



Definition of Palomar Testbed Interferometer Level 1 data FITS files

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KIV2_L1 Version 1.0

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1. Introduction

This document describes the FITS (Flexible Image Transport System) format specification used for the Palomar Testbed Interferometer (PTI) Level 1 data. For more information on FITS, see “Definition of the Flexible Image Transport System (FITS)”, *Astronomy & Astrophysics*, vol. 376, p. 359. Currently this standard covers the Level 1 data for the visibility amplitude, or V^2 mode. In this document, the Level 1 V^2 format will be referred to as PTIV2_L1. PTI Level 1 data are time-averaged visibility data (typically representing 25 seconds of data) with instrumental biases removed and are fully described at <http://msc.caltech.edu/PTISupport/v2/PTIV2dataProducts.html>. The V^2 mode is described in detail in “Fringe Visibility Estimators for the Palomar Testbed Interferometer”, by M. Colavita, *Pub. of the Astronomical Society of the Pacific*, vol. 111, p.111.

Files in this format are produced from the standard Level 1 files and may be used as input for the Level 2 processing programs for PTI data (wbCalib and nbCalib). PTIV2_L1 files are intended primarily for recording the PTI Level 1 data necessary for the calibration stage (Level 2) in a format familiar to the astronomical community. Each PTIV2_L1 file contains data from only 1 night, but multiple files may be given as input to the Level 2 processing programs. PTIV2_L1 files are produced via the MSC Level 1 database. See the PTI Support page (<http://msc.caltech.edu/PTISupport/index.html>) for instructions.

Note that for Level 2 data, the MSC uses the FITS definition adopted by the International Astronomical Union (IAU) working group on optical interferometry. This format is for distributing calibrated visibility data. See <http://www.mrao.cam.ac.uk/jsy1001/exchange/> for more details.

2. FITS file structure

The structure of a generic FITS files consists of the primary header and data unit (HDU) followed by extensions, which are optional. The data in PTIV2_L1 files are given in binary table extensions. The header information is given as keyword/value/comment sets. The keywords used are standard FITS keywords where appropriate (ORIGIN, OBJECT) and are Level 2 IAU standard keywords where appropriate.

A valid PTIV2_L1 FITS file must contain one PTI_BASELINE table, at least one PTI_SOURCE table and one or more PTI_SUM or PTI_SPEC tables. These tables are defined in the following sections, which

contain lists of keywords or column headings, data values or types and descriptions. Allowed data types are: I = integer (16 bit), A = character, E = real (32-bit), D = double (64-bit) and L = logical.

2.1. Header keywords

The primary HDU header is composed of the following keywords and comes at the beginning of the file. The first 4 keywords are required by the FITS format definition. The HISTORY lines contain the information from the info file (see Level 1 file definitions).

SIMPLE	L	Does the file conform to FITS standards
BITPIX	I	Number of bits used for pixel values
NAXIS	I	Number of axes in the array, = 0 in this case
EXTEND	L	Can the dataset contain extensions
ORIGIN	A	Institution that originated this FITS file
TELESCOP	A	Telescope that made the observations
INSTRUME	A	Instrument that made the observations
INSTMODE	A	Instrument observing mode
FITSDATE	A	Date FITS file was written (YYYY-MM-DD)
FILENAME	A	FITS file name
HISTORY	A	Lines describing the version of software used to produce the Level 1 data
COMMENT	A	Contact information
END		

3. Table specifications

All PTIV2_L1 tables are in the FITS binary table format. The data items are represented in separate columns. This is version 1 (Keyword PTIV2_VER).

3.1. PTI BASELINE

This table conveys the baseline information in the form of the ENU (East, North, Up) vector and a bias term. This information is necessary to calculate the u and v spatial frequencies of a given observation. Additionally, this table contains a baseline name and time information which allows data from the PTI_VIS2 table to be matched with the data from other tables. The table contains one row for each baseline from only one telescope array.

Keywords

PTIV2_VER	I	PTI V ² Level 1 FITS version number
EXTNAME	A	Extension name
ARRNAME	A	Array name for the baseline(s), ex. Palomar Testbed Interferometer

Column Headings

BASELINE_NAME	A(20)	Unique name for each baseline
DATE	A(10)	Date of baseline specification (format YYYY-MM-DD)
TIME	D	UTC time of baseline specification (seconds)
E	D	Baseline East component (meters)
N	D	Baseline North component (meters)
U	D	Baseline Up component (meters)
C	D	Baseline bias term (meters)
BASELINE_ORIG	A(7)	Origin of baseline terms. Values are DEFAULT (no baseline telemetry was present), PRESET (baseline from telemetry) and BFIT (baseline calculated by bFit program)

3.2. PTLSUM

The PTLSUM table contains the values from a V² sum file in a binary table. Each column of the sum file is represented as a column in the PTLSUM table. In addition, there is a BASELINE_NAME which must correspond to a row in the PTLBASELINE table. Each sum record is contained in one row of the table. All columns without specified units are dimensionless.

Keywords

PTIV2_VER	I	PTI V ² Level 1 FITS version number
EXTNAME	A	Extension name

Column Headings

MJD	D	Modified Julian Day
TIME	D	UTC time (seconds)
OBJECT	A(32)	Source name
DL_POS	D	Delay line optical path (meters)
WB_NPH	D	Wide-band photon flux (DN)
WB_INCV2	D	Wide-band incoherent V ²
WB_COHV2	D	Wide-band coherent V ²
SP_NPH	D	Summed spectrometer photon flux (DN)
SP_INCV2	D	Summed spectrometer incoherent V ²
SP_COHV2	D	Summed spectrometer coherent V ²
SP_COHRC	D	Summed spectrometer coherent ratio correction
SP_INCRC	D	Summed spectrometer incoherent ratio correction
WB_NPH_BACK	D	Wide-band background photon flux (DN)
WB_NPH_FORE	D	Wide-band foreground photon flux (DN)
SP_NPH_BACK	D	Summed spectrometer background photon flux (DN)
SP_NPH_FORE	D	Summed spectrometer foreground photon flux (DN)
SP_NPH_RC	D	Summed spectrometer ratio photon flux (DN)
JITTER	D	Phase jitter (radians)
SP_WAVELENGTH	D	Summed spectrometer wavelength (microns)
FRAC_LOCK	D	Fractional time locked
NLOCKS	I	Number of locks
CALFLAG	I	Calibration flag
FTRATE	I	Fringe tracker rate (Hz)
FRINGE_QUAD_X0	D	Fringe quadrature X (DN)
FRINGE_QUAD_Y0	D	Fringe quadrature Y (DN)
INT_TIME	D	Integration time (seconds)
BASELINE_NAME	A(20)	Baseline name, must correspond to an entry in the PTL_BASELINE table

3.3. PTL_SPEC

The PTL_SPEC table contains the values from a V² spec file in a binary table. Each column of the spec file is represented as a column in the PTL_SPEC table. The BASELINE_NAME column must correspond to a row in the PTL_BASELINE table. Each spec record is contained in one row of the table. All columns without specified units are dimensionless. The number of columns will vary with the number of spectrometer channels.

Keywords

PTIV2_VER	I	PTI V ² Level 1 FITS version number
EXTNAME	A	Extension name

Column Headings

MJD	D	Modified Julian Day
TIME	D	UTC time (seconds)
OBJECT	A(32)	Source name
DL_POS	D	Delay line optical path (meters)
JITTER	D	Phase jitter (radians)
FTRATE	I	Fringe tracker rate (Hz)
CALFLAG	I	Calibration flag
INT_TIME	D	Integration time (seconds)
BASELINE_NAME	A(20)	Baseline name, must correspond to an entry in the PTLBASELINE table
NCHAN	I	Number of spectrometer channels
For each channel (n), where n starts at 1		
CHn_NPH	D	Spectrometer channel n photon flux (DN)
CHn_WAVELENGTH	D(8.6)	Spectrometer channel n wavelength (microns)
CHn_COHV2	D	Spectrometer channel n coherent V ²
CHn_INCV2	D	Spectrometer channel n incoherent V ²
CHn_RC	D	Spectrometer channel n ratio correction

3.4. PTLSOURCE

This table contains information about the target sources and is optional. Included is coordinate and size information used in the calibration stage (Level 2 processing). Each source is listed on a separate line. If values for proper motion, parallax and angular size are not available from the data set, a value of 0 will be given.

Keywords

PTIV2_VER	I	PTI V ² Level 1 FITS version number
EXTNAME	A	Extension name

Column Headings

OBJECT	A(32)	Source Name
RA	D	Right ascension at equinox (degrees)
DEC	D	Declination at equinox (degrees)
EQUINOX	F	Equinox
PMRA	D	Proper motion in right ascension (degree/yr)
PMDEC	D	Proper motion in declination (degree/yr)
PARALLAX	D	Parallax (degree)
DIAM	D	Angular size (milliarcsec)
DIAMERR	D	Error in angular size (milliarcsec)
SPECTYP	A	Spectral type
ROLE	A(3)	Source role, allowed values are TRG and CAL
CALFOR	A(32)	If ROLE = CAL, name of target source for which this object is a calibrator

A. Sample Header

When we have one...

B. Version history

B.1. Version 1

- Adapted from KI Level 1 FITS