RGRS NEWSLETTER

No. 132

May 1972

MISCAT

This year the Station is taking part in a unique ionospheric experiment which goes by the name of "multistatic incoherent scatter". Bearing in mind that nowadays no project is complete without its acronym, we can contract this name to Miscat. The experiment is centred on RRE Malvern, makes use of the Chilbolton aerial and one of the Jodrell aerials, and also involves the University group at Aberystwyth.

Incoherent scatter, sometimes known as Thomson scatter, depends on the fact that radio waves are scattered by electrons in the ionosphere. The scattering is extremely weak because each electron has a "surface area" of only 10^{-28} square metres, and simple calculations then show that for typical experimental conditions

(a) only 1 part in 10^{11} of the power in a radio beam penetrating the ionosphere is scattered incoherently; and

(b) the combined "target area" presented by all the ionospheric electrons within the radio beam is only about 1 square centimetre less than the area of a new halfpenny.

The basic idea of ionospheric incoherent scatter dates back to an article by W. E. Gordon of Cornell University, published in 1958. To observe the phenomenon, one must use a radio frequency sufficiently high that ordinary, mirror-like "total reflection" from the ionosphere is impossible, and that there is no appreciable "partial reflection" from irregularities in the ionosphere. Incoherent scatter is very much weaker than either of these kinds of reflection, but has the great advantage that it gives a wealth of information on the density, composition, temperature and drift velocity of the ions and electrons in the ionosphere, over an enormous range of height (80 km to 7000 km has been achieved).

The first incoherent scatter experiment was made by K. L. Bowles in the U.S.A. in 1959, and at present installations exist at Jicamarca, Peru; Arecibo, Puerto Rico; Randle Cliff, Maryland; Millstone Hill, Massachusetts; Chatanika, Alaska; S.Santin-Nançay, France; Malvern, England, and "Somewhere in Russia". All use big aerials, the largest being the 300 m dish at Arecibo, constructed within a natural hollow. The radio frequencies employed range from 50 MHz at Jicamarca to 1300 MHz at Millstone Hill and Chatanika.

Most incoherent scatter systems use pulsed signals, with peak powers of several megawatts. At Malvern, the pulsed system in use since 1968 transmits 8 MW peak power at 400 MHz, and uses a fixed 43 m aerial pointing vertically upwards for both transmitting and receiving. Two incoherent scatter systems, the French one and our Miscat, transmit continuous waves instead of pulses. This has advantages for measuring the spectrum of the scattered signal, but it is necessary to use separate transmitting and receiving aerials (Tx and Rx in Fig. 1). The aerial beams, when set to meet at the desired observing height, define a "scattering volume" (shaded in Fig. 1) from which the signal is received. We usually study either the E region at about 120 - 150 km, or the F region at heights between 250 and 400 km.

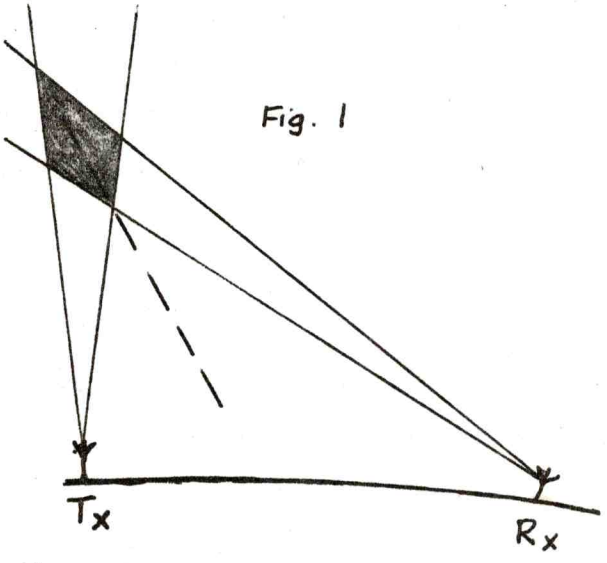

Fig. 1

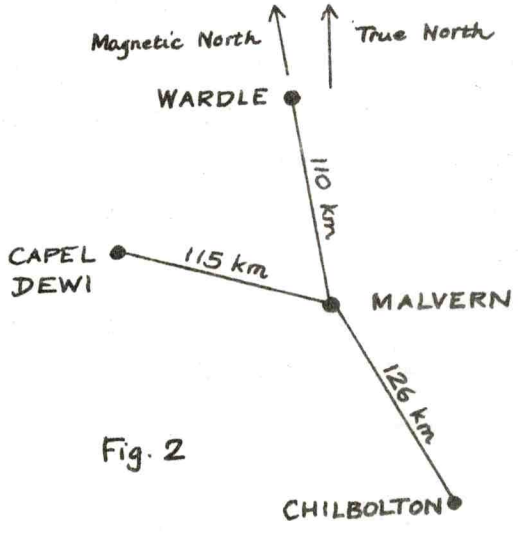

Fig. 2

Actually Miscat uses three receiving aerials, as shown in Fig. 2: the Chilbolton 25 m dish; the Jodrell Bank Mark III (36 x 25 m) at Wardle, Cheshire and a set of 25 x 12 m trough aerials (salvaged from a defunct Cambridge radio telescope) at Capel Dewi, near Aberystwyth. The transmitter at Malvern emits 40 kW power at 400 MHz, using the same aerial as the pulsed system.

In a system like Miscat, the power of the scattered signal is proportional to the electron density in the "scattering volume". We do not measure this power absolutely, so instead we calibrate the system with Slough ionosonde data.

We are interested in the spectrum of the scattered signal, which has a bandwidth of about 10 kHz; by analysing this spectrum we can determine the temperatures of both the ions and the electrons in the scattering volume. (It is interesting that in the daytime F region, the electron temperature is often double the ion temperature). We are particularly interested in the fact that the centre of the spectrum may be shifted by a small amount (of order 100 Hz) from the transmitter frequency. This represents a Doppler shift caused by a drift of the ions and electrons, and if we measure the shift we can determine the component of the drift velocity V in the direction shown by the dashed line in Fig. 1. By using three receivers we can measure three components of V, so that V is completely determined in a way that cannot be accomplished by any other technique. This is very interesting scientifically, because the velocity V plays a large part in the theory of the ionosphere, and ionospheric physicists are very keen to get measurements of it.

The Miscat experiment has a rather poor signal-to-noise ratio (about 0.1) which means that in order to obtain accurate values of V the data have to be averaged over periods of thirty minutes or so. This prevents us from studying rapid changes in V, and indeed we are not yet sure that sufficiently accurate values can be obtained even from 30 minutes' data. We are troubled by unwanted signals scattered from the troposphere, aircraft and satellites; these don't seem too serious, but if the worst comes to the worst we can set up shop as a troposcatter outfit ....

The complete Miscat system was first used in March 1972, though observations at Chilbolton and Wardle only have been made since the summer of 1971. At present we do a 36-hour F region run and a daytime 12-hour E region run each month, though many other modes of operation are possible. The received signals are recorded on magnetic video tape and subsequently analysed at Malvern, additional data being logged on punched paper tape.

For the duration of the project, three RRE staff (Nick Taylor, Robin Risk and George King) are seconded to RSRS, though they still work mainly at Malvern, and Peter McPherson of RSRS is on detached duty at Malvern. The Aberystwyth group, led by Phil Williams, assists with making observations at Wardle in addition to working at Aberystwyth.

In conclusion I should like to acknowledge the assistance given by RSFS staff at Chilbolton, and the provision of data by the Slough ionosonde group.

Henry Rishbeth

STATION NEWS

Scientists from the Canadian National Research Council are visiting R.S.R.S. in order to co-operate in running the long base-line interferometer. (The Chilbolton aerial is being used as one end of the base-line - the other end is a 140 foot aerial in Algonquin Park, Ontario). This facility will be used for Radio Astronomy. Quasars will be studied at a wave-length of 2.8 cm and it is hoped that angular sizes of about .0001 arcseconds will be detected.

News of Former Staff

Congratulations to Marilyn and David Harrison, on the birth of their son, James, on 14th March.

STAFF NEWS

Congratulations to:-

Valerie and David Eccles, on the birth of their son, Anthony David on May 5th.

Robin Guy on his marriage to Ruth Chapman on 6th May at Cowley (Middlesex).

R. W. Tucker now S.Ex.O.

B. P. Gardner now H.Ex.O.

Welcome to:-

D. R. Vizard	S.O.
W. A. Brown	S.C. Student
G. M. Naharnowicz	S.C. Student
A. E. Childs	Craftsman I
M. J. Hope	Craftsman I

Resignations

Nil

Other changes

G. Bennett	now H.S.O. from S.O. old style
D. S. Hall	now H.S.O. " " " "
J. A. Crawford	S.O. returned to duty at RSRS
R. G. Mills	H.S.O. (Temp.Act) left F.Is. (on secondment - returning to UKAEA)
D. A. Cowcher	H.S.O. left F.Is. now returned to duty at RSRS

The Editor,
RSRS Newsletter

Dear Sir,

I hear that the man responsible for the new decoration scheme in the RSRS entrance hall has designed entrance halls for British Embassies the World over.

At last we have some insight into the driving forces which mould our foreign policy! That mighty instrument which created and dismantled an Empire!

Without doubt this colour scheme reflects today's restless mood of British Delegations worldwide, in turn reflecting that of the nation. Thrusting, dynamic, trendy - "I'm backing Britain, buy Concorde, come and see our Union Jack Bikinis". The words leap out at one from every cunningly, seemingly randomly, placed lemon yellow floor tile, glinting in a tangerine sea. The gritty, abrasive, no-nonsense side of our national character is starkly emphasized in the bold pillar-box-and-guardsman red of that painted strip, purposefully wending its uncompromising way across the ceiling, defiant of all aesthetic rationale, unashamed of the shattered sensibilities of those who pass below, uninterested in the mundane problems of coexistence with that citrus melody which is, after all, only the floor.

One could go boringly on in this vein, there is the blue, the existing wood panelling, the now-emphasized lack of perpendicularity of the walls. This job is a piece of first class aesthetic vandalism by Britain's largest building concern - which has the gall to call itself, trendily, the Department of Environment!

Do we, who have to live with this piece of graphic crummudgeon, have no redress? Cannot the perpetrator be summoned to RSRS for an appointment that never materialises and so be kept waiting indefinitely in the entrance hall, forced into unending contemplation of his handiwork?

Yours etc.

Leonardo da Blimp
(Name and address supplied)

Definitions from WARC Conference, Benson

"The apogee is the apoastron of an earth satellite".
"The perigee is the periastron of an earth satellite".

Definition, simile or challenge?

SPORTS AND SOCIAL CLUB NEWS

Bridge Club

On the 14th April we won the return game against N.P.L. by 31 I.M.Ps. Our only defeat of the season was on the 4th May, when, after leading at the halfway stage, we lost the return game with Road Research by 10 I.M.Ps.

Sandwiched between these results we won back the ex-D.S.I.R. Cup, and on the subject of sandwiches, we were very grateful to Mrs Loudensack for her catering at the tournament.

Apart from lunchtime sessions in Room E127, Club activities have closed down till the autumn.

M. Johnson

Wine Circle

A 10% discount on wine and beer-making supplies has been negotiated with a retailer in Reading. This facility is available on production of a membership card. Further details can be obtained from me.

F. Bennett

The S.R.C. Sports Day will be held on June 19th at the Sports Ground, Chiswick.

It is hoped to hold a Cricket Afternoon and Evening Barbeque on June 24th. Further details will be posted on the Notice Board.

OBITUARY

Mr. A. Anderson

We much regret to report the death of Mr. Archibald Anderson on 4th May 1972; he was found stabbed to death, not far from his home; the victim of a seemingly motiveless attack.

'Andy', as he was generally known, had no relatives. A former seaman and a Naval pensioner, he has been with us since 1968, being chiefly employed in the gardens here. His many friends in Slough arranged the funeral, to which was sent a wreath from the Staff of R.S.R.S.

LETTER TO THE OUTSTATIONS

Dear Colleagues,

Few things are so evocative as smells, few smells so distinctive as a mains transformer done to a turn and browning nicely. A week or two ago, outside the measurements lab., old hands (nostrils?) could be observed appreciating this very bouquet. Reminiscence followed, tales of red-hot anodes and exploding electrolytics were conjured out of past years. The cause? The crystal clock had taken up smoking, lost interest in all else and stayed at 1350 U.T. for some hours, until research into this 'temps perdu' persuaded it to join us again in our own frame of reference.

Thus much within. Without, for the past few days, rough winds do not so much shake the darling buds of May as bid fair to rip 'em off. A sizeable specimen of tree, untimely ripped from its earthy matrix, breached our outer fence rendering us, presumably, insecure. Secure enough, though, were the aerials with their stays, impregnable as those of the most creaking Victorian dowager, there was no need to re-enact such ceremonies as righting the rhombic. That's a folk ritual unloved by all including

Yours sincerely,

The Editor

MAY 1972

List of Reprints

P. H. G. Dickinson Measurements of Solar Lyman-α radiation during the eclipse of 7th March 1970.

JATP 1972 Vol. 34. 621-625

INTERNAL MEMORANDA

Nil