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TO: S R JONES/L J C WOOLISCROFT - SHEFFIELD
M P GOUGH - SUSSEX
D J SOUTHWOOD/ S W H COWLEY - ICST
MRS C A H COATES - SERC
J L CULHANE/A M CRUISE/J A BOWLES/)
A D JOHNSTON/T J PATRICK/P H SHEATHER/) - MSSL
A COATES/B HANCOCK/K BARNSDALE/W GILFORD)
D JONES - BAS
J E HARRIES/A H GABRIEL/D RAMSDEN/)
P D CURTIS/P J BARKER/M C W SANDFORD/)
R F TURNER/D M SIMPSON/E DUNFORD/)
R HOLDAWAY/A J ROGERS/D A BRYANT/)
D R LEPINE/N W FERGUSON/K W PAVITT/) - RAL
D S HALL/A J HALL/H SHAH/C P CHALONER/)
A R O'HEA/J H PARKER/D J PARKER/)
M B COOKE/N G ANGOLD/T EDWARDS/)
MRS J C GILLING/MISS K J UNDERWOOD)

FM: A K WARD - RAL

PM comment to Directorate

URGENT
======

SUBJ: AMPTE UKS PRE-SHIP REVIEW

YOU ARE INVITED TO ATTEND A PRE-SHIP REVIEW OF THE AMPTE UKS ON THURS 6 JUNE AT COSENERS HOUSE, ABINGDON, STARTING AT 10:00 AM (9:45 AM COFFEE).

A COMBINED RAL/MSSL BOARD WILL REVIEW THE PROBLEMS THAT HAVE BEEN ENCOUNTERED AND THE SOLUTIONS ADOPTED DURING THE DEVELOPMENT OF THE UKS SPACECRAFT. THERE WILL ALSO BE A BRIEF STATUS REPORT ON THE UK GROUND DATA SYSTEM. THE REVIEW WILL BE FOLLOWED BY A (CLOSED) MEETING OF THE AMPTE PROJECT COMMITTEE.

THE REVIEW TEAM WILL CONSIST OF:

DR A H GABRIEL (CHAIRMAN)
DR J E HARRIES
M C W SANDFORD
R F TURNER
PROF J L CULHANE
DR A M CRUISE
J A BOWLES

REVIEW DOCUMENTATION WILL COMPRISE THE BOOK ISSUED FOR THE 2-4 MAY 1984 FLIGHT READINESS REVIEW IN MUNICH, AND THE RECOMMENDATIONS AND RESPONSES FROM THAT REVIEW.

IT WOULD BE VERY USEFUL IF AT LEAST 1 REPRESENTATIVE OF EACH SUBSYSTEM AND EXPERIMENT ATTENDS THE REVIEW, IN ORDER TO ANSWER ANY DETAILED QUESTIONS WHICH MAY ARISE.

A G E N D A

ITEM	PRESENTER	DURATION (MINS)
1. INTRODUCTION	WARD	10
2. VERIFICATION TEST PROGM	EDWARDS	20
3. SUBSYSTEM STATUS		
A. STRUCTURE	PATRICK	10
B. POWER	EDWARDS	15
C. THERMAL	SHEATHER	10
D. ATTITUDE/ORBIT CONTROL	SHEATHER	15
E. RANGING	O'HEA	5
F. COMMUNICATIONS	O'HEA	10
G. COMMAND AND DATA HDLG	PARKER	10
H. EXPERIMENTS	EDWARDS (OR EXPTRS)	20
4. GROUND SUPPORT EQUIPMENT	EDWARDS	5
5. LAUNCH CAMPAIGN	WARD	20
6. IN-ORBIT CHECKOUT	WARD	15
7. GROUND SYSTEM STATUS	DUNFORD/HOLDAWAY	25
8. DISCUSSION	ALL	20

THE PROPOSED SCHEDULE FOR THE DAY IS AS FOLLOWS:

9:45 COFFEE
10:00 START
12:30 LUNCH
13:15 RESUME
15:00 REVIEW BOARD CAUCUS
15:30 APC MEETING START
17:00 CLOSE

PLEASE LET KAREN UNDERWOOD X5619 KNOW WHETHER YOU WILL BE ATTENDING, AND WHETHER YOU REQUIRE TRANSPORT FROM DIDCOT STATION OR THE LAB, TO AND FROM COSENERS HOUSE. WE MUST HAVE THIS INFORMATION BY MONDAY IN ORDER TO BOOK LUNCHES.

REGARDS
*
817725 BASCAM G
837908 RUTHLB G

Science and Engineering Research Council
Rutherford Appleton Laboratory

Chilton, Didcot,
Oxfordshire OX11 0QX
Telegrams: Ruthlab Abingdon
Telex: 83159
Tel: Abingdon (0235) 21900
Extension:

Dr C Jordan
Department of Theoretical Physics
Oxford University
Oxford

14th June 1984

Dear Carol

I thought that it might be helpful if I outlined to you the general plan we have for scientific operations with the UK spacecraft UKS following the AMPTE launch in August. A detailed mission science plan will be issued in draft within the next week or so and I will of course send you a copy then for your comments.

The background against which the plan has to work is a somewhat unusual one. The UKS will be visible from Chilbolton, our main science data receiving station, for some hours at approximately the same time every day. A pass may be a short one of a few hours near perigee, or a longer one of up to 12 hours near apogee. The spacecraft has power to operate with all experiments running for approximately 4 hours at a time, after which the battery needs to re-charge for 12 hours. We can increase the operating time to 5.7 hours when the spacecraft is away from apogee by running the transmitter in its low-power mode. For reasons of economy we plan, in accord with our original proposal, to take scientific data on one pass every two days on average.

The way the UK AMPTE Science Team is proceeding is firstly to select which passes and which 4 - or 5.7 - hour segments of them give the best chance of encountering regions of particular interest, such as the bow shock and magnetopause. For each of these segments we decide upon the mode in which the spacecraft and each experiment will be operated and on any changes of mode to be undertaken after entering a new region, for example. We also decide beforehand on the criteria to be used in determining the best moment to begin operating in full science mode. At first we will base this on the average positions of the boundaries and then will experiment with using one of the instruments as a test probe to tell us, with only a small penalty in running time, something of the current state of the magnetosphere. For special events such as the ion releases science operations will be governed by a central decision made by Prof. Haerendel.

Scientific decisions during a pass will be made at the UK Operations Control Centre by a duty scientist who will be either myself or one of a number of deputies appointed from the Science Team. The duty scientist, working closely with a duty spacecraft engineer, will be responsible for implementing the Team's plans for a convenient sequence of passes. During a science period the readings from all five experiments will be displayed in readily interpretable form, in most cases as a set of colour spectrograms. These will permit an immediate assesment to be made of performance and findings as well as a controlled degree of interactive operation.

With this plan it will not be necessary for experimenters to attend every science period. It is clear though that the scientific return from the mission will benefit if experimenters and theory consultants can be present whenever practical in order to contribute to decision making during a pass and to help assess the results afterwards. It is foreseen that in practice team members will attend, either as duty scientist or experiment representative, for sequences of passes which hold special interest for them.

The principal groups will as a matter of course be kept informed of results by the "survey data plots" which will be mailed with their "experimenters' data tapes" within a few days of each pass. Available in addition via the SERC network will be "survey data files" containing broad averages of key quantities. The survey data plots and files will also be exchanged with German and American colleagues.

As you will know the spacecraft for the Kennedy Space Centre leaves on 19 June. I am enclosing some photographs taken very recently which show what has been produced by the dedicated teams at RAL, MSSL and the universities with the continued support of the solar system committe since the proposal was submitted just under three years ago. Testing of the real-time data handling systems was completed today, and attention in this area is now focussed on the post-pass data processing. The schedule for all concerned continues to be a very busy one but we are confident that it can be met and look forward to a truly exciting new mission in space plasma science.

Yours sincerely

D A Bryant

cc. Dr P J S Williams

approved by Aupte / Ch + AHG 9/6 19/6.

SERC PRESS NOTICE

FINAL TERRESTRIAL JOURNEY OF UKS

A British satellite, designed to play a major role in an international study of plasma physics in space, left the Rutherford Appleton Laboratory (RAL) at Chilton in Oxfordshire on Tuesday 19 June, bound for the Kennedy Space Center in Florida. UKS is a compact but versatile space vehicle that will participate in an ambitious series of experiments to explore the complex magnetosphere that envelops the Earth out to distances exceeding 100,000 km. Constructed jointly by RAL and the Mullard Space Science Laboratory (MSSL) of University College London, this spacecraft is the UK contribution to AMPTE (Active Magnetospheric Particle Tracer Explorers), a three-nation unmanned expedition to a vast natural plasma laboratory located on our own global doorstep. Experiments have been provided by the Universities of Sussex, Sheffield and Surrey, the Imperial College of Science and Technology, MSSL and RAL. Launch ~~on~~ about 11 August by a Thor Delta rocket will be in tandem with its two larger companion satellites, one from the USA and the other from the Federal Republic of Germany. Together, these three satellites will investigate some of the less-understood physical processes governing that most distant part of the Earth's environment, the magnetosphere.

This region is a huge comet-shaped pocket in the solar wind where it interacts with the Earth's magnetic field. Consisting of ionised gas, or plasma, continuously evaporated at very high speed from the Sun's corona into interplanetary space, 99% of the solar wind that encounters the geomagnetic field is deflected by it; the remaining 1% is trapped in the plasma and fields of the magnetosphere. Much is known already about the structure and dynamics of the trapped ions, but AMPTE is expected to shed light on the little-understood mechanisms that permit penetration of the geomagnetic barrier. Together with the other particles from the radiation belts, these ions are subsequently accelerated, and in some cases release their energy in the spectacular upper atmosphere Auroral displays.

In an attempt to explain these phenomena, the German satellite will release relatively small quantities of ions into the solar wind as tracers which will be detected by the American satellite as it patrols the magnetosphere. The UK spacecraft will be manoeuvred to keep close to the German Ion Release Module, and will make high resolution plasma measurements to help distinguish between temporal changes and spatial structure, an impossible task from a single moving vehicle. Spacecraft control will be via the 12.5 metre Chilton dish with telemetry received at the 25 metre Chilbolton dish routed to Chilton by high speed data lines. The active aspects of AMPTE should be visible from the Earth as a man-made comet when barium ions are released in the flanking magnetosheath in December, and possibly as additional Aurorae when lithium ions are released in the magnetospheric tail. For another planned six months after the releases, the three spacecraft will apply their advanced instrumentation to studies of the natural particles, fields and waves of the magnetosphere.

For further details, please contact: Dr D A Bryant, RAL Project Scientist, Mr A K Ward, RAL Project Manager, or Mr R T Elliott, RAL Press Officer, all at the Rutherford Appleton Laboratory, Chilton, Didcot, Oxon, OX11 0QX (Tel: 0235-21900); Mr T Patrick, MSSL Project Manager, Mullard Space Science Laboratory, Holmbury St Mary, Dorking, Surrey, RH5 6NT (Tel: 0306-70292).

Dr E Dunford   Dr D Bryant

AMPTE

I reported to the DHC the success of the AMPTE project and the considerable achievements already made. The DHC would like to join me in giving our warmest congratulations to all involved in the project. We are fully aware that the satellite was built in a very short time and at a small fraction of the cost of what is normal for such a satellite. This has only been achieved by extremely hard and dedicated work by all concerned. The success you have earned and the continuing scientific output which will result will bring considerable credit to yourselves and the Laboratory. Well done. Will you please pass on this message to all those who have been involved.

Geoff Manning

G MANNING
14 Sep 84

copy to: Deputy Director
Div Heads

18/9/84 fu

AMPTE

Continuing from 3 September —

A programme of scientific studies has ~~been in~~ continued in full swing with a pass being taken on almost every day. Half of these (one every 2 days) have been supported by Chilbolton (with data rates up to 16 kb/s) and half from Chilton (with lower data rates up to 8 kb/s depending on range and proximity to the solar direction).

Highly varied conditions have been encountered, making each pass ~~to~~ uniquely interesting. Solar wind speeds have been on the whole higher than average, resulting in a compressed magnetosphere and bow shock. Features of special interest have been the high resolution studies of the magnetopause (bounding the magnetosphere and magnetosheath) and the bow shock (between the magnetosheath and solar wind).

Throughout there has been a close correspondance between effects on the different experiments, ~~also~~ even though each responded in a different way. Close agreement ~~has been confirmed~~

with IRM experiments has been established.

The first chemical release was made at 0825 BST on 11 September when a lithium cloud was created ahead of the bow shock. The measurements obtained at the IRM and UKS (37 km away) are currently being examined closely to ascertain the exact nature of local perturbation (expansion speed, ionization rate etc), and CCE data are being studied for evidence of the penetration of lithium ions into the ring current region of the magnetosphere. [This release was on the fourth attempt ~~the~~ to find suitable conditions.] It is clear at once that intriguing results were obtained on the ion, electron, wave and magnetic field experiments — and that they correspond closely to those on the IRM.

A second release will be attempted on 18 September ~~on the~~ (and if necessary on alternate days until the closing of the window for this type of experiment on 28 September).

The orbit (almost exactly nominal) is such that the best conditions for the Barium release creating an artificial comet should be reached at 1200 GMT on 25 December! The next best chance will be on 27 December.

The spacecraft itself continues to support the scientific programme in the fullest possible way. The ground system is providing excellent support also though it is clearly somewhat overburdened, both in a hardware and software sense. Data handling is not yet at a routine stage and represents in fact something of a problem since some key S and A staff who have given splendid support are required to re-join other programmes eg. ROSAT.

Another possible problem area is travel. While it is fully practicable to operate the experiment without all experimenters being present, the experimenters (and visiting theorists) clearly gain immeasurably from participating in a science period and either adjusting their experiments optimally or contributing to the discussion generated from the real-time displays. The Sheffield group are nearing the end of the funds allocated for this already. Without continuing support from the other experimenters, the task of duty scientist is becoming a considerable burden, shouldered largely until now by the RAL

Sent to Edwin Lowell
10/10/84
[handwritten initials]

THE AMPTE MISSION

Project Scientist's report on the first 5 weeks

1. LAUNCH SEQUENCE

The launch of the three AMPTE spacecraft (the Charge Composition Explorer (CCE) from the USA, the Ion Release Module (IRM) from Germany and the United Kingdom Satellite (UKS) by a Delta rocket from Cape Canaveral proceeded smoothly and perfectly, beginning with lift-off at 1548 BST on 16 August.

After injection into an eccentric orbit of 9REx550 km altitude the CCE separated from the others and, by means of an on-board motor, adjusted its orbit inclination from 28.5° to 5° thereby attaining its mission orbit. On completing a full traversal of the CCE's 16-hour orbit, a motor on the IRM was fired at 0818 BST on 17 August to boost the IRM and UKS into their 18.7REx550 km altitude mission orbit.

2. SEPARATION AND COMMISSIONING

Approximately 4 hours after a full traversal of the 44.2 hour mission orbit the UKS separated from the IRM at 0845 BST on 19 August and began a transmission which was received by the United Kingdom Operations and Control Centre (UKOCC) at RAL via the Chilton antenna. Control was established at once, and by the end of the 12-hour pass during which the spacecraft was visible from Chilton its attitude was adjusted by means of gas jets, its rigid booms deployed and the process of checking its vital systems begun.

On the following four passes which occurred on 20-23 August the electric field booms were deployed, final adjustments were made to attitude (the spin axis being set within a few degrees of the ecliptic pole) and the experiments were switched on and checked. Real-time displays of the readings greatly facilitated and helped to ensure the safety of this operation, particularly with respect to the high voltages of the electron and ion spectrometers.

3. PRELIMINARY STUDIES

The full science programme began on 25 August with the UKS near apogee and within the solar wind. Using the low-power transmitter the spacecraft has supported 5-hour periods of scientific measurements each day from 25 August - 2 September. In addition there have been periods of engineering tests. These have included measurements by the on-board radar of the distance between the UKS and the IRM (at present 25 km at apogee).

Preliminary scientific measurements, which were given considerable impact by the graphical displays (in which the University of Sussex played a major role) forming continuously-developing images of the medium through which the satellite is moving, reveal with great clarity all of the expected features of the interaction between the solar wind and the magnetosphere in the post-noon region explored so far. While the measurements need yet to be validated, some immediate impressions can be given:-

The ion spectrometer gives the speed of the solar wind, its ionic composition and demonstrates the scattering caused as the ions penetrate the bow shock. Ions moving upstream are also observed, as is the marked increase in average energy as the magnetopause is crossed. Heating of the cold solar wind electrons at the bow shock, and anisotropies and structure within the magnetosheath and at the magnetopause boundary layer are immediately apparent. A continuous plot of electron density exhibits the expected fourfold increase of density across the bow shock and the transition to very low densities and high temperatures just within the magnetosphere. The particle correlator has detected evidence of significant temporal variations in both electron and ion streams. Changes in particle behaviour, particularly those at the bow shock, are accompanied by the appearance of electric-field waves as detected by the wave experiment. In the passes recorded so far, all of which were outside the geostationary distance, there has been no detectable magnetic wave activity. Measurements of the local magnetic field have served to co-ordinate the other observations and have revealed very clearly the nature of the transition from the dipole-like field of the magnetosphere to the more irregular fields of the magnetosheath and solar wind. The ability to interchange magnetometer sensor axes has proved an invaluable aid in calibration as has a direct comparison of measurements between the IRM and UKS.

4. RELEASE OF SOLAR WIND TRACER IONS

Twenty-six days after launch the first release of lithium ion tracers took place on Tuesday, 11 September, at 0825 BST when the mission's three spacecraft were in suitable positions for the release. At this time the UKS and IRM were "visible" only from the DSN station at Canberra. The UKS was confirmed to be working in the most suitable mode at the UKOCC via the DSN network then the network link was handed over to the Ion Release Module (IRM) while the UKS data continued to be received and recorded at Canberra. (These data were replayed to UKOCC via the network later the same day.) Conditions in the solar wind, as relayed from the UKS between 0500 hrs and 0600 hrs and continuously thereafter by IRM, were discussed and evaluated in a three-way link-up between the operations centres in the USA, Germany and at RAL. Computer programs were run at John Hopkins Applied Physics Laboratory to show whether or not ions, released under the prevailing solar-wind speed and density and magnetic field direction, would be expected to pass through the bow-shock to reach the magnetopause (the outer surface of the magnetosphere), and thereby stand a chance of finding their way into the radiation belts within the magnetosphere where the Charge Composition Explorer (CCE) was waiting to detect them.

At 0812 hrs conditions were deemed to be suitable and Professor Haerendel, at the German control centre, announced that he had sent the command for the release. At 0815 two of the IRM's sixteen cannisters were released and after a suitable interval, when they had reached a distance of 1 kilometre from IRM, the reaction between Li and CuO was activated to release an expanding cloud of lithium atoms which were photoionized by solar ultra-violet.

Measurements made at the IRM itself, at the UKS 35 kilometres away at the time of release, and at the CCE some 80,000 kilometres away, were examined very closely, (especially, in the case of IRM and UKS, those obtained within the first few tens of seconds of the event) in order to evaluate them to the point which allowed a second release to be embarked upon within the remaining section of the window, which closed 28 September.

On Thursday, 20 September, the second lithium release took place, this time with the UKS visible from Chilbolton. At the time of writing, the unique sets of data from both releases are being closely studied to reveal the nature of the expansion of clouds of lithium ions and electrons into the solar wind and their possible entry into the magnetosphere*. In December another release into the flank of the magnetosphere will produce a comet-like phenomenon visible from the West Coast of the USA. Further releases in March 1985 in the tail of the magnetosphere will, in addition to being further sources of tracer ions, enable studies to be made of the perturbation caused in the static plasma which prevails in this region. One more release of lithium a little later in the year should produce an artificial aurora.

In the AMPTE control centre (UKOCC) at the RAL, observations are given considerable dramatic impact by appearing as colour displays, only moments after being made by the satellite instruments, to give continuously forming images of the medium through which the satellite is moving. This permits optimisation of experiment modes and enables rapid comparisons to be made between conditions at the UKS and at the IRM. Data transmitted by UKS are collected by the 25 metre Chilbolton antenna as well as at the Chilton dish. From Chilbolton, high speed data lines route the data to UKOCC. The results from the three national control centres will be pooled for analysis.

All three satellites are reported by their respective authorities to be functioning well in orbit. The UKS is working faultlessly and its control and data reception using antennae at RAL and Chilbolton and processing by UKOCC are very effective.

*A statement issued by Johns Hopkins Applied Physics Laboratory on 26 September announces that results to date place an upper limit of solar wind plasma transfer into the magnetosphere of less than one per cent.

Carried out over a period of some 15 months the whole mission promises to open a new era of space plasma research.

D A Bryant
RAL
25 September 1984

AMPTE - launched and active

The three satellites of the Active Magnetospheric Particle Tracer Explorers mission (AMPTE) were launched successfully by a Delta rocket from the Kennedy Space Center on 16 August 1984. The satellites from West Germany, the USA and the UK have now begun to perform an ambitious series of experiments, some of which involve injections of tracer ions, to discover the mechanisms which govern the entry of particles of the solar wind into the Earth's magnetosphere and atmosphere (see SERC Bulletins Vol. 2 Nos. 4 and 11). The West German spacecraft, the Ion Release Module (IRM), was designed and produced by the Max Planck Institute for Extraterrestrial Physics near Munich, the American Charge Composition Explorer (CCE) by the Johns Hopkins Applied Physics Laboratory near Baltimore, and the United Kingdom Satellite (UKS) jointly by the Rutherford Appleton Laboratory (RAL) and the Mullard Space Science Laboratory who, together with Imperial College and the Universities of Sheffield and Sussex, produced a comprehensive set of instruments to observe positive-ion and electron distributions, the magnetic field, and electric and magnetic wave activity.

Even though there had been a last-minute delay of one week due to problems with a computer used for orbit calculations, and then because of contamination of the payload by flaking mylar in the air conditioning duct from the launch tower, the launch still took place within a two-week window set three years previously at a time when the UK team entered the project. The launch sequence went exactly to plan. The three spacecraft were injected into an eccentric orbit of 500 km perigee altitude by 9 Earth radii (RE) geocentric distance at apogee. The CCE separated from the others to remain in this orbit within the magnetosphere for the duration of the mission. On 17 August the IRM and UKS were boosted into their mission orbit of 500km x 18·5 RE which extends outside the magnetosphere and into the solar wind. It was not until 19 August, after a full traversal of this 44 - hr period orbit, that the UKS separated from the IRM and began a transmission which was received at the UK Operations and Control Centre (UKOCC) at RAL. By the end of the 10-hr period for which the UKS was 'visible' from Chilton its spin axes had been re-oriented by pulses from its gas jets, its rigid booms had been deployed and the process of checking its many instruments and systems had begun. Since 25 August the UKS has, like its German and American counterparts, been performing a regular series of studies of the natural medium and the disturbances produced by the injections of ions from the IRM.

The UKS is controlled and operated for typically 5-hr periods each day from the UKOCC via the 12-m antenna at Chilton. Data reception is shared equally between this antenna and the 26-m antenna at Chilbolton in Hampshire. At the UKOCC the observations made by the instruments on the satellite appear only moments later as line plots and colour spectrograms which provide continuously forming images of the medium through which the satellite is moving. This permits optimisation of the highly versatile instruments and enables assessments to be made of conditions currently prevailing in the solar wind and magnetosphere.

Lithium ion releases.

Two of the main aims of the AMPTE mission are to trace the flow of solar wind ions into the Earth's magnetosphere using lithium ions injected upstream in the solar wind and to evaluate the effect caused locally by the introduction of these ions.

The first such experiment was performed on 11 September, when the three spacecraft were suitably positioned in their orbits and the solar wind conditions as evaluated by the IRM and UKS were thought to be conducive for the entry of solar wind particles into the magnetosphere (principally the magnetic field in the solar wind being directed southward to oppose and cancel the northward field in the outer magnetosphere). Two of the IRM's sixteen canisters were ejected and when they were 1 km from the IRM a lithium - copper oxide reaction was activated to release an expanding cloud of lithium atoms which became photoionized by solar ultraviolet radiation. The effects were immediately apparent at the IRM and the UKS, 35 km away at the time. As expected the expanding plasma of ions and electrons produced a cavity in the solar wind magnetic field with a correspondingly enhanced field outside. The lithium ions were accelerated by the ambient electric field, and solar wind electrons were energized as a result of the disturbance. An intensive search began at once among the rich variety of magnetospheric ions being identified by the CCE for the arrival of some of the lithium ions. So far none have been discovered and the important implications of a possibly negative result are being carefully considered. For this first lithium release the IRM and UKS were both out of sight of their respective ground stations and their data were received and recorded by NASA's Deep Space Network station in Canberra.

A second lithium release was made on 20 September, this time with the UKS visible from Chilton where the antenna was used for commands, and Chilbolton where the data were received. Figure 2 taken from the real-time display at the UKOCC shows how the lithium ions were accelerated and solar wind electrons energized during this second release.

The science teams from all three spacecraft met at the Johns Hopkins University in October to begin a co-ordinated assessment of the results of these first two of the mission's seven active experiments.

Artificial comet and other releases.

As a result of the Earth's annual motion around the sun the IRM and UKS will in late December no longer penetrate the upstream solar wind but will be ideally positioned for a release of barium ions on the dawn flank of the magnetosphere where they will produce an artificial comet. The progression of the orbits is such that this event, with the IRM in the head of the 'comet' and the UKS in the tail, is scheduled to take place on Christmas Day!

Further releases in March and April 1985 in the downstream tail of the magnetosphere will, in addition to being further sources of tracer ions, enable studies to be made of perturbations caused in the relatively stationary plasma which prevails in this region. One of these releases is expected to produce an artificial aurora.

Natural studies.

Meanwhile, the three spacecraft are continuing to explore the natural magnetosphere and solar-wind with a resolution, afforded by their advanced instrumentation, that has not previously been possible. The phenomena of special interest to date have been the structure and composition of the solar wind, the energization of particles as they cross the bow shock formed upstream from the Earth and the equally intriguing process of the merging of solar-wind and magnetospheric plasmas and fields.

The mission which is scheduled currently for a period of 15 months is, after only the first three of these, clearly well on the way towards fulfilling its promise of pioneering a new era in space plasma physics.

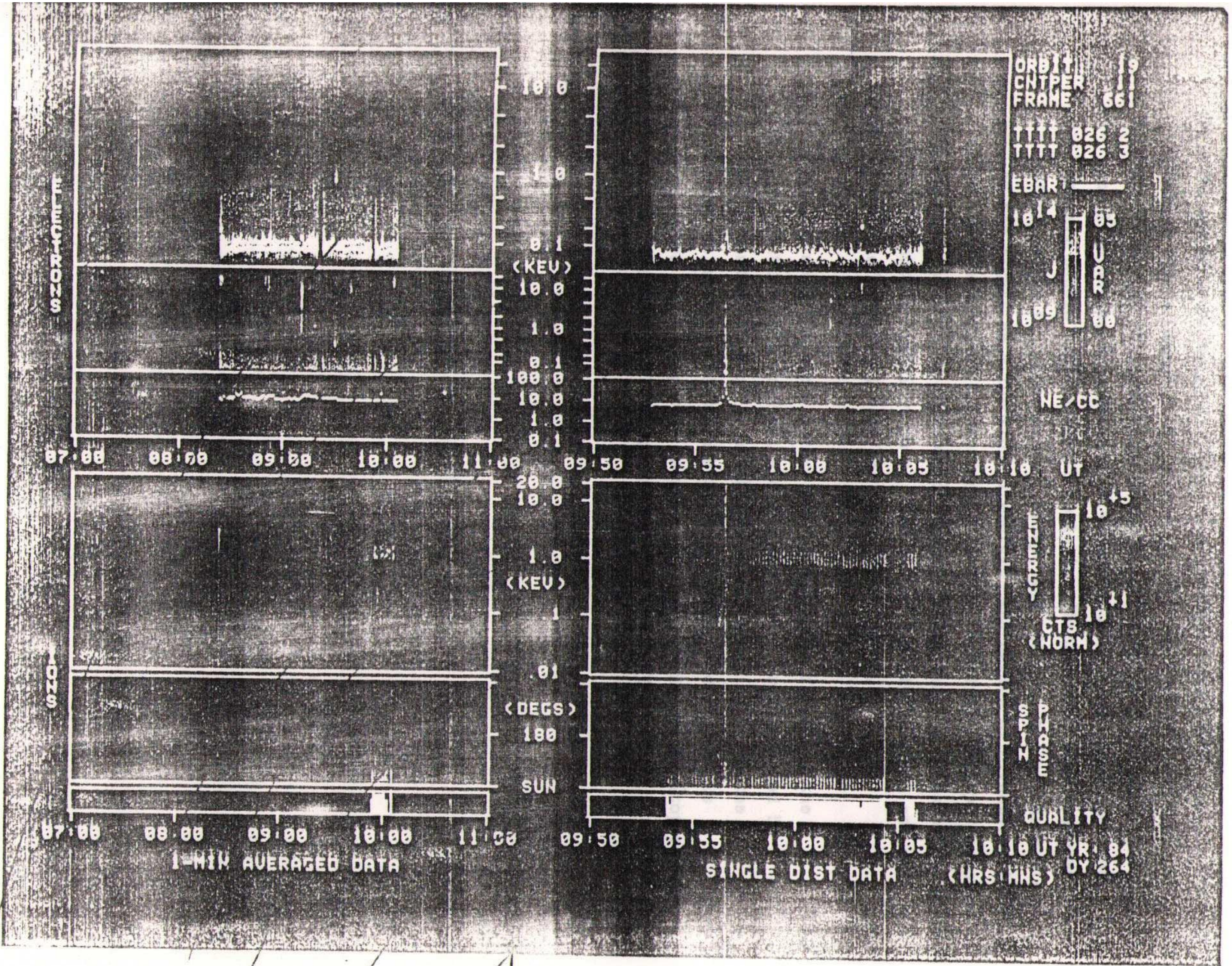
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Fig 2

Figure captions.

(1) The AMPTE - UKS Satellite being prepared for shipment to the Kennedy Space Center.

(2) Electrons and positive ions recorded by the AMPTE-UKS at the time of the lithium-ion release ~~of~~ at 0956 ~~Universal Time~~ UT on 20 September 1984. The six panels taken from the real-time display show the development of (from the top) electron intensity, according to the colour scale at the right, as a function of energy; the degree of directionality of the electrons as a function of energy; electron density; colour-coded count rate of the positive-ion detector as a function of energy; the azimuthal distribution of ions in the ecliptic plane; and a measure of the quality of the positive-ion data.

Clearly seen (in panel 4) are the curved trace formed by the accelerating lithium ions, and the horizontal traces formed by solar wind protons of 1 keV and alpha particles of twice the apparent energy. Electron heating caused by the release is indicated by a temporary increase in electron intensity (top panel) and a corresponding density enhancement (panel 3).

FIRST RESULTS FROM AMPTE (Summary of a talk given at the Royal Astronomical Society on 9 November 1984)

On 16 August this year three satellites were launched from Cape Canaveral to begin a unique series of experiments to investigate the interaction of the solar wind with the Earth's magnetosphere. The main aim is to discover using tracer chemicals how the solar wind enters and is transported through the magnetosphere. The studies, although designed primarily to tackle a major problem in geophysics, are likely to be of interest also in the realms of astronomy and laboratory plasma physics since with those three satellites we are able to investigate at first hand fundamental processes that undoubtedly apply throughout the universe with a resolution that is hard to match in the laboratory.

The spacecraft are collectively known as the Active Magnetospheric Particle Tracer Explorers (AMPTE). I am delighted to report that they are all working well and producing excellent data from which I will summarize some of the early results. The Ion Release Module (IRM), constructed by the Max Planck Institute for Extraterrestrial Physics in West Germany, carries a comprehensive set of instruments to record charged particles, plasma waves and magnetic fields. It carries also 16 canisters containing a mixture of copper oxide and lithium or barium which can be released on command into the solar wind and the magnetosphere to serve as sources of ions for tracing plasma flow. The Charge Composition Explorer (CCE), built by the Johns Hopkins Applied Physics Laboratory in the USA, orbits within the radiation belt region of the magnetosphere to observe and record the circumstances of the arrival of lithium and barium ions resulting from the releases. The third satellite (UKS) designed and constructed by the Science and Engineering Research Council and university groups in the United Kingdom follows in the same orbit as the IRM to observe with its equally comprehensive plasma instrumentation the local perturbations caused by ions and electrons from the releases. The three spacecraft are particularly well equipped to perform, between the seven planned release or active experiments, high resolution studies of the natural complex interaction between the solar wind and the magnetosphere. The CCE has an apogee of 9RE geocentric distance and a perigee of 500km7, while the IRM and UKS have an apogee of 18.5 RE and perigee of 500km.

On 11 September and 20 September 1984, lithium ions were released into the solar wind upstream from the bow shock created where the supersonic solar wind first encounters the Earth's magnetosphere as an obstacle. The local effects of the release as recorded by the IRM and UKS 30 kms away at the time were very striking : a magnetic cavity was produced together with a retardation in solar wind ion speed and a heating or energization of solar-wind electrons. Lithium ions picked up and accelerated by the solar wind electric field were observed with great clarity by the UKS. The ions have not, unfortunately, so far been distinguishable among the wide range of varied of ion species within the magnetosphere by the CCE.

The precession of the IRM and UKS orbit relative to the Sun-Earth line is such that conditions will be ideal for a release of bariums ions on the dawn flank of the magnetosphere to create an "artificial comet" visible from the Western USA and Eastern Pacific region on Christmas Day 1984. An extensive observer programme has been organized for this comet which, if all goes well, will have the IRM in the coma and the UKS some 200 km downstream in the tail, to which position it will have been manoeuvred by means of its orbit and altitude adjusting gas jets.

Natural studies have been concentrated primarily on the variability of the solar wind, the energization and scattering of particles as they cross the enigmatic collisionless bow shock and the equally intriguing and universally important process of the merging of solar wind and magnetospheric plasmas and fields. The latter has been revealed by the high resolution of the UKS measurements to occur more frequenctly and on a wider range of scale sizes than previously thought.

Several marked similarities have been noted already between phenomena occurring at the natural barrier to solar wind flow presented by the magnetosphere and at the artificial barriers created by the releases of lithium. Among these are included solar wind retardation, electron heating and plasma wave generation. the ability of the CCE's instrumentation to resolve the composition and charge state of energetic ions has been employed to great effect in analyzing for the first time the composition of the ions, whose motion forms the ring current of the radiation belt.

The UKS is controlled from an operations centre at the Rutherford Appleton Laboratory where data is collected using as 12-m antenna at Chilton and a 26-m antenna at Chilbolton depending primarily on the range of the spacecraft. During each typically 5-hour period of data acquisition the measurements being made at the spacecraft are displayed as line plots and colour spectrograms in readily assimilated form. This facility represents what is in effect a "window" through which events taking place in the highly variable medium being traversed by the spacecraft may be viewed. It permits the highly versatile instruments to be operated fully interactively as though in the laboratory and helps to ensure that each pass of the satellite is used to best effect. Full data sets are forwarded to the experimental groups in the form of magnetic tapes while summaries of key parameters are distributed throughout the AMPTE project as line plots, spectrographs and computer files.

Those interested in observing the UKS spacecraft in operation should please contact Mrs Ruth Jeans (tel 0235 21900 ext 5572).

D A Bryant
November 1984
Rutherford Appleton Laboratory

Reprinted from Nature, Vol. 312, No. 5995, p. 594, 13 December 1984

Magnetosphere

First success for a space mission and a comet for Christmas

from D.J. Southwood and D.A. Bryant

THE first active phase of the Active Magneto-spheric Particle Tracer Explorers (AMPTE) space mission is successfully accomplished. On 11 September 1984 and again on 20 September, lithium ions were released in the solar wind immediately upstream from the terrestrial magnetosphere, some 110,000 km from the Earth's surface. At a meeting of the AMPTE science team on 25–27 October at the Applied Physics Laboratory in Laurel, Maryland, the data from the releases were assimilated and cross comparisons were made between the three spacecraft involved in the mission.

AMPTE is a joint project of the United States, West Germany and Britain. Each national team has provided a spacecraft. The US Charge Composition Explorer (CCE) carries a comprehensive set of instrumentation to detect the mass and charge composition of the terrestrial ionized environment, the magnetosphere. Its task is to monitor whether test ions released by the German Ion Release Module (IRM) can penetrate to its orbit. The IRM is also fully instrumented to make plasma and field measurements. The third spacecraft is the British subsatellite, UKS, added to the programme at the behest of the German team, who recognized that the actual pick-up of the release ions by the surrounding plasma posed a significant scientific problem in its own right. The UKS orbits close to the IRM so that both spacecraft are able to monitor the local effects of the ion releases.

The first result of the release experiment in the solar wind is a null one; the team are convinced that no lithium ions made their way from the release site to the CCE, deep in the magnetosphere. However, no disappointment was evident in the team, in part because of their exhilaration at the unique measurements made by IRM and UKS as the ions were created. In any case, the null result provides an important constraint on our understanding of solar ion access. Furthermore, the quality of the data from the passive measurements made routinely in the mission is so good that inevitably major gains will be made in our knowledge of the Earth's ionized environment and in its interaction with the solar wind.

The lithium releases produced artificial cometary effects. Comparison of IRM and UKS data show that the clouds initially formed a cavity in the solar wind from which the magnetic field was excluded. The scale of the cavity must have been well constrained because in both cases it contained IRM, whereas UKS saw no cavity in one case, and in the other only partial exclusion of the field. The solar wind was slowed and diverted by the obstacle; in the process, the solar wind magnetic field was amplified. Magnetic forces led to the cloud being blown away from the vicinity of the spacecraft. Electron heating accompanied the field compression and the ion detectors recorded the signatures of classic cycloidal motion of the lithium ions as the solar wind picked them up and accelerated them. Further detailed plasma diagnostics were provided by plasma wave instruments. Beam instabilities, attributable to the interaction of lithium ions and solar wind protons, were detected but, during the passage over the spacecraft of the most intense electrical current sheets, no 'anomalous' (wave-induced) electrical resistivity seems to have been present.

Between the active ion-releasing phases of the mission, the three spacecraft make passive measurements of the Earth's ionized outer atmosphere. The measurements made during the magnetic storm of 4 September provide a high point of the mission so far; CCE monitored the build up and decay of a hot plasma 'ring current' about the Earth, and IRM and UKS detected extreme solar wind, bow shock and magnetopause conditions.

The next ion release from IRM is due to take place on 25 December at 12.18 UT. The date was chosen for scientific reasons; the ideal configuration of the spacecraft and the ambient flow, combined with the requirements imposed by the position of viewing sites, constrained the team to two dates, of which Christmas Day is preferred to 27 December. The release will be of barium, which ionizes much faster than lithium, and will be made on the dawn flank of the magnetosphere, just outside the magnetopause. A longer-lasting and more substantial cavity is expected. The prime purpose is to create an artificial 'comet' which will be visible from North America and the eastern Pacific. The comet may be visible to ground observers (and other wise men) on the dawn side of earth for about twenty minutes.

Further releases of barium and lithium are planned for late March 1985. The ions will be released into the tail of the magnetosphere and CCE will be tracing the access of the ions to regions closer to Earth. □

D.J. Southwood is in the Department of Physics, Imperial College, London SW7 2AZ; D.A. Bryant is at the Rutherford Appleton Laboratory, Chilton, Oxon. OX11 0QX, UK.

P R E S S   R E L E A S E

MAN-MADE COMET CREATED

The three AMPTE satellites (Active Magnetospheric Particle Tracer Explorers) achieved another of their major goals on 27 December 1984 by producing an artificial comet. The purpose of the experiment was to simulate under controlled conditions the interaction that takes place between the solar wind and material expelled from the surfaces of comets by solar radiation. The experiment was hugely successful - the comet-like interaction developing as planned and full sets of intriguing measurements being obtained by two spacecraft within the comet and from airborne and ground-based instruments.

At 1232 GMT on 27 December 1984 two canisters that had been ejected 10 minutes earlier from a German spacecraft, the AMPTE Ion Release Module (IRM), exploded to release an expanding cloud of barium atoms 64,000 miles above the Eastern Pacific Ocean. The atoms, 5×10^{24} in number and of total mass 1.25 kg, were ionized within tens of seconds by solar ultra-violet light to be transformed into a plasma of barium ions and electrons. The atoms and ions emitted light which was visible in the dawn sky from the Western USA (Pacific Standard Time 0432). Due to continued cloudy conditions, which had caused an attempt on Christmas Day to be abandoned, the comet was largely obscured from the prime observing sites and the main observations were made by two aircraft.

These showed over a period of some 12 minutes the appearance of a new "star" approximately 140 miles across, with a tail developing to a length of over 7,000 miles, ie more than ten times the angular diameter of the Moon. These events were caused by the expansion of the barium plasma being resisted by the pressure of the solar wind and the magnetic field embedded within the solar wind. The German spacecraft initially at the centre of the cloud and the British spacecraft, the AMPTE-UKS, 100 miles away at the beginning of the event, observed clearly that the flow of the solar wind was impeded so much by the barium cloud that its unusually high speed of more than 1,300,000 mph on the day in question was halved. The magnetic field was expelled from the cloud with a consequent amplification of the field outside. This major interruption of solar wind flow released energy which produced a rich variety of plasma wave oscillations, and a twentyfold increase in the energy of solar-wind electrons. The solar wind that flowed around the edges of the cloud drew away some of the glowing particles to form the visible tail, while the pressure exerted by the solar wind on the front caused the whole phenomenon to accelerate, tail first, downstream. While it was not anticipated that these barium particles released into the solar wind at the down flank of the Earth would eventually penetrate into the radiation belts within the magnetosphere, the American spacecraft, the AMPTE Charge Composition Explorer (CCE), remained alert to the possibility that some particles might enter.

The data from the three spacecraft and the ground and airborne observing sites are currently being intensively examined in order to clarify and refine the initial impressions so that they can be of value in connection with the forthcoming spacecraft investigations of the Giacobini-Zinner comet in 1985 and Halley's comet in 1986.

Meanwhile the AMPTE satellites are setting out on the next phase of their epic journey during which releases of barium and lithium ions will be made in the Earth's magnetosphere which is the source region of the particles that produce the highly intriguing phenomenon of the aurora borealis and australis - the northern and southern lights.

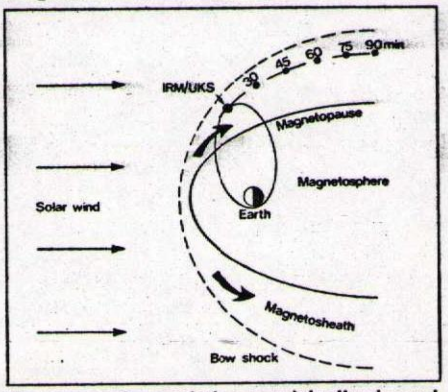
D A Bryant
RAL
31 December 1984

AMPTE

Christmas fireworks a success

THE artificial barium comet released on 27 December (two days later than first planned) as part of the AMPTE mission (Active Magnetospheric Particle Tracer Explorers) seems set to yield much of the information expected of it. Although the conditions for the release were not as expected, two of the AMPTE spacecraft were able to measure the effects both inside and outside the cometary cloud. Moreover there is enough barium left to run the experiment again under different conditions.

The cloud was released by the West German Ion Release Module (IRM). The 1.25 kg of barium, which was quickly photo-ionized, expanded to a diameter of about 250 km, while the tail extended to 11,600 km. At the time of release, a separate spacecraft, the UK Subsatellite (UKS), was about 150 km from IRM. The spacecraft were situated in the magnetized plasma that envelopes the Earth, originating from the Sun and interacting with the geometric field. Once ionized, it was expected that the cloud, being highly conducting, would "expel" the ambient magnetic field. The interest lies not only in this process but also in the way the external magnetic field re-enters the dissipating cavity thus formed, as well the electromagnetic process occurring near the cloud boundary and the overall behaviour of the ion cloud.



The comet release mission as originally planned (see text). The positions of the cloud as it is pushed downstream to the nightside are marked.

Preliminary indications are that the experiment was a success. Both spacecraft observed intensification of the ambient magnetic field by up to a factor of six or more, and IRM observed a drop in the interior field down to the noise level. The speed of the solar plasma was about 2 million km per hour, but this was halved near the cloud. A large variety of plasma oscillations was observed and the energy of electrons in the solar wind rose from 10eV to 1 KeV. The solar wind flowed around the cloud, drawing particles away to form the tail, while the pressure on the front caused the cloud to accelerate downstream.

The positions of both spacecraft relative to the comet were not as originally planned. At their height (100,000 km above the Pacific) and position at the dawn flank of the Sun-Earth reference frame, they were expected to be within the magnetosheath (see figure). This is the region of plasma flow immediately downstream of the "bow shock" where the supersonic solar wind is first affected by the geomagnetic field. But the experiment has highlighted the extremely variable position of the bow shock. At the time of the experiment it was much closer to the Earth than anticipated and both spacecraft became enveloped in the supersonic solar wind, to the detriment of the UKS's proximity to the cometary tail. However, both spacecraft measured significant effects; furthermore the flow conditions are "cleaner" in the solar wind than in the magnetosheath, and the repeat experiment (perhaps in June) should be all the more valuable as a result. **Philip Campbell**

~~Ask~~

*STOP PRESS. We have today been unable to establish contact with the spacecraft! The many possible reasons for this and remedies are being urgently explored. Will keep you advised.

AMPTE — Latest position and plans.

The "artificial comet" was produced highly successfully on 27 December as described in SERC Press Notice 85/1 and in the press (including Nature). It also appeared on TV (both channels). A Joint Science Working Group meeting will be held at MPE 31 Jan – 2 Feb to discuss the results and to complete joint papers on the September 1984 lithium releases. All systems are working well* (apart from the radar transponder on the IRM, for which tracking has proved an admirable substitute). The reluctance of the wave experiment to start has grown no worse and is routinely coped with by around 20 mins heating and has no impact on the science.

The orbit is precessing (in the Geocentric, Solar, Ecliptic frame of reference) into the tail of the magnetosphere. There are still some grazing crossings of the magnetopause though no solar wind entries.

At the UK Science Team of 21 January we shall discuss, among other topics, our future general strategy which takes into account the finite lifetime of the battery and other components and our main priorities. Now that we have a considerable quantity of valuable data already obtained the main priorities will be I feel to ensure that we can cover the 2 lithium and 2 barium releases in the magnetotail in the Spring, to explore the plasma sheet and tail lobes at the same time, and to remain in good shape for a second comet currently being considered for July 1985. The large-separation studies should begin shortly after this. In order not to overstress the spacecraft we may decide to revert to something like the original plan of one science pass per orbit. While one wouldn't like to have done this at the beginning of the satellite's life, it would seem sensible now to bank more heavily on the future.

A particularly testing time will come in February when the spacecraft will need to survive long eclipses.

We are doing our best to draw up a proposal to continue operations beyond the agreed 15 months which ends in November 85. We are aiming for the lowest possible level of resources that will enable us to coordinate studies with VIKING, due for launch in September 85, and GIOTTO. Another 6 months would be about right. I am sorry that we have been unable to develop plans and a proposal for this earlier.

We are, and have been for some time, distributing the summary data plots to our experimenters and the US and German control centres according to plan. We do not yet have any in return.

I hope these notes are useful

Duncan Bryant
16 Jan 85.

AMPTE file

RUTHERFORD APPLETON LABORATORY

Internal Memorandum

To: Dr J E Harries

From: R F Turner
R25

Ext: 6433

Date: 18 January 1985

cc: Dr G Manning
Dr P Williams
Dr A H Gabriel
Mr P J Barker
Dr E Dunford
Dr D Bryant
Mr A Rogers

AMPTE UKS LOSS OF COMMUNICATION

1. At the start of the observing period on Jan 16 at 0230 hrs routine commands sent to turn on the UKS spacecraft transmitter were unsuccessful. This situation still remains.

2. Termination of the previous pass at 0857 hrs on Jan 15 was entirely nominal with no sign of distress in any system.

3. Actions since then have centred around checking the ground system, using the Deep Space Network via Goldstone, attempting to command the second spacecraft transmitter on and conducting ground transmissions in a frequency sweeping mode in the event that some stages of the spacecraft receiver were inoperable.

4. We now await the event which may occur in the early hours of Monday Jan 21 when a preset time has elapsed since the last successful communication.

   At this point if the spacecraft has not received commands a stored command switches the back up transmitter on.

Ray Turner

Rutherford Appleton Laboratory

Internal Memorandum

N33/1 (10-81)

To: DR J. E. HARRIES

From: R. F. TURNER

Date: 21. JAN. 85

Ext: 6433

c.c. DR G MANNING
DR P WILLIAMS
DR A H GABRIEL
MR P J BARKER
DR E DUNFORD
MR A ROGERS.

AMPTE – UKS

1. WE HAVE NOT REGAINED COMMUNICATION.

2. AT 0140 THIS MORNING AN ONBOARD SWITCH WAS DUE TO SWITCH TO THE SECOND RECEIVER. WHEN WE CAME OUT OF ECLIPSE AT 0340 WITH VISIBILITY ON CHILTON, ATTEMPTS AT COMMUNICATION WERE NOT SUCCESSFULL.

3. A FURTHER ATTEMPT AT A HIGHER POWER IS PLANNED FOR 1400 – 1700 HRS TODAY USING THE DEEP SPACE NETWORK.

Ray Turner

AMPTE UK Satellite

After some 5 months of faultless operation of the AMPTE UKS, the UK Operations Control Centre (UKOCC) at Rutherford Appleton Laboratory (RAL) failed to acquire signal from the UKS at the start of pass 83 on 16 January 1985. The spacecraft had been operating normally up to the end of the previous pass with no hint of any impending problem. Extensive checks of ground equipment and operating procedures eliminated any fault in UKOCC, and in the following days various means, including the use of NASA's Deep Space Network (DSN), were adopted to try to re-establish communication with UKS, but without success. The UKS spacecraft engineering team are currently continuing urgent efforts to examine and implement strategies which might help to determine and circumvent what is believed to be an electronics problem on board the satellite. It is nevertheless possible that the mission of the UKS has terminated prematurely.

Notwithstanding this failure, the UKS has been an outstanding scientific success, enabling UK scientists to add a very important extra dimension to the world's first studies of injections of tracer particles into the solar wind. Fortunately, early in the mission the decision was taken to operate the spacecraft and its instruments twice as frequently as had been planned and, as a result, some 70% of the original aims have been achieved and a total scientific return very close to that originally envisaged has been obtained. Even at this early stage of data analysis we can recognise a number of major achievements:-

* The UKS has pioneered a direct interactive mode of operation which has been remarkably effective in achieving prompt data interpretation and rapid distribution of the scientific data to university groups. Direct consequences of this mode of operation are new discoveries such as the existence of local field nulls in the solar wind as well as within the magnetopause.

* The creation of artificial comets by injections of tracer particles into the solar wind have allowed the first-ever studies in-situ of the processes at work controlling the growth and dispersion of ionised atoms in a natural plasma. Cometary effects have been directly observed. In particular during the December barium release the UKS positioning allowed the direct detection of the magnetic field draping, long believed to occur in comets and which is central to tail formation.

* Studies of magnetohydrodynamic non-linear processes occurring in natural plasmas have achieved unprecedently high space and time resolution during traversals of different regions of the solar wind, the Earth's bow shock, magnetosheath, magnetopause and outer magnetosphere on the dayside and dawn flank of the Earth. The data set provides an enormous resource for future elucidation of these processes.

* The combined data obtained from UKS and its German and American counterpart spacecraft will also considerably extend our understanding of processes of fundamental importance throughout the universe, for example, those that form collisionless shock regions, and which give rise to magnetic reconnection of field lines by virtue of the multipoint measurements.

* The performance of the UKS instrument complement has demonstrated that UK scientists hold a word-class position in developing sensitive state-of-the-art instrumentation capable of making measurements of the three-dimensional distribution of ions and electrons, of electromagnetic wave activity, of wave-particle interactions and magnetic fields. This success holds great promise for UK involvement in future missions by the European Space Agency and others.

The probable loss of the UKS at this stage is disappointing but full attention will now be focused, earlier than would otherwise have been possible, on the analysis and interpretation of the very substantial set of results. It is too soon to attempt to evaluate fully the very great scientific gains that will stem from the mission, though a highly significant factor that has already emerged is the remarkable similarity between events triggered by the particles injected into the solar wind and the phenomena created by natural obstacles in the Solar System such as magnetized and unmagnetized planets and comets. The AMPTE UKS has been a major milestone in UK scientists' efforts to understand the mysteries of the far from empty space between the Earth and the sun.

25 January 1985

serc
1965-1985
SCIENCE AND ENGINEERING RESEARCH COUNCIL
Polaris House
North Star Avenue
Swindon SN2 1ET
Telephone 0793 26222
Telex 449466

PRESS NOTICE

OPERATIONAL PROBLEM WITH THE UK AMPTE SATELLITE 5 February 1985

The UK satellite (UKS) of the Active Magnetospheric Particle Tracer Explorers (AMPTE) mission has developed a problem after five months of faultless operation, in which about 70 per cent. of the science has already been obtained.

On 16 January the Operations Control Centre at SERC's Rutherford Appleton Laboratory in Oxfordshire lost contact with the satellite, which until then had been functioning normally. Extensive checks of ground equipment and operating procedures eliminated the possibility of this problem being due to a fault at the ground station and in the following days various means, including the use of NASA's Deep Space Network, were used to try to re-establish communication with UKS, but so far these efforts have been unsuccessful. The spacecraft engineering team is continuing to examine and implement strategies which may help to determine and circumvent what is believed to be an electronics problem on board the satellite. It is nevertheless possible that the UKS mission has terminated prematurely.

Even so, the UKS has been an outstanding scientific success, enabling UK scientists to add an extra dimension to the world's first studies of injections of tracer particles into the solar wind (the stream of ions and electrons which flow from the Sun). Early in the mission, it was decided to operate the spacecraft instruments twice as frequently as had been planned, and as a result about 70 per cent. of the original aims have been achieved, and a total scientific return very close to that originally envisaged has been obtained. The UKS was designed and built at low cost and in record time when the development of the two other spacecraft of the AMPTE mission was well under way. Such a performance from an essentially high-risk venture is a credit to the satellite design and construction teams at Rutherford Appleton Laboratory and the Mullard Space Science Laboratory of University College London, and the scientific groups which provided the on-board instrumentation.

Sir John Kingman FRS

Chairman

SCIENCE AND ENGINEERING RESEARCH COUNCIL

Polaris House
North Star Avenue
Swindon
SN2 1ET

Telephone 0793 26222
Telex 449466

Dr J E Harries
Rutherford Appleton Laboratory
Chilton
Didcot
Oxon
OX11 0QX

Our Ref: SP/278/03

11 February 1985

Dear John,

Thank you for your letter of 29 January, even though it contained confirmation of the disappointing news regarding AMPTE.

Nevertheless, the account of the mission, attached to your letter, shows just how successful the project had already been. I am sure that you are right that whether or not you regain contact, the AMPTE UKS has been a major milestone in understanding the region between the Earth and the sun. The project is a great credit to you and all of your project team, many congratulations on the remarkable results which have been achieved.

Yours sincerely,

John

→ ED, DAB

For circulation to AMPTE project & science teams, along with my own congratulations on this recognition

JEH 22/2/85

SR 22/2

Rutherford Appleton Laboratory

Internal Memorandum

N33/1 (10-81)

To: SEE LIST (LAST PAGE)

From: RAY TURNER

Ext: 6433

Date: 6 MAR 85

AMPTE – FURTHER ATTEMPTS TO ESTABLISH CONTACT.

1. ATTACHED IS A CURVE SHOWING ECLIPSE DURATION IN THE NEAR FUTURE.

THE ⊗ MARKS INDICATE THE THREE FURTHER ATTEMPTS WHICH I PROPOSE THAT WE SHOULD MAKE.

THESE ARE (FROM JOCKS NOTE):–

Nº 1	13th MARCH	1750Z – 2150Z
Nº 2	26th MARCH	1540Z – 1940Z (MAY BE PARTIALLY USED BY IRAS)
Nº 3	MAY–JUNE – NOT YET FIXED.	

2 THE CRITERIA I HAVE USED ARE:

(a) EXTREMES OF ECLIPSE DURATION.

(b) AVOIDANCE OF UNSOCIAL HOURS AS FAR AS POSSIBLE.

3 JOCK WILL ORGANISE OPPS SUPPORT (INC CHILBOLTON)

4 ENGINEER SUPPORT WILL BE DRAWN FROM T EDWARDS N ANGOLD M COOK D. PARKER & A. O'HEA. I AM HAPPY FOR ONLY TWO OR THREE TO GET INVOLVED PROVIDING ALL ASPECTS ARE ADEQUATELY SUPPORTED

5. PRIMARILY WE WILL LOOK FOR TRANSPONDER SIGNALS AND THEN FOR TRANSMITTER ON SEQUENCE.

Rutherford Appleton Laboratory

Internal Memorandum N33/1 (10-81)

To: From: Ext:

Date:

6 A MODIFIED VERSION OF THE PROCEDURE BELOW WILL BE ISSUED.

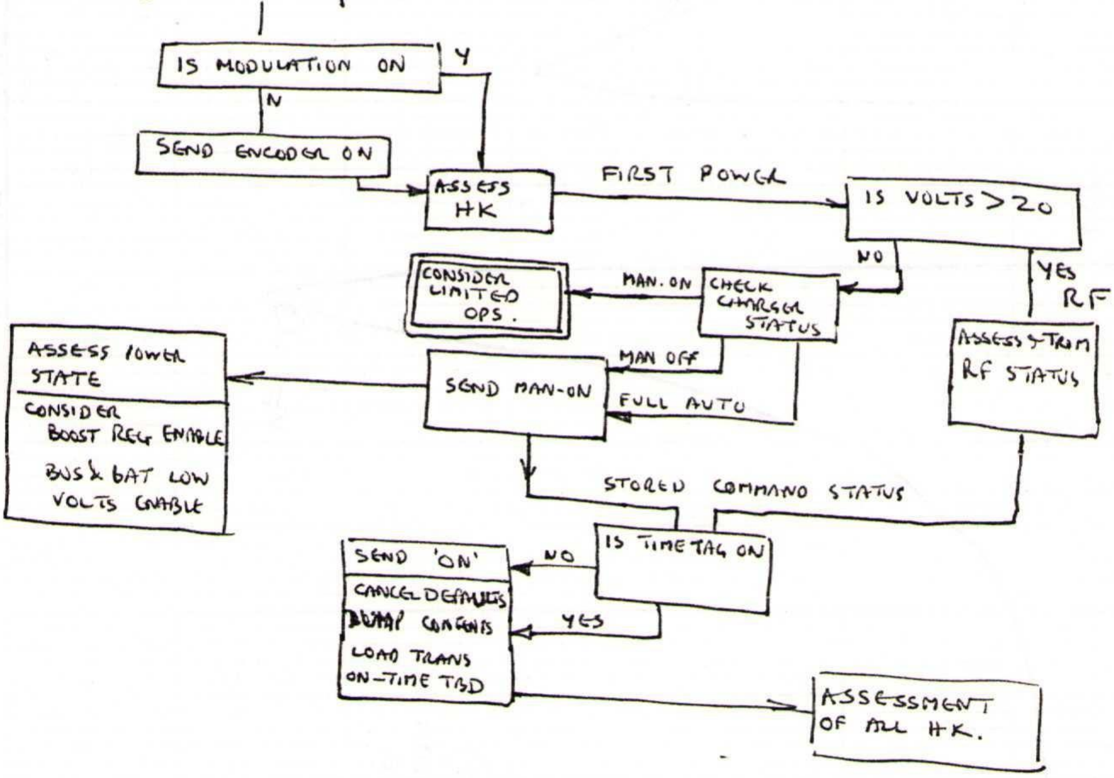
A. Establish next pass timings so that any Time Tag memory activity can be programmed.

B. All systems people available.

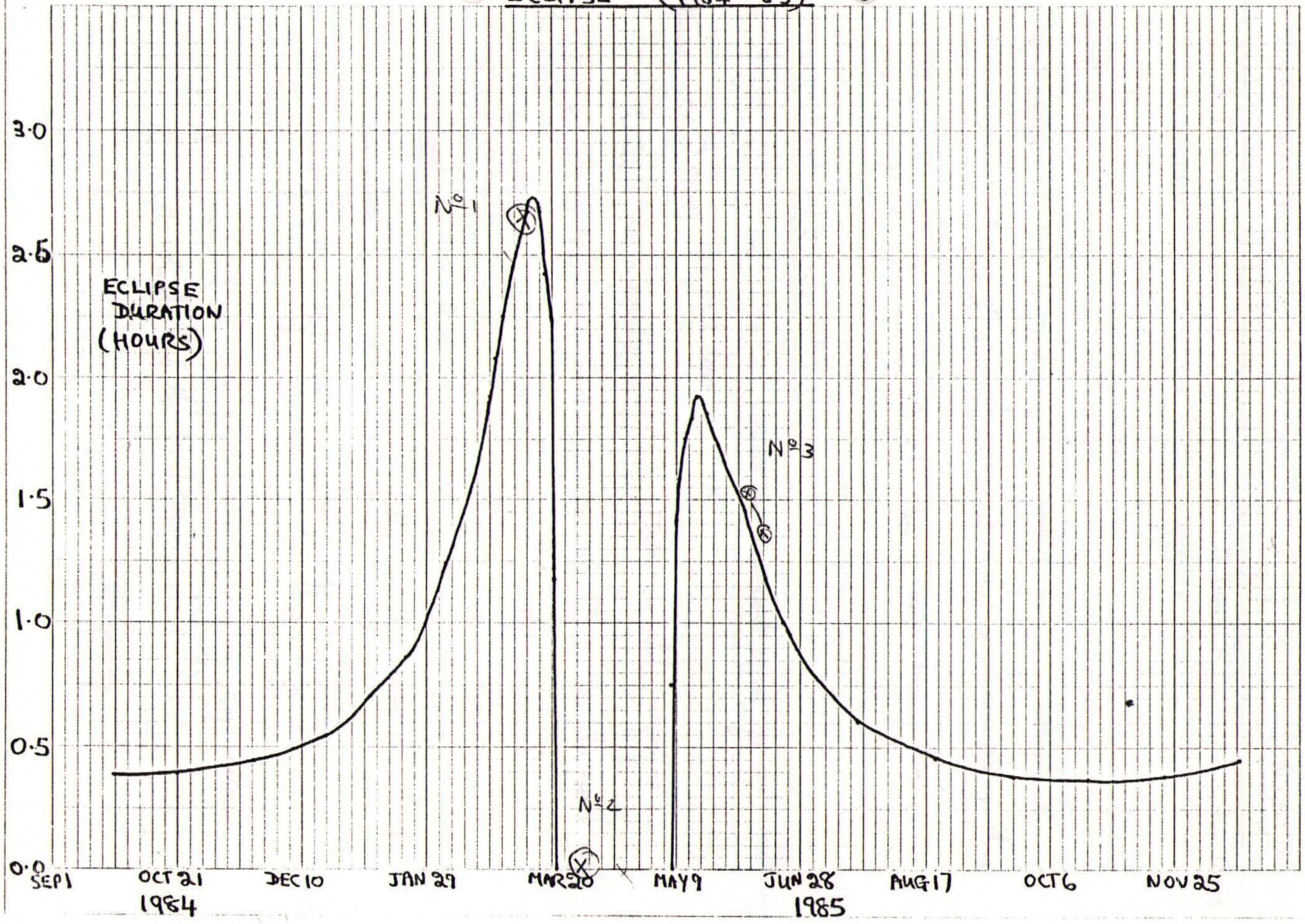
C. Recorders on?

D Try to raise spacecraft – (i) TRANSPONDER FIRST
(ii) TRANSMITTER.

E We get a signal



AMPTE - UKS : DURATION OF ECLIPSE (1984 - 85)



NASA

National Aeronautics and
Space Administration

Washington, D.C.
20546

Reply to Attn of: EES

MAY 8 1985

Dr. John E. Harries
Science and Engineering Research Council
Rutherford Appleton Laboratory
Chilton, Didcot
Oxfordshire, OX110QX
United Kingdom

Dear Dr. Harries: John

It is my understanding that it has now been over three months since you have had contact with the United Kingdom Subsatellite (UKS) and that it is not expected that additional useful data will be received. I am very sorry to learn of the unfortunate circumstance since UKS had been such a great contributor to the Active Magnetospheric Particle Tracer Explorers (AMPTE) project.

I hope that the British scientists will be able to continue to participate scientifically in the AMPTE project. The British participation to date has been very important for the high level of scientific return from AMPTE, not just for the data returned from UKS but also because of the physical insight and expertness in magnetospheric processes that they bring to the joint AMPTE science team. In addition, the work of the British optical observers, under the direction of Dr. David Rees of the University College, London, was extremely important and quite possibly critical in the success of the artificial comet experiment.

It is my understanding that UKS provided a wealth of data during its lifetime, much more than had been originally expected. It is a credit to the Science and Engineering Research Council and all of the institutions involved in UKS that you were able to produce such a scientifically fruitful spacecraft in such a short time, with such severely constrained weight and volume limits.

I want to thank you for your continuing participation in the AMPTE project. I look forward to many more such fruitful collaborations in the future.

Sincerely,

Bert

B. I. Edelson
Associate Administrator for
Space Science and Applications

Copy to all members of RAL AMPTE team, + heads of AMPTE university groups, with my congratulations.
John Harries 22/5/85.

✓ SR 23/5

Science and Engineering Research Council
RUTHERFORD APPLETON LABORATORY

SPACE AND ASTROPHYSICS DIVISION

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Extension: 5593
Direct Dial: 0235 44 5593

To: Dr D A Bryant and
Professor J L Culhane

31 May 1985

Dear

AMPTE UKS OPERATIONS : PROPOSED TERMINATION

Attempts, on 14 July 1985, to resume communication with AMPTE UKS having been unsuccessful, formal termination of the operations phase has been recommended by Ray Turner (Spacecraft Manager) and Alan Rogers (Operations Manager). Dr Harries is prepared to accept this recommendation subject to concurrence by the UK AMPTE Project Scientist and Professor Culhane.

In the event that Jim Bowles' ongoing examination of the receiver and associated circuitry results in a feasible alternative means of commanding UKS, it would still be possible to set up a trial run until the end of July 1985. The latter would, however, entail prior establishment of UKS orbital elements which, in itself, is a significant imposition on US Agencies which we would not want to invoke again unless it could be well justified.

May we please have your agreement to formal termination of operations on 30 June 1985 with the proviso that it will still be possible to respond, before 31 July 1985, to a recommendation from Jim Bowles.

Yours sincerely

PJB.

P J Barker
Head, Projects Group

cc: Dr J E Harries
Dr A H Gabriel
Mr A J Rogers
Mr F R Turner

Rutherford Appleton Laboratory

Internal Memorandum

N33/1 (10/81)

To: Mr P J Barker - R25

From: D A Bryant - R25

Ext: 6515

Date: 12 June 1985

AMPTE UKS OPERATIONS : PROPOSED TERMINATION

Following consultation yesterday with the UK AMPTE Science Team I hereby agree with your proposal to terminate formally UKS spacecraft operations on 30 June 1985, with the proviso that it will still be possible to respond before 31 July 1985 to any recommendation that Jim Bowles is able to make.

We understand that termination of spacecraft operations will not prejudice in any way the data processing now well in hand.

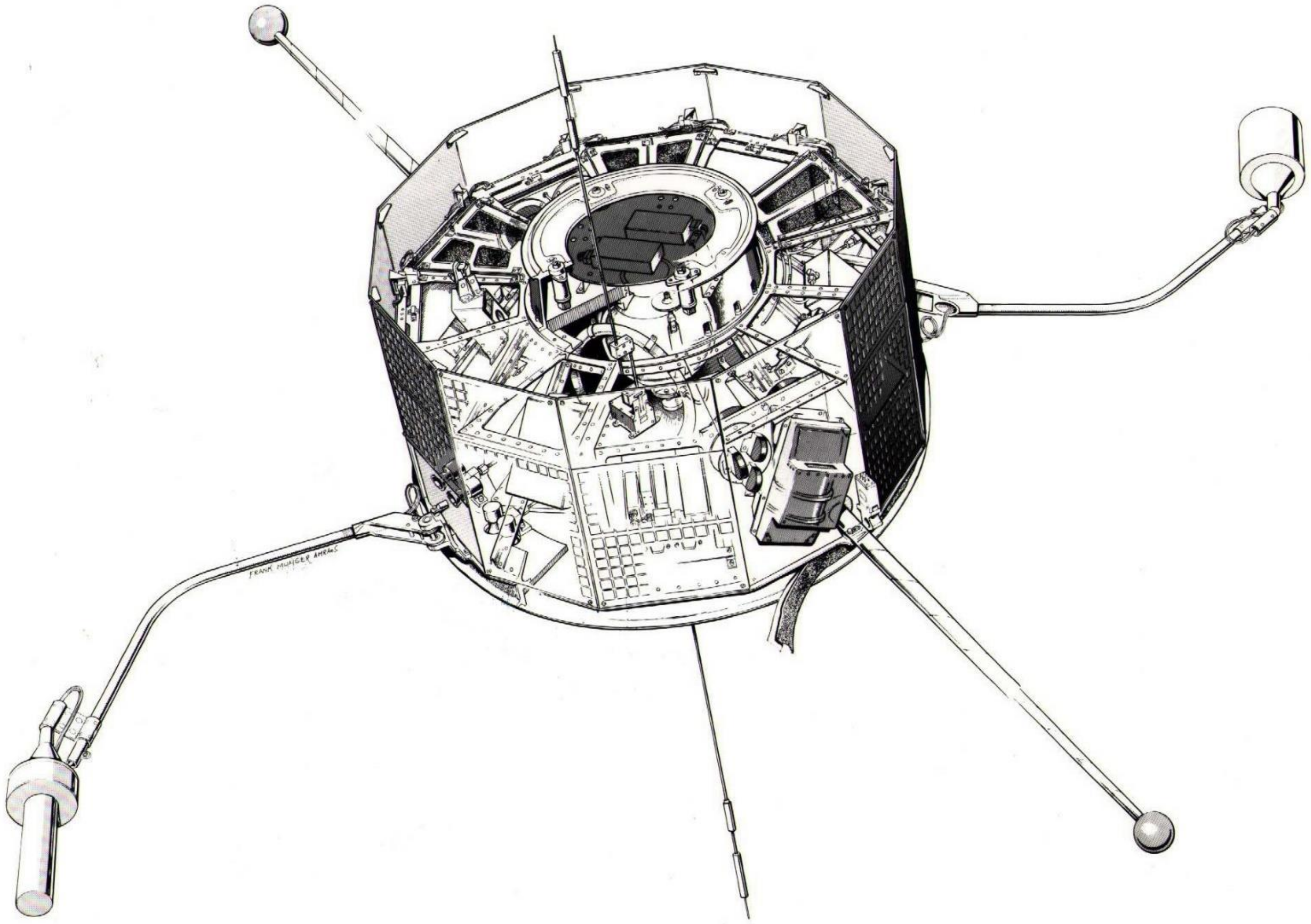
I should add, and this is a measure of the very high regard felt by the Science Team for the efficient and effective way the operations have been handled at RAL, that the Team urged that, if at all possible, the capability of responding to similar opportunities in the future should be retained.

May I again thank you and your colleagues for their truly magnificent support during UKS operations.

Duncan Bryant.

cc: Professor L Culhane - MSSL

Dr J E Harries
Dr A H Gabriel
Mr A J Rogers
Mr R F Turner



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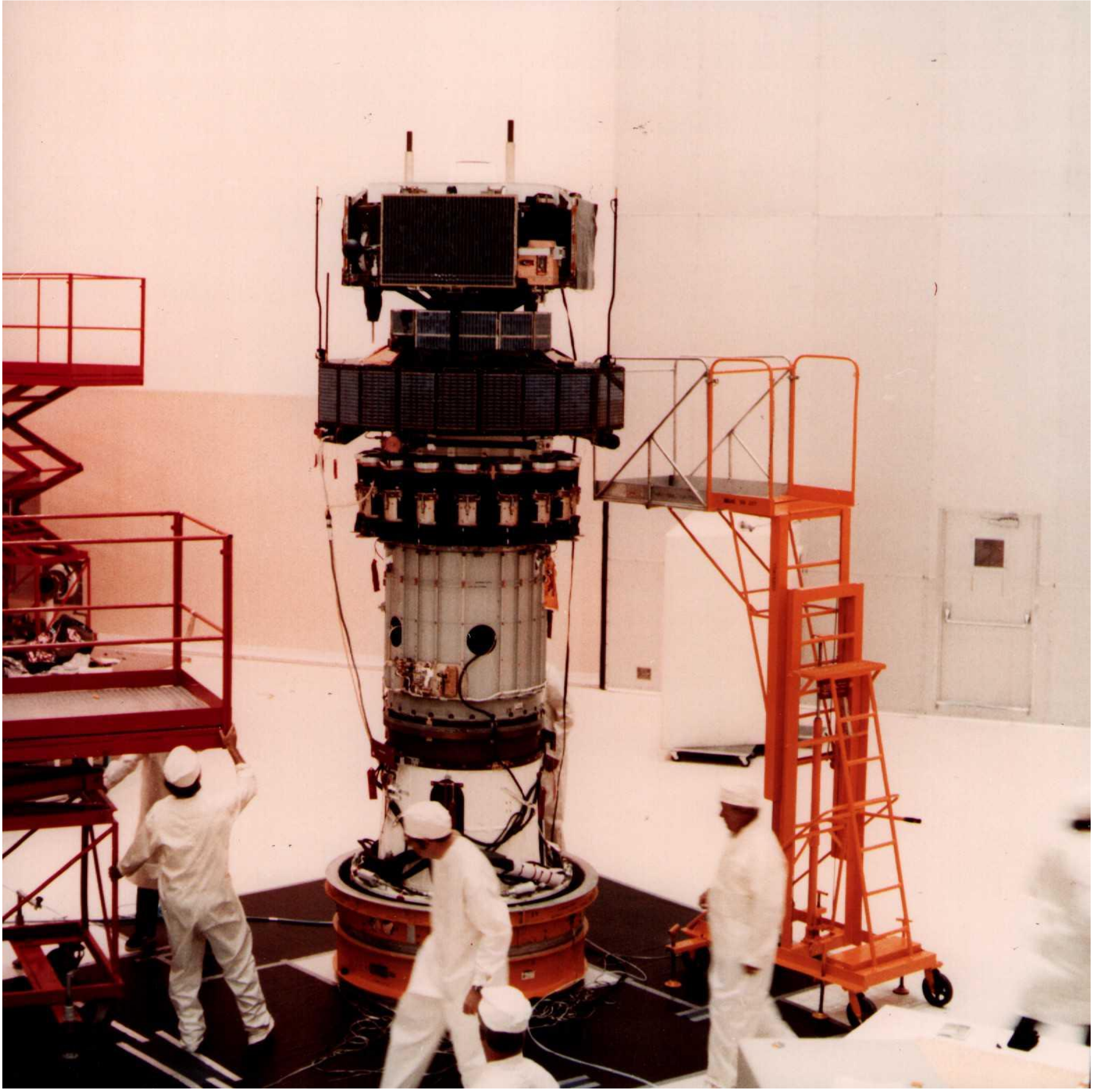

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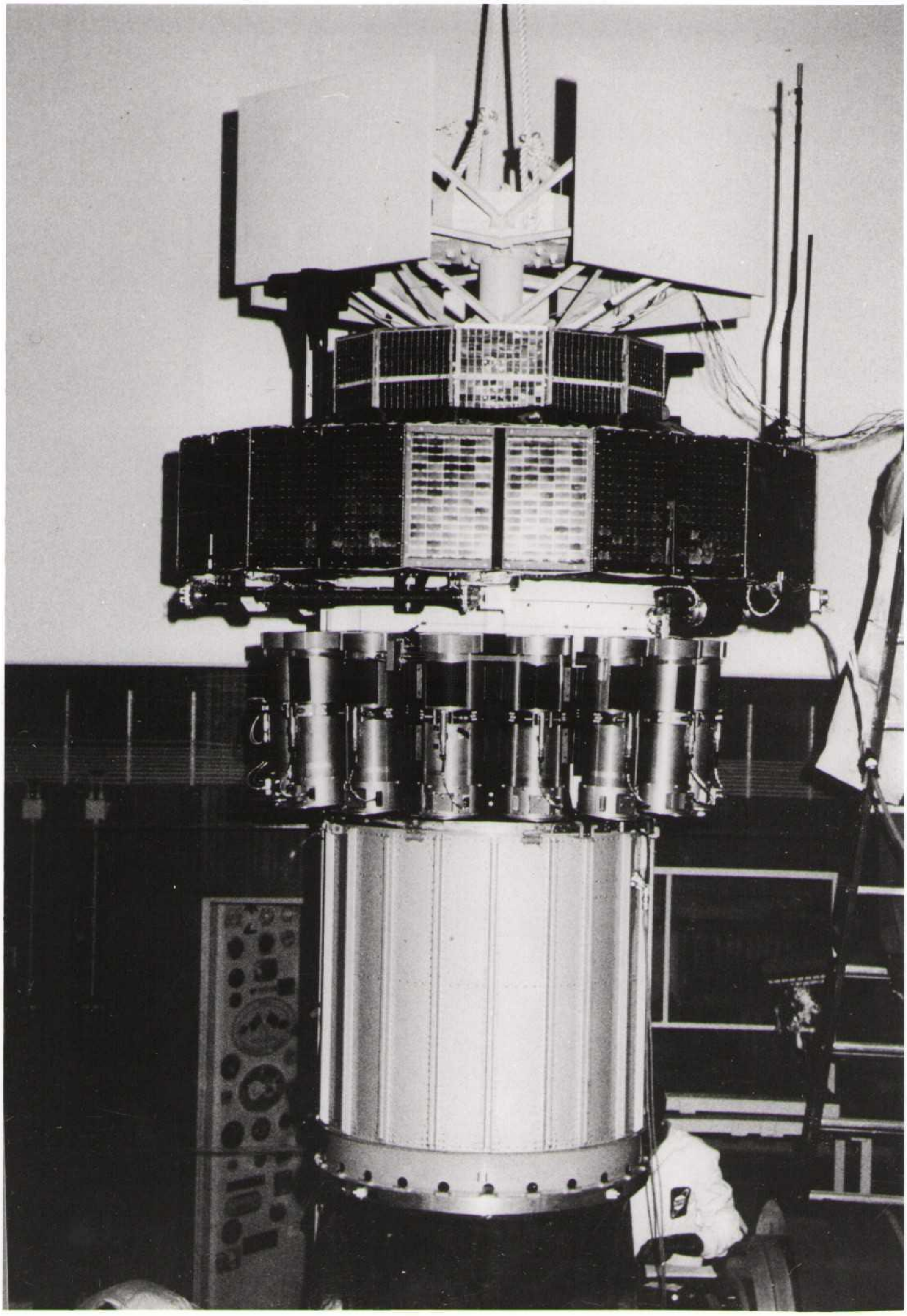

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