NICER CALIBRATION: Global Bad Times

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Summary and Release History

This document briefly describes release the NICER global bad times file. This file is used by the NICER standard analysis pipeline tools to exclude (or deselect) data from some or all detectors based upon known bad conditions. This file contains time intervals that cannot normally be determined from telemetry, so external knowledge must be applied.

Released Files

Public Release	NICER CALDB Ver	ID String	Comments
2022-10-20	xti20221001	20170601v001	Initial release

Table Notes: All files appear in NICER Calibration Database as `nicer/xti/cpf/gti/nixtibadtimes<S>.fits`, where *<S>* is the ID String above.

Introduction

In most cases, NICER data can be processed and screened using the data at hand. This means that the telemetry values stored with the data, typically the filter file, can be used to remove “bad” times and keep “good” times.

However, there are occasions where the telemetry is not enough. These may be when anomalies have occurred which prevented NICER from operating as normal, or because some other obstruction occurred. (Consider that NICER is mounted on the International Space Station, and occasionally nearby robotic activities can block the NICER field of view).

Thus, the NICER team has cataloged known bad times and stored them in a CALDB file for use by standard software. The software tool niautoscreen can read these files.

The Data

The global bad time file is based upon known significant events. These events can be found from the NICER Significant Events page (https://heasarc.gsfc.nasa.gov/docs/nicer/timelines/nicer_significant_events.html), but also from internal NICER team documentation. Thus, this is human-curated information that has been transformed into a FITS table.

A known bad time can be described in several ways.

When. The time interval is stored as the START and STOP column of the table. These entries are similar to a GTI file, but here the file is a "B"TI (Bad time interval file).

What. The detector or detectors that are affected are listed in the DET_ID column. For example a value of 14 means detector 14 (which happens to be FPM mechanical position 2-5). A special notation of *m*9 means that all FPMs in MPU *m* are affected, and a value of 99 means the entire array is affected.

How Bad. A simple good-bad quality indicator is sometimes insufficient. Some users may be more tolerant of problems than others. Thus, there is a graded quality indicator with the QUALITY column. The QUALITY values used are

QUALITY	Description
0	No known issues; data OK
1	Something non-routine occurred, but it had no known impact
2	Bad data with some possible good data; proceed with caution
3	Bad data with little or no good data

For most users, a quality setting of 1 will be appropriate. This will select good and non-routine data with no known issues, but exclude any time interval with significant known bad data. Typically those users selecting level 2 or 3 are expert-level, and will understand that little or no good data is recoverable from the data, and only with manual checking and filtering.

Why. The table also has a COMMENT column which describes why in narrative form that an interval was marked as non-good.

The file is indexed with the following CALDB indexing keywords

- CCNM = 'STDGTI'
- Boundary keyword DETNAM(99) - applies to all detectors

Typical Causes For Known Bad Times

For the most part, NICER data are free from known bad times. However there are a few problematic issues that are inventoried.

Initial deployment and commissioning. From 2017-06-03 through 2017-06-24T23:09 (UTC), this period corresponds to NICER being deployed and commissioned. NICERs systems may not be fully active during this phase. Pointing accuracy was low. (all MPUs, QUALITY=3)

MPU1 timestamp anomaly. From 2019-07-08 through 2017-07-23, MPU1 experienced an anomaly that scrambled timestamp values at the subsecond level. (MPU1, QUALITY=2)

NICER data corruption. On the full day of 2021-02-09 (UTC), NICER received partially corrupt data from the International Space Station. Some telemetry values would be reported as incorrect values. Although many of these values could be screened out, some possibly remain. (all MPUs, QUALITY=1)

NICER detector annealing. For much of the year 2020 and 2021, NICER engaged in an activity to reduce detector noise by using an annealing process. Put simply, the detector was allowed to warm up to room temperature, which in principle allows some radiation damage to the silicon to heal. During these times the detectors were disabled for science so no problems are expected. (various FPMs, QUALITY=1)