IAGA/URSI Joint Working Group on Passive Electromagnetic Probing of the Magnetosphere.

Newsletter — April 1990

Dear colleague,

Working Group meeting at Exeter

A meeting of the working group was held at Exeter, England on 1 August 1989, during the IAGA Scientific Assembly.

Present: A.J. Smith (UK, chairman), M.J. Rycroft (UK), G. Tarcsai (Hungary), J.P.S. Rash (South Africa), S. Sazhin (UK), F. Lefeuvre (France), M. Parrot (France), P. Ninorski (Bulgaria).

In his opening remarks, the chairman noted that the working group served as a forum for researchers using whistlers and VLF/ELF waves as a means of studying the physics of the ionosphere and magnetosphere and the interactions between them. Main areas of interest were: Plasma structures and boundaries, wave-particle and wave-wave interactions, wave induced particle precipitation, and wave propagation in the ionosphere and magnetosphere. Activities of the working group included facilitating coordinated observational campaigns and data exchange, and reporting of scientific results and exchange of ideas and information, both through meetings and a newsletter.

G. Tarcsai reported on work in Hungary. He described work in progress to use digital matched filtering to elucidate whistler fine structure and ducting mechanisms. He described the SAS experiment on the ACTIVE satellite which would be used to study VLF propagation. The wavenormal directions will be computed from the five components observed by SAS, by using a new technique — the matched filter parameter estimator method. Supporting VLF observations on the ground at Halley, Antarctica and at Lake Inari in Finland are planned. Whistler recording has continued at Tihany, the data being used in studies of plasmaspheric electron densities. A new project studying wave induced particle precipitation has been initiated.

On behalf of U.S. Inan who could not be present, A.J. Smith reported on activities of the Stanford University group. These included broadband whistler recordings at Palmer (Antarctica), South Pole, and Lake Mistissini (Quebec); ELF/VLF measurements on board the DE-1 satellite, and intensive use of subionospheric remote sensing, using a widely spaced network of VLF/LF transmitters and receivers, as a means of investigating the trimpi effect as an indicator of whistler induced particle precipitation. Future plans included the deployment of a major active VLF/ELF experiment in Antarctica — the proposed Wave Injection Facility (WIF) — and participation in PENGUIN — a network of AGOs (Automatic Geophysical Observatories) in Antarctica.

A.J. Smith reported on current and future activities of the British Antarctic Survey. Observations being made were: broadband VLF observations at Halley and Faraday; a VLF imaging network for precipitation mapping (in collaboration with the University of Otago, New Zealand), using OPAL (Omega phase and amplitude logger) receivers; group travel time, and Doppler shift measurements of whistler mode signals from VLF transmitters, for monitoring plasma density and drift characteristics in the plasmasphere; and digital whistler recordings for studying whistler fine structure. Future plans included participation in international programmes such as ISTP, CLUSTER, ACTIVE, etc, and deployment of an AGO network in Antarctica.

M. Parrot described work based on VLF observations by the low altitude satellite ARCAD-3. This included a study of the geographical distribution of ELF/VLF emissions, including a possible link to the location of powerful VLF transmitters, and also the use of a bicoherency technique for determining the characteristics of the observed waves.

J.P.S Rash reported on VLF work by his group at Durban and at Sanae, Antarctica.

Change of name

It was felt by some members of the working group that its name no longer reflected well the interests of the group members, due to changes in both techniques and scientific emphasis in the years since the working group was established. Thus much work now, such as the various imaging networks, rely heavily on the use of VLF transmitters and thus the technique is not truly passive. It was also felt desirable to specify

the frequency range of interest, i.e. VLF/ELF, in the title, to avoid any overlap with for example the ULF community. It was therefore proposed that the name of the WG should be changed to Joint Working Group on VLF ELF Remote Sensing of the Ionosphere and Magnetosphere (VERSIM). This proposal was carried unanimously by the meeting and will now be put to the parent bodies of the working group, namely IAGA and URSI. If anyone has any views on this, please let us know.

Symposium proposed for IUGG Assembly, Vienna 1991. In view the interest in the topic, a half day symposium on "Wave induced particle precipitation" was suggested. This was endorsed unanimously by the meeting, and transmitted to the Chairman of IAGA Division III for consideration.

23rd URSI General Assembly. The Assembly will be held in Prague from 28 August to 5 September. More information may be obtained from the Local Organising Committee, Chairman: Professor V Zima, 182 51 PRAHA, CZECHOSLOVAKIA. Scientific sessions which may be of particular interest to the working group are:

JS4: VLF Triggered emissions. Convenor Dr Y Omura.

JS8: Magnetospheric and ionospheric effects of lightning. Convenors Professor U S Inan and Dr H J Strangeways.

During the Assembly, a meeting of the working group will probably be arranged. Details to be announced later.

SCAR meeting, Sao Paulo. Meetings of the SCAR Atmospheric Sciences working group will be held during 16 to 21 July 1990. One of the sessions of particular interest to our working group will be a symposium on *Studies of the Antarctic ionosphere and magnetosphere using very low frequency radio waves.*

Obituary — Dyfrig Jones (1940–1989). Readers will no doubt have heard of the tragic death of Dyfrig Jones in August 1989. The following is taken from a fuller obituary published in the URSI Bulletin No. 251 (December 1989) by Richard Horne, his colleague at British Antarctic Survey.

Dyfrig Jones began his scientific career at the University College of Wales, Aberystwyth, where he completed a PhD on the 'Interpretation of Ionospheric Drift Data'. He then moved to Cambridge to work at the Cavendish Laboratory with K. G. Budden. He constructed a low frequency radio receiver to study electron whistlers and investigated various dynamic spectrum analysis techniques. In parallel with the experimental work, he conducted a theoretical study of the conversion of electron whistlers to ion-whistlers in the ionosphere and magnetosphere, work for which he was awarded his second PhD from the University of Cambridge in 1970.

After Cambridge, he worked at the European Space Agency on the two highly successful GEOS satellites, developing computer simulation software to investigate signal analysis techniques, and designing digital correlators for auto- and cross-correlation. These correlators were flown on GEOS-1 and 2 (launched in 1977 and 1978) — the first satellites to include on-board digital wave signal processing. This technique had the advantage of reducing the amount of data telemetered to the ground, and proved to be so successful that similar correlators were included on the InterKosmos, MAGIK and AMPTE UKS satellites.

While at ESA he began work on the generation of non-thermal continuum radiation in the Earth's magnetosphere. The higher frequency component of this radiation has a wavelength of the order of 10^4 m and escapes from the Earth's magnetosphere. Dyfrig called the radiation terrestrial myriametric radiation (TMR) and proposed that it is generated by a three stage process whereby electrostatic waves, propagating near the magnetic equator, are refracted by the large density gradient near the plasmapause into Z mode waves which are then mode converted at the radio window into the O mode to become the TMR. This theory, which he later called the linear mode conversion window (LMCW) theory, predicted that the TMR should be emitted at a frequency equal to the source electron plasma frequency, and should be beamed away from the magnetic equator to northern and southern latitudes at a precise angle which depends on the electron plasma and gyro frequencies. Furthermore, he predicted that the polarization of the northern and southern beams should be predominantly right handed and left handed respectively. In 1987, data from the Dynamics Explorer 1 satellite was able to confirm the predicted beaming of TMR and, in the following year, to confirm the predicted polarization.

In 1979 Dyfrig joined the British Antarctic Survey where he became head of the Space Plasma Physics Group,

and continued his work on planetary radio emissions, which extended to include whistler mode waves and the generation of auroral kilometric radiation; he also developed pattern recognition and signal compression techniques which he applied to Antarctic data to reduce the amount of data sent, via satellite link, from Antarctica to Cambridge However, the outer radio planets remained the focus of his research interest.

Dyfrig showed that the beaming of TMR, and analogous radiations at the other radio planets, could be used to determine the density gradient in the source region. He applied this 'remote sensing' technique to radiations emitted from Jupiter, Saturn and Uranus. For Jupiter, he predicted that broadband kilometric radiation was generated at the edge of the plasma torus formed by the moon Io, and predicted density gradients which were in remarkable agreement with in situ measurements made by Voyager 1. He also predicted that narrowband kilometric radiation is emitted from source regions on the northern and southern flanks of the Io torus. At Saturn, he used Saturnian kilometric radiation to predict a large density gradient at about 10 Saturnian radii from the planet. Again this prediction showed remarkable agreement with in situ observations. Later on, he also used the same technique to predict the existence of large density gradients at Uranus.

Despite his illness, which was first diagnosed in October 1984, Dyfrig continued his work on the radio planets until only a few months before his death. He published more than 80 scientific papers, not including reports and general review articles, and in the summer of 1989 he was awarded the ScD degree by the University of Cambridge in recognition of his scientific achievements. He showed tremendous drive and enthusiasm in his work which he communicated to others. He will be sadly missed by all his colleagues and friends.

Other news:

M. Hayakawa (Nagoya University, Japan) sends the following information on recent activities:

1) A wave particle interaction experiment at L=1.9, in collaboration with IZMIRAN and the University of Otago, using special transmissions from the ALPHA transmitter at Komsomolskamur and ground based observations near the conjugate at Ceduna, Australia, was carried out in August 1989. Transmissions from the NWC transmitter to New Zealand, which passed close to Ceduna, were recorded in Dunedin and Wellington as a possible means of detecting transmitter induced precipitation.

2) VLF emissions and whistlers at low and medium latitudes. The frequency drift of low latitude VLF emissions is being studied. The propagation mechanisms for equatorial whistlers, are being investigated by data from a network of VLF direction finding receivers in China (in conjunction with Wuhan University), and modelling using the wave distribution function method.

3) In situ studies of magnetospheric waves. Chorus in off-equatorial regions, half gyrofrequency VLF emissions, role of hiss in triggering chorus etc. are being studied using data from the Aureol-3 satellite (in collaboration with the LPCE group). Non-linear wave-wave interactions are investigated using Isis reception of signals from Siple and Omega transmitters (in collaboration with Stanford, CRL, and Chiba University).

News from Dr L.R. Piazza (CRAAE, San Paulo). The group has been operating a modified VLF Tracor receiver at the Brazilian Antarctic station, since February 1989, in an experiment to detect trimpi events.

A international workshop to define the scientific and engineering requirements for a new international ELF/VLF wave injection facility to be placed in Antarctica was held at Stanford University in April 1989. The workshop, which was sponsored by the US National Science Foundation, was attended by over 25 scientists from 5 countries. The workshop participants recommended that an international facility should be established in Antarctica, ideally by 1992 or 1993, in order to provide a basis for remote diagnostic probing of the magnetosphere and to stimulate magnetospheric wave particle interactions in order to address a number of important scientific questions. These are detailed in a report of the workshop produced by Professor U.S. Inan and Dr M.J. Rycroft, which also lists the location and capabilities the facility should have in order to be able to address these questions.

With very best wishes and hoping to see some of you at URSI in Prague.

A.J.Smith
(IAGA Co-chairman of the JWG)

British Antarctic Survey
High Cross
Madingley Road
Cambridge CB3 0ET, UK

Telephone: +44 223 61188
FAX: +44 223 62616
Telex: 817725 BASCAM G
Electronic mail:
CBS%UK.AC.NBS.VC::U_AJS
(SPAN ECD1::323AJS)

U.S. Inan
(URSI Co-chairman of the JWG)

STAR Laboratory
Dept of Electrical Engineering
Stanford University
Stanford, CA94305, USA

Telephone: +1 415 723 4994
FAX: +1 415 723 9251
Telex: 348402 STANFRD STNU
Electronic mail:
INAN@STAR.STANFORD.EDU
(SPAN STAR::INAN)