Bulletin
of the Rutherford Appleton Laboratory
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A Major Extension for EISCAT

EISCAT, the European Incoherent Scatter radar facility for the study of the Earth's upper atmosphere, will be further enhanced later this year when a VHF radar is brought into regular use. The first test data have already been recorded using this new system which complements the existing UHF radar and gives an extra dimension to a facility already producing some of the world's finest ionospheric observations.

The EISCAT system provides scientists with their most powerful ground-based tool for remote observations of the ionospheric and magnetospheric regions of the terrestrial environment. It is heavily used by UK university physicist, supported by the EISCAT Group at RAL who assist with the design and running of special UK experiments and maintain a database on a UK project computer at the Laboratory.

The incoherent scatter technique employs radio signals of too great a frequency to be coherently reflected from the ionosphere (a partially ionised layer of the upper atmosphere about 70 to 700 kilometers above the Earth's surface). Although virtually all the radiowave energy penetrates the ionosphere and escapes into space, a small fraction is scattered back to Earth by free electrons. If the transmitter is powerful enough (several Megawatts), and highly sensitive receivers and large, high-gain antennae are employed, the weak (picowatt) scattered signals can be detected, and detailed analysis of their spectrum yields values for a wide range of ionospheric and neutral atmospheric parameters.

The UHF radar was brought into operation in 1981 and uses radio frequencies near 930MHz with the transmitter and a receiver at Tromso, Norway, and additional receivers at Kiruna, Sweden, and Sodankyla, Finland. This system can study the plasma along the Tromso beam direction in the approximate altitude range 90-900km with additional full vector velocity information at one or more points determined by the intersection of the transmitter and remote receiver beams. The new VHF radar operates near 244MHz and has only one receiver, co-located with the transmitter at Tromso. This system has a substantially higher peak power

The antenna for the new EISCAT VHF system at Tromso: the huge parabolic cylinder reflector has total dimensions of 120 by 40 metres.

than the UHF radar (5MW as opposed to 2MW) and this, coupled with a very large steerable antenna (about the size of a football field), gives the ability to observe at lower plasma densities allowing observations to be made at all altitudes between about 70 and several thousand kilometres and over a range of latitudes.

Both systems are equipped with very sophisticated computer control systems and can transmit and receive very complex radar pulse trains including the use of up to 16 frequencies, and mixed multi-pulse and long-pulse schemes. Additionally, phase reversal may be employed to allow some, or all of the transmitter output to be Barker coded to provide very fine range resolution.

The radars are operated, on average, for two days each week and these operations are divided equally between Common Programmes - regular observations of general interest designed for long-term studies - and Special Programmes. In the latter, scientists from the associate countries can run detailed programmes of their own design aimed at furthering individual research projects. Special Programme time is allocated in proportion to each associate's financial involvement and averages one day per month for each of the main contributors, including the UK.

EISCAT on Show

The topics studied by the UK community encompass most of the currently active areas of ionospheric research. This was recently demonstrated when the RAL EISCAT section, assisted by several University groups, mounted a special display for Professor Sir John Kingman, the SERC Chairman. Time constraints allowed the work of only a small fraction of the UK EISCAT community to be included in the display with representatives from Leicester University, University College of Wales, Imperial College and Ulster Polytechnic being present; in addition dramatic video recordings of an auroral substorm over EISCAT - a sudden brightening of the visible aurora - were shown using data from the all-sky cameras developed by the Universities of Southampton and Sussex. Substorm phenomena have also been studied by EISCAT in conjunction with the German IRM satellite of the AMPTE mission. The satellite was then in a region of the Earth's magnetosphere known as the geomagnetic tail. It is in this region that the complex plasma processes occur which eventually result in the spectacular optical emissions of the aurora. The display included a colour graphics terminal that was used to plot data, as if in real time, from the UK Special Programme "EASE" (EISCAT-AMPTE Substorm Experiment), obtained using a radar program which is, in all likelihood, the most complex ever devised.

Other results on display included comparisons of EISCAT data with results from the UK subsatellite (UKS) of AMPTE when in the solar wind. The solar wind carries with it a magnetic field of solar origin called the interplanetary

EISCAT (cont'd from p1)

magnetic field (IMF) which was monitored by the UKS. The solar wind, and the IMF embedded within it, generate large-scale "convective" motions of plasma in the high-latitude ionosphere which are known to vary with the orientation of the IMF relative to the Earth's magnetic-field axis. By pointing the EISCAT UHF radar to the north, changes in plasma convection were observed following a swing of the IMF from northward to southward, the delay in the response being measured accurately for the first time and being of great interest to the theory of the interaction of the solar wind with the Earth's magnetosphere.

Exciting Future

The first four years of operation of the EISCAT UHF system have allowed this, and other, exciting work to be carried out by UK scientists. Increasing system reliability and developments in the use of radar controller and correlator promise even greater returns in the near future. In addition, opportunities offered by VHF system and collaborative research with spacecraft missions, such as Sweden's VIKING, ESA's CLUSTER and NASA's Global Geospace Mission, mean that EISCAT will remain at the forefront of auroral-physics studies for a long time into the future.

M Lockwood and A P van Eyken

Internal Events

NIMROD LECTURES
R61 CONFERENCE ROOM - 1400 hrs

22 July C Fisher/RAL
'Latest Results on Charm Hadroproduction and Charm Decay properties from LEBC/EHC (360 GeV $\pi^+\bar{p}$ and 360 GeV pp)

5 August Review of the Bari Conference

HEP SEMINARS
R61 CONFERENCE ROOM - 1100 hrs

24 July D Perkins/Oxford
'Cygnus X3'

Dr Hans-Otto Wüster

It was with a deep sense of loss that we at the Rutherford Appleton Laboratory learned of the sudden death of Dr Hans-Otto Wüster, Director of JET.

We mourn with them the passing of a dynamic international physicist whose loss to the Fusion community will leave a large void.

Informatics Explained

Last July, the Laboratory's Computing Division was split into two Divisions, Central Computing Division and Informatics Division. There were a number of reasons for this but the two main ones were the increasing size of the Computing Division and the decision by Council to implement the findings of the Computing Review Working Party. This recommended that the Interactive Computing Facility and the Single User System programme should be given back to the Engineering Board for it to run. These two activities, together with the Alvey infrastructure activities managed from RAL together with management and technical support effort for Alvey subject directors, produced a viable Information Technology programme which could be run by a new Division - called Informatics. To solve the acute shortage of space in the Atlas Centre, the new Division is moving to the R1 Link Building. The main functions of the new Division are described below.

Interactive Computing Facility

The ICF consists of a set of multi-user mini systems, primarily in university engineering departments, providing interactive facilities for research workers in computer aided design and computer science. The computers are mainly PRIME and GEC systems. Applications software support is provided by Technology Division while Informatics is responsible for the systems software and user support. All the computers are connected to JANET (Joint Area Network) and users in the university and polytechnic departments can and do access remote systems as well as their local ones.

The major item of work at the moment is installing UNIX as a second operating system on the PRIMEs. This is part of a general move towards UNIX as the standard operating system supported by the Division.

Single User Systems

It has long been envisaged that one day computing resources would become so cheap that a research worker could eventually have his own powerful computing system on his desk. There is, of course, a danger when this happens that different researchers will purchase different and incompatible systems making it very difficult to exchange ideas and software. The Council's single user system programme is aimed at producing a common hardware and software base to avoid this fragmentation and isolation.

Informatics Division currently provides support for over 200 ICL PERQ systems and about 50 SUN systems throughout the UK. To give some indication of the power of these systems, each is approximately equal in power to the ATLAS computer which used to provide computing resources for Harwell, Rutherford and the universities and polytechnics!

Alvey Programme

A few years ago, the Laboratory was asked to provide coordination and support for the Specially Promoted Programme in Distributed Computing Systems. The work consisted of giving advice to grant applicants, organising workshops, distributing information and providing hardware and software support for the programme. This was so successful that later the Laboratory provided similar support for the Software Technology Initiative and the Robotics programme.

When the government set up the Alvey programme two years ago, the Laboratory was asked to provide similar support for this programme. Informatics Division's main responsibility is for supporting three of the four areas - Software Engineering, Man Machine Interface and Intelligent Knowledge Based Systems.

Briefly, Software Engineering research is mainly concerned with turning the production of software from, effectively, a cottage industry to a real industrial process, with the ability to predict the performance of the software before it is written and with confidence that the software will perform the task specified. With the move to interactive working and the widening of the user population, it is becoming more important that computer systems are easy to use. The Man Machine Interface programme is aiming to explore the problems in this rather complex discipline; a mixture of computer science, psychology and human factors analysis. The third area, Intelligent Knowledge Based Systems (IKBS) effectively what is also known as 'Artificial Intelligence') is concerned with the construction of computer systems which mimic human intelligence - for example in understanding of natural language, planning, making inferences etc. The commercially very active area of 'Expert Systems' is a subset of IKBS. In all three areas, the Division is providing coordination and support together with a small research programme of its own.

To provide computing facilities to support its research initiatives, the Alvey Directorate has provided an infrastructure of multi-user minis and single-user systems which, naturally, Informatics has installed and supports.

The Division has recruited many new staff over the last year so it is the youngest Division in more ways than one. It has a stimulating and important programme to support which is in the forefront of the Council's Information Technology activities.

(We are indebted to Professor F R A Hopgood, Director Informatics Division for this summary of their function and programme).

Another Award for RAL

At a short ceremony during a meeting at the Department of Trade & Industry in London on 21 June 1985, Dr J McElroy, the Assistant Adminstrator of the National Environmental Satellite, Data and Information Service, (National Oceanic and Atmospheric Administration, USA), presented a plaque commemorating 25 years of meteorological satellites to Dr J E Harries, acting on behalf of the RAL. The presentation was made to celebrate many years of co-operation between RAL/SERC and NOAA: scientists from the two organisations co-operate extensively in satellite remote sensing of the atmosphere. Currently, projects of common interest include the US Advanced Microwave Sounding Unit (AMSU) and the UK Along Track Scanning Radiometer (ATSR). The plaque will eventually be on display, in or nearby the Watson-Watt Conference Room, R68.

Dr Harries (left) Associate Director for ASR receives the award from Dr J H McElroy, NOAA.

GIOTTO On Target

Giotto, Europes first interplanetary probe, scheduled to encounter Halley's Comet next March, was successfully launched by Ariane Rocket from Kourou, French Guiana on Tuesday 2 July at 1223 hrs BST. Thirty hours later the on-board TPS motor placed the satellite into the correct solar orbit for encounter next March.

Giotto carries 10 experiments to record information about the Comet's nucleus and the way the solar wind flows past the comet. Two of these have special interest for RAL, the Laboratory being involved with Mullard Space Science Laboratory (MSSL), in plasma experiments and with University of Kent in dust-particle experiments. The MSSL experiment, concerned with the coma and tail of the comet, will investigate the composition and distribution of positive ions and interactions with the solar wind, while the Kent experiment will look at the distribution and properties of dust particles in the inner coma. (Bulletin No. 5. 1985).

Three other satellites will intercept Halley's Comet, two from the Soviet Union and one from Japan, but it is Giotto that will produce the most detailed observations because it will pass closer than the other spacecraft, coming within 1000 kms of the comet's nucleus.

Giotto's 700 million kilometre voyage, has now begun. Its four hour encounter with Halley's Comet on 13/14 March 1986 is awaited in excitement.

RAL TECHNOLOGY LECTURES

The next lecture in this series will be held on Thursday 8 August 1985 at 3.00 pm in the R22 Lecture Theatre.

THE SLAC LINEAR COLLIDER (SLC)

by

DR J R REES
ASSOCIATE DIRECTOR
STANFORD LINEAR ACCELERATOR CENTER

In 1980 the Stanford Linear Accelerator Center proposed to build the first in a new species of colliding-beam machines. Called the SLAC Linear Collider (SLC), it is an electron-positron collider to operate at centre-of-mass energies up to 100 GeV and at luminosities up to 6×10^{30} cm^{-2} s^{-1} so that the Z^0 meson could be copiously produced. Construction of the SLC project started in October 1983. High-intensity electron and positron sources, low-emittance damping rings, improvements to the two-mile linac and extremely strong-focusing beam transport systems have been developed and are under construction. The project will be completed in October 1986.

FOR YOUR DIARY: The next lecture in the series will be held on Thursday 26 September 1985 by Mr R A Lawes, Technology Division, and will be entitled "Developments in Lithography at RAL".

Table Tennis AGM

The Club AGM will be held on Wednesday 17 July at 12.30 in the Club Room in R58. Could you, please, make an effort to attend as previous meetings have failed to achieve a quorum.

Duncan Gibson

Film Badge Notice

It is period 8 colour strip YELLOW.

Please be sure you are wearing the correct dosimeter and return all old ones.

NEXT FILM ISSUE
Monday 12 August

Sales to Employees

The sale of scrap metal and plastics to RAL employees will take place (subject to the usual conditions) in the R24 scrap compound on Friday 19 July from 12 - 12.30.

Honours for Audrey

Hearty congratulations to Audrey Foster who was honoured with the award of the MBE in the Birthday Honours List.

Amy and Alan Say Goodbye

Amy Brooks

Amy's farewell party was beautifully arranged and a lovely occasion.

Modestly she would tell you she had lots of help, but as those who know her realise, hers was the guiding hand. "She saw us all through the IRAS trauma", said Eric Dunford, IRAS Project Manager, who was making a presentation to Amy on her retirement on 13 June. She had done a marvellous job, he said and would be difficult to replace, though she had worked very hard to leave things ship-shape for her successor - this no doubt a legacy of the latter part of her career, at Portsmouth with, to quote Amy, "all those nice sailors!" She had also worked at ADASTRA House in her youth- the Services seemed to appeal.

To add extra sparkle to the occasion it was also Amy's birthday, so amongst the gifts from colleagues there was also a huge cake, and a basket of flowers. Amy thanked everyone for these, for the gift of a magnificent bronze and for their presence. "I entirely agree with everything he's said, "she joked at Eric. It has been traumatic - but fun. It has certainly strengthened my nerve, working here! I'm sorry to leave you, thank you very much indeed".

Thank you from all of us for a lovely party Amy, we'll miss you, and we wish you a long, and happy life as a lady of leisure!

Amy shows off to Eric the bronze she was given by her many friends and colleagues. 85-RC 3389

Alan Downing

Alan Downing of EBW left us for pastures new on Friday 28 June. Having started as an architect, providing houses, schools, etc and having for the last twelve years had a hand in a multitude of projects for the Council Works Unit, he is now off to give the Oxford Regional Health Authority the benefit of his experience, in hospital building.

From the long catalogue of works accomplished, quoted by Joe Paxton in his presentation address, it emerged that Alan was no stranger to Buckinghamshire (the area he will have to cover) and as he himself said - "it will be nice to get back to my old stamping grounds. The prospect of being involved with the re-building of "Stoke-Mandeville", had an excitement and worth-while quality that very much appealed, he explained.

On behalf of all Alan's friends and colleagues Joe presented books, a Peter Bradley card and a bottle and wished him all the very best for the future.

Alan thanked everyone for the gifts, and for their help and guidance. Making so many friends at RAL had been a very pleasant experience, he said, and he very much appreciated the special card - "If I've caused a few laughs on my way-----! I've learned a lot here and I wish you, and my successor well".

Alan receives the Card from Joe. 85-RC 3712

Thanks

Sandy Reynolds thanks all her friends and colleagues at RAL for the lovely presents given to her when she left. She wishes to say a special thank you and goodbye to anyone she missed seeing before she went.

Daphne Barrand also writes to say a very big thank you to all her friends and colleagues for her delightful leaving presents and for making her years at RAL such happy ones.

On the Receiving End

Dr Geoff Manning had the tables pleasantly turned on him on Friday 28 June. Normally it is he who does much of the "giving" at the Laboratory but, on that day it was his turn to receive, when the Matchplay Golf Championship trophy was formally presented to him by Doug House (also a winner on many occasions).

And, to remind him of the occasion (he'll no doubt have to give it back one day) he was given a pair of wine goblets "a memento that you did actually win something once!" (non-attributable).

Dr Manning admires his glasses, whilst Dr House protects the Cup. 85RC 3715.

RAL Wives

The weather was kind to us on Thursday 20 June, when we enjoyed a very pleasant coffee morning in Joy McWhirter's garden. Many thanks to her for her hospitality.

Our next event to round off the summer will be a pub lunch and walk. This will be held on

Thursday 18 July

at "The Waggon and Horses", Culham. We shall meet there at 12.30 pm for lunch, where a wide selection of hot and cold food can be obtained from the buffet inside. There is a large garden by the car park with a play area, so please bring your pre-school children. After lunch, there will be the possibility of either a short or a longer walk by the Thames.

We hope to see many of you there! Meanwhile, if you wish to know any more about our get-togethers, please telephone:

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