

CROSS-SCALE TRS

MISSION OBJECTIVES

Planetary Exploration Studies Section (SCI-AP)
Science Payload and Advanced Concepts Office (SCI-A)



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1 INTRODUCTION

The Cross-scale TRS is one of ESA's Technology Reference Studies (TRS, see also <http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=33170>). The purpose of the TRSs is to provide a focus for the development of strategically important technologies that are of likely relevance for future scientific missions. This is accomplished through the study of several technologically demanding and scientifically interesting missions, which are not part of the ESA science programme. The TRSs subsequently act as a reference for possible future technology development activities. The TRSs will not interfere with (or replace) the standard ESA mission selection process.

The purpose of this mission objective document is to provide a global overview of the Cross-scale TRS. It provides a set of broad statements (mission statement/objectives/constraints/trade-off priorities). The statements are primarily qualitative in order to maximize the flexibility of the mission design. Each objective and constraint, given in this document, is quantified and detailed in either the science priority document or the mission requirements document. The quantitative requirements and constraints in the science priorities and mission requirements documents are subject to trades, the qualitative statements in this document are not¹.

The document is (currently) an open document and regular updates, primarily refinements, are expected. Particularly, iterative steps with industrial study partners and the TRS study manager are foreseen.

2 APPLICABLE DOCUMENTS

The mission objective document is one of the documents that constitute the complete mission profile for the Cross-scale TRS. The current list of applicable mission documents is:

CS Mission Objectives	SCI-A/2005/072/CS/MvdB	AD_MOD
CS Mission Requirements	SCI-A/2005/073/CS/MvdB	AD_MRD
CS Payload resources	SCI-A/2005/077/CS/MvdB	AD_PLR

The following documents contain general requirements for Technology Reference Studies:

Margin Philosophy for SCI-A Studies	SCI-A/2003.302/AA	AD_MARGIN
CDF Model Input Specification	CDF-IFS-001	AD_CDF
<i>Including associated CDF Model Input Excel sheets:</i>		
Mission	CDF-IFS- 001a Mission Issue2 Rev3.xls	
Entry element	CDF-IFS-001b Entry Element Issue2 Rev3.xls	

¹ Unless the statement is TBC.

3 MISSION STATEMENT

The objective of the Cross-scale Technology Reference Study is to:

Establish a feasible mission profile for a cost-efficient investigation in near-Earth space of fundamental plasma processes that involve coupling across multiple length scales

More specifically, the study profile shall:

- *Optimize the scientific return of in-situ multi-dimensional space plasma exploration*
- *Establish the feasibility of a cost-efficient mission concept*
- *Include a technology development and demonstration plan for critical and enabling technologies*

In the following sections the mission statement is elaborated into primary objectives, constraints and trade-off priorities. The objectives and constraints are generally qualitative statements, quantitative statements can be found in the Cross-scale Mission Requirements Document [AD_MRD].

3.1 Primary objectives

- 1.1 The CS TRS shall perform an in-situ multidimensional scientific exploration of universal plasma phenomena occurring in near-Earth space
 - a) Three length scales shall be explored at the same time
 - b) With a constellation of up to twelve S/C
 - c) With at least two S/C for the smallest length scale
- 1.2 The CS S/C constellation shall visit at least the following relevant regions in near-Earth space where the scientifically most interesting plasma processes occur
 - a) Bow shock
 - b) Magnetosheath
 - c) Magnetopause and tail current sheet (reconnection regions)
- 1.3 The CS S/C constellation shall be in an optimized spatial configuration to measure multiple scale plasma phenomena when visiting the regions mentioned in 1.2. When multiple regions of interest are visited within one orbit, the spatial configuration shall be optimized for at least one of these regions
- 1.4 The relative timing of science data between any two S/C shall be retrievable
- 1.5 The relative position of each S/C in the constellation shall be known
- 1.6 The acquired science data shall be relayed to Earth

3.2 Primary constraints

The mission profile shall fulfil the requirements subject to the following constraints:

- 2.1 The overall mission cost shall be less than 350 M€(TBC)
(Including S/C, qualification/integration/verification, launch costs, and operations)
- 2.2 The technology development horizon is not more than 5 years (TRL 5 or higher before end of 2011)

4 TRADE-OFF PRIORITIES

The trade-off priorities for the mission study are:

- 1: Achieve primary science requirements
- 2: Low risk mission (i.e. fulfilment of ESA risk standards)
- 3: Low cost mission
- 4: Achieve secondary science goals

5 LIST OF ABBREVIATIONS

CS	Cross-scale
S/C	Spacecraft
TBC	To be confirmed
TRL	Technology Readiness Level
TRS	Technology Reference Study