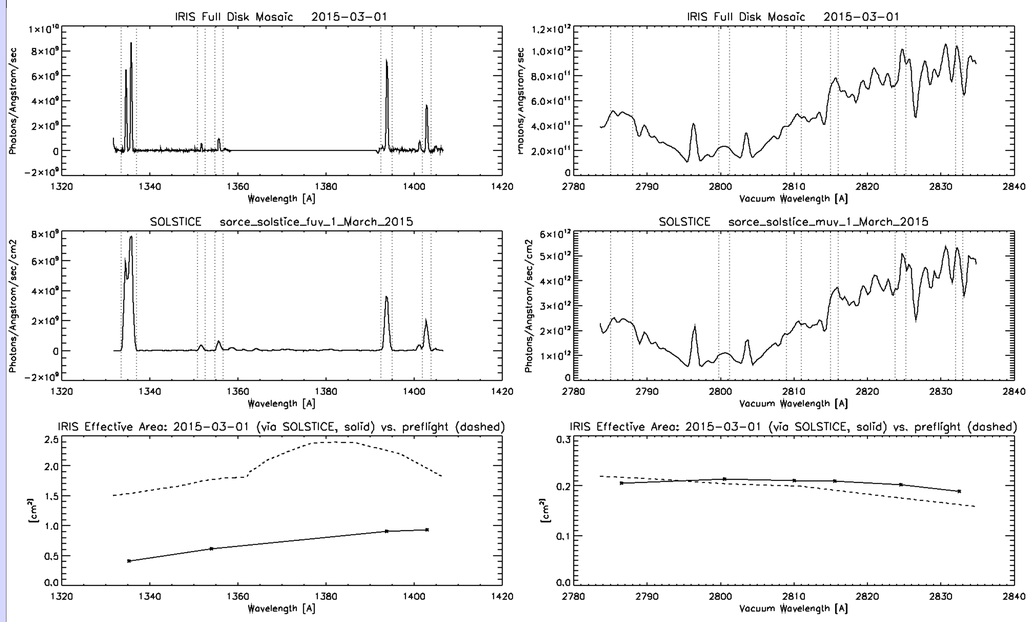
Absolute Throughput Calibration of the IRIS Spectrographs

Jean-Pierre Wülser - Lockheed Martin Solar & Astrophysics Laboratory

Introduction

The IRIS team has been tracking the relative sensitivity of IRIS since first-light on 2013 July 17. An absolute calibration, however, has been elusive until SORCE/SOLSTICE successfully resumed observations in 2014. This poster presents the results of the IRIS - SOLSTICE cross-calibration, the IRIS throughput trending and the implementation of the calibration in SolarSoft.

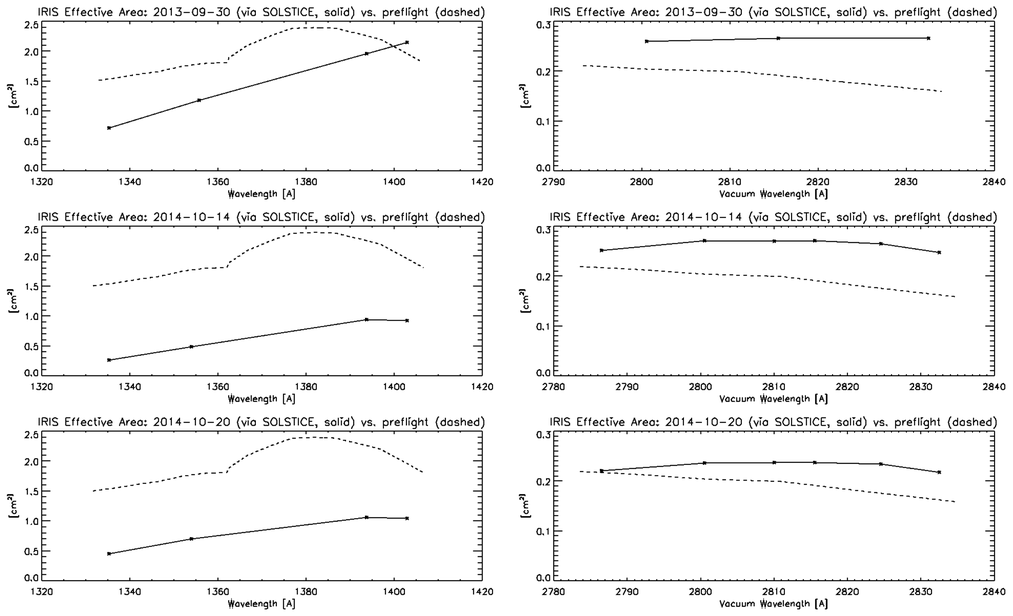
Cross-Calibration IRIS – SORCE/SOLSTICE



Top: Integrated IRIS FUV (left) and NUV (right) spectra of the sun from a full disk mosaic observed on 2015 March 1.

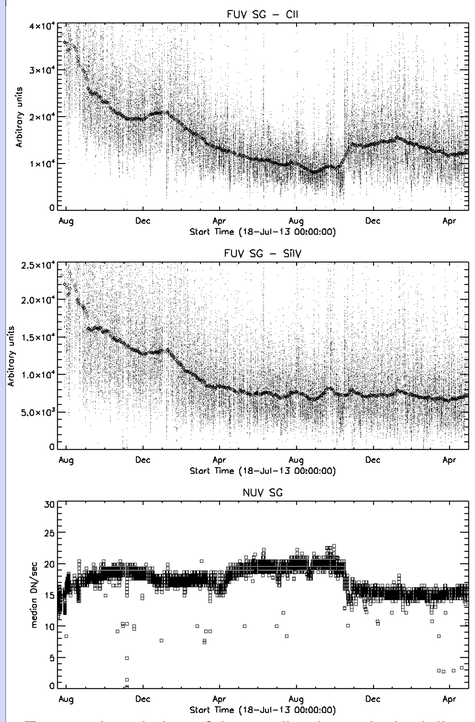
Middle: SORCE/SOLSTICE spectra from the same day. Dotted vertical lines indicate the spectral windows used for cross-calibration.

Bottom: Crosses connected by a solid line indicate the IRIS effective area derived from the ratio of the IRIS and SOLSTICE spectra in the cross-calibration windows. The pre-launch best-estimate effective area is indicated by a dashed line. The measured FUV effective area is clearly lower than the pre-launch estimate. The measured NUV effective area is flatter than the pre-launch estimate, but of similar magnitude.



IRIS – SOLSTICE cross-calibrations for three other dates. Unfortunately, SORCE wasn't operating during the early part of the IRIS mission – a SOLSTICE spectrum from 2013 July 13 was used to compare with the IRIS mosaic of 2013 September 30. For the calibrations on 2014 October 14 and 20, SORCE/SOLSTICE was operating again. These calibrations were carried out before and after an IRIS detector bake-out, respectively. The bake-out increased the IRIS response at its shortest FUV wavelengths. The NUV response slightly decreased.

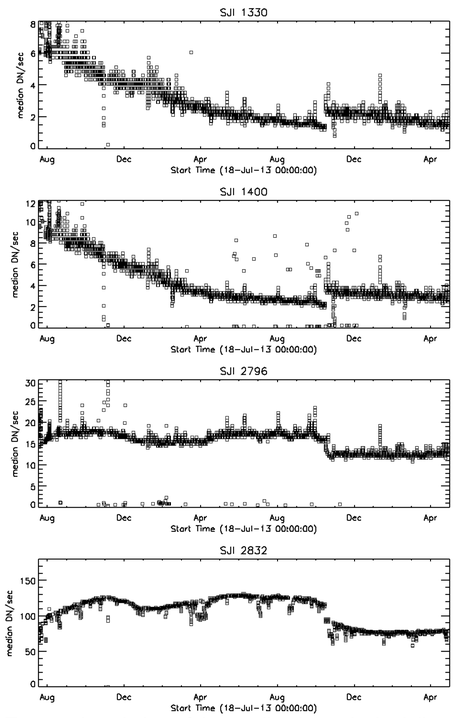
IRIS Throughput Trending



Temporal evolution of the median intensity in daily quiet sun spectral observations near disk center.

Top and middle: Intensity of the C II and Si IV lines, respectively. Dots are individual measurements, diamonds are running 30 day averages. The IRIS FUV response has been decreasing with time but is flattening out. The jump on 2014 October 15 is due to a detector bake-out.

Bottom: median intensity in the NUV spectra. The NUV trend could be due to thin film effects of contaminants on the detector.



Temporal evolution of the median intensity in daily slit-jaw images of the quiet sun. The trends are similar to the ones in the spectrographs.

IRIS Response in SolarSoft

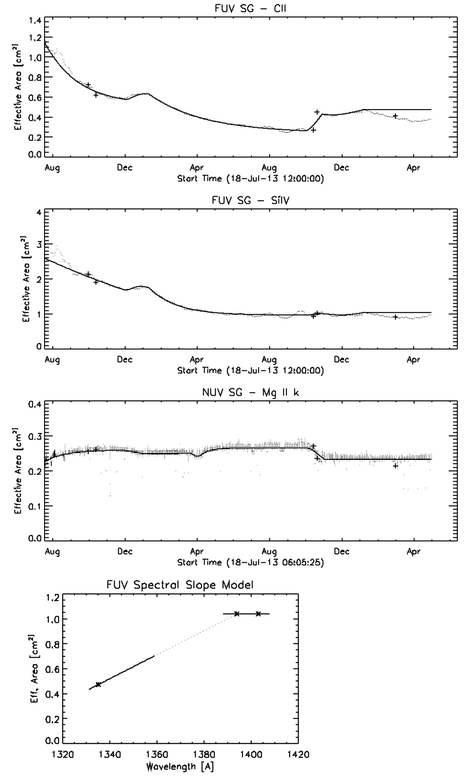
Temporal

- IRIS – SOLSTICE cross-calibrations require full-disk mosaics and are done infrequently. The trending observations are needed to fill in the time evolution.
- The implemented calibration approach is illustrated in the panels on the right. Parameterized time evolution functions (solid lines) are fitted to the trending data and then scaled with the SOLSTICE cross-calibration results (crosses). The scaled 30 day trending averages are also shown (dotted lines).
- The current functions are based on trending through January 2015. The figure shows that the solutions have started to diverge from the measurements and require an update.

Spectral

- Currently, a simplified but fairly robust model is being used for the spectral response in the IRIS spectrographs:
  - FUV: The SOLSTICE calibrations suggest that the response is close to linear at the short wavelengths, and nearly flat at the longer ones. This allows the construction of the spectral response from only two trended wavelengths. The model is illustrated in the figure on the right.
  - NUV: The SOLSTICE results indicate that the spectral slope doesn't change significantly with time. The model keeps the spectral slope fixed and adjusts only the overall amplitude with time.

The described model is implented in v.3 of the SolarSoft function iris_get_response.pro



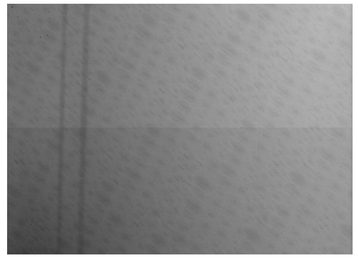
Future Work

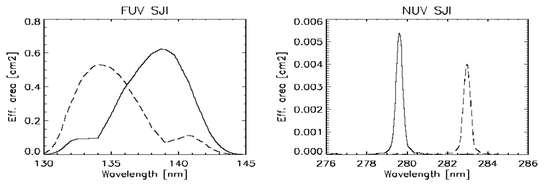
Spectrographs

- Updates of the trending portion of the calibration
- Burn-in:
  - The LED (blue light) calibration image on the right shows a detector burn-in at the location of the C II lines. Its amplitude at FUV wavelengths is about 12-15%
  - In the future, the burn-in will be included in the FUV flat-field and will require a corresponding adjustment of the FUV spectral response for consistency

Slit-jaw imagers

- The absolute calibration of the slit-jaw imagers is still in progress
- Preliminary analysis suggests that the spectral shape of the filter response curves has slightly changed since the pre-launch estimates shown on the right
- The current calibration still uses the pre-launch spectral shapes but scales them with a (relative) trending function





Acknowledgements

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