The Extreme Ultraviolet Spectrometer (EUS) for Solar Orbiter

Financial Plan

Submitted by R.A. Harrison and E.C. Sawyer

on behalf of a consortium including

the Rutherford Appleton Laboratory, UK; the Max Planck Institute for Solar System Research, Germany; the Mullard Space Science Laboratory, UK; CNR – National Institute for the Physics of Matter, Italy; the University of Oslo, Norway; the NASA Goddard Space Flight Center, USA; the Naval Research Laboratory, USA; the Institut d'Astrophysique Spatiale, France; Southwest Research Institute, USA; and the Astronomical Institute of the Academy of Sciences, Czech Republic.

1 General

The EUS consortium will be led by the Rutherford Appleton Laboratory with Prof Richard Harrison as the Principal Investigator and funded in the UK by the Particle Physical and Astronomy Research Council (PPARC) (or its successor organisation). Collaborating groups are listed in the management plan. These would be funded by their own national agencies.

2 Consortium

The following table lists the co-investigator institutions providing major hardware contributions and their role in the EUS project. There are some duplications in this list, which is inevitable at this stage of a project, the final consortium responsibilities will be established when the instrument design is optimised and when the funding situation is clarified.

Organisation	**Lead scientist**	**Likely role**
Rutherford Appleton Laboratory	Prof. Richard Harrison	PI, science team lead Project management System design Thermal design Structure Detectors (option 1) AIV Calibration
Max Planck Institute (MPS)	Dr. Werner Curdt	Electronics On board software Telescope mirror with heat

		rejection system Calibration
Mullard Space Science Laboratory	Prof. Louise Harra	Instrument power supply Main electronics, On-board software Mechanism design and manufacture Filters
University of Oslo	Dr. Viggo Hansteen	Supply of EGSE hardware and software
Goddard Space Flight Centre	Dr. Joe Davilla Dr Roger Thomas	Optical design support Supply of optical components Gratings Detectors (option 2)
CNR-National Institute for the Physics of Matter	Dr. Luca Poletto	Optical design support Supply of optical components Design and supply of mechanisms Support to calibration
Naval Research Laboratory See note 1	TBC	Design and supply of mechanisms
Czech Astronomical Institute	Prof Petr Heinzel	Supply of specific hardware components Software
Southwest Research Institute	Dr. Don Hassler	Electronics Mechanical/thermal design Mechanisms TVLS grating Intensified APS detectors (option 2)
Institut d'Astrophysique Spatiale	Dr. Jean-Claude Vial	Supply of optical components

Note 1: NRL have been very active in the instrument specification and design. They are very keen to participate in the instrument development and production. However, at the present time they are seeking US Department of Defence approval which is required for a formal commitment. Thus, their involvement is to be confirmed. The EUS team expects this to be a temporary situation and we anticipate full involvement from NRL in the instrument development.

3 Support for the heat shield/system study

The following tables provide details of the support available for the heat shield/system study. Note that we make full use of established working groups in particular topical areas within the consortium (see Management Plan).

3.1 Technology development

Activity	**Lead group**	**Support group(s)**	**Resource available Staff years, all groups**
Heat shield thermal analysis and design support	RAL	Thermal/Mechanical working group[1]	0.2
Spacecraft system support	RAL	System working group	0.3
Critical subsystems development			
Heat rejection systems	RAL	MPS + Thermal/Mechanical WG	0.5
Mirror coatings	MPS	Optical WG	0.5
Detectors (APS)	RAL	Detector WG	1.5
Stable structures	RAL	Thermal/Mechanical WG	0.2
Total resource available			3.2

[1] See management plan section 7.2

3.2 Instrument development

Activity	**Lead group**	**Support group**	**Resource available Staff years, All groups**
Science requirements definition	RAL	Science WG	0.2
System design specification	RAL	System WG	0.2
Interface definition			
Thermal Mechanical Optical Electrical	RAL RAL RAL MPS	Thermal/Mechanical WG Optical WG Electronics WG	0.3
Optical design	RAL	Optical WG	0.9
System design	RAL	System WG	0.2
Total resource available			1.8

In addition to the staff effort listed above, we have resources to cover travel to meetings and laboratory equipment etc.

4 ROM estimate for the instrument.

Costings so far have been based on the actual costs to build similar instruments by similar consortia.

The table below represents the resources available to each group based on preliminary discussions with their funding agencies. Detailed costing will be carried out in the study phase.

Group	**Funding agency**	**Funds potentially available.**	**Notes**
RAL MSSL	PPARC	€20M over 8 years plus post launch support	*A significant UK involvement in Solar Orbiter is contained within the PPARC operating plan and is being reviewed.*
MPS	DLR	€4.4M	
CNR-INFM	ASI	€5.5M over 8 years (plus contingency) plus post launch support	
GSFC NRL SWRI	NASA	€10M TBC	*Rough estimate of potentially available funds.*
IAS	CNES	€3M TBC	
Oslo	NRC	€3M TBC	
Czech Astron. Inst		€3M TBC	*€60k available per year for 3 years plus anticipated contribution beyond that, TBC*

Anticipated Total ROM Cost of EUS Build	**€30M**

The total ROM cost of the EUS instrument build is an estimate based on previous experience, taking the above figures into account and noting that the instrument design needs to be optimised to confirm the contribution of each institute and country, and noting that the funding situation of each contributor is yet to be clarified through the detailed proposal and peer review.

We anticipate instrument operations which utilise the successful experiences of the CDS and SUMER teams on SOHO, i.e. regular planning and individual teams providing commands to a deferred command store for the science operations, combined with routine health monitoring and data processing. A dedicated EUS operations facility will interface to the ESA spacecraft operations centre as required. Such plans have been included in discussions with PPARC and other agencies (some are indicated above) and are included in financial operating plans. The actual costs must be established as the spacecraft operations concept becomes clearer. These costs are over and above those listed in the table above.