Definition of Keywords and Their Organization in HDF5

# Introduction

Here is the definition of keywords and how they are organized in hdf5 file.

To ensure compatibility for other programing languages, Python-specific objects, like list, dict and tuple, are excluded.

*Version 0.1*.

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# File Name

**startdatetime\_enddatetime.hdf5**

**startdatetime** is a date time string when the file is created;

**enddatetime** is a date time string when the file is closed;

The date time string contains year, month, day, hour, minute and second.

Example:

20160229093022\_20160229124807.hdf5

Notice:

The start and end date time is not accurate, use ‘obstime’ attribute in the hdf5 file.

# Data type

**String** is ASCII character.

**Integer** is 32bits, signed.

**Float** is 64 bits.

**Complex** is 64 bits – A two-element compound with field firstly 32 bits real part and then 32 bits imaginary part.

# Attribute for Data File

Keywords are stored as data file’s attributes.

The keywords are all lower case.

**Keywords:**

**Type A: Common**

|  |  |  |  |
| --- | --- | --- | --- |
| **Keyword** | **Data Type** | **Annotation** | **Example** |
| nickname | String | Any nick name for the data file. | “Keyword Example Data” |
| comment | String | Comment. | “Here is comment.” |
| observer | String | observer’s name. | “Someone” |
| history | String | history of the data file. | “No history.” |
| keywordver | String | keyword’s version. | “0.0”, “0.1”, “1.2” |

**Type B: Site**

|  |  |  |  |
| --- | --- | --- | --- |
| **Keyword** | **Data Type** | **Annotation** | **Example** |
| sitename | String | Name of the observation site | “Hongliuxia Observatory” |
| sitelat | Float | Unit: degree; Site’s latitude. | 44.17639 |
| sitelon | Float | Unit: degree; Site’s longitude. | 91.7413861 |
| siteelev | Float | Unit: meter; Site’s elevation above sea level. | 1500.0 |
| timezone | String | Beijing Time, 8 hours ahead of GMT | “UTC+08h” |
| epoch | String | Epoch | 2000.0 |

**Type C: Antenna**

|  |  |  |  |
| --- | --- | --- | --- |
| **Keyword** | **Data Type** | **Annotation** | **Example** |
| telescope | String | Tianlai telescope type and generation; Use Roman number for generation. | “Tianlai-Dish-I”,  “Tianlai-Dish-II”,  “Tianlai-Cylinder-I” |
| dishdiam | Float | Diameter of dish; For cylinder: -1.0 | 6.0 |
| nants | Int | Number of antennas. | 16, 3 |
| npols | Int | Polarization of each feed. | 2 |
| nfeeds | Int | Number of feeds | 32, 192 |
| cylen | Float | Length of cylinder; For dish: -1.0 | 50.0 |
| cywid | Float | Width of cylinder; For dish: -1.0 | 50.0 |

**Type D: Receiver**

|  |  |  |  |
| --- | --- | --- | --- |
| **Keyword** | **Data Type** | **Annotation** | **Example** |
| recvver | String | Version of receivers ( the analog devices). | “0.0” |
| lofreq | Float | Unit: MHz; Local Oscillator frequency. | 935.0 |

**Type E: Correlator**

|  |  |  |  |
| --- | --- | --- | --- |
| **Keyword** | **Data Type** | **Annotation** | **Example** |
| corrver | String | Version of correlator. | “0.0” |
| samplingbits | Int | ADC sampling bits. | 8 |
| corrmode | Int | Correlation mode. | 1 |
| inttime | Float | Integration time. | 1.0 |
| obstime | String | The middle date and time when the first visibility data block is observed; Format: “yyyy/mm/dd HH:MM:SS.FFFFFF”;  Note: the time corresponds to when the visibility data is firstly received from the correlator, instead of when the source’s signal is received by feeds or digitalized by ADC. | “2016/02/29 09:30:22.639220” |
| sec1970 | Float | Seconds since epoch 1970 Jan. 1st ; Equals “obstime”. | 1456709422. 639220 |
| nfreq | Int | Number of frequency points. | 512 |
| freqstart | Float | Unit: MHz; The lowest frequency in the bandpass. | 685.0 |
| freqstep | Float | Unit: MHz; Frequency step of the bandpass. | 0.244140625 |

# Array and Its Attribute

Use Array to store mass data and regular data.

**Arrays:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Keyword** | **Data Type** | **Dimname** | **Attribute** | **Annotation** |
| vis | Complex | Time, Frequency,  Baseline | dimname | Visibility data |
| feedno | Int | Feed No. |  | Starting from 1. |
| channo | Int | Feed No.,  (Channel No. of XPol,  Channel No. of YPol) | dimname  badchn | Starting from 1.  For Dish:  X=> Horizontal,  Y=> Orthogonal.  For Cylinder:  X => East-West  Y => North-South  badchn: bad channels, Array of data type integer. |
| blorder | Int | Baselines,  Baseline Name |  | Example:  [[2, 8], [1, 17], [42, 43], [42, 55], …] |
| feedpos | Float | Feed No.,  (X, Y, Z) coordinate | dimname  unit | Feeds’ positions in right hand Cartesian Coordinate with X-Y plane being the horizontal plane, and X axis pointing to the east.  Unit: meter  Origin: |
| antpointing | Float | Source No.,  Feed No.,  (Az, Alt, AzErr, AltErr) | dimname  unit | Antenna pointing and its error;  For cylinder: (0, 90, x, x.)  Unit: degree |
| pointingtime | Float | Source No.,  (starttime, endtime) | dimname  unit | Start pointing time and end pointing time expressed in seconds since epoch 1970;  Unit: second |
| polerr | Float | Feed No.,  (XPolErr, YPolErr) | dimname  unit | Unit: degree |
| nspos | Float | NoiseSource No.,  (X, Y, Z) coordinate | dimname  unit | Noise Source Position;  XYZ origin is the same as feedpos;  Unit: meters |
| noisesource | Float | NoiseSource No.,  (Start, Stop, Cycle) | dimname  unit | Start: Start time;  Stop: Stop time;  Cycle: Source On Cycle;  Unit: second |
| transitsource | Float | Sources,  (time, SourceRA, SourceDec, SourceAz, SourceAlt) | dimname  unit  srcname | Unit: (second, degree, degree, degree, degree)  srcname: Source's name |
| ~~weather~~ | ~~Float~~ | ~~Weather Data,~~  ~~(Sec1970, RoomTemperature, RoomHumidity, Temperature, Dewpoint, Humidity, Precipitation, WindDirection, WindSpeed, Pressure)~~ | ~~dimname~~  ~~unit~~ | ~~Unit: (second, Celcius, %, Celcius, Celcius, %, millimeter, degree (0 to 360; 0 for North, 90 for East), m/s, Pa)~~  **Refer to** [**Here**](http://tianlai.bao.ac.cn/wiki/index.php/Weather_Data_of_Tianlai_Observatory) **for Weather Data** |

# Python Example

See create\_hdf5.py. (*Online* [*http://cosmology.bao.ac.cn/~lijixia/create\_hdf5.py*](http://cosmology.bao.ac.cn/~lijixia/create_hdf5.py) )

See read\_hdf5.py. (*Online* [*http://cosmology.bao.ac.cn/~lijixia/read\_hdf5.py*](http://cosmology.bao.ac.cn/~lijixia/read_hdf5.py) )