Bulletin
of the Rutherford and Appleton Laboratories 1 Dec. 1980 No.18

HOLEBC ~ A Holographic Bubble Chamber

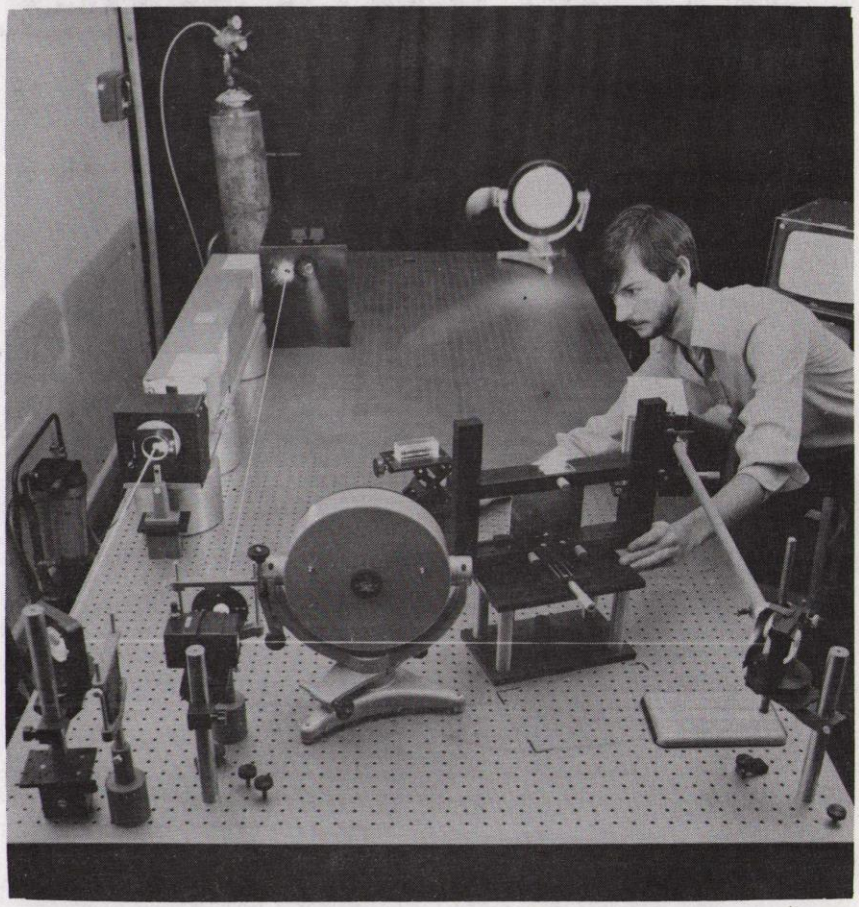
At the Rutherford and Appleton Laboratories tests are currently well advanced towards an experiment using a small Lexan Holographic Bubble Chamber (HOLEBC) planned to be built and used at CERN next year to look for the shorter-lived charmed particles. This follows a successful test carried out at CERN in the summer, when a small heavy liquid bubble chamber, the Bern Infinitesimal Bubble Chamber (BIBC), was equipped and run with holographic optics.

Bubble Chambers and Short-lived Particles

Bubble Chambers have always excelled in making clear what happens near the collision point when elementary particles interact. In the 1960s and early 1970s this virtue was greatly exploited to study the physics of 'strange' particles, which decay after travelling a few centimetres in the bubble chamber, leaving a characteristic 'Kink' or 'Vee' in the track at the decay point.

The great discovery of the 1970s was that these 'strange' particle are only the first members of an extended family of particles - the next members are the celebrated 'charmed particles'. 'Charmed' Particles have much shorter life times than the 'strange' particles and decay after travelling only a few millimetres in the chamber. Nevertheless by running a bubble chamber with high resolution optics and with high densities of bubbles per centimetres of track, and by photographing the bubbles when they are still small (about 50μm), it is possible to observe charmed particle decay in the same way as strange particle decays were observed earlier.

A small bubble chamber, the Little European Bubble Chamber (LEBC) was built and has recently been used in two highly successful experiments at CERN searching for charmed particles. But LEBC does not go far enough. Some charmed particles have lifetimes so short that their tracks will be only a fraction of a millimetre long and it is quite probable that the next (and eagerly awaited) family of particles, the 'beautiful' particles, will also have such short lifetimes.



At work in the Holography Lab. 64365/6

In trying to increase the optical resolution by another factor of 10, though, a fundamental limitation is reached. As resolution is increased, the depth of field decreases. This fact (familiar to all photographers) means that in photographing objects of diameter about 5μm, the volume which is in focus is reduced to a thickness of less than 1mm, giving an intractable problem in getting the beam into the chamber and reducing the useful volume of the chamber almost to zero.

Enter Holography

At this point a different and fascinating optical technique enters the field. Whereas conventional photography records the intensity of the light forming an image of an object, holography records the interference between light scattered by an object and a coherent beam which undergoes no scattering. The coherent light needed to do this is produced by a laser On reprojecting a hologram, again using coherent light from a laser, the original

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INTERNAL Events

NIMROD LECTURES
R61 CONFERENCE RM - 14.00 hrs.

1 Dec. Dr L Criegee/DESY
'Jet Physics with the Pluto Detector'.

TO BE HELD IN R22.

8 Dec. Dr K J Peach/Edinburgh
'The RMS Experiments'

15 Dec. Prof H J Lubatti/Seattle
'Hadron Production in Neutrino Interactions'.

HEP SEMINARS
R61 CONFERENCE RM - 11.00 hrs.

3 Dec. Dr T Vematsu/DESY
'Virtual Photon Structure'

10 Dec. Dr P L Woodworth
'TASSO Results on Particle Production in e^+e^- Annihilations'.

SCIENTIFIC DISCUSSION MEETINGS
R61 CONFERENCE ROOM - 15.00 hrs.

8 Dec. Dr H Rishbeth/RAL
'Data Bases'.

ASTROPHYSICS SEMINARS
R61 CONFERENCE RM - 14.00 hrs.

10 Dec. Dr Tde Jong/Amsterdam
'Star Formation in Galaxies'.

17 Dec. Dr Douglas C Heggie/Edinburgh
'Global Clusters in Collapse'.

RAL LECTURE
LECTURE THEATRE - 13.15 hrs.

11 Dec. Prof E A Ash FRS/UCL
'Acoustic and Photo-acoustic Imaging'.

EXTERNAL Events

NPD COLLOQUIUM
CONF RM H8 - AERE - 15.30hrs.

4 Dec. Dr N Charman/UMIST
'The Physics of the Eye'.

THEO PHYS. SEMINARS
LECTURE TH. 424.4 - AERE - 14.00hrs.

2 Dec. Dr C P Jackson/AERE
'The Method of Characteristics for Highly Non-Linear Hyperbolic Equations'.

9 Dec. Dr M S S Brooks/Karlsruhe
'Calculated Ground State Properties of Actinide Metals and Compounds'.

COMPUTER & NATURAL LANGUAGE
NPD LECT.TH. - OXFORD - 16.30hrs.

4 Dec. Dr J M Gill/Warwick
'Computer Generation of Braille'.

HEP SEMINARS
DAMPT - CAMBRIDGE - 15.00hrs.

5 Dec. Dr E Farhi/CERN
'A Survey of Technicolour'.

ELEM.PART.PHYS.SEMINARS
WESTFIELD COLLEGE - 14.00hrs.

4 Dec. Dr M Pennington/Durham
'Perturbative QCD: How is it Doing?'

PHYSICS COLLOQUIA
CLARENDON LAB - OXFORD - 16.15hrs.

5 Dec. Prof P G Burke/Daresbury
'The Calculation of Atomic Processes and Applications in Astrophysics'.

THEORY GROUP SEMINARS
DARESBURY - 14.00hrs.

1 Dec. Prof S Wakoh/Tokyo
'X-ray Absorption Structure in Solids'.

15 Dec. Prof C J Joachin/Bruxelles
'Eikonal Methods in Quantum Collision Theory'.

PART PHYS SEMINARS
BIRMINGHAM - 16.15hrs.

5 Dec. Dr D Bailin/Sussex
'Superfluid Quark Matter'.

ELEM PART PHYS SEMINARS
NPD LECTURE TH. - OXFORD - 14.30hrs.

4 Dec. Dr M Bardadin-Otvinowska/Warsaw
'Jets in K^--proton Interactions at 110 GeV/c'.

PHYSICS COLLOQUIA
BRISTOL - 16.30hrs

1 Dec. G Neilson/Bristol
'Structure of Ions in Water'.

HEP SEMINARS
MANCHESTER - 14.00hrs.

2 Dec. Dr F Combley/Sheffield
'Results from the European Muon Collaboration'.

9 Dec. Prof A Clegg/Lancaster
'Vector Meson Photoproduction'.

SHEP SEMINARS
SOUTHAMPTON - 14.30hrs.

3 Dec. Dr E Fahri/CERN
'Technicolour-An Introductory Review'.

12 Dec. Prof P Landsberg/Southampton
'Some Questions in Relativistic Thermodynamics'.

ELEM PART PHYS.THEORY SEMINARS
NPD LECTURE TH - OXFORD - 14.30hrs

5 Dec. Prof E J Squires/Durham
'Why Quarks Are/Are Not Composite'.

Missing

If the AVO you are using has the Serial No. 53259 please contact K J Apsimon on Ext 6614. He would like it back!

Film Badge Notice

Period 13 commences Monday, 1 December 1980. Colour Strip PURPLE for βγ films.

Please change your film promptly and return all old ones.

Anyone needing a new film holder please contact Mrs J A Coates R12 Ext 430

Trade Exhibition

There will be a trade exhibition in Conference Room, R12 from 1000-1600 hrs on Tuesday 9 December.

CONTROL AND READOUT LTD will be demonstrating a wide range of temperature and process instrumentation.

The 403 Trip Amps provide accurate low cost process monitoring and the 505 Power Switches solve the control problems encountered with 'difficult' high-tempco heater loads. The 207 range of microprocessor based digital temperature indicators are featured along with the 600 series scanners and an extensive range of process indicators and alarms. Recent additions to the controller range include an automatic control system with manual override; the full range of PID and on-off process controllers will be shown along with digital programming systems.

Library Notice

The Library shelves are being denuded again. This time the following books are missing:-

NRPB - 'The Application of Cost Benefit Analysis to the Radiological Protection of the Public'.

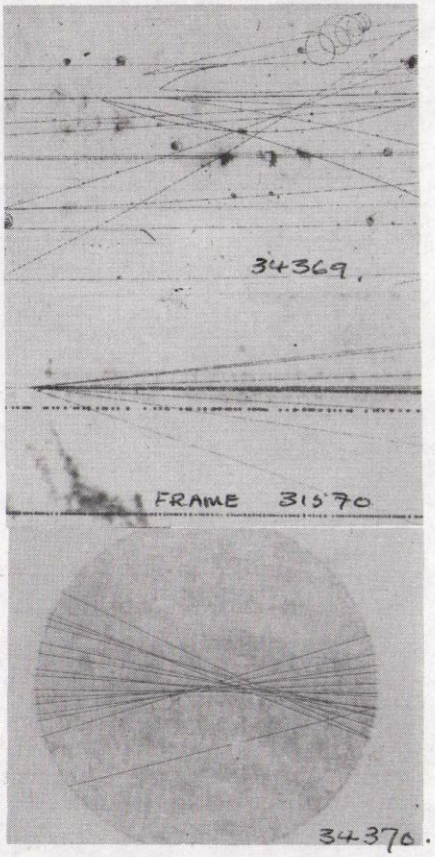
W.T.Eadie - 'Statistical Methods in Experimental Physics'. (3 copies now missing).

R.W.Coles - 'Microcomputers for Hobbyists'.

Could we ask people stealing books from the Library to let us know, so that we can replace them immediately and so inconvenience fewer people!

Holography *continued*

wavefront of light from the object is reproduced, just as though the object were still there producing it. The image associated with this wavefront is aberrationfree, the resolution is determined essentially by the size of the hologram (allowing resolution of about 2μm to be achieved) and within very broad limits, objects at different depths can be equally well constructed giving a 3-dimensional image. Thus the problem of decoupling the image resolution from the depth of field is solved, and in a bubble chamber experiment the whole volume of the chamber can once again be used to study particle interactions.



In search of short-lived particles.
The upper picture shows a 50 cm length of the CERN 2m Bubble Chamber.
The middle picture, a 1.5 cm length of LEBC.
The lower picture, reconstructed from a Hologram, shows a 3mm length of copper wires which simulate the tracks expected in HOLEBC.

The technique need not stop at one experiment, however. Most bubble chambers both large & small could probably be equipped with holographic optics, permitting physicists to look for and study a variety of short-lived particles wherever their presence is suspected.

We are indebted to Robert Sekulin for this interesting look at a new technique.

RAL Colours

The next lecture in this series will be held as usual in the Lecture Theatre on Thursday 11 December at 3.15 pm.

ECENT ADVANCES IN HIGH RESOLUTION ACOUSTIC MICROSCOPY

by

Prof Eric A Ash, FRS
Professor of Electrical Engineering, University College London

Acoustic microscopy is reaching a certain maturity. It is now possible to attain resolutions which are wholly comparable with those attained by optical microscopy. Micrographs of biological material can be obtained without the use of the staining techniques usually essential in optical microscopy. Examination of living material is possible.

Acoustic microscopy is also beginning to play a role in the broad field of nondestructive examination, with applications ranging from metallurgy to microelectronics. The prognosis for applications of this kind will be discussed.

A number of variants of acoustic microscopy are appearing - notably photoacoustic microscopy. It offers a whole range of new possibilities. An attempt to predict the (immediate) future for these new microscopical techniques will be made.

Every Little Helps

Now and then a minor crisis in life stops us in our tracks and makes us stand back and re-assess the situation, often with beneficial results.

Major financial re-adjustments have already been put into effect at all SRC establishments but as Cervantes says in Don Quixote "Many a pickle makes a mickle" (didn't know that, did you?), and individual personal economies could save significant sums when compounded. Each of us has a specific job to do and it is the intimate knowledge of that task which will make areas of economy more apparent to us than to others. It is in these areas that you are asked to take stock and look for ways of reducing expenditure.

Some economies spring readily to mind - external phone calls are cheaper after 1 p.m. - keep it short, - will a telex or a letter do?

Do you need so many Xerox copies, can it be backed-up? Use old envelopes for internal mail, adopt the 'switch-it-off' code.

Is your journey really necessary? Can you share vehicles? Re-use everything possible before drawing new from stores (those things you kept for emergencies - this is it!) Draw small quantities. Have the Loan Pool got it? Before ordering, consider near equivalents, readily available in stores. The possibilities are legion, use your imagination - it may even become a way of life!

SMM Doing Well

The SMM satellite launched on St. Valentine's Day 1980 has now been in orbit some 9 months. Much of this time has been spent in learning how to use the highly flexible and complex instruments on board, and overcoming minor problems occurring in the hardware. Some time has been spent in optimising displays of the multi-dimensional data sets to provide ready access to the solar features of interest, from this the most sophisticated astronomical satellite ever flown.

Multi-instrument data sets have now been accumulated on several tens of solar flares, the prime object of the mission. Although a complete understanding of the data must await full and thorough analysis; from the "quick look" processing,some pointers towards appreciating some aspects of the flare phenomenon are beginning to emerge.

The X-ray polychromator, the instrument in which RAL plays a major role, has been concentrating on two activities; polychromatic mapping of flare spawning regions with the flat crystal spectrometer (FCS), and high resolution spectroscopy with fast time resolution of the hot (25 to 50 million degrees) aspects of flares using the bent crystal spectrometer (BCS).

Temperatures and densities at several stages of many flares have been measured by the BCS along with plasma velocity measurements, from spectral line broadening, during the highly turbulent impulsive phase. This turbulent phase is seen to be coincident with a burst of hard x-rays observed by another of the SMM instruments.

The structure of active regions has been well mapped by the FCS and the changes occurring in such regions before, during and after a solar flare should throw some light on the relaxation of the magnetic field configurations seen as a result of flaring.

One of the few spectral scans carried out with the FCS has shown the spectral lines from a cool flare with unprecedented resolution and work on line identification is progressing well.

The mission is funded to continue until February 1982 and if the instrument hardware and spacecraft systems remain in good condition then an extension to this timescale may be sought.

We thank Barry Kent for this up-date.

Darts Team in Final

This year the Laboratories' Darts team reached the finals in the Civil Service Southern Regional Competition. The semi-finals and finals were all played at the Civil Service Sports Club, Southampton on Sunday 16 November.

Our semi-final was played against Post Office Telecommunications, Oxford, where after a poor start the team settled down, started to put their darts and beat Oxford. In the final the very strong team from Bournemouth Post Office was our opponent. This was their fourth appearance in the finals, and sadly the Labs' team, in only their second year in competition, lost 4-2. Nevertheless they made good showing.

The team was A Forster, R Wyatt, K Biles, T Morgan and P Angel and the games played, 4 singles, two pairs, one team game and the best of three.

This Competition is open to all RecSoc members and it is hoped that more teams will enter next year. With the provision of a Club facility for practice, one of our teams could actually win!

For more information on the Darts sections activities pleasecontact A Forster on Ext 6300.

Darts Competition

Come along all you Darts enthusiasts - get your names entered for the Laboratories Open Darts Championship which will take place in January or February 1981 - if there are enough takers.

It is hoped to run both singles and pairs in a knock-out evening competition on site, perhaps taking two evenings to complete.

Please send your names and entrance fee of 75p to A Forster, building R6 by 8 December. All fees will be spent on trophies.

Chess Tournament

The 1981 Chess Tournament will start on 5 January 1981.

It will be an All-Play-All or Swiss Tournament depending on the number of participants. It is a lunchtime event and caters for all standards of player.

We hope that many of our new colleagues from Ditton Park will join us and enjoy this long standing event.

All England Finalist

Lee Cooke has won her way through to the All England Finals of the County Bar Billiards (Ladies) Championship.

In a three cornered knock-out competition at the 'Woodman' North Leigh on 4 November, Lee, representing Wallingford and District, won three out of four games against the Oxford City and Witney Area champions. Lee says she started badly, but made it in the end.

On 29 November at High Wycombe she will pit her skills against eight other county champions.

Yoga is obviously good for co-ordinating brain, eye and elbow!

Lunchtime Music

Lecture Theatre - 3 December - 1230 hrs

Symphony No 3 in C Minor
Op 78 "Organ"

Saint-Saens

This symphony was written for the Royal Philharmonic Society and first performed on 19 May 1886 with Saint-Saens himself conducting.

In some ways the work is influenced by Liszts symphonic poems. Every trick of the trade is used to pile up to an exciting climax, producing a grandiose effect. It is a successful piece and justifies completely its lasting popularity.

Aldeburgh Lifeboat

The donation to the Royal National Lifeboat Institution, made by the Laboratories in memory of Henry Walker, is to be used to purchase a horizontal screen wiper for the new Aldeburgh lifeboat. This type of wiper is essential for clearing spray, for improved visibility in rough seas.

Christian Fellowship

The 4 December meeting will be held in R2 Conference Room at 12.30pm. A monthly prayer meeting, it will be led by Lester Gale. All are welcome.

Coffee at Cosener's

Calling All Wives - with connections with Rutherford and Appleton Laboratories

Come and have a mincepie and glass of sherry with us at the Christmas Coffee Morning at Cosener's House, Abingdon on Tuesday 9th December between 10.30 and 12.00, when you will have the opportunity to meet other wives who live in the area - and if you are new to Oxfordshire or to England the possibility of learning something about the facilities around Abingdon, Didcot and Wantage.

There is a room with a television next door to the coffee lounge where pre-school children can watch or play. Any further information from Ann Corbett, tel. Abingdon 20434 or Mary Rousseau, tel. Wantage 3676.

Thanks

The Oxfordshire conservationist who happened to mention the hedgehog/plastic cup problem to the 'Bulletin' editor, never in his wildest dreams expected the message to reach such a large and august readership as the entire circulation of the 'New Scientist'!

Thanks 'Ariadne'.

Restaurant News

This year Christmas Lunches will be served from Tuesday 16 to Friday 19 December.

Details of prices and arrangements will appear in the next issue.

Accommodation Required

Comfortable lodgings required for Craftsmen away from home. If anyone can help please contact Ext. 476/263, SRC Accommodation Office.

Bulletin

Editor: Jean Banford
Building R20
Rutherford and Appleton Laboratories
Chilton, Didcot, Oxon OX11 0QX
Abingdon (0235) 21900 ext 484

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