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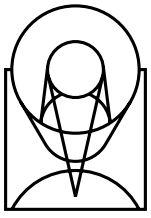
HST Data Handbook

Volume II: Heritage Instruments



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Preface

How to Use this Handbook

Welcome to Volume II of the third edition of the *HST Data Handbook*. This volume focuses on the instruments that are no longer onboard the spacecraft—the *heritage* instruments. These instruments are: FOS, GHRS, HSP, and WF/PC-1.

The goal of this handbook is to show you how to work with HST data files, from acquiring them through the Archive, to displaying them on your workstation, to analyzing them with the IRAF and STSDAS software packages. This handbook assumes no previous knowledge of HST data, IRAF, or STSDAS beyond that needed to compose a successful HST observing proposal, but if you are unfamilar with IRAF, a basic primer is provided in Appendix A.

This volume is intended to be the primary source of calibration, data reduction, and reference information for the heritage instruments.

The many years of operation of these instruments have provided a rich legacy of unique observational material in the HST Archive. Readers of this volume will commonly be archive researchers who, as time passes, will be more and more likely to have little or no direct knowledge of the instruments used to obtain their data. As a result, many discussions in this volume are more detailed than the overview of the data reduction process for current instruments found in Volume I. Nonetheless, some topics remain beyond the scope of this document and we point toward other sources of more detailed information when needed.

Additional help with HST data is always available via E-mail to the STScI Help Desk at `help@stsci.edu`.

In order to improve the Data Handbook, we need your help. Please send your comments, corrections, or suggestions to `help@stsci.edu.` We need to know what is missing and what is too detailed, what is effective and what is not, so that we can improve the Data Handbook and the rest of the HST documentation.

If you have no previous experience with HST, you should read the first three chapters in Volume I of this handbook before specific instrument chapters. Appendixes B, C, and E, describe HST file names, Observation Logs, and Internet resources, respectively, and contain information of general interest. The rest of this preface provides more complete information on using the *HST Data Handbook*.

Handbook Structure

This edition of the *HST Data Handbook* is organized as two volumes: Volume I provides general information on retreiving and reducing HST data and includes the more specific information needed to analyze data from the instruments currently onboard the spacecraft (FOC, FGS, NICMOS, STIS, and WFPC2). Volume II covers the instruments that have been retired (FOS, GHRS, HSP, and WF/PC-1).

Part 1 of Volume 1 leads observers through the following three-step process, applicable to HST data files from any instrument:

- Chapter 1 on *Getting HST Data* demonstrates how to search the HST Archive for observations of interest and how to retrieve data.

  If you already know how to search for and download HST data, or if all the data files you need are present on your disk, you can skip Chapter 1.

- Chapter 2 on *HST File Formats* describes the FITS and GEIS formats used for transferring and reducing HST data. It explains how HST data are stored in these files and shows how to access these data. STIS and NICMOS observers especially should read this chapter, as the procedures for accessing these data differ from those for other instruments. Observers working with FOC, FOS, FGS, GHRS, HSP, WF/PC-1, or WFPC2 data will need to convert the FITS files they receive from the Archive into GEIS format.

  If you are not using STIS or NICMOS data and are already familiar with the standard GEIS format for HST data, you can skip Chapter 2.

- Chapter 3 on *STSDAS Basics* introduces software designed specifically for HST data and gives a few examples.

  If you are already familiar with STSDAS, you can skip this chapter and proceed to the relevant instrument chapters.

Parts 2 through 6 present multi-chapter sequences on each *active* HST instrument. These parts are described in the Volume I Preface.

Parts 7 through 10 are contained in Volume 2 and present multi-chapter sequences on each *heritage* HST instrument, consisting of the following topics:

- *Instrument Overview*, providing a fundamental understanding of the instrument and the vocabulary associated with it.

  If you are not already familiar with the details of your chosen instrument, you should begin here.

- *Data Structures and Data Assessment*, describing the contents of the various data files, the meanings of selected header keywords, methods and principles of data quality assessment, the content and utility of the paper products, and the relationship of the data products to the original Phase II proposal.

If you are not familiar with the filenames, header keywords, details of evaluating observational data quality, or contents of the paper products and data files from this particular instrument, you should read this chapter next.

- *Calibration and Recalibration*, describing how the calibration pipeline processes your observations before they enter the Archive, how to determine if your data files would benefit from recalibration, and how to recalibrate them.

  If you do not know how your data have been calibrated, you should read this chapter.

- *Error Sources*, describing the various sources of error afflicting pipeline calibrated data and the limiting accuracies of the calibrations.

  All observers using a given instrument should read this chapter to acquaint themselves with the peculiarities of the data that remain after calibration.

- *Data Analysis*, describing certain methods and IRAF/STSDAS tasks for analyzing the data.

  Most observers will find this chapter useful when determining how they should reduce their data.

The *Error Sources* and *Data Analysis* chapters are combined in the WF/PC-1 and HSP parts.

Five Appendixes to this handbook, provide some additional general information that you might find useful:

- Appendix A, the *IRAF Primer*, is an introduction to IRAF and is intended for those who have no prior experience with this data reduction software.
- Appendix B, on *HST File Names*, shows how to interpret the names of the files you receive from the Archive and explains why certain STIS and NICMOS observations belong to associations of exposures.
- Appendix C, on *Observation Logs*, discusses the files created by the Observatory Monitoring System (OMS); these files record information on guiding, such as spacecraft jitter, during a given observation.
- Appendix D, the *Task Example Index*, provides pointers to the examples of various IRAF/STSDAS tasks scattered throughout the handbook.
- Appendix E, listing *Resources on the Internet*, indicates where you can access some of the many valuable tools and documents available through the STScI Web pages.

Handbook Updates

Our understanding of the heritage HST instruments and the data they produced has matured, but may continue to improve. In order to allow for an evolving understanding and recognizing that some users of heritage data may be working with the active instruments as well, we have organized this handbook so that its chapters are modular. You will be able to update your handbook simply by removing old chapters and indexes and replacing them with new ones. In fact, you may want to customize your handbook by placing only the chapters you need into a looseleaf notebook. When updated chapters become available, we will announce them on the HST Web pages and in the electronic Space Telescope Analysis Newsletters (STANs). You can then download these updates via the Internet or request paper copies from the Help Desk (`help@stsci.edu`).

Typographic Conventions

To help you understand the material in the *HST Data Handbook*, we will use a few consistent typographic conventions.

Visual Cues

The following typographic cues are used:

- **bold** words identify a STSDAS or IRAF task or package name.
- `typewriter-like` words identify a file name, system command, or response that is typed or displayed as shown.
- *italic* type indicates a new term, an important point, or a mathematical variable.
- ALL CAPS identifies a header keyword or a table column.

Keystrokes

Keystroke commands and sequences are identified by the following formats.

- Shift-Q - When two keys are linked by a *dash*, both keys should be pressed at the same time.
- Esc D - When a *space* separates two keys, a sequence is indicated. Press one key, release it, then press the other.
- M - Press *only* the key. If we meant that you should press shift with the key, we would say so, such as in the first example, above.

Comments

Occasional side comments point out three types of information, each identified by an icon in the left margin.

Tip: No problems...just another way to do something or a suggestion that might make your life easier.

Heads Up: Here is something that is often done incorrectly or that is not obvious.

Warning: You could corrupt data, produce incorrect results, or create some other kind of severe problem.

PART VII:

FOS

Chapter 29: FOS Instrument Overview

Chapter 30: FOS Data Structures and Data Assessment

Chapter 31: FOS Calibration and Recalibration

Chapter 32: FOS Error Sources

Chapter 33: FOS Data Analysis

- FOS

PART VIII:

GHRS

Chapter 34: GHRS Instrument Overview

Chapter 35: GHRS Data Structures & Data Assessment

Chapter 36: GHRS Calibration & Recalibration

Chapter 37: GHRS Error Sources

Chapter 38: GHRS Data Analysis

- GHRS

PART IX:

HSP

Chapter 39: HSP Instrument Overview

Chapter 40: HSP Data Structures

Chapter 41: HSP Calibration

Chapter 42: HSP Error Sources and Data Analysis

- HSP

PART X:

WF/PC-1

Chapter 43: WF/PC-1 Instrument Overview

Chapter 44: WF/PC-1 Data Structures

Chapter 45: WF/PC-1 Calibration

Chapter 46: WF/PC-1 Error Sources and Data Analysis

WF/PC-1

Appendixes

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Appendix E
Resources on the Internet

This appendix lists locations of World Wide Web (WWW) sites and similar resources mentioned in this handbook. Resources are organized by topic, corresponding to the structure of this handbook.

Resource	Location
General Resources	
STScI Web Site	URL: http://www.stsci.edu
STScI Help Desk	E-mail: help@stsci.edu
HST Keyword Dictionary	URL: http://archive.stsci.edu/keyword
Archive Resources	
Hubble Data Archive	URL: http://archive.stsci.edu/
ST-ECF Archive Site	URL: http://archive.eso.org/
CADC Web Site	URL: http://cadc.dao.nrc.ca/
StarView Software	URL: http://archive.stsci.edu/starview.html
Archive User Registration Form	URL: http://archive.stsci.edu/registration.html
Archive Help	Email: archive@stsci.edu
Archive FTP Site	FTP: archive.stsci.edu
Software Resources	
STSDAS Page	URL: http://ra.stsci.edu/STSDAS.html
IRAF Page	URL: http://iraf.noao.edu/
SAOimage and SAOtng	FTP: sao-ftp.harvard.edu
TinyTim	URL: http://scivax.stsci.edu/~krist/tinytim.html

Resource	Location
FOC Resources	
FOC Page	URL: http://www.stsci.edu/ftp/instrument_news/FOC/topfoc.html
Instrument Science Reports	URL: http://www.stsci.edu/ftp/instrument_news/FOC/foc_bib.html
Instrument Handbook	URL: http://www.stsci.edu/ftp/instrument_news/FOC/foc_handbook.html
FOCSIM Exposure Simulator	URL: http://www.stsci.edu/ftp/instrument_news/FOC/Foc_tools/focsim/focsim.html
FGS Resources	
FGS Page	URL: http://www.stsci.edu/ftp/instrument_news/fgs/html/TOPfgs.html
Instrument Science Reports	URL: http://www.stsci.edu/ftp/instrument_news/fgs/html/fgs_isr.html
Instrument Handbook	URL (PostScript): http://www.stsci.edu/ftp/instrument_news/fgs/html/fgshbv6book.frame.ps
STANs	URL: http://www.stsci.edu/ftp/instrument_news/fgs/html/fgs_stans.html
NICMOS Resources	
NICMOS Page	URL: http://www.stsci.edu/ftp/instrument_news/NICMOS/topnicmos.html
Instrument Science Reports	URL: http://www.stsci.edu/ftp/instrument_news/NICMOS/nicmos_doc_isr.html
Instrument Handbook	URL: http://www.stsci.edu/ftp/instrument_news/NICMOS/nicmos_doc_handb.html
STANs	URL: http://www.stsci.edu/ftp/instrument_news/NICMOS/nicmos_doc_stan.html
calnicc Software	URL: http://ecf.hq.eso.org/nicmos/calnicc/calnicc.html
NICMOSLook Software	URL: http://ecf.hq.eso.org/nicmos/nicmoslook
STIS Resources	
STIS Page	URL: http://www.stsci.edu/ftp/instrument_news/STIS/topstis.html
Instrument Science Reports	URL: http://www.stsci.edu/ftp/instrument_news/STIS/isrs/stisisr_index.html
Instrument Handbook	URL: http://www.stsci.edu/ftp/instrument_news/STIS/ihb/stis_ihb_v1.html
STANs	URL: http://www.stsci.edu/ftp/instrument_news/STIS/documents/stan/stan_index.html
WFPC2 Resources	
WFPC2 Page	URL: http://www.stsci.edu/ftp/instrument_news/WFPC2/wfpc2_top.html
Instrument Science Reports	URL: http://www.stsci.edu/ftp/instrument_news/WFPC2/wfpc2_bib.html
Instrument Handbook	URL: http://www.stsci.edu/ftp/instrument_news/WFPC2/Wfpc2_hand/wfpc2_handbook.html

Resource	Location
WFPC2 Resources (Continued)	
STANs	URL: http://www.stsci.edu/ftp/instrument_news/WFPC2/wfpc2_stan.html
WFPC2 History Memo	URL: http://www.stsci.edu/ftp/instrument_news/WFPC2/Wfpc2_memos/wfpc2_history.html
Warm Pixel Tables	URL: http://www.stsci.edu/ftp/instrument_news/WFPC2/wfpc2_warmpix.html
Exposure Time Calculator	URL: http://www.stsci.edu/ftp/instrument_news/WFPC2/Wfpc2_etc/wfpc2-etc.html
CTE Report	URL: http://www.stsci.edu/ftp/instrument_news/WFPC2/Wfpc2_cte/ctetop.html
WFPC2 Polarization Calibration Tool	URL: http://www.stsci.edu/ftp/instrument_news/WFPC2/Wfpc2_pol/wfpc2-pol2.html
Dithering/Drizzle Software	URL: http://www.stsci.edu/~fruchter/dither/
FOS Resources	
FOS Page	URL: http://www.stsci.edu/ftp/instrument_news/FOS/topfos.html
ISRs	URL: http://www.stsci.edu/ftp/instrument_news/FOS/fos_bib.html
Instrument Handbook	URL: http://www.stsci.edu/ftp/instrument_news/fos/InstHandbookv60.ps
STANs	URL: http://www.stsci.edu/ftp/instrument_news/FOS/fos_stans.html URL: http://www.stsci.edu/ftp/instrument_news/STIS/documents/stan/stan_index.html
FOS Proposal Finder	URL: http://www.stsci.edu/ftp/instrument_news/FOS/propfind.html
GHRS Resources	
GHRS Page	URL: http://www.stsci.edu/ftp/instrument_news/GHRS/topghrs.html
ISRs	URL: http://www.stsci.edu/ftp/instrument_news/GHRS/ghrs_isr_access.html
Instrument Handbook	URL: http://www.stsci.edu/instrument-news/handbooks/ghrs/GHRS_1.html
STANs	URL: http://www.stsci.edu/ftp/instrument_news/GHRS/ghrs_stan.html URL: http://www.stsci.edu/ftp/instrument_news/STIS/documents/stan/stan_index.html
HSP Resources	
HSP Page	URL: http://www.stsci.edu/ftp/instrument_news/HSP/tophsp.html
ISRs	URL: http://www.stsci.edu/ftp/instrument_news/HSP/hsp_bib.html
WF/PC-1 Resources	
WF/PC-1 Page	URL: http://www.stsci.edu/ftp/instrument_news/WFPC/wfpc1_top.html
ISRs	URL: http://www.stsci.edu/ftp/instrument_news/WFPC/wfpc1_bib.html

Resource	Location
Additional Resources	
OMS Information	URL: http://www.stsci.edu/ftp/instrument_news/Observatory/taps.html
Science Instrument Aperture File	URL: http://www.stsci.edu/ftp/instrument_news/Observatory/siaf.html
Calibration Data Base	URL: http://www.stsci.edu/ftp/instrument_news/Observatory/cdbs/cdbs.html
HST Proposal Info	URL: http://presto.stsci.edu/public/propinfo.html

Appendix F:

Task Example Index

This index references examples and descriptions of IRAF/STSDAS tasks and some other software mentioned in Volume 2 of this handbook.

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