Solar Physics and Solar Terrestrial Physics STFC Consultation ad-hoc Advisory Panel Report to PPAN

Michael Thompson, Chair

14 May 2008

Contents

Executive Summary

This is the report of the ad-hoc panel convened to consider community inputs to the Programmatic Review of those projects in the areas of Solar Physics and Solar Terrestrial Physics. The principal points of our report are as follows.

1. The Panel has many misgivings about the Programmatic Review (Section 2). In particular, our opinion is that the community consultation process should have taken place before the PPAN / PALS / Science Board recommendations of priorities were made. We are concerned too that the Programmatic Review has taken place without PPAN having in place a supporting advisory structure or an up-to-date strategy for the whole of STFC science.
2. We are concerned that our field, which is already a small fraction of the budget, has taken a disproportionately large hit. Compared to many other STFC-supported fields, Solar and STP are inexpensive and provide excellent value for money in terms of science output and engaging the public interest in STFC science (Section 2).
3. On the timescale of the next six to eight years, Hinode/EIS and STEREO/HI have the highest priority for UK solar physics, with Hinode/EIS likely to attract the larger user base. To reflect this, their ranking should be amended to high, and funding continued subject to successful review, as is normal (Sections 4.5, 4.8).
4. On the longer timescale Solar Orbiter has the highest priority for the solar physics community. It is therefore hard to understand why this mission is not at the top of the Medium-High category, if not higher. We recommend that it be moved up accordingly (Section 4.7).
5. We recommend that BiSON should be removed from the Programmatic Review. It is not a facility, and will be reviewed within the Astronomy rolling grant programme (Section 4.1).
6. We recommend that both SOHO/CDS and Cluster be supported at existing levels until at least the end of 2009 (Sections 4.2, 4.6).
7. We recommend that STFC clarifies with EISCAT the legal status of its option to withdraw on 31 December 2011; and that STFC conducts a more complete and accountable review of the project involving consultation with other stakeholders including NERC, Government (DEFRA, MoD, FCO), the international STP community, and EISCAT itself to consider wider national interests and alternative options for support (Section 4.6).
8. STFC should consider its policy for the long-term protection and curation of datasets, in order that the strategic value of the UKSSDC can be properly assessed. If STFC believes that expensively acquired datasets have value, and that it has a responsibility for their protection, it needs to properly fund a facility such as the UKSSDC. However, in its current incarnation, the UKSSDC is under-funded and is unable to provide a comprehensive service for all such datasets (Section 4.9).
9. We urge STFC to restore within its programme the strategic priorities for STP articulated by the PPARC Solar System Advisory Panel (Section 3.2).

1 Introduction

The Solar and Solar Terrestrial Physics ad-hoc Panel was assigned the set of projects relating to solar physics and STP in which STFC is involved (BiSON, Cluster, EISCAT, Hinode/EIS, SOHO/CDS, Solar Orbiter, STEREO/HI, UKSSDC). The Panel regarded its task firstly to synthesize the community responses, in response to STFC's invitation for inputs, to the initial ranking of these projects by PPAN, and to embed these within its own recommendations for this area of the STFC programme. Secondly there were many aspects of the community input that related to the review process in general, and the Panel sought to present a constructive set of comments and recommendations on STFC review and advisory structures. Some commentary about the Panel's working procedures are presented in Annexe B.

2 General Comments

There are a number of general comments that we wish to make.

- The Panel has many misgivings about the Programmatic Review process. In particular, the community consultation process should have taken place before the PPAN / PALS / Science Board recommendations of priorities were made.
- The feedback to project PIs is largely generic and unspecific: this is totally uninformative for the community in framing its inputs to the consultation process.
- We are also concerned that PPAN made its decisions without a supporting advisory structure or an up-to-date and homogenous written strategy for STFC science: the strategy documents specifically given to PPAN in support of its work were piecemeal and did not, for example, include the latest Solar System strategy document (2006) drawn up by PPARC's Solar System Advisory Panel in consultation with its communities. Without any deliberate bias, therefore, we feel that PPAN members may have been most strongly supportive of those science areas about which they had most information. We cannot otherwise understand the overall very low priority afforded to solar physics and STP (our highest ranked project, Solar Orbiter, was only 34th in the ranked list, even though this is the top priority for the solar community in the next ten years; and every other solar and STP project reviewed was in the bottom two priority categories).
- Whilst we support an emphasis placed upon new projects, there seems to be no articulated strategy for the balance in the STFC programme between new build and exploitation of existing facilities.
- We are concerned that our field, which is already a small fraction of the budget (3.9% of requested funds) has taken a disproportionately large hit. Compared to many other STFC-supported fields, Solar and STP are inexpensive and provide excellent value for money in terms of science output and engaging the public interest in STFC science.
- The responses from the international community indicate a mismatch between international perception of the scientific worth and standing of UK Solar and STP and PPAN's perception. Our international standing is reflected in the 2005 PPARC/EPSRC-sponsored 'International Perceptions of UK Research in Physics and Astronomy' review which stated that "UK researchers have an exceptionally strong standing in solar physics as well as space-based and ground-based space physics".
- We are concerned about inadequate consultation in the review process with all stakeholders, including other research councils and international partners. This is of particular concern with regard to STP: STFC's negotiation problems with GEMINI are paralleled with its interactions with EISCAT.
- In considering the future of whole areas, and in negotiating with other parties, STFC must exert proper stewardship for fields it has hitherto accepted as part of its scientific programme. It should prioritise the successful handover of programmes to other stakeholders, if that is the appropriate course of action.
- In the case of ESA programmes, such as Solar Orbiter, STFC should aim to fund the UK hardware contributions to a level commensurate with our relative national contribution to the ESA science programme.

3 Overview by Area

Before reviewing individual projects we believe it is useful to contextualise those with a brief overview of the Solar Physics and STP areas. A general point to make is that STP and Solar Physics make high-resolution studies of astrophysical plasma processes that are ubiquitous across the universe. There is growing interdisciplinary interest in exploiting this common interest in cosmic plasmas - as evidenced by several joint sessions at the 2008 National As-

tronomy Meeting and strong support for sessions at future meetings. This provides further evidence of the need for a strong solar physics and STP element in STFC strategy.

3.1 Solar Physics

The major thrust of solar physics in the UK, and worldwide, is to understand our star's magnetic nature. The Sun's magnetic energy, though a small fraction of its radiant energy, utterly dominates its observed behaviour at all wavelengths and on timescales from milliseconds to hundreds of years (and longer). It determines the structure and evolution of the heliosphere and influences the magnetised, and in some cases also the unmagnetised, environments of the planetary bodies within it. Particularly since the 1995 launch of SOHO, the operation of a 'super-observatory' of missions and instruments with freely-available data and an almost universal analysis software structure, coupled with increasing computing power, has seen rapid advances in solar physics observations, theory, and the dialogue between them. Solar physics provides extremely detailed observational ground truths for its physical theories.

Major missions are being planned by the international community, with an emphasis on two main topics: (1) understanding why the Sun is magnetic (helioseismology and surface / atmospheric vector field measurements); and (2) understanding how the Sun produces and influences the heliosphere (solar wind, interplanetary field and non-thermal particles). In an exercise carried out in August 2006, the UK solar physics community identified its own top mission priorities. Under the assumptions that existing missions and facilities (SOHO, BiSON) would continue and that the then yet-to-be-launched Hinode/EIS and STEREO/HI would be funded throughout their intended mission lifetimes, the two top priorities identified were for a PI role in a spectrometer or imager on the Solar Orbiter (launch 2015) and post-launch support for the Solar Dynamics Observatory (launch Jan 2009). These address the main questions described above, but neither aspiration has been supported by STFC, leaving the UK solar physics community in a precarious position looking on timescales beyond the next few years.

The STFC-funded UK solar physics community comprises of the order of one hundred academics and RAs/RFs, plus a similar number of PhD students, mostly located in universities. Research interests cover all regions of the Sun, from the interior, probed by helioseismology, to the outer solar wind, studied with interplanetary scintillation. The UK has strengths in both theory (particularly MHD simulations, but with kinetic simulations of plasma processes also a growing area) and observations (particularly space-based UV to X-ray spectroscopy and imaging of magnetic activity), and most research groups involve elements of both. In terms of instrumentation, the UK has particular expertise in developing EUV and X-ray spectrometers for space, which we are now at risk of losing. The 2005 ‘International Perceptions of UK Research in Physics and Astronomy’ review stated that “the UK has a world-leading role in helioseismology, dynamo theory, coronal activity, magnetic reconnection and shock physics, thus covering many of the important aspects of the Sun-Earth connection”.

3.2 Solar Terrestrial Physics

STP concerns all aspects of how the Sun’s particles and magnetic field affect the Earth. It is the only area of STFC-funded astronomy in which both remote sensing and in situ measurements can be combined to understand fully the astrophysical plasma processes that are ubiquitous across the universe. It is also unique in its direct relevance to Society through its environmental influence on satellites, global positioning systems, radio communications, astronauts, airline passengers, and electricity supply networks, collectively known as Space weather.

A substantial international programme for STP is planned for the next decade (see Figure 1) focused on two main areas:

i) Radiation belts and aurora. The energisation of charged particles in magnetic fields is a fundamental unsolved problem of relevance to all astrophysical plasmas. Earth’s radiation belts and aurora provide the only laboratory for comprehensively investigating the potential mechanisms, and are also central to understanding Space weather. The international programme addresses the four essential coupled elements necessary to understand particle energisation and effects within the radiation belts and aurora: source (Themis including a European ground-based instrument network); transport (StormDARN), acceleration (RBSP and Orbitals); and loss (Kuafu and Eiscat-3D “super-observatory”).

ii) Fundamental plasma physics processes and coupling. The interactions between plasma scales are central to the understanding of many fundamental and universal plasma physics processes (collisionless shocks, magnetic reconnection and turbulence) which are themselves important to understanding the causal

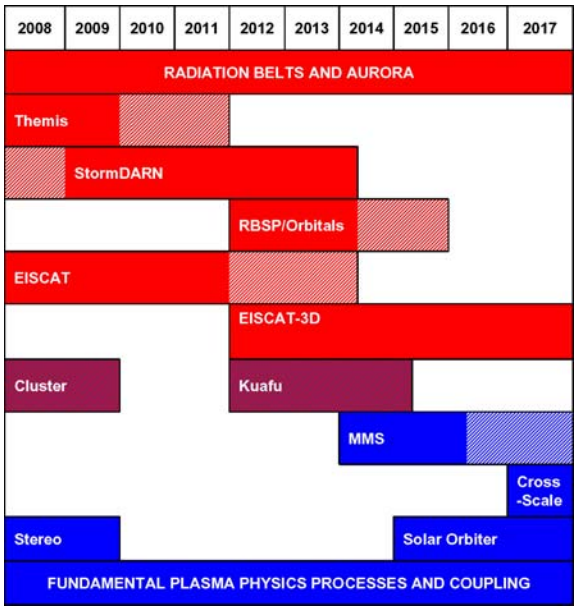

Figure 1: Timeline of the international STP programme.

chain of events between the solar corona and heliosphere/solar wind and between structures

in the solar wind and disturbances to the Earth system. The interactions across scales will be addressed by Cross-Scale (which is a natural follow-on from Cluster and NASA/MMS) and the Sun-Earth chain by Solar Orbiter, STEREO and Kuafu.

UK scientists have excellent opportunities to take leadership (PI) roles in these space missions and ground-based facilities and leverage high-impact results from this programme. A strategy for doing this was developed and published by the PPARC Solar System Advisory Panel in 2006. It identified that there would be a long-term re-alignment of solar system priorities towards the Aurora Programme and the missions laid out in the ESA Cosmic Vision and that consequently science priorities for STP would change and concentrate on 3 overall objectives:

- Involvement in Kua Fu as a precursor to the high-priority Cross-Scale mission proposed under ESA CV.
- Ground-based research to be refocused towards the new opportunities afforded by the international StormDARN initiative….
- …and towards understanding of the solar influences on the atmosphere and particularly on the mesosphere/lower thermosphere boundary through exploitation of EISCAT 3D and associated instrumentation.

The strategy also recommended that PPARC find an effective way of supporting work that bridges the traditional PPARC/NERC divide. The strategy appears not to have been considered (or its existence even recognised) by PPAN in its Programmatic Review, and none of its priorities have been supported by STFC, leaving the UK with no STP programme in the medium term up to 2015 and seriously jeopardising its involvement in Solar Orbiter and Cross-Scale beyond that.

4 Projects

4.1 BiSON

4.1.1 Overview

The Birmingham Solar Oscillation Network (BiSON) is funded as a rolling grant to the University of Birmingham, together with a standard grant to Sheffield Hallam University which funds one PDRA. The network consists of 6 helioseismology telescopes for studying the low-degree modes of oscillation of the Sun. BiSON data are extensively utilised by the BiSON team and by a worldwide community, as they are the highest quality low-degree data available and are key for studies of the solar core.

4.1.2 Synthesis of Community Inputs

There were 73 responses concerning BiSON, including very strong support from the international community. Such a response belies the PPAN impression of a small and low-impact experiment. Respondents stressed the need for maintaining a long and continuous time series for performing helioseismology of the deep solar interior, the uniqueness and world-leading nature of BiSON, the fact that BiSON is able to monitor the *variable* Sun over time, and that the BiSON team's expertise make them not only world-leading in low-degree helioseismology but also potentially leaders in modal analysis in the emergent field of asteroseismology.

4.1.3 Panel Comments

This panel strongly endorses the community comments.

We do not believe that BiSON should have been part of the programmatic review. It is not funded as a facility. It is funded, and to the best of our knowledge has always been funded, as a rolling grant. It is of course appropriate that it be reviewed, but within the context of the Rolling Grant programme. There are certainly other programmes, e.g. SuperWASP, that should have been reviewed if it was appropriate to review BiSON in this way.

That BiSON is different from the facilities considered in the PR is evident from the investigators responses to the questions from PPAN. They detailed the size of the group in Birmingham, the number of PhDs in Birmingham, and so on.

At our request the project has broken down their STFC awards into its different components. This is the source of the costs we quote on the BiSON factsheet (Annexe D): these represent the network operations and we believe are more appropriate than the costs used by PPAN.

4.1.4 Recommendations

This panel recommends that BiSON should be removed from the Programmatic Review. It is not a facility, and will appropriately be reviewed within the Astronomy rolling grant programme.

4.2 Cluster

4.2.1 Overview

Cluster is ESA's four-spacecraft mission to study plasma processes controlling the dynamics of Earth's magnetosphere. Each spacecraft has identical instruments making in-situ measurements of electromagnetic fields, plasma properties, etc). The use of four spacecraft allows the determination of gradients in these parameters in 3D. This gives Cluster the unique capability to fully resolve the spatial and temporal variability of the space plasma environment.

STFC funds PIs roles on 3 instruments plus a key CoI role on a fourth; it also funds the UK node of the Cluster data system and development of key (UK-led) software tools. These activities cost ~£890k pa. ESA operations activities on Cluster cost ~7.5 MEuros pa, of which ~£1.1M may be attributed to the UK subscription. This investment underpins the UK's major science role on Cluster.

4.2.2 Synthesis of Community Inputs

There were 73 inputs concerning Cluster stressing its continuing importance to global progress in space plasma physics and its potential for new results (as recognised by PPAN):

a. Cluster remains unique in its ability to study small and medium scale plasma processes in a quantitative manner. The current use of very different separations between different spacecraft pairs allows 1D sampling of the multi-scale behaviour of plasma processes. This is now a key target, and valuable preparation for the proposed Cross-Scale mission to study 3D multi-scale behaviour.
b. Due to orbital evolution, Cluster will encounter new regions (e.g. auroral acceleration, day-side reconnection & near-Earth plasma sheet regions), revealing new physics during 2008/9. The design of the spacecraft configurations for these targets is complete.
c. There are currently new opportunities for study of global magnetospheric physics through collaboration with NASA's THEMIS mission. Cluster and Themis provide well-instrumented spacecraft at eight or nine well-separated locations.
d. Orbital evolution will take Cluster into the outer radiation belt during 2009, where it is well-equipped for study of plasma waves thought to be responsible for the enhancements of electron fluxes that are a hazard to spacecraft in the geosynchronous and GPS/Galileo orbits. This opportunity occurs ahead of NASAs Radiation Belt Storm Probes mission (2011).

The health and readiness of the mission to address these opportunities was confirmed by a technical review in November 2007 (i.e. after the PR inputs had been submitted). The UK is well-positioned to continue its leading role in exploiting these opportunities.

Responses stress that UK technical leadership is critical to overall mission success. One leading non-UK scientist noted that "*… such cuts would have severe consequences for the international partners in the mission (quite apart from what it would mean to the UK groups directly).*" The responses make it clear that there is world-wide community interest and support for the whole range of UK activities.

The technical role is complemented by a scientific leadership. The UK has excellent scientific productivity from the mission, as shown by both bibliographic data and supportive comments from their international peers. We represent only 13% of the Cluster science community but 20% of the first-authorships on science papers.

4.2.3 Panel Comments

Cluster has well-established opportunities for important new science through to current end of mission in December 2009, some 15 months beyond the current STFC commitment to the UK teams (Sep 2008). Thus the key issue is the level of STFC funding for that period and the obligation to support data delivery to the Cluster Active Archive until Nov 2010. Funding has been refined over the years to focus on instrument operations and data activities critical to delivering the new results. Further cuts will damage the scientific return both to the UK and to the wider international community. The latter has political impact as it involves key partners in Europe, the US, Russia, China and Japan.

4.2.4 Recommendations

1. Given the global significance of Cluster and the critical leadership role of the UK, we recommend that STFC support UK participation in instrument operations at existing levels to end of 2009. We understand the need for economy

but contend that Cluster PLS costs have already been much refined. Thus formulaic cuts are not appropriate. STFC should tension cuts against the potential damage to international science.
2. The unique nature of the Cluster data-set means that it will be an important resource for years to come. We therefore recommend that STFC ensure that the UK teams can support the completion of the Cluster Active Archive, which is currently planned for November 2010.
3. We note that ESA and the Cluster science team are now developing a case for extension of operations beyond Dec 2009. It is premature to comment on that case - but we recommend that STFC give the UK Cluster community a fair opportunity to present it when ready.

4.3 EISCAT

4.3.1 Overview

The European Incoherent Scatter radar facility is the world's leading facility of its type and a central component of the most comprehensive regional network for investigating the ionised and neutral upper atmosphere under both natural and artificially-controlled conditions. Other capabilities include measurements of the solar wind close to the Sun and the monitoring of space debris.
The UK annual subscription of £0.3M (of an annual EISCAT budget of £2.5M) buys >400 experiment-hours of dedicated observing time on the radar and ~2000 experiment-hours of common pre-defined synoptic observing time. In addition, STFC supports the post-processing, distribution and archiving of all available EISCAT data for UK scientists and provides local training and support.

4.3.2 Synthesis of Community Inputs

At least 44 individual or collective submissions from international scientists explicitly highlighted the value of EISCAT and UK involvement in it. Other key points included:
1. In stark contrast to PPAN feedback on its concerns about UK impact, the UK currently supplies the EISCAT Director and two committee Chairs. Since EISCAT's inception, the UK has produced about 32% of its first author papers for 23% of investment. Over 1000 papers mention EISCAT in their title or abstract in the ISI database with an H-index of 41, which is comparable to JCMT (H = 42 but High priority) and Cassini (H = 30 but Medium-High priority).
2. EISCAT science (and STP in general) has developed from an initial discovery of new phenomena into a phase more directed towards mature scientific understanding and knowledge exchange with diverse stakeholders. STFC needs to balance its fundamental astronomy remit with obligations to the wider scientific agenda, Government and other stakeholders.
3. STFC is legally bound to continue paying the EISCAT subscription until at least end 2011 and possibly end 2013. To ensure that this is not wasted, STFC should provide adequate support for exploiting EISCAT through grants.
4. An EU-funded design study of a next-generation EISCAT is underway that would provide entirely new access to the middle atmosphere, as well as improve spatial and temporal resolution by an order of magnitude and include interferometric observations as standard.

4.3.3 Panel Comments

The panel questions what measures of impact were used by PPAN and suggests that impact was not objectively assessed. The STFC PR assessment of EISCAT gave an incomprehensible argument about impact, and inadequate consideration of other stakeholders.

4.3.4 Recommendations

The panel recommends that
1. STFC clarifies with EISCAT the legal status of its option to withdraw on 31 December 2011.
2. STFC conducts a more complete and accountable review of EISCAT involving consultation with other stakeholders including NERC, Government (DEFRA, MoD, FCO), the international STP community, and EISCAT itself to consider wider national interests and alternative options for support.
3. For whatever the duration of the EISCAT subscription, existing grants should continue to be fully supported and assessment of new proposals associated with EISCAT should not be disadvantaged in the STFC review process by a low priority label.

4.4 Ground-based STP

4.4.1 Overview

We include this separate section because STFC explicitly invited community input on ground-based STP. After the consultation period, STFC proposed to reduce the scope to EISCAT alone. Our panel feels that it must report the community opinion that was sought by STFC.

Ground-based observations are an integral part of STP. They involve remote sensing of the upper atmosphere by active & passive techniques at both radio & optical wavelengths. They provide data on the state of the upper atmosphere and the closely coupled magnetosphere. They give a view of the magnetosphere that is different to, and a vital complement to, spacecraft

measurements. The UK has strong involvement giving an excellent return on modest investment (operations costs < £500k/year). The success of the UK ground-based community has been recognised by major awards to leading members. Some of these reflect paradigm shifts in our understanding of magnetospheric physics.

4.4.2 Synthesis of Community Inputs

There were 66 responses concerning ground-based STP. Key issues in the input are:

1. Anomalous treatment of ground-based STP, which is the only item on the PR priority list that is not a specific facility. The PR reviewed EISCAT, but erroneously labelled it ground-based STP. If left uncorrected, the low ranking applied to ground-based STP kills this research area. New ground-based facilities will automatically be given a low score for strategic importance because of the low priority given to EISCAT. Similarly, world-class research & small instrument proposals are doomed by association.

2. High international profile and scientific impact of UK ground-based STP. PPAN's concern about UK profile and scientific impact is incomprehensible. The response of the scientific community and the bibliographic analyses supplied to us all indicate that the UK has high scientific impact and leadership in g-b STP. For example, the Senior Editor of the American Geophysical Union Journal of Geophysical Research-Space Physics, the highest-ranking journal within the field of STP, said, *"I am in an excellent position to judge the quality and quantity of science produced internationally. I cannot understand how this perception of UK STP has arisen. Despite the small size of the UK STP community, their work is highly regarded and highly cited. The UK's contribution to advancements within [STP] arise in large part due to their involvement and leadership in international collaborative experimental efforts such as the SuperDARN and EISCAT radars and Cluster … The UK's expertise in STP is widely recognized, and scientists trained within UK institutions are highly sought after and many now work within the US and Canada. These scientists have been enablers and collaborators of high-quality science throughout the world."*

UK g-b STP science is clearly regarded as world-leading and punches well above its weight.

3. New opportunities. Ground-based STP is developing rapidly at international level: (a) an EU-funded design study for a much more capable incoherent scatter radar, (b) deployment of the new StormDARN radars to focus on the physics of the radiation belts, (c) UK ground-based support sought by NASA & other space agencies to complement future space activities.

4.4.3 Panel Comments

We are impressed by the national and international response to the consultation. Many world-leading scientists took time to contribute – and none can understand why STFC has taken its position against ground-based STP. STFC is out-of-step with international scientific opinion.

Much work in STP lies at boundaries, e.g. between STFC and other stakeholders. The STP community is exploring these boundaries, e.g. how work on coupling between space and atmosphere can be co-funded by STFC and NERC. We welcome those steps.

We note the growing support for an STP super-observatory at Svalbard; this would form part of the SAIEOS project which has been scientifically approved by ESFRI and is now awaiting political approval. This will give a major stimulus to STP work in the high Arctic. The UK is well-placed to benefit from this project.

4.4.4 Recommendations

1. We ask that STFC (a) clarify that the lower priority assessment applies only to EISCAT and (b) publicly recognise the high international impact of UK work in ground-based STP.

2. The judging of new proposals in any research area should never be influenced by the low priority of an existing facility – the low priority applies to the facility not the subject area. We strongly recommend that STFC undertake to properly consider g-b STP proposals that link with new science opportunities.

3. We urge STFC to ensure that its strategy identifies and encompass where there is exciting science at the boundaries of its remit. We contend that much new work in STP is exactly that and recommend that STFC engage with the community to develop strategy in these areas.

4.5 Hinode/EIS

4.5.1 Overview

The Extreme ultraviolet Imaging Spectrometer (EIS) is a UK-led solar imaging spectrometer on the Japanese-led Hinode mission, launched in September 2006. The UK was invited by the Japanese to build EIS, which will be the only solar EUV spectrometer in operation once SOHO/CDS is decommissioned. EIS provides plasma spectroscopy, required to discover the physical state (temperature, density, flow speeds and turbulent speeds, abundances) of the solar plasma, which cannot be learned by imaging alone. Its design takes advantage of spectral diagnostics for high temperature plasmas unavailable to CDS.

4.5.2 Synthesis of Community Inputs

There were 49 responses concerning Hinode. The input reflected the fact that Hinode overall, and EIS in particular, are vital for UK solar physics. EIS spectroscopic observations are essential in their own right, and as a core part of multi-instrument observing campaigns. Data became generally available only in May 2007 and only 3 months prior to the PR input, accounting for an apparently low publication rate at that stage. There have now been three journal special issues, and 34 post-launch EIS science publications, including in press. Furthermore, the publication rate is increasing.

4.5.3 Panel Comments

Hinode/EIS significantly improves on other solar EUV spectrometers in terms of spectral, spatial and temporal resolution. It is already producing world-beating science, with a healthy and accelerating publication rate. Its spectroscopic data are crucial to understanding the solar upper atmosphere. The solar cycle will rise over the next few years, and with it many new opportunities for Hinode observations. Although at present Hinode is operating on its backup antenna with increased ground-station coverage to ameliorate the loss in data rate, it is the top international solar physics mission at present, and failure to support it would seriously jeopardise the UK's high standing in solar physics.

4.5.4 Recommendations

The minimum level of action should be to place Hinode/EIS in a separate category 'too early to assess'. However, the panel feel it should be assigned a 'high' ranking, reflecting its actual importance to UK solar physics. Hinode's PLS funding should continue at the awarded level until at least the previously agreed renewal date. Proposals for EIS data exploitation must not be adversely affected by EIS's former ranking.

4.6 SOHO/CDS

4.6.1 Overview

SOHO is a joint ESA/NASA mission launched in 1995 to study the Sun. The UK has played a major role by providing one of the main instruments, the Coronal Diagnostic Spectrometer. CDS provides spectroscopy at temperatures from 30,000K to a few million K. It is the only spectrometer observing the transition region plasma. Of all the instruments available, CDS is often thought of as the tool-box that provides the physical context of the other observations.

4.6.2 Synthesis of Community Inputs

Inputs were received from 48 respondents. The input stresses the major role that CDS, in particular, and SOHO, in general, has played in understanding the Sun and its atmosphere. The Sun is a variable star and continued observations are essential to fully understand its evolution over at least one complete solar cycle. Some of the main points are listed below.

(1) SOHO has been extended by NASA and ESA until the end of 2009, with possible further reduced operations for 2010-2014. CDS is fully operational with its operations and data analysis techniques well understood. There is a definite end to the mission; support is not open-ended.

(2) CDS is the only space spectrometer covering the entire chromospheric to coronal spectral region.

(3) CDS spectra can be used to calibrate SDO's Atmospheric Imager Assembly narrow band filter images (as it did previously for the TRACE narrowband images).

(4) There are 50 to 60 papers published each year using CDS data (700 in total), with no obvious sign of this decreasing. This represents exceptionally good value for PLS money.

(5) Due in part to its well-designed software and interface, CDS data has been widely used (over 15 UK institutes, and many more worldwide, including traditional theory groups.)

(6) The majority of observations using CDS are part of Joint Observing Programs that utilise an array of different instruments (both space and ground based) to form a super observatory.

4.6.3 Panel Comments

SOHO and CDS have been over whelming successes and continue to be heavily used. The age of the mission can be the only reason it is listed in the "Medium Low" category, as the science achieved, and still being carried out, has been excellent. If SOHO and CDS continue until the end of 2009, we have a unique opportunity of observing a complete solar cycle (in particular the rise of the new cycle) with a single, well-calibrated spectrometer. Studying the entire chromosphere to coronal spectral range is of vital importance in understanding flow of energy through the highly dynamic transition region – including the study of energy propagation by waves (where the UK plays a leading scientific role). This is where CDS excels.

4.6.4 Recommendations

The strategic importance of CDS suggests it should be ranked at least in the Medium-High category and should be funded until December 2009. Thereafter, the status of Hinode/EIS should be folded into decisions on CDS operations.

4.7 Solar Orbiter

4.7.1 Overview

Solar Orbiter is an approved ESA mission and is now also a NASA Sentinel within the 'Living with a Star' program. It will provide in situ measurements of the solar wind and magnetic field in the inner heliosphere (~0.2 AU). It will also get out of the ecliptic plane and provide high-latitude view of the Sun. Both aspects will provide unique insights. The mission is a high priority for the European Solar Physics community and for the Solar Physics community in the UK.

4.7.2 Synthesis of Community Inputs

There were 7 responses concerning Solar Orbiter. That there were relatively few comments is unsurprising given that Solar Orbiter was – uniquely amongst solar and STP projects – placed in one of the top two priority categories. It was pointed out that Solar Orbiter is clearly agreed by the community as its next big flagship mission (Solar Community meeting, Manchester, 2006). As one respondent put it, it is now well appreciated that the Sun-Earth chain is one physical system. Solar Orbiter is therefore very important, and its merging with the NASA sentinels has enhanced the science that will result from it. Solar Orbiter will look at the inner part of the chain (cause and effect between the Sun and the solar wind). The UK needs to support its proposed instrument PIs.

4.7.3 Panel Comments

No doubt there would have been much more comment, and anger, if it had been known, as this panel now knows, that Solar Orbiter is the lowest-ranked project in the Medium-higher category. We cannot understand such a low assessment by PPAN.

4.7.4 Recommendations

Given that this mission has the highest priority for the solar physics community, it is hard to understand why this mission is not at the top of the Medium-High category, if not higher, and we recommend that it be moved up accordingly.

4.8 STEREO

4.8.1 Overview

The unique STEREO mission is studying the Sun and heliosphere from off the Sun-Earth line. It consists of 2 identical spacecraft orbiting the Sun at approximately 1AU, one ahead of and the other trailing the Earth and separating at 22.5 degrees per year. The UK is PI on the Heliospheric Imager (HI). HI provides visible light images of interplanetary coronal mass ejections (ICMEs) and the extended corona/solar wind plus non-solar targets such as asteroseismology and extra-solar planets.

4.8.2 Synthesis of Community Inputs

There were 43 responses concerning STEREO. PR input came 6 months after HI science started, accounting for a low publication rate at that stage. HI's unique and changing vantage point, large field of view and high sensitivity mean that in combination with near-Sun coronagraph and disk images the entire life of a CME can be studied. Interfaced with numerical models, HI observations pin down the 3D structure of ICMEs. HI also provides space weather alerts.

4.8.3 Panel Comments

STEREO/HI has already made several significant discoveries in addition to carrying out its principal science goals of ICME imaging into the far heliosphere. Its post launch costs are very small. As well as the scientific loss, withdrawal would have a very damaging impact on relations with NASA & other partners.

4.8.4 Recommendations

STEREO deserves to be in at least a medium/high category, but could alternatively be classed as 'too early to assess' and reviewed at the end of the 2 year nominal mission in late 2008 (with a view to supporting HI through at least the 4-year mission that will take spacecraft to their optimal separation for ICME imaging). STEREO is not a mission that will go on forever.

4.9 UKSSDC

4.9.1 Overview

UKSSDC is the national archive and data centre for Solar System science, and includes the World Data Centre (WDC) for STP. It provides a data curation and access service, by which unique and irreplaceable data sets and their metadata, which may have been years in acquisition and/or expensively obtained, remain viable and usable in the long-term. The archives of UKSSDC currently include solar, interplanetary, ionospheric and geomagnetic data.

4.9.2 Synthesis of Community Inputs

There were 7 responses concerning the UKSSDC. Respondents commented:

i) That PPAN applied a 'one-size fits all' approach, resulting in the impact of UKSSDC being poorly assessed. Issues include:

a. The UKSSDC is not a 'science facility' per se, but provides a powerful enabling service for UK scientists to access data, and their metadata, potentially many years after the

knowledge resident in the original PI groups has been disbanded. The database access it offers thus underpins high-impact science;
b. UKSSDC provides unrestricted access to its data holdings and has limited ability to record its use and scientific impact, beyond download statistics. Productivity metrics possibly applied to other STFC facilities do not readily apply here;
c. UKSSDC data provides background against which other datasets are more accurately analysed and results correctly interpreted.
ii) The association between UKSSDC and the WDC imposes international obligations. Should UKSSDC be closed down, arrangements for transfer of holdings would need to be negotiated with the International Council of Scientific Unions (ICSU) via the Royal Society.
iii) STFC does not have a ratified formal data policy. Its priority for funding exploitation of current missions misses the potential value of the long-term datasets and of their long-term curation. STFC does not appear to recognise an obligation to take care of the datasets which may have cost PPARC/STFC many millions of pounds to acquire, which are effectively deemed surplus to requirements at the end of a mission.
iv) Decisions endangering the existence of valuable data sets for use by future generations must be very carefully considered. UKSSDC includes unique and irreplaceable datasets and every consideration must be given to 're-housing' should STFC decide to relinquish responsibility for them.

4.9.3 Panel Comments and Recommendations

i) The availability of long-term datasets enables the rapid testing of new ideas without the need for an expensive new mission/facility. This is especially true of STP, in which time-series analysis underpins the discipline and knowledge of conditions at a particular place and time is unique and irreplaceable;
ii) Operation of the UKSSDC is rather ad hoc, and it has an eclectic collection of data, rather than acting as the repository of all data from PPARC/STFC facilities. STFC should decide whether it wishes to discard datasets at the end of missions (or leave it to the vagaries of individual PI institutes to continue to serve these data), or put in place procedures and funding by which these can remain available. UKSSDC could form the core of such an operation;
iii) The STFC should develop a data policy that recognises the importance of century-scale environmental change.

5 Recommendations and Priorities

1. On the timescale of the next six to eight years, **Hinode/EIS** and **STEREO/HI** have the highest priority for UK solar physics, with Hinode/EIS likely to attract the larger user base. To reflect this, their ranking should be amended to high, and funding continued subject to successful review, as is normal. Proposals for exploitation of data from these missions must not be adversely affected by their former ranking.
2. On the longer timescale **Solar Orbiter** has the highest priority for the solar physics community. It is therefore hard to understand why this mission is not at the top of the Medium-High category, if not higher. We recommend that it be moved up accordingly.
3. We recommend that **BiSON** should be removed from the Programmatic Review. It is not a facility, and will be reviewed within the Astronomy rolling grant programme. This recommendation is notwithstanding that BiSON is doing world-leading science.
4. We recommend that **CDS** should be supported until at least the end of 2009.
5. We recommend that the STP community should be entitled to make a case, to be subject to full peer review, for participation in upcoming international programmes and that STFC, NERC and other stakeholders work together to assess the joint priority and strategic importance of this cross-disciplinary science, in line with the recommendations also made by the IUSS select committee.
6. We urge STFC to restore within its programme the strategic priorities for STP articulated by the PPARC Solar System Advisory Panel (Section 3.2).
7. UK groups currently possess expertise in space plasmas technology, instrumentation and data handling which are vital to the science objectives of (possible) future missions, such as Solar Orbiter, Kuafu and Cross-Scale. STFC should seek to preserve this capability. In addition, in the case of ESA programmes, STFC should aim to fund the UK hardware contributions to a level commensurate with our relative national contribution to the ESA science programme. The panel already recognises this as a potential threat to the UK Solar Orbiter involvement, and would hope to see this trend reversed in future.
8. Given the global significance of **Cluster** and the critical leadership role of the UK,

we recommend that STFC support UK participation in instrument operations at existing levels to end of 2009. We understand the need for economy but contend that Cluster PLS costs have already been much refined. Thus formulaic cuts are not appropriate. STFC should tension cuts against the potential damage to international science.

9. The unique nature of the Cluster dataset means that it will be an important resource for years to come. We therefore recommend that STFC ensure that the UK teams can support the completion of the Cluster Active Archive, which is currently planned for November 2010.
10. We note that ESA and the Cluster science team are now developing a case for extension of operations beyond Dec 2009. It is premature to comment on that case - but we recommend that STFC give the UK Cluster community a fair opportunity to present it when ready.
11. We recommend that STFC should clarify with **EISCAT** the legal status of its option to withdraw on 31 December 2011.
12. STFC should conduct a more complete and accountable review of EISCAT involving consultation with other stakeholders including NERC, Government (DEFRA, MoD, FCO), the international STP community, and EISCAT itself to consider wider national interests and alternative options for support.
13. For whatever the duration of the EISCAT subscription, existing grants should continue to be fully supported and assessment of new proposals associated with EISCAT should not be disadvantaged in the STFC review process by a low priority label.
14. We ask that STFC (a) clarify that the lower priority assessment applies only to EISCAT and (b) publicly recognise the high international impact of UK work in **ground-based STP**.
15. The judging of new proposals in any research area should never be influenced by the low priority of an existing facility – the low priority applies to the facility not the subject area. We strongly recommend that STFC undertake to properly consider ground-based STP proposals that link with new science opportunities.
16. We urge STFC to ensure that its strategy identifies and encompass where there is exciting science at the boundaries of its remit. We contend that much new work in STP is exactly that and recommend that STFC engage with the community to develop strategy in these areas.
17. We recommend that outside of the programmatic review, STFC should consider its policy for the long-term protection and curation of datasets, in order that the strategic value of the **UKSSDC** can be properly assessed. Many datasets have been expensively obtained, using STFC funds, over long periods of time, and are unique and irreplaceable. If STFC believes that these assets have value, and that it has a responsibility for their protection, it needs to properly fund a facility such as the UKSSDC. However, in its current incarnation, the UKSSDC is under-funded and is unable to provide a comprehensive service for all such datasets.
18. We are asked to comment on opportunities if an uplift in funds were available. We recommend that uplift should be used to deliver the strategy outlined in the 2006 PPARC Solar System Advisory Panel report. Finally we note again that Solar and STP are inexpensive and provide excellent value for money in terms of science output and engaging the public interest in STFC science: a small uplift in the budget would save all the projects in our area.

A Panel Membership

Michael Thompson (Chair)	Sheffield University	michael.thompson@sheffield.ac.uk
Lyndsay Fletcher	Glasgow University	lyndsay@astro.gla.ac.uk
Mervyn Freeman	BAS	mpf@bas.ac.uk
Mike Hapgood	RAL	m.a.hapgood@rl.ac.uk
Alan Hood	St Andrews University	alan@mcs.st-and.ac.uk
Chris Owen	MSSL	cjo@mssl.ucl.ac.uk

B Panel's Working Methods

All members of the Solar Physics and Solar Terrestrial Physics ad-hoc Panel reviewed all inputs that were within its remit to the community consultation conducted by STFC. The Panel met twice, on April 1st and April 21st. Several institutional conflicts of interest were declared, but the Chair did not consider these amounted to grounds for the individuals concerned to exclude themselves from the discussions. CJO declared a conflict of interest as PI of a proposed instrument suite to be flown on Solar Orbiter, and was absent from the room when Solar Orbiter was discussed. LF and MJT also declared involvement with Solar Orbiter instrumentation not funded by STFC but the Chair did not consider this grounds for them to exclude themselves from the discussion. MPF declared a conflict of interest regarding SuperDARN, as PI of one of the radars, but was not excluded from the discussion of ground-based STP because it dealt with wider issues than just SuperDARN. It was noted that MAH and MPF work for STFC (at RAL) and NERC (at BAS) respectively. The written report was iterated by email and is agreed by all panel members.

Science & Technology Facilities Council

C Terms of Reference

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4 April 2008

Dear colleagues,

Thank you for agreeing to chair an ad-hoc advisory panel to STFC as part of our 2007-8 programmatic review.

Your panels have been set up to provide independent advice to PPAN and PALS, as well as to the Science Board and the STFC executive. The panels will use material generated by the Programmatic Review, and comments received during the consultation.

The information that will be made available to you will be

- The inputs received as part of the consultation process
- The project information made available to PPAN and PALS on your projects
- The financial information made available to PPAN and PALS on your projects
- Feedback from PPAN and PALS on the projects
- Any additional information on the PPAN and PALS rankings which the chairs of these committees agree to provide

The output of your panel should be a report that digests and summarises the community's input, adds your panel's commentary about the prioritisation of the projects and recommends a course of action. This course of action can include adjusting priorities, recommending reductions in funding on some projects to support increases in others, or changes in time scale for projects. Panels are also invited to explain what could be done with a modest increase in funding for their area of science in order to allow us to tension the opportunities that exist in different areas.

Normal rules relating to conflict of interest will apply during your panel's meetings. STFC will cover reasonable expenses relating to the activities of these panels but cannot undertake to provide administrative support.

The panels' reports will be delivered to PPAN or PALS and to the Director, Science Programmes. The panel chairs will make a presentation of the contents of the report to the PPAN or PALS committees. The Science Board will receive the reports together with PPAN and PALS committees' recommendations on the route forward.

The panel reports will be made public after STFC council has considered the recommendations on the future science programme (currently foreseen for 1 July).

Thanks to you all, and to your committee members, for agreeing to help in this process.

With best regards

Yours sincerely

John Womersley
Director, Science Programmes

D Project Factsheets

<table>
<tr><td>Project Name</td><td colspan="3">BiSON</td></tr>
<tr><td>Initial PPAN Ranking: Lower</td><td colspan="3">Summary of PPAN "Feedback": “The ranking reflects PPAN’s concerns about the size of the user base and breadth of the science, though the science itself is recognised to be excellent.”</td></tr>
<tr><td>Project Schedule: Build</td><td>Launch</td><td>Operations</td><td>End of mission</td></tr>
<tr><td>Budget CSR Yr1
£251k (operations)</td><td>Yr2
£251k</td><td>Yr3
£251k</td><td>Yr4-> EOM</td></tr>
<tr><td colspan="2">Number of community responses received</td><td>73</td><td></td></tr>
<tr><td colspan="2">Type of respondents (PIs, teams, PGs, etc.)</td><td colspan="2">PI, UK and international community</td></tr>
<tr><td colspan="4">Community comments: summary of common and salient points
• Need for maintaining a long, continuous time series to study deep solar interior.
• Unique and world-leading.
• Able to monitor the variable Sun over time.
• BiSON team’s expertise make them not only world-leading in low-degree helioseismology but also potentially leaders in modal analysis in the emergent field of asteroseismology.</td></tr>
<tr><td colspan="4">Inter-relationships with other projects (space, ground, theory, etc.) if any
• Complements SOHO/MDI and Solar Dynamics Observatory/HMI (launch Jan. 2009).
• Similar coverage to SOHO/GOLF but BiSON has a much longer time series.</td></tr>
<tr><td colspan="4">Project SWOT Analysis</td></tr>
<tr><td colspan="2">Strengths
• Low-degree coverage of helioseismology giving access to the deep solar core.
• Uniquely long time series over 25 years.</td><td colspan="2">Opportunities
• Study of solar-cycle and decadal variations.
• Superb signal/noise ratio for identifying v. low frequency modes for studying solar core.</td></tr>
<tr><td colspan="2">Weaknesses
• None identified.</td><td colspan="2">Threats
• Cessation of STFC funding is the only one.</td></tr>
<tr><td colspan="4">Panel remarks
This panel strongly endorses the community comments.
We do not believe that BiSON should be part of this review as it is not funded as a facility. It is of course appropriate that it be reviewed, but that should be within the context of the Rolling Grant programme. There are certainly other programmes, e.g. SuperWASP, that should have been reviewed if it was appropriate to review BiSON.
That BiSON is different from the facilities considered in the PR is evident from the responses from the investigators to the questions from PPAN. They responded about the size of the group in Birmingham, the number of PhDs in Birmingham, and so on. (It belies the impression of a small and low-impact experiment that such a large number of international scientists responded to the Consultation in support of BiSON.) This is not an appropriate or fair comparison.</td></tr>
<tr><td colspan="4">Panel recommendations
• Remove BiSON from the Programmatic Review. It is not a facility, and will be reviewed within the Astronomy rolling grant programme.</td></tr>
</table>

<table>
<tr><td>Project Name</td><td colspan="3">Cluster</td></tr>
<tr><td>Initial PPAN Ranking
Medium-lower</td><td colspan="3">Summary of PPAN "Feedback". High impact mission with new results expect. Support is expected to continue at an appropriate level to EOM.</td></tr>
<tr><td>Project Schedule:</td><td>Launch
Jul & Aug 2000</td><td>Operations
Feb 2001-date</td><td>End of mission
Dec 2009: extension case under discussion</td></tr>
<tr><td>Budget CSR Yr1
£890k</td><td>Yr2
£690k</td><td>Yr3
0</td><td>Yr4> EOM
0</td></tr>
<tr><td colspan="2">Number of community responses received</td><td>73</td><td>12 UK
61 International</td></tr>
<tr><td colspan="2">Type of respondents (PIs, teams, PGs, etc.)</td><td colspan="2">9 PIs, 3 teams, 48 CoIs, 13 RAs. Includes key players from US, EU, Russia, China & Japan.</td></tr>
<tr><td colspan="4">Community comments: summary of common and salient points
Cluster remains vital to global progress in space plasma physics:
a. still unique tool to study small & medium scale physics of collisionless plasma processes and to do so in a quantitative manner.
b. many opportunities for new science: (a) orbit evolution will take Cluster to new regions & processes, e.g. auroral acceleration, dayside reconnection, radiation belts & near-Earth plasmasheet, (b) collaboration with NASA THEMIS enables exciting new work on large-scale physics of the magnetosphere. Planning is in place to address these opportunities.
UK technical leadership is absolutely critical to mission success. Reduced UK support will damage science worldwide. UK has excellent scientific productivity from the mission.</td></tr>
<tr><td colspan="4">Inter-relationships with other projects (space, ground, theory, etc.) if any
• works closely with other STP projects on large-scale study of space environment.
• plasma physics theorists exploiting Cluster data to test cutting-edge theory</td></tr>
<tr><td colspan="4">Project SWOT Analysis</td></tr>
<tr><td colspan="2">Strengths
• Spacecraft in good health (review Nov 07)
• Vibrant international team with major UK leadership</td><td colspan="2">Opportunities
• Collaboration with STEREO & THEMIS
• Novel science targets identified for 2008/9; further new potential after Dec 2009</td></tr>
<tr><td colspan="2">Weaknesses
• None identified</td><td colspan="2">Threats
• Cuts to national funding of UK technical leadership will undermine whole mission</td></tr>
<tr><td colspan="4">Panel remarks
Cluster has great opportunities for new science to EOM. Key issue is the level of funding for 15 months operations beyond current STFC commitment (Sep 2008) & support of data delivery to Cluster Active Archive. Funding has been refined over the years to focus on activities critical to delivering the new results. Further cuts have the potential to damage the scientific return both to the UK & worldwide The latter carries a high political impact.</td></tr>
<tr><td colspan="4">Panel recommendations
Support UK participation in operations at close to existing levels to end of 2009. Cluster PLS costs have already been much refined; tension cuts against potential damage to the mission.
Ensure the UK teams can support the completion of Cluster Active Archive.
Give Cluster groups, when ready, opportunity to present case for extension of operations.</td></tr>
</table>

<table>
<tr><td>Project Name</td><td colspan="3">EISCAT</td></tr>
<tr><td>Initial PPAN Ranking
Low</td><td colspan="3">Summary of PPAN "Feedback" Concern about UK involvement and scientific impact. Individual cases for access still considered by AGP</td></tr>
<tr><td>Project Schedule:</td><td>Launch</td><td>Operations
Since 1981 (mainland),
1994 (32 m Svalbard),
1999 (42 m Svalbard)</td><td>End of mission
Unclear.
UK committed until at least Dec 2011</td></tr>
<tr><td>Budget CSR Yr1
£0.14M
(+£0.3M subscription)</td><td>Yr2
£0.14M
(+£0.3M subscription)</td><td>Yr3
£0.14M
(+£0.3M subscription)</td><td>Yr4-> EOM
£0.3M subscription</td></tr>
<tr><td colspan="2">Number of community responses received</td><td>>44</td><td></td></tr>
<tr><td colspan="2">Type of respondents (PIs, teams, PGs, etc.)</td><td colspan="2">Joint PI and UK user community (1), international (>43)</td></tr>
<tr><td colspan="4">Community comments: summary of common and salient points
• world’s leading facility of its type
• incomprehensible and unsupported argument about impact
• inadequate consideration of other stakeholders
• continuing financial commitment to EISCAT
• future new science opportunities from next-generation radar under development</td></tr>
<tr><td colspan="4">Inter-relationships with other projects (space, ground, theory, etc.) if any
• central component of the most comprehensive network of instruments anywhere in the world for investigating both the ionised and neutral components of the upper atmosphere
• complementary to current and future space-based STP missions</td></tr>
<tr><td colspan="4">Project SWOT Analysis</td></tr>
<tr><td colspan="2">Strengths: World’s leading facility of its type, providing the only means anywhere in Europe to measure the density, temperature and velocity of the ionised upper atmosphere between 60 and 1000 km altitude under both natural and artificially-controlled conditions</td><td colspan="2">Opportunities: EU-funded design study of a next-generation EISCAT radar is underway. Novel science targets include global change on the upper atmosphere, Near-Earth Objects, magneto-telluric surveys of the Earth’s crust and radio and radar studies other planets</td></tr>
<tr><td colspan="2">Weaknesses: Assessment of strategic importance complicated: science at STFC/NERC boundary; also of interest to other stakeholders</td><td colspan="2">Threats: STFC has rated EISCAT as low priority and aims to end funding at end 2011.</td></tr>
<tr><td colspan="4">Panel remarks: The Panel endorses the community comments, especially those concerning the inadequate justification of ranking and inadequate consideration of other stakeholders.</td></tr>
<tr><td colspan="4">Panel recommendations
STFC should
1. clarify with EISCAT the legal status of the option to withdraw on 31 December 2011;
2. conduct a complete and accountable review of EISCAT involving consultation with other stakeholders in EISCAT science including NERC, Government (DEFRA, MoD, FCO), EISCAT and its user community; consider wider national interests & alternative options for support.
3. For the duration of UK subscription, existing grants should be fully supported and new grants for scientific exploitation, user support, and supporting instrument operations associated with EISCAT should not be disadvantaged in the STFC review process by any low priority label.</td></tr>
</table>

<table>
<tr><td>Project Name</td><td colspan="3">Ground-based STP</td></tr>
<tr><td>Initial PPAN Lower Priority</td><td colspan="3">Summary of PPAN "Feedback": Concern about UK involvement & science impact. Individual cases for access still considered by AGP</td></tr>
<tr><td>Project Schedule:</td><td>Launch
n/a</td><td>Operations
n/a</td><td>End of mission
n/a</td></tr>
<tr><td>Budget CSR Yr1
£100k (tbc)</td><td>Yr2
£100k (tbc)</td><td>Yr3
0</td><td>Yr4-> EOM
0</td></tr>
<tr><td colspan="2">Number of community responses received</td><td>66</td><td>UK 13
International 53</td></tr>
<tr><td colspan="2">Type of respondents (PIs, teams, PGs, etc.)</td><td colspan="2">3 PIs, 2 teams, 54 CoIs, 7 RAs, includes many leading international scientists</td></tr>
<tr><td colspan="4">Community comments: summary of common and salient points
• Review procedure is anomalous – blights area without making peer review of whole area.
• UK ground-based STP has high international profile and scientific impact so PPAN concern about impact is incomprehensible. Strong bibliographic evidence & international support.
• Exciting opportunities for new science with UK leadership and high impact using new instruments such as ASK, SCANDI and future instruments such as EISCAT-3D and StormDARN.
• UK ground-based capabilities actively sought by international partners – in particular NASA.</td></tr>
<tr><td colspan="4">Inter-relationships with other projects (space, ground, theory, etc.) if any
• Critical engagement with space-based STP missions from ESA, NASA and CNSA
• Strong relationships with international ground-based partners & potential roles in new projects</td></tr>
<tr><td colspan="4">Project SWOT Analysis</td></tr>
<tr><td colspan="2">Strengths
• International recognition as world leaders in ground-based STP
• Strong appeal to young scientists
• Global role in space-ground coordination</td><td colspan="2">Opportunities
• Collaboration with STEREO, THEMIS, RBSP and KuaFu
• Involved in STORMDARN & EISCAT-3D
• Svalbard super-observatory: SAIEOS/ESFRI</td></tr>
<tr><td colspan="2">Weaknesses
• Subject lies at STFC/NERC boundary</td><td colspan="2">Threats
• Current STFC position destablises STP at national, European and world levels.</td></tr>
<tr><td colspan="4">Panel remarks
We were deeply impressed by the response to the consultation. A large number of world-leading scientists took time to contribute – and none of them can understand why STFC has taken its position against ground-based STP. STFC is out-of-step with international scientific opinion.</td></tr>
<tr><td colspan="4">Panel recommendations
STFC should
1. clarify that the lower priority mark applies only to EISCAT;
2. publicly recognise high international impact of UK work in ground-based STP;
3. fully assess and consider new g-b STP proposals to link with new spacecraft missions and other new science opportunities (& where necessary provide bridging funding to keep options open);
4. recognise that STFC strategy must identify & encompass exciting science at boundaries of its remit; STFC should work with the STP community to develop strategy in these areas.</td></tr>
</table>

<table>
<tr><td>Project Name</td><td colspan="3">Hinode/EIS</td></tr>
<tr><td>Initial PPAN Ranking:
Lower</td><td colspan="3">Summary of PPAN "Feedback": PPAN’s main concern was UK impact. They stated that impact was difficult to assess so early. Current PLS will be honoured & reviewed in the future.</td></tr>
<tr><td>Project Schedule:</td><td>Launch
Sept. 2006</td><td>Operations
Started 01/07</td><td>End of mission
Review 09/09</td></tr>
<tr><td>Budget CSR Yr1
£330k</td><td>Yr2
£330k</td><td>Yr3
£330k</td><td>Yr4-> EOM
N/A</td></tr>
<tr><td colspan="2">Number of community responses received</td><td>49 unique responses.</td><td></td></tr>
<tr><td colspan="2">Type of respondents (PIs, teams, PGs, etc.)</td><td colspan="2">PI & ex-PI (2), UK users (17), UK community (21), international (9)</td></tr>
<tr><td colspan="4">Community comments: summary of common and salient points:
Hinode/EIS data opened for general use in May 07, much too soon before the PR input (Sept 07) for its excellence to be reflected in publications;
Hinode/EIS is an extremely high priority for UK/international solar physics;
Hinode/EIS should at minimum be reclassified as ‘too early to assess’</td></tr>
<tr><td colspan="4">Inter-relationships with other projects (space, ground, theory, etc.) if any:
Multiple space- and ground-based instruments working in combination is core to solar physics. Hinode/EIS is in constant use in this way. EIS diagnostics of the plasma state are crucial for meaningful comparisons with theory. Atomic physics & plasma diagnostics theory advance hand-in-hand with solar spectroscopic observations.</td></tr>
<tr><td colspan="4">Project SWOT Analysis</td></tr>
<tr><td colspan="2">Strengths
EIS provides essential diagnostics of the solar plasma, unobtainable by imaging alone. Its capabilities are greatly superior to previous instruments, and it provides entirely new diagnostics for hot plasmas (e.g. flares)</td><td colspan="2">Opportunities
This is a brand new instrument, a core and unique part of an extraordinary solar super-observatory. Solar activity is rising, and with it many new targets for observation and discovery.</td></tr>
<tr><td colspan="2">Weaknesses
None</td><td colspan="2">Threats
Data downlink restricted to low-gain antenna problem (will be resolved in coming months with more downlinks.)</td></tr>
<tr><td colspan="4">Panel remarks
Hinode/EIS is clearly <u>the</u> top priority for current UK solar physics. Publications have increased rapidly since the PR input and EIS is set to have a major impact internationally. The ranking is ill-founded and we are concerned that it will unfairly bias panels against forthcoming grant proposals using Hinode data.</td></tr>
<tr><td colspan="4">Panel recommendations
Hinode/EIS must at least be reclassified as ‘too early to assess’. However, it should be classed as ‘high’, reflecting its actual importance to UK solar physics.</td></tr>
</table>

<table>
<tr><td>Project Name</td><td colspan="3">SOHO/CDS</td></tr>
<tr><td>Initial PPAN Ranking
Medium-lower</td><td colspan="3">Summary of PPAN "Feedback": “The ranking reflected PPAN’s view that this was a high impact mission. It is expected that support will continue at an appropriate level until the end of the project’s lifetime. Although the mission was nearing the end of its lifetime, there was still an opportunity for new results.”</td></tr>
<tr><td>Project Schedule: Build</td><td>Launch
December 1995</td><td>Operations
1995 to date</td><td>End of mission
Dec 2009. Possible reduced support to 2014</td></tr>
<tr><td>Budget CSR Yr1
£300K</td><td>Yr2
£300K</td><td>Yr3
£0K</td><td>Yr4-> EOM</td></tr>
<tr><td colspan="2">Number of community responses received</td><td>48</td><td>24 UK, 24 International</td></tr>
<tr><td colspan="2">Type of respondents (PIs, teams, PGs, etc.)</td><td colspan="2">PI, UK and international community</td></tr>
<tr><td colspan="4">Community comments: summary of common and salient points
• CDS provides unique coverage of transition region temperatures.
• High publication rate, still averaging over 50 papers per year.
• Provides temperature, density, dynamic, ionisation information, elemental abundances.
• CDS will confirm predicted band emission of AIA images from SDO. Hence, a sufficient overlap is extremely important.
• CDS has over 30 active UK users.</td></tr>
<tr><td colspan="4">Inter-relationships with other projects (space, ground, theory, etc.) if any
CDS is used as part of a super solar observatory, with some of the other 11 SOHO instruments, TRACE, STEREO, Hinode and ground-based telescopes. This multi-wavelength approach has been very successful in understanding the physical processes of many solar phenomena.</td></tr>
<tr><td colspan="4">Project SWOT Analysis</td></tr>
<tr><td colspan="2">Strengths
A vital part of multi-wavelength studies: provides detailed plasma diagnostics in a temperature range not covered by current or planned spectrometers and long-term synoptic data on UV irradiance.</td><td colspan="2">Opportunities
Overlap with SDO, in particular, will allow quick calibration of their instruments and enhance the science return. Complementary coverage of EIS.</td></tr>
<tr><td colspan="2">Weaknesses
Over 13 years old.
The hot temperature coverage is now superseded by EIS, which has higher temporal, spectral and spatial resolution.</td><td colspan="2">Threats
The present financial threat: the PPAN view that future lies with Orbiter is true but there is at least a six-year gap between the end of CDS and the start of Orbiter science.</td></tr>
<tr><td colspan="4">Panel remarks
CDS plays an important role in understanding (i) the energy flow form the solar interior to the solar corona, (ii) the energy release mechanism in flares and CMEs, (iii) the propagation of waves into and in the corona. It provides important density and temperature diagnostics.</td></tr>
<tr><td colspan="4">Panel recommendations
CDS has an important role to play in the UK and international effort in Solar Physics. It should definitely be supported at least until the end of 2009.</td></tr>
</table>

<table>
<tr><td>Project Name</td><td colspan="3">Solar Orbiter</td></tr>
<tr><td>Initial PPAN Ranking
Medium-Higher</td><td colspan="3">Summary of PPAN "Feedback": “The ranking reflected the recognition that this project was either currently delivering the highest quality results or was of the highest strategic priority for the future.”</td></tr>
<tr><td>Project Schedule: Build</td><td>Launch
2015</td><td>Operations</td><td>End of mission</td></tr>
<tr><td>Budget CSR Yr1
£700k</td><td>Yr2
£900k</td><td>Yr3
£1.0m</td><td>Yr4-> EOM</td></tr>
<tr><td colspan="2">Number of community responses received</td><td>7</td><td></td></tr>
<tr><td colspan="2">Type of respondents (PIs, teams, PGs, etc.)</td><td colspan="2"></td></tr>
<tr><td colspan="4">Community comments: summary of common and salient points
• Solar Orbiter is clearly agreed by the community as its next big flagship mission (Solar Community meeting, Manchester, 2006).
• It is now well appreciated that the Sun-Earth chain is one physical system. Solar Orbiter is therefore very important, and its merging with the NASA sentinels has enhanced the science that will result from it. Solar Orbiter will look at the inner part of the chain (cause and effect between the Sun and the solar wind).
• The UK needs to support its proposed instrument PIs.</td></tr>
<tr><td colspan="4">Inter-relationships with other projects (space, ground, theory, etc.) if any</td></tr>
<tr><td colspan="4">Project SWOT Analysis</td></tr>
<tr><td colspan="2">Strengths
• In situ measurements in inner heliosphere
• Out-of-ecliptic: high-latitude view of Sun.</td><td colspan="2">Opportunities</td></tr>
<tr><td colspan="2">Weaknesses</td><td colspan="2">Threats</td></tr>
<tr><td colspan="4">Panel remarks
Unsurprisingly given that Solar Orbiter was – uniquely amongst solar and STP projects – placed in one of the top two PR categories – there was relatively little comment on this project amongst respondents to the Solar Physics & Solar Terrestrial Physics Panel. No doubt there would have been much more comment, and anger, if it had been known, as the Panel now knows, that Solar Orbiter is the lowest-ranked project in the Medium-High category. This panel cannot understand this assessment by PPAN.
Solar Orbiter will provide in situ measurements of the solar wind and magnetic field in the inner heliosphere. It will also get out of the ecliptic plane and provide high-latitude view of the Sun. Both aspects will provide unique insights.</td></tr>
<tr><td colspan="4">Panel recommendations
• Given that this mission has the highest priority for the solar physics community, it is hard to understand why this mission is not at the top of the Medium-High category, if not higher, and we ask that it be moved up accordingly.</td></tr>
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<table>
<tr><td>Project Name</td><td colspan="3">STEREO/HI</td></tr>
<tr><td>Initial PPAN Ranking:
Medium/low</td><td colspan="3">Summary of PPAN "Feedback": Potentially a high impact mission but too early to tell; case to be reviewed in due course.</td></tr>
<tr><td>Project Schedule:</td><td>Launch
Oct 2006</td><td>Operations
Started 04/07</td><td>End of mission
04/09 (ext to 04/11)</td></tr>
<tr><td>Budget CSR Yr1
£187k</td><td>Yr2
£187k</td><td>Yr3
£187k</td><td>Yr4-> EOM
N/A</td></tr>
<tr><td colspan="2">Number of community responses received 42 individuals + 1 community</td><td></td><td></td></tr>
<tr><td colspan="2">Type of respondents (PIs, teams, PGs, etc.)</td><td colspan="2">PI (1), UK users (7) UK community (25), international (9) & STP community (1)</td></tr>
<tr><td colspan="4">Community comments: summary of common and salient points:
STEREO/HI data opened for general use in April 07, much too soon before the PR input (Sept 07) for its excellence to be reflected in publications;
STEREO/HI is an extremely high priority for UK/international solar physics;
STEREO/HI addresses several topics – ejections, comets, stellar variability
STEREO/HI should at minimum be reclassified as ‘too early to assess’</td></tr>
<tr><td colspan="4">Inter-relationships with other projects (space, ground, theory, etc.) if any:
The use of multiple space- and ground-based instruments in a ‘super-observatory’ is core to solar and STP. STEREO/HI and other ground and space-based observatories provide complete imaging of interplanetary disturbances from their source on the Sun, out past Mars, and links remote sensing and in-situ CME observations. Is being used for asteroseismology, stellar variability too.</td></tr>
<tr><td colspan="4">Project SWOT Analysis</td></tr>
<tr><td colspan="2">Strengths
Unique STEREO orbit provides entirely new viewpoints; large FOV and high dynamic range, high sensitivity make this a very versatile instrument.</td><td colspan="2">Opportunities
A brand new instrument, a core and unique part of extraordinary super-observatory. Orbit in coming years will give 3D info and space weather alerts.</td></tr>
<tr><td colspan="2">Weaknesses
none</td><td colspan="2">Threats
none</td></tr>
<tr><td colspan="4">Panel remarks
STEREO/HI is clearly a high priority for current UK solar physics. Since the PR input, there have been several papers reporting entirely new types of observation and HI was reportedly the ‘star of the show’ at recent AGU and EGU General Assemblies. The ranking is ill-founded and we are further concerned that it will unfairly bias panels against forthcoming grant proposals using STEREO/HI data.</td></tr>
<tr><td colspan="4">Panel recommendations
STEREO/HI must be removed from the ‘Lower’ category and at minimum be reclassified as ‘too early to assess’ and re-assessed when the mission comes up for review. However, its true importance to UK and international solar/heliospheric physics should be reflected in a ‘high’ ranking.</td></tr>
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<table>
<tr><td>Project Name</td><td colspan="3">UKSSDC</td></tr>
<tr><td>Initial PPAN Ranking:
Medium Lower Priority</td><td colspan="3">Summary of PPAN "Feedback": “The ranking reflected PPAN’s view that the facility did not undertake science directly and thus direct science impact was low. The value of the facility for solar and solar terrestrial physics data access was recognised.”</td></tr>
<tr><td>Project Schedule:</td><td>Launch
Opened 1957</td><td>Operations
1957 to date</td><td>End of mission
N/A</td></tr>
<tr><td>Budget CSR Yr1
£150k</td><td>Yr2
£150k</td><td>Yr3
£150k</td><td>Yr4-> EOM
N/A</td></tr>
<tr><td colspan="2">Number of community responses received</td><td>7</td><td></td></tr>
<tr><td colspan="2">Type of respondents (PIs, teams, PGs, etc.)</td><td colspan="2">PI (1), Community (1, MIST), Users (5).</td></tr>
<tr><td colspan="4">Community comments: summary of common and salient points:
PPANs assessment metrics are inappropriate for UKSSDC and underestimated its value;
The UKSSDC (in particular the associated World Data Centre) are subject to international agreements which need to be factored into any decision to close;
The role of UKSSDC is poorly defined since STFC does not have a formal data policy;
The UKSSDC houses some unique long-term datasets for which special provision should be made so as not to lose them for potential use by future generations.</td></tr>
<tr><td colspan="4">Inter-relationships with other projects (space, ground, theory, etc.) if any: The UKSSDC is a repository and access point for a number of Solar and STP projects (e.g. TRACE, SOHO, STEREO, Ionosondes, etc.) It provides a means for long-term curation of these data and their metadata.</td></tr>
<tr><td colspan="4">Project SWOT Analysis</td></tr>
<tr><td colspan="2">Strengths: Provides long-term guardianship of datasets, ensuring their availability after missions end and PI groups have moved on. An important element in the WDC chain.</td><td colspan="2">Opportunities: Current data holdings are limited, so value of UKSSDC could be enhanced by a drive to include a broader set of data obtained under PPARC/STFC funding.</td></tr>
<tr><td colspan="2">Weaknesses: No clear metric demonstrates the science value of the facility. Not clear how to evaluate it against its competitor facilities. Needs a ratified STFC data policy to clarify its role.</td><td colspan="2">Threats: STFC does not appear to recognise the value of long-term datasets, and hence the value of their proper curation. If STFC assumes that high-impact science is associated with current missions only, the justification for the continued existence of UKSSDC is weakened.</td></tr>
<tr><td colspan="4">Panel remarks
The role and relevance of the UKSSDC would be greatly clarified if STFC had a ratified data policy – does it value the data assets obtained through UK participation in missions or simply consider them expendable once the formal mission is over?
Often Solar/STP science is facilitated, like fields such as climate change, by the analysis of time series data, in which an observation at a particular point and time are unique and irreplaceable. STFC should carefully consider how it might protect the data holdings for use by future generations should it decide to close the UKSSDC.</td></tr>
<tr><td colspan="4">Panel recommendations: Outside of the programmatic review, STFC should consider its policy for the long-term protection and curation of datasets, in order that the strategic value of the UKSSDC can be properly assessed. Many datasets have been expensively obtained, using STFC funds, over long periods of time, and are unique and irreplaceable. If STFC believes that these assets have value, and that it has a responsibility for their protection, it needs to properly fund a facility such as the UKSSDC. However, in its current incarnation, the UKSSDC is underfunded and is unable to provide a comprehensive service for all such datasets.</td></tr>
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