

Progress at the SOFIA Data Center (SDC)

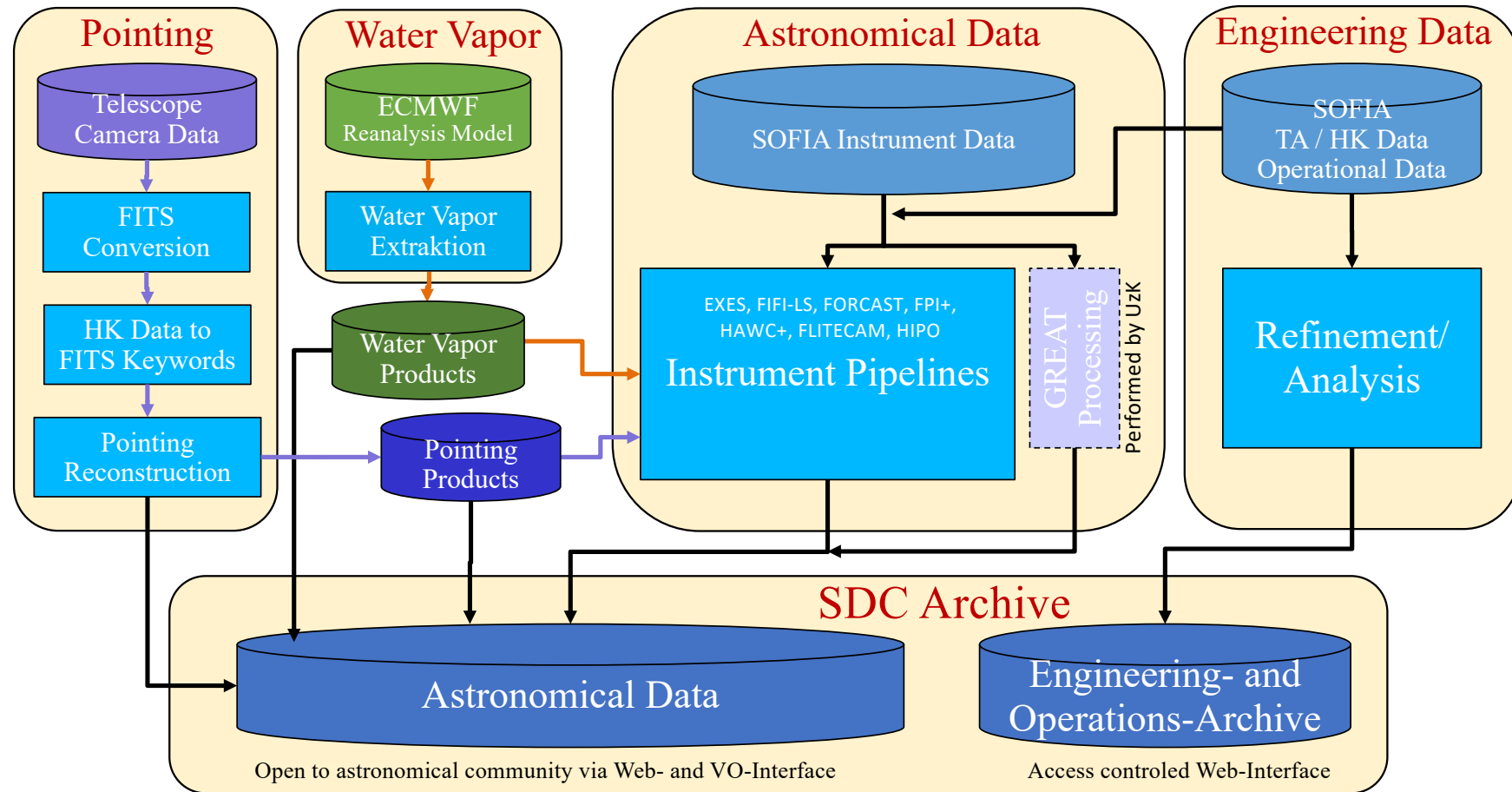
Infrastructure, Data Pipelines, and Archiving

B. Schulz, A. Bryant, J. Früh, B. Greiner, M. Hütwohl, C. Iserlohe,
T. Keilig, B. Knieling, M. Ruoff, K. Schindler, M. Wiedemann, O. Zeile

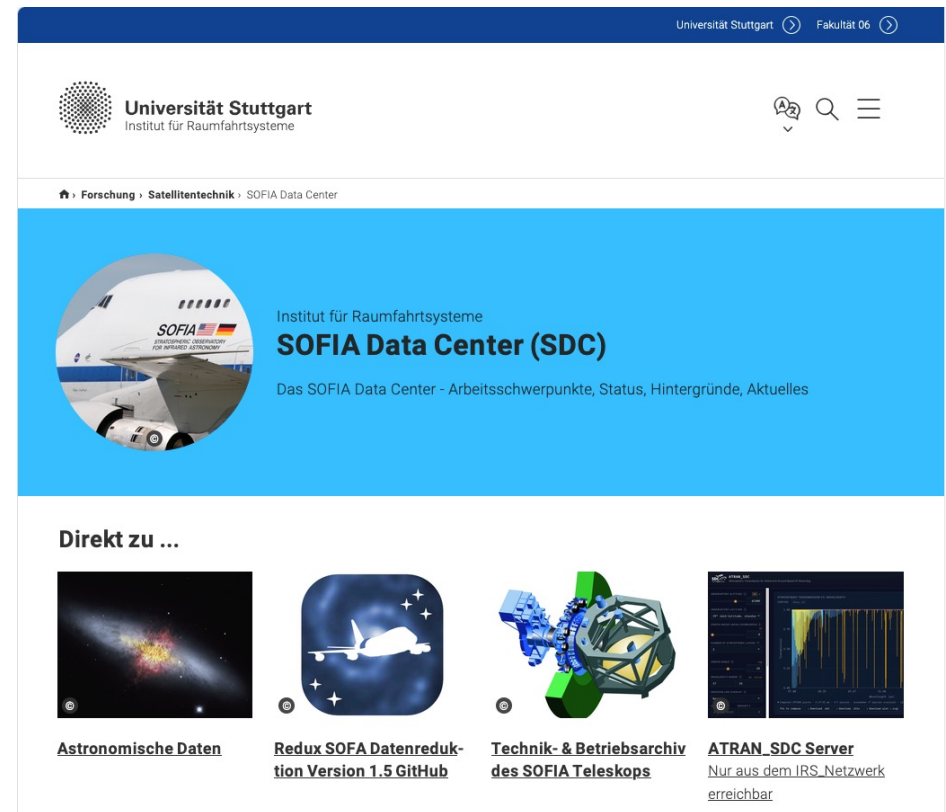
SOFIA Data Center, IRS, Universität Stuttgart

- The **SOFIA Data Center (SDC)** was created in Stuttgart to:
 - Ensure preservation of the unique SOFIA data and documentation
 - Improve data quality by additional analysis and pipeline reprocessing
 - Provide access to SOFIA data and documentation in an online archive
 - Support astronomers in all instrumental aspects of SOFIA data
- The SDC project **began in July 2024** and has a nominal lifetime of **5 years**. Then the data holdings and website will be transferred to the **DZA in Görlitz**.
- The SDC helps **bridging the substantial gap** in access to Far-IR data until the next opportunity comes up.

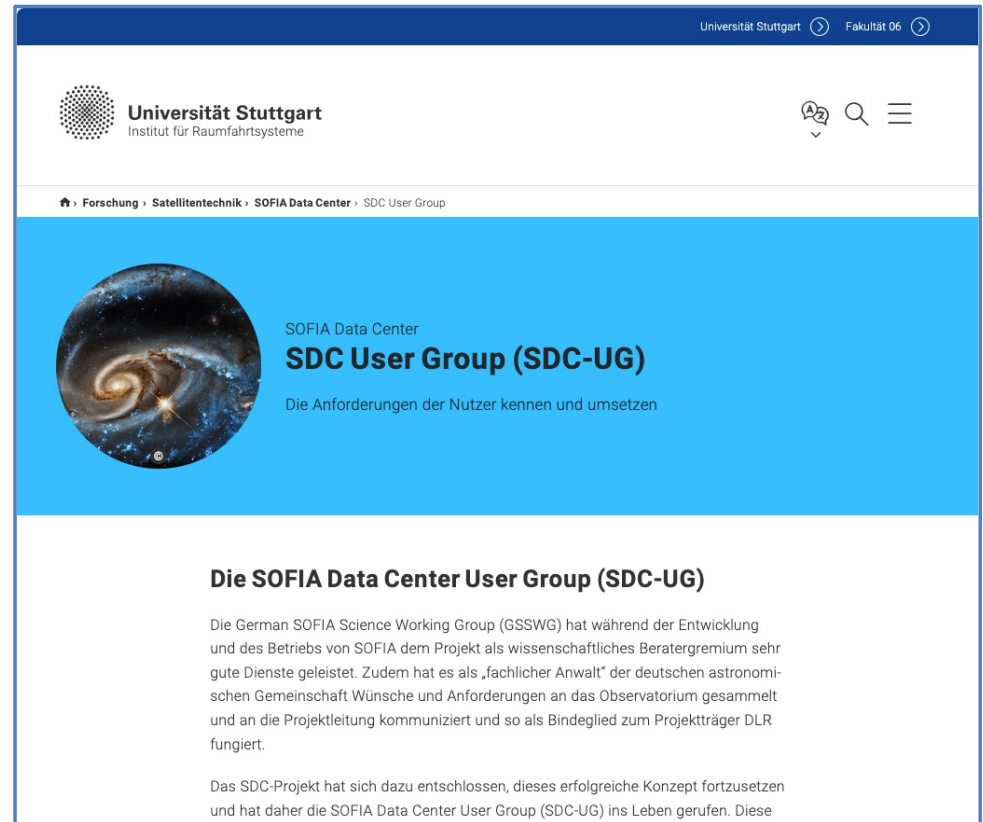
Reprocessing Workflow



- First version of the **SDC Homepage** online (Nov 2025)
- Have specific virtual machine for all https-based services
- Domain „**sofiadatacenter.de**“ active since March 2026
- Ensures **longer term stability** of URLs appearing in publications

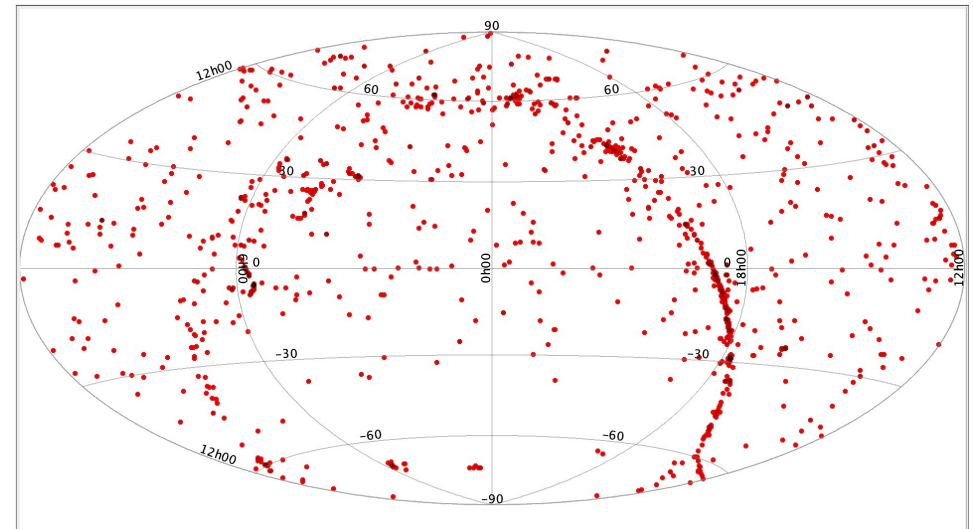


- SDC-UG
 - Planned as “technical advocate” of the German astronomical community.
 - Established March 2025, 3 meetings since
 - Has 10 members that are proven experts in the field of far-infrared astronomy and astronomical databases.
 - Receives reports by the SDC about its work and the status of the SDC-project.
 - Provides technical and scientific advice to the SDC project.
 - Two members appointed by RdS reporting annually
- Current chairs:
 - Dr. Verena Wolf (Chair on maternity leave)
 - Dr. Guido Fuchs (Co-Chair and acting Chair)



- FITS keywords for all data products collected in Postgres database
 - Full Inventory
 - Comparison of current data products with information from the former SOFIA archive of the SMO (DCS)
 - Grouping of combined data products

All Distinct SOFIA Pointings



- FITS keywords for all data products collected in Postgres database
 - Full Inventory
 - Comparison of current data products with information from the former SOFIA archive of the SMO (DCS)
 - Grouping of combined data products
- Linking SOFIA observation programs and publications
 - Sending e-mail letters to PIs and Co-Is
 - Automated searches in ADS manually filtered
 - Existing list in IRSA

Linking SOFIA observation programs and publications

- 130 PIs or Co-Is of 326 completed proposals sent an e-mail
- 1/3 proposals without response
- 38% have refereed publications
- 5% have non-refereed publications
- 6% in preparation for publication
- 14% not published
- Search for SOFIA and Prop-ID strings resulted in 366 Entries
- Table from IRSA contained 305 distinct Prop-IDs
- In combination, 457 observation programs could be linked to 438 refereed publications

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- First DaCHS archive prototype created using FORCAST Level 4 image data (March 2026)
 - Sandbox
 - Gaining experience with DaCHS



This is our first attempt to publish FORCAST Level 4 imaging data. Ingestion is currently limited to *_MOS_*.fits files and previews are taken from png

Browser interface to FORCAST Level 4 Imaging data

[Help](#)
[Service info](#)
Metadata
 Identifier
 ivo://sodiadatcenter.d
 Cite this
[Advice on citing this re](#)
 Description
 This is our first attempt
 Keywords
 Infrared astronomy
 Creator
 SOFIA Data Center
 Created
 2025-12-11T09:57:42Z
 Data updated
 2026-03-16T10:27:43Z
 Metadata updated
 2026-04-14T13:06:08Z
 Source
 2018JAI.....740005H
 Reference URL
[Service info](#)
[Log in](#)

Please correct the following error(s):

- **Field size [deg]** : Field hSIZE: When you give a value for Position, you must give value(s) for hSIZE, too

Position
 18 20 47.0 -16 10 18
ICRS Position, RA,DEC, or Simbad object (e.g., 234.234,-32.45).
 Field size [deg]
 0.1
Size in decimal degrees
Field hSIZE: When you give a value for Position, you must give value(s) for hSIZE, too
 Target Name
 2MASS J06070781-0603487
 2MASS J225600297+6202574-1
 AB Aur (1)
 AT2019hik
 BD +20 307
 bet leo
 CH Cyg
 cygx-bright03.5
 Field_13
 G025.40-00.14
Object a targeted observation targeted
 Table
 Sort by ASC
 Limit to 100 items.
 Output format More output fields
 Go
[\[Result link\]](#)

Please report errors and problems to the [site operators](#). Thanks.

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Browser interface to FORCAST Level 4 Imaging data

SDC
SOFIA DATA Center

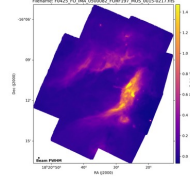
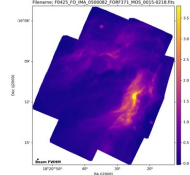
Parameters

- Field size: 0.1
- Position: 18 20 47.0 -16 10 18

Result

Matched: 2

[Send via SAMP](#) [Quick Plot](#)

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	18 20 34.23	-16 10 45.79	17767

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[F0425_FO_IMA_0500082_FORF371_MOS_0015-0218.fits](#)

Metadata

Identifier
[ivo://sofiadatascenter.d](#)

Cite this
[Advice on citing this re](#)

Description
This is our first attempt

Keywords
[Infrared astronomy](#)

Creator
SOFIA Data Center

Created
2025-12-11T09:57:42Z

Data updated
2026-03-16T10:27:43Z

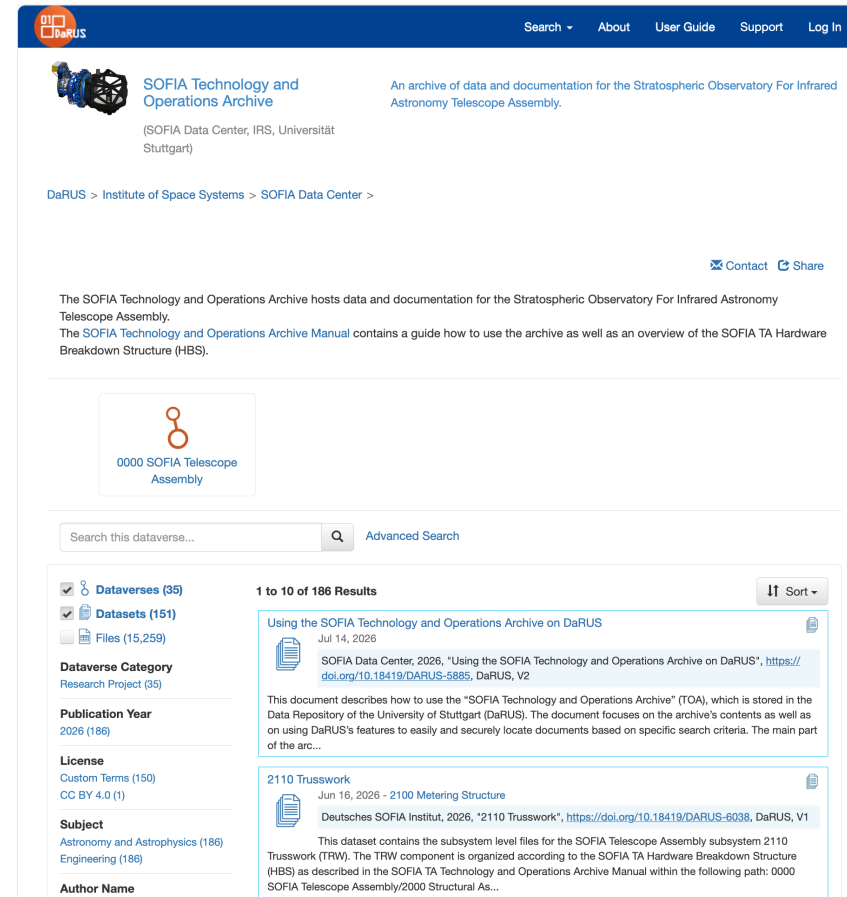
Metadata updated
2026-04-14T13:06:08Z

Source
[2018JAI.....740005H](#)

Reference URL
[Service info](#)

[Log in](#)

- The TOA contains documentation about the SOFIA telescope
 - Development
 - Manufacture
 - Installation
 - Modifications and improvements
 - Operational activities
 - Uncontrolled documents



The screenshot shows the SOFIA Technology and Operations Archive (TOA) website. The header includes a search bar and navigation links: Search, About, User Guide, Support, and Log In. The main content area features the TOA logo and a description: "An archive of data and documentation for the Stratospheric Observatory For Infrared Astronomy Telescope Assembly." Below this, it states "(SOFIA Data Center, IRS, Universität Stuttgart)". A breadcrumb trail reads "DaRUS > Institute of Space Systems > SOFIA Data Center >". There are links for "Contact" and "Share". A paragraph explains that the TOA hosts data and documentation for the SOFIA Telescope Assembly and mentions a manual for using the archive. A large orange icon represents the "0000 SOFIA Telescope Assembly". A search bar with the placeholder "Search this dataverse..." and a magnifying glass icon is present, along with a link to "Advanced Search". On the left, a sidebar shows filters for "Dataverses (35)", "Datasets (151)", and "Files (15,259)". Below these are sections for "Dataverse Category" (Research Project (35)), "Publication Year" (2026 (186)), "License" (Custom Terms (150), CC BY 4.0 (1)), "Subject" (Astronomy and Astrophysics (186), Engineering (186)), and "Author Name". The main results area shows "1 to 10 of 186 Results". The first result is titled "Using the SOFIA Technology and Operations Archive on DaRUS" by SOFIA Data Center, dated Jul 14, 2026, with a DOI link. The second result is titled "2110 Trusswork" by Deutsches SOFIA Institut, dated Jun 16, 2026, with a DOI link.

- The TOA contains documentation about the SOFIA telescope
 - Development
 - Manufacture
 - Installation
 - Modifications and improvements
 - Operational activities
 - Uncontrolled documents
- Located in the Data Repository of the University of Stuttgart (DaRUS)
 - Based on “Dataverse”
- Descriptive filenames
- Filter and search functions
- User Manual
- Access is granted if there is a legitimate interest



Publication Year
2026 (186)

License
Custom Terms (150)
CC BY 4.0 (1)

Subject
Astronomy and Astrophysics (186)
Engineering (186)

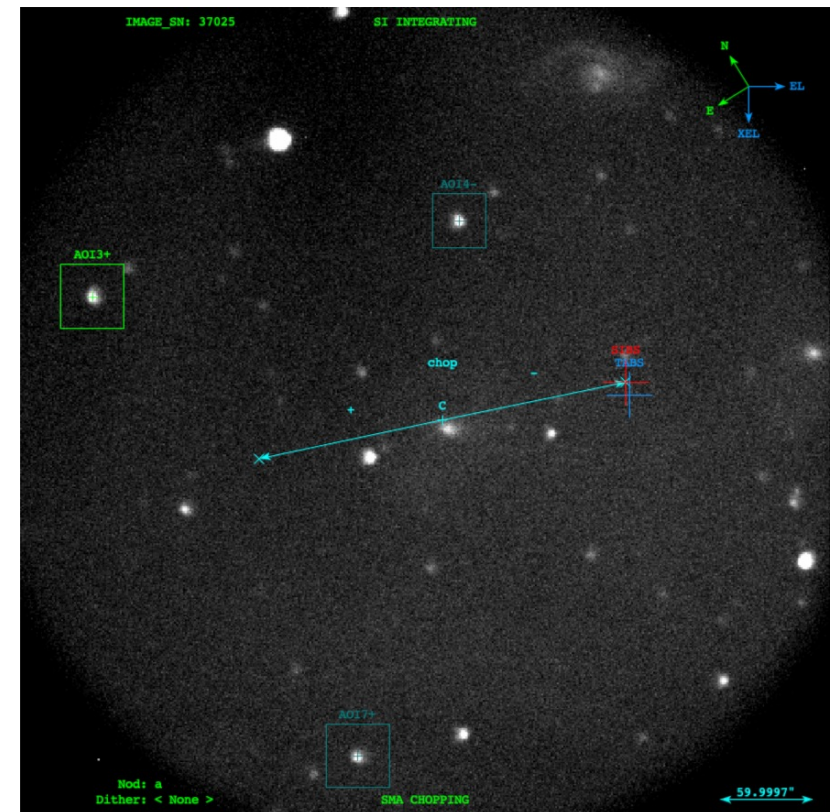
Author Name

Data Repository of the University of Stuttgart (DaRUS). The document focuses on the archive's contents as well as on using DaRUS's features to easily and securely locate documents based on specific search criteria. The main part of the arc...

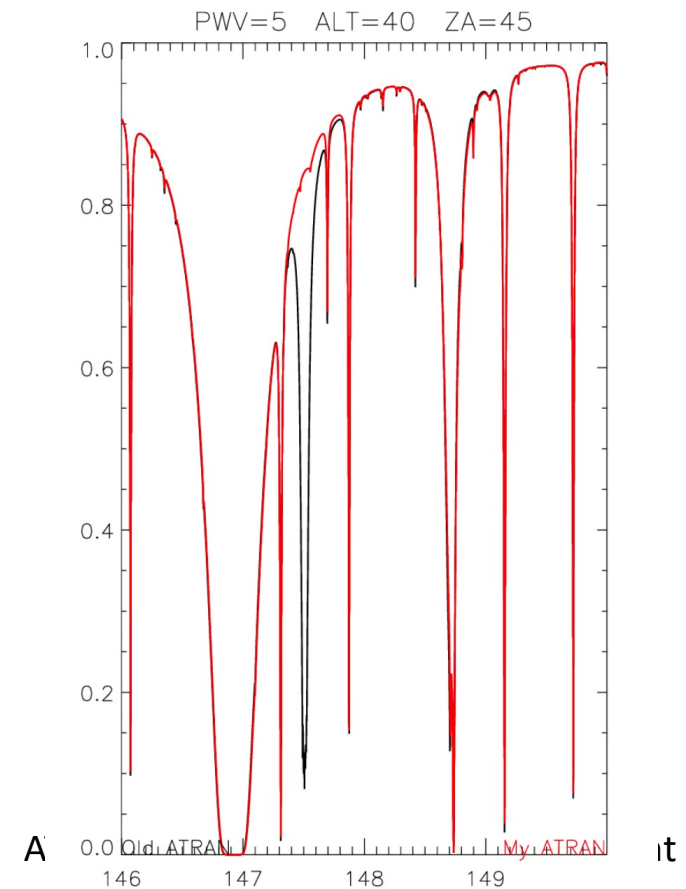
2110 Trusswork
Jun 16, 2026 - 2100 Metering Structure
Deutsches SOFIA Institut, 2026, "2110 Trusswork", <https://doi.org/10.18419/DARUS-6038>, DaRUS, V1

This dataset contains the subsystem level files for the SOFIA Telescope Assembly subsystem 2110 Trusswork (TRW). The TRW component is organized according to the SOFIA TA Hardware Breakdown Structure (HBS) as described in the SOFIA TA Technology and Operations Archive Manual within the following path: 0000 SOFIA Telescope Assembly/2000 Structural As...

- >5300h of new unpublished CCD images for serendipity science
- Improved telescope pointing from actual object positions
- Entirely new pipeline for all 3 SOFIA telescope cameras producing new products for the archive
 - Level 1: FITS file with full header and WCS
 - Level 2: Improved WCS from plate solving solution
 - Region files for DS9 overlays
 - Tables with telescope pointing versus time for all flights
- FITS header definitions
- Advanced processing and logging system with Snakemake
- Automatic plate solving based on SExtractor und SCAMP
- Last touches for Version 1.0.0 under way
- Process ~90,000 images per flight, >700 flights
- App for time synced display of camera images



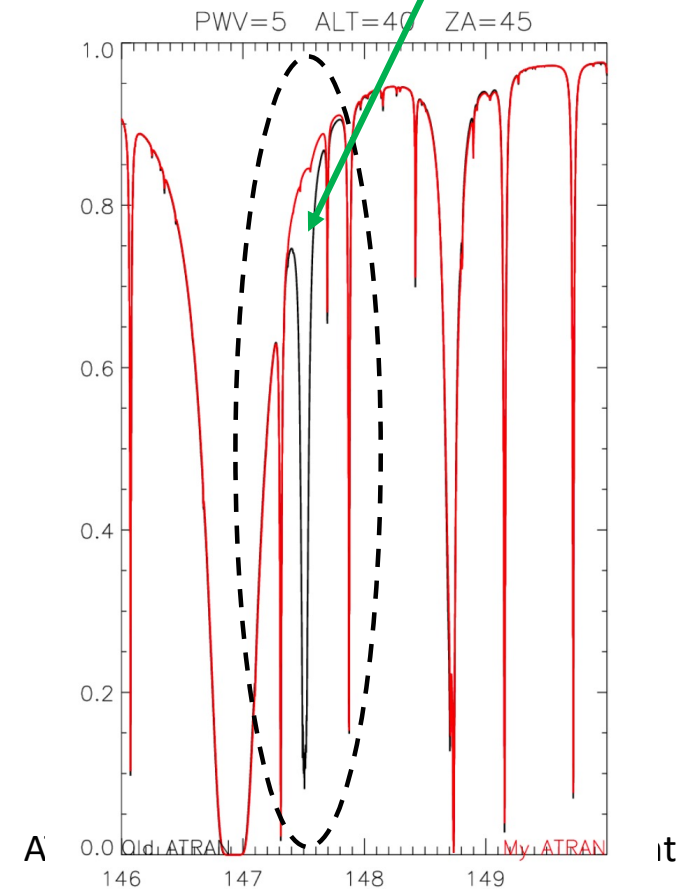
- Atmospheric transmission calculation ATRAN by S. Lord used for FIFI-LS and FORCAST
- Discovery and fix of $^{17}\text{O}^{16}\text{O}$ issue in ATRAN line database last summer



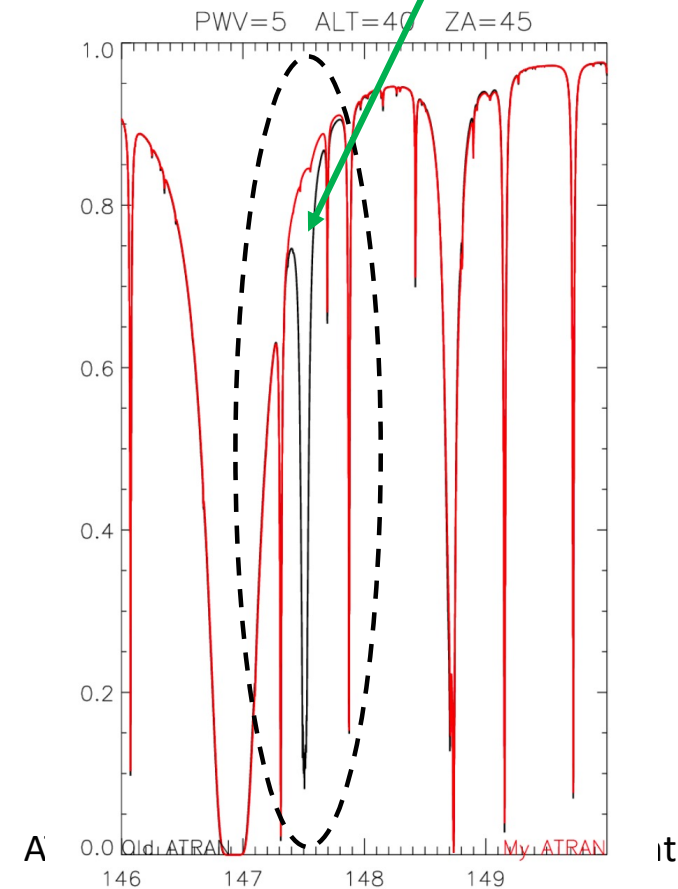
Atmospheric Corrections

$^{17}\text{O}^{16}\text{O}$
too strong

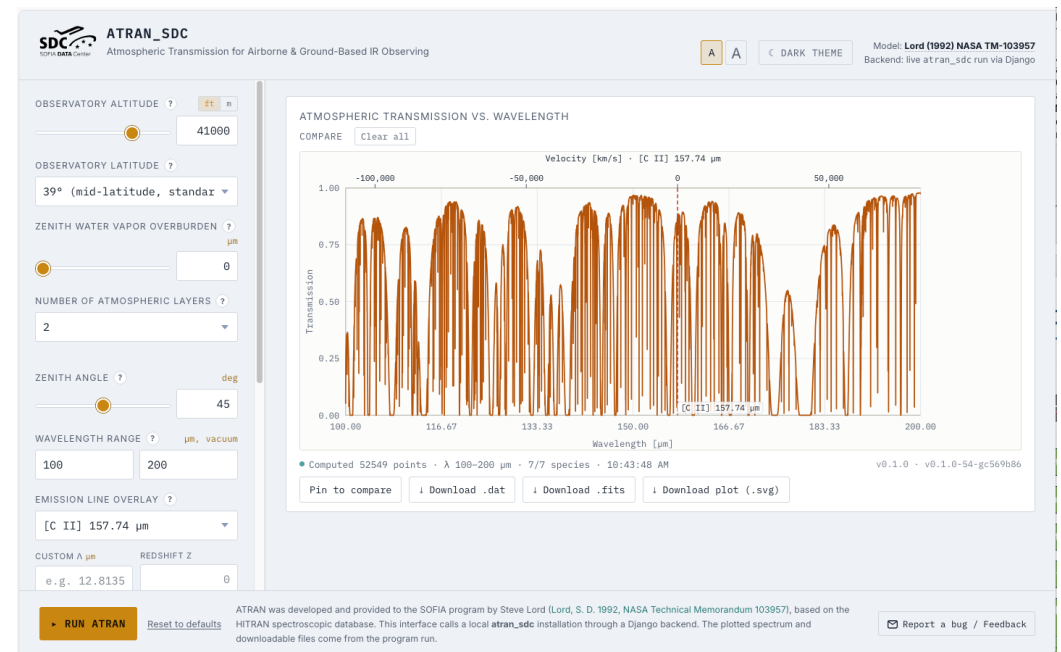
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- Agreement to maintain SOFIA specific version (**ATRAN_SDC**)
 - Code remains undisclosed and property of S. Lord
- New **corrected transmission spectra** published in DaRUS for automatic download by Redux pipeline
 - FIFI-LS, FORCAST



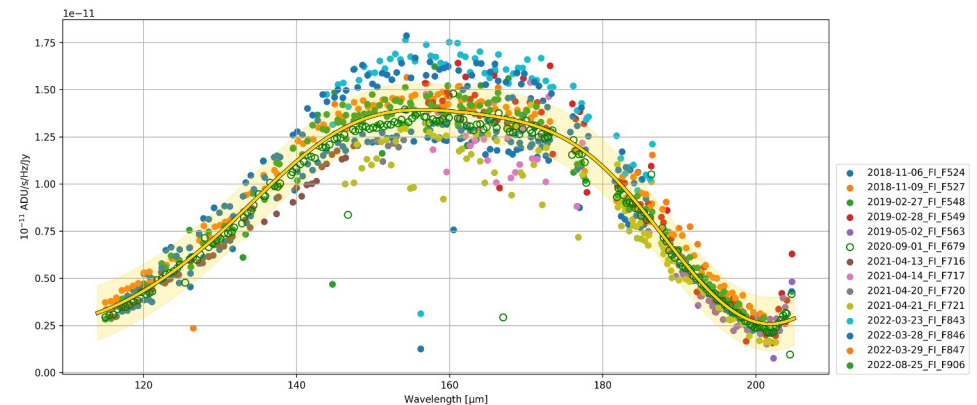
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 - FIFI-LS, FORCAST
- **ATRAN_SDC Webserver** with modern interface and new features (close to going public)
 - Emission line overlay with redshift
 - Species breakdown
 - Ozone separation option



ATRAN_SDC Server under development

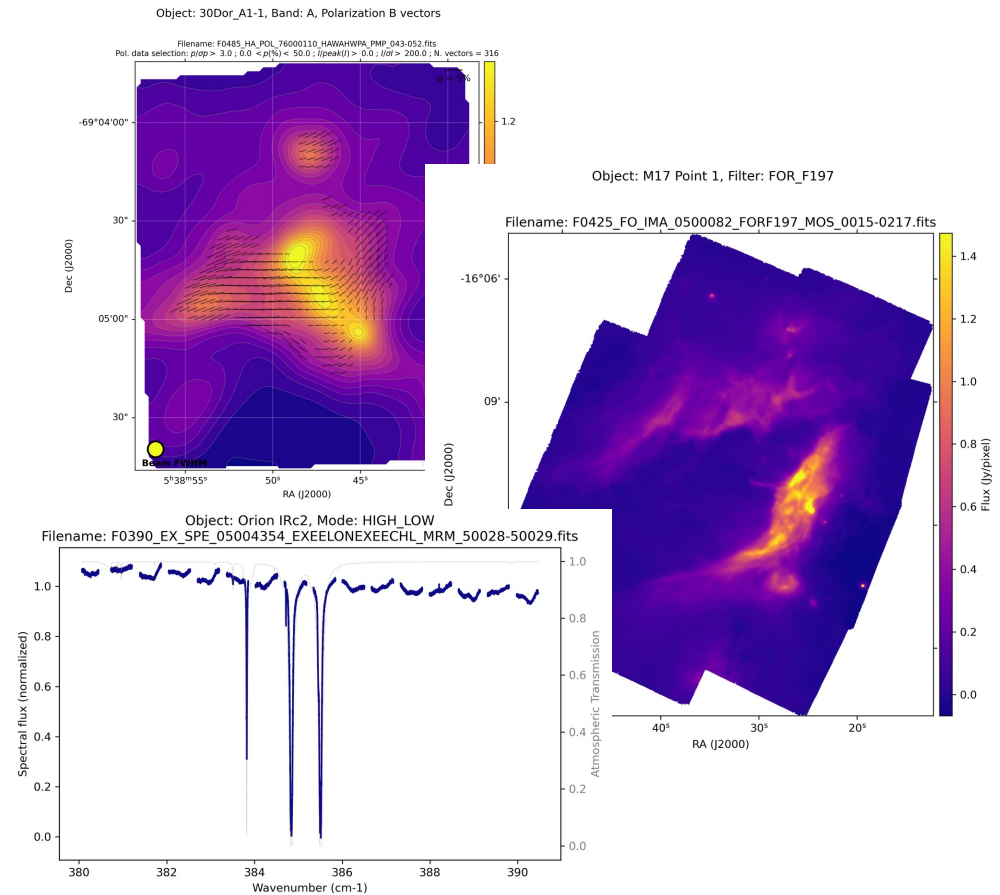
- Data Reduction
 - Enhanced noise reduction features
 - Implemented off-nod interpolation
 - Implemented telluric & background scaling to improve telluric correction in new unchopped observing modes
- Calibration
 - Systematic and stat. error propagation
 - **New flux calibration** with drizzle resampling and fully time & wavelength-resolved Mars flux model
- Telluric atmosphere correction
 - Improved use of ECMWF satellite data
 - Interpolation between **ATRAN_SDC** spectra
 - Possible separate treatment of **Ozone**
- Pipeline Postprocessing
 - Automated **spectral line extraction**
- Data Reprocessing
 - Updated bad file list
 - **Fully automatic reprocessing** of Level 3 and 4 (~72h for >99% of archived FIFI-LS data)
- **More improvements planned!**

- Documentation
 - **Pipeline Users Manual** overhauled
 - Detailed description of more complex procedures
 - Automatic build of manual in PDF format using „Sphinx“



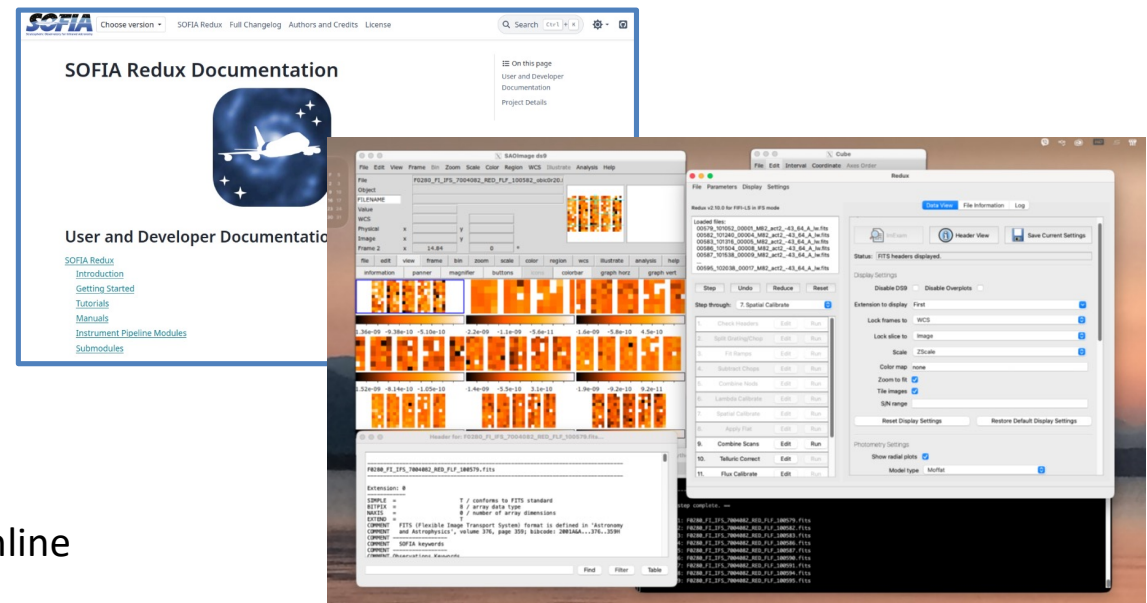
Continuing productive collaboration with former instrument scientist **C. Fischer** and pipeline developer **N. Fischer**

- HAWC+
 - Inventory of available archival data
 - Extracted **reduction parameters** from Level 3 products
 - Investigation of high **resource consumption** of HAWC+ pipeline
 - Impact analysis of **telluric absorption**
- FORCAST
 - Inventory of available archival data
 - Planned update of **telluric correction** with ATRAN spectra and **WCS correction**
- EXES
 - Inventory of available archival data
 - Establish external **working group**
 - **Plans for pipeline change** to exclude telluric correction and combination of spectra from Level 3 products
- GREAT
 - Data treated by GREAT Team in Cologne



Redux Pipeline System

- Development home transferred from IPAC to SDC
- DS9 SAMP Interface repaired
- Update to current library versions
- First Redux Version 1.4.0 from SDC (Dec 2025)
- Adapted to new API of Numpy 2.4
- Documentation now on <https://redux.sofiadatacenter.de>
- Moved large calibration file downloads for FLITECAM und EXES to DaRUS
- Adapted to Photutils 3.0
- Documentation updates
- Version 1.5.0 released (June 2026)
- Additional Debug- und Info-Logging
- Restructuring and consolidation of Redux online documentation
- Public at:
 - https://github.com/SOFIA-Data-Center/sofia_redux
- Forked from:
 - https://github.com/SOFIA-USRA/sofia_redux
- **GitHub.com contributions** through issues or pull requests **welcome** and will be synced to internal



- SDC home page and domain established
- SDC User Group well established and working with reporting channel to RdS
- Astronomical Archive
 - Data inventory
 - Publication investigation: About 50-60% of SOFIA data is published
 - Internal SDC VO-Archive prototype
- Technical and Operations Archive (TOA) online and ready
- New telescope imager pipeline with automatic plate solving close to Version 1.0
- Atmospheric Corrections
 - SDC specific ATRAN_SDC incl. fix of ¹⁷O¹⁶O issue.
 - Public ATRAN_SDC server soon available
- Major improvements in FIFI-LS pipeline
 - New flux calibration
 - New ATRAN_SDC transmission spectra
 - Full automatic reprocessing setup
 - Documentation overhaul
- Preparation and planning for other science instruments
- Redux Pipeline System
 - Latest Version 1.5.1 from SDC
 - Up to date with current libraries
 - Many improvements

That's All for Now!



Picture: B. Schulz (2018)