Getting your hands on Mars data and some sample science

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Comparative Aeronomy on Earth and Mars Workshop

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Copies of talk available…

The Basic Idea

- You are excited about doing some comparative Earth/Mars science, but do not know what Mars data exists, how to find it, where to start in the literature, or what is coming in the future

- I aim to give an overview of those topics, with many useful references

Outline

- Types of data that are (and are not) available
- Good places to start
- Getting at the Data
- Literature
- Opportunities
- Example Studies

Available Data (Old)

- Mariner 6, 7, and 9 Ultraviolet Spectrometer
- Viking Lander vertical profiles of ion and neutral composition (2 of each)
- 433 ne(z) profiles from radio occultations by many spacecraft
- Phobos 2 data (some particles and fields expts)
- GCM output (PDS volume mogc_0001 and http://data.engin.umich.edu/tgcm_planets_archive/thermo.html)

Available Data (Recent)

- Mars Global Surveyor (MGS) 3-axis Magnetometer data along flight path
- MGS Electron Reflectometer, energy spectra of electrons with some spatial resolution
- MGS TES T(p) in lower atmosphere (0 – 60 km)
- MGS and Mars Odyssey Accelerometer thermospheric densities (100 – 160 km) along aerobraking flight path

Anticipated Data (Mars Express)

- PFS (IR spectrometer) T(p), H2O, CO2, trace species, aerosol properties
- SPICAM (UV spectrometer) O3(z), H2O, rho(z) from 40 – 200 km (?), airglow
- MARSIS (subsurface radar) topside ionospheric sounding
- ASPERA (ion spectrometer and energetic neutral imager)
- MaRS (radio occultations) T(p), ne(z)

Desired Data

- Thermospheric Dynamics
- Ionospheric Dynamics
- Additional ion/neutral composition profiles
- Higher resolution magnetic field data
- Observations of escaping species
- General observations near magnetic anomalies

Places to Start

- National Space Science Data Center (NSSDC)
  - http://nssdc.gsfc.nasa.gov
- Planetary Data System (PDS)
  - http://pds.jpl.nasa.gov (Main)
  - http://pds-ppi.igpp.ucla.edu (Ion., Plasma, etc)
  - http://pds-atmosphere.nmsu.edu (Atm.)
- "Mars", ed. Kieffer et al., University of Arizona Press, 1992

Mars - Mozilla

File Edit View Go Bookmarks Tools Window Help

Back Forward Reload Stop http://nssdc.gsfc.nasa.gov/planetary/planets/marspage.html

Home Bookmarks

Missions to Mars

- Mars Chronology - Timeline of all Mars missions

- Mars Exploration Rovers - Two NASA Rovers to Mars (2003)
- Mars Express - ESA Mars Orbiter and Lander (2003)
- 2001 Mars Odyssey - NASA Orbiter Mission to Mars (2001)
- Mars Polar Lander - NASA attempted lander to Mars (1999)
- Deep Space 2 - NASA attempted penetrator mission to Mars (1999)
- Mars Climate Orbiter - NASA attempted orbiter to Mars (1998)
- Nozomi (Planet-B) - ISAS (Japan) orbiter to Mars (1998)
- Mars Global Surveyor - NASA Mars orbiter (1996)
- Mars Pathfinder - NASA lander and rover to Mars (1996)
- Mars 96 - Russian attempted mission to Mars (1996)
- Mars Observer - NASA attempted mission to Mars (1992)
- Phobos - Soviet missions to Mars (1988)
- Viking - NASA orbiters/landers to Mars (1975)
- Mars 6 - Soviet Mars lander (1973)
- Mars 5 - Soviet Mars orbiter (1973)
- Mariner 9 - NASA Mars orbiter (1971)
- Mars 3 - Soviet Mars orbiter and lander (1971)
- Mars 2 - Soviet Mars orbiter and lander (1971)
- Mariner 7 - NASA Mars flyby (1969)
- Mariner 6 - NASA Mars flyby (1969)
- Mariner 4 - NASA Mars flyby (1964)

Mariner 6

NSSDC ID:1969-014A

Other Name(s)

- Mariner F
- Mariner Mars 69A
- 03759

Launch Date/Time: 1969-02-24 at 01:29:02 UTC
On-orbit dry mass: 411.8 kg
Nominal Power Output: 449 W

Description

Mariner 6 and 7 comprised a dual-spacecraft mission to Mars, the sixth and seventh missions in the Mariner series of spacecraft used for planetary exploration in the flyby mode. The primary objectives of the missions were to study the surface and atmosphere of Mars during close flybys to establish the basis for future investigations, particularly those relevant to the search for extraterrestrial life, and to demonstrate and develop technologies required for future Mars missions and other long-duration missions far from the Sun. Mariner 6 also had the objective of providing experience and data which would be useful in programming the Mariner 7 encounter 5 days later. Each spacecraft carried a wide- and narrow-angle television camera, an infrared spectroscope, an infrared radiometer, and an ultraviolet spectroscope. The spacecraft were oriented entirely to planetary data acquisition, and no data were obtained during the trip to Mars or beyond Mars.

Discipline(s)

Astronomy
Planetary Science
Solar Physics

Sponsoring Agencies/Countries

NASA-Office of Space Science Applications/United States

Personnel Information
Launch/Orbital Information
Publication Information

Experiment Information
Data Set Information

NSSDC home page

For questions about this mission, please contact:
Dr. David R. Williams
GSFC-Code 633
NASA Goddard Space Flight Center, Greenbelt, MD 20771
301-286-1258
david.r.williams@gsfc.nasa.gov

NSSDC Master Catalog Display: Experiment List

Number of records: 8

Mariner 6

Experiment Name	Principal Investigator
IR Spectrometer	Prof. George C. Pimentel
Two-Channel IR Radiometer Mars Surface Temperature	Dr. Gerry Neugebauer
UV Spectrometer	Dr. Charles A. Barth
S-Band Occultation	Dr. Arvydas J. Kliore
Thermal Control Flux Monitor (Conical Radiometer)	Mr. Joseph A. Plamondon
Mars TV Camera	Dr. Robert B. Leighton
Celestial Mechanics	Dr. John D. Anderson
General Relativity	Dr. John D. Anderson

NSSDC Master Catalog Display: Dataset List

Number of records: 21

Dataset Name	Spacecraft,Experiment
Mariner 6 and 7 Master Data Records (PDS)	Mariner 6
Mariner 6 & 7 TV Reduced Data Records on CD-WO (PDS)	Mariner 6,Mars Surface TV Camera
Near-Encounter Maximum Discriminability Optimal Presentation Photos	Mariner 6,Mars Surface TV Camera
Near-Encounter Photometrically Decalibrated Photos	Mariner 6,Mars Surface TV Camera
Raw-Analog Near-Encounter Photos	Mariner 6,Mars Surface TV Camera
Far-Encounter Maximum Discriminability Alternative Contrast Enhanced Photos	Mariner 6,Mars Surface TV Camera
Near-Encounter Enhanced Photographs	Mariner 6,Mars Surface TV Camera
Far-Encounter Maximum Discriminability Optimal Presentation Photos	Mariner 6,Mars Surface TV Camera
Near-Encounter Maximum Discriminability Alternative Contrast Enhanced Photos	Mariner 6,Mars Surface TV Camera
Far-Encounter Photometric Photographs	Mariner 6,Mars Surface TV Camera
Near-Encounter Photographic Mosaics	Mariner 6,Mars Surface TV Camera
Near-Encounter Photometric Photographs	Mariner 6,Mars Surface TV Camera
Far-Encounter Photometrically Decalibrated Photos	Mariner 6,Mars Surface TV Camera
Raw-Analog Far-Encounter Photos	Mariner 6,Mars Surface TV Camera
MR6/MR7 Mars Infrared Spectrometer Calibrated Data V1.0 (PDS)	Mariner 6,IR Spect 1.5-15 Micron Mariner 7,IR Spect 1.5-15 Micron
IR Spectrometer Data	Mariner 6,IR Spect 1.5-15 Micron
Reduced Two-Channel Infrared Radiometer Data of Mars	Mariner 6,2 Channel IR Radiometer
Upper Atmosphere Far-UV, Middle-UV, and Lyman-Alpha Spectra	Mariner 6,UV Spectrometer Exper
Celestial Mechanics Range and Range-Rate Listing	Mariner 6,Celestial Mechanics
Mariner 4,5,6,7,9,10 and Pioneer Venus Radio Science on CD-WO (PDS)	Mariner 6,S-Band Occultation
S-Band Doppler Residuals/Refractivity Data	Mariner 6,S-Band Occultation

Upper Atmosphere Far-UV, Middle-UV, and Lyman-Alpha Spectra

NSSDC ID:PSPA-00105

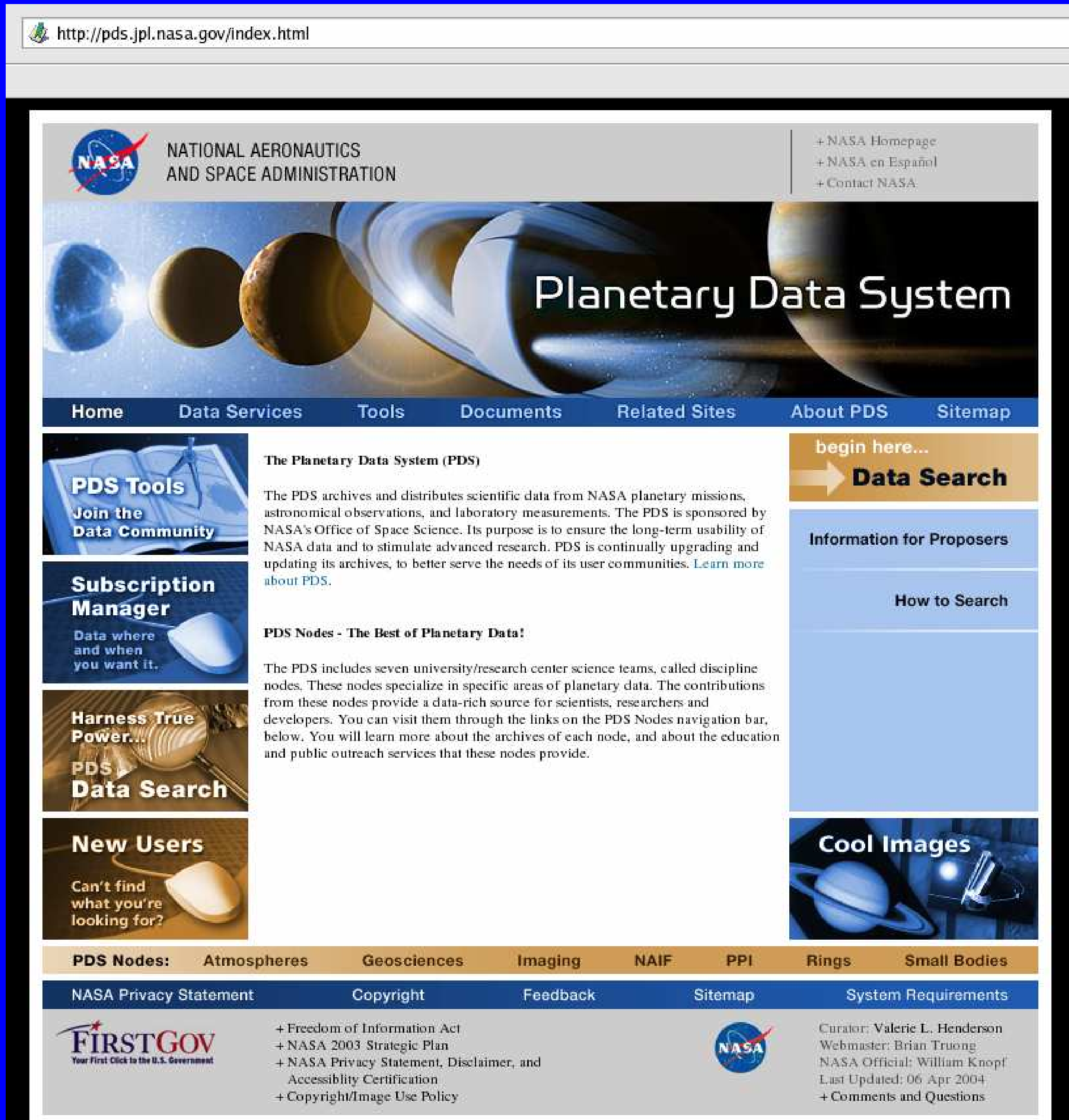
Other ID(s)

69-014A-04A

Availability: At NSSDC, Ready for Offline Distribution (or Staging if Digital)
Time Span: 1969-07-31 to 1969-07-31 (as determined by NSSDC)

Description

This data set, supplied by the experimenter, consists of a reformatted binary magnetic tape generated on a CDC 6400 computer. The tape was derived from the original experimenter's data tape, which contained both the Mariner 6 and 7 ultraviolet spectrometer (UVS) data. The data set contains less than 30 min of UV data. File 1 contains unprocessed (as transmitted by the spacecraft) data between 1900 and 4000 A, while file 2 contains the same data calibrated in units of rayleighs/A. These spectra represent atmospheric emissions from the 90- to 240-km altitude region. The formats for the two files are identical. The first record of each file provides a six-word description of the file contents including information on whether the data are processed or unprocessed, whether the spectra are middle UV (1900 to 4000 A) or far UV (1100 to 1800 A), what units the data are in, and the record size. The subsequent records consist of a 10-word description of one spectrum (the spectral number, spacecraft ID, altitude at first wavelength, altitude at last wavelength, slit height, solar incident angle, solar emission angle, and phase angle) and the data from that spectrum. Each spectrum is presented as alternating words of wavelength and relative amplitude. These two files of data are unique in that no times of observation are given. The subsequent file contains Lyman-alpha (1216 A) data derived from emissions observed near the planetary surface to 30,000-km altitude. The file consists of a series of three-word sequences that give (1) the integrated value of the Lyman-alpha signal in rayleighs, (2) the planetocentric distance of that signal in km, and (3) the actual time the signal was taken expressed in units of UT (in decimal form) times 10 to the 4. The quality of the data is excellent.



http://pds.jpl.nasa.gov/index.html

NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION

+ NASA Homepage
+ NASA en Español
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Planetary Data System

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Data where and when you want it.

Harness True Power...
PDS Data Search

New Users
Can't find what you're looking for?

The Planetary Data System (PDS)

The PDS archives and distributes scientific data from NASA planetary missions, astronomical observations, and laboratory measurements. The PDS is sponsored by NASA's Office of Space Science. Its purpose is to ensure the long-term usability of NASA data and to stimulate advanced research. PDS is continually upgrading and updating its archives, to better serve the needs of its user communities. Learn more about PDS.

PDS Nodes - The Best of Planetary Data!

The PDS includes seven university/research center science teams, called discipline nodes. These nodes specialize in specific areas of planetary data. The contributions from these nodes provide a data-rich source for scientists, researchers and developers. You can visit them through the links on the PDS Nodes navigation bar, below. You will learn more about the archives of each node, and about the education and public outreach services that these nodes provide.

begin here...
Data Search

Information for Proposers

How to Search

Cool Images

PDS Nodes: Atmospheres | Geosciences | Imaging | NAIF | PPI | Rings | Small Bodies

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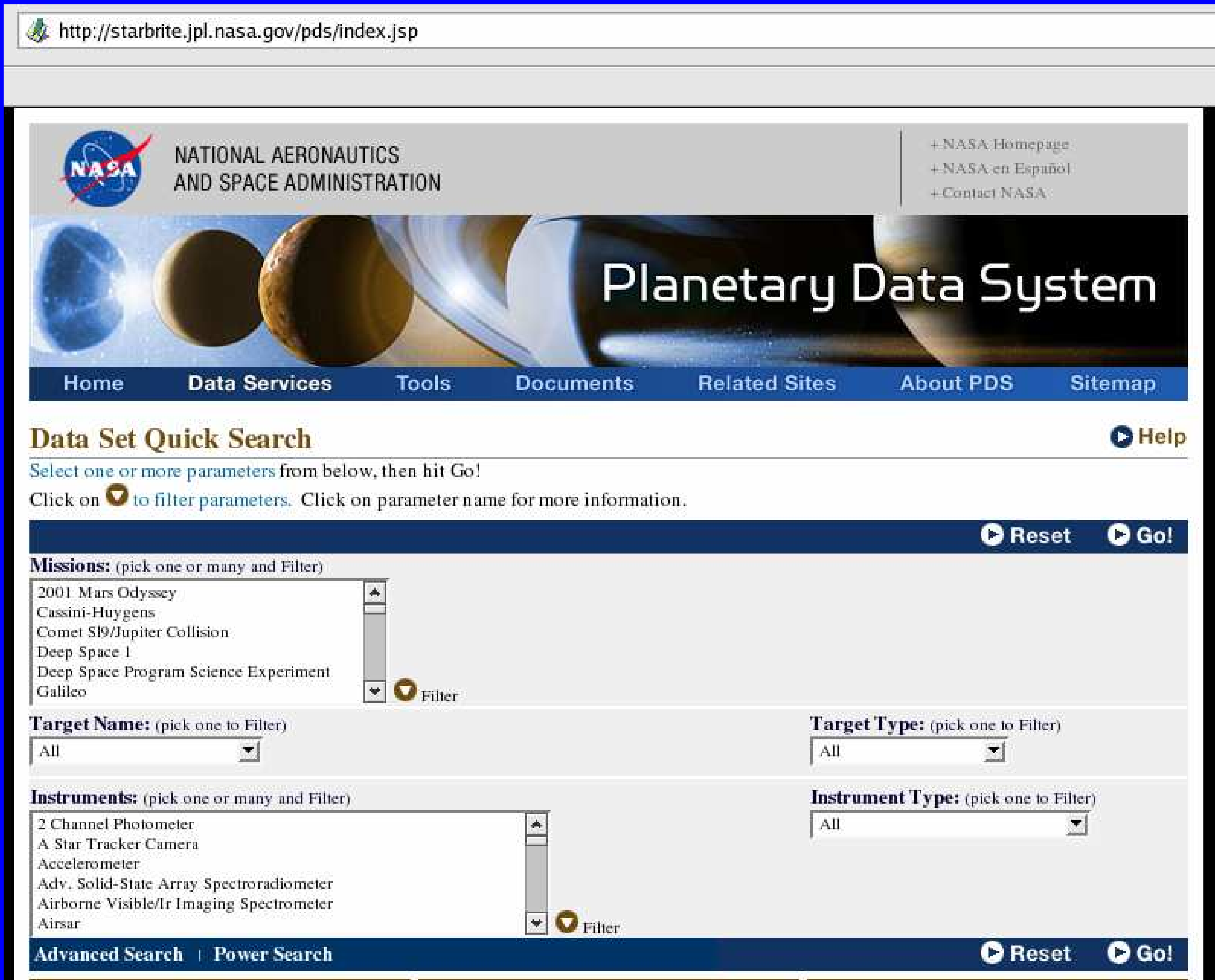
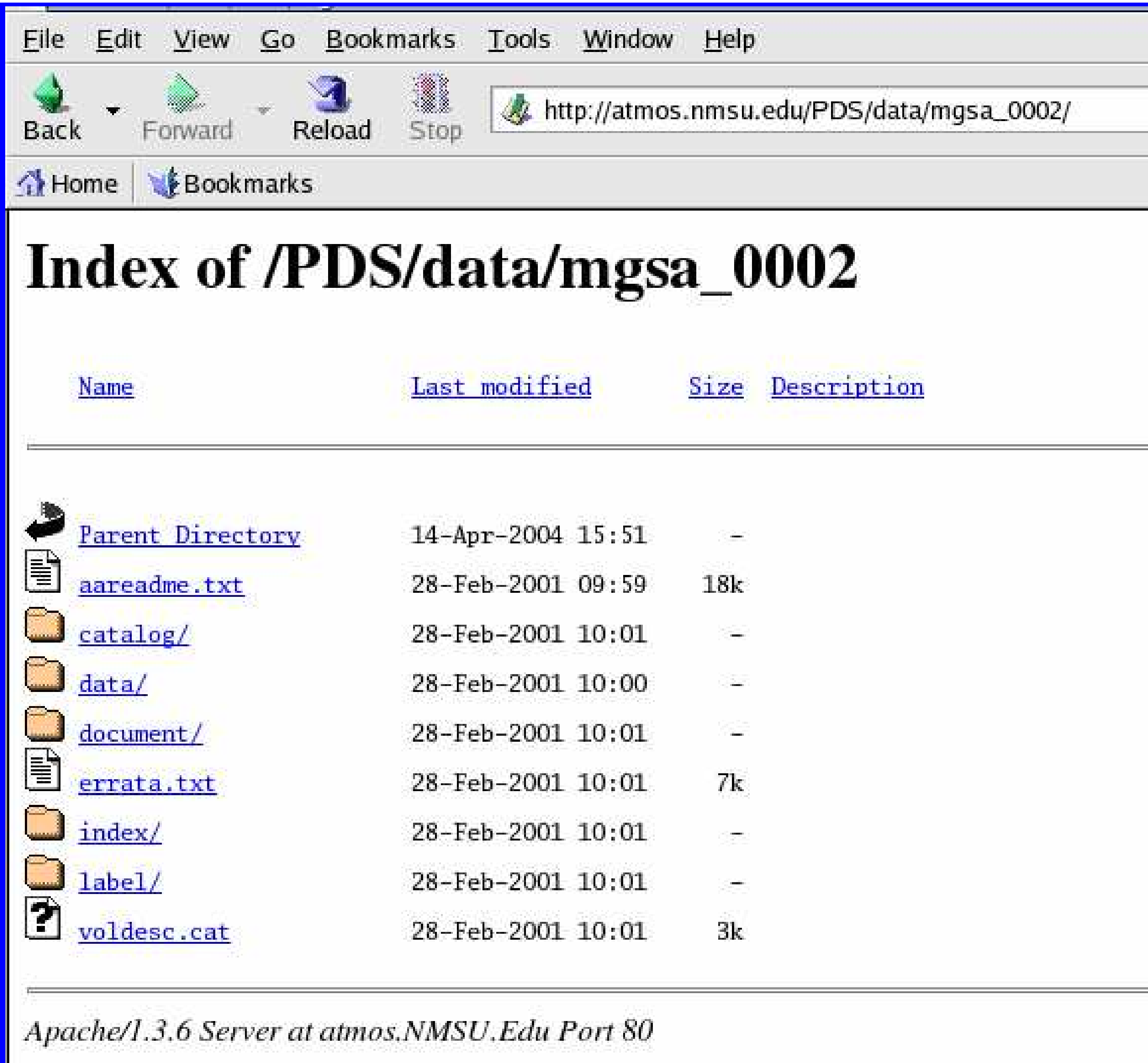
Curator: Valerie L. Henderson
Webmaster: Brian Truong
NASA Official: William Knopf
Last Updated: 06 Apr 2004
+ Comments and Questions


http://starbrite.jpl.nasa.gov/pds/index.jsp
NASA
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
+ NASA Homepage
+ NASA en Español
+ Contact NASA
Planetary Data System
Home
Data Services
Tools
Documents
Related Sites
About PDS
Sitemap
Data Set Quick Search
Help
Select one or more parameters from below, then hit Go!
Click on to filter parameters. Click on parameter name for more information.
Reset
Go!
Missions: (pick one or many and Filter)
2001 Mars Odyssey
Cassini-Huygens
Comet Sl9/Jupiter Collision
Deep Space 1
Deep Space Program Science Experiment
Galileo
Filter
Target Name: (pick one to Filter)
All
Target Type: (pick one to Filter)
All
Instruments: (pick one or many and Filter)
2 Channel Photometer
A Star Tracker Camera
Accelerometer
Adv. Solid-State Array Spectroradiometer
Airborne Visible/Ir Imaging Spectrometer
Airsar
Filter
Instrument Type: (pick one to Filter)
All
Advanced Search | Power Search
Reset
Go!



Index of /PDS/data/mgsa_0002

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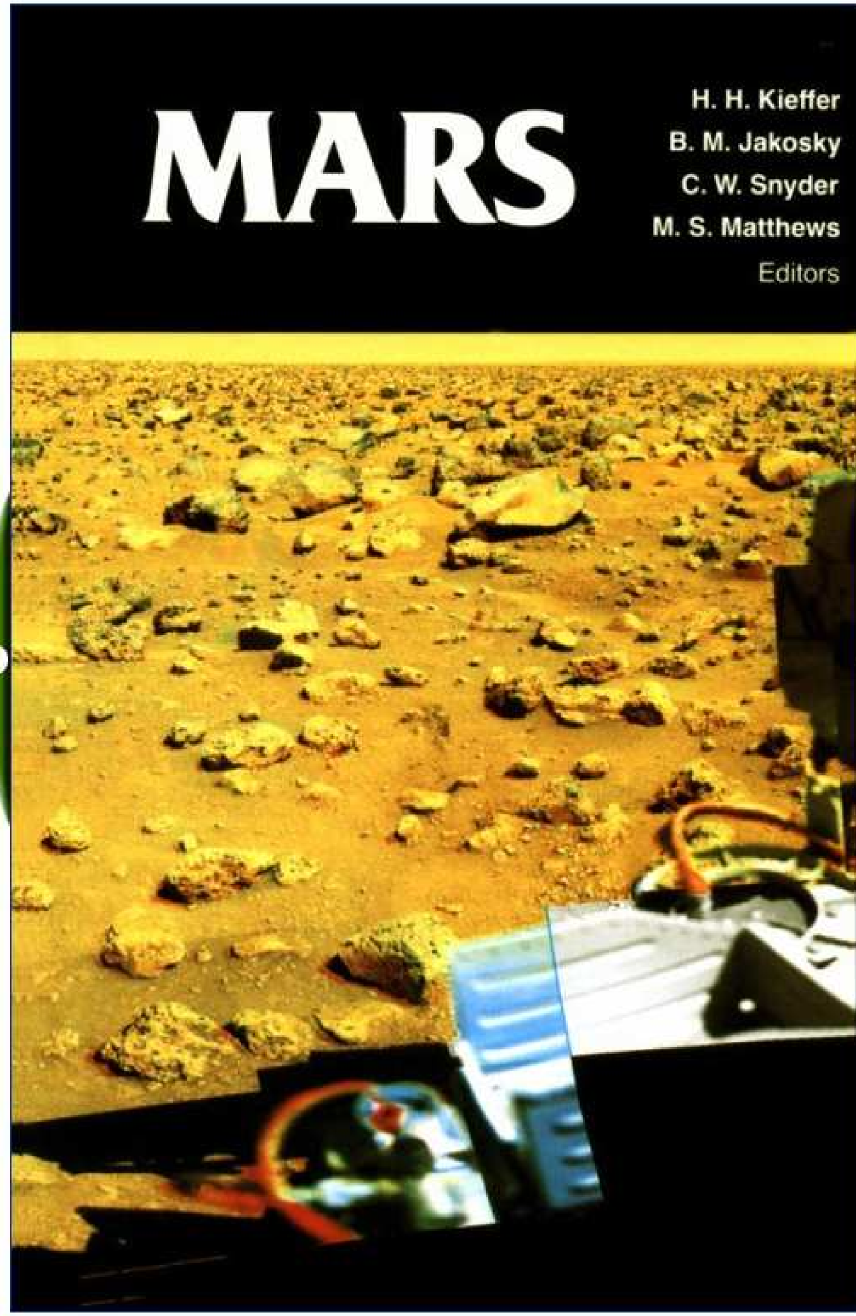
aareadme.txt	28-Feb-2001 09:59	18k	
catalog/	28-Feb-2001 10:01	-	
data/	28-Feb-2001 10:00	-	
document/	28-Feb-2001 10:01	-	
errata.txt	28-Feb-2001 10:01	7k	
index/	28-Feb-2001 10:01	-	
label/	28-Feb-2001 10:01	-	
voldesc.cat	28-Feb-2001 10:01	3k	

Apache/1.3.6 Server at atmos.NMSU.Edu Port 80


MARS
H. H. Kieffer
B. M. Jakosky
C. W. Snyder
M. S. Matthews
Editors

PART V—CURRENT ATMOSPHERES

Space Science Series

- **Planets, Stars and Nebulae Studied with Photopolarimetry.** T. Gehrels, ed. 1974. Cloth $7
- **Planetary Satellites.** Joseph A. Burns, ed. 1977. Cloth $55.00s
- **Asteroids.** T. Gehrels, ed. *See Arizona Books on Request.*
- **Protostars and Planets.** T. Gehrels, ed. *See Arizona Books on Request.*
- **Comets.** Laurel L. Wilkening, ed. 1982. Cloth $60.00s
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- **Venus.** D. M. Hunten, L. Colin, and T. M. Donahue, eds. 1983. Cloth $90.00s
- **Satellites.** Joseph A. Burns and Mildred Shapley Matthews, eds. 1986. Cloth $80.00s
- **Meteorites and the Early Solar System.** John F. Kerridge and Mildred Shapley Matthews, ec
- **Mercury.** Faith Vilas, Clark R. Chapman, and Mildred Shapley Matthews, eds. 1989. Cloth $
- **Asteroids II.** Richard P. Binzel, T. Gehrels, and Mildred Shapley Matthews, eds. *See Arizona*
- **Origin and Evolution of Planetary and Satellite Atmospheres.** S. K. Atreya, J. B. Pollack,
- **Solar Interior and Atmosphere.** Arthur N. Cox, William C. Livingston, and Mildred Shapley
- **Uranus.** Jay T. Bergstralh, Ellis D. Miner, and Mildred Shapley Matthews, eds. 1991. Cloth $
- **The Sun in Time.** Charles P. Sonett, Mark S. Giampapa, and Mildred Shapley Matthews, eds.
- **Protostars and Planets III.** Eugene Levy and Jonathan I. Lunine, eds. *See Arizona Books on*
- **Resources of Near Earth Space.** John S. Lewis, Mildred Shapley Matthews, and Mary L. Gu
- **Mars.** Hugh H. Kieffer, Bruce M. Jakosky, Conway Snyder, and Mildred S. Matthews, eds. 1
- **Hazards Due to Comets and Asteroids.** T. Gehrels, ed. 1995. Cloth $85.00s
- **Neptune and Triton.** Dale P. Cruikshank, ed. 1996. Cloth $125.00s
- **Cosmic Winds and the Heliosphere.** J. R. Jokipii, C. P. Sonett, and M. S. Giampapa, eds. 19
- **Venus II: Geology, Geophysics, Atmosphere, and Solar Wind Environment.** Steven W. B
- **Pluto and Charon.** S. Alan Stern and David J. Tholen, eds. 1998. Cloth $90.00s
- **Origin of the Earth and Moon.** Robin M. Canup and Kevin Righter, eds. 2000. Cloth $55.0
- **Protostars and Planets IV.** Edited by Vince Mannings, A. P. Boss, and S.S. Russell, eds. 20
- **Asteroids III.** William F. Bottke, Alberto Cellino, Paolo Paolicchi, and Richard P. Binzel, eds

Other references

- Atmospheres in the Solar System: Comparative Aeronomy, Eds. Mendillo, Nagy, and Waite, AGU Geophysical Monograph 130, 2002
- Venus and Mars: Atmospheres, Ionospheres, and Solar Wind Interactions, Eds. Luhmann, Tatrallyay, and Pepin, AGU Geophysical Monograph 66, 1992

$ - http://research.hq.nasa.gov/code_s/open.cfm 13 August 2004

B.5 MARS DATA ANALYSIS

1. Scope of Program

The objective of the Mars Data Analysis (MDA) program is to enhance the scientific return from the Mars Pathfinder (MPF), Mars Global Surveyor (MGS), Mars Odyssey (MO), and Mars Exploration Rover (MER) missions by broadening scientific participation in the analysis of their respective data sets and to fund high priority areas of research that support planning for future Mars missions. The MDA program supports scientific investigations using publicly available (released) data obtained during and after the aerobraking phase of MO and MGS, data obtained by MPF in its primary and extended mission phases, and data obtained from the MER mission on the surface of Mars. Where justified to support planning for future Mars missions, investigations that use data collected by other spacecraft (e.g., Viking and Mariner 9) or derived from other sources (e.g., ground-based radar) will also be considered.

3. Programmatic Information

It is anticipated that approximately $3.4M will be available for new investigations supported by the MDA program in Fiscal Year 2005, split between investigations for data analysis and investigations for advanced planning for Mars missions. These funds are expected to be sufficient to support 30-40 new investigations, which may be proposed for up to a three-year period of performance.

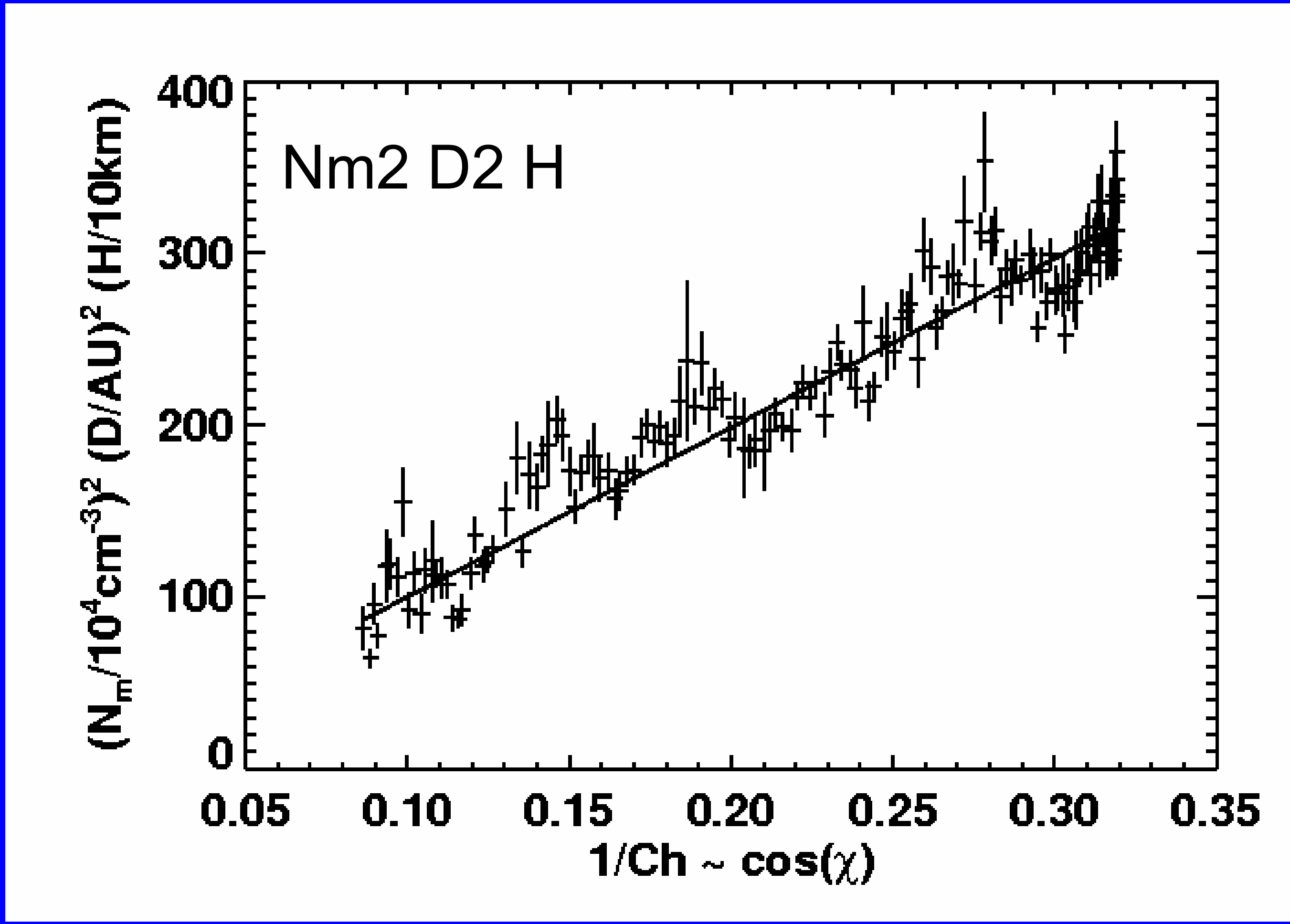
Mars Aeronomy Workshop
Tentatively scheduled for 17-18 August 2004, Washington, DC

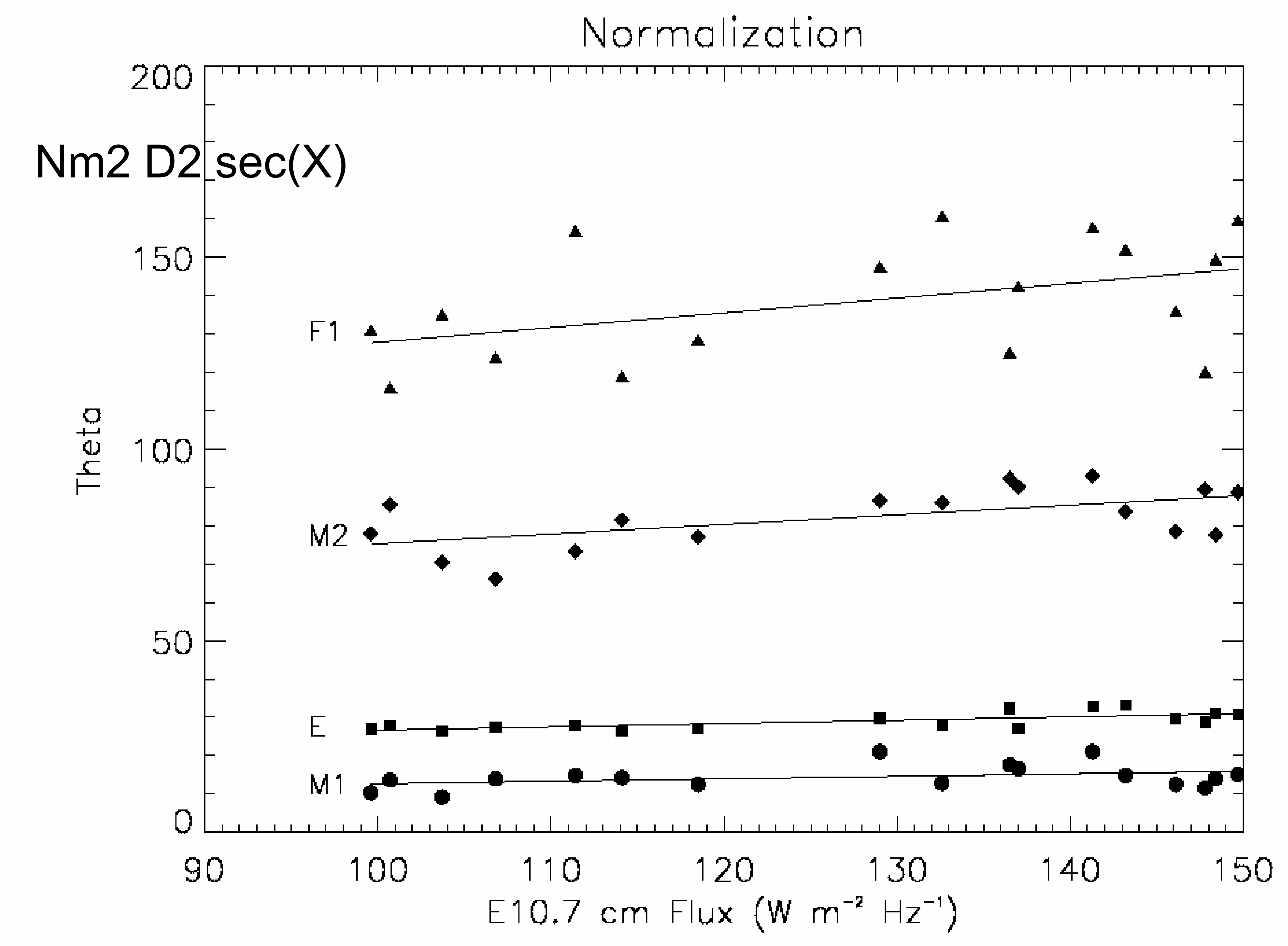
The NASA Office of Space Sciences' Solar System Exploration and Sun-Earth Connections Divisions are sponsoring a workshop to consider the goals for studies of the Martian upper atmosphere/ionosphere in light of the recently announced exploration vision for space, and to assess possible pathways to their implementation in the current environment. Specific goals of the workshop will be: 1) Revisit the science questions identified in the recent NRC and MEPAG studies and determine whether or not this list should be revised in response to the new Vision, and, if so, in what manner; 2) Understand which operational requirements of the Office of Exploration involve this region and what further understanding is required in order to support these requirements; and 3) Summarize the opportunities available for support of the study of this region.

The results will be made available to the community at large in the form of a white paper as guidance to goals and opportunities for studies of the Martian upper atmosphere/ionosphere. Broad community participation is encouraged.

Details are being developed and will be announced shortly, including organizing committee, venue, firm dates, and agenda. Contacts: Denis Bogan (Solar System, email denis.j.bogan@nasa.gov), Mary Mellott (Sun-Earth Connections, mmellott@hq.nasa.gov), Bruce Jakosky (Chair of Organizing Committee, Univ. of Colorado, bruce.jakosky@lasp.colorado.edu).

Example Studies
(As presented earlier today)




Normalization
Nm2 D2 sec(X)
Theta
200
150
100
50
0
F1
M2
E
M1
90
100
110
120
130
140
150
E10.7 cm Flux (W m⁻² Hz⁻¹)