Data Processing for Observing Cycle 1

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SOFIA Data Products

Defined in the Data Processing Plan for SOFIA SIs :

Level 1: raw SI data in standardized format (FITS)

Level 2: corrected for instrument artifacts (e.g., flats, darks, bad pixels)

Level 3: flux calibrated (e.g. BSCALE/BUNIT keywords, MJy/sr)
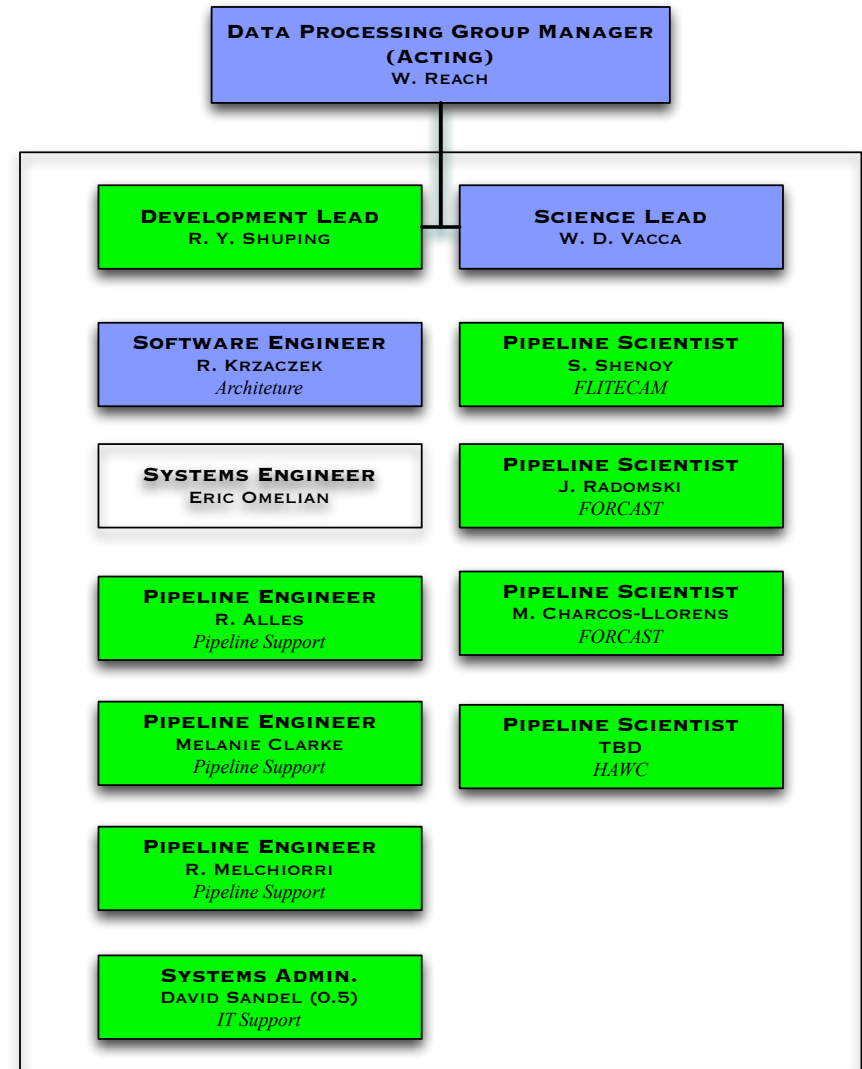
Level 4: high-order products possibly combining multiple observations
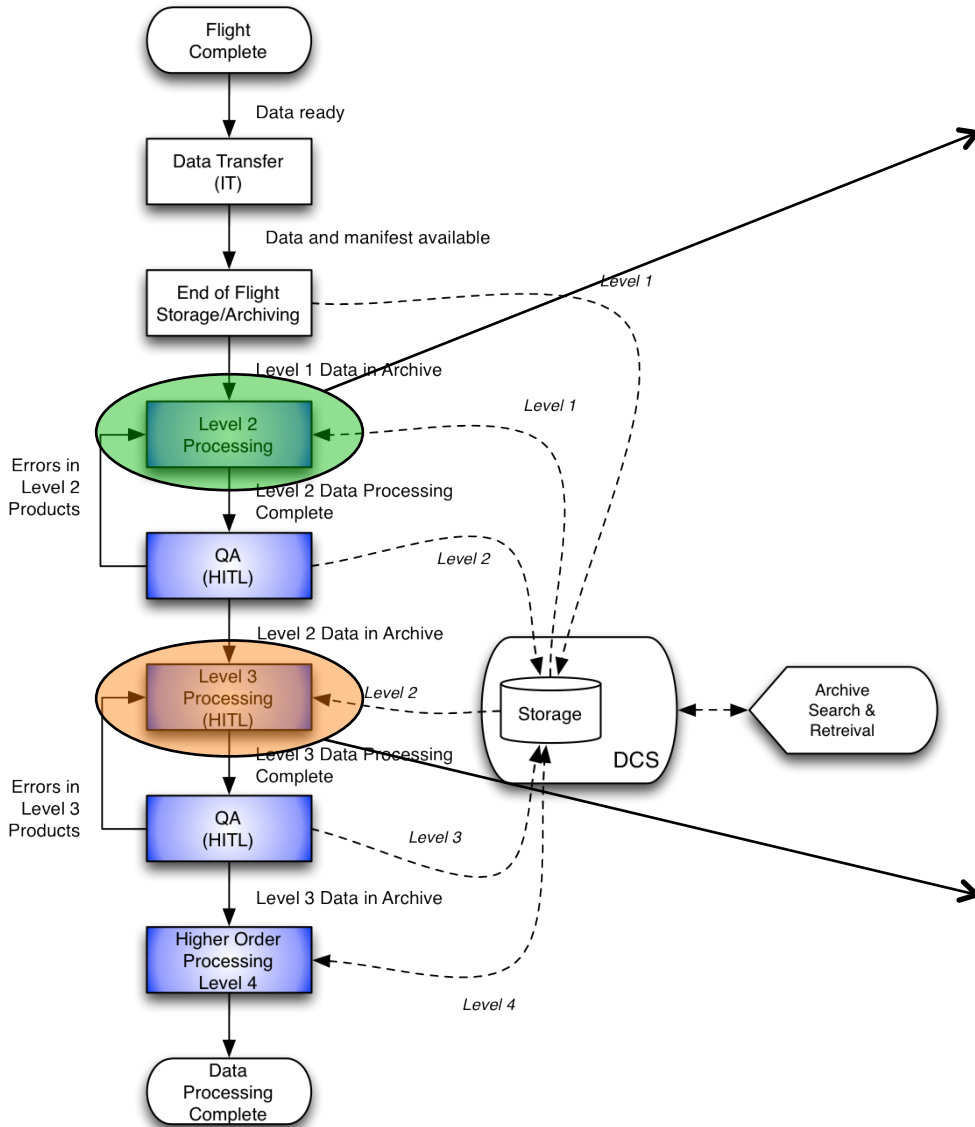
(e.g. mosaics, spectral cubes)

SOFIA Data Processing Team

- **Provide science-grade data products to GIs and science community**;
    - process/analyze data;
    - quality assurance;
- Curate processed data in the archive and re-process as needed.
- Develop pipelines and other needed software tools.
- Support SI teams on pipeline development/delivery.

DATA PROCESSING GROUP MANAGER (ACTING)
W. REACH

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SYSTEMS ADMIN.
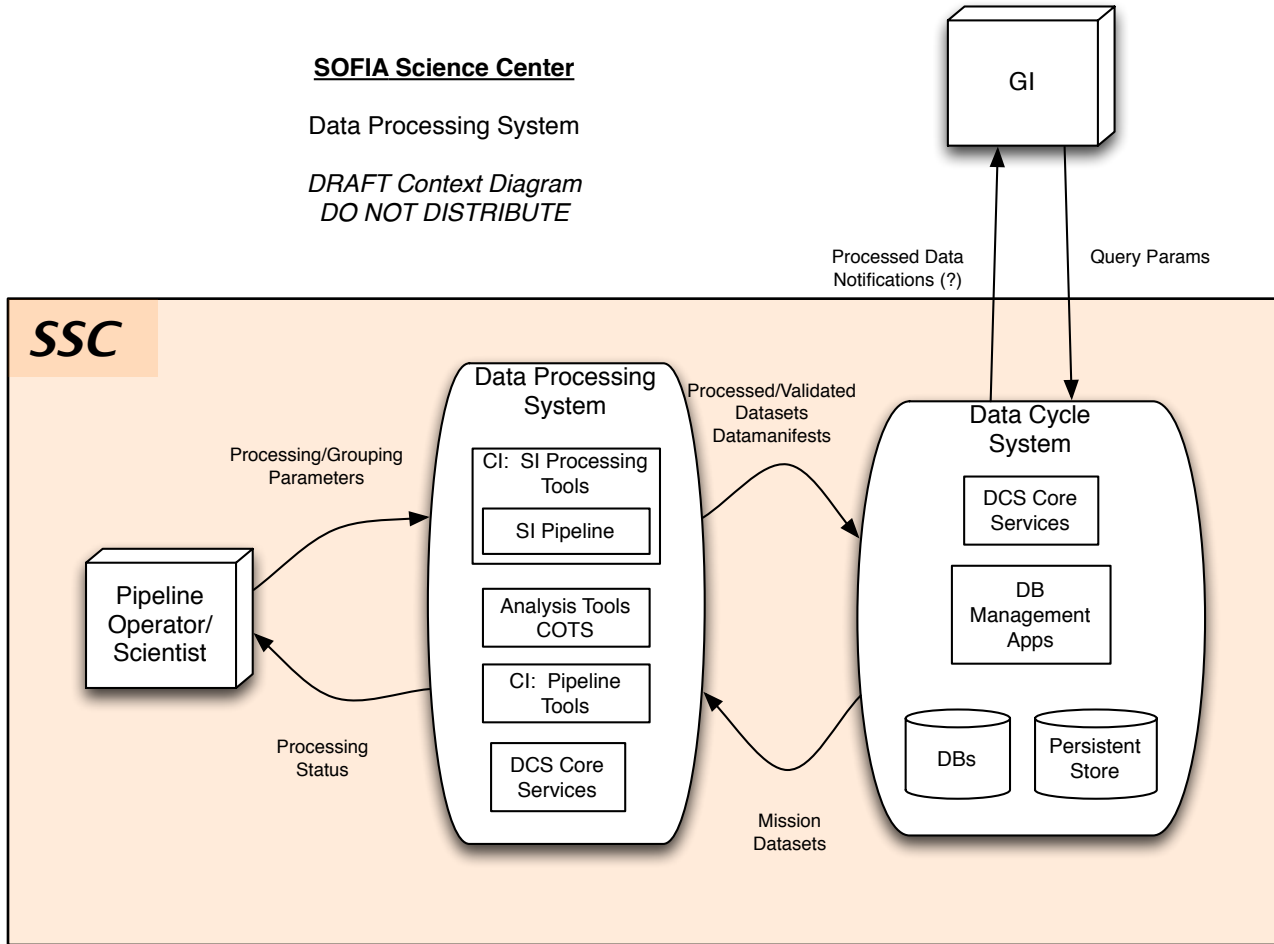DAVID SANDEL (0.5)
IT Support

Data Processing Flow

Two modes of Level 2 Processing:

- **Manual**: operator runs established version of pipeline interactively in stand-alone environment (workstation) on a single observation.

- **"Automatic"**: pipeline is run automatically on data for a whole mission. Some provision for user-interaction will be made.

Level 3 Processing will be highly user interactive, utilizing both COTS and custom tools/pipelines.

System Context

SOFIA Science Center

Data Processing System

DRAFT Context Diagram
DO NOT DISTRIBUTE

GI

Processed Data
Notifications (?)

Query Params

SSC

Data Processing
System

CI: SI Processing
Tools

SI Pipeline

Analysis Tools
COTS

CI: Pipeline
Tools

DCS Core
Services

Processing/Grouping
Parameters

Pipeline
Operator/
Scientist

Processing
Status

Processed/Validated
Datasets
Datamanifests

Mission
Datasets

Data Cycle
System

DCS Core
Services

DB
Management
Apps

DBs

Persistent
Store

Requires access to persistent store

See Shuping et al. (ADASS 2012) for more on the DCS.

Data Processing System by instrument

- **FORCAST imaging**: Ready for operations
- **FORCAST grisms**: Operational; commissioning updates in-work
- **FLITECAM imaging**: Ready for operations
- **FLITECAM grisms**: Operational; waiting for additional wave cals.
- **GREAT**: Learning from Basic Science Level 3 deliveries (2013 Mar)
- **FIFI-LS**: Preliminary pipeline received; agreement with SI team to revisit
- **EXES**: Negotiating with SI team to obtain source code in summer
- **HAWC+**: HAWC pipeline installed and tested; tabled until HAWC+ ready
- **HIPO**: No need for reduced or calibrated products

OC1 Level 2 Pipeline Processing

- **FORCAST (Imaging/Grism)**: DRIP/FG
    - Chop/Nod subtraction
    - Non-linear response correction
    - Bad-pixel removal
    - Droop & "jailbar" (cross-talk) correction
    - Optical distortion correction (I)
    - Field rotation/alignment (I)
    - Flatfield correction (G)
    - Optimal spectral extraction (G)
    - Wavelength calibration (G)

- **FLITECAM (Imaging/Grism)**: FDRP/FSpextool
    - Nod subtraction
    - Flatfield correction
    - Bad-pixel removal
    - Optimal spectral extraction (G)
    - Wavelength Calibration (G)(TBD)

Flux Calibration for FORCAST and FLITECAM

- On each flight, observations of standard stars will be obtained at each altitude (as in Basic Science).
  - *See backup slides for standard star selection*
- For imaging, fluxes and wavelengths have been derived for each standard star for each filter using a comprehensive model of the instrument throughput and atmospheric transmission
- Corrections for differences in airmass, altitude, and pwv, between targets and standards have been derived from ATRAN models for each passband and incorporated into the calibration software
- Calibration parameters applied to Level 2 data to produce Level 3 products; calibration params also stored in archive for reference.
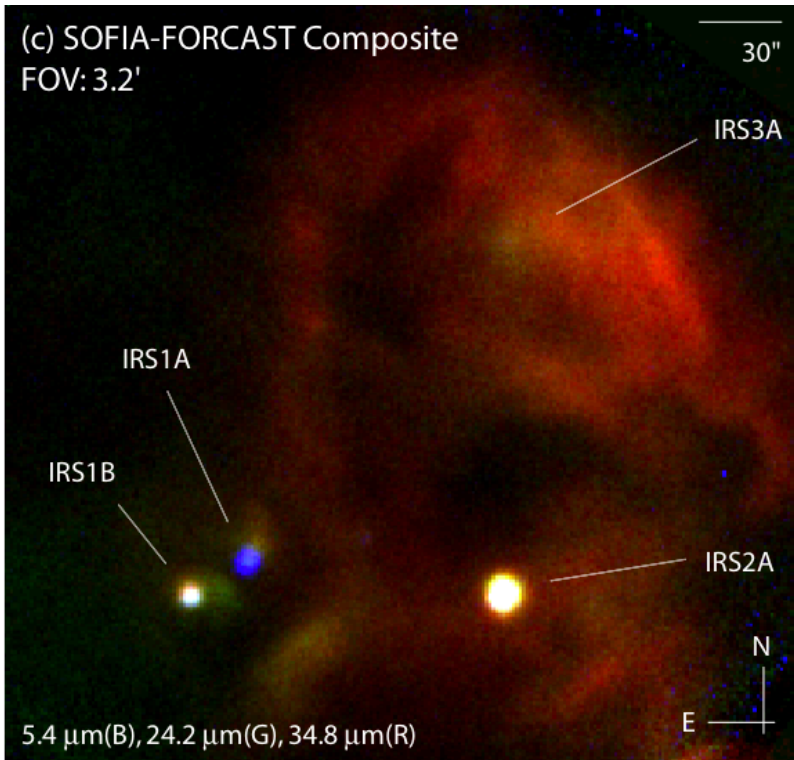
FORCAST Basic Science Flux Calibration Results

- Method worked well for calibrating FORCAST Basic Science data (Herter et al. 2013, in press)
    - RMS Response Uncertainty: ~6.1% (flight–by–flight)
    - Anecdotal results for a few Basic Science targets indicate that the calibration is good to <20% (3 sigma)
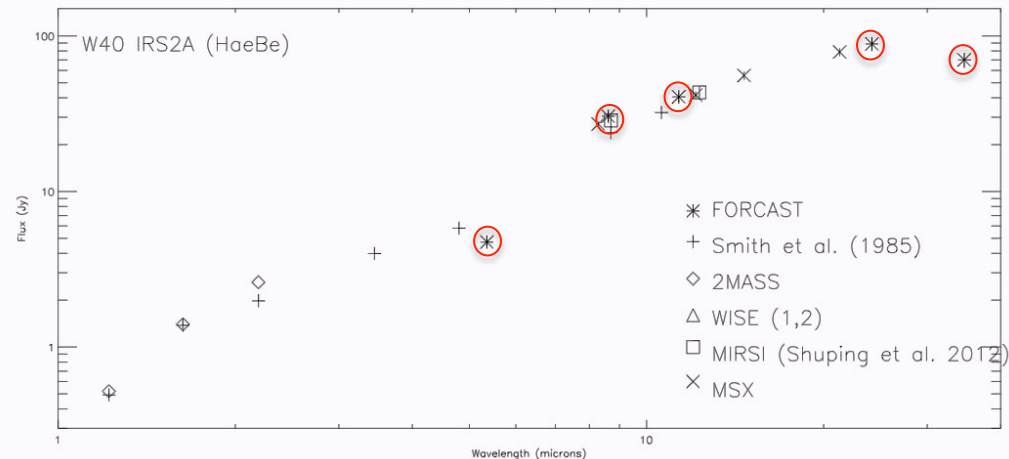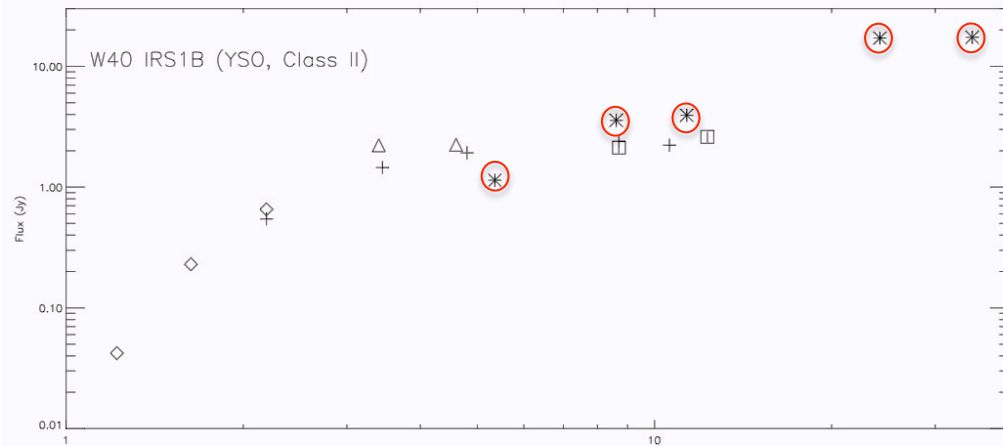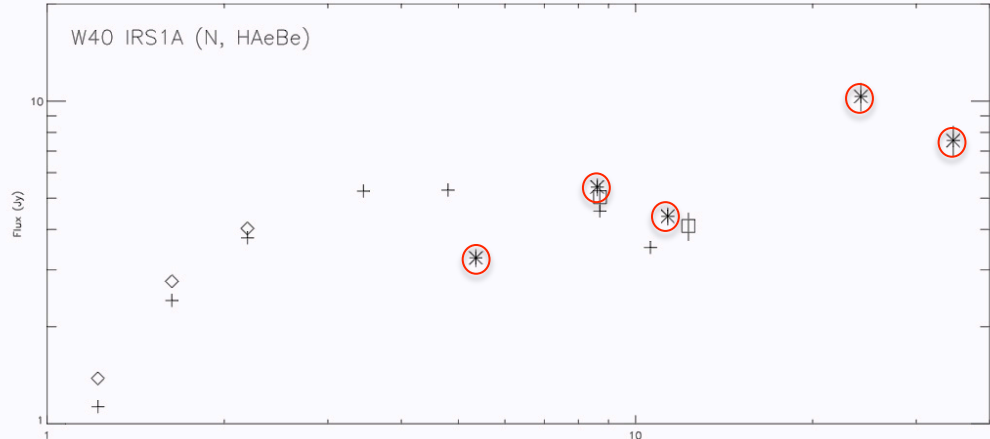   - Currently analyzing standards from Basic Science to evaluate overall accuracy.
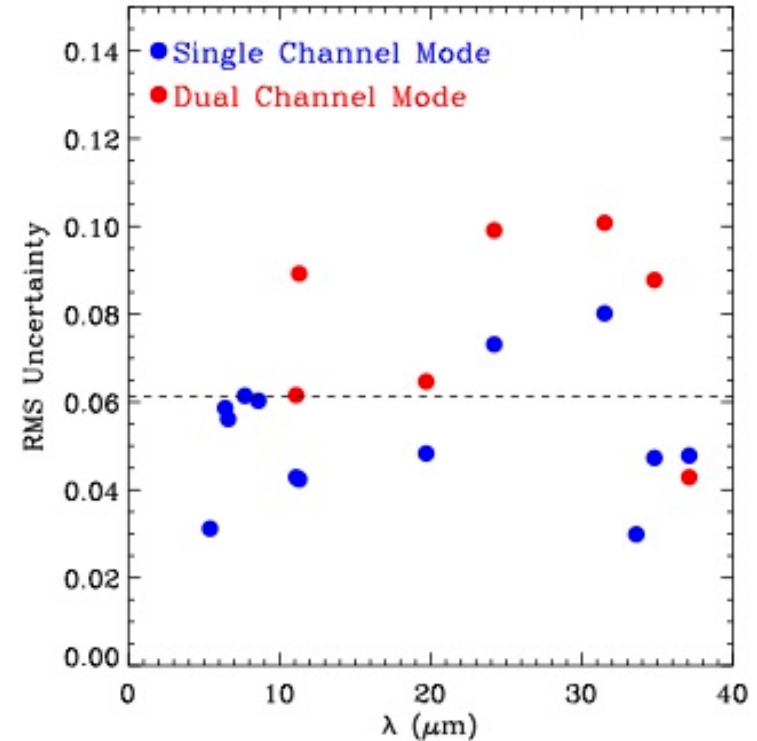
Herter et al. (2013)

FORCAST Observations of W40
(Shuping & Vacca, Basic Science 81_0067)

(c) SOFIA-FORCAST Composite
FOV: 3.2'

30"

IRS3A

IRS1A

IRS1B

IRS2A

N

E

5.4 μm(B), 24.2 μm(G), 34.8 μm(R)

Agreement with existing datasets is good.

W40 IRS1A (N, HAeBe)

W40 IRS1B (YSO, Class II)

W40 IRS2A (HaeBe)

* FORCAST
+ Smith et al. (1985)
◇ 2MASS
△ WISE (1,2)
□ MIRSI (Shuping et al. 2012)
× MSX

Data Distribution Timeline

- **Level 2 data** available to GI within *2 weeks* of flight series completion
  - *OC1B Exception*: delivery within 4 weeks
- **Level 3 (Flux Calibrated) data** available to GI within *4 weeks* of flight series completion
  - *OC1B Exception*: delivery within 6 weeks
- Data distribution via SOFIA Archive
  - GI data released to public after 1–year (from archive insertion).
  - Standards and calibration parameters released immediately.

System Development Status

- Requirements and design reviews complete
- Development hardware/network ready and in-use
- Production hardware/network almost ready, awaiting formal test
  - Dev environment serves as backup
- V&V with commissioning data underway
- Development of standard operating procedures underway
- Formal system testing coming up in prep for Cycle 1