STARDUST
Science Data Management Plan

SD - 77000 - 5

Prepared by:

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18 March 1999

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Dust Flux Monitor Instrument

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11/15/98	All	First draft
06/11/99	All	Second draft
03/18/00	Most	Third draft

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this document is to provide a plan for the generation, validation, and transfer to the Planetary Data System (PDS) the STARDUST archives containing Level 0 and Level 1A data, documentation, and related algorithms and software. A second purpose is to delineate plans for the additional release of data through Press Conferences and the posting of a subset of data and documentation that shows interesting and timely results on the Internet. The handling of dust samples is covered in other project documentation; however the data described herein are important to archive for the later interpretation of the returned particles.

1.2 Scope

The plan covers archiving of Level 0 and 1A datasets and related engineering data to be acquired or derived during the STARDUST Mission, which will launch in February 1999 and return to earth in January 2006.

Specific activities addressed in this plan are:

1. Generation of high-level mission, spacecraft and instrument description documentation, instrument calibration reports, algorithms, and documentation of software used to produce Level 1A data records (also referred to as Experiment Data Records or EDRs).
2. Reduction of telemetered science packet data (i.e., packetized Level 0 data) to Level 1A EDRs, with associated documentation.
3. Generation of SPICE archives for use with software from the Jet Propulsion Laboratory's Navigation and Ancillary Information Facility (NAIF).
4. Generation and validation of archive volumes containing STARDUST data, software, algorithms, documentation, and ancillary information.
5. Delivery to the PDS of validated STARDUST archives.
6. Release of limited data to the general public through news conferences and through the posting of data on the Internet.

The curation and analysis of Wild 2 and Interstellar dust samples are not included in this document but are defined in the STARDUST Science Operations and Analysis Plan, SD-40000-300, October 1997.

1.3 Contents

This plan begins with overviews of the STARDUST Mission and the Ground Data System (GDS). This is followed by a description of the data release policies, archive collections and functions, roles and responsibilities for organizations and personnel associated with the generation, validation, and archiving of STARDUST data. The document ends with specific plans for archiving and for posting of subsets of data for outreach and educational purposes. For reference, Appendix I is a glossary of terms used in this document.

1.4 Applicable Documents and Constraints

The STARDUST Science Data Management Plan is responsive to the following NASA HQ and Project documents pertaining to the management and archive of project data:

Announcement of Opportunity, Discovery Program, AO-96-OSS-02, September 20, 1996.

OSSA Program Directive, Science Data Management Policy, March 5, 1992.

Science Objectives and Analysis Plan, SD-500-2, September 7, 1996.

The plan is consistent with the principles delineated in the following National Academy of Sciences reports:

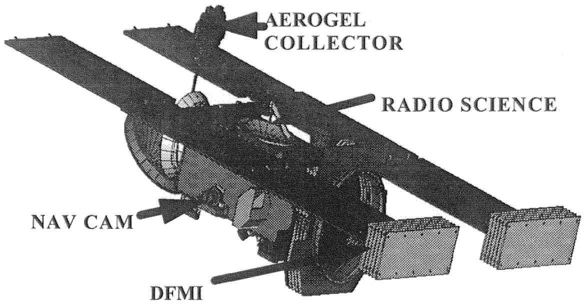


Figure 1. STARDUST Spacecraft - Top

Data Management and Computation, Volume 1, Issues and Recommendations, 1982, National Academy Press, 167 p.

Issues and Recommendations Associated with Distributed Computation and Data Management Systems for the Space Sciences, 1986, National Academy Press, 111 p.

The plan is also consistent with the following Planetary Data System documents:

Planetary Data System - National Space Science Data Center Memorandum of Understanding.

Planetary Science Data Dictionary Document, November 1992, JPL D-7116, Rev. D.

Planetary Data System Data Preparation Workbook, Feb 17, 1995, Version 3.1, JPL D-7669, Part-1.

Planetary Data System Data Standards Reference, July 24, 1995, Version 3.2, JPL D-7669, Part-2.

2.0 OVERVIEW OF STARDUST MISSION

2.1 Mission Overview

STARDUST is the fourth in a series of NASA Discovery Missions. Prof. Donald Brownlee of the University of Washington is Principal Investigator (PI), and Lockheed Martin

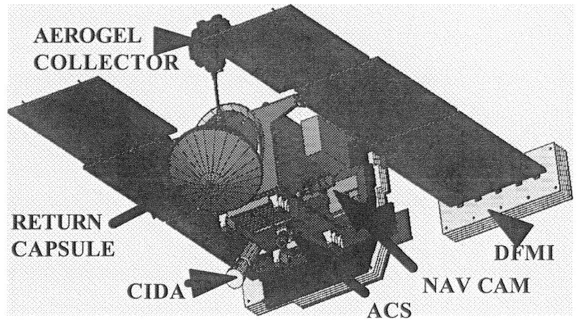


Figure 2. STARDUST Spacecraft - Bottom

Astronautics (LMA) provides the spacecraft (Figure 1), sample return capsule (Figure 2) and spacecraft operations. The Jet Propulsion Laboratory (JPL) provides project and mission management

Consistent with a low-cost Discovery Mission, the flight and science teams are small. The spacecraft has few science instruments relies on engineering subsystems to provide bonus science data.

STARDUST will return intact cometary dust from comet P/Wild-2. These samples are expected to be well-preserved relics of the original solar nebula -- fundamental building blocks of the solar system. The mission also provides for collection of particles from a flux of contemporary interstellar particles streaming through the solar system. These interstellar dust particles were discovered in 1993 by instrumentation on the Ulysses mission and have since been confirmed by the Galileo mission.

All samples will be returned to Earth for detailed analysis in specialized microanalysis laboratories around the world. Extensive discussions and justification of the science value of this mission and on the merits of cometary exploration in particular and sample return in general can be found in the original STARDUST Discovery Proposal (JPL D 12181A October 21, 1994), in numerous scientific publications, and on the STARDUST homepage

http://stardust.jpl.nasa.gov/

The only science required to make STARDUST a successful mission is to collect samples during a coma flythrough of the comet Wild-2 and return them to earth. All other science objectives provide added value.

STARDUST is highly focused towards its specific mission goals and carries only three instruments that are exclusively designed to collect scientific data (Table 1). These are the JPL/LMA-supplied Sample Collector, the German Max Planck Institut fur Extraterrestrial Physics-supplied Cometary and Interstellar Dust Analyzer (CIDA) for real-time determination of dust chemical composition, and the University of Chicago-supplied Dust Flux Monitor Instrument (DFMI) for determining the dust spatial and size distribution.

Science data are also produced by three STARDUST engineering subsystems: the JPL-provided Navigation Camera (NC) for coma and nucleus imaging; the LMA-provided radio transmitter for Radio Science (RS); and the LMA-provided attitude control subsystem which will measure spacecraft attitude and angular rate during Wild 2 flyby (High Rate Science, HRS).

The science data returned from these engineering subsystems are bonus to their primary roles for optical navigation, telecommunications and spacecraft attitude control, respectively. Secondary and tertiary objectives are capabilities-driven. For example, the comet imaging is predicated on a camera whose cost is low because the optics, CCD, filter wheel and shutter are residual hardware from the Voyager and Cassini programs.

STARDUST Prioritized Science Goals

The investigations possible with the STARDUST mission include:

Sample Collection and Analysis
(upon return to Earth)
Comet particle composition measurements
(CIDA instrument)
Cometary coma and nucleus imaging
(Using the Navigation Camera)
Dust flux measurements
(Dust Shield Monitors and Foil Detector)
Radio Science
(Doppler tracking within the coma)
High Rate Science
(Spacecraft attitude and angular rate at Wild 2)

The STARDUST Mission, in addition to the Wild 2 flyby, will have other mission phases where science data and particles are collected.

Earth Gravity Assist, with lunar and earth images, and possible dust detection

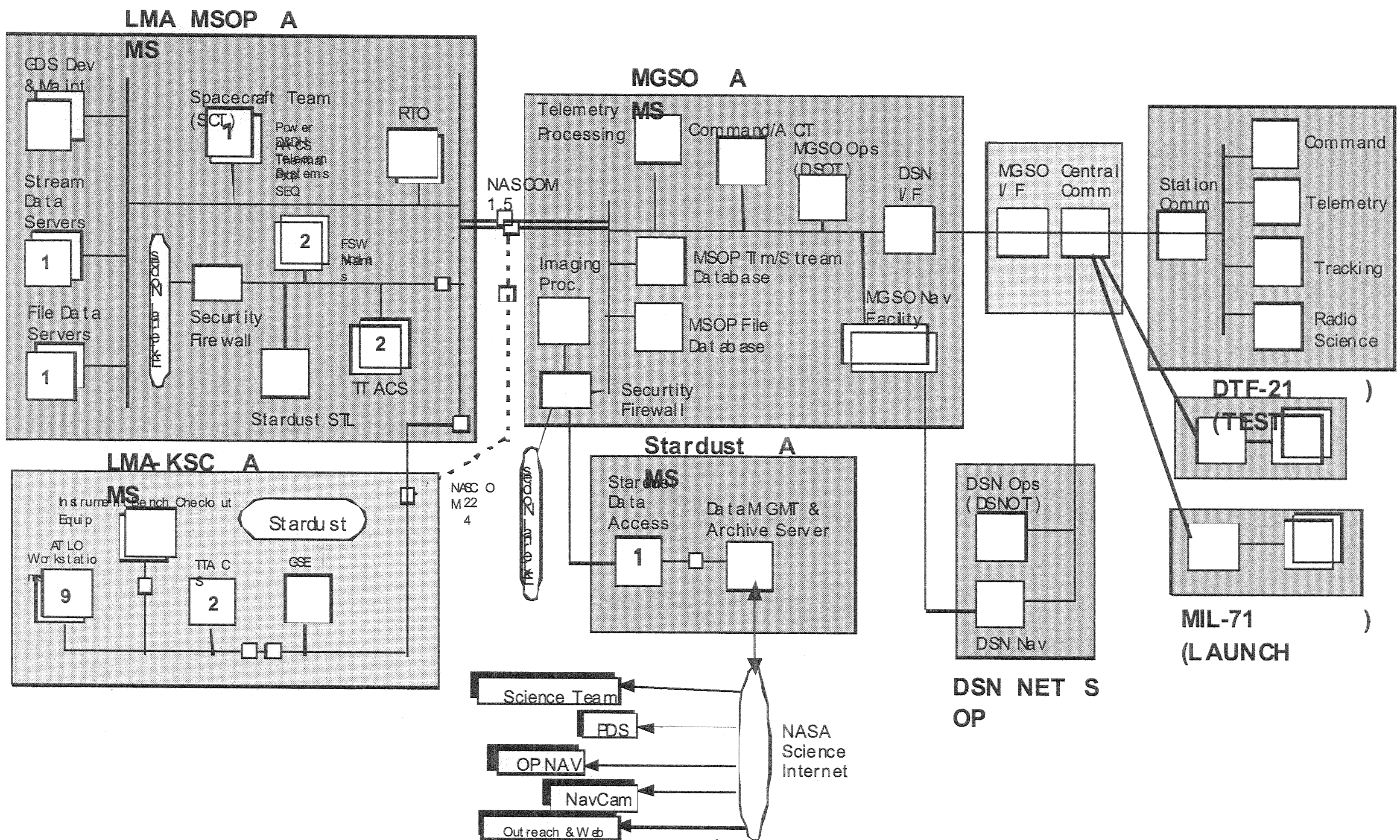
Multiple cruise phases, with interstellar dust particle collection, and with CIDA and DFMI operating

2.2 Ground Data System

The STARDUST Ground Data System (GDS - Figure 3) is provided by JPL's Multimission Ground Systems Office (MGSO) and Mars Surveyor Operations Office (MSOO), with augmentation by LMA. Because of the simplicity of the science and engineering instruments providing science data (minimal commanding and monitoring), low data rates and a small science team, STARDUST will not implement a GDS with instrument science teams tied directly into the GDS with project-provided Science Operations and Planning Computers (SOPC's) as done by many other JPL projects. Instead, a Data Management and Archive (DM&A) function will be provided by the JPL Navigation and Ancillary Information Facility (NAIF) to extract all archival channelized and packetized telemetry, convert these data to instrument Health and Safety Monitor files and PDS-approved Experiment Data Records (EDRs), place these derived / reduced files on a PC/NT File Server accessible via the NASA Internet for science team access, produce and maintain the SPICE Kernels and associated software, produce the archival data volumes, and provide the interface to the Planetary Data System (PDS).

DM&A will work with the instrument teams and the PDS to define EDR file formats and contents. DM&A will produce draft versions of these EDRs from the telemetered data, along with catalogs and SPICE Kernels for distribution to the science teams. The science teams will not have to operate in the formal, secure environment of other missions providing SOPCs, and will not have to interface with a secure (inside the firewall) command and telemetry stream.

Stardust Ground Data System



Each Instrument Team Leader is responsible for retrieving the Level 1A EDR products from the DM&A File Server ("dusty") and providing copies to their respective team members. "ftp" transfers will be used to obtain data from DM&A by the approved Team Leaders. After each instrument team validates their Level 1A EDRs they will approve archival data volume production and delivery to the PDS. Table 2 lists the expected volume of telemetered Level 1A science data.

3.0 DATA RIGHTS AND RELEASE POLICY

Because of the expected widespread scientific and public interest in science results from Wild 2 and the strong commitment of STARDUST scientists to releasing data on a timely basis, it is important to establish a clear release policy.

A cornerstone of the policy is the need for a reasonable interval of time to generate and validate standard data products and archive volumes before release to the general community. Based on experiences from the Magellan and Clementine missions, a six month period was necessary to produce useful products. At the same time, it is important to release significant data and findings immediately. STARDUST scientists are encouraged to validate and release data products as soon as possible, with the six month period considered to be a maximum for this mission (although certain data sets such as global maps may require more time to generate). Thus, the policy also defines a separate release of a significant subset of data, using modern technologies to reach a wide audience. The release policy is summarized as follows:

1. The generation/validation time period for standard data products is defined to be the period from receipt of DM&A-produced EDRs at instrument PI facilities until release of archive volumes to the Planetary Data System. During the generation/validation period, Team Leaders are expected to extract EDRs from the DM&A server, generate standard products, and validate the EDR and standard products. Efforts involving all of the STARDUST investigators are expected to be underway during this period. Generation and validation of archive volumes may require up to six months from time of receipt of EDR data from DM&A in order to produce useful archive volumes.

2. To ensure rapid dissemination of new and significant information, Instrument Teams will also release a subset of data earlier as a form of public outreach and education. These releases will typically be available within a day or so of data receipt. Postings on Internet (e.g., the STARDUST Instrument Team, Data Management and Archive, and Outreach World Wide Web Sites) will be used as a cost-effective way for widespread dissemination of these special products. The posted data will include images, spectra, dust counts and other forms of data that illustrate mission events and significant science results. Postings will include documentation.

3. During the generation/validation period, use and analysis of raw and derived products from a particular instrument, or use of the results of unpublished papers derived from such analysis must be done with the agreement of the relevant Instrument Leaders and Science Team members.

4. By the end of the six month generation / validation period, the relevant archive volumes and posted products will have been transferred to the Planetary Data System which will make them available to the general science community after successful completion of a peer review process.

4.0 PUBLIC INFORMATION RELEASE POLICY

Public information release includes press conferences and written material concerning both mission operations and scientific analyses. Specific policy statements for Public Information Release for the STARDUST Mission are:

1. Information concerning spacecraft and instrument anomalies may only be released by the STARDUST Project Director, in coordination with LMA, NASA Headquarters and the Principal Investigator.

2. Information concerning scientific results may be released during press conferences and press releases organized by the STARDUST Project and the Jet Propulsion Laboratory's Public Information Office, in coordination with NASA Headquarters and the Principal Investigator.

3. Information concerning scientific results from a given instrument may also be released by the Instrument Teams. For example, such releases may be organized by the home institution of the Principal Investigator, the CIDA Team Leader, the DFMI Team Leader, the Imaging Team Leader, the Radio Science Team Leader or the High Rate Science Team Leader.

4. Before data are deposited in the Planetary Data System, information concerning scientific results from a given study may only be released by the Instrument / Investigation Team Leader.

5. In cases 2 through 4, the STARDUST Project Director must receive, in advance of the release, a copy of the release material (e.g., images, spectra, captions, summary of results), a schedule for the release, and a statement of the mechanisms for release. The intent is not to require concurrence for the release, but only to make sure that the PI, STARDUST Project, the Jet Propulsion Laboratory Public Information Office, and NASA Headquarters are informed of the releases before they happen.

5.0 ARCHIVE COLLECTIONS AND VOLUMES

5.1 Overview

The Planetary Data System has developed archive concepts that are being applied to all current planetary missions and have been used for data restorations going back to the early Mariner flights. These concepts are embraced and will be implemented by STARDUST.

Seven STARDUST archive collections are defined as part of this Science Data Management Plan. Five of these correspond to the assemblage of standard products and associated information for the Navigation Camera, CIDA, DFMI, Radio Science and High Rate Dynamical Science. For reference, Table 3 shows the standard products to be produced by each instrument. The sixth collection corresponds to the SPICE data sets. The seventh is the assemblage of engineering products that need archiving, including raw science packet data. Table 4 summarizes the components of the various STARDUST archive collections.

5.2 High-Level Catalog Templates

The Planetary Data System has developed a suite of templates used to provide high-level information about a mission, spacecraft, instruments, and archive collections and volumes (Planetary Data System Standards Reference, 1994). The templates provide a high level view of a mission and its archives and are also used to populate a high level catalog operated by the Planetary Data System. The templates will be generated under the auspices of STARDUST Data Management and Archive team.

5.3 Algorithms and Software for Level 1A Products

Data Management and Archive is responsible for providing algorithms, associated documentation and data, or published references to these items, that describe how science packet data are converted to Level 1A data. Further, documented software for generating Level 1A data products will be submitted.

5.4 Data Product Labels

STARDUST data products will have labels that do not utilize CCSDS Standard Format Data Units (SFDUs) but instead utilize the Planetary Data System Labeling scheme. Label structures will be described in data product documents.

5.5 Science Data Packets

Instrument raw science data will consist of data packets containing time-ordered sequences of observations obtained by a given instrument, together with engineering information defining the operational state of the instruments. Unchannelized science instrument packet data and channelized engineering telemetry will be accessed within the firewall on the Telemetry Data Server (TDS) by STARDUST Data Management and Archive during EDR production. The exact contents of science and engineering packet data will be instrument-dependent. The MGSO will produce "safed" archive volumes containing packet data and relevant engineering data.

5.6 Standard Data Products

Standard Data Products are those Level 1A data objects generated from science packets and SPICE files, or from other data products. Standard Data Products will typically be generated from science packet data and SPICE data by DM&A and later validated by the Instrument Teams. Table 3 lists Standard Products for STARDUST. The total volume is expected to be approximately five gigabytes. Standard Products are sometimes called operational products in other missions, since they are produced routinely using well-defined procedures. During the STARDUST Mission it is expected that increased knowledge of instrument calibrations and operating nuances, together with increased knowledge of Wild 2 and better understanding of how to process data, will result in updates to some Standard Data Products. Standard Data Products are the primary constituents of the archive volumes to be provided to the Planetary Data System.

5.7 Special Derived Data Products

Special Data Products are defined to be products derived from Level 1A products produced during the course of scientific research. They are called Special Products as opposed to Standard Data Products because they are difficult to predefine and schedule since they will be dependent on the specific scientific content of STARDUST observations. Examples of potential higher level derived products include 3-dimensional, topographic models of the nucleus, dust flux and color models, nucleus albedo maps, and controlled photomosaic map products. Special Data Products, if produced, will be delivered directly to the Planetary Data System by the investigator who produced the product.

5.7 Estimated Archive Data Volume

An estimate of data volume for each experiment is provided in Table 2. The total volume (not including the safed engineering data) is estimated at a bit under 5 Gbytes.

6.0 OVERVIEW OF ARCHIVING FUNCTIONS

Standard products form the core of the archives to be produced by STARDUST and released to the PDS for distribution to the science community. These products and associated SPICE ancillary information will be placed on archive volumes for validation and transfer to the PDS. A logical grouping of volumes is termed an archive collection (Appendix I). Table 4 lists the key elements associated with archive collections and Table 5 lists suppliers of data and information for STARDUST archive collections. There will be one archive for each instrument, one for SPICE files and one for Level 0 science packets and engineering data. This last will be treated as a "safed" archive, not subject to peer review or normal PDS cataloging. It will reside at the PDS' NAIF node. This treatment is consistent with engineering data from other missions.

6.1 Generation

Figure 4 shows the flow of components through the various stages of archive volume generation, validation, transfer to the Planetary Data System, and distribution of products to the science community. Also shown is posting of timely results on the Internet / www for education and outreach.

Generation of the Level 0 archive is the responsibility of TMOD/TCDM. Only those Level 0 channelized telemetry and science packets needed for the production of Level 1A science EDRs, SPICE Kernels and Small Forces Files will be archived.

DM&A will work with the Instrument Teams and the PDS to develop the Level 1A EDR file formats and content definitions.

DM&A will produce all Level 1A EDRs. The Instrument Teams will be responsible for validating these EDRs and producing the associated documentation, algorithms or software to generate higher levels products. After validation archive volumes will be generated for the Instrument Teams by DM&A.

DM&A will assemble, and in most cases produce the SPICE Kernels, which include:

SPK - high precision, numerically integrated spacecraft trajectory, planetary and cometary ephemerides
PcK - selected planetary and cometary physical and dynamical parameter values
IK - science instrument field of view specifications
CK - spacecraft attitude, spacecraft body-fixed rates, and NAVCAM mirror position
EK - description of all mission, spacecraft, instrument, station and tracking events
LSK - leapseconds file
SCLK - spacecraft clock calibration parameters

In addition DM&A will produce the Small Forces File (SFF) giving spacecraft delta V history resulting from attitude control thruster firings

DM&A will transfer the archive volumes to the PDS for peer review and data ingestion based on the release schedule given in Section 5 of this Plan.

6.2 Validation and Delivery

Validation of Level 0 science packets, EDRs and SPICE files will be an intrinsic part of standard product generation. Validation of standard products will be done in part during analysis of the data. However, a key additional requirement is the validation of archive volumes for integrity of scientific content, file structures, directory structures, compliance with PDS standards, and integrity of the physical media used to transfer the dataset collections. This validation will be overseen by DM&A and will rely on participation of the Instrument Teams.

Final validation and peer review will take place under PDS auspices as a check of archive volumes before release to the planetary community. Any problems will be referred back to the STARDUST Project for correction.

7.0 ROLES AND RESPONSIBILITIES

In this section the roles and responsibilities for personnel and organizations involved in STARDUST archive generation, validation, transfer, and distribution are summarized.

7.1 STARDUST

The Project and Deputy Project Scientists provide an oversight function for implementation of the Science Data Management Plan. The STARDUST Data Management and Archive (DM&A) Group will advise the Project with regard to archiving. DM&A will work in an advisory role with STARDUST and the PDS to help ensure that detailed plans are in place for generation of Planetary Data System-compatible products and associated documentation, and that archive volumes are generated, validated, and transferred to the Planetary Data System.

TMOD/TCDM is responsible for producing and delivering to PDS/NAIF the archive volumes containing Level 0 packets and engineering files. This collection need include only those items needed to produce the Level 1A products. These volumes will not be peer reviewed–they will only be safed.

The STARDUST DM&A will produce archive volumes containing Level 1A EDRs and SPICE files. Instrument Teams are responsible for reviewing and validating these archive volumes. PDS will help with review of the initial archival products.

Radio Science will produce its own standard archive volumes consistent with PDS standards. The Radio Science archive will not include reduction software, but will instead provide documentation to explain how the processing is carried out.

Table 5 lists the suppliers for each component of the archive collections. Each Instrument Team will also be responsible for posting a subset of reduced data (and relevant documentation) on their STARDUST Outreach system accessible via the Internet for public access. Finally, the author of each archive collection is responsible for publishing a Software Interface Specification document that delineates the format and content of the respective volumes.

The STARDUST Project will provide funds for prodution and distribution of archive volume sets for use by the STARDUST Project community. The

PDS will provide funds for replication and distribution of volume sets for the NASA-supported science community once the volumes are released to and approved by the PDS.

7.2 Planetary Data System

The PDS Small Bodies Node is the designated point of contact for STARDUST on archive-related issues. The interfaces between the STARDUST teams and elements of the Planetary Data System are summarized in Table 6. The PDS Central Node is the interface between STARDUST and the NSSDC.

The PDS will work with DM&A to ensure that the STARDUST archives are compatible with PDS standards and formats. The PDS will maintain active archives of released STARDUST products for access by the science community.

7.3 National Space Science Data Center

The National Space Science Data Center will maintain a "deep archive" of the data for long-term preservation and for filling large delivery orders to the science community. The PDS will serve as the interface between STARDUST and NSSDC (see PDS-NSSDC MOU).

80 Archive Generation, Validation, and Release Schedules

8.1 Postings for Outreach and Education

It is anticipated that Instrument Team Leaders will develop World Wide Web sites. These sites will have pointers to the STARDUST Project Web site and to the other STARDUST instrument sites. Within a month after earth gravity assist, each of the instrument Web sites will provide access to data and documentation that illustrate results from the observations. Updates to the postings of reduced data and documentation will be done periodically during cruise, after earth gravity assist and also during Wild 2 approach and flyby.

For imaging, a subset of images will be posted after launch, after earth flyby, during Wild 2 approach and after flyby, and after Sample Return Capsule release.

8.2 Archive Volumes for Science Community Use

Standard products will be generated systematically during the course of the mission. These products will be used for analyses and some of them will be posted for education and outreach. Standard products also provide the research community the best derived data for their analyses.

The standard products are the core data sets for archive volumes to be delivered to the PDS. All SPICE files used to help generate the standard products will be released to the PDS at the same time that the standard products are released.

Standard products will be included in archive volumes for delivery to the PDS within six months after receipt of the last Level 0 data used in generating the standard products.

The first delivery of archives to the PDS is planned to take place within six months after launch. It should contain pre-launch calibration data plus flight data through launch + 30d. This will be followed by a delivery every twelve months during the remainder of the mission. This spacing fulfills a request from the PDS Small Bodies Node to limit deliveries to once per year and also places the deliveries within 6 months of launch, Earth Gravity Assist, Wild 2 flyby and Earth return. The last data acquired through the end of the nominal mission (January 2006) will be delivered by April 2006.

During the period between receipt of data and delivery of archive volumes to the PDS, standard products will be generated and validated, archive volumes will be assembled and placed on relevant media (e.g., CD's, DVD's), and the volumes will be validated.

8.3 Data Management Contingency Plan

Few contingencies are possible during the management of STARDUST file and stream data.

Routine operational practices and redundant hardware as well as redundant storage at key locations for limited periods within the GDS are planned. STARDUST project data will be backed up as part of routine daily operations. If significant amounts of expected data are not present, a replay from the most convenient location within the GDS will occur. The following contingencies cannot be accommodated with routine operations:

1. Data recorded on the spacecraft but not earth received

2. Earth received data that the GDS is not able to process

Data recorded on the spacecraft, but not received on Earth, is possible. Should any STARDUST data fall into this category and be of such importance that it must be recovered, only a change in spacecraft data storage management and down-link strategy can recover the data. Once on the ground the data will be processed like any other telemetry data.

Earth received data that cannot be processed by the GDS due to a GDS or spacecraft problem will require retention at the most convenient of the temporary locations where data is captured until the problem that was preventing processing has been corrected or a work around has been implemented

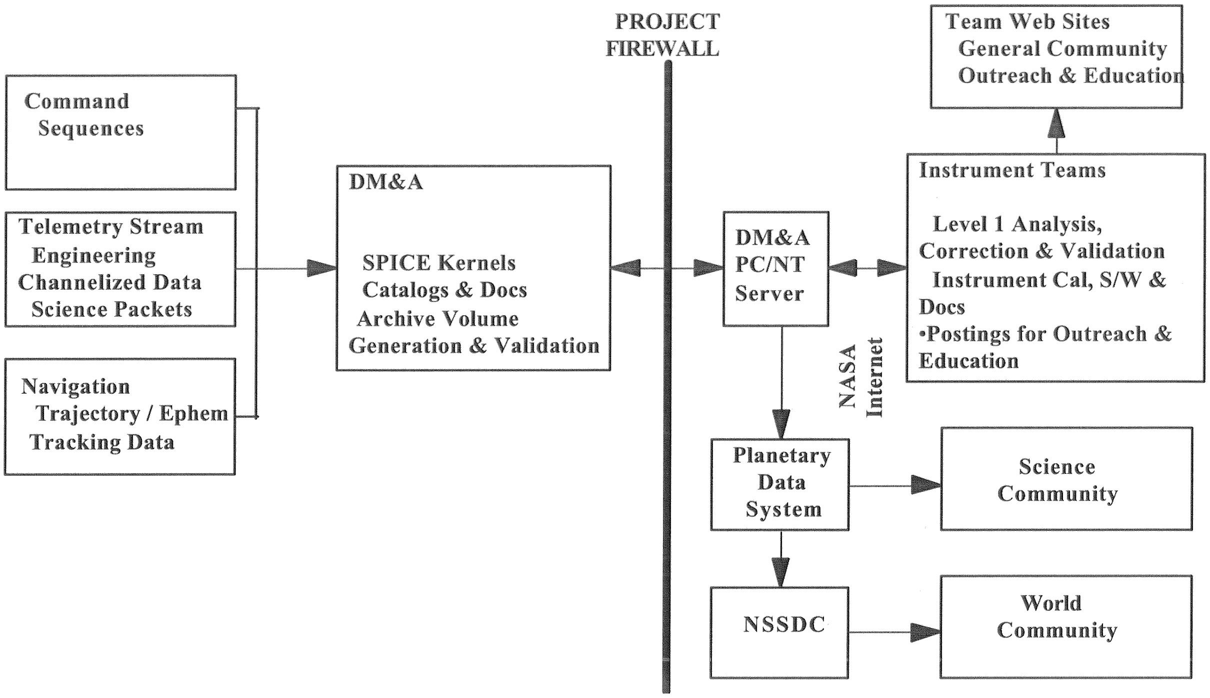


Figure 4. STARDUST Downlink Data Flow, Processing and Interfaces

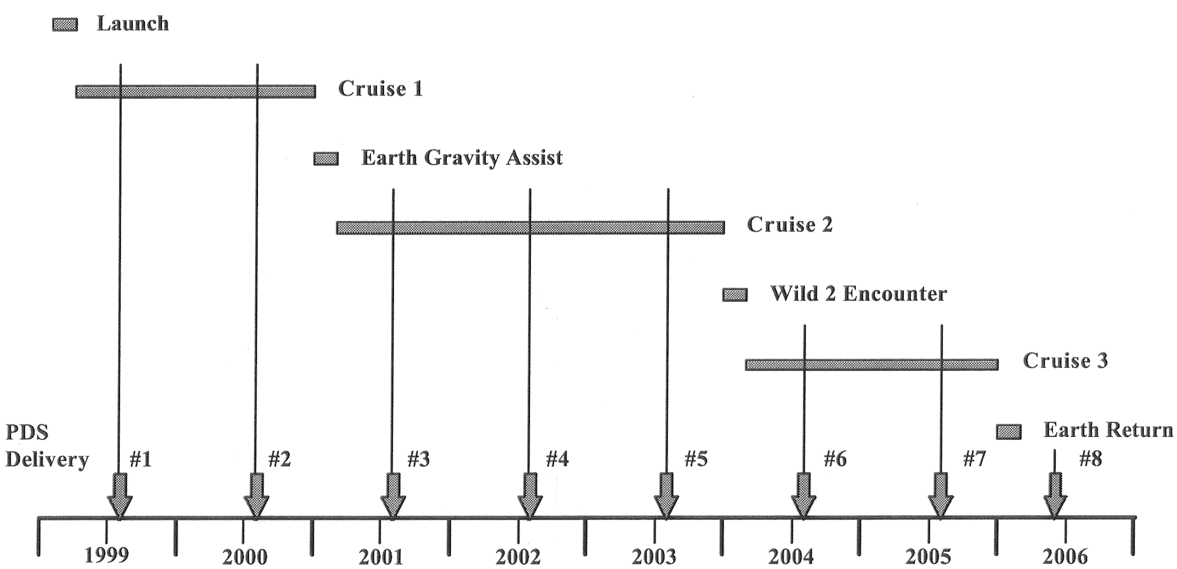


Figure 5. Data Volume Archive Deliveries to PDS as a Function of Mission Phase

TABLE 1. STARDUST Telemetered Flight Science Data

Investigation	Description	Team Lead
Navigation Imaging Camera	CCD-based camera having 1024 x 1024 active pixels with a 3.5 x 3.5 deg^2 field of view, 8 filters, and a mirror to change pointing over a 200 deg angle. Navigation is primary function; science is is bonus.	Drs. Ray Newburn & Shyam Bhaskaran, Jet Propulsion Laboratory
Dust Flux Monitor Instrument	Two acoustic and two PVD sensors counting dust impacts from $1.0*10^{-11}$ to $1.0*10^{-3}$ grams.	Dr. Tony Tuzzolino, University of Chicago
Cometary and Interstellar Dust Analyzer	Time of Flight Mass spectrometer	Prof. Jochen Kissel, Max Plank Institute fur Kern Physics
High Rate Attitude Science	Spacecraft orientation and angular rate taken at 100 Hz during Wild 2 flyby	Dr. Ben Clark, Lockheed Martin Astronautics
Radio Science	X-band 2-way coherent doppler and ranging radiometric measurements of the spacecraft from the DSN	Dr. John Anderson, Jet Propulsion Laboratory

TABLE 2. Estimated Instrument Data Volumes

Instrument	Data Returned, Mbytes
CIDA	100
DFMI	20
High Rate Science	1
Navigation Camera	3,500 (includes 3,000 from pre-launch calibrations)
Radio Science	50
SPICE Kernels	1,000
Total	4,671

TABLE 3. Standard Data Products

Source	Standard Data Product
CIDA	Time-of-flight Records (CIDA-TOF)
DFMI	Time series of dust counts (DFMI-CNTS)
High Rate Science	SPICE C Kernel (CK)
Navigation Camera	Full frame images (NC-IMG)
Radio Science	Line-of-sight Acceleration Profiles (RS-LOSAP)
SPICE	SPICE Kernels

TABLE 4. Components of STARDUST Archive Collections

Science Data Archive Collections (one for each of the 3 instruments)

- Mission, spacecraft, instrument, and dataset templates
- Software Interface Specification Documents or equivalent
- Processing Descriptions, Algorithms, and Software (to use in understanding reduced data record generation)
- Instrument Calibration Reports and associated data needed to understand Level 1A product generation
- Level 1A EDRs for CIDA, DFMI and Nav Camera
  - Labels
  - Data Objects
  - Index Files
  - Catalogs

Radio Science Collection

- Mission, spacecraft, instrument and dataset templates
- Software Interface Specifications or equivalent
- Processing description
- Data Products
  - Orbit Data Files
  - Suite of related ancillary files

SPICE Archive Collection

- SPICE Kernel Software Interface Specification Documents or equivalent
- SPICE Kernels
  - Included in this collection will be the High Rate Science data
- Small Forces Files

Level 0 Packet and Engineering Data Archive Collection

- Archive Collection and Volume Software Interface Specification Documents
- Level 0 Science Packet Data Products[1]
- Engineering File Data Products[2]

[1] Subset needed to produce Level 1A and SPICE prodcuts

TABLE 5. STARDUST Archive Collection Component Suppliers

Data Management and Archive Team (DM&A)
- Planetary Data System templates
- Level 1A EDRs
- SPICE kernel files (except SPK)
- Small Forces File
- Project documentation
- Experimenter 's Notebook contributions

Spacecraft Team (SCT)
- Experimenter's Notebook contributions

Navigation Team (NAV)
- SPK files
- Experimenter 's Notebook contributions

Investigation Teams (NAVCAM, CIDA, DFMI)
- Instrument calibration reports and associated data
- Experimenter's Notebook contributions

Radio Science Team
- Orbit data files
- Related ancillary files

TMOD / TCDM
- Level 0 packet and engineering data archive

TABLE 6. Planetary Data System Responsibilities for Archiving STARDUST Data

Planetary Data System Organization	Responsibility
Central Node/Mission Interface Team	Overall coordination with STARDUST Project, including joint planning efforts
Small Bodies Node	Archive CIDA, DFMI and NAVCAM volumes

Image Node	Archive NAVCAM volumes
NAIF Node	Archive SPICE Kernels, High Rate Science, Radio Science, Level 0 packets and ancillary engineering files

APPENDIX I — Glossary of Selected Terms

Archive collection — Data Products, supplemental data, software, and documentation that are logically linked to facilitate their use and administration.

Archive Volume — A volume represents a single unit of media. The media supported by PDS are CD-ROMs and magnetic tape. Within each volume is a directory structure, listing the subdirectories and files contained on that volume. Magnetic tapes have a "virtual" directory structure provided in a directory and file map included on the volume.

Data product — A labeled grouping of data resulting from a scientific observation. A product label, identifies, describes, and defines the structure of the data. Examples of data products are planetary images, spectrum tables, and time series tables.

Data Set- A logical grouping of data products.

Experiment Data Record -- Level 1.0 data product produced from instrument packet data with PDS labels

High-level catalog — High-level descriptive information about mission, spacecraft, instrument, data sets, and related items. Catalog inputs derived from templates expressed in Object Description Language (ODL) which are suitable for loading into a catalog.

Reduced data records — Raw science data that have been processed to some level and output as set of data products.

Science packets — Level 0 (raw) data for a given instrument in unchannelized telemetry packetized form.

Special Data Products -- derived from Level 1.0 products by use of data analysis, data transformation in space, spectra and/or time. Examples include dust models, 3-dimensional topography models and map products.

Standard data product — Reduced data record generated in standard or predefined way using well-understood procedures. Processed in "pipeline" fashion.

APPENDIX II — Definition of Processing Levels for Science Data Sets

LEVEL 0 — Instrument science packets (e.g., raw voltages, counts) at full resolution, time ordered, with duplicates and transmission errors removed. Corresponds to Space Science Board's Committee on Data Management and Computation (CODMAC) Edited Data (see National Academy press, 1986).

NOTE: Following levels correspond to Reduced Data Records and may correspond to Standard or Special Data Products.

LEVEL 1A — Level 0 data which have been located in space and may have been transformed (e.g., calibrated, rearranged) in a reversible manner and packaged with needed ancillary and auxiliary data (e.g., radiances with the calibration equations applied). Corresponds to CODMAC Calibrated Data.

LEVEL 1B — Irreversibly transformed (e.g., resampled, remapped, calibrated) values of the instrument measurements (e.g., radiances, magnetic field strength). Corresponds to CODMAC Resampled Data.

LEVEL 1C — Level 1A or 1B data which have been resampled and mapped onto uniform space-time grids. The data are calibrated (i.e., radiometrically corrected) and may have additional corrections applied (e.g., terrain correction). Corresponds to CODMAC Derived Data.

LEVEL 2 — Geophysical parameters, generally derived from Level 1 data, and located in space and time commensurate with instrument location, pointing, and sampling. Corresponds to CODMAC Derived Data.

LEVEL 3 — Geophysical parameters mapped onto uniform space-time grids. Corresponds to CODMAC Derived Data.