SPIRE Lethbridge Meeting Minutes

May 14, 2007, Monday

<u>TF SPIRE spectrometer 8:50</u>

Bad channels: SLWC2 and SLWE3, SSWD5, SSWD7; SSWF2 with jumps, has been bad in prior test campaigns

Band edges:

- 50% of the single mode region in order to do further processing is derived as follows: a small spectral transmission profile in the single mode region is averaged to define 100% response. The 50% response line is computed and the intersection of the transmission profile
- 90% range for the calibration range, to be quoted for users
- Derived band edges are consistent for PFM3/4
- What is the variation across pixels?

Phase:

- Thermal response is of the same order as the filter effect of the read-out electronics.
- Dependence of thermal constant on background and other conditions to be quantified.
- The time-constant of the thermal response is derived from the data.
- Is the remaining optical phase due to the ZPD variation depending on port?

Vignetting:

- Port dependence of vignetting?
- Offset has to be taken care of as well.
- Removal of vignetting shows no impact beyond one wavenumber.

<u>GL FTS Beam Map Summary 9:35</u>

- Model of the propagated spectrum
- Comparison with PFM1
- Modes couple differently with the telescope and have to be understood accurately
- Offset of beam width between Y and Z
- The beam width is not a lambda/D behavior
- More work is required to inform an updated version of the observer’s manual

<u>TF SPIRE spectrometer 10:10</u>

Channel Fringes

- Apodization: increase of spectral resolution by 50% to decrease fringing
- Cut-off just prior to channel fringe is possible for SLW, but not SSW

- Keeping things simple for the astronomer is a high priority
- Does the SSW channel fringe occur in low-resolution measurements?
- Removing scaled and shifted copies of the central burst is effective at removing the channel fringes.
- Is high frequency content being affected?
- Data on the reflectance of the lens could inform the channel fringe removal, but is hard to get by.
- Add a line to affected interferogram to check whether it's affected by the channel fringe removal.
- Early phase: clean, unambiguous at the cost of spectral resolution.

Spectral resolution/Instrumental Line Shape

- SLW and SSW arrays were used to determine the spectral resolution element, which turns out to be very consistent.

Modulation efficiency

- Fit of an apodized cosine function
- Focus on ILS rather than detailed modeling of the natural apodization.

Obliquity

- Measurements of the same laser line gives different line positions for different off-axis angles of the detectors.
- Calibration values from data.
- Doesn't matter, because it's very small.
- Calibration can and should be repeated in-flight.

Next steps

- Implementation of the calibration will drive data analysis
- Moving effort from data analysis to software development
- Pipeline will be distributed to users and should produce unambiguous results that 90% of the users will be happy with.

<u>TL SPIRE spectrometer pipeline review 11:05</u>

Overview:

- Correction for the RC detector roll-off is now part of the EDP
- Level 0.5 products as starting points for adventurous users
- Where does unit conversion take place?
- Full/Simple pipeline depending how the detectors are modeled
- PCal to be discussed later
- Electrical/optical cross-talk separate to begin with
- SCal/Telescope correction have been updated

The following calibration files have been removed as proper:
SCalSpecFlat, SCalSpecStray, SCalSpecDerPar, SCalSpecScalTempHist.

The following file will persist in some way or other:
SCalSpecOffsetHist

Offset

- The offset will be set by each AOT
- How are the offsets passed on to the observation.
- Pasquale will define the way the offsets are passed into the pipeline

Level-0 products

- Level-0 products require the Observation Context to process data. or auxiliary products
- The observation context includes the calibration context and the auxiliary context from spacecraft

[…]

BSM

- S/C pointing is combined with BSM pointing

Detector Processing

- Output for the Simple model: V
- Output for the Full model: W
- Consider simple detector conversion for the spectrometer
- Should masked data be eliminated or persist?
- How important is memory efficiency for data processing.
- AI: We have to decide what amount of memory we can assume a user to have available for Herschel DP when processing GT KP observations. This has to be consolidated w.r.t. the requirements for the photometer.

Telescope correction

- Create a model spectrum from telescope information
- Herschel telescope has 3 thermometers.
- The time-constant of the telescope will be large and the telescope temperature should change very little with time. NB: That depends on how strongly the temperature gradient of the telescope is. That needs to be checked because pointing will re-direct the telescope and may change the temperature of the telescope.
- There will be significant change across the mirror as it points to the sky.
- Experimental data may supply the relevant information.
- We need to develop both, to model, and measure, the emission from the telescope more thoroughly.

Baseline correction

- Telescope and SCal will produce different vignetting and will be treated differently.

Fourier Transform

- SCalCal not needed anymore.

Level-1 data products:

- Should the ILS be removed for Level-1 data products.
- Beam-size as a function of wavelength and ILS will be passed on to the astronomer as usage context.
- AI on EP and KK to check whether a maximum of 60 min. of data in one BB is acceptable.
- Assembling data from various BB’s needs another processing step.

<u>14:30 Pipeline module review</u>

- AI: BSS to check whether the simple pipeline is good enough for the spectrometer? Do we need to consider non-linearities?
- AI: BSS to develop a task to remove the ILS from the spectrum. NB: The ILS is affected by the loss of modulation efficiency.
- We will provide users with a raw spectrum incl. the ILS and a spectrum where the ILS has been removed (either by apodization or some other means).
- Optical cross-talk will be inserted to after removal of SCal and the telescope emission.
- Can we remove SCal and telescope emission in one go by observing blank sky?
- Will we have enough calibration time to properly measure the beam width as a function of time?
- The full/simple pipeline introduces a weak dependency for the Telescope, SCal tasks. The problem boils down to a W <=> V conversion. A suitable calibration product has to defined.

<u>16:05 TF: Spectrometer Pipeline Next Steps</u>

Add:

- Modulation Efficiency Removal
- ILS Removal

AI: Schedule test campaign for the SPIRE iFTS DP

How stable will the thermal time-constants be? This will depend on bias, i.e. source strength, and bath temperature. This will have to be monitored. Define the sensitivity.

No effort will be put into Step & Integrate.

Create OPD at an early point as currently implemented.

Zero-infilling will ensure consistent grids for the three resolution modes.

A wave-number grid with a convenient step size will be implemented.

Baseline removal useful to measure the ILS in the interferogram domain.

Sunil/Tanya can request several calibration measurements (once every 10K) of the cooling telescope.

Calibration for point sources on the optical axis only.

May 15, 2007, Tuesday

<u>DN Introduction to Fourier transform spectroscopy 8:35</u>

Spectral analysis will be complicated by the instrumental line shape of the FTS.
Interactive tools will be required to analyze spectra accurately to its full resolution.
ILS correction for quick and dirty processing of spectra.

Tools for IRAF data?
KP are required to develop tools and provide to the HSC.

KISS – use apodization to safely remove the ILS. It is TBD how much spectral resolution we should sacrifice, i.e. which apodization function we should use? Starting point: 1.5

Apodization optimization tool on best effort basis.

Un-apodized spectra are always available.

<u>JPB The SPIRE imaging FTS 9:45</u>

The lines have to be removed in order to recover the SED.

Issues:

- truncation
- channel fringes (effect of removal scheme on line information)
- micro-vibrations

<u>EP AOT for the SPIRE iFTS 11:00</u>

Cross-calibration of the two bands will be a problem, especially for low-resolution data where the overlap is covered only by one independent data point.
The scan-direction for mapping can be controlled only indirectly by selecting the observation date.
Dead pixels will be confirmed during IST in September 2007.

EP Spectroscopy with Herschel 11:30

Stitching together spectral bands is important to measure SEDs, less so for line information.

Is cross-calibration of the SPIRE iFTS with Planck feasible?
Large maps with the iFTS will be done as part of the science programs.

Data from the SPIRE iFTS can be compared to the data from the SPIRE photometer.

Pedro at ESA coordinates calibration between instruments.
Bilateral coordination with PACS is important to get any work done.
Calibration steering group.
SPIRE should sort out is calibration scheme first and then present it to the other instruments and ESA.

Calibration Review 13:20

The SPIRE pipeline description will be elaborated by Lethbridge & Marseille to describe in detail the processing algorithms in about 4 weeks from now. This description will be reviewed by the instrument team (at least Matt & Tanya). After that first iteration, the description of the calibration products will be updated.

Intensity calibration:

Stable instrument: observe a previously known spectrum: match measured spectrum to the expected spectrum.

One-pass calibration for SCal and telescope as straightforward way of calibrating.

Subtract the blank sky in the interferogram domain
Ratio against measured spectrum in the spectral domain

Telescope drifts can be calibrated for with dedicated time.

Cool-down phase: Set SCal to a series of temperatures

Blank sky and known calibration source

For all spectral resolutions? If we could have a full-resolution AOT then we only need one set of measurements. There may have to be a trade-off between low/med/hi-res.

SNR has to be 10x better than scientific observations.

Line flux calibration:

Lines are not necessary because the SED match will tell us whether the wavelength calibration is correct.

Line observations as cross-check.

Strong source correction:

If no bolometer model is used, then the non-linearity correction has to be done This task has to be implemented.

Different SCal setting for bright sources will require a complementary set of calibration measurements

Very bright sources cannot be offset by SCal (<120/160K)

PCal processing:

Use the same process as the photometer.
SMEC will be parked well away from the central burst and the channel fringes.

Calibration source candidates:

Uranus, Neptune, asteroids, HII regions

BSch Bolometer in SPIRE 14:35

Dark Pixels can see some stray-light that falls through the cracks. That has not yet been quantified.

Thermistor Pixels are mounted directly on the base plate. A signal on these pixels could be due to electrical or optical cross-talk. The time constant of the thermistor should be much shorter and the phase should be significantly different for electrical or optical cross-talk.

MG SPIRE sensitivity model 15:20

Each detector is modeled as the median of all detectors in a given array.
Primary emissivity of ~1% is a pessimistic assumption.
Fundamental assumption for noise estimates: Point source on-axis

JPB Transmission & SNR measurements 15:40

Transmission analysis shows differences between PFM3 and PFM4.
There are differences between the transmission for SCal2 and SCal4 (factor between 1.1 – 1.3).
Transmission matches roughly the boundaries for the modes.

Transmission in the SCal port will depend on the location of the SCal source in the beam. Additional sources (warm and cold) were observed in PFM4..
The warm source seems to have disappeared in PFM5.

Differences in SCal transmission probably not due to differences in the performance of FIR-filters across their aperture. It is more likely that straylight from the SCal cavity is responsible for such differences.

<u>NL Bolometer Noise Analysis from PFM5 16:30</u>

Thermal stability is probably not directly related to the bath temperature.
Recommendation for bias settings still have to be consolidated.
Thermal environment in space may very well differ from ground-based testing.

<u>PH/TF SCal and the telescope compensation scheme 17:00</u>

The SCal design is based on predictions of the thermal emissivity of the telescope which have changed since then from 4% to 1%.

Transmission profiles for SCal2/4 are different. Consistently so only for the pixels in the unvignetted FoV, i.e. not the outer ring.

May 16, 2007, Wednesday

<u>TF Demo of the data processing software for the SPIRE spectrometer 8:40</u>

PixelViewer is specific to the layout of the detector grid. This could be extended to the photometer.

How does the glitch removal affect the noise statistics? Can we still keep track of the measured error?