

1.1. LS-003 LAT Livetime Cubes

Version: 1.0

Revision date: 12/5/07

Product Description:

The livetime cube provides the LAT livetime at different positions on the sky in different inclination bins. These files contain the livetime cube summed over a processing run (covering ~1/4 of a day).

Naming Convention	gll_lt_rnnnnnnnnn_vxxx.fit	nnnnnnnnnn = MET of beginning of run xxx = version number
Originator of Product	LISOC	
Product Format	FITS	
Production Latency Requirement	1 day	
Product contains data for	Processing run	
Number of deliveries per day	4	
Typical size		
Product Content		
Primary HDU:		
Extension 1	LAT exposure	
Extension 2	Good time intervals	

LS-003 Primary Header

Definition:

```
SIMPLE = T / file does conform to FITS standard
BITPIX = 8 / number of bits per data pixel
NAXIS = 0 / number of data axes
EXTEND = T / FITS dataset may contain extensions
CHECKSUM= / checksum for entire HDU
TELESCOP= 'GLAST' / name of telescope generating data
INSTRUME= 'LAT' / name of instrument generating data
EQUINOX = 2000.0 / equinox for ra and dec
RADECSYS= 'FK5' / world coord. system for this file
                (FK5 or FK4)
DATE = 'YYYY-MM-DDThh:mm:ss' / file creation date (UTC)
DATE-OBS= 'YYYY-MM-DDThh:mm:ss' / start date/time of the obs. (UTC)
DATE-END= 'YYYY-MM-DDThh:mm:ss' / end date/time of the obs. (UTC)
TSTART = / mission time of the obs. start
TSTOP = / mission time of the obs. end
TIMEUNIT= 's' / units for the time related keywords
TIMESYS = 'TT' / type of time system that is used
GPS_OUT = / whether GPS time was unavailable at
                any time during this interval
MJDREFI = 51910.0 / Int. part of MJD of SC clock start
MJDREFF = 7.428703703703703D-4 / Frac. part of MJD of SC clock start
OBSERVER= 'Peter Michelson' / LAT PI
FILENAME= 'gll_lt_rnnnnnnnnnn_vxxx.fit' / name of this file:
                nnnnnnnnnn = MET of beginning of run
                xxx = version number
ORIGIN = 'LISOC' / name of organization making file
CREATOR = / software and version creating file
VERSION = 1 / release version of the file
END
```

Example:

```
SIMPLE = T / file does conform to FITS standard
BITPIX = 8 / number of bits per data pixel
NAXIS = 0 / number of data axes
EXTEND = T / FITS dataset may contain extensions
CHECKSUM= / checksum for entire HDU
TELESCOP= 'GLAST' / name of telescope generating data
INSTRUME= 'LAT' / name of instrument generating data
EQUINOX = 2000.0 / equinox for ra and dec
RADECSYS= 'FK5' / world coord. system (FK5 or FK4)
DATE = '2009-01-09T23:22:12' / file creation date (UTC)
DATE-OBS= '2009-01-09T01:02:03' / start date/time of the obs. (UTC)
DATE-END= '2009-01-09T03:52:10' / end date/time of the obs. (UTC)
TSTART = 253155723.184 / mission time of the obs. start
TSTOP = 253165930.184 / mission time of the obs. end
TIMEUNIT= 's' / units for the time related keywords
TIMESYS = 'TT' / type of time system that is used
GPS_OUT = F / whether GPS time was unavailable
MJDREFI = 51910.0 / Int. part of MJD of SC clock start
MJDREFF = 7.428703703703703D-4 / Frac. part of MJD of SC clock start
OBSERVER= 'Peter Michelson' / LAT PI
FILENAME= 'gll_lt_r0253166000_v000.fit' / name of this file:
ORIGIN = 'LISOC' / name of organization making file
CREATOR = / software and version creating file
VERSION = 1 / release version of the file
END
```


LS-003 Extension Header 1

Name: EXPOSURE

Purpose: This extension lists provides the event list.

Definition:

```
XTENSION= 'BINTABLE'           / binary table extension
BITPIX   = 8                   / 8-bit bytes
NAXIS    = 2                   / 2-dimensional binary table
NAXIS1   =                     / width of table in bytes
NAXIS2   =                     / number of rows in table
PCOUNT   = 0                   / size of special data area
GCOUNT   = 1                   / one data group (required keyword)
TFIELDS  = 1                   / number of fields in each row
CHECKSUM =                     / checksum for entire HDU
DATASUM  =                     / checksum for data table
TELESCOP= 'GLAST'              / name of telescope generating data
INSTRUME= 'LAT'                / name of instr. generating data
EQUINOX  = 2000.0              / equinox for ra and dec
RADECSYS= 'FK5'                / world coord. system for this file
                                (FK5 or FK4)
DATE      = 'YYYY-MM-DDThh:mm:ss' / file creation date (UTC)
DATE-OBS  = 'YYYY-MM-DDThh:mm:ss' / start date/time of the obs. (UTC)
DATE-END  = 'YYYY-MM-DDThh:mm:ss' / end date/time of the obs. (UTC)
OBSERVER  = 'Peter Michelson'   / LAT PI
ORIGIN    = 'LISOC'              / name of organization making file
EXTNAME   = 'EXPOSURE'           / name of this binary table extension
TSTART    =                     / mission time of the obs. start
TSTOP     =                     / mission time of the obs. end
MJDREFI   = 51910.0              / Int. part of MJD of SC clock start
MJDREFF   = 7.428703703703703D-4 / Frac. part of MJD of SC clock start
TIMEUNIT  = 's'                  / units for the time related keywords
TIMEZERO  = 0.0                  / clock correction
TIMESYS   = 'TT'                 / type of time system that is used
TIMEREFF  = 'LOCAL'              / reference frame used for times
CLOCKAPP  =                     / clock drift correction applied?
GPS_OUT   =                     / GPS time unavailable at any time
                                during interval?
PIXTYPE   = 'HEALPIX '           /
ORDERING  = 'NESTED '           /
HIER_CRD  = 'EQU '              /
NSIDE     =                     /
FIRSTPIX  =                     /
LASTPIX   =                     /
THETABIN = 'SQRT(1-COSTHETA) '  /
NBRBINS   =                     /
COSMIN    = 0.                  /
NDSKEYS   = 1                   / # of data subspace keywords in
                                header
DSTYP1    = 'TIME '             /
DSUN11    = 's '                /
DSVAL1    = 'TABLE '            /
DSREF1    = ':GTI '             /
TTYPE1    = 'COSBINS'           /
TFORM1    = '39E'               / data format of field: 4-byte REAL
TUNIT1    = 's'                  / physical unit of field
END
```

Example:

```
XTENSION= 'BINTABLE'           / binary table extension
BITPIX  = 8                     / 8-bit bytes
NAXIS   = 2                     / 2-dimensional binary table
NAXIS1  =                       / width of table in bytes
NAXIS2  =                       / number of rows in table
PCOUNT  = 0                     / size of special data area
GCOUNT  = 1                     / one data group (required keyword)
TFIELDS = 17                   / number of fields in each row
CHECKSUM=                       / checksum for entire HDU
DATASUM =                       / checksum for data table
TELESCOP= 'GLAST'              / name of telescope generating data
INSTRUME= 'LAT'                / name of instr. generating data
EQUINOX = 2000.0               / equinox for ra and dec
RADECSYS= 'FK5'                / world coord. system for this file (FK5 or FK4)
DATE    = '2009-01-09T23:22:12' / file creation date (UTC)
DATE-OBS= '2009-01-09T01:02:03' / start date/time of the obs. (UTC)
DATE-END= '2009-01-09T03:52:10' / end date/time of the obs. (UTC)
OBSERVER= 'Peter Michelson'    / LAT PI
ORIGIN  = 'LISOC'              / name of organization making file
EXTNAME = 'EVENTS'            / name of this binary table extension
HDUCLASS= 'OGIP'              / format conforms to OGIP standard
HDUCLAS1= 'EVENTS'            / ext. contains events
HDUCLAS2= 'ALL'                / ext. contains all events detected
TSTART  = 253155723.184        / mission time of the obs. start
TSTOP   = 253165930.184        / mission time of the obs. end
MJDREFI = 51910.0              / Int. part of MJD of SC clock start
MJDREFF = 7.428703703703703D-4 / Frac. part of MJD of SC clock start
TIMEUNIT= 's'                  / units for the time related keywords
TIMEZERO= 0.0                  / clock correction
TIMESYS = 'TT'                 / type of time system that is used
TIMEREFF= 'LOCAL'              / reference frame used for times
CLOCKAPP= 'NO'                 / clock drift correction applied?
GPS_OUT  = 'NO'                / GPS time unavailable at any time during
interval?
PIXTYPE  = 'HEALPIX '         /
ORDERING= 'NESTED '          /
HIER_CRD= 'EQU '              /
NSIDE    = 64                 /
FIRSTPIX= 0                   /
LASTPIX  = 49151              /
THETABIN= 'SQRT(1-COSTHETA) ' /
NBRBINS  = 39                 /
COSMIN   = 0.                 /
NDSKEYS  = 1                   /
DSTYP1   = 'TIME '           /
DSUNI1   = 's '               /
DSVAL1   = 'TABLE '          /
DSREF1   = ':GTI '           /
TTYPE1   = 'COSBINS'         /
TFORM1   = '39E'              / data format of field: 4-byte REAL
TUNIT1   = 's'                / physical unit of field
END
```

LS-003 Extension Header 2

Name: GTI

Purpose: Provides a list of the time intervals during which there are usable data.

Definition:

```
XTENSION= 'BINTABLE'           / binary table extension
BITPIX   = 8                   / 8-bit bytes
NAXIS    = 2                   / 2-dimensional binary table
NAXIS1   =                     / width of table in bytes
NAXIS2   =                     / number of rows in table
PCOUNT   = 0                   / size of special data area
GCOUNT   = 1                   / one data group (required
                               keyword)
TFIELDS  = 2                   / number of fields in each row
CHECKSUM =                     / checksum for entire HDU
DATASUM  =                     / checksum for data table
TELESCOP = 'GLAST'            / name of telescope generating
                               data
INSTRUME = 'LAT'              / name of instrument generating
                               data
EQUINOX  = 2000.0              / equinox for ra and dec
RADECSYS = 'FK5'              / world coord. system for this
                               file (FK5 or FK4)
DATE      = 'YYYY-MM-DDThh:mm:ss' / file creation date (UTC)
DATE-OBS  = 'YYYY-MM-DDThh:mm:ss' / start date/time of the obs. (UTC)
DATE-END  = 'YYYY-MM-DDThh:mm:ss' / end date/time of the obs. (UTC)
OBSERVER  = 'Peter Michelson'    / LAT PI
ORIGIN    = 'LISOC'              / name of organization making file
EXTNAME   = 'GTI'                / name of this binary table ext.
HDUCLASS  = 'OGIP'              / format conforms to OGIP standard
HDUCLAS1  = 'GTI'                / ext. contains good time intervals
HDUCLAS2  = 'ALL'                / ext. contains all science time
TSTART    =                     / mission time of the obs. start
TSTOP     =                     / mission time of the obs. end
MJDREFI   = 51910.0              / Int. part of MJD of SC clock start
MJDREFF   = 7.428703703703703D-4 / Frac. part of MJD of SC clock start
TIMEUNIT  = 's'                  / units for time-related keywords
TIMEZERO  = 0.0                  / clock correction
TIMESYS   = 'TT'                 / type of time system that is used
TIMEREF   = 'LOCAL'              / reference frame used for times
CLOCKAPP  =                     / clock drift correction applied?
GPS_OUT   =                     / GPS time was unavailable at any
                               time during this interval?
ONTIME    =                     / sum of GTI lengths
TELAPSE   =                     / time between first GTI START and
                               last GTI STOP
TTYPE1    = 'START'              / start time of good time
                               intervals
TFORM1    = 'D'                  / field data format: 8-byte DOUBLE
TUNIT1    = 's'                  / physical unit of field
TLMIN1    = 0.0                  / minimum value
TLMAX1    = 1.0D+10              / maximum value
TTYPE2    = 'STOP'              / stop time of good time intervals
TFORM2    = 'D'                  / field data format: 8-byte DOUBLE
TUNIT2    = 's'                  / physical unit of field
TLMIN2    = 0.0                  / minimum value
TLMAX2    = 1.0D+10              / maximum value
```

END

Example:

```
XTENSION= 'BINTABLE'           / binary table extension
BITPIX   = 8                   / 8-bit bytes
NAXIS    = 2                   / 2-dimensional binary table
NAXIS1   =                     / width of table in bytes
NAXIS2   =                     / number of rows in table
PCOUNT   = 0                   / size of special data area
GCOUNT   = 1                   / one data group (required keyword)
TFIELDS  = 2                   / number of fields in each row
CHECKSUM =                     / checksum for entire HDU
DATASUM  =                     / checksum for data table
TELESCOP= 'GLAST'             / name of telescope generating data
INSTRUME= 'LAT'               / name of instr. generating data
EQUINOX  = 2000.0             / equinox for ra and dec
RADECSYS= 'FK5'              / world coord. system for file (FK5 or FK4)
DATE     = '2009-01-09T23:22:12' / file creation date (UTC)
DATE-OBS= '2009-01-09T01:02:03' / start date/time of the obs. (UTC)
DATE-END= '2009-01-09T03:52:10' / end date/time of the obs. (UTC)
OBSERVER= 'Peter Michelson'   / LAT PI
ORIGIN   = 'LISOC'            / name of organization making file
EXTNAME  = 'GTI'              / name of this binary table ext.
HDUCLASS= 'OGIP'              / format conforms to OGIP standard
HDUCLAS1= 'GTI'               / ext. contains good time intervals
HDUCLAS2= 'ALL'               / ext. contains all science time
TSTART   = 253155723.184      / mission time of the obs. start
TSTOP    = 253165930.184      / mission time of the obs. end
MJDREFI  = 51910.0            / Int. part of MJD of SC clock start
MJDREFF  = 7.428703703703703D-4 / Frac. part of MJD of SC clock start
TIMEUNIT = 's'                / units for time-related keywords
TIMEZERO = 0.0                / clock correction
TIMESYS  = 'TT'               / type of time system that is used
TIMEREF  = 'LOCAL'            / reference frame used for times
CLOCKAPP = 'NO'                / clock drift correction applied?
GPS_OUT  = 'NO'                / GPS time was unavailable during interval?
ONTIME   = 10207.0            / sum of GTI lengths
TELAPSE  = 10207.0            / time between first GTI START and last GTI STOP
TTYPE1   = 'START'            / start time of good time intervals
TFORM1   = 'D'                / field data format: 8-byte DOUBLE
TUNIT1   = 's'                / physical unit of field
TLMIN1   = 0.0                / minimum value
TLMAX1   = 1.0D+10            / maximum value
TTYPE2   = 'STOP'            / stop time of good time intervals
TFORM2   = 'D'                / field data format: 8-byte DOUBLE
TUNIT2   = 's'                / physical unit of field
TLMIN2   = 0.0                / minimum value
TLMAX2   = 1.0D+10            / maximum value
END
```