# WFC3 Quicklook Anomalies Database

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ABSTRACT

*The WFC3 Quicklook anomalies database is introduced. While previously available only for internal (STScI) users, the contents of the table are being made available to external users. This ISR describes the database, its structure, how to access it, and caveats regarding its completeness.*

## 1   Introduction

The WFC3 Quicklook project is a data management software used for the quick access and inspection of Hubble Space Telescope Wide Field Camera 3 science and calibration data. A large portion of the project involves handling the front-end web interface that allows Quicklook team members to visually inspect new and existing data. Anomaly "flagging" is one of the features of the Quicklook web interface: it allows Quicklook team members to mark observations that contain anomalies that might negatively impact the quality of WFC3 science and calibration products. The Quicklook "flagging" procedure involves displaying the new science and calibration images[1], inspecting these images for anomalies, occasionally performing a deeper analysis to verify an anomaly, and then flagging these images with the specific anomaly/ies. As anomalies are flagged, the WFC3 Quicklook anomalies database is populated with new entries.

With this report, we announce the availability of the WFC3 Quicklook anomalies database to the public. Section 2 summarizes the table structure and contents, section 3 describes caveats within the table contents, and section 4 provides several examples on how to access the tabulated information.

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[1] The images being evaluated are `FLT` images. Drizzle products are currently not evaluated on Quicklook.

## 2    Table Structure

The table that accompanies this ISR is an `ascii` snapshot of the Quicklook anomalies database (called `ql_anomalies_database_YYYY-MM-DD.dat`[2]). It is a record of all the individual science and calibration images that have been flagged with at least one image anomaly. For a quick reference of the list of anomalies in the UVIS and IR detectors, see Table 1 below. A fully-documented and in-depth description of these anomalies can be found in WFC3 ISR 2017-22. Table 2 provides a list of the column names in the Quicklook anomalies database, and their basic descriptions. The names of these columns are the same as the keywords in the primary headers of the FITS files for these observations.

| Anomaly | Detector(s) | Origin |
|---|---|---|
| Cosmic Ray Shower | UVIS | detector |
| Crosstalk | IR, UVIS | detector |
| Data Transfer Error | IR, UVIS | act-of-nature |
| Detector-Filter Ghost | IR, UVIS | scatter/reflection |
| Diamond Feature | IR | scatter/reflection |
| Diffraction Spike | IR, UVIS | scatter/reflection |
| Dragon's Breath | UVIS | scatter/reflection |
| Earth Limb/Shine | IR | scatter/reflection |
| Excessive Saturation | IR, UVIS | detector |
| Figure-8 Ghost | UVIS | scatter/reflection |
| Filter Ghost | UVIS | scatter/reflection |
| Fringing | UVIS | scatter/reflection |
| Guidestar Failure | IR, UVIS | act-of-nature |
| IR Banding | IR | detector |
| Persistence | IR | detector |
| Prominent Blobs | IR | detector |
| Satellite Trail | IR, UVIS | act-of-nature |
| Scattered Light | UVIS | scatter/reflection |

Table 1: Known anomalies in the IR and UVIS detectors, and their origins. This is a version of Table 1 from WFC3 ISR 2017-22.

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[2]Where `YYYY-MM-DD` is the date when the file was updated.

| Column Name | Column Description | Data Type (Example) |
|---|---|---|
| PROPOSID | The proposal ID number | Integer (e.g. 15713) |
| TARGNAME | The name of the target | String (e.g. NGC-104) |
| ROOTNAME | Root name of the FITS file for the given observation | String (e.g. ie0f01yjq) |
| DETECTOR | The detector used for the observation | String (UVIS or IR) |
| SUBARRAY | Determines if subarray was used | Boolean (T if subarray, F if full frame) |
| CCDAMP | The amplifier used for the observation | String (e.g. ABCD for full frame) |
| FILTER | The filter used for the observation | String (e.g. F606W) |
| EXPTIME | The exposure time in seconds | Float (e.g. 20.0) |
| DATE−OBS | Date the file was written (YYYY-MM-DD) | String (e.g. 2020-01-02) |
| EXPSTART | MJD of start of observation | Float (e.g. 5.885022897590E+04) |
| MTFLAG | Moving target flag | Boolean (T if it is a moving target) |
| FGSLOCK | Commanded FGS lock | String (FINE, COARSE, GYROS, UNKNOWN) |
| EXPFLAG | Exposure interruption indicator | String (e.g. NORMAL) |
| SCAN_TYP | Scan type | String (C : bostrophidon; D : C with dwell; N : N/A) |
| CHINJECT | Charge injection | String (e.g. NONE) |
| IMAGETYP | Type of exposure identifier | String (e.g. EXT) |
| CALWF3_SUB_ERROR | calwf3 subarray error | Numerical Boolean (1 : flagged) |
| CR_SHOWER | Cosmic Ray Shower | Numerical Boolean (1 : flagged) |
| CROSSTALK | Crosstalk | Numerical Boolean (1 : flagged) |
| CTE_CORRECTION_ERROR | CTE Correction Error | Numerical Boolean (1 : flagged) |

| Column Name | Column Description | Data type | | |
|---|---|---|---|---|
| DATA_TRANSFER_ERROR | Data Transfer Error | Numerical | Boolean | (1 : flagged) |
| DETECTOR_FILTER_GHOST | Detector Filter Ghost | Numerical | Boolean | (1 : flagged) |
| DIAMOND | Diamond shape found on a source | Numerical | Boolean | (1 : flagged) |
| DIFFRACTION_SPIKE | Diffraction spike found on a source | Numerical | Boolean | (1 : flagged) |
| DRAGONS_BREATH | Dragon's breath | Numerical | Boolean | (1 : flagged) |
| EARTH_LIMB | Earth limb in the observation | Numerical | Boolean | (1 : flagged) |
| EXCESSIVE_SATURATION | Excessive saturation from one or more sources | Numerical | Boolean | (1 : flagged) |
| FIGURE8_GHOST | Figure 8 ghost | Numerical | Boolean | (1 : flagged) |
| FILTER_GHOST | Filter ghost | Numerical | Boolean | (1 : flagged) |
| FRINGING | Fringing | Numerical | Boolean | (1 : flagged) |
| GUIDESTAR_FAILURE | Guidestar Failure | Numerical | Boolean | (1 : flagged) |
| IR_BANDING | IR Banding | Numerical | Boolean | (1 : flagged) |
| PERSISTENCE | Persistence found in an IR observation | Numerical | Boolean | (1 : flagged) |
| PROMINENT_BLOBS | Prominent blobs found in an IR observation | Numerical | Boolean | (1 : flagged) |
| SATELLITE_TRAIL | One or more satellite trails found | Numerical | Boolean | (1 : flagged) |
| SCATTERED_LIGHT | Scattered light | Numerical | Boolean | (1 : flagged) |
| OTHER | An unidentifiable anomaly | Numerical | Boolean | (1 : flagged) |

Table 2: The structure of the table in `ql_anomalies_database_YYYY-MM-DD.dat` (left to right): The name of the column in the table, a description of the column, and its data type (with an example). Rows that are shaded represent the database columns that can also be found as keywords in the primary headers of the `FITS` files.

## 3   Caveats

There are a handful of issues that make it difficult to identify some Quicklook anomalies with certainty. One example would be a guidestar failure during a Drift And SHift (DASH) mode observation. DASH mode is an observing technique used to cover a large field of view that exceeds the detector FOV. DASH mode involves taking the first `multiaccum` ramp under FGS control, then taking the remaining ramps under the (less precise) gyro control. Images under gyro control will exhibit small drifts between the non-destructive reads, resulting in calibrated images that appear to have experienced a loss of lock. Figure 1 presents an image with a guidestar failure (left), and an image observed using DASH mode (right), side by side for comparison. Other examples of anomalies difficult to identify include: satellite trails during a loss of FGS lock, scattered light on an observation of a nebula, crosstalk in an exposure with low background, and persistence in any bright or crowded observation.
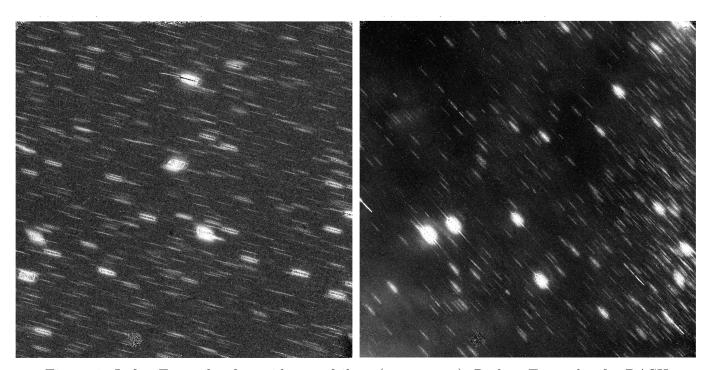


Figure 1: Left - Example of a guide star failure (`ib8d89veq`), Right - Example of a DASH mode observation (`idnm52dvq`)

## 4   How to Access The Quicklook Anomalies Database

The Quicklook anomalies database is a comma-delimited `ascii` file that can be opened and read several ways. The following are two examples of how the file can be handled.

## 4.1 Python

If you would like to access the table's contents via `Python`, you have the option to do so with `astropy.table`. In Figures 2 through 4 we use `astropy.table` to read the Quicklook anomalies archive and index the table object to determine what datasets in program 11202 have been flagged with anomalies[3].

```
[In [6]: from astropy.table import Table

[In [7]: t = Table.read('ql_anomalies_database_2020-02-27.dat', format='ascii')

[In [8]: indexes = t['PROPOSID'] == 11202 # What rows have `PROPOSID` equal to 11202?

[In [9]: anomalies_11202 = t[indexes]

In [10]:
```

Figure 2: A table object is generated using the `ql_anomalies_database.dat` file. We then index this table object to return a version of the table that only contains datasets from proposal 11202.

```
[In [34]: anomalies_11202.more()

PROPOSID   ROOTNAME     TARGNAME      DETECTOR SUBARRAY ... prominent_blobs satellite_trail scattered_light other
--------- ---------- ---------------- -------- -------- ... --------------- --------------- --------------- -----
    11202 ia1l62jaq SDSSJ0758+3034        IR    False ...               0               0               0     1
    11202 ia1l62jbq SDSSJ0758+3034        IR    False ...               0               0               0     1
    11202 ia1l62jcq SDSSJ0758+3034        IR    False ...               0               0               0     1
    11202 ia1l62jeq SDSSJ0758+3034        IR    False ...               0               0               0     1
    11202 ia1l64vbq SDSSJ1108+0252        IR    False ...               0               0               0     0
    11202 ia1l64vcq SDSSJ1108+0252        IR    False ...               0               0               0     0
    11202 ia1l64veq SDSSJ1108+0252        IR    False ...               0               0               0     0
    11202 ia1l66kcq SDSSJ1244+0111        IR    False ...               1               0               0     0
    11202 ia1l66kdq SDSSJ1244+0111        IR    False ...               1               0               0     0
    11202 ia1l66keq SDSSJ1244+0111        IR    False ...               1               0               0     0
    11202 ia1l66kgq SDSSJ1244+0111        IR    False ...               1               0               0     0
    11202 ia1l69fiq SDSSJ1614+4522        IR    False ...               0               0               0     0
    11202 ia1l69fjq SDSSJ1614+4522        IR    False ...               0               0               0     0
    11202 ia1l69fkq SDSSJ1614+4522        IR    False ...               0               0               0     0
    11202 ia1l69fmq SDSSJ1614+4522        IR    False ...               0               0               0     0
    11202 ia1l76lpq SDSSJ0808+4706        IR    False ...               0               0               0     0
    11202 ia1l76lqq SDSSJ0808+4706        IR    False ...               0               1               0     0
    11202 ia1l76lrq SDSSJ0808+4706        IR    False ...               0               0               0     0
    11202 ia1l76ltq SDSSJ0808+4706        IR    False ...               0               0               0     0
    11202 ia1l77ocq SDSSJ0822+2652        IR    False ...               0               1               0     0
    11202 ia1l78ucq SDSSJ0841+3824        IR    False ...               1               0               0     0
    11202 ia1l78udq SDSSJ0841+3824        IR    False ...               1               0               0     0

-- f, <space>, b, r, p, n, <, >, q h (help) -- q
```

Figure 3: From here, we can navigate through this table using `astropy.table`'s `more()` method.

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[3]Versions of all software used: `astroPy v3.2.2`, `Python v3.7.4`, in an `IPython v7.8.0` terminal

```
[In [35]: anomalies_11202.write('anomalies_11202.dat', format='ascii')

 In [36]:
```

Figure 4: We also have the option to write this table object into another `ascii` file for future reference, essentially creating a personalized Quicklook anomalies database with all relevant programs.

## 4.2    Excel

In this section we will filter for a single program ID (`PROPOSID` = 11202) in the Quicklook anomalies database, with Microsoft Excel [4]. Begin by opening the downloaded file in a new Microsoft Excel sheet and follow the steps below:
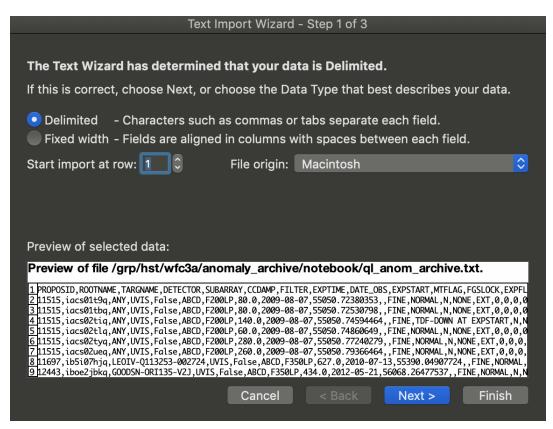


Figure 5: The Text Import Wizard should pop up with a notice that your data is delimited. Click on `Delimited` and then press `Next`.
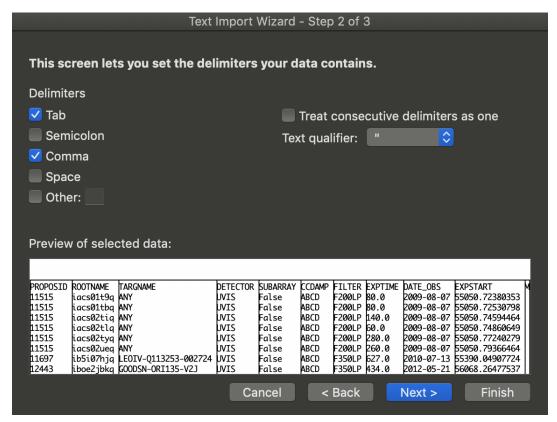
-----
[4]Microsoft Excel version 16.34

Figure 6: Next, select the delimiters used to separate the data. For this table the `Comma` delimiter was used. Once selected, press `Finish`.

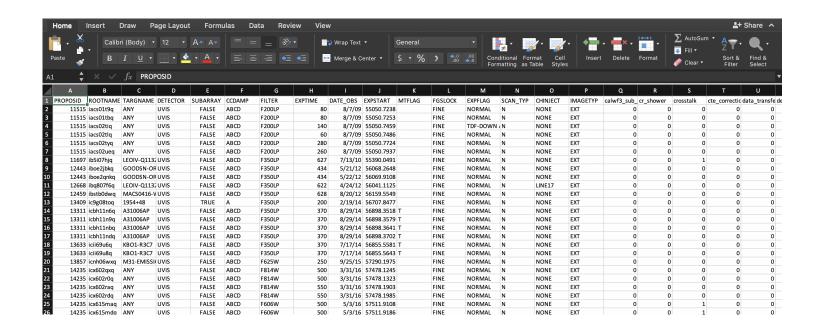| PROPOSID | ROOTNAME | TARGNAME | DETECTOR | SUBARRAY | CCDAMP | FILTER | EXPTIME | DATE_OBS | EXPSTART | MTFLAG | FGSLOCK | EXPFLAG | SCAN_TYP | CHINJECT | IMAGETYP | calwf3_sub_ | cr_shower | crosstalk | cte_correcti | data_transfe de |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11515 | iacs01t9q | ANY | UVIS | FALSE | ABCD | F200LP | 80 | 8/7/09 | 55050.7238 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 11515 | iacs01tbq | ANY | UVIS | FALSE | ABCD | F200LP | 80 | 8/7/09 | 55050.7253 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 11515 | iacs02tiq | ANY | UVIS | FALSE | ABCD | F200LP | 140 | 8/7/09 | 55050.7459 | | FINE | TDF-DOWN | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 11515 | iacs02tlq | ANY | UVIS | FALSE | ABCD | F200LP | 60 | 8/7/09 | 55050.7486 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 11515 | iacs02tyq | ANY | UVIS | FALSE | ABCD | F200LP | 280 | 8/7/09 | 55050.7724 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 11515 | iacs02ueq | ANY | UVIS | FALSE | ABCD | F200LP | 260 | 8/7/09 | 55050.7937 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 11697 | ib5i07hjq | LEOIV-Q113 | UVIS | FALSE | ABCD | F350LP | 627 | 7/13/10 | 55390.0491 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 1 | 0 | 0 |
| 12443 | iboe2jbkq | GOODSN-OR | UVIS | FALSE | ABCD | F350LP | 434 | 5/21/12 | 56068.2648 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 12443 | iboe2qnkq | GOODSN-OR | UVIS | FALSE | ABCD | F350LP | 434 | 5/22/12 | 56069.9108 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 12668 | ibq807f6q | LEOIV-Q113 | UVIS | FALSE | ABCD | F350LP | 622 | 4/24/12 | 56041.1125 | | FINE | NORMAL | N | LINE17 | EXT | 0 | 0 | 0 | 0 | 0 |
| 12459 | ibstb0dwq | MACS0416-V | UVIS | FALSE | ABCD | F350LP | 628 | 8/20/12 | 56159.5549 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 13409 | ic9g08toq | 1954+48 | UVIS | TRUE | A | F350LP | 200 | 2/19/14 | 56707.8477 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 13311 | icbh11n6q | A31006AP | UVIS | FALSE | ABCD | F350LP | 370 | 8/29/14 | 56898.3518 | T | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 13311 | icbh11n9q | A31006AP | UVIS | FALSE | ABCD | F350LP | 370 | 8/29/14 | 56898.3579 | T | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 13311 | icbh11nbq | A31006AP | UVIS | FALSE | ABCD | F350LP | 370 | 8/29/14 | 56898.3641 | T | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 13311 | icbh11ndq | A31006AP | UVIS | FALSE | ABCD | F350LP | 370 | 8/29/14 | 56898.3702 | T | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 13633 | icii69u6q | KBO1-R3C7 | UVIS | FALSE | ABCD | F350LP | 370 | 7/17/14 | 56855.5581 | T | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 13633 | icii69u8q | KBO1-R3C7 | UVIS | FALSE | ABCD | F350LP | 370 | 7/17/14 | 56855.5643 | T | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 13857 | icnh06wxq | M31-EMISSI | UVIS | FALSE | ABCD | F625W | 250 | 9/25/15 | 57290.1975 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 14235 | icx602qxq | ANY | UVIS | FALSE | ABCD | F814W | 500 | 3/31/16 | 57478.1245 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 14235 | icx602r0q | ANY | UVIS | FALSE | ABCD | F814W | 500 | 3/31/16 | 57478.1323 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 14235 | icx602raq | ANY | UVIS | FALSE | ABCD | F814W | 550 | 3/31/16 | 57478.1903 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 14235 | icx602rdq | ANY | UVIS | FALSE | ABCD | F814W | 550 | 3/31/16 | 57478.1985 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 0 | 0 | 0 |
| 14235 | icx615maq | ANY | UVIS | FALSE | ABCD | F606W | 500 | 5/3/16 | 57511.9108 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 1 | 0 | 0 |
| 14235 | icx615mdq | ANY | UVIS | FALSE | ABCD | F606W | 500 | 5/3/16 | 57511.9186 | | FINE | NORMAL | N | NONE | EXT | 0 | 0 | 1 | 0 | 0 |

Figure 7: You will be left with your data separated by columns and from there may begin filtering and parsing the data as necessary.
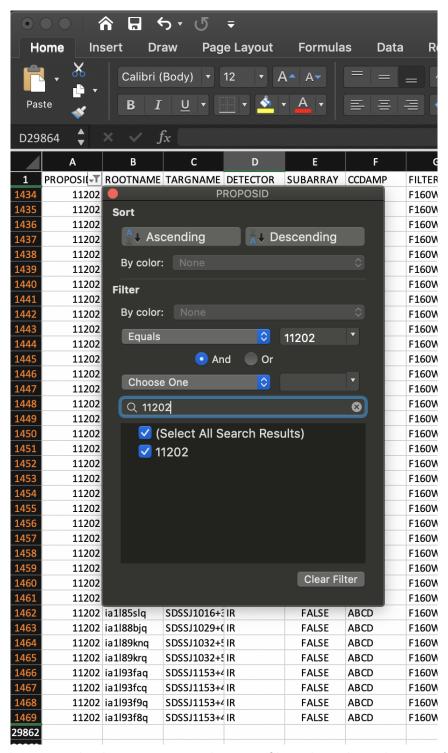
Figure 8: In this example the `PROPOSID` column is filtered to show datasets from program 11202 only. The user can now navigate the database to see the anomaly flags for these data.

# 5    References

C.M. Gosmeyer & The Quicklook Team. 2017. WFC3 ISR 2017-22. *WFC3 Anomalies Flagged by the Quicklook Team.* (Baltimore: STScI)
http://www.stsci.edu/files/live/sites/www/files/home/hst/instrumentation/wfc3/
documentation/instrument-science-reports-isrs/_documents/2017/WFC3-2017-22.pdf

`astropy.table` Documentation.
https://het.as.utexas.edu/HET/Software/Astropy-1.0/table/

Dressel, L., 2019. Wide Field Camera 3 Instrument Handbook, Version 12.0. *The Drift and Shift Observing Strategy.* (Baltimore: STScI)
https://hst-docs.stsci.edu/display/WFC3IHB/7.10+IR+Observing+Strategies#id-7.
10IRObservingStrategies-7.10.67.10.6TheDriftandShift(DASH)ObservingStrategy

# 6    Aknowledgements