-locked regime or variable in the range $10^5 - 10^6$ pulses per second in the Q-switched/mode-locked regime. The first experiments on the application of Ultra-Fast PLD for deposition of thin carbon films demonstrated a spectacular increase, up to 25 times, in the deposition rates over what could be obtained with a conventional low repetition rate, high energy laser. Moreover, the experiments show that the microroughness of the deposited diamond-like film was extremely low – it was in the range < 1 nm, i.e. in the order of atomic layer thickness [12]. The number of particulates deposited was less than one per mm^2. The thickness of the film produced at the distance of 24 cm from the target varies within ±5% over the substrate area of ~ 250 cm^2, which is superior to that using conventional e-beam deposition. The technique makes it possible to virtually eliminate the major disadvantage of the conventional PLD method, which is the presence of particulates affecting the film quality.

2.3. *New carbon nanostructures*

The Ultra-Fast laser deposition technique has been applied to evaporation of graphite in an inert atmosphere of Ar gas. Continuous evaporation, which is beyond the reach of other PLD methods, resulted in a high collision frequency between carbon atoms and ions in the laser plume and argon atoms in the chamber. This created the optimal vapour temperature and density for the efficient formation of 4-membered sp^3 bonds typical of diamond. A new fractal amorphous carbon nano-foam with a large fraction of tetrahedrally-bonded atoms, a diamond-like carbon foam, was produced [16,17].

We have collected a range of structural data that suggest these carbon foams have a novel structure with well-defined structural units at the Å length scale, and a fractal ordering at a micron length scale. At the smallest scales the structure of the 6-mn clusters has a

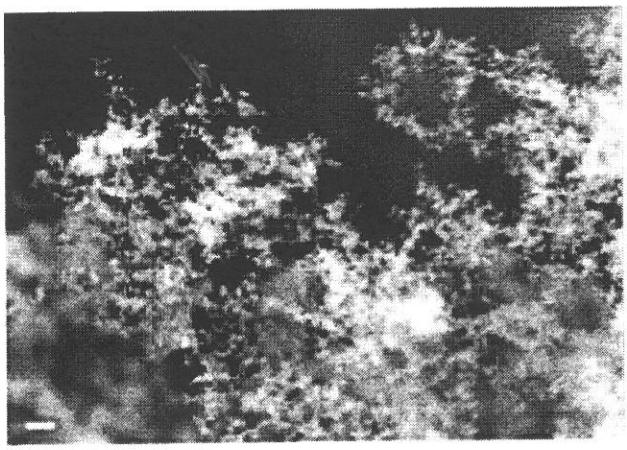

***Figure 3**. Scanning electron micrograph of the foam, showing the web-like appearance at low magnification (100 nm scale bar in lower left corner)*

characteristic length of 5.6±0.4 Å with a signature of hyperbolic surfaces typical for schwarzites. The sp^3-bonding is mostly located on the surface of the clusters. This bonding is responsible for the connections between the clusters. At a larger scale >100 nm the deposited carbon demonstrates a fractal ordering with the estimated fractal dimension of 2.4. At a still larger scale > 10 μm the cluster-assembled carbon foam has a web-like appearance similar to the patterns generated by a diffusion-limited aggregation process. The cluster-assembled carbon nanofoams, with a surface area 300 – 400 m^2/g are comparable to that of carbon aerogels but with a hundredth of their density (2-10 mg/cm^3), and resistivity nine orders of magnitude larger, are of particular academic and industrial interest.

2.4. *Nonlinear gallium films for all-optical switching*

The Ultrafast Laser Deposition method was applied recently for deposition of alpha-gallium crystalline films, which have unique nonlinear optical characteristics displaying very large changes of reflectivity as it is heated towards its melting temperature. All previous attempts to deposit these highly nonlinear gallium films by magnetron sputtering, electron-beam evaporation, and by a conventional UV laser deposition with nanosecond pulses, have failed to produce a stable high-quality gallium film with repeatable reflectivity characteristics over a large number of heating-cooling cycles. Instead

of the desired alpha-phase, films deposited by these methods appeared to be in a highly reflective 'metallic' phase, showing no change in reflectivity before or after the phase transition. Picosecond high repetition rate laser ablation is the only method to date, which allows deposition of alpha-gallium thin films [18,19].

3. Obstacles in the Ultra-Fast Laser Deposition

3.1. Scanning speed

Although the experiments on ultrafast PLD have so far demonstrated a number of advantages over the conventional low-repetition rate PLD, an important issue has arisen relating to the achievable speed at which the beam can be scanned across the target surface. The ideal speed of scanning ~ 10^3 m/s would allow each laser pulse to arrive at a fresh target spot using a conventional mode-locked laser with repetition rate ≈100MHz. However, commercially available scanners combined with a telecentric focusing system currently only allow a scanning speed of up to 10 m/s. This means that in the time taken for the focal spot (10 microns diameter) to move 10 microns, 100 laser pulses hit the target. This can lead to crater formation, alteration of the laser power per unit of the target surface area, and absorption of the laser energy in the vapour trapped within the crater. This in turn leads to a reduction of the evaporation rate.

3.2. Laser power and repetition rate

Our investigations on the mechanisms responsible for the decrease of the evaporation rate [19] at high pulse repetition rate due to crater formation offer a clear view on the optimal laser parameters required for efficient evaporation. In order to achieve optimal evaporation as noted above strong absorption is required. Clearly the choice of laser wavelength therefore depends on the material to be evaporated. In some cases such as graphite, infra-red wavelengths are adequate, whereas for many dielectric materials (glasses) UV emission is required. The laser system best able to meet the requirements for ultra-fast PLD is currently the Nd system, which is demonstrably scalable to high average power. An optimised Nd laser for the ablation and deposition applications would have the following characteristics:

- total average laser power ..... ~10-100 W
- pulse duration ..... 1–10 ps
- peak pulse energy ..... 1 – 10 μJ
- repetition rate in ..... 1–10 MHz
- wavelength range ..... fundamental, 2^{nd}, 3^{rd}, and 4^{th} harmonics (1064, 532; 355; 266 nm)

The required repetition rate range of 1 – 10 MHz with ps-range pulses lies between the standard mode-locking (~100 MHz) and typical Q-switching rates (<50 kHz). Commercially available mode-locked laser systems can produce short pulse duration and high average powers, but the single-pulse energy is limited and the repetition rates are too high to avoid crater formation. Using Q-switched lasers at repetition rates of 1-50kHz, the pulse duration is usually longer than ideal (ns rather than ps) and this increases the evaporated volume and the chance of contamination of the deposited films by particles. Furthermore only at the upper limit of available repetition rates can a continuous plume be produced.

As an apparent solution, one could suggest a combination of two schemes, i.e. a mode-locked Q-switched laser system for Ultra-Fast laser ablation. Such a system, based on an 'Antares' mode locked laser produced by Coherent, is operating at the Laser Physics Centre, ANU. The laser generates from 50,000 to 500,000 pulses per second with the pulse energy in the range of 50 – 500 μJ, following in Q-switched envelopes of 20 to 50 60-ps pulses. Although this laser system demonstrated a number of advantages over the conventional high-power low-repetition-rate laser ablation (see Section 2), the drawback of this scheme is in a variation, up to an order of magnitude, of a pulse energy within a single envelope. As a result, the conditions of evaporation fluctuate, which in turn leads to a partial loss of control over the evaporation process. Furthermore since the pulses are produced in high repetition rate bursts, the problem of crater formation cannot be eliminated entirely.

After close investigation of various laser schemes, we are developing a long cavity mode-locked Nd:YVO_4 laser oscillator [21,22] for Ultra-Fast PLD. This has two advantages: it reduced the pulse repetition rate to the point where crater formation becomes less of a problem, and it increases the single pulse energy to a level where efficient harmonic conversion can be obtained. By using a semiconductor saturable absorber modulator (SESAM) [23] for mode-locking pulses with duration in the few ps range can be obtained, which is close to ideal. In order to achieve repetition rates <10 MHz, the oscillator will contain an encapsulated multi-pass cell. This allows a relatively compact design and provides good stability through the re-imaging properties of the multi-pass cell.

3.3. Harmonic generation

A high average power, MHz-range repetition rate, picosecond UV laser is a very attractive tool for laser deposition, micromachining, photolithography, and surface modification. Harmonic generation will substantially increase the range of materials which can be deposited. Efficient generation of harmonics of the fundamental frequency is one of the advantages of the picosecond laser pulses. Second (532 nm) and third (355 nm) harmonic generation of the high-average-power <10-ps mode-locked laser pulses will be most efficient using non-critical phase-matching of Lithium Triborate – LiB_3O_5 (LBO) crystal. LBO has the highest energy density and power density damage thresholds, wide acceptance angle, and small walk-off. It is the best candidate for high-average-power second and third harmonic generation.

Fourth (266 nm) and, optionally, fifth (213 nm) harmonics can be generated using Cesium Lithium Borate – $CsLiB_6O_{10}$ (CLBO) crystals. CLBO offers better performance in deep-UV as CLBO has a larger effective non-linear coefficient for UV-generation, small walk-off angle and low angle sensitivity. However, durability issues such as hygroscopicity of the nonlinear crystal require protective housing in order to keep water vapour, oxygen, and ultraviolet light separate from each other at the crystal surface. A resent report from the University of Osaka on the improvement of laser damage

resistance of CLBO for high-power deep-UV lasers [24] promise for up to a year trouble-free operation time.

4. Conclusion

Ultra-Fast Laser Deposition provides an improved thin film laser deposition technology for many applications. We expect in our own work to use the process for amorphous diamond-like carbon films, for deposition of superconducting YBCO-films, for deposition of glass films for waveguiding and all-optical switching applications, for deposition of gallium films with exceptional optical nonlinearity, and for deposition of carbon nanotubes and carbon nanopaper.

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AOS SIGNS AGREEMENT WITH SPIE

New benefits for members of SPIE and AOS

On a recent visit to the USA, the President of the AOS, Professor Keith Nugent, attended the Pacific Rim Leadership meeting of the SPIE. At that meeting, he met with the President of the SPIE and signed a Memorandum of Understanding (MOU) between the two societies.

The MOU sets out a number of ways in which the two organisations may better work together. Of most direct benefit to members is the discount offered to people who are members of both organisations. In particular, if you are a member of the AOS then you are now entitled to a discount on the SPIE membership fees $US20 discount on your SPIE fees (see box below for more information). Alternatively, if you are an SPIE member, you are entitled to a $A25 discount on your AOS fee.

This information will now appear on your fee invoice and you can decide what you want to do then. Please also bring this development to the attention any of your colleagues who are SPIE members.

There are other less immediate benefits to this arrangement, including better contacts between the societies and mutual participation in conferences.

In general this is an excellent development and the AOS expresses gratitude to Ken Baldwin for his work in organising and negotiating this agreement. Ken is a member of the AOS council (and former President) with responsibility for international liaison.

AOS Members Entitled to SPIE Member Discount

AOS members are invited to join SPIE at a discount of US$20 off regular member dues. Please complete the online membership form at *http://www.spie.org/membership_form.html*, print and fax it along with a copy of your AOS dues receipt to 1 360 647 1445. Be sure to write in the SPIE Membership Dues portion of the form that you are eligible for the US$20 discount as an AOS member. If you have any questions about this membership, please contact Mr. Paul Giusti at *membership@spie.org*.

AUSTRALIAN OPTICAL SOCIETY

SPIE
THE INTERNATIONAL SOCIETY FOR OPTICAL ENGINEERING

Q: What's the easiest way to observe Doppler's effect optically (not accoustically) in one's everyday life?

A: Go out in the evening and look at the cars. They lights are white or yellow when they approach, but they are red when they are moving away of you.

AUSTRALIAN OPTICAL SOCIETY

AOS 2000

THE 13TH CONFERENCE OF THE AUSTRALIAN OPTICAL SOCIETY

University of Adelaide 11-15 December 2000

The Australian Optical Society AOS2000 will be held as part of the biennial Australian Institute of Physics Congress AIP2000. Information can be found on the web at the following websites:

AOS 2000 page http://www.physics.mq.edu.au/~aos/aos2000.htm

AIP 2000 page http://www.physics.adelaide.edu.au/aip-sa/aip2000/front.html

The AOS conference will include a plenary lecture (see page 19), a number of invited lectures (see opposite page) as well as contributed talks and poster sessions. The conference will be held at the Nth Tce. campus of the University of Adelaide with the trade exhibit and poster sessions in the student union. December is early summer and Adelaide is at its best, surrounded by clean beaches and excellent wine-growing districts. Rundle Street, with a large variety of cafes and restaurants, is nearby.

CALL FOR PAPERS

A copy of the call for papers in pdf format is available at:

http://www.physics.mq.edu.au/~aos/AIP2k_AOS2k.pdf.

This contains the instructions and a pro forma for submitting papers. Papers are to be submitted to the AIP2000 organisers who will forward them to the relevant conference program committee.

Important Note: The deadline for submission of abstracts *was* the 31st of July 2000. There have been many late submissions of abstracts. Anybody who still wishes to submit an abstract for AOS2000 may still do so. As well as submitting the abstract electronically to the AIP organisers they should copy the submission to the program committee convenor at *mwh@physics.adelaide.edu.au*

Notification of acceptance of papers
Acceptance of submissions (oral or poster) will be made by the 6th of October (by email to the corresponding author). This date was earlier advertised as the 15th of Sept. There has been a delay in the transmission of abstracts to the program committees, which has resulted in a change to the date for notifications of acceptance.

AOS 2000

- INVITED SPEAKERS -

The following have accepted invitations to present papers at AOS2000:

- **Dr Jim Gardner (CSIRO)**
  How well can we measure colour?
- **Prof. Min Gu (Swinburne Univ. of Technology)**
  Three dimensional bit optical storage in polymers
- **Assoc. Prof. Deb Kane (Macquarie Univ.)**
  The effects of optical feedback on semiconductor lasers
- **Ramin Lalezari (Research Electro-optics Inc, Boulder Colorado)**
  Ion Beam Sputter Deposition of Optical Interference Coatings
- **Prof. Gerd Leuchs (Univ. of Erlangen)**
  Quantum communication with bright pulsed light
- **Dr. Andre Luiten (Univ. of Western Australia)**
  Linking the Microwave and Optical Frequency Domains with a Phase-Coherent Bridge
- **Prof. Jesper Munch (Univ. of Adelaide)**
  Precision interferometry: from Michelson to gravitational waves
- **Dr Richard Powell (Univ of Arizona and Optical Soc. of America)**
  Overview of Solid State Lasers With Applications as LIDAR Transmitters and Optical Image Amplifiers
- **Dr Harry Quiney (Univ of Melbourne)**
  Quantum electrodynamics, time-reversal & parity violation: a relativistic QED approach to atomic and molecular theory
- **Prof. Colin Sheppard (Univ. of Sydney)**
  Characterization of beam propagation by moments, or Scattering and the theory of imaging
- **Prof. Josh Silver (Univ of Oxford)**
  From QED to Vision Correction - How we do physics at Oxford these days
- **Dr B Varcoe (M.P.I. for Quantum Optics)**
  The Creation Of Photon Number States, The Ultimate Quantum State Of Light
- **Dr. Jose Varghese (Biomolecular Research Institute, Melbourne)**
  Using glass monocapillary optics to obtain X-ray diffraction data from weekly diffracting protein crystals
- **Dr. A. Wilson (Univ. of Otago)**
  Atom Laser Output Coupling and Phase Encoding of Bose-Einstein Condensates

AOS 2000

- PROGRAM COMMITTEE -

- M Hamilton (chair), University of Adelaide
- C Walsh, CSIRO
- C Chantler, University of Melbourne
- J Hermann, DSTO

Newport

AIP/AOS Table Sale !

Vibration isolation systems available at reduced prices!

This year AIP and AOS will be held at the University of Adelaide from Sunday December 10th to Friday December 15th. Coherent Scientific, as a major sponsor of both conferences, would like to extend an offer to all customers through our annual table sale. ALL vibration isolation systems from Newport will be available at reduced prices. The offer will end at the close of the conferences. Shipment of all tables will then be consolidated.

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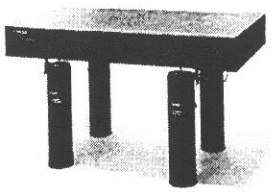

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Responsible for inventing steel-core honeycomb table tops in the 1970's, in 2000 Newport is still leading the way with new high performance systems like the **Electro-Damp** Active Vibration Control System, **Formel** Granite-Honeycomb tables and **Stacis 2000** Stable Active Control Isolation systems.

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AOS 2000

- PROGRAM OUTLINE -

AIP2000 runs from the evening of Sunday December 10 to Friday Dec 15. The program of AOS2000 proper will run from Tues Dec 12 to Fri Dec 15. The planned layout of AOS sessions is:

Tuesday 12/12	*Wednesday 13/12*	*Thursday 14/12*	*Friday 15/12*
Congress Plenaries	Congress Plenary + Bragg medal presentation	Congress Plenaries (incl. AOS plenary)	Congress Plenaries
2 parallel AOS sessions	Congress Plenary + AIP AGM	2 parallel AOS sessions	2 parallel AOS sessions
LUNCH			
1 AOS session	Tours	1 AOS session	2 parallel AOS sessions
1 AOS session + AOS poster session	Tours	1 AOS session + AOS poster session	2 parallel AOS sessions

Sessions: Oral sessions last 1.5 hours, and poster sessions 2.5 hours (overlapping with afternoon tea and running past the end of the parallel oral session).

Because there are regions of common interest, AOS sessions will be coordinated with sessions of the Australian Society for General Relativity and Gravitation (ASGRG), and of the Atomic and Molecular Physics and Quantum Chemistry (AMPQC) groups.

Tours: these will mostly be local wine-tasting tours and the like. However one of the planned tours is of local physics and optics based industry. This is still being organised. It will be free but numbers will be limited. Stay tuned to the websites for updates.

NOTE: The program committee is aware that AOS conferences are normally 3-day events, and that this one breaks the mould because it has to fit in with the AIP congress. It is intended to arrange the program so that sessions relevant to particular interest groups will be concentrated as much as possible at one end, or the other, of the week. This cannot of course be finalised until the reviewing of submitted abstracts is finished.

AOS 2000

- PLENARY LECTURE -

Professor Sajeev John

Photonic Band Gap Materials: A New Frontier in Quantum and Nonlinear Optics

Sajeev John is a professor of physics at the University of Toronto. He received his Bachelors degree in physics in 1979 from the Massachusetts Institute of Technology and his PhD in physics at Harvard University in 1984. His Ph.D. work at Harvard introduced the theory of classical wave localisation in disordered systems and in particular the localisation of light in strongly scattering dielectrics. From 1984 -1986 he was an NSERC postdoctoral fellow at the University of Pennsylvania as well as a laboratory consultant to the Corporate Research Science Laboratories of Exxon Research and Engineering from 1985-1989. From 1986-1989 he was an assistant professor of physics at Princeton University. While at Princeton, he co-invented (1987) the concept of photonic band gap materials. He was a laboratory consultant to Bell Communications Research (Red Bank, NJ) in 1989. In the fall of 1989 he joined the senior physics faculty at the University of Toronto. He is also a project leader for Photonics Research Ontario, a Canadian centre of excellence and is an associate member of the Canadian Institute for Advanced Research. His current research interests include light localisation, photonic band gap materials, applications of lasers in medicine, and high temperature superconductivity.

AOS 2000

- REGISTRATION -

Registration and accommodation are being handled by the organisers of AIP2000 and intending participants should register directly with the congress (a registration form is included on the following pages, or online at the AIP2000 website). The following information regarding registration is supplied by the AIP.

AIP2000 Congress Registration

Congress registration includes morning and afternoon teas, lunches, program, book of abstracts, satchel and attendance at the Welcome Reception on Sunday 10 December. Please note that the Congress Dinner is not included, although subsidised, and tickets are available at AUD$40 per registered delegate. Additional tickets can be purchased at a cost of AUD$75 per guest.

Teacher Registration (Mon. & Tues.)

The South Australian Science Teachers Association will be holding "The Australian Conference for Teachers of Physics" within the AIP2000 Congress on Monday 11 and Tuesday 12 December. The teacher registration entitles attendance on Monday and Tuesday only and includes morning and afternoon teas, lunches, program, book of abstracts and a satchel.

Student Registration

Student registrations must include proof of full time student status. A signed letter of authority from the Head of Department of the relevant institution must be attached. Registrations without this information will not be accepted. Student registration fee entitles attendance from Monday to Friday and includes morning and afternoon teas, lunches, program, book of abstracts, satchel and attendance at the Welcome Reception on Sunday 10 December.

AOS 2000

- REGISTRATION FEES -

There will be a single fee for all participants of the congress, entitling them to attend any of the subconferences of AIP2000 including AOS2000 (the AOS is a cognate society, so members of the AOS receive the members discount). All fees quoted in Australian dollars and include GST. The confirmation receipt will be in the form of a tax invoice. The ABN for the AIP2000 Congress is 81 004 566 509.

Type	Early*	Late
Member (AIP or cognate)	$395	$495
Non-member	$425	$525
Student	$225	$275
Teacher (Mon & Tues)	$150	$150

**The deadline for early registration is 13 Oct 2000.*

Payment of Fees

All payments must be made in Australian dollars. Payments should include registration fees, hotel deposit (one night's tariff), optional social functions and/or optional tours.

Overseas Delegates: Payment may be made by Visa, Mastercard, American Express, or Bank Draft in AUD$ made payable to "AIP2000 Congress". (Personal or company cheques not accepted.)

Australian Delegates: Payment may be made by Visa, Mastercard, Bankcard, American Express, or cheques made payable to "AIP2000 Congress"

Confirmation of Booking

A confirmation of your registration and a tax invoice/receipt will be forwarded as soon as possible after receipt. Please contact the Secretariat if you have not received this letter within a reasonable time frame.

Cancellations

Substitute delegates are welcome, however, please notify Staffords Conference Management of such changes. It is a condition of the acceptance of registration that cancellations should be notified in writing to Staffords Conference Management. Note the accommodation section, in the Registration Form, for cancellation information.

Conference Secretariat: Staffords Conference Management
1st Floor, 128 Fullarton Road
Norwood SA 5067
Telephone: +61 8 8364 1005
Fax: +61 8 8332 8810
email: aip@staffords.on.net

Registration Form

AIP2000 Congress ABN: 81 004 566 509

Registrations on-line available after 18 September:
www.physics.adelaide.edu.au/aip-sa/aip2000

Title ..... First Name ..... Surname .....

Position .....

Affiliation/organisation .....

City ..... State ..... Postcode .....

Country ..... Tel .....

Fax ..... Email .....

Name for Name Badge .....
(if different to First Name above)

Accompanying Person Details

First Name ..... Surname .....

Dietary Requirements

Delegate ..... Accompanying Person .....

Registration Fees

Payable	Early bird on or before 13 October	Regular on or after 14 October	
AIP (or Cognate) Member	AUD$395	AUD$495	$ .....
Non Member	AUD$425	AUD$525	$ .....
Student	AUD$225	AUD$275	$ .....
Teacher (Mon & Tue)	AUD$150	AUD$150	$ .....

Welcome Cocktail Reception (included in registration fee)
Please indicate with a ✔ if you will be attending ..... ❑

Women in Physics Forum (refer to page 6 for further details)
Please indicate with a ✔ if you will be attending ..... ❑

Conference Dinner (optional extra)	1 ticket @ AUD$40	$ .....
Additional tickets required	No of tickets ..... @ AUD$75	$ .....

Optional Tours (refer page 3 for details)

T1 Fleurieu Peninsula	No of tickets ..... @ AUD$60.50	$ .....
T2 McLaren Vale	No of tickets ..... @ AUD$60.50	$ .....
T3 Adelaide Hills	No of tickets ..... @ AUD$60.50	$ .....
T4 Cleland Wildlife Park	No of tickets ..... @ AUD$55.00	$ .....

Tours of Physics-based Industry in Adelaide (included in registration fee)
Please indicate with a ✔ if you will be attending ..... ❑

Accommodation

Please include a deposit of one night's tariff. (Note the Accommodation section for GST information.)

Hotels	Single	Double	Twin*	
Stamford Plaza Adelaide	❑ $165	❑ $165	❑ $165	Deposit = $ .....
Adelaide Paringa Motel	❑ $ 70	❑ $ 85	n/a	Deposit = $ .....
Apartments	**One bedroom**		**Two bedroom***	
Adelaide Ritz All-Suites	❑ $154		❑ $198	Deposit = $ .....
Budget	**Single**		**Breakfast**	
Lincoln College	❑ $ 36		included	Deposit = $ .....
St Mark's College	❑ $ 36		included	Deposit = $ .....
Royal Adelaide Hospital	❑ $ 18		❑ $ 4	Deposit = $ .....

Arriving: ..... (Day / Date) Departing: ..... (Day / Date)

❑ Smoking ❑ Non smoking ❑ Late check-in (after 6pm)

*Name of person if sharing with a delegate/s .....

TOTAL FEES $ .....

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Monday	❑ AMPQC		❑ CMP	❑ SASTA	❑ AINSE/NUPP	❑ STSP	❑ OzCUPE	❑ ASGRG
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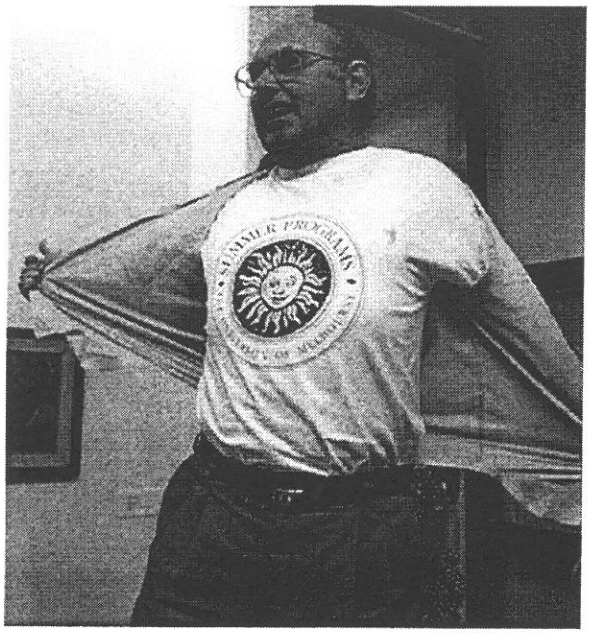
Thursday	❑ AMPQC	❑ AOS	❑ CMP	❑ Plasma2000	❑ AINSE/NUPP	❑ STSP	❑ VSA	❑ MP
Friday	❑ AMPQC	❑ AOS	❑ CMP	❑ Plasma2000	❑ AINSE/NUPP	❑ STSP	❑ VSA	

Reference

OzCUPE	Computers in Physics Education
STSP	Solar, Terrestrial and Space Physics
VSA	7th Vacuum Society of Australia Congress
AMPQC	Atomic and Molecular Physics and Quantum Chemistry
CMP	Condensed Matter Physics
AINSE/NUPP	18th AINSE Nuclear and Particle Physics Conference
SASTA	Australian Conference for Teachers of Physics
AOS	AOS2000 – 13th Conference of the Australian Optical Society
ASGRG	Australian General Relativity Workshop – Australasian Society for General Relativity and Gravitation
Plasma2000	Plasma2000 – 23rd AINSE Plasma Science and Technology Conference
MP	Medical Physics

In Honour of Professor Tony Klein FAA



Tony Klein was not only an excellent physicist, but he was also a renowned wit and pricker of pretension. On his retirement first as Head of the School of Physics, and then from the University of Melbourne, he inspired a number of people to make a serious effort to match him.

In this article, we publish some of the efforts made on these two events. In order to raise the tone, we have also included two earlier poems written in honour of Tony by the distinguished Australian poet Chris Wallace-Crabbe. The other authors are Roger Rassool, Bill Wignall and Geoff Opat.

I have also included Tony's retirement speech.

I hope you enjoy the literary works inspired by the newest Life Member of the Australian Optical Society.

Keith Nugent

Klein's way

(To the tune of "My Way")

And now, the time is near
For him to face, this ragged curtain
As friends, let's make it clear
Let's state the case, of which we're certain
He's done a lot for us
He's overseen a lot of projects
But more, as he would say
I did it MY way.

Regrets, he's had a few
But as you know, we should not mention
The things, he used to do,
When he was in administration
He blew a fuse or two,
When things would not,
Follow his direction
He'd say, to me and you
Just do it MY way.

Yes there were times, I'm sure you knew
When others failed, Physics grew and grew
But when at all, if there was doubt
He'd grab the stand, and shout it out
We are the top, and there we stay
If we do it MY way

He's loved, he's laughed and cried
But not yet had, his share of losing
And now, as years subside
We find it all, so quite amusing
To think, he's scrutinised
With guarded eye, tonight's performance
This is, our only chance
Let's do it OUR way

For what is this man, what has he got ?
One rubber dinghy, he calls a yacht
A four wheel drive, to crash through trees
An airconditioner, to cool his cheese
The record shows, he stole the shows,
And did it Klein's way

Modern Chairman Academical

(with apologies to Gilbert & Sullivan - Pirates of Penzance)

(1)
He is the very model of a Chairman Academical,
He 'as information mechanical, physical, and optical
He knows the Deans of Parkville, and joins in fights profesorial,
From Medicos to Engineers, with language rather nautical,
He's very well acquainted with equipment electronical,
He understands electronics, both linear and digital,
About the Norton theorem he's teeming with a lot o' news,
With many gloomy facts about the current that will blow a fuse.

Chorus
With many gloomy facts about the current that will blow a fuse.
With many gloomy facts about the current that will blow a fuse.
With many gloomy facts about the current that will blow a fuse.

He's very good at integral and differential calculus,
He knows the scientific names of every bloody nucleus,
In short, in matters mechanical, physical, and optical,
He is the very model of a Chairman Academical.

Chorus
In short, in matters mechanical, physical, and optical,
He is the very model of a Chairman Academical.

(2)
He knows our mythic history, Prof. Hercus and Sir Leserly,
He uses hard statistics in his work in the laboratory,
He tells of Faraday using ice-pail and electrophorus,
In heat he quotes the temperatures in Farenheit and Celsius
He can tell undoubted genii like Einstein and Archimedes,
He knows the croaking chorus from the Deans of all the Faculties,
Then he can smell a rat in matters he has never heard before,
And often takes the "mickey" out of yet another ruddy bore.

Chorus
And often takes the "mickey" out of yet another ruddy bore.
And often takes the "mickey" out of yet another ruddy bore.
And often takes the "mickey" out of yet another ruddy bore.

Then he applies to A.R.C., an experiment to perform,
And tells you every detail of a secretary's uniform;
In short, in matters mechanical, physical, and optical,
He is the very model of a Chairman Academical.

Chorus
In short, in matters mechanical, physical, and optical,
He is the very model of a Chairman Academical.

(3)
In fact, when he knows what is meant by "formula" and "tenure track",
When he can tell at sight a grant of money from a "clawing back",
When such affairs as sorties and surprises he's more wary at,
And when he knows precisely what is meant by "secretariat",
When he has learnt what progress has been made in modern deanery,
When he knows more of tactics in the University scenery,
In short, he has a smattering of elemental strategy,
You'll say a better head has ever walked in the Varsity.

Chorus
You'll say a better head has ever walked in the Varsity.
You'll say a better head has ever walked in the Varsity.
You'll say a better head has ever walked in the Varsity.

(4)
He guards the Physics budget with a zeal that's born of penury,
And guides us from these present days into the future century
But still in matters mechanical, physical, and optical,
He is the very model of a Chairman Academical.

Chorus
But still in matters mechanical, physical, and optical,
He is the very model of a Chairman Academical.

Dear Tony,
God is watching
Every time you vote;
Above the Council Chamber
He takes a little note.

He merely classes Pennington
Among the goats and kine
But for his Chosen Person
He concentrates on Klein.

The crawlers and time-servers
He views with acrimony
But for a soul worth saving
The Lord says, "Give me Tony."

So if you're aware of something
Neither particle nor wave
It's merely your Well-Wisher
Watching how you behave.

Cloud Chambers Of Taxonomy
(for Tony Klein)

Like plain morality or the universe,
things grow more complicated and eccentric
the more you peer at them
So it appears with physics, which had flaunted
the locked Meccano world of Locke and Newton
in which those forces which had long been God's
played perfect snooker with us.

I think it was pi-mesons threw me out
of that clean laboratory. Solidity now swam
and all hard edges blobbed
in space-time like a super minestrone.
The tiny and gigantic were in league,
putting the kibosh on childhood's farm
of linearity and momentum.

The fact that my wife's a relative of Einstein
doesn't help much with chance or superstrings,
while bloody chaos theory
gets out there now and has me by the balls.
In today's glass, that fickle siren, Physics,
has more of Monet than Gauss or Torricelli
about its personal style.

While (glory be!) not even the absent God
would have had the visionary gumption to
come up with anti-matter.
And as for parallel universes -- wow!
Yours the new menagerie of ogres and pixies,
the intellectual ballet of excitement,
worlds without end. Amen.

Chris Wallace-Crabbe

Rap-ide-Klein (A rap song)

Back in '65, when the world was new
There came this guy called Tony who
He had some hair, and a real big smile
And said I'm your man, I'm Tony Klein

Now Tony was an Engineer it seems,
But saw the light, and swapped his genes
From Lucas Heights, he came on down,
To mark his spot, be bought a crown

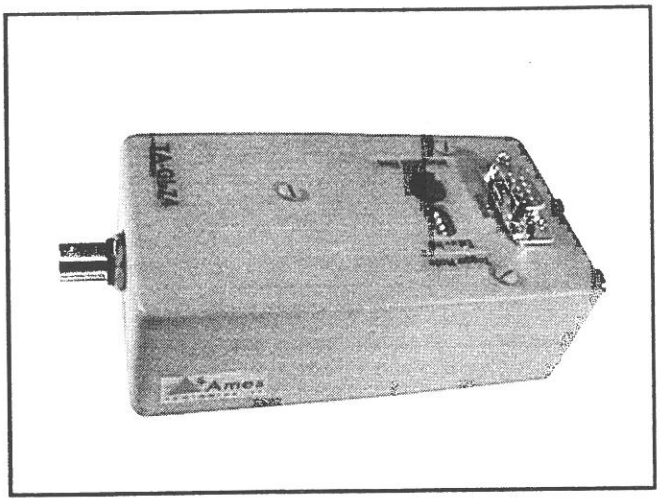
He learnt of Sir Les, and Hercus too
Then played in the pit when Caro was new
He understands things, both linear and digital
Knows all modes, both optical and physical

But if bureacraticy will trigger his fuse
Studley park feathers are what he will use
Marshman's on the lookout, on the 9th floor
Potter's not phased, he's had one before

Piranhas in the fishtank, how obscene
But under his ruling, we formed quite a team
Now his jumping ship, should we throw him a line
To avoid future risk, be it called deKlein

TA-GI-74: TRANSIMPEDANCE AMPLIFIER / GATED INTEGRATOR

Ames PHOTONICS Inc



TA-GI-74

- ☐ **Low noise**
- ☐ **Built-in sample and hold circuit**
- ☐ **Gain programmed by timing**
- ☐ **Internal / External trigger modes**
- ☐ **Switch selectable integration time control**
- ☐ **Single power supply (+5V DC 250 mA)**
- ☐ **PC interface connector**
- ☐ **Compact**

The TA-GI-74 is a precison inverting integrating amplifier with a sample / hold circuit and integration time control logic. The unit integrates low level current for a user specified period of time (integration time) and holds the resulting voltage in the sample and hold circuit. The input signal may be positive or negative; the polarity of the output signal is opposite to the input. The TA-GI-74 provides a precision lower noise alternative to conventional transimpedance operational amplifiers that require a very high value feedback resistor to achieve high gain.

APPLICATIONS

- Precision low current measurement
- Optical signal detection from photodiodes and PMTs
- Ionization chamber measurements
- CW and pulsed spectrophotometry

MODES OF OPERATION

The TA-GI-74 supports two modes of operation: external trigger and internal self-trigger. Selection between the two modes is made via an on-board dip switch. The external trigger mode allows the user to synchronize the start of integration with an external event. This mode is preferable for the detection of pulsed or modulated signals. In self-trigger mode, a new integration cycle commences immediately after the previous integration cycle is complete. This mode of operation is functionally equivalent to that of a transimpedance amplifier and can be used for detection of continuous wave (cw) signals.

SPECIFICATIONS

Integration time:	20 µs - 2 s (rotary switch selectable)
Gain:	10^{10} V/A s
Gain error:	+/- 5%
Nonlinearity:	+/- 0.005%
Input current range:	+/- 100 µA
Output voltage:	+/- 10V
Output noise:	10µV rms
External trigger input:	TTL / CMOS compatible. In external trigger mode the rising edge of the trigger pulse starts the integration.
Power requirements:	+5V DC 250 mA
Operating temperature:	-40 to + 85°C
Dimensions:	120 x 65 x 40 mm
Weight:	200g

ORDERING INFORMATION

D7280	TA-GI-74 Transimpedance amplifier / gated integrator

Ames Photonics Inc
PO Box 1864 Ames
Iowa IA 50010-1864
USA

Tel: (515) 663-8008 Fax: (515) 663-8009
Email: sales@aphot.com
http://www.aphot.com

KLEIN'S FAREWELL SPEECH

University House, Melbourne University

December 1998

*Thanks, Geoff; Thanks, Keith - I am overwhelmed....

In the Oz vernacular...You wouldn't be dead for quids on a day like this ... Otherwise you couldn't be there to listen to your eulogies!

A word, before I start, to the poets who spoke earlier...I mean the amateurs, not the pro: ...
Don't give your day job just yet!
* Now, before I get carried away ...not that I intend to get carried away...but you never know....I would like to thank you all for coming and to thank you for your generosity ...I am greatly touched and honoured ... thank you.

* First about the portrait....it's very good, isn't it? I must say I am very pleased with it and I will be greatly honoured when it joins the portraits of my predecessors on the walls of the Physics Conference Room.

But meanwhile, thank you Christine for doing such a fine job.

I want to tell you that, at one stage, after one of the sittings, I said to Christine: "It looks a bit dopey, doesn't it?".

"I can't help it, she said ...I paint what I see....."

But can't you put a bit more intelligence into it I asked?...

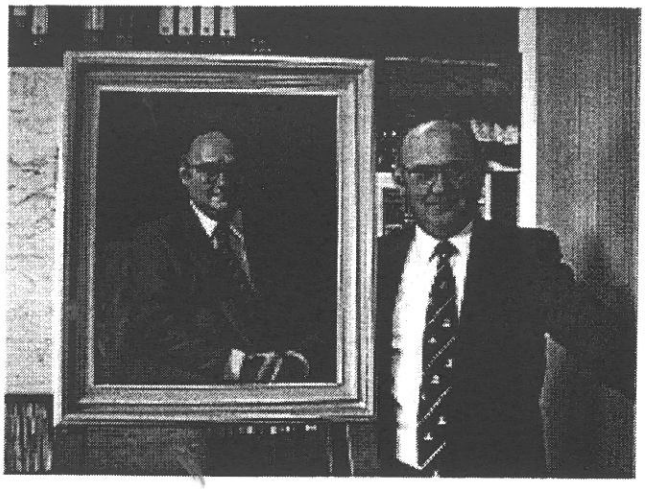
Oh sure she said, and reached for this small tube of special paint and a special little brush ...and proceeded to put some highlights into the eyes... Zap...zap....and it came to life. I must say she is an extremely talented artist and I am very pleased that we found her. I hope that she gets a lot more commissions from the University after this.

Now let me rewind to the beginning:

Thank you for your very witty and generous remarks, Vice-Chancellor. Although you haven't known me for as long as most of the other people here, you formed a pretty accurate impression of my foibles. As for your poetry……I would suggest that you don't give up your day job!

To rewind right to the very beginning.....it will be 45 years next February that a mob of 140 young hopefuls were milling around outside the hallowed portals of the Old Engineering School Building, one Monday morning.

At precisely 9 a.m. the doors were opened from inside by a tall, fair-haired, very handsome young man: Dr Peter Whitton, Senior Lecturer in Mechanical Engineering, He led us up to the top floor Drawing Office where we were to spend the next two weeks in "Boot Camp" - learning Engineering Drawing and



become a tightly welded team by the time of the regular start of term in March.

* It is not widely known that Geoff Opat was also one of the young hopefuls ... but after spilling Indian ink over his drawing, he spat the dummy, went home and told his old man that he was going to be a scientist and to hell with Engineering! In my case, it took me ten years to come to the same conclusion!

* Peter Whitton, whom I am delighted to see here tonight, was a brilliant lecturer. He taught me about bridge trusses and steam engines and other such terribly useful stuff. What sticks in my mind is one occasion when I went to see him about a very curly problem in graphical statics and he said to me: " I will explain to you the principles behind this - the rest you will have to figure out yourself..."

This statement was to have a great influence on my intellectual development: It taught me that you don't have to remember everything - only the principles - the rest you can figure out for yourself!

No wonder Peter Whitton went on to great heights - he became Professor of Mechanical Engineering in 1965 - the year I came back as a Senior Lecturer - and later he became Deputy Vice-Chancellor.

An even greater intellectual influence was another young Senior Lecturer - Dr David Caro, who taught 1st year Physics... and was building a cyclotron in his spare time. It was rumoured that taking lectures from this man was like trying to take a sip from a fire hose. Well, I found that I could drink from this particular fire hose and, in fact, I came top in the subject. My mind was warped for life!

Of course David went on to great heights too and was Professor and Head of Physics by the time I came back to Melbourne. As you heard, he offered me a job in 1965 - which I accepted, quite adventurously, in preference to a job at Monash in Electrical Engineering. David also went on to become DVC - and eventually VC.

With teachers like these I really had outstanding role models not only as a student but later as a teacher and, even later, as a Head of Department.

I must now say a few words about my 30-odd year collaboration with Geoff Opat who, by the way, after disappearing from the Engineering cohort, re-appeared on Her Majesty's Service at Nasho, as you've heard. He re-appeared again on the staff of the Physics School having accepted a job a few months before me.

J. Paul Getty, the Bill Gates of the oil industry a generation ago, gave his recipe for success as follows:

"Rise early, Work hard, strike oil!" Well, I certainly struck oil when I went to work with Geoff....and the two of us struck oil when we went to work with neutrons - when our particle physics work came to an end. Let me just say that I learned more physics from Geoff than from many textbooks put together - and that's probably because Geoff knows more physics than many textbooks put together!.

The neutron work was, in my case, rewarded by a Personal Chair in 1983 - the greatest honour that this University has bestowed upon me .....I owe a great debt of gratitude to many generous people for that .....some of them probably here tonight.

Of course I didn't realise the down-side of that at the time - that I had to serve as Head of Department which, for me was a pretty onerous but very rewarding job. One of the most rewarding tasks was the Staff Renewal Programme which saw the selection and appointment of a large number of new, young, vigorous staff, of both sexes - a task in which I was, of course, assisted by Geoff and other senior colleagues.

I am very proud indeed of the younger generation in Physics and I greatly rejoice in their achievements. More than half of them are now Associate Professor and Readers and, of course, Keith Nugent serves with great distinction as Professor and Head of Department.

I am particularly proud of the successful "succession planning" that this represents and would just like to mention in passing that they've done brilliantly well in the round of Research Grants announced earlier this week. I congratulate you all !

I am also very proud of the Physics Building Extension that went up in my time as Head (Cnr Swanston St and Tin Alley). It is built of glass and concrete, but had it been built of bricks and mortar, the mortar would have been made out of my blood! As it is, it worked out extremely well, but it wasn't easy!

I want to change tack at this point and talk about the question that everyone has been asking me: what I am going to do in my retirement

Well, there are at least two answers.

First, this is not a real event - it simply marks my transition from the payroll to the Super fund. I will continue as a Professorial Associate in Physics (Thank you, Vice-Chancellor), in the same old office (Thank you, Keith); I will come in regularly (initially, anyway) but will do only those things which amuse me - such as research, reading, talking with colleagues - and having lunch at University House.

It is really just a "rite of passage" - like modern marriage : After the wedding the bride and groom go home and keep on doing exactly what they've been doing all along.....

I won't even give up lecturing - I will give the odd lecture here and there.... in fact the next performance is on Monday morning at 9.30 in the Laby Theatre, "A guided tour of the Electromagnetic Spectrum" for a Summer School for students from Singapore. You are all welcome to come along.....lots of interesting demonstrations.

Now for the second answer to what I will be doing:

I hereby announce that I am planning to start a Private University. The details are still sketchy but I can tell you that it is designed to add value to the University of Melbourne AND to Melbourne University Private and I hope it will be inter-operable with both.

It will consist of only three Faculties, largely because that is all that the computerised timetabling program can handle.

The three Faculties will be: Health, Wealth and Happiness.

For HEALTH: I intend to recruit Professor Jim Pittard to run this - he is also retiring this year and may be at a loose end next year (although I doubt it!). As a microbiologist, Jim may be just the bloke to deal with subjects such as the international intellectual contagion of fashionable heresies that infect the world – for example post-modernism; global free-market capitalism and so on. And as an immunologist he may be able to address the problems of Diplomatic Immunity, as in the case of General Pinochet, for example.

* WEALTH: In view of his outstanding success with "SCAM" - or whatever the acronym is for the Cooperative Research Centre for Screwing Cash out of the Advanced Mineral Industry, I intend to approach Professor Tom Healy to head up the Faculty of Wealth.

I know that he would be outstanding in all aspects, including the new advanced mineral process of making gold out of lead.

* Now for HAPPINESS: Well, I intend to deal with this myself, but I may sub-contract some of the courses, namely: WINE, WOMEN AND SONG.

SONG -is clearly a job for a poet - I will ask Chris Wallace-Crabbe - Thanks Chris - your poem has clearly stood the test of time - I enjoyed it as much today as on the day you first sent it to me, in 1993!

WINE - is clearly one for Victor Spitzer - thank you, Vic for your generous gift of the Ten Billion Mark banknote.

WOMEN - Well, it will be strictly BYO: As for me, I will bring Suzanne, who is responsible for my happiness - and who stood by me during all the roller-

coaster rides of the last 25 years. Thank you Suzanne for all that you have put up with!

* There is a serious aspect of my private University that I would like to stress:

In his new book quoted in "The Age" this week, George Soros, the high priest of global capital, admits that the free market system is incapable of coping with important aspects of human existence such as ethics and morality. I assert that the list of failures goes on to include education, fundamental research and indeed, intellectual endeavours in general.

This is certainly true in Australia where successive Governments, of both parties, in their headlong rush towards the global economy, seem to be hell-bent on wrecking the higher education system and now the research funding system.

Well now: Since, in my private University, the payroll will be met by the superannuation fund, we will have time to concentrate on the eternal verities without continual worries of the kind that occupy the other Universities.

I think that there ought to be room somewhere and somehow, for old-fashioned Universities of the kind that I have in mind. Remember Bologna and Padova are still there and thriving after more than 800 years!

* So, as the Sun slowly sinks in the West.... Hey, wait a minute, I hear some people say: He hasn't told us any jokes.... We want our money back!

Oh, all right, I will tell you my all-time favourite joke. It is, of course, an Ethnic joke - they are, after all the funniest... and Political Correctness has never stopped me in the past....

You see, it is all right to tell ethnic jokes..... about extinct tribes. Such as the Hittites. So, there was this Hittite priest, Rabbi Cohen....

No, I won't tell that one. Are there any Norwegians present? No?

That's good! I won't have to tell it slowly.

It is my favourite joke because it highlights the disparity between human aspiration and human achievement that is, after all, the essence of humour.

Johansson is running to catch the cross-fjord ferry and he is running late. The ferry has just pulled out by the time he gets to the jetty.

"Yump, Johansson, yump" shout the passengers on board.

"In two yumps you can make it!"

So let's drink to the good old University of Melbourne, "Harvard of the South"

In two yumps we can make it!

Prof. Tony Klein
December 1998

AOS Technical Optics Award

Call for nominations for *2000*

This 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 2000/2001 award, which will be presented at the next AOS Conference.

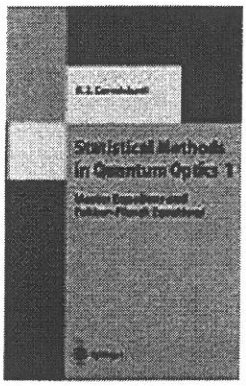
Details of the applicant's or nominee's activities and achievements should be sent to the Secretary:

Dr Peter Farrell
Department of Applied Physics
Victoria University
PO Box 14428
MCMC Melbourne
Vic. 3001

to be received by **30 November 2000**

Book Reviews

The following two book reviews have been previously published in "The Physicist", the journal of the Australian Institute of Physics. They are reprinted here with kind permission.



Statistical Methods in Quantum Optics 1: Master Equations and Fokker-Planck Equations

by H.J. Carmichael
Springer-Verlag, Berlin 1999
xxi+361 pp., AUD$90.50
ISBN 3-540-54882-3

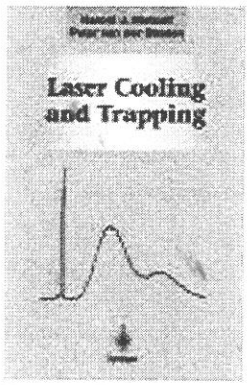
Howard Carmichael stands out in the field of theoretical quantum optics for the originality and rigor of his work, qualities reflected in this two volume work. The first volume, reviewed here, develops the theoretical methods for treating dissipation in quantum optics: the Master Equations and Fokker-Planck Equations of the title. The second volume will apply these methods to systems such as the parametric oscillator.

This volume has spontaneous emission from two-level atoms and the damped harmonic oscillator as its target systems. In the final two chapters these are combined into a treatment of the laser.

Although it is not short of clear physical insight and heuristic models, the primary focus of the book is on clarifying the foundations of quantum optics. This is what most distinguishes it from other quantum optics texts, such as Walls and Milburn. It has more in common with seminal works such as Haken's Handbuch der Physik volume on laser theory. Those, like myself, who have struggled with Haken's Handbuch will be pleased to see many of the gaps filled in by Carmichael.

For quantum optics researchers this book is a must have. It contains the distilled wisdom of a deep thinker. Non-specialists may find it too technical and prefer a text with a more direct route to applications.

C. M. Savage
Dept. of Physics & Theoretical Physics
ANU



Laser Cooling and Trapping

by Harold J. Metcalf and Peter van der Straten
Springer, 1999
xvi + 323, $US29.95 (paperback)
ISBN 0 - 387 - 98728 - 2

The rapidity with which a new field expands and reaches maturity often oustrips the supply of good textbooks. The cooling and trapping of atoms by laser light is no exception. Although laser cooling has only become an experimental reality in the last twenty years, by 1997 its significance had already been recognized through the joint award of the Nobel Prize in Physics to Claude Cohen-Tannoudji, Steve Chu and Bill Phillips.

However it has taken most of that time for the first wide-ranging textbook on this topic to appear. Written by one of the earliest contributors to this field - Hal Metcalf from Stonybrook, New York, and his colleague from Utrecht in the Netherlands, Peter van der Straten, the book fills a gap that has been crying out to be filled for some time.

This introductory text does not aim for completeness - no work in such a rapidly expanding field can. It aims to present a foundation of the underlying principles from which new workers and students in the field can launch their own investigations. Other books exist on specialist sub-topics on atom optics and are listed in the appendix to this text, but none provide such a comprehensive background to the field.

Sensibly the book starts with a review of the quantum mechanical principles and theoretical models on which much of laser cooling and trapping is based. The introductory section finishes by emphasising the key features of laser cooling and trapping including one of the important differences between atom optics and conventional light optics: namely, the ability of dissipative light forces to compress the phase space density of atoms in "violation" of Liouville's theorem.

The second section of this three-part book covers the full range of techniques used for laser cooling and trapping of atoms. Importantly from an experimentalist's perspective, the key limitations and advantages of each process are delineated, and the theory is well interspersed with sample references to experimental demonstrations.

The final part of the book goes beyond the purview of the title. Here, gathered under "Applications", are many experiments which illustrate the realisation of a new branch of optics - atom optics - which has been synergised by the development of laser cooling and trapping. Atom optics is the ultimate demonstration of complementarity - where de Broglie matter waves are manipulated by optical elements made from light.

Nowhere is this more dramatically encapsulated than in the 1995 realisation of the first Bose-Einstein condensate, in which the de Broglie waves of adjacent atoms overlap to form a macroscopic (sub-millimetre) quantum state. These and many other key developments in atom optics which now have real-life applications (such as atom interferometry for measuring gravity gradients) are copiously illustrated by experimental example.

The result is a comprehensive 323 page book, well laid out with 115 illustrations, many of them from the original works. The reference list is extensive (370 publications), and the extremely useful appendixes contain well-compiled sets of data on important atomic properties relevant to atom optics.

The only criticism is that there is no concession to the modern world of dot.com publishing, either through the use of web-based information, computer software or cd rom formatting. However, this is but a small shortcoming which may well be addressed in time.

A strong recommendation for any book in your own field is to see it written the way you would have written it. This is certainly the case here, as during the delivery of a number of graduate courses on atom optics with one of my colleagues, a text on this subject was in a formative stage of development. The topic headings and the purview of this book almost exactly match what was planned.

If you are a researcher or a teacher in laser cooling and trapping or a related field of atomic, molecular and optical physics, then this is a "must buy" text for your bookshelf. And buy one for your students too, because your copy will invariably disappear.

K. Baldwin
Research School of
Physical Sciences and Engineering
ANU

Have you read any interesting (and relatively new) books lately? Write a review, and share your opinions on what is good and not so good in the world of optics literature. See the submission guidelines on page ?

EDITORIAL

Hopefully this edition of the *AOS News* will reach you during September 2000, or not too long thereafter. As stated in the Incoming President's Message, the AOS Council (including myself as newly "appointed" editor) plans to make the timely production of this publication a priority. It is important that ALL members of the AOS take responsibility for this; I think a degree of complacency at all levels contributed to the twelve-month hiatus of the *AOS News*. Such a statement comes of course from a greenhorn editor in his first issue, and I am sure that the steep learning curve has only just begun.

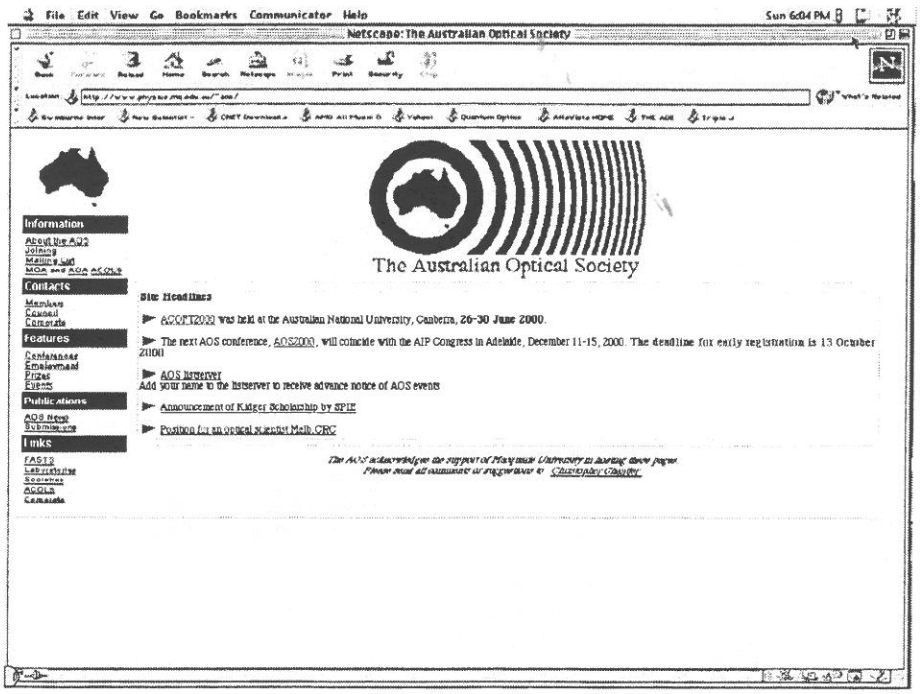
Thanks to the efforts of the AOS Council members (and especially Duncan Butler), this issue is more than just a stopgap measure. There are several articles of interest, including a report on ultrafast laser ablation, some light-hearted literary tributes to Prof. Tony Klein, and information on the upcoming AOS Conference in Adelaide. I would also like to thank the Australian Institute of Physics for allowing the inclusion of book reports previously published in "*The Physicist*".

As a final comment in my first editorial, I would implore all members to consider contributing *something* to their own newsletter. There are numerous ways to do this; from full scientific articles (latest results, review article, maybe a chapter of a thesis-in-progress) to short comments and discussions, even something humorous (anecdotes, jokes, cartoons etc.). The guidelines for submitting material are in the News and on the web, but please feel free to contact me or any of the editorial board (listed on page 2) for advice and suggestions.

Wayne Rowlands

Australian Optical Society on the World Wide Web

http://www.physics.mq.edu.au/~aos/



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There are also many links to websites of interest to AOS members.

http://www.physics.mq.edu.au/~aos/

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 2001, the award will be valued at up to $1500. The Society now invites applications from suitably qualified people for this prize for 2001.

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 2000, 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 2000. 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 Peter Farrell
Department of Applied Physics
Victoria University
PO Box 14428
MCMC Melbourne,Vic. 3001
Fax. (03) 9688 4698

and **must be received by 31 October 2000** The winner will be announced early in 2001.

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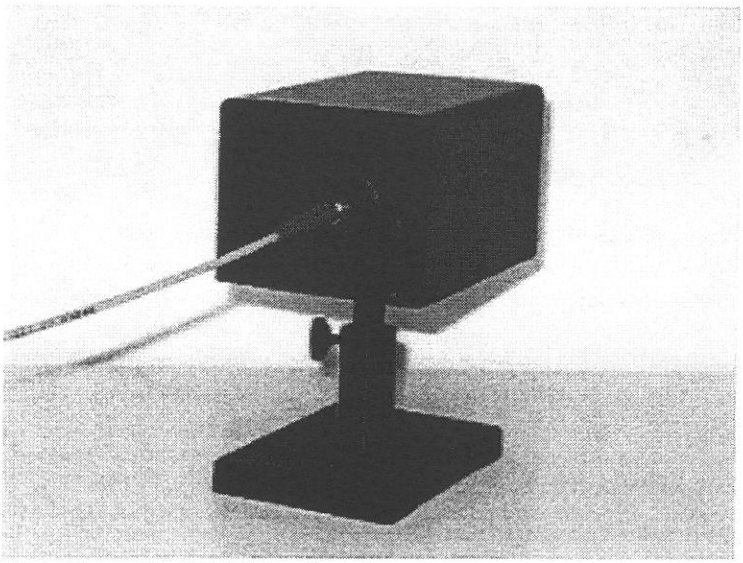

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For more information please contact Rodney Trickett of Raymax Applications, Sydney
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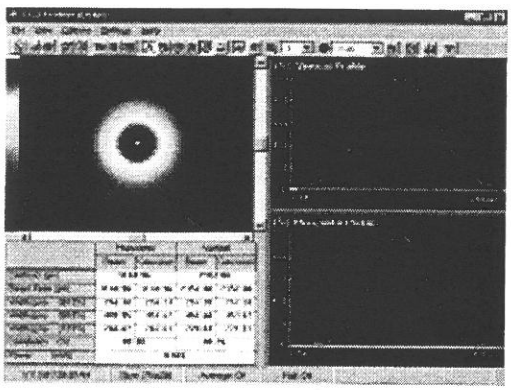

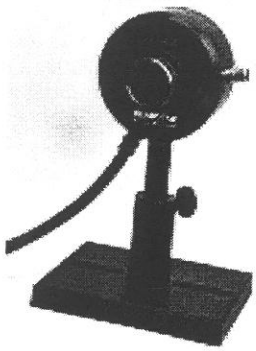

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For more information please contact Rodney Trickett of Raymax Applications, Sydney.
Email: sales@raymax.com.au, or phone 02 9979 7646.

Meetings Calendar

The following list of optics-related conferences is compiled from several sources and should be used as a guide only.

Date	Meeting 2000	Contact	Location
Sep 20-26	International Seminar on Novel Trends in Nonlinear Laser Spectroscopy and High-Precision Measurements in Optics	SPIE	Vladimir-Suzdal, Russia
Sep 25-29	24th International Congress on High Speed Photography and Photonics	SPIE	Sendai, Japan
Sep 25-29	European Symposium on Remote Sensing	SPIE	Barcelona, Spain
Sep 25-28	Interferometry in Speckle Light: Theory and Applications	SPIE	Lausanne, Switzerland
Sep 26-30	Optics of Crystals	SPIE	Mozyr, Belarus
Sep 26-30	International Conference on Optical Storage - OS 2000	SPIE	Kiev, Ukraine
Sep 28-Oct 4	International Conference on Optical Holography and its Applications	SPIE	Kiev, Ukraine
Oct 2-6	8th International Conference on Nonlinear Optics of Liquid and Photorefractive Crystals	SPIE	Crimea, Ukraine
Oct 2-6	2nd International Conference Singular Optics (Optical Vortices): Fundamentals and Applications	SPIE	Crimea, Ukraine
Oct 3-7	Saratov Fall Meeting 2000: Laser Physics and Photonics and Optical Technologies in Biophysics and Medicine	SPIE	Saratov, Russia
Oct 9-12	Second International Asia-Pacific Symposium on Remote Sensing	SPIE	Sendai, Japan
Oct 10-13	Ninth International Symposium on Advanced Display Technologies	SPIE	Moscow, Russia
Oct 11-13	OFS 2000 - 14th International Conference on Optical Fiber Sensors	SPIE	Venice, Italy
Oct 16-18	XXXII Boulder Damage Symposium: Annual Symposium on Optical Materials for High Power Lasers	SPIE	Boulder, USA
Oct 22-26	OSA Annual Meeting	OSA	Providence, USA
Oct 22-26	16th Interdisciplinary Laser Science Conference	OSA	Providence, USA
Oct 22-26	Optical Networking and Communications Conference (Opticomm 2000)	SPIE	Richardson, USA
Oct 26-27	Nonlinear Optics for the Information Society	OSA	Enshede, Netherlands
Nov 1-3	International Topical Symposium on Advanced Optical Manufacturing and Testing Technology (AOMATT CHINA 2000)	SPIE	Chengdu, China
Nov 5-8	Photonics East®	SPIE	Boston, USA
Nov 8-10	Optics and Optoelectronic Inspection and Control	SPIE	Beijing, China
Nov 13-14	International Symposium on Adaptive Optics	OSA	Murcia, Spain
Nov 13-14	17th European Conference on Mask Technology for Integrated Circuits and Micro-Components	SPIE	Munich, Germany
Nov 15-17	ODF 2000 - 2nd International Conference on Optical Design and Fabrication	SPIE	Tokyo, Japan
Nov 27-Dec 2	International Symposium on Microelectronics and Assembly (ISMA 2000)	SPIE	Singapore
Nov 29-Dec 1	ICEM2000 - 2nd International Conference on Experimental Mechanics	SPIE	Singapore
Dec 11-15	13th Conference of the Australian Optical Society	AOS	Adelaide, Australia
Dec 12-15	IPC2000 - International Photonics Conference	OSA	Taipei, Taiwan ROC
Dec 13-15	Smart Materials and MEMS	SPIE	Melbourne, Australia
Dec 18-20	Photonics 2000: International Conference on Fiber Optics and Photonics	SPIE	Calcutta, India
Date	**Meeting 2001**	**Contact**	**Location**
Jan 9-11	Optics in Computing	OSA	Lake Tahoe, USA
Jan 10-12	Ultrafast Electronics and Optoelectronics	OSA	Lake Tahoe, USA
Jan 20-26	Photonics West®	SPIE	San Jose, USA
Feb 5-8	Fourier Transform Spectroscopy	OSA	Coeur d'Alene, USA
Feb 5-8	Optical Remote Sensing of the Atmosphere	OSA	Coeur d'Alene, USA
Feb 18-23	Optical Fiber Communication Conference	OSA	San Francisco, USA
Feb 18-23	Medical Imaging	SPIE	San Diego, USA
Feb 25-Mar 2	Microlithography	SPIE	Santa Clara, USA
Mar 4-8	Smart Structures & Materials/ NDE for Health Monitoring & Diagnostics	SPIE	Newport Beach, USA
Mar 17-22	Optical Fibre Communication Conference	OSA	Anaheim, USA
Mar 25-28	Nonlinear Guided Waves and Their Applications	OSA	Clearwater, USA

Date	Meeting 2001 (cont.)	Contact	Location
Mar 27-30	Large Lenses and Prisms	SPIE	London, UK
Apr 10-11	Opto-Northeast	SPIE	Rochester, USA
Apr 16-20	AeroSense: Aerospace/Defense Sensing and Controls	SPIE	Orlando, USA
Apr 22-25	Optical Data Storage	SPIE	Santa Fe, USA
Apr 25-27	Photomask Japan	SPIE	Kawasaki City, Japan
May 6-11	CLEO - Conference on Lasers and Electro-Optics	OSA	Baltimore, USA
May 6-11	QELS - Quantum Electronics and Laser Science Conference	OSA	Baltimore, USA
May 10-13	Correlation Optics 2001	SPIE	Chernivtsi, Ukraine
May 21-23	5th International Conference on Quality Control by Artificial Vision	SPIE	Le Creusot, France
May 30-Jun 1	Microelectronic and MEMS Technologies	SPIE	Edinburgh, UK
Jun 3-6	Complex Adaptive Structures	SPIE	Hutchinson Is., USA
Jun 6-8	Optical Engineering for Sensing and Nanotechnology (ICOSN 2001)	SPIE	Yokahama, Japan
Jun 20-22	Laser and Laser Information Technologies (ILLA 2001)	SPIE	Vladimir, Russia
Jun 26-Jul 1	XVII International Conference on Coherent and Nonlinear Optics (ICONO 2001)	SPIE	Minsk, Belarus
Jul 29-Aug 3	International Symposium on Optical Science and Technology (SPIE Annual Meeting)	SPIE	San Diego, USA
Aug 20-24	ITCom 2001: International Conference and Exhibits on the Convergence of IT and Communications	SPIE	Denver, USA
Sep 3-7	IV Iberoamerican Meeting of Optics (IV RIAO) and the VII Latin American Meeting of Optics, Lasers & Applications (VII OPTILAS)	SPIE	Tandil, Argentina
Sep 17-21	X-Ray and Neutron Capillary Optics	SPIE	Zvenigorod, Russia
Sep 17-18	Opto-Southwest	SPIE	Tuscon, USA
Oct 2-5	Photomask Technology	SPIE	Monterey, USA
Oct 22-24	2nd International Symposium on Multispectral Image Processing and Pattern Recognition	SPIE	Wuhan, China
Oct 22-25	Micromachining and Microfabrication	SPIE	San Francisco, USA
Oct 28-31	ISAM/EIS	SPIE	Newton, USA
Nov 12-16	APOC 2001-Asia-Pacific Optical Communications Conference and Exhibits	SPIE	Beijing, China
Nov 21-23	Microelectronics and Micro-Electro-Mechanical Systems	SPIE	Adelaide, Australia
Nov 26-Dec 1	Photonics and Applications	SPIE	Singapore
Nov 26-28	ETOP 2001: The 7th International Conference on Education and Training in Optics and Photonics	SPIE	Singapore

Further information on the above conferences can be obtained from:

OSA
(The Optical Society of America)
2010 Massachusetts Avenue, N.W.
Washington, D.C. 20036-1023
USA

Phone: +1 202.223.8130
Fax: +1 202.223.1096
email: custserv@osa.org

SPIE
(The International Society for Optical Engineering)
PO Box 10
Bellingham WA 98227-0010
USA

Phone: +1 360 676 3290
Fax: +1 360 647 1445
email: spie@spie.org

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Adelaide
SA 5000
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photeng@ozemail.com.au

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Submission Guidelines

The *AOS News* is always looking for contributions from its members. Here's a short summary of the how to make a submission.

What can you submit?

* ***Scientific Article***
A scientific paper in any area of optics.
* ***Review Article***
Simply give a run down of the work conducted at your laboratory, or some aspect of this work. Authors of scientific or review articles will receive proofs by fax.
* ***Conference Report***
If you have been to conference recently, writing a short report would be greatly appreciated.
* ***News Item***
Any newsworthy stories in optics from Australia or abroad.
* ***Book Review***
If you have read an interesting (and relatively new) book in some field of optics please consider a review for the *AOS News*.
* ***Cartoon or drawing***
If you have some artistic bent why not consider submitting a cartoon!

How can you submit?

The easiest way is by email. Either send the document text in your mail, or attach a word processor file using Eudora or your favorite mail program. We accept nearly all file formats. (Famous last words!).

If you don't have an email account, or cannot send diagrams or pictures via email, we are happy to accept hard copies. (One copy only is required).

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