APAF-SRS-15-03561-V1.0

April 24, 2001

SOFTWARE REQUIREMENTS SPECIFICATION
Version 1.0

For The

Swedish Institute of Space Physics (IRF)

Mars Express
ASPERA-3 Processing
and Archiving Facility
(APAF)

SwRI Project No. 15-03561

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REVISION NOTICE

Document Revision History			
Revision	Date	Section	Description of Changes
Initial Review (Draft)	Feb-28-2001		
Initial Release (1.0)	Apr-24-2001		Changes made to draft based on APAF Software Requirements Review to prepare for delivery.

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ACRONYMS

APAF	ASPERA-3 Processing and Archiving Facility
ASPERA-3	Analyzer of Space Plasma and Energetic Atoms (3rd Version)
Co-I	Co-Investigator
DDID	Data Disposition system Interface control Document
DDS	Data Disposition System
DPU	Data Processing Unit (of the ASPERA-3 instrument package)
DSID	Data System Interface Document
ELS	Electron Spectrometer (of the ASPERA-3 instrument package)
E/PO	Education and Public Outreach
ESA	European Space Agency
ESOC	European Science Operations Center (Darmstadt, Germany)
FMI	Finnish Meteorological Institute (Helsinki, Finland)
GIF	Graphics Interchange Format
ICD	Interface Control Document
IDFS	Instrument Data File Set or Instrument Description File Set
IMA	Ion Mass Analyzer (of the ASPERA-3 instrument package)
IRF	Swedish Institute of Space Physics (Kiruna, Sweden)
MEX	Mars Express
NASA	National Aeronautics and Space Administration
NISN	NASA Integrated Services Network
NPD	Neutral Particle Detector (of the ASPERA-3 instrument package)
NPI	Neutral Particle Imager (of the ASPERA-3 instrument package)
OA	Orbit/Attitude (information from the Mars Express spacecraft)
OPD	Operations Procedures Document
PDMP	Project Data Management Plan
PDS	Planetary Data System
PI	Principal Investigator
PIDF	Plot Interface Definition File
PM	Project Manager
SDD	Software Design Document
SDDAS	Southwest Data Display and Analysis System
SDP	Software Development Plan
SPM	Software Project Manager
SU	Scanning Unit (of the ASPERA-3 instrument package)
SwRI	Southwest Research Institute (San Antonio, Texas USA)
UMU	Umeå Univeristet (University in Umeå, Sweden)
VIDF	Virtual Instrument Description File

1.0 SCOPE

This Software Requirements Specification (SRS) identifies the requirements for the ASPERA-3 Processing and Archiving Facility (APAF) ground data system for the Mars Express mission.

1.1   Project Identification

Project Title:	ASPERA for Mars Express
Project Number:	15-02853 / 15-03561
Contract Number:	NASW-99030 / NASW-00003
Principal Investigator:	Winningham, John D.
Project Manager:	Scherrer, John R.
Software Project Manager:	Jeffers, Sandee J.
Start Date:	June 14, 1999
End Date:	September 30, 2007

1.2   Data System Overview

The ASPERA-3 instrument package (or ASPERA-3 experiment) will be flown on the Mars Express mission of the European Space Agency (ESA) and will be launched in June 2003 according to the current schedule. ASPERA-3 contains a number of different sensors that will measure the particles, neutral atoms, and fields in the near Martian environment. Southwest Research Institute is providing the data system to produce data products in a form suitable for analysis and archiving. These data products will be put into a form known as the Instrument Data File Set (IDFS).

The ASPERA-3 Processing and Archiving Facility (APAF) is a ground data system responsible for processing all of the ASPERA-3 telemetry. The APAF data system acquires the telemetry data via NISN, processes the data into IDFS data sets, distributes the IDFS data sets to the ASPERA-3 team, provides web-based displays of the most current data for public view, stores the telemetry and IDFS data sets on a local SwRI archive, and submits the ASPERA-3 IDFS data sets to PDS for long-term archival.

The first step in defining the IDFS data sets is to identify the physical instruments that make up the ASPERA-3 experiment and any ancillary data necessary for scientific analysis. There are six components of the ASPERA-3 package, plus the orbit and attitude data from the spacecraft:

1. Data Processing Unit (DPU)

2. Electron Spectrometer (ELS)

3. Ion Mass Analyzer (IMA)

4. Neutral Particle Detector (NPD)

5. Neutral Particle Imager (NPI)

6. Scanning Unit (SU)

7. Orbit/Attitude (OA)

Each of the physical components will be divided into logical groups (called virtual instruments) in which each logical group will be formatted as an IDFS data set. Each of the seven components described above

will have an associated Software Design Document (SDD) that will define and fully describe all of the data products contained within each individual virtual instrument.

1.3   Goals and Objectives

The APAF ground data system is to provide data processing algorithms and support to IRF for the ASPERA-3 science team (including Co-I's) in preparation for the Mission Operations and Data Analysis (MO&DA) phase of the Mars Express mission. In addition, validation and archiving of all ASPERA-3 scientific data in the NASA Planetary Data System (PDS) within 6 months of receipt in a form useable by the general scientific community is to be provided by the APAF.

1.4   Document Overview

Section 2 is an overview of the descriptions of requirement determination, qualification procedures, rationale, and traceability that are used in the identification and the definitions of the requirements. The requirements of the APAF data system are categorized and defined in Section 3. Section 4 contains general information to aid in the understanding of this specification.

1.5   Related Documents

Program-Level Requirements for the ASPERA-3 Mission of Opportunity Project: approved Nov. 1999

APAF Software Development Plan: APAF-SDP-15-02853, Version 1.2 released November 27, 2000

APAF Project Data Management Plan: APAF-PDMP-15-03561, Version 1.1 released December 29, 2000

APAF Data System Interface Document: APAF-DSID-15-03561, Version 1.0 released August 18, 2000

ESA Mars Express Space / Ground Interface Control Document (SGICD): ME-ESC-IF-5001,
        Issue 1, May 1999

ESOC Data Disposition system Interface control Document (DDID): to be released sometime 2000

ASPERA-3 Packet Definitions: from FMI and UMU, preliminary document from FMI issued July 2000

ELS Software Design Document: ELS-SDD-15-03561, Version 1.0 to be released December 15, 2001

IMA Software Design Document: IMA-SDD-15-03561, Version 1.0 to be released December 15, 2001

NPD Software Design Document: NPD-SDD-15-03561, Version 1.0 to be released December 15, 2001

NPI Software Design Document: NPI-SDD-15-03561, Version 1.0 to be released December 15, 2001

DPU Software Design Document: DPU-SDD-15-03561, Version 1.0 to be released September 1, 2002

SU Software Design Document: SU-SDD-15-03561, Version 1.0 to be released September 1, 2002

OA Software Design Document: OA-SDD-15-03561, Version 1.0 to be released September 1, 2002

APAF System Design Document: APAF-SDD-15-03561, Version 1.0 to be released December 4, 2002

APAF Operations Procedures: APAF-OPD-15-03561, Version 1.0 to be released May 23, 2003

2.0   REQUIREMENTS SPECIFICATION DESCRIPTIONS

2.1   Requirement Identification

Each requirement shall be:

- Necessary: It states a condition for the acceptance of the system.
- Verifiable: It is stated in such a way that an objective test can be defined for it.
- Attainable: It is technically feasible and can be accomplished within schedule and budget.
- Clear: It is singular, concise, and simple.

Each requirement shall be:

- assigned a project-unique identifier.
- annotated with associated qualification (verification) methods (see section 2.2).
- annotated with rationale (see section 2.3).
- annotated with associated traceability to their source (see section 2.4).

2.2   Qualification Provisions

For each requirement in Section 3, the method(s) to be used to verify that the requirement has been met is annotated. Qualification methods included in this specification are:

- Demonstration: observing function of the system without requiring instrumentation, special test equipment, or subsequent analysis.

- Analysis: processing accumulated data obtained during characterization, calibration, or testing of the instrumentation. For example, simulated instrument data sets can be created from the accumulated calibration and test data by putting this data into the expected telemetry format that will be input into the APAF data system. These simulated data sets can then be processed into IDFS data sets and the Southwest Data Display and Analysis System (SDDAS) can be used to analyze the output from the APAF data system.

2.3   Rationale

The rationale behind each requirement is documented, if applicable, in Section 3 along with each requirement. Rationale may include:

- assumptions
- why a requirement is needed
- how a requirement is related to expected operations
- design decisions made at higher system levels

2.4   Requirements Traceability

The relationship between each requirement and the project item(s) that it addresses is documented along with each requirement identified in Section 3. A requirement may address any number of project items including a system-level requirement, a customer request document (e.g., an RFP), a proposal, or other documentation. A requirement may also address a higher-level design element. For proper traceability, the following information is provided for each requirement:

- Requirement Identifier
- Requirement Description
- Requirement Source (e.g. RFP, proposal, SRS, etc): Source of the requirement
- Verification Method (what method will be used to verify the requirement)

3.0   REQUIREMENTS

The APAF ground data system requirements are categorized according to functional areas and are defined in the following sections in table format.

3.1   Capability or Functional Requirements

The requirements associated with the functionality of the APAF ground data system are itemized in the table below. The mnemonic, *FR*, is used in the requirement identifiers to show that these requirements are *F*unctional *R*equirements unless otherwise specified.

Requirement Identifier	Requirement Description	Verification Method(s)	Source	Rationale & Comments
APAF-FR-01	The APAF system shall acquire from ESOC the telemetry data of the ASPERA-3 Experiment and Mars Express Orbit/Attitude.	Demonstration	ESOC Data Disposition system Interface Document	To automatically process the data on a daily basis.
APAF-FR-02	The APAF system shall process all ASPERA-3 science data into IDFS data sets.	Demonstration and Analysis	Proposal, NASA Discovery Office Program-Level Requirements	Section 4.1.1 of Program-Level Requirements, Baseline Science Requirements. APAF PDMP
APAF-FR-03	The APAF system shall process the engineering and ancillary information necessary for calibration and science validation into IDFS data sets.	Demonstration and Analysis	NASA Discovery Office Program-Level Requirements	Section 4.5.1, Science Data Management
APAF-FR-04	Intermediate files of cleaned-up ASPERA-3 and MEX OA telemetry shall be generated in the event that cleaned-up telemetry is not provided by ESOC.	Demonstration and Analysis	APAF Software Requirements Review Minutes	To support the ASPERA-3 team in meeting mission goals and objectives
APAF-FR-05	The ASPERA-3 and MEX OA telemetry data shall be stored on a local SwRI archive.	Demonstration	APAF Project Data Management Plan	For data availability and re-processing
APAF-FR-06	The ASPERA-3 and MEX OA IDFS data sets shall be stored on a local SwRI archive.	Demonstration	APAF Project Data Management Plan	For data availability and analysis
APAF-FR-06a	Any APAF-generated intermediate files of ASPERA-3 and MEX OA cleaned-up telemetry shall be stored on a local SwRI archive.	Demonstration	APAF Software Requirements Review Minutes	For data availability and re-processing, and to support the ASPERA-3 team
APAF-FR-07	Web-based displays of the most current ASPERA-3 data shall be provided for public view.	Demonstration	APAF Project Data Management Plan	E/PO and monitor instrument performance
APAF-FR-08	Web-based displays defined by the ASPERA-3 team shall be provided where any available ASPERA-3 data (as opposed to just the most current) can be used for science analysis.	Demonstration	APAF Software Requirements Review Minutes	To support the ASPERA-3 team in meeting mission goals and objectives

Requirement Identifier	Requirement Description	Verification Method(s)	Source	Rationale & Comments
APAF-FR-08a	The web-based displays defined by the ASPERA-3 team to be used for science analysis shall be password protected until the ASPERA-3 data is made public.	Demonstration	APAF Software Requirements Review Minutes	To support the ASPERA-3 team in meeting mission goals and objectives
APAF-FR-09	The APAF ground data system shall have built-in error handling.	Demonstration	APAF Project Data Management Plan	For better data integrity
APAF-DR-01 (Listed as a *Delivery Requirement*)	ASPERA-3 and MEX OA IDFS data and any APAF-generated intermediate files of ASPERA-3 and MEX OA cleaned-up telemetry shall be provided to all ASPERA-3 Co-I's.	Demonstration	NASA Discovery Office Program-Level Requirements APAF Software Requirements Review Minutes	Section 4.1.1, Baseline Science Requirements; To support the ASPERA-3 team in meeting MEX mission goals and objectives
APAF-DR-05 (Listed as a *Delivery Requirement*)	IDFS data access software developed by SwRI shall be made available to the ASPERA-3 Co-I's.	Demonstration	APAF Software Requirements Review Minutes	To support the ASPERA-3 team in meeting mission goals and objectives
APAF-DR-06 (Listed as a *Delivery Requirement*)	Science analysis software developed by SwRI to analyze IDFS-formatted data shall be made available to the ASPERA-3 Co-I's.	Demonstration	APAF Software Requirements Review Minutes	To support the ASPERA-3 team in meeting mission goals and objectives

3.2   External Interface Requirements

The requirements associated with external interfaces of the APAF data system are identified and described in the *APAF Data System Interface Document (APAF-DSID-15-03561-V1.0)*. For ease of reference, they are listed in the following tables.

The external interface identifiers (ID) begin with APAF-DS to denote the APAF Data System. The next two characters refer to the category of the interface – either II for Input Interface or OI for Output Interface. Sequential numbers starting at 1 follow to uniquely identify the interfaces.

The input interfaces are identified in the following table.

Interface ID	Interface Description	Document Reference
APAF-DS-II-1	System Parameters	Programmers Guide to the ASPERA-3.org Web Server This document describes the configuration of phobos.space.swri.edu, which is the computer to be used for the development of the APAF data system
		ESOC Data Disposition system Interface control Document (DDID)
APAF-DS-II-2	ASPERA-3 and Mars Express Orbit/Attitude Telemetry Data	ME-ESC-IF-5001 Mars Express Space / Ground Interface Control Document (SGICD) (ESA Document)
		Packet Definitions (from FMI and UMU)

Interface ID	Interface Description	Document Reference
APAF-DS-II-3	Virtual Instrument Descriptions for the ASPERA-3 Experiment Data and the Mars Express Orbit/Attitude Data	APAF-SRS-15-03561 APAF Software Requirements Specifications
		Program-Level Requirements for the ASPERA-3 Mission of Opportunity Project
		The Software Design Documents shall fully document the instrument parameters, spacecraft parameters, and science information necessary for IDFS descriptions.
		The www.ASPERA-3.org web site is used for obtaining and reviewing IDFS information.
APAF-DS-II-4	Operator Input	APAF-OPD-15-03561 APAF Operations Procedures Document

The output interfaces are identified in the following table.

Interface ID	Interface Description	Document Reference
APAF-DS-OI-1	Distribution of ASPERA-3 and MEX OA IDFS Data Sets	APAF-PDMP-15-03561 APAF Project Data Management Plan
		APAF-OPD-15-03561 APAF Operations Procedures Document
APAF-DS-OI-2	System Logs	APAF-OPD-15-03561 APAF Operations Procedures Document
APAF-DS-OI-3	Local Archive of ASPERA-3 and MEX OA Telemetry & IDFS Data	APAF-OPD-15-03561 APAF Operations Procedures Document
		Local Archive Configuration Files
APAF-DS-OI-4	Web-based Displays	www.ASPERA-3.org
		APAF-OPD-15-03561 APAF Operations Procedures Document

3.3   Internal Interface Requirements

All internal interfaces are left to the design. The Software Design Documents of each of the seven components (see section 1.2) shall contain the detailed information of the internal interfaces.

3.4   Internal Data Requirements

All internal data requirements are left to the design. The Software Design Documents of each of the seven components (see section 1.2) shall contain the detailed information of the virtual instrument data items.

3.5   Security and Privacy Requirements

There are no security requirements associated with the APAF ground data system. However, there are privacy issues related to intellectual property and sensitive information and data. The requirement associated with the privacy of the APAF ground data system is in the table below. The mnemonic, *PR*, is used in the requirement identifier to show that this requirement is a *P*rivacy *R*equirement.

Requirement Identifier	Requirement Description	Verification Method(s)	Source	Rationale & Comments
APAF-PR-01	The APAF system web server shall be password protected where appropriate to allow only pertinent ASPERA-3 team members access.	Demonstration	APAF Software Development Plan	Section 10.0, Security Plan

3.6   Computer Resource Requirements

The requirements associated with computer resources are listed in the table below. Computer resources include computer hardware, computer software, and computer communication. The mnemonic, *CR*, is used in the requirement identifiers to show that these requirements are *C*omputer resource *R*equirements.

Requirement Identifier	Requirement Description	Verification Method(s)	Source	Rationale & Comments
APAF-CR-01	There shall be a UNIX-based APAF system development computer. (Done: phobos.space.swri.edu)	Demonstration	APAF Software Development Plan	Section 4.1.1, Hardware Resources
APAF-CR-02	There shall be a UNIX-based APAF system production computer with an archival system.	Demonstration	APAF Software Development Plan	Section 4.1.1, Hardware Resources
APAF-CR-03	There shall be a web server for the APAF system. (Done: www.aspera-3.org)	Demonstration	APAF Project Data Management Plan	For web-based displays, and for information exchange
APAF-CR-04	There shall be a network connection between SwRI and NISN.	Demonstration	Proposal APAF Project Data Management Plan	For data transfers and distribution

3.7   Logistics-Related Requirements

The SwRI software team shall provide system maintenance and software support.

The logistics-related requirements of the APAF ground data system are itemized in the following table. The mnemonic, *LR*, is used in the requirement identifiers to show that these requirements are *L*ogistical *R*equirements.

Requirement Identifier	Requirement Description	Verification Method(s)	Source	Rationale & Comments
APAF-LR-01	SwRI shall provide APAF system maintenance.	Demonstration	NASA Discovery Office Program-Level Requirements	Section 4.4 – to satisfy mission needs
APAF-LR-02	SwRI shall provide software support for the APAF system.	Demonstration	NASA Discovery Office Program-Level Requirements	Section 4.4 – to satisfy mission needs

3.8   Delivery Requirements

The APAF data system requirements for delivering the ASPERA-3 IDFS data, Mars Express Orbit/Attitude IDFS data, and software are described in the following table. The mnemonic, *DR,* is used in the requirement identifiers to show that these requirements are *D*elivery *R*equirements.

Requirement Identifier	Requirement Description	Verification Method(s)	Source	Rationale & Comments
APAF-DR-01 (Also Listed in Functional Requirements)	ASPERA-3 and MEX OA IDFS data and any APAF-generated intermediate files of ASPERA-3 and MEX OA cleaned-up telemetry shall be provided to all ASPERA-3 Co-I's.	Demonstration	NASA Discovery Office Program-Level Requirements APAF Software Requirements Review Minutes	Section 4.1.1, Baseline Science Requirements; To support the ASPERA-3 team in meeting MEX mission goals and objectives
APAF-DR-01a	ASPERA-3 IDFS data that are electronically distributed shall be provided to the ASPERA-3 Co-I's within 24 hours of acquiring ASPERA-3 telemetry as long as the transmission and processing are error-free.	Demonstration	APAF Software Requirements Review Minutes	To support the ASPERA-3 team in meeting mission goals and objectives
APAF-DR-01b	MEX OA IDFS data that are electronically distributed shall be provided to the ASPERA-3 Co-I's within 24 hours of acquiring MEX OA telemetry as long as the transmission and processing are error-free.	Demonstration	APAF Software Requirements Review Minutes	To support the ASPERA-3 team in meeting mission goals and objectives
APAF-DR-01c	Any APAF-generated intermediate files of ASPERA-3 and MEX OA cleaned-up telemetry that are electronically distributed shall be provided to the ASPERA-3 Co-I's within 24 hours of acquiring ASPERA-3 and MEX OA telemetry as long as the transmission and processing are error-free.	Demonstration	APAF Software Requirements Review Minutes	To support the ASPERA-3 team in meeting mission goals and objectives
APAF-DR-02	ASPERA-3 IDFS data and MEX OA IDFS data shall be provided to NASA PDS.	Demonstration and Analysis	NASA Discovery Office Program-Level Requirements	Section 4.1.1, Baseline Science Requirements
APAF-DR-02a	ASPERA-3 data shall be provided to NASA PDS in PDS-compliant form.	Analysis	NASA Discovery Office Program-Level Requirements	Section 4.5.1, Science Data Management
APAF-DR-02b	ASPERA-3 data shall be calibrated and validated prior to depositing in the NASA PDS.	Analysis	NASA Discovery Office Program-Level Requirements	Section 4.5.1, Science Data Management
APAF-DR-02c	ASPERA-3 data shall be provided to NASA PDS no later than 6 months after acquisition.	Demonstration	NASA Discovery Office Program-Level Requirements	Section 4.5.1, Science Data Management
APAF-DR-03	SwRI shall provide IDFS data processing algorithms to IRF.	Demonstration	NASA Discovery Office Program-Level Requirements	Section 4.4, Ground System Requirements
APAF-DR-04	Science analysis software shall be integrated into the NASA approved data repository.	Demonstration	NASA Discovery Office Program-Level Requirements	Section 4.5.2, Analysis Software

Requirement Identifier	Requirement Description	Verification Method(s)	Source	Rationale & Comments
APAF-DR-05 (Also Listed in Functional Requirements)	IDFS data access software developed by SwRI shall be made available to the ASPERA-3 Co-I's.	Demonstration	APAF Software Requirements Review Minutes	To support the ASPERA-3 team in meeting mission goals and objectives
APAF-DR-06 (Also Listed in Functional Requirements)	Science analysis software developed by SwRI to analyze IDFS-formatted data shall be made available to the ASPERA-3 Co-I's.	Demonstration	APAF Software Requirements Review Minutes	To support the ASPERA-3 team in meeting mission goals and objectives
APAF-DR-07	How the ASPERA-3 and MEX OA data and exactly what data sets are to be distributed to each Co-I shall be determined by the needs and resources available six months prior to MEX launch. The distribution mechanisms shall be clearly defined/described in the APAF Operation Procedures Document.	Demonstration	APAF Software Requirements Review Minutes	To support the ASPERA-3 team in meeting mission goals and objectives

3.9   Other Requirements Considered

This section identifies the requirements considered but not part of the APAF ground data system requirements.

3.9.1   Required States and Modes

The APAF data system is not required to operate in more than one state or mode.

3.9.2   Adaptation Requirements

There are no installation-dependent requirements for the operation of the APAF data system. However, if any are identified, they shall be documented in the APAF Operations Procedures Document.

3.9.3   Safety Requirements

The APAF data system will not impose hazards to personnel, property, or the environment. Therefore, there are no safety requirements of the APAF ground data system.

3.9.4   Software Quality Factors

Although the APAF data system and associated software will be developed with the highest quality possible, there are no requirements concerned with software quality. Some of the software quality factors that will be considered when developing the APAF data system include: reliability, maintainability, availability, flexibility, portability, testability, and usability.

3.9.5   Design and Implementation Requirements

There are no requirements that constrain the design and implementation of the APAF software.

3.9.6   Personnel-Related Requirements

There are no identified requirements related to personnel that will use the software. However, the APAF Operations Procedures Document will aid personnel in the operational use of the APAF system.

3.9.7   Training-Related Requirements

Since the members of the SwRI software team are experienced with data system and IDFS processing software development, there are no training-related requirements for developers of the APAF data system. In addition, the APAF Operations Procedures Document shall provide installation and operations

procedures of the APAF system in enough detail where there are no training-related requirements for users and operators of the APAF data system.

3.9.8   Precedence and Criticality of Requirements
There are no requirements of the APAF data system that need special treatment or consideration at this time.

4.0   NOTES

To aid in the understanding of this specification, the requirements imposed on SwRI for the development and operation of the ASPERA-3 Mission of Opportunity (MO) of the NASA Discovery Program as they are relevant to the APAF ground data system are documented here. These are taken directly from the *Program-Level Requirements for the ASPERA-3 Mission of Opportunity Project* which is an appendix to the NASA Discovery Program Plan.

In Section 4.1.1, *Baseline Science Requirements,* it states:

"…the ASPERA-3 MO shall provide the complete data set of the integrated ASPERA-3 investigation to all ASPERA-3 Co-I's and the NASA Planetary Data System (PDS). The specific measurements delivered shall be as follows:

4.1.1.1 Measure integral ENA fluxes in the energy range of 0.1 to 60 keV.

4.1.1.2 Measure mass/energy resolved neutral hydrogen and oxygen atom spectra in the energy range of 0.1 to 100 keV.

4.1.1.3 Measure ion energy/mass/angle resolved spectra in the energy range of 0.001 to 40 keV; 1-1e6 atomic mass units per unit charge (amu/q); with 4pi steradian coverage.

4.1.1.4 Measure the electron spectra in the energy range of 0.001 to 20 keV, with 4pi steradian coverage.

4.1.1.5 Measure ions and electrons in the energy range of 0.001 to 40 keV; 1-1e6 amu/q."

In Section 4.3, *Launch Requirements,* it states:

"…data processing software shall meet the delivery requirements of the IRF in order to support the launch date and operation of the ESA Mars Express mission."

In Section 4.4, *Ground System Requirements,* it states:

"SwRI shall develop the ASPERA-3 data reduction system and software to be used during instrument integration, test, calibration and mission operations for the full ASPERA-3 experiment. This task will include interfacing with all ASPERA-3 sensor teams to determine and effect data packetization and storage strategies. This system shall be available on a schedule to satisfy the mission needs per agreement with IRF, and to satisfy the data availability requirements established in Section 4.5.1.

SwRI shall provide processing algorithms to IRF in preparation for the mission operations and data analysis phase of Mars Express on a schedule to satisfy the mission needs per agreement with IRF."

In Section 4.5.1, *Science Data Management,* it states:

"…the ASPERA-3 MO PI shall be responsible for collecting engineering and ancillary information necessary to validate and calibrate the scientific data prior to depositing it in the NASA PDS in a PDS-compliant form. The time required to complete this process shall be the minimum necessary to provide accurate scientific data to the science community and the general public, but it shall not exceed six months after acquisition."

In Section 4.5.2, *Analysis Software,* it states:

> "Science analysis software developed by the ASPERA-3 MO PI team for this project shall be integrated into the NASA approved data repository. The PI team and the science community shall have equal on-line access to this software."

In Section 4.5.3, *Data Management Plan,* it states:

> "The ASPERA-3 MO Project shall develop a project data management plan to address the total activity associated with the flow of science data, including planning, acquisition, processing, data product generation and validation, archiving, and preservation. The plan shall identify science and supplementary data products, systems associated with handling the data, and the roles, responsibilities, and operational interfaces affecting those data and systems."

Note: This Program-Level requirement has been met with the generation and delivery of the APAF Project Data Management Plan (PDMP).