

Bulletin

of the Rutherford Appleton Laboratory

16 Feb 1987 No.2

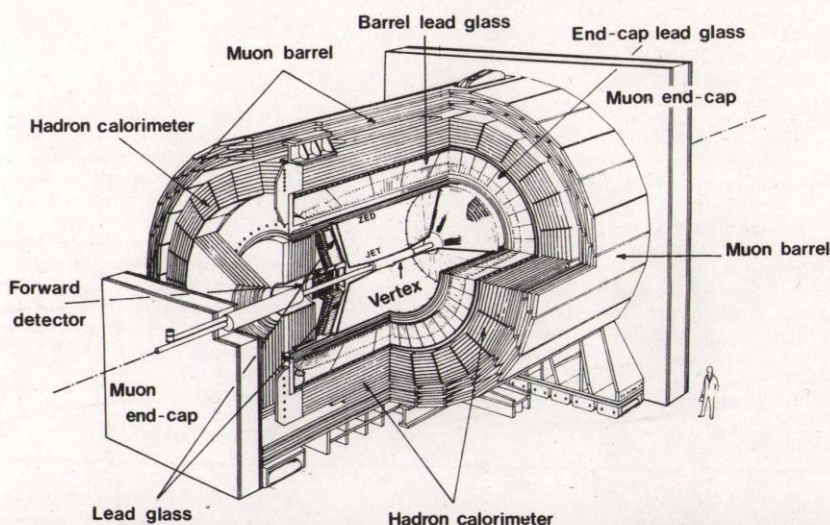
OPAL ~ Major milestone

As announced in the Bulletin of 1 December 1986, here is a report of a recent success for OPAL, one of the three CERN Large Electron Positron Collider experiments in which RAL is a major collaborator.

In November, the first of four end-cap calorimeters was commissioned at CERN. The four electromagnetic calorimeters are being designed and constructed by the Physics Apparatus Group in collaboration with HEP Division, Cambridge University and Queen Mary College. Tests in a high energy electron beam demonstrated that the calorimeter had achieved the full design performance and a successful calibration was completed.

The OPAL apparatus (see diagram) consists of concentric layers of cylindrical detectors surrounding the beam pipe, which in turn encloses the interaction region. "End-cap" detectors close the ends of the cylinder to complete the solid angle coverage. The large solenoidal coil, indicated on the drawing, generates an axial magnetic field of 0.4T enabling the momentum of charged particles to be determined from the curvature of their tracks.

The discovery of the W and Z particles at the CERN collider confirmed the hypothesis that the weak and electromagnetic forces are different manifestations of a single "electro-weak" force, but an important puzzle remains. The symmetry between the two forces is badly broken since the photon, which mediates the electromagnetic force, is massless while the W and Z, carriers of the weak force, have masses of order 100 x proton mass. How does this happen? A mechanism for causing the spontaneous breakdown of symmetries was proposed some time ago by P W Higgs, now a Professor at Edinburgh University. If the Higgs mechanism is responsible for generating the large W and Z masses then there should exist a new type of particle - the "Higgs" boson. Assuming the Higgs particle is sufficiently light to be generated at LEP, a promising means of identification would be in processes where a high energy photon or an electron-positron pair is produced in association with the Higgs particle. Thus it is very important to be able to measure the energy of photons and



The first Dee, assembly nearly complete, at CERN

(Photo. CERN)

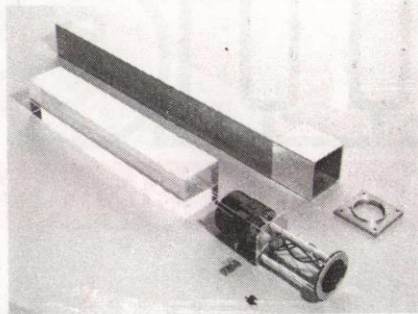
electrons very precisely in order to identify the production of Higgs particles and separate them from less interesting events which might occur one million times more frequently.

In OPAL, the electromagnetic calorimetry is specially designed to measure the energies with high precision. Lead glass Cherenkov
(cont'd over)

OPAL (cont'd from p1)

counters are used to detect electrons and high energy photons (gamma rays). The sensitive element in each of these counters is a block of lead loaded glass (50% by weight lead) measuring typically 90 x 90 x 500mm³. An electron or photon entering a block initiates a shower of secondary electrons and photons. The electrons emit visible light in the form of Cherenkov radiation as they travel through the lead glass before finally stopping. The amount of light produced is proportional to the energy of the incident particle. As the diagram shows, a layer of lead glass counters completely surrounds the interaction region. Counters situated in the cylindrical part of the detector are located in a region of low magnetic field outside the coil and photomultiplier tubes are used to detect the light. In the end-cap regions, which are in the full magnetic field, conventional phototubes will not operate and a more innovative approach is required.

A special device, the vacuum phototriode (VPT), has been developed in collaboration with industry, which is able to operate in the full OPAL magnetic field. It is essentially a single stage photomultiplier tube and gives a gain factor of at least ten. The VPT is used in conjunction with a state-of-the-art low noise amplifier developed at RAL.



The components of a single lead glass container

In the OPAL end-cap electromagnetic calorimeters there are 2264 lead glass counters in total, arranged in four "Dees", two Dees covering each end of the detector. Each counter is enclosed in a brass can, with walls less than 0.5mm thick, which is fixed at one end to a stiff aluminium back-plate and supports the weight of the glass. The services for the counters are made available from behind the back-plate through connectors at the rear of the brass can. The front surface of the Dee is contoured by using brass support cans of varying length in order to follow the domed shape of the pressure vessel windows which retain the gas for the central drift chamber.

A monitoring system to track the performance of each counter is provided by Cambridge University and Queen Mary College. It consists of a laser light source which excites a scintillator cell and the resulting scintillator light is fed down optical fibres to each counter. By comparing the output of each lead glass/VPT counter with the light measured by reference diodes, the relative gains can be monitored.

Each counter must be calibrated by placing it in an electron beam of known energy. In order to facilitate this, the Dee is mounted on a stage which is moved under computer control. To ensure optimum operation of the VPTs, calibrations are performed in an axial magnetic field of a few hundred Gauss produced by a pair of coils located upstream and downstream of the Dee.

All the lead glass counters of the first Dee were successfully calibrated at the start of November in a 5 day run at the CERN SPS accelerator (more than half were measured twice). The measurements confirmed performance expectations based on prototype results.

Preparations for the second Dee are now well underway and very shortly counters will be mounted on the back-plate and full commissioning will begin. By the end of Autumn 1987 we should have all four Dees built, checked and calibrated.

Paul Jeffreys

RAL Fund

From The Director

Last year it was announced through the Bulletin that applications were being sought for awards from the RAL Fund to young members of staff. I am pleased to invite applications for 1987. These may be submitted up to 31st March 1987.

The RAL Fund was set up early in 1985 with the intention of providing financial support for activities associated with the Laboratory but which cannot properly be paid for with public money.

Two schemes have been promoted in the first instance, but other possibilities will be considered that do not overstretch the limited resources of the Fund.

The first scheme is to institute an annual award for a young and junior member of staff who, during the year, has shown special endeavour and initiative which is a credit to the Laboratory. Nominations are invited from supervisors - they should produce a case for their nominee of not more than one page and submit it through their Division Head. Closing date for nominations is 31st March 1987.

The second scheme is to support young people who wish to undertake some charitable or other worthy cause that might require some modest financial support from the Laboratory and I shall be pleased to consider any application for this type of activity.

Young is defined as less than 30, junior to be up to and including HSO or equivalent grades.

Nimrod Lecture

of

General Interest
"MUON CATALYSED FUSION"

by
S. Jones
(Brigham Young Univ.)
Monday 23 February
2p.m.
R61 Conference Room.

Recent results show a μ^- to catalyse a number of dt \rightarrow an fusions that is large and possibly increasing to a region of interest for energy production. However, a limit may come from μ^- sticking to the α after fusion - a crucial experiment will benefit from the pulsed muon beam at ISIS.

Trade Exhibition

Entran Ltd are exhibiting their range of transducers (for measuring pressure, acceleration, force and strain) on Tuesday 3 March in the R12 conference Room from 1000-1600 hrs.

Sales to Employees

The sale of scrap material to RAL employees will take place on Fridays 20 February and 6 March from 1200-1230 hrs in the R24 scrap compound.

Film Badge Notice

It is period 2 Colour strip PURPLE Please be sure you are wearing the current dosimeters and return all beta-gamma films and fast neutron badges promptly to Jenny Coates, R12.

NEXT FILM ISSUE
Monday 23 February

ASTRO-C in orbit

On Thursday, February 5th, at 6:30 GMT the ASTRO-C satellite was successfully launched from the Kagoshima Space Centre in Japan, and now orbits the Earth at a mean altitude of 560km., with an orbital period of 100 minutes. Once in orbit a satellite traditionally receives a new name, and we must now learn to call this one 'GINGA', the Japanese for Galaxy.

RAL interest lies principally with the Large Area Counter (LAC), an experiment dedicated to the study of Cosmic X-Ray sources, and which was described in the last Bulletin issue. The launch effectively marks the end of the hardware stage of the project which lasted some three years, and the next milestone occurs sometime in the next 2-3 days when power is applied to the experiment. Should all go well at this nail-biting stage we should record our first X-ray photons, and so commence a period of scientific observations that, with luck, might last as long as 5 years.

Site EMERGENCY

Wednesday 4 March

A site emergency exercise has been organised by Harwell for Wednesday 4 March, 1987. The exercise will include the Rutherford Appleton Laboratory.

When the Klaxons sound all personnel must enter the nearest main building and close all external doors and windows. The main gates will be closed; all incoming commercial traffic will be directed to the bus park on Fermi Avenue, private vehicles destined for RAL will be permitted to drive to our main gate.

During the exercise no one will be allowed to enter the site or to move outside any building without the permission of the RAL Emergency Controller (Ext 5545). Special arrangements have been made to convey previously authorised visitors to R1 and R20 if they arrive during the exercise.

If there are any queries with regard to the exercise please contact Eric Hartley, Ext 5329 before the 4th, and Ext 5545 during the exercise.

STAY INSIDE, CLOSE EXTERNAL DOORS AND WINDOWS, DO NOT USE THE TELEPHONE SYSTEM EXCEPT FOR CALLS CONNECTED WITH THE EXERCISE OR FOR EMERGENCIES.

Umpires will monitor the site during the exercise. The sounding of a CONTINUOUS NOTE on the klaxons will signal the end of the exercise.

Eric Hartly
Health and Safety.

Chinese delegation at RAL



Members of the Chinese Science Policy committee pictured as they toured RAL with acting Director Paul Williams.

The visit was part of a fact-finding tour by the delegation, to see how British technology research is transferred to production.

Professor Hu Ping, the leader of the delegation said that he had noticed a number of similarities between Britain and China in the area of technology transfer. Both countries have an excellent research base, and are examining ways of exploiting this research.

Internal Events

NEUTRON DIVISION SEMINARS R3 CONF RM - 1330 hrs

- | | |
|--------|---------------------------------------------------------------------------------------------------------------------|
| 24 Feb | Dr U Steigenberger/RAL
'Magnetic semiconductors, and neutron scattering experiments with polarisation analysis.' |
| 3 Mar | Dr C. Gilmore/Glasgow
'New methods of solving crystal structures' |
| 17 Mar | Dr E. Salje /Dept Earth Sciences Cambridge.
'Structural phase-transitions with coupled order parameters.' |

ASTROPHYSICS EVENTS R6 CONF. RM - 1400hrs,

- | | |
|--------|----------------------------------------------------------------------------------|
| 4 Mar | Dr Raman Prinja/UCL
'UV Observations of O-star winds' |
| 18 Mar | Dr Charles Cunningham/RAL
'The James Clerk Maxwell millimetre-wave telescope' |
| 1 Apr | Dr Josephine Murray/RAL
'Interstellar medium abundances' |

Royal opening for JCMT

HRH The Prince Philip, Duke of Edinburgh will open the James Clerk Maxwell Telescope, the Palace has announced. The ceremony takes place at the Mauna Kea Observatory, Hawaii on Monday 27 April 1987.

Christian Fellowship

The Fellowship meets in the R2 Conference Room at 12.30pm every Thursday, unless otherwise advertised. All are most welcome.

Programme for Feb - March.

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|--------|----------------------------------------|
| 27 Feb | Music and praise - Steve Walters |
| Friday | |
| 5 Mar | Book Review - Mark Hillier |
| 12 Mar | Prayer Meeting - Ray Powell |
| 19 Mar | Bible Study - Young People |
| 26 Mar | Personally Speaking - Open Fellowship. |

More information can be got from Margaret Summers Ext 5617.

Dead-eyed C(h)ris

Chris Emson, Chris Greenough and Chris Hunt won the "Vice President's Challenge Shield" in the Harwell Inter-departmental Pistol Shooting competition on 9 January. The trio, competing under the team name 'Cyclops', also won gold medals. All are from Technology's Computing Applications Group.

Cyclops started to compete last year, having never before fired an air pistol, and were silver medallists. This year, with another Chris (Hunt) dragoned in to replace Ron Mount who had since left RAL, they scored victory over their Harwell opponents 'Parabellums' by two points.

Thirty two teams of 3 competed for the Shield, the preliminary rounds being shot as a round-robin in 10 leagues. The second round was a knock-out competition.

Cyclops won their league, but their progress in the second round was nail biting for the first two matches; in each case just one point dividing them from their opponents. In the semi-finals they managed a 10 point lead and finally on a very cold day with frozen trigger fingers, they gained the two points advantage which gave them victory.

Two other RAL teams competed - 'Gigglebytes' (R27 Ladies team) and 'Myopics' (R1) - both reaching the last 16 stage. Congratulations to all.

Chris Emson displays the Shield, protected by Chris Greenough (left) and Chris Hunt.



A Special guest



Chairman of SERC, Professor 'Bill' Mitchell (right) sampling the hospitality of RAL on a recent visit to the Laboratory.

The RecSoc Bar was just one stop on a guided tour of the RecSoc Club House where he was shown the latest improvements to the facilities. Tudor Morgan, (centre) RecSoc Chairman, also outlined plans for future expansion. RAL Acting Director Paul Williams (left) enjoys a quiet half too.

The Poetry of Physics

Deeper I looked and deeper still
 Into the depths of all things
 But where I looked there seemed no end
 Other mysteries lay hidden within
 A new Universe beyond my knowing
 Beyond the reach of any hand
 Deep that I could not touch
 Nor even my eyes see
 A universe much less than sight
 Of new strange patterned constellations
 Unfamiliar to me by their names
 And new stars of elusive light
 Created at a cataclysmic instant
 In a maelstrom of whirling stars
 Hurlled as if by vengeful gods
 Together in underworld caverns of steel
 Nova stars forged of the old
 Constellations drawn anew
 Re-orderings of ancient forces
 In new patterns to bind the stars
 Patterns conceived by brave minds
 That see through the Universe
 transparent
 Can image Time when Time was new
 For a code that will close the circle.

Ian Bailey

Thanks

Fred Knott wishes to thank most sincerely everyone at the Lab who contributed to his magnificent retirement presents. He also extends his good wishes to everyone he was unable to see before leaving. Veronica, his wife, thanks you all for the beautiful bouquet.

Bulletin

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Deadline for insertions: