HESSI
SMEX Mission

Project Data Management Plan

University of California
Space Sciences Laboratory
Berkeley, CA 94720

University of California
Project Data Management Plan
for the HESSI Mission

Prepared by:	Dr. Gordon Hurford (GSFC 682.0 / UCB) HESSI Co-Investigator	Date
Prepared by:	Dr. Richard Schwartz (GSFC 682.3 / ITSS) HESSI Associated Investigator	Date
Concurrence:	Dr. Robert P. Lin (UCB) HESSI Principal Investigator	Date
Concurrence:	Dr. Brian R. Dennis (GSFC 682.0) HESSI Mission Scientist	Date
Concurrence:	Dr. William Wagner (NASA HQ Code SR) HESSI Program Scientist	Date
Concurrence:	Mr. Frank Snow (GSFC 410.0) HESSI Mission Manager	Date

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1.0 Introduction

This document describes the Project Data Management Plan (PDMP) for the High Energy Solar Spectroscopic Imager (HESSI) mission. HESSI is a NASA Small Explorer (SMEX) mission with launch scheduled for July 4, 2000.

1.1 Purpose and Scope

This PDMP is designed to be consistent with the HESSI Level-1 Requirements Definition document. It will describe the generation and delivery of HESSI science data products to the Solar Data Analysis Center (SDAC) and elsewhere, institutional responsibilities for data analysis, and the transfer of archival data products to the National Space Science Data Center (NSSDC). Covered in this plan are:

1. Brief description of the instruments
2. Description of the data flow
3. Description of the science data products
4. Processing requirements and facilities
5. Policies for access and use of HESSI data
6. Data product documentation

1.2 PDMP Development, Maintenance, and Management Responsibility

The HESSI Principal Investigator, Dr. Robert Lin[1], is responsible for the development, maintenance, and management of the PDMP through the life of the mission. The point of contact for the PDMP is Dr. Gordon Hurford[2], HESSI Co-Investigator. The HESSI PDMP will be modified and updated as required in accordance with the Configuration Management Plan for SMEX Missions.

2.0 Project Overview

The HESSI mission was selected in October 1997 as a result of AO-97-OSS-03 for SMEX missions. The lead American institutions for the development of HESSI are the University of California at Berkeley and Goddard Space Flight Center. The Paul Scherrer Institut in

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[1] Space Sciences Lab, University of California, Berkeley CA 94720. rlin@ssl.berkeley.edu (510) 642-1149
[2] Code 682.0, NASA/GSFC, Greenbelt MD 20771. ghurford@pop600.gsfc.nasa.gov (301) 286-4255

Switzerland is developing and integrating the imager and aspect systems. Spectrum Astro is developing the spacecraft.

The Phase B study began on February 23, 1998 and the Mission Confirmation Review was held on August 17, 1998. Mission Confirmation was granted on October 2, 1998. The HESSI mission is scheduled to be launched July 4, 2000.

2.1 Science Objectives

The primary scientific objective of the HESSI is to understand particle acceleration and explosive energy release in the magnetized plasmas at the Sun, processes that also occur at many other sites in the universe. The Sun is the most powerful particle accelerator in the solar system, accelerating ions up to tens of GeV and electrons to hundreds of MeV. Solar flares release up to 10^{32}-10^{33} ergs in 10^{2}-10^{3} s. The accelerated 10-100 keV electrons (and possibly >~1 MeV/nucleon ions) appear to contain a significant fraction, perhaps the bulk, of this energy, indicating that the particle acceleration and energy release processes are intimately linked. How the Sun releases this energy, presumably stored in the magnetic fields of the corona, and how it rapidly accelerates electrons and ions with such high efficiency, and to such high energies, is presently unknown.

The hard X-ray/γ-ray continuum and γ-ray lines are direct signatures of energetic electrons and ions, respectively, at the Sun. HESSI will provide the first hard X-ray imaging spectroscopy, the first high-resolution spectroscopy of solar γ-ray lines, the first imaging above 100 keV, and the first imaging of solar γ-ray lines. HESSI combines an imaging system consisting of 9 rotating modulation collimators (RMCs), with a high-resolution spectrometer consisting of 9 germanium detectors (GeDs) covering energies from soft X-rays (3 keV) to high-energy γ-rays (15 MeV). HESSI's hard x-ray imaging spectroscopy provides spectral resolution of ~1 keV, spatial resolution down to ~2 arcsec, and temporal resolution as short as tens of milliseconds. These parameters are, for the first time, commensurate with physically relevant scales for energy loss and transport of the >~10 keV electrons that are believed to contain much of the energy released in flares.

HESSI's γ-ray imaging spectroscopy will provide the first imaging of energetic protons, heavy ions, relativistic electrons, neutrons, and positrons; the first information on the angular distribution of accelerated ions; and detailed information on elemental abundances for both the ambient plasma and the accelerated ions.

With the fleet of spacecraft (SOHO, Wind, ACE, Ulysses, TRACE, GOES, Yohkoh, SAMPEX, CGRO, etc.)[3] that are already in place, a HESSI launch in mid-2000 will provide the high energy measurements needed for comprehensive studies of the solar maximum.

2.2 Data Acquisition and Access Overview

The HESSI mission will operate with an 85% duty cycle with the imager/spectrometer in its baseline operational mode. Operationally, the only difference between day and night will be the night-time absence of attitude control and solar aspect data. The remaining 15% of operations will differ only in the suppression of science data acquisition during passage through the South Atlantic Anomaly. The HESSI Level-0 data will be processed into Level-1 and Level-2 data (Quick-look Browse Products) within 24 hours after their receipt in the Mission Operations

[3] See List of Acronyms in Appendix I-4.

Center and Science Operations Center (MOC/SOC) at UCB. These Level 0-2 data products will be transferred to the Solar Data Analysis Center (SDAC) at GSFC and to the Swiss co-investigator institution, Eidgen”ossische Technische Hochschule (ETH), in Zurich where they will be posted immediately on the World Wide Web for use by the HESSI team, the international community of scientists, and the public.

2.3 Summary of Mission Operations

The HESSI Mission uses a single instrument consisting of an Imaging System, Spectrometer and Instrument Electronics, all mounted in a Sun-pointed, spin-stabilized spacecraft. The HESSI mission summary is shown Table 1.

Table 1 HESSI Mission Summary

Orbit Description	Inclination: 38º Apogee: 600 km Perigee: 600 km Period: 96 min.
Launch Date	4 July 2000
Launch Vehicle	Pegasus XL (SELSV II)
Nominal Mission Duration	2 years
Potential Mission Life	Over 10 years
Spacecraft + Instrument Mass	~260 kg
Spin Rate	15 rpm
Attitude Control Accuracy	spin axis: ≤0.2º from Sun center
Attitude determination	Instrument SAS gives spin axis attitude to 1.5 arcsec; RAS gives roll angle to 3 arcmin.
On-Board Data Storage Capacity	4 Gbytes
Typical Data Acquisition Rate	100 kbits/sec

HESSI will be launched in mid-2000 on a small-fairing Pegasus XL (SELVS II) vehicle into a 600-km circular, 38° inclination orbit. The launch configuration will have the spacecraft ON and the instrument OFF (detectors warm). Following injection into orbit, the spacecraft will reorient towards the Sun, deploy its solar arrays, and spin up to 15 RPM.

Once the operational attitude, orientation and spin rates have been achieved, the instrument electronics and cryocooler will be powered. Using a preprogrammed thermal profile, the cryocooler will cool the spectrometer to operational temperatures within a few days. This will be followed by a brief detector checkout period in which high voltages are turned on before normal operations begin.

Meanwhile the spacecraft will transition from coarse to Fine Sun Sensor (FSS) pointing. The Imager’s Solar Aspect System (SAS) and Roll Aspect Sensor (RAS) will be activated and the analysis of initial data will result in commands to electronically align the FSS with the optical axis of the imager. Fine mechanical adjustment of the solar panel orientation will be used to coalign the principle moment with the optical axis. Normal operations for the remainder of the mission will consist of the spacecraft using its FSS aspect in a fully-automated closed-loop magnetic-torquing control system to keep the axis of rotation within 0.2 degrees of Sun center.

In normal operation the germanium detectors (GeDs) are cooled to ≤75 K; GeD high voltage is on; and observations are taken continuously. Because of the large thermal mass of the GeDs the cryocooler can be cycled over time scales of hours if needed. Normal data acquisition is based on storage of the energy and arrival time of every detected photon, together with instrument SAS and RAS aspect information. These data are stored in the spacecraft's 4 Gbyte mass memory until telemetered. Ground data systems will convert these data into X-ray and γ-ray images and spectra.

An 11-m ground station from Allied Signal and EMP, currently under construction at UCB, will provide command transmission and data reception. The Mission Operations Center and Science Operations Center at UCB will operate the spacecraft and instrument, write the data onto CD-ROMs, and distribute the data to the Solar Data Analysis Center (SDAC) at GSFC and the High Energy Data Center (HEDC) in Zurich. The SDAC will archive and distribute both data and analysis software to outside users in the U.S., and coordinate access to context observations from other spacecraft and ground instruments. The HEDC will perform the same functions in Europe. A program of ground observations is supported directly by HESSI to provide the most critical context data. All users will have equal access to the ground-based data.

3.0 Science Instrumentation

The HESSI scientific objectives will be achieved with high resolution imaging spectroscopy observations from soft X-rays to γ-rays, using a single instrument consisting of an Imaging System, a Spectrometer, and Instrument Electronics. The Imaging System is made up of nine Rotating Modulation Collimators (RMCs), each consisting of a pair of widely separated grids mounted on the rotating spacecraft. Pointing information is provided by the Solar Aspect System (SAS) and Roll Angle System (RAS).

The Spectrometer has nine segmented GeDs, one behind each RMC, to detect photons from 3 keV to 15 MeV. Each detector is made from a single germanium crystal, which is electrically divided into independent front and rear segments to provide an optimum response for low and high energy photons, respectively. The GeDs are cooled to <~75 K by a space-qualified long-life mechanical cryocooler to achieve the highest spectral resolution (Table 2) of any presently available γ-ray detector. As the spacecraft rotates, the RMCs convert the spatial information from the source into temporal modulation of the photon counting rates of the GeDs. The Instrument Electronics amplify, shape, and digitize the GeD signals, provide low-voltage power and GeD high voltage, format the data, and interface to the spacecraft electronics.

Specific HESSI instrument performance parameters are given in Table 2.

Table 2 HESSI Instrument Performance Parameters

Number of Germanium Detectors	9
Number of Independent Detector Segments	18
Front Segment Detector Diameter	6.1 cm
Rear Segment Detector Diameter	7.1 cm
Front Detector Segment Thickness	1.5 cm
Rear Detector Segment Thickness	6.5 cm
Energy Range	3 keV to 15 MeV
Energy Resolution (FWHM)	0.5 keV to 30 keV increasing to 2 keV at 1 MeV, 5 keV at 15 MeV
Imaging Technique	Fourier-transform imaging with rotating modulation collimators
Angular Resolution	2.3 arcsec to 40 (or 300) keV 7 arcsec to 400 keV 36 arcsec to 2.2 MeV
FOV	Full Sun
Range of Collimator Resolutions (FWHM)	2.3 – 189 arcsec
Time-averaged Sensitive Area	up to 118 cm^2
Temporal Resolution	Tens of ms for basic image ≥2 s for detailed image
Max Photon-tagged Event Rate	50,000 events/sec/segment
Time Resolution	Events recorded with 1µs relative, 1 ms absolute accuracy
Attenuators	On-board logic selects one of 4 states
Rate Mode	Activated by on-board logic

3.1 Data Acquisition

The primary science data will be returned in event data packets, indicated in Table 3 along with other packet types. The contents of these packets include the time, energy and detector-segment identification of each detected event. The relative time resolution of 1 µs is sufficient that coincident events are indicated by identical time-tags, instead of conventional flags. Aspect data from SAS and RAS are included with sufficient time resolution that the instantaneous aspect associated with each detected event can be inferred.

To help accommodate the large dynamic range expected in flare count rates as a function of time and energy, instrument logic will control the mechanical insertion of either or both of two x-ray attenuators between the lower grids and detectors. As an additional measure, in large flares, should the memory and/or data storage rates approach their limits, on-board instrument logic will apply increasingly stringent energy criteria to favor the retention of high energy photons, along with an unbiassed subset of the more numerous low energy photons. At exceptionally high rates, time-tagging of each detected event in the front segment detectors will be replaced by recording in Fast Rate Counters with sufficient time resolution to permit imaging, albeit with lower spectral resolution. In all cases, Monitor Rates with lower time resolution are used to provide an overview of detector performance and as input to support on-board decision-making.

Table 3 HESSI Data Packets

HESSI PACKET TYPES
State-of-Health Packets
Event data
SAS Data
RAS Data
Fast Rates data
Monitor Rates
Diagnostic IDPU Memory dump

4.0 HESSI End-to-End Data Flow

4.1 Overview

Design and operations planning for space-based telescopes typically require difficult tradeoffs among time resolution, spectral range and resolution, spatial resolution, image quality, etc. Instead of transmitting such a preselected subset of potential images and spectra, the HESSI telemetry includes all of the information about each detected photon. Thus, the data analyst can make these tradeoffs during the data analysis phase, as opposed to during the instrument design or operations planning phase. By making these decisions on a case-by-case basis *in response to* the unique characteristics of the solar event under study and the relevant scientific objectives, the scientific return from the observations will be significantly enhanced. *Therefore a key driver of our data analysis approach is the preservation of this flexibility for use by the data analyst*.

To maintain this flexibility, the generation of extensive secondary databases will be minimized. Instead, most scientific analysts will use the primary database with the most current calibration information, and be provided with the software necessary to apply such calibration data to yield images and spectra with the time, spatial and spectral resolution and range most appropriate to their objectives.

The data flow will follow the FAST model that was designed to minimize interfaces and the production of extensive secondary databases. Data will be telemetered directly from the spacecraft to the MOC/SOC at UCB, where the raw telemetry files will be reformatted into a primary database and where health, safety and spacecraft and instrument status will be confirmed using automated algorithms.

The primary database includes the following principal elements: time-tagged photons, SAS and RAS data, Monitor Rates, Fast Rate Counter output (when appropriate), housekeeping data and "catalog" information (discussed below). Except for the catalog, the primary database has no "value-added". This catalog includes pointers to make the primary database appear as a sequence of time-ordered, non-duplicated, and quality-flagged data; a summary of spacecraft/instrument status; detector rates above representative energy thresholds; a list of identified flares; orbital averages of full-resolution spectra and, for solar events, sets of representative images and spatially integrated spectra. As with FAST, to ensure prompt preparation, the primary database is generated without routine operator intervention.

The primary database and catalog will be made available at UCB by network access using a CD-ROM jukebox, and will be shipped daily to GSFC and ETH on CD-ROMs and/or via the Internet.

At GSFC, the HESSI solar data analysis, distribution, and archiving tasks will be conducted under the auspices of the Solar Data Analysis Center (SDAC). We will take full advantage of the

SDAC facilities and experienced personnel developed through the coordinated analysis of data from SMM, Yohkoh, CGRO, and SOHO. In addition to HESSI data, SDAC and ETH will also maintain a database of other relevant spacecraft and ground-based observations.

The time line for these activities is given in Table 4. The primary database and the quick-look data products will be available on line, typically within 30 hours of receipt at UCB. (Longer latencies can be anticipated during non-routine periods where support from additional ground stations is used, as described in the next section.) While this telemetry-driven latency may limit the role of HESSI data in 'now-casting' solar activity, the HESSI database should prove valuable in the context of Space Weather research.

All data products, including the latest analysis software and calibration data, will be shipped to the NSSDC on high-density magnetic tape or CD-ROM's for archiving within 2 months of real time.

Table 4 Data Timeline

	Process	**Time Required**
1.	Data telemetered to UCB	0-48 hrs
2.	Reformat primary database and generate catalog	≤6 hrs
3.	Generate CDs and ship to GSFC and ETH. Data on line at UCB	≤24 hrs
4.	Data products to NSSDC	≤2 months

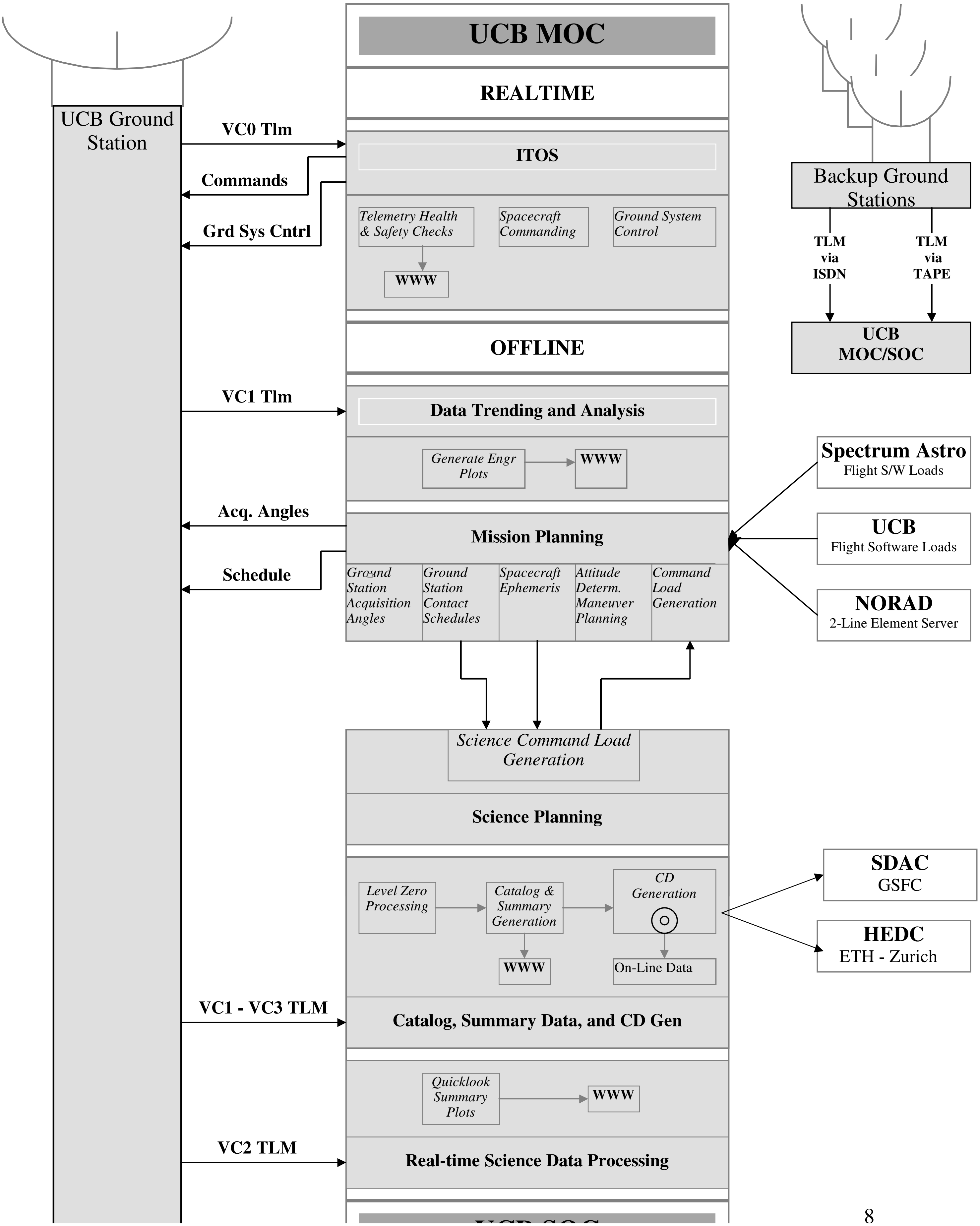
The HESSI mission will maintain a series of World Wide Web (WWW) pages that provide the latest information about all aspects of HESSI operations, including the type and accessibility of HESSI data. These pages are located at the following URL: http://hessi.ssl.berkeley.edu/

4.2 Science and Mission Operations Center

The HESSI mission operations scenario is simple and efficient. Both the spacecraft and the instrument are fully autonomous during normal operations. No commands need be sent to the spacecraft for days or even weeks at a time, other than those required to activate the transmitter and dump data during each ground-station pass. Thus, once all spacecraft and instrument functions have been activated and verified in the Post-Launch and Early Orbit phase, the normal mission operations scenario consists merely of reading out science data from the onboard memory each orbit and verifying the health and safety of the mission.

We are installing an autonomous dedicated ground station at Berkeley for command transmission and data reception. The HESSI Mission Operations Center (MOC) and Science Operations Center (SOC) will be co-located at the Space Sciences Laboratory on the campus of the University of California at Berkeley. Figure 1 is a block diagram of the Ground Data System. To satisfy mission operations requirements, HESSI will use the Integrated Test and Operations System (ITOS) and other Commercial Off the Shelf Software (COTS). Science operations requirements will be satisfied by using the same type of system used by the FAST Science Operations Center. For most of the mission both the MOC and SOC facilities will perform their required functions autonomously with a minimal 5 day per week dayshift staffing to monitor system performance, perform off-line trending and analysis of the spacecraft and instrument, and perform system maintenance and upgrades.

Figure 1. HESSI Ground Data System



Normal Operations (MO&DA). HESSI science observations will occur continuously with data stored on-board and dumped periodically to the UCB ground station. Each of the 5 to 6 ground station contacts per day at UCB will collect approximately 100 to 300 Mbytes of data, consisting of limited coverage provided by of real-time engineering and science data (VC0 and VC2 respectively) and full coverage from the stored engineering and science data (VC1 and VC3).

Real-Time Operations. The MOC will autonomously configure the necessary ground communication and control elements for each contact. The ground station will forward real-time engineering data (VC0) to the MOC, which will autonomously receive, process, and perform limit checking on all telemetry points. Configuration monitors will respond to anomalous spacecraft conditions by paging key personnel or executing STOL procedures. Access to the real-time data will be available via the HESSI WWW site.

The ground station will also route stored engineering data (VC1) to the MOC, which will run autonomous off-line trending and analysis procedures using pre-defined parameters and configurations. Access to the output of these procedures will also be available through the HESSI WWW site.

Prepared command loads and procedures will be forwarded to the ground station during designated contacts for uplink to the spacecraft or will be forwarded to the ground station prior to contact with the ground station uplinking the command load at the designated time.

Mission Planning. The HESSI orbital elements will be downloaded periodically from NORAD and used to produce spacecraft ephemeris, the ground station contact schedule, and antenna acquisition angles. The antenna acquisition angles and contact schedule will be forwarded to the UCB ground station for automated antenna control. The contact schedule and spacecraft ephemeris will be used to produce the spacecraft Absolute Time Sequence (ATS) load, which will include transmitter on/off commands and commands to dump telemetry data. The spacecraft ATS load will be combined with the science ATS load and forwarded prior to or during a ground station contact for uplink to the spacecraft. Other table and software loads will also be produced and uplinked periodically.

Additional ground station support is expected during increased solar activity periods or during a UCB ground station outage. Contacts will be scheduled on an as-needed basis. Data communication will occur with engineering data being shipped over a dial-up ISDN line to the MOC with the Internet as backup and science data will be recorded to tape at the ground station and delivered to UCB SOC.

Database Maintenance. The telemetry and command database will require periodic updates and maintenance with distribution to all required ground support elements.

Science Operations. Initially, real-time science data (VC2) will be routed to the SOC and quick-look summary data will be produced, with access via the HESSI WWW site at UCB**.**
The ground station will then route the stored engineering and science data to the SOC. Upon reception of data, autonomous Level Zero Processing will occur to sort the data by Application Identification (APID). Following this, catalog and summary data will be produced with access to the summary data via the HESSI WWW site.

Science Planning. HESSI will use a modified version of the FAST science ATS command generation software. This will use spacecraft ephemeris, contact schedule, and rules files to produce a series of time-tagged commands which will control instrument data collection. For example, time-tagged on/off commands would control science data acquisition during predicted SAA passages. The science ATS load will be passed over to the MOC mission planning system for combining with the spacecraft ATS load in preparation for transmission to the spacecraft.

4.3 Data Products and Access Overview

This section discusses all the HESSI data products, how and where they are generated, and how and when they will be accessible.

4.3.1 Level-0 Data – Primary Science Data

The primary data product of the HESSI mission is what is normally considered to be Level 0 data. Following the discussion in section 4.1, the approach of the HESSI data analysis is to create a robust data analysis system which will allow the routine production of Level 2 quality images and spectra by any scientist given the Level-0 data, the calibration database, and the software installation. Scientists on the PI team will interact with the data set in the same way.

Each Level-0 data file (available from the SDAC and ETH) will consist of a complete set of time-ordered source data packets and a standard file header in CCSDS format. The packets will be organized into FITS files up to 50 Mbytes in length or of the duration of a single orbit between local midnights. The telemetry packets will be completely preserved within the FITS file, that structure only being used to facilitate the documentation and the addition of autonomously generated browse products. These browse products will consist of several FITS extensions. The first extension will be a table of the packet number, packet type, and time range included. The second extension will be an observing summary which includes broadband rates and ephemerides. The third extension will include any autonomously created quick-look products for flares observed during the file's duration.

The Level-0 FITS files will be collected daily and imprinted on CDROMs for distribution to GSFC and ETH. Also, as each FITS file is completed by the MOC/SOC, the file will be transmitted to GSFC and ETH over the Internet as well. By the time of the mission we expect that this means of transmission will be the primary method of data dissemination.

4.3.2 Level-1 Data

In order to accomplish the HESSI scientific goals, the ability to quickly survey the large number of flares observed is essential. The result of Level-1 data processing in the MOC/SOC will typically be referred to as a Quick-look Product (QLP). All QLP data sets are created as FITS files and browser viewable image formats such as GIF. The SOC will post the most recent QLP data on the HESSI web pages. On the web page any user will be able to easily access the entire QLP archive for either image or FITS files. Additionally, a simple summary event catalog will be available for browse and for search via a web page. The browser-viewable products are well-suited to public access, since no special analysis skills or HESSI-specific software will be required. The Quick-look Product summaries for the HESSI instrument mission are given in Table 5.

Table 5 Level 1 Data Products (Browse Products)

Quick Look Product	Estimated number/day	Data Volume
Flare Images	10	36 kbyte
Flare Light Curves	20	20 kbyte
Flare Spectra	20	20 kbyte

The software algorithms for the QLP production will be built from the most robust algorithms (especially for imaging) within our software library. The QLP software will operate without human intervention by first identifying flares on the basis of rotation-averaged fluxes during solar observations. This software, as with all the HESSI software, will be documented and included as a living document with the SolarSoftWare (SSW) package available at the SDAC.

4.3.3 Orbital Files

A daily or orbital attitude history file will be produced in the SOC. From this file and the software within the HESSI segment of SSW, it will be possible to reconstruct the orbit to within 10 km at any time during the mission. The orbital files will appear on the CDROMs distributed to and archived at UCB, SDAC, and ETH.

4.4 Data Archiving and Distribution

Once a designated amount of VC2 and VC4 data is received at the SOC, it will be copied to CD-ROM along with associated ephemeris, catalog, and summary data. At least three copies of each CD data set will be produced with copies being distributed to SDAC and HEDC. At UCB on-line data access from the SOC will be via either a RAID or a CD-ROM jukebox system. The HESSI CD-ROM production system will be the same as that used by the FAST mission, a fully autonomous system producing multiple copies of data sets for distribution. At GSFC, all data products, including the latest analysis software and calibration data, will be converted to high-density magnetic tape and shipped to the NSSDC for archiving within 2 months of real time.

4.5 Archival Data Volume

The estimated volume of mission data acquired over nominal 2-year lifetime is approximately 1 Tbyte based on 700 days at 1.5 Gbyte/day. The QLP are a small fraction of the volume of the Level 0 data files. Based on these estimates the total HESSI Mission data volume to be archived at the NSSDC will be approximately 1 Terabyte over the 2-year lifetime of the mission.

4.6 Archive Data Access

The SDAC's on-line archive will be used for rapid access to all the archived HESSI data. At the SDAC we expect to create an archive capable of holding up to 250 Gbytes for immediate on-line access either through direct Telnet, FTP, or web interface. While this is a large database capable of holding the most important events observed with HESSI, it will not hold the entire database including all of the ancillary observations, both ground and space based. Additionally, we expect the availability of a 10 Tbyte near-line (<1 minute) archive at ETH. Both of these data archives will be open for public use without reservation.

Acknowledgments

The preparation of this document was greatly aided by the assistance of Kate Harps, Dave Curtis and David Smith.

Appendix A - Acronym List

ACE	- Advanced Composition Explorer
APID	- Application Identification
ATS	- Absolute Time Sequence
CD-ROM	- Compact Disk - Read Only Memory
CGRO	- Compton Gamma Ray Observatory
COTS	- Commercial Off-The-Shelf
ETH	- Eidgen”ossische Technische Hochschule
FAST	- Fast Auroral SnapshoT
FITS	- Flexible Image Transport System
FOV	- Field of View
FSS	- Fine Sun Sensor
FTP	- File Transfer Protocol
FWHM	- Full Width at Half Maximum
GeD	- Germanium Detector
GIF	- Graphic Interchange Format
GOES	- NOAA’s Geostationary Operational Environmental Satellite
GSFC	- Goddard Space Flight Center
HEDC	- High Energy Data Center at ETH
HESSI	- High Energy Solar Spectroscopic Imager
ISDN	- Integrated Services Digital Network
ITSS	- Information Technology Scientific Services
ITOS	- Integrated Test and Operations System
MO&DA	- Mission Operations and Data Analysis
MOC	- Mission Operations Center
NASA	- National Aeronautics and Space Administration
NORAD	- North American Air Defense Command
NSSDC	- National Space Science Data Center
PI	- Principal Investigator
PDMP	- Project Data Management Plan
QLP	- Quick Look Product
RAS	- Roll Angle System
RMC	- Rotating Modulation Collimator
SAMPEX	- Solar Anomalous and Magnetospheric Particle EXplorer
SAS	- Solar Aspect System
SDAC	- Solar Data Analysis Center
SELSV II	- Small Expendable Launch Vehicle Services II
SMEX	- SMall EXplorer
SOC	- Science Operations Center
SOHO	- SOlar and Heliospheric Observatory
SSW	- Solar SoftWare
TRACE	- Transition Region And Corona Explorer
UCB	- University of California, Berkeley
URL	- Uniform Resource Locator
VCn	- Virtual Channel n
WWW	- World Wide Web