EIS Steering committee reports

February 19, 1999

Matthew Whyndham

Progress reports submitted to the PPARC steering committee for the EIS project.

Contents:

Report 1 - November 98

At present, the project remains in a system definition (breadboarding) stage. Refer to the Gantt chart (overview.MPP).

Some technical progress has been made, mostly in the areas least likely to be affected by the contributions of the US partner, as well as in forming the management structure of the UK teams. However, there is significant difficulty in making substantial progress in the absence of the US partner.

The next major milestone, the Preliminary Design Review, may need to be adjusted to account for the late selection of a US partner. The time of the PDR will have been determined before the next meeting of this committee.

An additional milestone is expected during the next reporting period - a System Requirements Review. The timing of this cannot be decided without the involvement of the US partner.

The remainder of this report details the activities of the MSSL portions of the project, as follows

- Project management WBS 4000
- Systems engineering 2000
- Science 6000
- Focal plane assembly 1700
- Electronics 1A00

There has been no notable activity in other areas.

Project management & Systems engineering

The PM has been active in forming the EIS management plan, which comprises plans for a general project management and a Systems Engineering Management Plan. The former is primarily focused on the establishment of the appropriate interfaces between the participating institutes and the mechanisms for communication of technical information.

The main object of the systems engineering plan is, at present, the formation of an appropriate set of performance requirements for all major EIS subsystems given the overall scientific objectives of the Solar-B mission in general and the EIS consortium in particular.

These plans will continue to evolve over the coming months, and will encompass other topics. To be successful they must have the collaboration of the entire Consortium, including the US partner.

Science

There were two UK consortium meetings during which the scientific goals of the EIS instrument were discussed and refined. An additional meeting was held to focus specifically on EIS Science in the light of the US proposals.

A plan exists to develop the Science goals of the EIS instrument and to compare them with the capabilities of the hardware as the design is developed. A number of observational scenarios have been developed for this purpose.

Focal plane assembly

Very encouraging reports of the performance of EEV's 42 series CCDs have been received. These reports relate to a) quantum efficiency (~80 percent) in the EIS waveband-namely 250 to 300 Angstroms and b) tolerance to a mission equivalent dose of the UV radiation. If these results are characteristic of the flight devices than the scientific value of the instrument will be greatly enhanced and a major source of operational risk will have been substantially ameliorated.

The PM and the newly appointed detector scientist will participate in NAOJ's continuing tests of EEV and other CCDs 9-13 November.

The cooling requirements of the CCD detector must be established soon, in order to feed this information into Birmingham University's thermal design.

It is expected that a breadboard camera will be developed during the next reporting period.

Electronics

Some conceptual design work is being carried out in this area. We, in conjunction with scientists at NAOJ, are considering various architectural concepts relating the experiment electronics to the spacecraft Mission Data Processor. These studies involve both the hardware and software elements of EIS.

Report 2 - February 99 (MSSL)

This report follows the workpackage breakdown for elements 6000 (Science), 1700 (Focal Plane Assembly), 1A00 (Electronics), 2000 (System Engineering) and 4000 (Project Management).

There has been negligible activity in the other workpackages.

Science and General Issues
Inc. WP 6000

The selection of the US partners for the Solar-B instrument teams has now been made. The partner for the EIS team is the group led by George Doschek of the US Naval Research Laboratory (with whom the consortium was associated prior to the pre-selection blackout period). The completion of this important phase means that it has been possible to make much more progress in instrument design.

A consortium meeting was held at NRL in Washington DC in late January with the principal aims of:

- Defining the optical configuration of the instrument

- Selection of a wavelength range or ranges for the spectrometer

In preparation for this meeting, the UK Science Team met to discuss the scientific objectives of the instrument. The possibility of using a wavelength range in the region of 400 Angstroms was felt to be worth pursuit, since some lines associated with the "transition region" conditions of the solar atmosphere would be usefully observed there. The wavelength ranges put forward up to now were seen as being weak in these respects.

It should be recognised though that the use of this wavelength range would depend on a multi-layer technology (based on Silicon/Scandium) that is, at present, relatively immature. It would be dependent moreover on the US team's ability to pursue its development.

Cambridge and RAL prepared a study of the 400-Angstrom range in the same manner as for the established candidate ranges.

It was agreed that the merits of telescope configurations and wavelength ranges could only be assessed if quantitative spectroscopic performance data was available. Therefore both NRL and MSSL produced lists of count-rate for the spectral lines in each of the four candidates ranges, and for each of the two telescope configurations, for quiet Sun, active region, and flare conditions.

In brief, the MSSL and NRL analyses were in partial agreement, with the main differences being due to the way in which solar conditions are modelled rather than to differences in understanding of the instrument technologies.

The two instrument concepts differ in the spatial resolution and throughput. They share the same grating layout and hence have equal spectral resolution. The (NRL) Cassegrain provides 1 arc second pixel images whereas the (NAOJ Baseline) off-axis paraboloid telescope provides approximately 2 arc second pixel images. However, the latter has of the order three times the effective area of the Cassegrain system by virtue of having two reflections on multi-layer surfaces (reflectivity ~30%) as opposed to the Cassegrain's three reflections.

The choice of telescope type and wavelength range is a question of balancing the apparently diverse needs of a range of possible uses for EIS, each having its particular requirements for spatial resolution,

spectroscopic performance and wavelength coverage. This scientific tradeoff is being conducted by the whole consortium, coordinated by MSSL.

The technologies of both concepts are being investigated to find if there are any technological drivers that will influence the choice. Although these feasibility studies are not complete, the main consequences of the choice for the UK hardware teams are clear.

Birmingham University

Can build either type of structure but would prefer Cassegrain because the mass budget is more easily achievable. Symmetry and dynamic behaviour considerations also lead to a preference for the Cassegrain. The thermal control issues may be very different for the two telescope types -this needs further study.

MSSL

If two wavelength ranges are selected, then the probable requirement will be for a larger format imaging device, which would most likely be met by providing two of the baseline CCD's in the focal plane assembly. Depending on the total number of devices delivered, this would increase the cost of the CCD procurement. There would also be a marginal cost increase in the readout electronics and data handling electronics, but the increase power consumption of these would likely be more significant.

The nature of the mechanisms in the Cassegrain and Baseline systems is different, which leads to some differences in the mechanism driver electronics. The impact of this on the MSSL electronics package is uncertain.

RAL

The telescope type choice will affect only the details of the FM AIV procedures. If two wavelength ranges are selected than the effort involved in the end to end calibration may be marginally increased.

The consortium meeting at NRL exposed a good deal of the thinking behind the two concepts but was unable to reach a decision. A PI-level teleconference between the parties is scheduled for 16th February with a suggested date for a decision by 20th February. It has been agreed that the final decision, at least on telescope type, must be made before or during the Solar-B mission kick-off meeting at ISAS in March.

Focal Plane Assembly WP1700

The detector scientist has been active (in consultation with EEV) in determining the properties of the EEV range of CCDs that relate to radiation tolerance. The main factor here is that the value of charge-transfer efficiency is related to operating temperature, clocking rate and is a function of radiation dose. The temperature requirement will affect the instrument thermal design and the clocking rate will limit the cadence of observation.

A breadboard readout electronics system is under development.

Electronics WP1A00

Discussions of the data handling protocols between EIS and spacecraft electronics are continuing at more detailed levels. All specifications are currently tentative. A baseline protocol should be agreed during the March meeting in order to facilitate progress.

Systems Engineering and Project Management WP 2000, 4000

The addition of the NRL group adds considerable systems engineering expertise to the consortium as a whole. The main focus of system engineering activities continues to be with the UK project manager and the system design team (SDT), which will now meet or teleconference regularly.

The SDT will shortly consider a draft interface list for each of the instrument configurations - this will identify each institute sharing that interface.

Before the March meeting, these lists, and the format of the information that will be required for each interface, will have been agreed by all participants. At the meeting, or shortly afterward, each party will be expected to provide data related to each interface characteristic. The interfaces will then be placed under "voluntary" configuration control. This means that changes must be copied to the PM and the other parties sharing the interface, but formal approval need not be sought. The number of such changes should be minimised. At some future date during development, the interfaces will be placed under mandatory configuration control, wherein approval will be required to deviate from an interface characteristic. This future date will be prior to the Preliminary Design Review (and indeed prior to the System Requirements Review if there is one).

The accompanying Gannt chart shows milestones (draft status) for reviews with additional information drawn from the NASA master schedule. I have tentatively placed the Critical Design Review at Nov '00, although I expect this to be subject to discussion at the kick-off meeting.