

STIX IDL GSW update

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On behalf of the STIX Software Team
STIX Team Meeting Autumn 2023, Wrocław



Release Version History

- Version 0.1.0 was released on 31st March 2022
 - First public release, basic functionality for file reading, spectroscopy and imaging.
- Version 0.2.0 was released on 10th July 2022
 - Advancements in all areas particularly the demo scripts, aspect handling added.
- Version 0.3.0 was released on 3rd Nov 2022
 - Improved imaging capabilities and supports the draft version of the official level 1 data products.
- Version is 0.4.0 - 12th Apr 2023
 - First official release compatible with the release versions of our L0, and L1 FITS files.
- **Version is 0.5.0 – 4th Nov 2023**
 - Latest release uploaded last weekend. General improvements to spectroscopy, imaging and aspect

Current Release v0.5 (General & Spectroscopy)

- Changelog at <https://github.com/i4Ds/STIX-GSW/releases/tag/v0.5.0>
- General
 - Update calibration data
 - Current best livetime parameters
 - Easier download of data files
 - Software version now included in output FITS files
 - Flexibility of output directory
- Spectroscopy
 - Semi-transparent grids
 - keyword to shift time bins by time step
 - corrected ELUT formula
 - update transmission

Current Release v0.5 (Imaging & Aspect)

- Imaging
 - `stx_map2fits`
 - `stx_imaging_pipeline` accepts 'method' keyword
 - Grid and detector separation values updated
 - Implemented new definition of (u,v) points
 - Corrected ELUT formula
- Aspect
 - `SAS_OK` flag used to indicate reliability of solution
 - Error codes included with data when solution
 - More info in talks from Frederic Schuller

Update Calibration Data

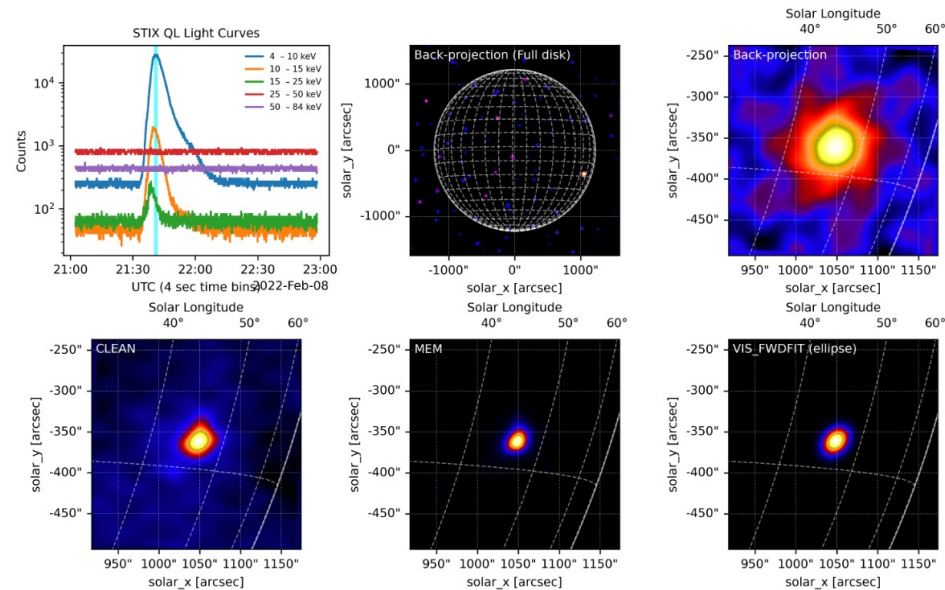
- IDL> stx_check_config_files
- STIX Configuration files are already up to date v0.1.2
- Currently Updates
 - ELUT
 - Science Channels
- Accessed through mirror of STIX-CONF at <http://dataarchive.stix.i4ds.net/STIX-CONF>
- Additional data products straightforward to add
- ELUTs changed on 19th June (update of calibration) 3rd July (lcomp= 2), 31st July (Fine thermal bins) and 5th November (return to nominal bins)

Download Of Data Files

- IDL> ephemeris_file = stx_get_ephemeris_file('09-May-23 06:14:37.094', '09-May-23 06:36:12.194')
- IDL> ephemeris_file
- User/stix/solo_L2_stix-aux-ephemeris_20230509_V01.fits
- data_file = stx_get_science_fits_file('1178428688')
- IDL> data_file
- User/stix/solo_L1_stix-sci-xray-cpd_20200607T213709-20200607T215208_V01_1178428688-49155.fits

Flare Location (i)

2022-02-08T21:40:34.097 - 2022-02-08T21:41:34.097
4 - 10 keV Aspect corrected



- `flare_location_hpc = [1050., -375.]`
- `time_range = ['8-Feb-2022 21:00:00.00', '8-Feb-2022 21:40:00.437']`
- `aux_fits_file = stx_get_ephemeris_file(time_range[0], time_range[1])`
- `aux_data = stx_create_auxiliary_data(aux_fits_file, time_range)`
- `flare_location_stx = stx_hpc2stx_coord(flare_location_hpc, aux_data)`
- `stx_convert_spectrogram, fits_path_data = fits_path_data, flare_location_stx = flare_location_stx`

Flare Location (ii)

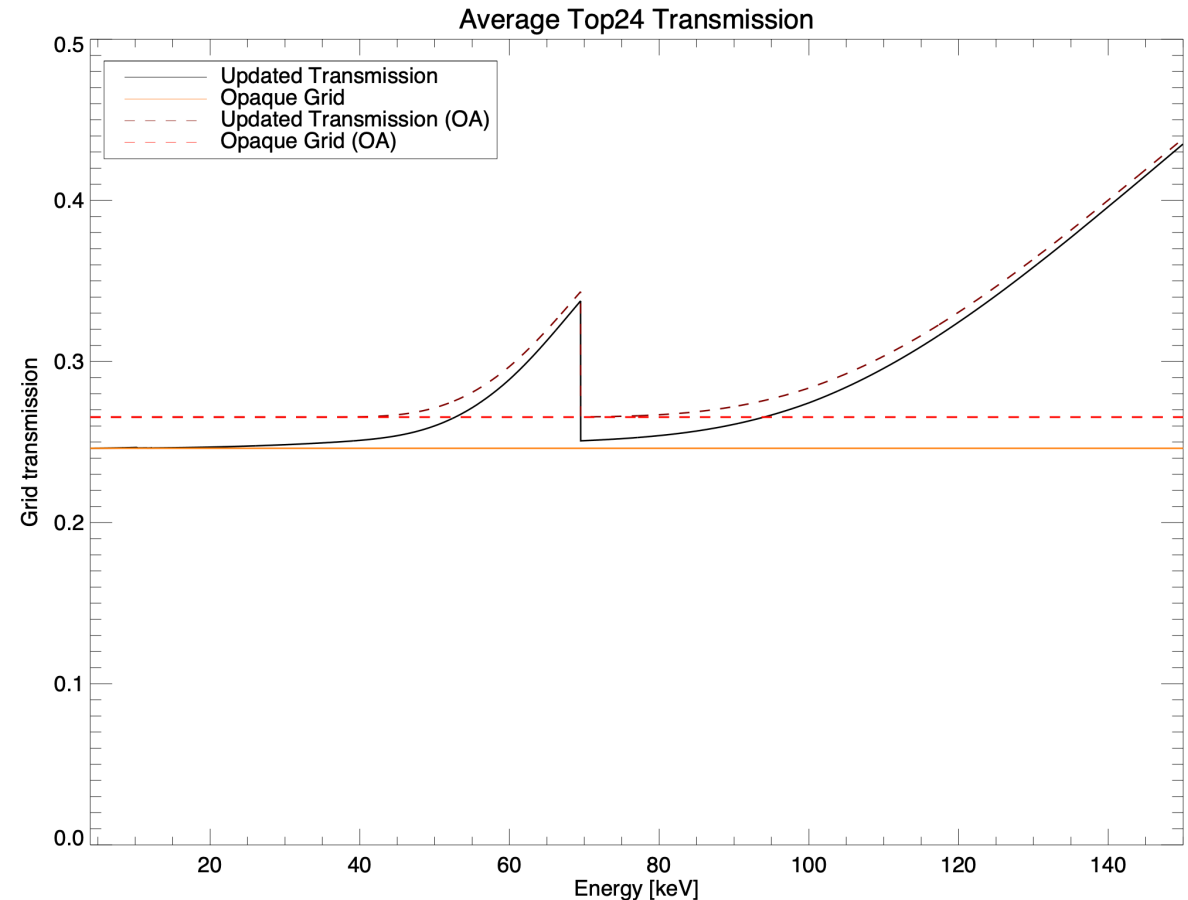
- `time_range = ['8-Feb-2022 21:00:00.00', '8-Feb-2022 21:40:00.437']`
- `aux_fits_file = stx_get_ephemeris_file(time_range[0],
time_range[1])`
- `aux_data = stx_create_auxiliary_data(aux_fits_file, time_range)`
- `stx_estimate_flare_location, fits_path_data, time_range , aux_data,
flare_loc = flare_location_hpc`
- `flare_location_stx = stx_hpc2stx_coord(flare_location_hpc, aux_data)`
- `stx_convert_spectrogram, fits_path_data = fits_path_data,
flare_location_stx = flare_location_stx`

Flare Location (iii)

- `stx_convert_spectrogram`, \$
- `fits_path_data = fits_path_data`, \$
- `flare_location_hpc = flare_location_hpc`,
`aux_fits_file = aux_fits_file`
- `stx_convert_pixel_data`, \$
- `fits_path_data = fits_path_data`, \$
- `flare_location_hpc = flare_location_hpc`, \$

Semi-transparent Grids

- Previous STIX GSW assumed fully opaque grids when calculating the response.
- This causes a notable divergence in the 63- 70 keV energy bin
- Updated version uses correct tungsten transmission for each grid
- Bridge factor included
- The corner cutting and shadowing depending on source location is also calculated
- Simplified version is still used in imaging pipeline
- Effects included: slit/pitch ratio, grid thickness, internal shadowing, corner cutting, grid transparency, and bridges.



Shift Time Bins

- For events prior to 9th December 2021 incorrect time reporting on board meant the duration had to be shifted for a single bin
- This is only possible for full time resolution data
- For the vast majority of observations this has been fixed in the FITS file
- For some events although not automatically detected it is still possible to shift
- HISTORY: 'Time and count arrays were shifted to fix offset'
- COMMENT: 'Time and count arrays offset not fixed as possibly summed on board'
- stx_convert_spectrogram, ..., /shift_duration
- stx_convert_pixel_data , ..., /shift_duration

Next Update

- Planned in the coming months
- Summing finest bins in current ELUT (fine bins) in `stx_convert`
- Light curve tool: do ELUT correction after summing in energy
- Option to skip ELUT correction
- Fuzzy grid parameters (Anna Volpara)

Future Plans

- Finest grids
- Imaging Spectroscopy (Andrea Battaglia)
- Fine energy binning DRM
- Simulated DRM using GEANT (Hualin Xiao)
 - DRM for each detector/pixel
- Spectral dependent ELUT correction
- Flare search and selection

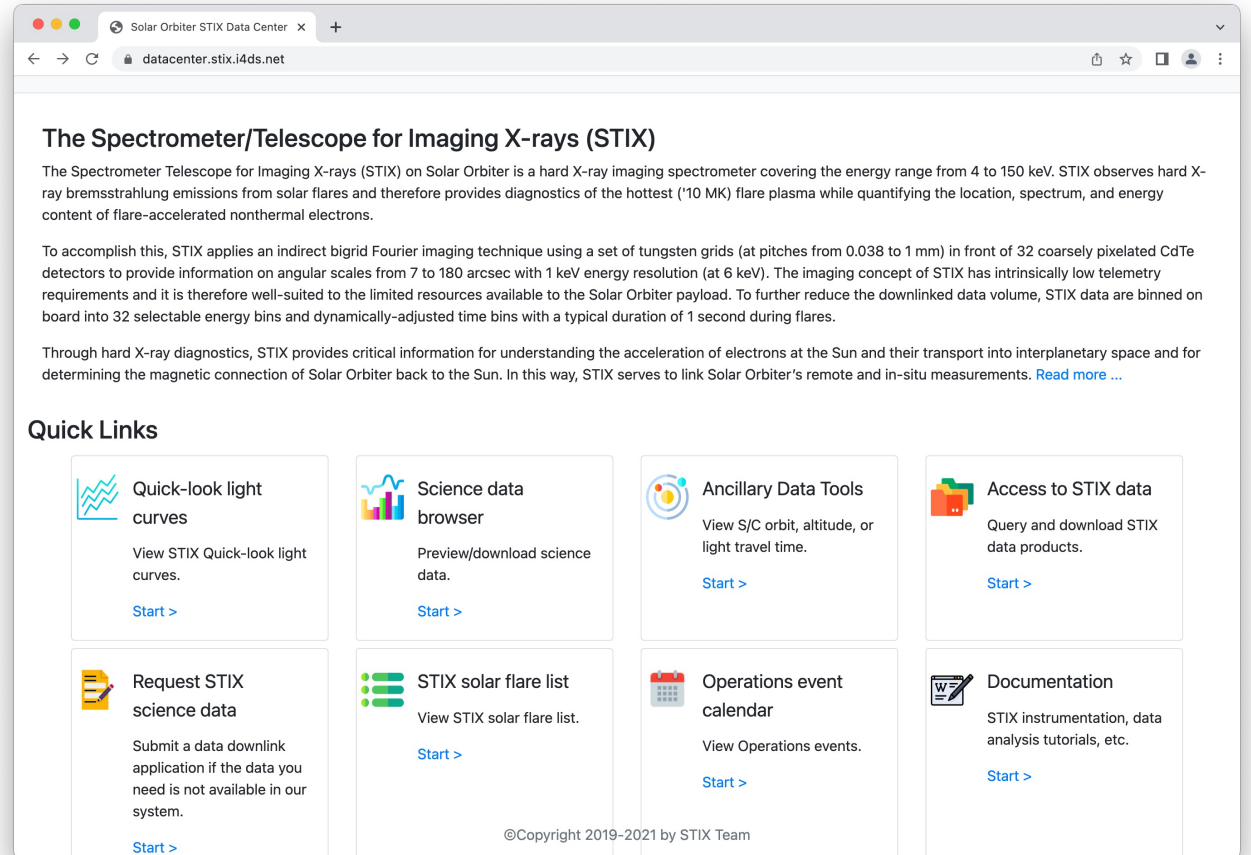
Data Access

Official L1 FITS file are available at

<https://datacenter.stix.i4ds.net/view/list/fits>

<http://dataarchive.stix.i4ds.net/fits/>

<https://soar.esac.esa.int/soar/>



The Spectrometer/Telescope for Imaging X-rays (STIX)

The Spectrometer Telescope for Imaging X-rays (STIX) on Solar Orbiter is a hard X-ray imaging spectrometer covering the energy range from 4 to 150 keV. STIX observes hard X-ray bremsstrahlung emissions from solar flares and therefore provides diagnostics of the hottest (~ 10 MK) flare plasma while quantifying the location, spectrum, and energy content of flare-accelerated nonthermal electrons.

To accomplish this, STIX applies an indirect bigrid Fourier imaging technique using a set of tungsten grids (at pitches from 0.038 to 1 mm) in front of 32 coarsely pixelated CdTe detectors to provide information on angular scales from 7 to 180 arcsec with 1 keV energy resolution (at 6 keV). The imaging concept of STIX has intrinsically low telemetry requirements and it is therefore well-suited to the limited resources available to the Solar Orbiter payload. To further reduce the downlinked data volume, STIX data are binned on board into 32 selectable energy bins and dynamically-adjusted time bins with a typical duration of 1 second during flares.

Through hard X-ray diagnostics, STIX provides critical information for understanding the acceleration of electrons at the Sun and their transport into interplanetary space and for determining the magnetic connection of Solar Orbiter back to the Sun. In this way, STIX serves to link Solar Orbiter's remote and in-situ measurements. [Read more ...](#)

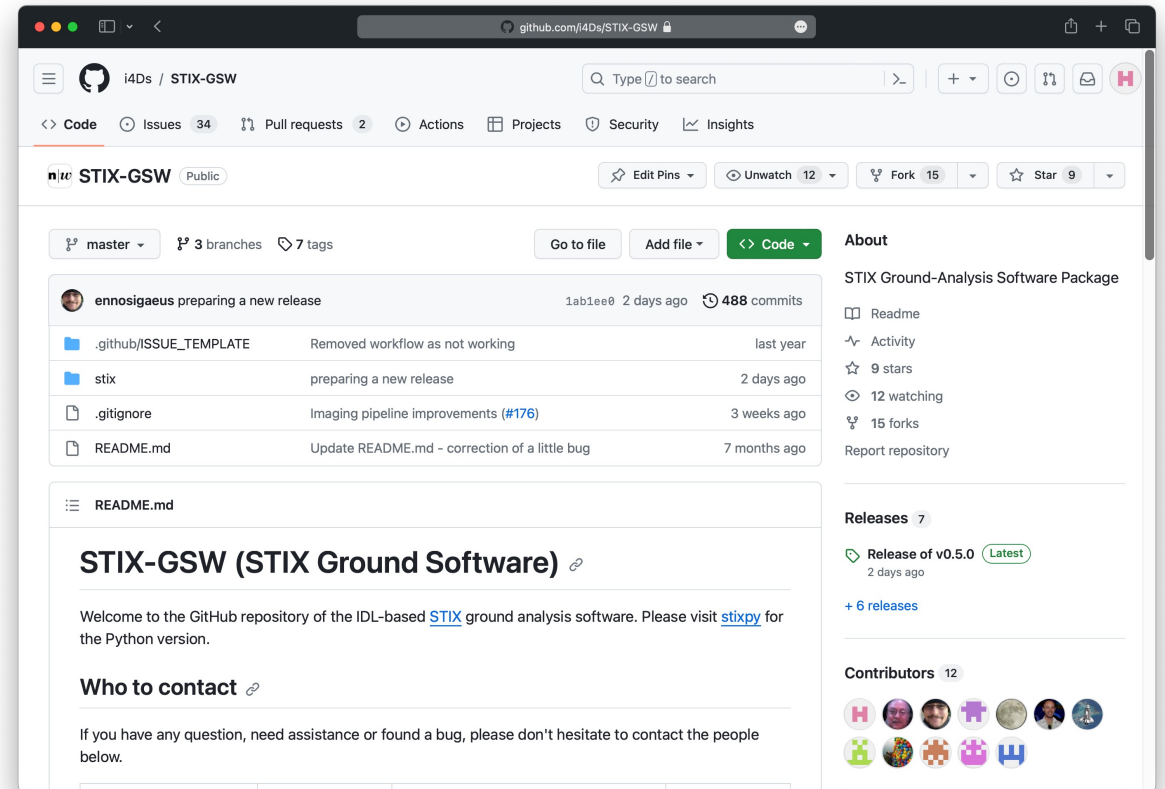
Quick Links

- Quick-look light curves**
View STIX Quick-look light curves.
[Start >](#)
- Science data browser**
Preview/download science data.
[Start >](#)
- Ancillary Data Tools**
View S/C orbit, altitude, or light travel time.
[Start >](#)
- Access to STIX data**
Query and download STIX data products.
[Start >](#)
- Request STIX science data**
Submit a data downlink application if the data you need is not available in our system.
[Start >](#)
- STIX solar flare list**
View STIX solar flare list.
[Start >](#)
- Operations event calendar**
View Operations events.
[Start >](#)
- Documentation**
STIX instrumentation, data analysis tutorials, etc.
[Start >](#)

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STIX GitHub

- The development of the STIX Ground software occurs on GitHub
- <https://github.com/i4Ds/STIX-GSW>
- Users are encouraged to make issues for features they would like to see and bugs that they find
- It is also possible to download the “development” version that is currently being worked on before the official release to SSW



Who to contact

If you have any question, need assistance or found a bug, please don't hesitate to contact the people below.

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