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SIRTF Science Center

Downlink Segment

Subsystem Design Specification

AOT Products Subsystem: GETPH_ONLINE

5 May 2005

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SIRTF Science Center

Subsystem Design Specification

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1 Revision History

Version	Description	Date
1.0	Initial version	June 20, 2004
1.5	Included functionality to query for "refinedPointing" fileTypes (i.e., super-boresight pointing history files prefixed by "SBPHF"), as opposed to just regular "pointingHistory" filetypes.	May 5, 2005

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1. Introduction

1.1. Purpose and Scope

The Subsystem Design Specification is a document that describes the basic requirements, assumptions, definitions, software-design details and necessary interfaces for each subsystem. The document will be used to trace the incremental development of each subsystem and also to allow trace-back of levied requirements; this document should have sufficient detail to allow future modification or maintenance of the software by developers other than the original developers. This document is an evolving document as changes may occur in the course of science instrument hardware design and maturity of operational procedures. This document is not intended to repeat sections or chapters from other Project documents; when appropriate, references to proper sections of primary reference documents will be made.

1.2. Document Organization

This document is organized along the major themes of Requirements; Assumptions; Operational Concept; Functional Descriptions; Functional Dependencies; Input; Output; Other S/S Interfaces; Algorithm Descriptions (when applicable); and Major Liens.

The material contained in this document represent the current understanding of the capabilities of the major SIRTF systems. Areas that require further analysis are noted by TBD (To Be Determined) or TBR (To Be Resolved). TBD indicates missing data that are not yet available. TBR indicates preliminary data that are not firmly established and are subject to change.

1.3. Relationship to Other Documents

The requirements on the operation of SIRTF flow down from the Science Requirements Document (674-SN-100) and the Facility Requirements Document (674-FE-100). The Science Operations System is governed by the SOS Requirements Document (674-SO-100). The current document is also cognizant of the requirements that appear in the Observatory Performance and Interface Control Document (674-SEIT-100) as well as the Flight Ground Interface Control Document (674-FE-101). This document is also affected by the FOS/SOS Interface Control Document (674-FE-102) that governs interfaces between the Flight Operations System and the Science Operations System. Related Software Interface Specifications (SIS) will be as indicated in Section 2.2 of this document.

1.4. Change Procedure

This document is a level 4 document according to the SIRTF Project Documentation Plan (674-FE-103). Changes to this document after approval require the approval of the SOS Change

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Board (TBD). The process for change control is described in the SOS Configuration Management Plan.

2. Overview

The GETPH_ONLINE program reads as input a spacecraft clock (SCLK) time range, queries the Science Operations Database (SODB) for the best version of the Boresight Pointing History File (BPHF) containing this time range, extracts 2-Hz sampled pointing information for the requested time range and writes the results to a user specified output filename. The output filename is a table in IPAC format whose content and structure is required by downstream modules in the SSC automated pointing transfer thread.

The main use of GETPH_ONLINE is in querying the correct BPHFs for a SCLK time range pertaining to a DCE's integration. The software returns two BPHFs if the input DCE SCLK range falls on a pointing history (12-hour separated) boundary. The software also has the ability to query for refined-BPHFs (prefixed as SBPHF) which are registered in the database under the "refinedPointing" fileType, as opposed to the regular "pointingHistory" (BPHF) fileType. GETPH_ONLINE is written in standard ANSI/ISO C.

2.1. GETPH_ONLINE Requirements

GETPH_ONLINE is initiated by a startup script under the control of the pipeline executive and does its required functions for a given starting and ending SCLK time; this involves performing the following tasks.

A.) Retrieve the command line parameters passed by the start up script and use them to run the program.

B.) Read in as input a start and end SCLK time in seconds and optionally a flag "-t" to query for superboresight "refinedPointing" fileTypes.

C.) Produce as primary output a table in IPAC format containing pointing and uncertainty information for the requested time range.

D.) Provide exit codes to the pipeline executive and also provides logon and logoff messages identifying the version number and write any error messages to the standard output devices.

E.) Produce a processing summary.

2.2. Applicable Documents

The following documents are relevant to the GETPH_ONLINE program of the AOT PRODUCTS Subsystems.

A.) The SOS Downlink Requirements Document

B.) The SOS Requirements Document

C.) The SOS Downlink Software Development Guidelines

D.) The following Software Interface Specifications (SIS)

SFO-SIS-3030 (Boresight Pointing History File format)

2.3. Version History

2.3.1. Version 1.0

Initial version created on June 20, 2004

2.3.2. Version 1.5

Included functionality to query for “refinedPointing” fileTypes (i.e., super-boresight pointing history files prefixed by “SBPHF”), as opposed to just regular “pointingHistory” filetypes.

2.4. Liens

No liens have been identified.

3. Input

3.1. GETPH_ONLINE Input

GETPH_ONLINE takes all of its input from the command line which is set up by the startup script. This is controlled by the pipeline executive or executed standalone. The command-line parameters that can be defined for GETPH_ONlLINE are listed in Table 1. Command-line option flags are defined in Table 2.

Namelist variable	Description	Dim.	Type	Units	Default
NONE	Required Start SCLK time.	1	R*4	Seconds	Null
NONE	Required End SCLK time	1	R*4	Seconds	Null
NONE	Required output filename	256	Char	-	Null
NONE	Optional “-t” flag to query for “refinedPointing” fileType.	1	Char	-	Query for regular BPHF.

Table 1: Input Parameters for getPH_online

Command-line option	Value Name
-s	Start SCLK time (sec)
-e	End SCLK time (sec)
-f	Output table filename
-t	None. Specified as a flag.

Table 2. Command-line options

3.2. GETPH_ONLINE Required Environment Variables

Prior to execution, the getPH_online software requires the following environment variables to be set. These define the database server, actual database to query and user role. These are summarized in Table 3 where the values specified are not necessarily realistic.

Environment Variable	Value name (example only)
INFORMIXSERVER	sodb1
TARGETDB	sodb_dnl1
SODB_ROLE	pipelineopsrole

Table 3: Environment Variables

4. Processing

4.1. GETPH_ONLINE Processing

GETPH_ONLINE begins processing by writing its name and version number to standard output, checks that the required command-line parameters were passed to it and that the required environment variables were set. If this condition is not true, it writes a message stating which parameters are missing, recommends a look at this document, and terminates by issuing an appropriate exit code to the pipeline executive; otherwise it proceeds as follows.

If an error occurs during processing, an error message is written to standard output, a termination-status code is written to the log file, and an exit code to the pipeline executive issued.

After processing, the program name and version number, namelist filename (if used), input, and output filenames, values of other input parameters, date and time, processing time, and a termination-status code are written to standard output.

4.2 GETPH_ONLINE Processing Phases

GETPH_ONLINE operates in seven phases: initialization, read SCLK inputs, database query, BPHF header data retrieval, pointing history search for input SCLK range including boundary check and data storage, table-file output, and termination. This processing level is depicted in Figure 1.

4.1.1. GETPH_ONLINE Initialization

GETPH_ONLINE initializes itself by performing the following tasks.

A.) A message is printed to STDOUT (verbose mode only), which includes the program name and version number.

B.) The command-line inputs (see Tables 1 and 2) are read and checked for correct data range, consistency, etc. If any errors are encountered, a message is printed, and execution aborts.

C.) The environment variables are read (see Table 3). If these have not been set prior to execution, a message is printed and execution aborts.

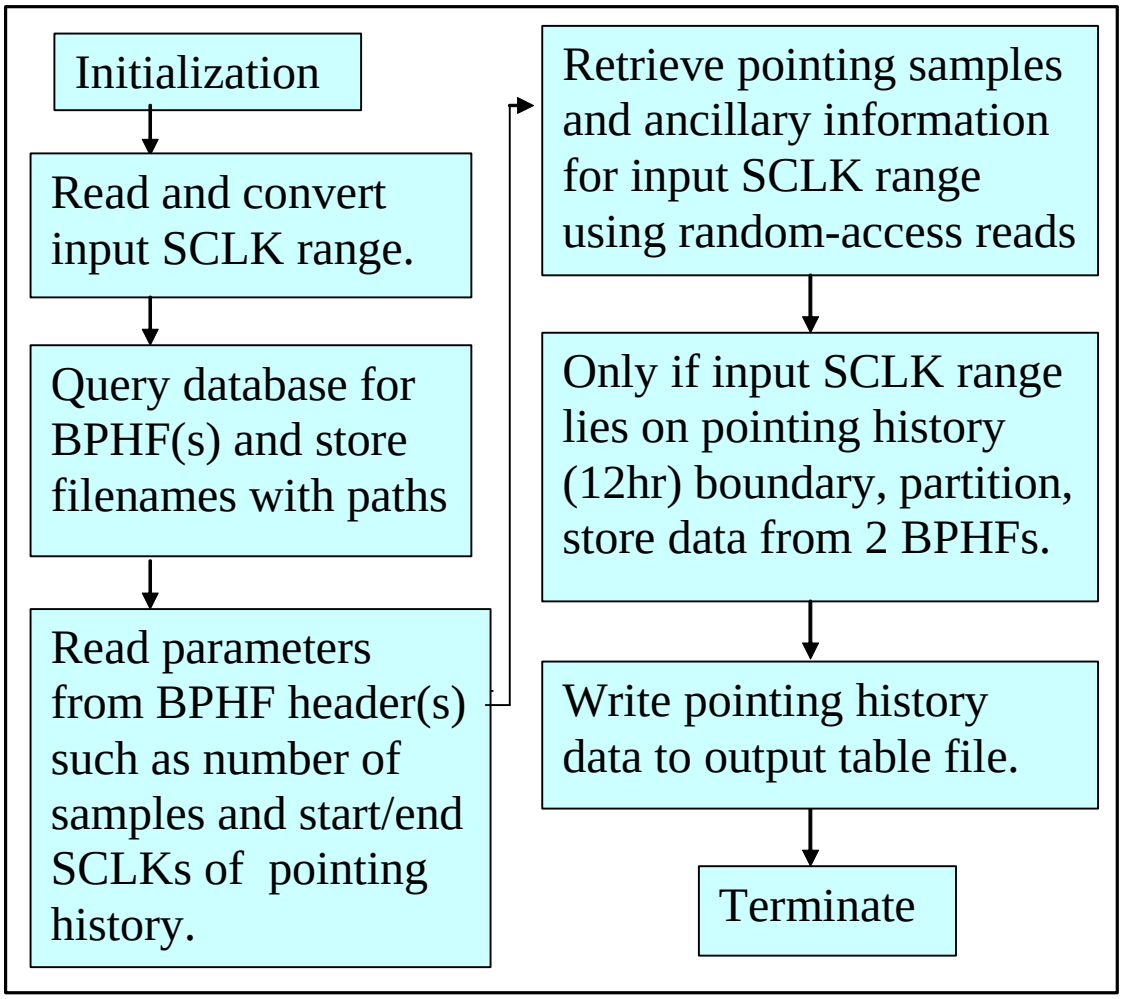

Figure 1. GETPH_ONLINE data and processing flow

4.1.2. Read and Convert Input SCLK Range

The start and end times for which the pointing history is requested are read in as 32-bit floating point numbers in seconds. Since the database query routines perform searches with times in unsigned long integer (32-bit) format, we convert the input times to long integers by rounding off the start and end times to the lowest and highest integer respectively.

4.1.3. Database Queries

The pre-set environment variables: "INFORMIXSERVER", "TARGETDB" and "SODB_ROLE" are used to connect to the appropriate database. We first query the database for the pathname associated with the "pointingHistory" telemetry "fileType". For all database queries we use routines from SDM's C-API **"libsdm_sodb"** library. The generic "pointingHistory" (or "refinedPointing" if "-t" flag was specified) fileType pathname is obtained using the following routine:

fileTypePath = sdm_getFileTypePath(dbms_handle, fileType);

Next, we query for *the latest* BPHFs that were down-linked (or more precisely, ingested) for the requested input SCLK range. This information is stored in a structure formed by a call to the following routine:

fileInfoArray = sdm_getTelemetryFileInfo(dbms_handle, fileType, startTime, endTime);

The actual BPHFs are contained in arrays: "fileInfoArray[0]", "fileInfoArray[1]" with reversed time order, i.e., the latest is stored in the array indexed by [0]. A maximum of only two BPHFs can be retrieved and stored. Each BPHF spans a 12 hour time period. Two BPHFs will be retrieved if the input SCLK range falls on a boundary which joins two BPHFs.

Last, the BPHF names are concatenated with their respective paths (fileTypePath above). For "PointingHistory" fileTypes, the fileTypePath is generically of the form: "…./raw_archive_path/timeperiod/YYYY.MM/pointingHistory". The "YYYY.MM" represents the corresponding year and month. These are obtained from ancillary database output above. The actual BPHF name has the form (for example): "BPHF.0768139200.03.pntg", where the number after the first period is the starting SCLK over which the BPHF pertains and the second number "03" is the version number. The BPHF is always in binary format. For "refinedPointing" fileTypes, the leading path above (i.e., "pointingHistory") is replaced by this fileType.

4.1.4. Read BPHF Header Information

Information contained in the header of any Spitzer BPHF is outlined in the SIS: "SFO-SIS-3030". The parameters that are read from here (from both BPHFs if two exist) are: SAMPLFREQ, NSAMPLS, SCLKBGN, SCLKEND. These parameters are used to check for file sizes and which time-snippet pertains to which BPHF if the input SCLK range fell on a PH boundary.

4.1.5 Retrieve Pointing Sample Information

Memory is allocated for the output PH samples to retrieve from the BPHFs. Memory allocation is performed by predicting the number of extracted samples one would expect from the input SCLK range (rounded to the nearest integer) and the sampling frequency, which by default is 2 Hz for Spitzer. For the given start SCLK time, the BPHF is opened in binary "read-only" mode (read-only for fear of corrupting the original BPHF), and samples are read by moving to the specific position in the file. This specific file position is found by computing the expected number of bytes into the BPHF for which the start-time pertains. The standard C-functions "lseek" and "tell" are used to set the appropriate pointers.

If two BPHFs exist, the same method is used, only that here the input SCLK range is split up between the two corresponding BPHFs and pointing samples retrieved and stored from each.

If a Super-Boresight Pointing History File was queried for instead (SBPHF) by specifying the "-t" flag on the command-line for getPH_online, we also check that the "NStars" column field value for each pointing sample is greater than some number "NSTARSMAX" specified in the getPH_online.h include file before retaining the sample. This tolerance is currently set at 1000000 which is the number added to the pre-existing raw-BPHF sample by the SBPHF generation software if refinement was successful. By retaining only such samples, we can be confident that we have only refined samples in the final pointing history for the DCE.

If the final number of pointing samples extracted from the input BPHF (or SBPHF) is less than some number "MINSAMPS" as specified in the getPH_online.h include file (now set to 2), we abort with an error message. This could happen if a too small time range is specified on input, or, for the SBPHF case, the NStars field was below its nominal value (see above) for too many of the samples.

4.1.6 Output Pointing History Data File

The 2 Hz sampled pointing information is written to an output file specified by the "-f" command-line option. This file is in IPAC table format with a header listing BPHF inputs and column descriptions. The data content of this file does not reflect the complete contents of the original BPHF. Only selected fields which are needed by the SSC pointing transfer thread are retained. An example of this output is as follows.

```
\character comment = Output from getPH_online, version 1.0
\character Date-Time = Mon Jun 21 09:29:35 2004
\character comment = used two consecutive PHFs.
\character BPHF 1 = /ssctst1/archive/raw/timeperiod/2004.05/pointingHistory/BPHF.0768657600.03.pntg
\character BPHF 2 = /ssctst1/archive/raw/timeperiod/2004.05/pointingHistory/BPHF.0768700800.03.pntg
\character comment = SCLKBGN refers the SCLKBGN for the 1st PHF
\character comment = SCLKEND refers the SCLKEND for the 2nd PHF
\character comment = The first 16 records are from the 1st PHF
\int SCLKBGN = 768657600
\int SCLKEND = 768744000
```

```
\character comment = alpha means R.A in boresight
\character comment = delta means Dec in boresight
\character comment = gamma means twist angle in boresight
\character comment = ualpha means standard deviation in alpha
\character comment = udelta means standard deviation in delta
\character comment = ualphadelta means costandard deviation in alpha and delta
\character comment = ugamma means standard deviation in gamma
\character comment = delta_y means change in the +Y direction
\character comment = delta_z means change in the +Z direction
|time    |alpha      |delta      |gamma      |ualpha     |udelta     |ualphadelta|ugamma     |delta_y    |delta_z    |
|int     |double     |double     |double     |double     |double     |double     |double     |double     |double     |
|msec    |degree     |degree     |degree     |arcsec     |arcsec     |arcsec     |arcsec     |arcsec     |arcsec     |
 43192490  164.240197    6.795383   23.845043    1.083166    1.082672    0.026306    6.429482   0.001774   -0.000649
 43192990  164.240194    6.795386   23.845053    1.083166    1.082672    0.026306    6.429482  -0.001755    0.002898
 43193490  164.240194    6.795389   23.845053    1.083166    1.082672    0.026306    6.429482  -0.005358   -0.000686
 43193990  164.240194    6.795389   23.845053    1.083166    1.082672    0.026306    6.429482  -0.005358   -0.000686
 43194490  164.240194    6.795389   23.845058    1.083166    1.082672    0.026306    6.429482   0.001769   -0.000624
 .
 .
 .
 ~
```

4.1.7 Termination

Summary output is written both to standard output (see example run in section 8) and to the header of the output IPAC table. The program also issues an appropriate exit code to the system to be picked up by the pipeline executive.

5. Tutorial

If the getPH_online program is executed on the command-line with no arguments, the following tutorial will be printed to standard output.

```
Program: "getPH_online", Version 1.5, Thu May  5 12:34:30 2005

Purpose: Get boresight pointing history for input SCLK range.

Usage: getPH_online
    -s  <Start SCLK time (sec)> (Required)
    -e  <End SCLK time (sec)>   (Required)
    -f  <Output table filename> (Required)
    -t  <refinedPointing Flag>  (Optional; if specified, use "refinedPointing"
        fileType. Default: use regular "pointingHistory" fileType)

Required environment variables:
INFORMIXSERVER
TARGETDB
SODB_ROLE

Example which queries regular "pointingHistory":
getPH_online -s 734443250 -e 734443260 -f ptghist.tbl
```

6. Output

GETPH_ONLINE is capable of generating the following output:

A.) Standard-output processing and status messages.

B.) An output table file in IPAC format containing diagnostic information in the header.

All GETPH_ONLINE disk output is written to the pathnames that are specified with the output filenames in the command-line.

7. Testing

GETPH_ONLINE has been successfully unit-tested as a stand-alone program for a variety of different input cases. The tests were designed to check GETPH_ONLINE robustness and capability of generating corrected results.

Here is a summary of the unit tests that were conducted:

1. Executed GETPH_ONLINE with inputs read from and output written to directories different from where the program was run.

2. Executed GETPH_ONLINE using different Informix databases.

3. Executed GETPH_ONLINE with different input SCLK ranges, including bogus values to ensure error checking and reporting works and SCLK ranges which straddle a BPHF boundary.

4. Executed GETPH_ONLINE in “Super-Boresight” mode, i.e., with the “-t” flag specified.

5. In addition, GETPH_ONLINE was tested against the existing pointing server on the segment test system. A MIPS manifest consisting of 1010 records (BCDs) was processed through the pointing thread spread over 21 jobbers (3 jobbers per drone). This was done using the pointing server and then "getPH_online" alone. The plot below shows processing time (per 3-jobber CPU) versus wall clock. There's virtually no difference between the two BPHF retrieval methods. It's also interesting to note a slight bimodality in the DCE processing time where the ratio is ~1.25. This is consistent with the drone speeds we currently have on segment test: ~500MHz/400MHz.

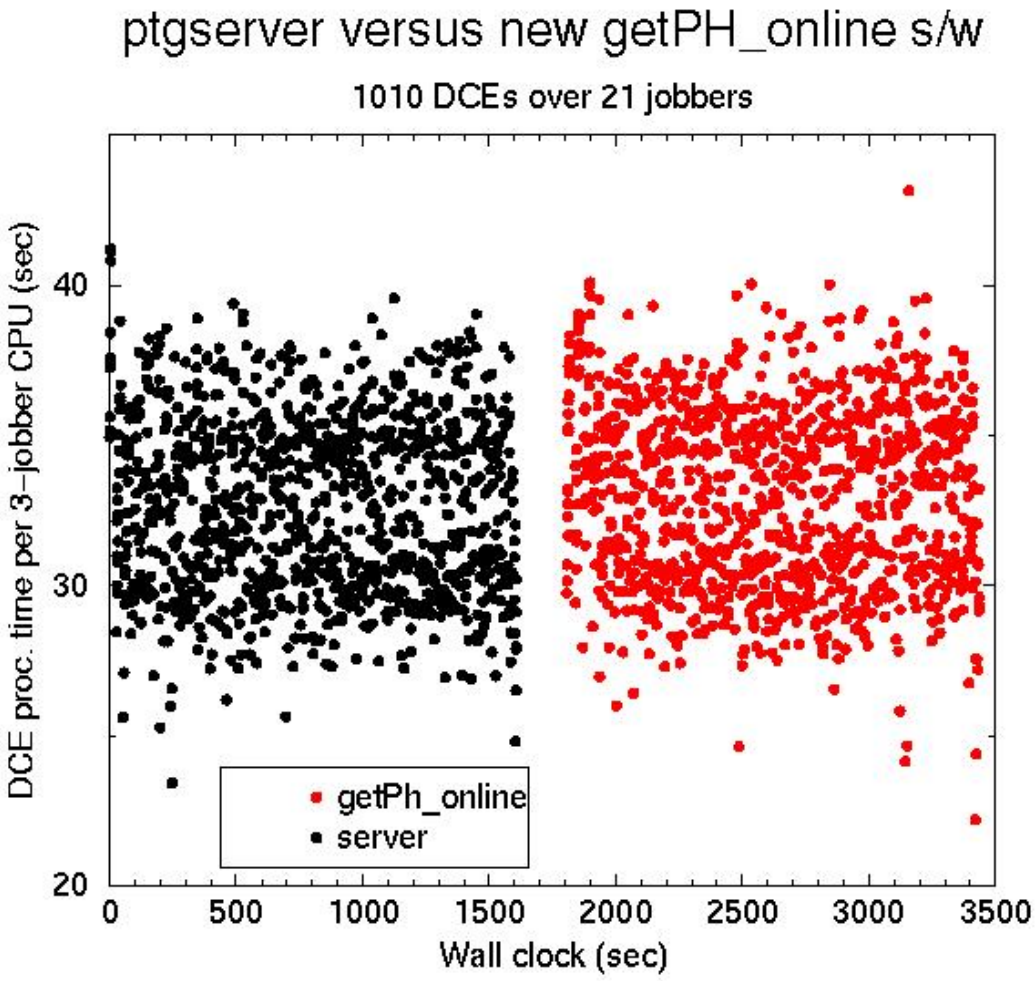

Figure 2: getPH_online performance.

8. Usage Example

```
Set environment variables, e.g.,

setenv INFORMIXSERVER sodb1
setenv TARGETDB       sodb_dnl5
setenv SODB_ROLE      pipelineswrole
```

Execute program to retrieve latest BPHF for input SCLK time range in seconds:

getPH_online –s 768700792.988 –e 768700805.948 –f ptghistory.dat

with the correct BPHF loaded in the database, this will write the following to standard output. This is a case where the input SCLK range straddled a 12-hour BPHF boundary.

```
Program: "getPH_online", Version 1.5, Thu May  5 12:36:07 2005

getPH_online_dbquery: For input DCE sclk range: 785116795 -> 785116810

getPH_online_dbquery: BPHF name 1 =  BPHF.0785116800.02.pntg
getPH_online_dbquery: BPHF 1 size =  6913600
getPH_online_dbquery: BPHF 1 version = 2
getPH_online_dbquery: BPHF 1 startSclk = 785116800
getPH_online_dbquery: BPHF 1 endSclk =  785160000
getPH_online_dbquery: BPHF 1 month/year =  11 / 2004

getPH_online_dbquery: BPHF name 2 =  BPHF.0785073600.03.pntg
getPH_online_dbquery: BPHF 2 size =  6913600
getPH_online_dbquery: BPHF 2 version = 3
getPH_online_dbquery: BPHF 2 startSclk = 785073600
getPH_online_dbquery: BPHF 2 endSclk =  785116800
getPH_online_dbquery: BPHF 2 month/year =  11 / 2004

Found two pointing history files for above sclk range; continuing...

getPH_online_dbquery: BPHF Path/Filename(s) =
/ssctst1/archive/raw/timeperiod/2004.11/pointingHistory/BPHF.0785073600.03.pnt
g
/ssctst1/archive/raw/timeperiod/2004.11/pointingHistory/BPHF.0785116800.02.pnt
g

Header of BPHF1: SCLKBGN=785073600 SCLKEND=785116800 NSAMPLS=86402 SAMPLFREQ=2
Header of BPHF2: SCLKBGN=785116800 SCLKEND=785160000 NSAMPLS=86402 SAMPLFREQ=2

Output pointing history table filename: ptghistory.dat
Number of samples extracted from BPHF(s) = 29
```

9. Glossary

BPHF	Boresight Pointing History File
DCE	Data Collection Event

DN	Data Number
IOC	In-Orbit Checkout
IPAC	Infrared Processing and Analysis Center
PH	Pointing History
SCET	Spacecraft Ephemeris Time
SCLK	Spacecraft Clock
SDM	Science Data Management team at SSC
SDS	Subsystem Design Specification
SIS	Software Interface Specification
SODB	Science Operations Database
SSC	Spitzer Science Center
TBD	To Be Determined
TBR	To Be Resolved