1. Introduction

Despite careful calibrations and data processing, there are some minor problems in the final IRIS level-2 data product. Some of these problems were corrected in a mission-long data reprocessing completed in August 2017, although some still persist and may not be solved soon. While the underlying causes vary from telemetry data dropouts to pipeline software bugs, most of these problems, especially those that are ongoing, have negligible to minor impact on science data in general.

The purpose of this document is to provide IRIS data users a comprehensive list of known problems (Section 2) together with examples and figures for some well-understood ones (Section 3).

2. List of Known Problems in Level-2 IRIS Data

See the table on the next page.
<table>
<thead>
<tr>
<th>Problems</th>
<th>Symptom</th>
<th>Underlying Cause</th>
<th>SIJ Spectra</th>
<th>Severity (Significant, Moderate, Minor, Negligible)</th>
<th>Scope (% of obs affected)</th>
<th>Action/Correction on/Mitigation</th>
<th>Primary fix by</th>
<th>Date Fixed</th>
<th>By</th>
<th>Date</th>
<th>Status</th>
<th>Notes</th>
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<tbody>
<tr>
<td><strong>Dark correction</strong></td>
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<tr>
<td>Dark quadrant/periodal</td>
<td>Different offset in upper and lower halves of spectra due to 2 amplifiers/CCDs</td>
<td>Imperfect dark correction</td>
<td>N Y</td>
<td>Minor, usually noticeable except for low-intensity continuum spectra</td>
<td>Retrospective misregistration, long data, and continuing improvement of dark long-term tracking</td>
<td>Steve Saar, RSRE</td>
<td>2016-Jun</td>
<td>Reza Rezaei, AC, Spain</td>
<td>2017-Jan</td>
<td>Closed</td>
<td>After the 2016-June reprocessing, the residual offset is only on the order of 0.0-0.3 DN, which is the best we can achieve with the current dark long-term trend</td>
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<tr>
<td>Dark steps in time (FUV)</td>
<td>Faint ghost, usually noticeable in space-time plots of low-intensity continua spectra</td>
<td>Retrospective misregistration, long data, and continuing improvement of dark long-term tracking</td>
<td>Y N</td>
<td>Minor to Moderate</td>
<td>Retrospective misregistration, long data, and continuing improvement of dark long-term tracking</td>
<td>Ryan</td>
<td>Pending</td>
<td>Reza Rezaei, Switzerland</td>
<td>2016-Feb</td>
<td>Closed</td>
<td>Affected 12% obs before the 2017-Jan correction</td>
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<td>Dark hot pixels</td>
<td>Some pixels remain persistently in time at an elevated high value on the order of a few DN.</td>
<td>Imperfect dark correction</td>
<td>Y N</td>
<td>Minor</td>
<td>Retrospective misregistration, long data, and continuing improvement of dark long-term tracking</td>
<td>Ryan</td>
<td>Pending</td>
<td>Reza Rezaei, Switzerland</td>
<td>2016-Feb</td>
<td>Closed</td>
<td>Affected 12% obs before the 2017-Jan correction</td>
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<td><strong>Background subtraction</strong></td>
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<td>Periodic vertical stripes</td>
<td>Periodic - Vertical stripes in spectroheliograms, at a period equal to the number of SJI channels used, usually noticeable when CIV SJI is used with a dip at times of 2796 SJI</td>
<td>Imperfect correction of filter wheel position dependency, seeing, spectrophotograph background</td>
<td>N Y</td>
<td>Minor, peak-to-peak amplitude ~0.2 DN, usually noticeable in space-time plots of low-intensity continuum spectra</td>
<td>Under investigation</td>
<td>Pending</td>
<td>Reza Rezaei, AC, Spain</td>
<td>2017-Jan</td>
<td>Open</td>
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<td>FUV background update/down L-shape</td>
<td>An upside-down L-shaped feature appears near SIV 1394</td>
<td>Retrospective misregistration, long data, and continuing improvement of dark long-term tracking</td>
<td>N Y</td>
<td>Minor to Moderate</td>
<td>Under investigation</td>
<td>Pending</td>
<td>Reza Rezaei, AC, Spain</td>
<td>2017-Jan</td>
<td>Open</td>
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<td><strong>Flat-field</strong></td>
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<td>CDD burn-in</td>
<td>CDD burn-in</td>
<td>Y Y</td>
<td>Moderate</td>
<td>CDD flatfield corrects burning to some extent.</td>
<td>Open</td>
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<td>Open</td>
<td>Open</td>
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<td><strong>Wavelength calibration</strong></td>
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<td>Wavelength shifts</td>
<td>Wavelengths of some spectral windows are incorrectly shifted; examples include the following:</td>
<td>Bug in fitToDate.pro</td>
<td>N Y</td>
<td>Moderate</td>
<td>Under investigation</td>
<td>Pending</td>
<td>Reza Rezaei, AC, Spain</td>
<td>2017-Jan</td>
<td>Open</td>
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<tr>
<td>FUV 2 window being redshifted by 0.0458 A (10 km/s)</td>
<td>Bug in fitToDate.pro</td>
<td>N Y</td>
<td>Moderate</td>
<td>Under investigation</td>
<td>Pending</td>
<td>Reza Rezaei, AC, Spain</td>
<td>2017-Jan</td>
<td>Open</td>
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<tr>
<td>FUV (B) bright donut (inner tube)</td>
<td>Bug in instrument code Martin's code now includes double-precision for all wavelength related keywords</td>
<td>Under investigation</td>
<td>N/A</td>
<td>N/A</td>
<td>Under investigation</td>
<td>Pending</td>
<td>Reza Rezaei, AC, Spain</td>
<td>2017-Jan</td>
<td>Open</td>
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<td>Flat field</td>
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<td><strong>Slit-jaw imager</strong> (SJI)</td>
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<tr>
<td>Ghost, geometric features</td>
<td>Features of regular geometric shapes in off-limb SJI, moving together with the slit thru the raster, with the following subcategories:</td>
<td>Scatter light in the optical paths</td>
<td>Y N</td>
<td>Negligible, usually on the order of a few DN, only show up against off-limb with faint background</td>
<td>N/A</td>
<td>N/A</td>
<td>Ryan, and Ross planners</td>
<td>2016-May</td>
<td>Open</td>
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<tr>
<td>Faint bright donut (inner tube)</td>
<td>Bug in instrument code Martin's code now includes double-precision for all wavelength related keywords</td>
<td>Under investigation</td>
<td>N/A</td>
<td>N/A</td>
<td>Under investigation</td>
<td>Pending</td>
<td>Reza Rezaei, AC, Spain</td>
<td>2017-Jan</td>
<td>Open</td>
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<tr>
<td>Dark quadrants (usually only in C1 channel)</td>
<td>Bug in instrument code Martin's code now includes double-precision for all wavelength related keywords</td>
<td>Under investigation</td>
<td>N/A</td>
<td>N/A</td>
<td>Under investigation</td>
<td>Pending</td>
<td>Reza Rezaei, AC, Spain</td>
<td>2017-Jan</td>
<td>Open</td>
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<td>Other, miscellaneous problems</td>
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<tr>
<td>Modulation</td>
<td>Residual wobble seen in SJI</td>
<td>Imperfect wobble correction</td>
<td>Y Y</td>
<td>Minor</td>
<td>Improvement of dark correction with weekly calibration run</td>
<td>Open</td>
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<tr>
<td>Rough motion with wide patterns</td>
<td>Image motion near edges of wide patterns, especially with rotation tracking</td>
<td>Under investigation</td>
<td>N/A</td>
<td>N/A</td>
<td>Under investigation</td>
<td>Pending</td>
<td>Reza Rezaei, Switzerland</td>
<td>2016-Feb</td>
<td>Closed</td>
<td>Affected 12% obs before the 2017-Jan correction</td>
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3. IRIS Idiosyncrasies Examples

This document provides specific examples and figures for some known idiosyncrasies in IRIS data and accompanies the spreadsheet/MS-Excel file IS0409a_iris_idiosyncrasies.xlsx that has the list of all known idiosyncrasies to date. Both documents are periodically updated to reflect the current status and fixes (if applicable) of these issues.

We encourage IRIS planners and the general science community to report (email to bdp@lmsal.com) new issues in IRIS data/calibration not yet documented, which can help the IRIS team improve IRIS data quality and in turn better serve the science community.

**Dark Quadrants/Pedestal**

Problem: Different offset in upper and lower halves of spectra due to two amplifiers/CCDs, and imperfect dark correction.

1) This can often be seen in continuum maps from level-2 data, with a jump of a fraction of a DN, e.g., left panel below:

![Fig. Raster maps. Left: C II continuum (where a jump in the vertical direction can be seen), Middle: log C II amplitude, Right: 280 nm continuum (Courtesy of Reza Rezaei of IAC, Spain).](image)

Fig. Continuum profiles averaged over the entire raster as a function of position along the slit before (left) and after (right) a manual correction to remove the pedestal (Courtesy of Reza Rezaei of IAC, Spain).

![Continuum profiles](image)

Note: As of 2017-Jan-16, Dr. Reza Rezaei has graciously released his IDL package for IRIS analysis, including those for performing the manual corrections in the above examples, to Solar Soft (SSW) at:

https://sohowww.nascom.nasa.gov/solarsoft/packages/mosic/

User Manual:


SSW installation, setup, and startup - for example:

> setenv SSW_INSTR "iris mosic"
> source $SSW/gen/setup/setup.ssw
> sswidl

....

IDL> which,'analyze_iris' ; verify suite visible
/archive/ssw/packages/mosaic/idl/iris_reza/analyze_iris.pro

Fig. Continuum raster maps before (left) and after (right) a manual correction to remove the pedestal in the vertical direction. The periodic vertical stripes have also been removed (Courtesy of Reza Rezaei of IAC, Spain).

![Continuum maps](image)
Fig. Data reprocessing in 2016-Jun improved the dark correction, where less negative pixels are present in the new data (red) than the old data (black), while the north-south pedestal still remains (Courtesy of Reza Rezaei of IAC, Spain).

2) A subtle, typically $0.2 - 0.3$ DN jump can be seen in the latest level-2 data, as of 2017-Jan-31. This level is about as good as the current long-term trending in dark correction can achieve.

Fig. Upper left: space-time plot of the C II 1335.7 continuum, with its temporal average shown on the right (note the lower half is about 0.2 DN higher than the upper half) and spatial average shown at the bottom. Large spikes are due to hot pixels or cosmic ray hits.
Dark Steps in time

Problem: incorrect dark correction based because of missing housekeeping temperature data due to telemetry dropouts. Fixed with interpolating missing temperature data from neighboring orbits. Examples below show the raster maps before and after the fix.

Fig. Raster map (space-time plot) of Si IV 1402.77 continuum showing multiple patches due to temperature data gaps, which are also clearly seen as jumps in the slit-averaged temporal profiles at the bottom. Note that the upper and lower halves of the CCD are not correlated in time, because each has its own dark correction.
Fig. Same as the above figure, but after the fix with missing temperature data interpolated.
Dark hot pixels

Problem: Some pixels remain persistently in time at an elevated high value on the order of a few DN.

Fig. Example of a few hot pixels appearing as a persistent horizontal stripe in a raster map (also a space-time plot), and a spike of 5 DN in the spatial profile on the right. Note this is distinct from cosmic ray hits on the CCD that appear sporadic in time, best shown in the slit-averaged temporal profile in the bottom panel. See details in the next figure.

Fig. Zoom-in view of the raster map shown above (panel 1) showing the effect of the hot pixels, which are identified in the original spectra (panels 2 – 8), as marked by the yellow arrows.
**Periodic Vertical Stripes**

Problem: imperfect filter-wheel position dependent FUV background correction causing periodic vertical stripes in raster maps.

Symptom: FUV continuum raster maps show vertical dark/bright stripes evenly spaced in time (x-direction), or temporal profiles from such raster maps display a cycle with a time-step period equal to the number of SJI being used, e.g., at 2, 3, or 4 steps. This is particularly noticeable when NUV SJI is used with dips at times of 2796 SJI.

Cause: residuals of FUV spectrograph background correction, which is filter-wheel position or SJI cycle dependent.

In general, the peak-to-peak amplitude of this residual is at 0.2 – 0.3 DN level (as shown in the 5 example obs below), but in worst cases, it can be ~1 DN (as shown later for the 20130814_184518 obs, early in the mission). This small residual is generally not a concern, unless FUV continuum is important in the science subject. Dr. Reza Rezaei has developed a simple manual correction to remove such stripes/periodicities and released his algorithm to SSW (see the NOTE above under “Dark Quadrants/Pedestals” for release instruction/details).

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Fig. Example of vertical stripes in FUV continuum raster maps together with the slit-averaged temporal profiles next to it (zoom in on the PDF to see details). For the first five obs (when NUV SJI is used), the profiles cycle in 2, 3, or 4 steps (same step number as SJI channels being used), with dips occurring at the 2796 SJI times (e.g., marked by a plus sign/cursor). The peak-to-peak amplitude is about 0.2 DN. The periodicities are somewhat less obvious in the new level-2 data (reprocessed with dark correction in 2016-Jun) than what Dr. Reza Rezaie reported in the old level-2 data. The last panel is a counter example, 20140517_115025_3820359296, which has only two FUV SJI channels and no NUV SJI, and thus does not show such a periodicity.
Fig. Temporal profiles of FUV spectra (continuum) showing the effect before (top) and after (bottom) the filter-wheel position dependent FUV SG background correction, which leaves residuals with dips occurring at the NUV 2796 SJI times.

**Ghost, Geometric Features in SJI Images**

Problem: Artificial features of various shapes in SJI images due to scatter light in the optical path.

Symptom: Features of regular geometric shapes appear in off-limb SJI, moving together with the slit in the FOV thru the raster, with the following subcategories.

SJI Channels: mostly in 1400, but sometimes in 1330, and 2796 (C1: North Pole)

Cause: scatter light in the optical paths

Impact on science: Negligible, usually on the order of a few DN, only show up against off-limb with faint background.

(A) Ghost of solar limb (arc) on the left plus a vertical step on the right, appears off the East limb; see two examples below, one on the left and the other on the right. Note the artifacts move with the slit as it scans from left to right.
Fig. Sample 1400 SJI images of the above two examples showing ghost solar limb off the East limb, with sample mouse clicks across the vertical step showing (x, y-position, pixel value). The cyan-colored box marks the region that is enlarged in the right panel and vertically averaged to obtain the horizontal spatial profiles shown there. Note the typically 2 DN jump across the edge of this artificial feature is negligibly small, compared with the intensity of on-disk features of >a few hundred DN.
(B) Bright donut (inner tube) shape with a dark, central vertical bar running across it, appears off the West limb.

Fig. Sample 1400 SJ1 images of the above example showing the bright donut (inner tube) shape with a dark, central vertical bar, with sample mouse clicks showing (x, y-position, pixel value). The cyan-colored box marks the region that is enlarged in the right panel and vertically averaged to obtain the horizontal spatial profiles shown there. Note the typically 1 – 2 DN dip at the location of the dark, central bar is negligibly small, compared with the intensity of on-disk features of > a few hundred DN.
(C) Ghost of circular arc (seen in C1: North Pole synoptic obs, not found in C2: South Pole obs). Two examples are shown below for this feature in 2796 SJI images.

Fig. Enlarged views of the boxed region in the above 2796 SJI images together with horizontal spatial profiles on the right (by vertically averaging the corresponding images). Note the jumps across the circular shaped steps are on the order of 2 – 4 DN, which is negligibly small, compared with the intensity of on-disk features of > a few hundred DN.