

Bulletin

of the Rutherford Appleton Laboratory

6 Dec 1983 No.19

Art and Craft Exhibition '83

Lunchtimes at RAL took on a new aspect on Tuesday, Wednesday and Thursday the 15, 16, 17 November when the 1983 Art and Craft Exhibition took place, attracting hundreds of visitors and oceans of praise.

Beautifully displayed in a most attractive setting of plants and flowers, the exhibits were of the usual very high standard and as varied and interesting as ever. Music played by the woodwind section of the RAL music group and Chris Reason, on the spinet he had made, enhanced the delightfully relaxed atmosphere.

Very professional examples of needlework, knitting, embroidery, tapestry, woodwork, toys, pottery, water colours, oil paintings and etchings, showed the very many talents that the staff of RAL normally keep well hidden under various bushels. An unusual display on the art of calligraphy caused much comment as did the very colourful demonstration of fishing fly making. Small groups of people stood entranced by the detail of the model railway layout built round Houghton Park Station. The new venue in the R68 Watson-Watt conference room proved very popular with guests and former colleagues.

Arriving very early for a Laboratory Tour, a party of foreign visitors had the unexpected and, it seemed, delightful surprise of a special viewing, giving them an unusual insight into the life of RAL. Indeed, one visitor went away determined to suggest that something similar should be attempted at his home establishment.

The Exhibition was a great success and a very pleasant social occasion. Many old friendships were renewed and perhaps, new interest fired, ready for the next exhibition.

Congratulations and thanks are due to the organising committee, especially Jenny Coates and Myra Gilbert, to the exhibitors, and to the AERE Grounds Department for providing the plants, to the Light and Heavy Gangs, and all who gave so much help and encouragement.

Sue Ryder Collection

The collection made at the Exhibition in aid of the Sue Ryder Home at Nettlebed raised £55 - floral arrangements by Jan Aird. Thank you to all contributors.



83RB 5390



83RB 5393



83RB 5385



83RB 5392

Versatile VULCAN

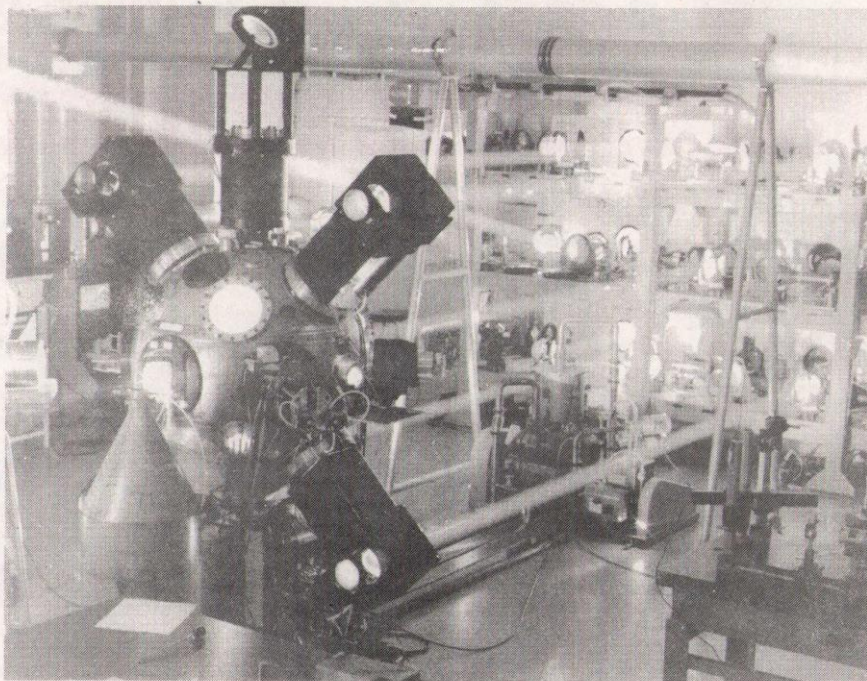
"The VULCAN laser system is now undisputably the most versatile and clearly one of the most scientifically successful high power laser systems in the world". Such was the feeling that emerged amongst the delegates at the European Conference on Laser Interaction with Matter held at Imperial College in September where much of the recent work performed by users and staff at the Central Laser Facility (CLF) at RAL was reported. The 26 papers given undoubtedly dominated the week of presentations in terms of both scientific quality and number.

Many of these scientific success stories were directly attributable to the highly successful outcome of a three month long laser system upgrade which was completed earlier this year. During this upgrade important changes were made to the whole laser system in order to significantly improve operating reliability and output capability. The most significant effect was achieved by the installation of three additional disc amplifiers so that each of the six 108 mm diameter beams feeding the cubically symmetric implosion facility now has its own dedicated power amplifier. It is worth noting that these very expensive laser amplifiers are now manufactured in the UK at a fraction of the cost of the original American equipment. In addition, changes made to the layout of components and beam paths in the rest of the laser system mean that each final amplifier can now be run safely and reliably at much higher output levels than before. These two modifications have almost trebled the output from the system, making VULCAN the most powerful laser in Europe. For experiments in the six beam target chamber energy levels of 1 kilojoule are now available in nanosecond (10^{-9} seconds) pulses for ablative compression experiments while power levels of 3 Terawatts (3×10^{12} watts) have been delivered routinely in 100 picosecond (10^{-10} seconds) pulses for the alternative exploding pusher type of compression.

Increased Capabilities

In addition to these major increases in operating level in the six beam facility, the capabilities of the other target area have been substantially increased by the addition of a second powerful beam line. This means that the full range of synchronised long and short pulses that are a unique feature of the laser system at the CLF are now available to the experimentalists in this area so opening up a wide range of exciting experimental possibilities. The novel X-ray shadowgraphy experiments, pioneered by the users of the CLF may now be performed in both target areas.

With this range of impressive experimental facilities it is not surprising that many major new scientific results have been obtained by the collaborative teams of University users and Laser Division staff. The most notable



S Knight

successes have been achieved in the area of high density implosions which were systematically studied for a nine week period using the frequency doubled (green) output from the VULCAN laser. The large photograph was taken in the compression target area during such a laser shot. The six laser beams are so intense, each beam having a power of over 100 Gigawatts (1 Gigawatt = 10^9 watts), that their paths to the target chamber are clearly marked by the light scattered from the minute dust particles in the air. Optimisation of the symmetry and uniformity of target illumination was one of the early objectives of the experimental campaign since the attainment of high density compression requires that the small (200 μ m diameter) hollow spherical targets collapse very symmetrically to a small fraction of their initial size under the intense pressure (greater than 10 million atmospheres) created on the outside by the hot laser produced plasma.

One of the simplest and also most effective diagnostics of symmetric illumination is to look at the light emitted from the target at twice the laser frequency (a wavelength of 0.26 μ m). This light is produced mainly at the angle of specular (ie mirror-like) reflection and a symmetrically illuminated target will look like the reflection of the six laser beams in a polished sphere. One such image showing three bright "reflections" and also the target support fibre, is shown in Figure 1a.

The acid test of the uniformity of implosion is of course the smallness of the implosion "core". The best way to observe this imploded material is to look at its shadow in front of an



Fig. 1a

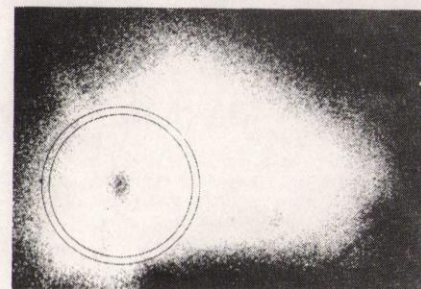


Fig. 1b

X-ray emitting background (in fact another laser produced plasma) - a technique first demonstrated at the CLF. Figure 1b shows such an X-ray shadow, taken close to the time of

pellet compression together with the initial size and thickness of the hollow target. The implosion core is measured to be less than 15% of the initial radius giving a volumetric compression of about $\times 200$. Direct measurement of the X-ray transmission through the centre gives a compressed density of 10 g cm^{-3} , the highest level ever achieved in an implosion driven by direct laser irradiation.

New Experiments

As well as the exciting results in the field of implosions many other new experiments have been performed. One novel idea that has been very successful involves the measurement of the range of energetic α -particles in both cold and heated material. This work is very relevant to ion beam driven ICF schemes and involves passing 3.5 MeV α -particles, (generated by the thermonuclear reactions occurring inside a Deuterium-Tritium filled glass shell target imploded with four laser beams), through a foil target heated with two other laser beams. The energy lost by the α -particles passing through the foil is recorded by analysis of tracks formed when they strike a CR39 plastic foil. This is the first time such an experiment has been performed successfully and results indicate that the range of α -particles in hot (1 million degree) material is substantially less than that in cold material.

EXAFS Breakthrough

Another major first for a CLF team has been in the area of X-ray analysis using the powerful technique of EXAFS (extended X-ray absorption fine structure) which is widely used to acquire information about the structure of materials. Conventionally relatively low intensity X-ray sources such as synchrotrons (eg the SRS at Daresbury) have been used for this work involving long data collection times. CLF scientists have made a major breakthrough here by utilising the extremely high spectral brightness of laser produced plasmas in the soft X-ray region to reduce the data collection time to less than 1 ns. This opens up the exciting possibility of using EXAFS techniques to study rapid changes in the structures of solids with subnanosecond time resolution, for example shock wave induced phase changes or thermally induced structure changes, as in pulsed laser annealing of semiconductors.

There is now no doubt that Vulcan will continue to be one of the most scientifically successful high power laser systems in the world and will continue to produce exciting new results since earlier this year the Science Board approved a £1.7 million capital scheme to upgrade all its facilities over the next few years. Major developments for the future are the commissioning of a new 12 beam compression facility next year permitting greatly improved target irradiation uniformity and compression ratios to be attained, the construction of a versatile new 6 beam target area in 1985 dedicated to the study of

various possible X-ray laser schemes and the reconstruction of the whole laser system with a trebling of output levels by 1987.

(We thank Phil Rumsby for this latest news from the Central Laser Facility.)

Missing

Information on the following missing items is requested:

Calculator HP55, Serial No. 15035/01678 lost from R25 room 1.91. Please contact B Patchett, Ext. 6368.
Keithley Digital Volt Meter Type 130, Label No. R016166. Please contact D Norgrove, Ext. 5694.

Library Notice

Please check your offices for the book entitled 'Recent Developments in Gauge Theories' by G T'Hooft, and return if found to the Library.

ANNUAL REPORTS

Spare 1982-83 Annual Reports would be welcomed by the Library.

IRAS is Dead

We regret to announce the sudden demise of IRAS on Tuesday 22 November. After 300 days of its expected 200 day life-span, the satellite's helium coolant began to run out ending any further collection of astronomical data.

As the last issue of the *Bulletin* detailed IRAS has collected a wealth of new information about the Universe, which as it is analysed, will continue to produce exciting discoveries. We have not heard the last from IRAS!

Millimetre Telescope Carousel 'Launched'

Test erection of the Carousel which will house the Millimetre Wave Telescope, due for erection on Mauna Kea, Hawaii in February 1984, has just been completed.

On Thursday, 24 November, at the invitation of the manufacturers - Robert Watson's of Bolton - representatives of the project participants watched the carousel being put through its paces. Among the guests were Professor Malcolm Longair, Astronomer Royal for Scotland, Professor Graham Smith, Astronomer Royal and Dr Geoff Manning, Director RAL.

A report on the event, and on the progress of the project will appear in the next issue of the *Bulletin*.

Space VIPs at RAL



Professor Roger Bonnet, Director of Scientific Programmes for the European Space Agency (ESA) and Dr Vittorio Manno, Assistant to the ESA Director, pictured with Drs Alan Gabriel and David Llewellyn-Jones while visiting RAL to discuss future programmes in space.

Dr Llewellyn-Jones is explaining the ATSR (Along Track Scanning Radiometer) to our guests.

Another Yachting Success

Roughly coincident with the America's Cup triumph by Australia and the German success in the Admiral's Cup races another even more notable yachting event took place. It can now be revealed that five members of SERC staff ventured offshore and for the second time in SERC (and SRC) history returned adjudged winners of a yacht race, on this occasion for a trophy known as the Cariad Cup.

The crew comprised four Ruthapples and one from that other place in Wiltshire, who was the person to be bullied (very properly) into accepting the role of skipper. For the benefit of the uninitiated, yacht skippers are in no way to be envied since their principal duties, apart from organising the entry with all the paperwork, is to take the blame when things go wrong and to buy the beer when things go right.

The Cariad Cup race is one of three races run during the CSSA (Civil Service Sailing Association) Cowes Rally held this year September 16 to 18. The third race this year was abandoned due to bad weather, and so the trophy for overall winner was not awarded.

SERC yacht racing is of particular note since every year within the writers memory someone from SERC (or SRC) has entered a yacht in the CSSA Inter-departmental race and some years more than one entry. The 1981 season was especially notable when SERC entered no less than five yachts with one of the SERC entries, skippered by Clive Sutherland, winning the Eric Seal Trophy. This year the IDOR was held at a particularly awkward time of the year for most people. However, a yacht was entered for SERC, skippered by John Magraw and, in very trying conditions came a very creditable fourth.

The Cowes Rally, scheduled at a better time for most, was felt to be a suitable alternative for other SERC yachting people so it was decided to give it a try. After an encouraging result of fourth in the first race on Friday the 16th we went into the Saturday race with high hopes. In a fleet of 27 boats our yacht 'Ariadne' a masthead rig GK 29 - had an excellent start on which we built throughout the race which covered the East and West Solent in excellent conditions and SW winds of Force 5-6. We crossed the line third after a Sigma 36 and a Sigma 33 and were later placed first after handicaps were calculated.

So congratulations to the Skipper Lawrence Byrne, who was ably hindered by Tony Damerell, Martin Hall, John Macdougall and Geoff Stapleton.

G.S.

Sports Awards

RAL winners of events at the 1983 Indoor and Outdoor Sportsdays were presented with their individual Trophies by Dr Geoff Manning on Friday 18 November.

Introducing the recipients, Mike Courthold (Hon. General Secretary, RecSoc) thanked Dr Manning for agreeing to present the trophies. "We are disappointed there are fewer than usual," he said, "However it has prevented the embarrassment of a Trophy Cabinet full to overflowing."

RAL Trophies are provided by the RecSoc so that winners may each have a personal memento of their success. Winners at this year's Indoor Sportsday were Kay Knight and Tony Short who won the badminton mixed doubles (again); Roger Wolfenden and Dave Wootton, badminton men's doubles; Jenny Coates, Will Johnson and Malcolm Edwards, squash; Steve Hancock and Steve Stoneham, crib; and the darts team of Ian Forster, Ricky Mills, Del Forsyth and Steve Wooldridge.

David Walker won the first 3,000 metre race to be staged at the Outdoor Sports, where Lorna Claringbold and Tim Pett (as usual) gained the mixed tennis title and Richard Lawrence and Bill Pulford won the men's tennis doubles.

"Congratulations to all, competitors and winners alike," said Geoff Manning after the presentation ceremony. "I hope you'll all compete again next year."

Sales to Employees

Sales of scrap metal and plastics to employees will take place in the R40 scrap compound at 12.30 pm. on Friday 16 December.

Film Badge Notice

Period 13 commenced on Monday 5 December. Colour strip GREEN. Please check that you are wearing the correct dosimeter and all old ones are returned.

Coffee at Cosener's

The Rutherford Appleton Wives' Group will be meeting at The Cosener's House in Abingdon on December 14th for the Christmas coffee morning, with sherry and mince pies to get us into the Christmas mood. If you haven't been able to come in the past or are new to the Lab. do try and come along. The coffee morning is held from 10.30 to 12 noon.

Carol Service

The RAL Carol Service will take place this year on Wednesday 21 December at 12.30 pm in the Lecture Theatre. It will be led by the Rev. Rewter of the Bible Pattern Church, Newbury. The service will be one of lessons and carols.

W and Z on BBC2

The BBC have remade the 'Horizon' film on the finding of the W and Z particles by the UA1 and UA2 teams at CERN. Now entitled "Towards One Force of Nature" it will be screened on BBC2, Sunday 18 December at 12.15 pm.

Poppy Appeal

As a result of all the hard work of the collectors and the generosity of contributors the RAL collection amounted to £145.55.

Thank you all.

Bulletin

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Deadline for insertions: