



SUBJECT: **FTS Pipeline Scientific Validation: Documentation Review Responses**

PREPARED BY: **Ed Polehampton, Peter Davis-Imhof, Jean-Paul Baluteau**

DOCUMENT No: **SPIRE-RAL-DOC-003218**

ISSUE: **1.0** **Date:** **20th February 2009**

APPROVED BY: **Date:**



Project Document

Ref: SPIRE
Issue: 1.0
Date: 20/Feb/09
Page: 2 of 22

FTS Pipeline Scientific Validation: Documentation Review Responses

Distribution

Jean-Paul Baluteau	LAM
Peter Davis-Imhof	Blue Sky Spectroscopy
Ed Polehampton	RAL
Peter Ade	Cardiff University
Trevor Fulton	Blue Sky Spectroscopy
Nanyao Lu	IPAC
David Naylor	University of Lethbridge
Giorgio Savini	University College London
Christian Surace	LAM
Bruce Swinyard	RAL
Dominique Benielli	LAM
Scott Jones	University of Lethbridge
Sarah Leeks	RAL
Chris Pearson	RAL
Tanya Lim	RAL
Matt Griffin	Cardiff University
Michael Pohlen	Cardiff University
Pasquale Panuzzo	CEA

Change Record

ISSUE	DATE	Changes
DRAFT 0.1	09 February 2009	
DRAFT 0.2	17 February 2009	Added section on the pipe description
Issue 1.0	20 February 2009	



FTS Pipeline Scientific Validation:
Documentation Review Responses



1 INTRODUCTION.....5
1.1 THE SPIRE FTS VALIDATION GROUP5
1.1.1 Group Membership5
1.1.2 Objectives.....5
1.2 STRUCTURE OF THIS DOCUMENT5
1.3 DOCUMENTS.....6
1.3.1 Applicable Documents.....6
1.3.2 Reference Documents.....6
2 RESPONSE TO IMPLEMENTATION OF DOCUMENTATION REVIEW SUGGESTIONS7
2.1 SPIRE SPECTROMETER PIPELINE DESCRIPTION (TREVOR'S) DOCUMENT7
2.1.1 General Comments.....7
2.1.2 First Level Deglitching7
2.1.3 Electrical Crosstalk.....7
2.1.4 Clipping Correction8
2.1.5 Time Domain Phase8
2.1.6 Non-Linearity8
2.1.7 Bath Temperature.....8
2.1.8 Interferogram Creation.....8
2.1.9 SCAL9
2.1.10 Baseline Correction9
2.1.11 Level 2 Deglitching9
2.1.12 Channel Fringing.....9
2.1.13 Phase Correction10
2.1.14 Apodisation10
2.1.15 Fourier Transform10
2.1.16 Flux Conversion.....11
2.1.17 Optical Crosstalk11
2.1.18 Spectral Averaging.....11
2.1.19 Spatial Regridding11
2.2 PIPELINE DESCRIPTION (CHRIS'S) DOCUMENT12
2.2.1 General Comments.....12
2.2.2 Compute BSM Angles.....12
2.2.3 First Level Deglitching12
2.2.4 Remove Electrical Crosstalk.....12
2.2.5 Clipping Correction13
2.2.6 Time-Domain Phase Correction13
2.2.7 Nonlinearity Correction.....13
2.2.8 Bath Temperature fluctuation correction.....13
2.2.9 Interferogram Creation.....13
2.2.10 SCal and Telescope Correction.....13
2.2.11 Interferogram Baseline Correction.....13
2.2.12 Level 2 Deglitching14
2.2.13 Phase Correction14
2.2.14 Apodisation14
2.2.15 Fourier Transform14
2.2.16 Flux Conversion.....14
2.2.17 Spatial Regridding15
2.3 MODULE REQUIREMENTS DOCUMENT16
2.3.1 General Comments.....16
2.3.2 Compute BSM Angles.....17



Project Document

Ref: SPIRE
Issue: 1.0
Date: 20/Feb/09
Page: 4 of 22

**FTS Pipeline Scientific Validation:
Documentation Review Responses**

2.3.3	<i>SPIRE Instrument Pointing Product</i>	18
2.3.4	<i>Electrical Crosstalk</i>	18
2.3.5	<i>First Level Deglitching</i>	18
2.3.6	<i>Clipping Correction</i>	19
2.3.7	<i>Time Domain Phase</i>	19
2.3.8	<i>Non-Linearity</i>	20
2.3.9	<i>Bath Temperature</i>	20
2.3.10	<i>Interferogram Creation</i>	20
2.3.11	<i>SCAL</i>	20
2.3.12	<i>Baseline Correction</i>	21
2.3.13	<i>Level 2 Deglitching</i>	21
2.3.14	<i>Channel Fringing</i>	21
2.3.15	<i>Phase Correction</i>	21
2.3.16	<i>Apodisation</i>	21
2.3.17	<i>Fourier Transform</i>	21
2.3.18	<i>Flux Conversion</i>	21
2.3.19	<i>Optical Crosstalk</i>	21
2.3.20	<i>Spectral Averaging</i>	21
2.3.21	<i>Spatial Regridding</i>	22



1 INTRODUCTION

1.1 The SPIRE FTS Validation Group

1.1.1 Group Membership

Coordinators:

Ed Polehampton (RAL)
Jean-Paul Baluteau (Marseille)
Peter Davis-Imhof (Blue Sky Spectroscopy)

Members:

Peter Ade (Cardiff)
Trevor Fulton (Blue Sky Spectroscopy)
Nanyao Lu (IPAC)
David Naylor (Lethbridge)
Giorgio Savini (Cardiff)
Bruce Swinyard (RAL)
Christian Surace (Marseille)
Dominique Benielli (Marseille)
Scott Jones (Lethbridge)

Cross-members (coordinating across all 4 groups):

Sarah Leeks (RAL)
Chris Pearson (RAL)

1.1.2 Objectives

The Objectives of the validation group are:

1. To ensure the pipeline conforms to the top-level documentation in terms of their overall architecture and detailed implementation.
2. To ensure that the developer documentation for individual modules conforms to the top-level documentation in terms of requirements and algorithms.
3. To verify that testing carried out at the developer module level is adequate and documented
4. To test the pipeline to validate the correct operation of individual modules and end-to-end systems.
5. To identify and initiate correction of errors or omissions in the pipeline documentation.
6. To identify and report errors in the module implementation and operation.
7. To document all results from the test phases.

The software test of pipeline modules aims to check:

- Consistency with the (already reviewed) top-level documents and module requirements
- Consistency with calibration file definitions (as described in the Pipeline Description Document)
- Correctness and clarity of implementation (i.e. algorithms used are correct and method clear)
- Commonality in use of symbols and terminology (i.e. inputs/outputs to each module use consistent terminology, algorithms use consistent symbols)
- Status of module-level testing (i.e. testing that has been carried out so far)

1.2 Structure of this Document

This document contains our response to the changes carried out as a result of the review of top level pipeline documents carried out as part of Phase 1 of Scientific Validation. Sections in blue refer to change requests that have not yet been fully addressed.



Project Document

Ref: SPIRE
Issue: 1.0
Date: 20/Feb/09
Page: 6 of 22

**FTS Pipeline Scientific Validation:
Documentation Review Responses**

--

1.3 Documents

1.3.1 Applicable Documents

1.3.2 Reference Documents

User Guide	SPIRE Pipeline User Guide, version 0.02, 18 September 2008
Chris' Document	SPIRE Pipeline Description (SPIRE-RAL-DOC-002437)
Trevor's Document	SPIRE Spectrometer Pipeline Description (SPIRE-BSS-DOC-002966)
Module Requirements	SPIRE Data Processing Pipeline Module Requirements (SPIRE-ICS-DOC-002998)



2 RESPONSE TO IMPLEMENTATION OF DOCUMENTATION REVIEW SUGGESTIONS

2.1 SPIRE Spectrometer Pipeline Description (Trevor's) Document

This section lists the comments made in the Phase 1 documentation review by their identifier [FTS-xx], with comments on whether the recommendation was implemented. There are several new recommendations made which are numbered [FTS-Ph2-xx]. The points which still require work to be done are written in blue. Comments are organised by the sections used in the original documentation review. There are also some comments in the Module Requirement Document section that refer to this document (to move information from the requirements into this document).

2.1.1 General Comments

[FTS-1] DONE

[FTS-2] Still to add reference to Mapping note in the text (end of first sentence of sect 2.3). In the list of documents, the mapping note is given AD05 when it should be AD06.

[FTS-3] DONE

[FTS-4] Section 2.3 and the figure have disappeared completely...

[FTS-5] Section 2.3 and the figure have disappeared completely

[FTS-6] DONE

[FTS-7] Fig 2.1 has disappeared

[FTS-8] DONE

[FTS-9] DONE

[FTS-11] Sec 3.1 of Trevor's Document lists the 6 major processing groups on the spectrometer pipeline. Chris' doc lists 5 as it doesn't include the common part. It would be good to have consistency between the two and decide if the common part is considered part of the spec pipeline.

CPP: Since the Engineering conversion is addressed in a different section of the Pipeline Description Document it should not be included in the spectrometer pipeline discussion. I suggest renumbering Trevor's document list to be 0-5 instead of 1-6 then the numbers between the documents will be consistent again

Additional corrections:

[FTS-Ph2-1] second para. of Chap 2: extra "(s)" in first sentence after "templates"

[FTS-Ph2-2] First para in sect 2.3: should add "observation" to "...is limited by the maximum observing time for one observation"

2.1.2 First Level Deglitching

[FTS-37] Report still to be completed and incorporated

[FTS-38] Still to add details of Bernhard's SAG1 method when information on this is received.

[FTS-39] cannot replace "section" with "appendix"

[FTS-40] DONE

Additional corrections:

[FTS-Ph2-3] sect 3.1.1, point 2 (a) extra "is" in first sentence not needed.

[FTS-Ph2-4] sect 3.1.1, point 2 (b) "identified" spelt wrongly

2.1.3 Electrical Crosstalk

Additional corrections:



FTS Pipeline Scientific Validation:
Documentation Review Responses

[FTS-Ph2-5] sect 3.1.2, first para: "Electrical crosstalk arises after the detector has registered far infrared radiation, and is due to..."

[FTS-Ph2-6] sect 3.1.2, first para: The definition of Optical crosstalk needs to be clarified and this section may need updating. See also later in Optical Crosstalk section

2.1.4 Clipping Correction

[FTS-57] Has not been addressed – QC metrics are not mentioned

[FTS-58] Para 2 sect 3.1.4 still refers to "missed samples" – should be changed to "samples with incorrect values"

[FTS-59] Still to add last part – extra sentence in first paragraph emphasising that this task most important in IA.

[FTS-60] DONE

[FTS-61] DONE

[FTS-62] DONE

[FTS-63] DONE

Additional corrections:

[FTS-Ph2-7] para 3 sect 3.1.4 first sentence. remove "are reconstructed"

[FTS-Ph2-8] para 4 This refers to a specific observation in PFM4 – that fact should be mentioned.

[FTS-Ph2-9] Some explanation of when the clipping correction is not applied should be added – e.g. for samples flagged as truncated?

[FTS-Ph2-10] in Note: second sentence missing "a" in "additional"

[FTS-Ph2-11] Should mention that clipping of the baseline can occur at high OPD and that this task will not correct for that. Clipped samples at high OPD should be masked so that they are not used in Interferogram creation.

2.1.5 Time Domain Phase

[FTS-69] Not addressed: Could add to end of para 3: "The thermal response should not change with bias voltage, but this should also be monitored to ensure that it true after launch."

[FTS-70] One instance of ω_s is still present in para 4 (just before equation 3.9): should be changed to ω .

[FTS-71] DONE

[FTS-72] DONE

[FTS-73] DONE

Additional corrections:

[FTS-Ph2-12] para 3 characterizes is missing a "c"

[FTS-Ph2-13] should add "in most cases" to first sentence of para 3.

[FTS-Ph2-14] last para, first sentence "The shift in the time domain...." should be replaced with " The time domain phase correction function..."

2.1.6 Non-Linearity

[FTS-80] DONE

[FTS-81] DONE

2.1.7 Bath Temperature

[FTS-89] – this comment did not need to be put into the document

2.1.8 Interferogram Creation

[FTS-96] DONE

[FTS-97] DONE

[FTS-98] DONE



FTS Pipeline Scientific Validation:
Documentation Review Responses

[FTS-99] Would help to write something after eqn 3.17 like "where n is the scan number and i is the detector"

Additional corrections:

[FTS-Ph2-15] Sect 3.2.1 second para in point 1(a): in first sentence replace "is" with "in"

[FTS-Ph2-16] First para in point 1(b) – should change "a shifting factor, ZPD....." to "a shift, ZPD..." (as its not a multiplying factor)

[FTS-Ph2-17] point 1(d) regularly-spaced should not be hyphenated.

2.1.9 SCAL

[FTS-103] Section 3.3.1 title not changed

[FTS-104] DONE

[FTS-105] DONE

[FTS-106] DONE

Additional corrections:

[FTS-Ph2-18] sect 3.3.1 para 2: first sentence should say "first SPIRE beamsplitter"

[FTS-Ph2-19] extra "direction" at end of first Note in sect 3.3.1 should be deleted

[FTS-Ph2-20] second Note in sect 3.3.1: last sentence should be "mechanism forward and reverse.." (delete "s")

[FTS-Ph2-21] could be made clearer that the "model-based" method is an alternative that is not currently being adopted. It might be confusing to call it "model based pipeline" because this is independent of the model based approach to bolometer processing, isn't it?.

[FTS-Ph2-22] Fig 3.4: The calibration box labelled "beamsplitter profiles" is not needed and should be removed from the figure.

2.1.10 Baseline Correction

[FTS-113] DONE

[FTS-114] – this was included in the test plan for phase 1

[FTS-115] cannot be changed

[FTS-116] DONE

[FTS-117] DONE

Additional corrections:

[FTS-Ph2-23] in point 2 (FT method) "measured" is spelt wrongly

[FTS-Ph2-24] in the Note, last sentence: "...found to be the most robust when applied to data from lab testing."

[FTS-Ph2-25] should mention the clipped baselines. This will affect the baseline fit. Clipped samples will be masked and not included in the fit.

[FTS-Ph2-26] should be made clear that the fitted baseline is returned to the user by the task

2.1.11 Level 2 Deglitching

[FTS-122] Should still note that the problem for only 2 scan repetitions is still to be solved (could do this in the Note)

Additional corrections:

[FTS-Ph2-27] the description should be updated to follow the refactoring of this task

2.1.12 Channel Fringing

[FTS-126] Should make clearer that channel fringe correction will not be applied in standard pipeline – could add a sentence to this effect at beginning of the first paragraph in this section (in addition to what is already written in the Note).



[FTS-127] DONE

2.1.13 Phase Correction

[FTS-129] Suggestion to re-word the Note to say:

"During the initial stages of the mission, the non-linear portion of the phase referred to in Equation 3.30 may not be sufficiently quantified. During this period, it will be possible to carry out an n^{th} -order polynomial fit. Low values of n may be used to approximate the in-band non-linear phase (see Equation 3.34). However, this will be carefully monitored as problems of residual phase have been found when using a fourth order polynomial fit, and in addition for observations with a low signal to noise ratio, the fit will be difficult. A polynomial of order one or two may be the safest way to monitor the residual phase without being affected by low signal to noise in the data."

[FTS-130] DONE

[FTS-131] See modified Note text above

Additional corrections:

[FTS-Ph2-28] para just before step 1 in sect 3.3.5:

The phase correction module is separated into two components: the first step quantifies any phase that is present in the measured interferogram, and the second step removes the phase from the measured interferogram.

[FTS-Ph2-29] first para of step 1 in sect 3.3.5:

This step of the phase correction process is to quantify the phase of the measured intergerogram. To this end, the spectrum of the double-sided (see Section A.3.1) portion is computed for each interferogram (Equation 3.27). This is carried out using the Fourier Transform task (Section 3.4.1).

[FTS-Ph2-30] first para of step 2: replace "identified" in first sentence with "quantified".

2.1.14 Apodisation

[FTS-134] Could the table in Sect A.4 be moved into the main text? The apodisation function used in the SPG is not shown. This should be written into the text where the table of possible functions is mentioned.

The keywords used for apodizing functions should be standardised – could all of them contain the broadening at the end as `_XX`

There is a minus sign and sigma missing from the Gaussian definition.

[FTS-135] DONE

[FTS-136] DONE

Additional corrections:

[FTS-Ph2-31] last sentence of first paragraph – an extra "that" should be removed: "apodizing functions to allow for an optimal..."

2.1.15 Fourier Transform

[FTS-141] This was answered in a Note. Could the reason for Double-sided and Single-sided transforms be written as the first sentence in the relevant section? ie. adding a sentence to say which part of the pipeline uses each one – the double-sided transform is needed as input to the Phase correction module, and only the single-sided transform is used to produce the final spectrum for level-1 products. And also clarify in the last paragraph before the note that it should be the Single-sided part of the processing step that produces the spectra in level 1 SDS.

Additional corrections:

[FTS-Ph2-32] Fourier should always have a capital letter

[FTS-Ph2-32] what about the division by delta-sigma in Equation 3.37



2.1.16 Flux Conversion

[FTS-148] Should add "point" into second paragraph: "...perform a calibration observation of a point source with known flux"

[FTS-149] There are two calibration products in Fig 3.6 – the reason for having two products should either be explained in the text, or only one product should be shown. The first product should just be called RSRF table (the acronym already contains the word Spectral).

The RSRF table is not mentioned in the text anywhere – it should be mentioned that the calibration observation of source with known flux will be used to derive the RSRF which will then be applied to the data to do the flux conversion.

[FTS-150] Should add this as extra point to the Note: "The flux conversion for lines will depend on the apodization function used – see [Apodization Note]."

[FTS-151] DONE

[FTS-152] DONE

[FTS-153] DONE

Additional corrections:

[FTS-Ph2-33] the last sentence of last paragraph before the Note is not clear. It could be removed.

[FTS-Ph2-34] spelling mistake for Standard Product Generation in the Note.

2.1.17 Optical Crosstalk

[FTS-157] DONE

[FTS-158] this comment did not need to be included in the document.

Additional corrections:

[FTS-Ph2-35] The definition of Optical Crosstalk should be clarified and the first paragraph should be updated if necessary. This requires some investigation before updating with corrected wording.

[FTS-Ph2-36] "neighbouring detectors are separated by a distance approximately twice the detector field of view. Therefore even if a...."

2.1.18 Spectral Averaging

[FTS-160] DONE – but why is this in a Note and not in the main text? Also it should be noted that the SPG pipeline will combine forward and reverse scans, and that the interactive version will allow averages of forward and reverse scans to be calculated separately.

[FTS-161] QC information to compare forward and reverse scans is not mentioned.

[FTS-162] DONE

Additional corrections:

[FTS-Ph2-37] First sentence of para 2 in Note: "outliers that reside at an as yet..."

[FTS-Ph2-38] second to last sentence: "These outliers will..."

2.1.19 Spatial Regridding

[FTS-167] this did not need to be added to the document

[FTS-168] Not added – but maybe this should be investigated outside of the document?

[FTS-169] in the Note "bot" should be replaced with "both"

Additional corrections

[FTS-Ph2-39] para 3 "Ground based measurements have shown that the beam of the ..."

[FTS-Ph2-40] para 3 : second to last sentence should begin "The" and not "Th"



2.2 Pipeline Description (Chris's) Document

This section lists the comments made in the Phase 1 documentation review by their identifier [FTS-xx], with comments on whether the recommendation was implemented.

2.2.1 General Comments

[FTS-10] DONE

[FTS-11] Sec 3.1 of Trevor's Document lists the 6 major processing groups on the spectrometer pipeline. Chris' doc lists 5 as it doesn't include the common part. It would be good to have consistency between the two and decide if the common part is considered part of the spec pipeline.

Moved to Trevor's section

[FTS-12] In general, the output product from each module has an error column. However, neither Trevor's document or Chris' define precisely how the systematic errors from each module are propagated. We recommend that a separate document be produced detailed the error propagation through the pipeline. This should ensure that the final error on the level-1 spectrum contains all the relevant systematic and statistical errors accumulated during the pipeline flow. The results of this document for each module should be inserted with the description of the output product.

An additional document should be written. No correction required for Chris' document at this stage.

2.2.2 Compute BSM Angles

[FTS-25] Add an explanation about the meaning of the Y and Z angle errors and how they are computed or estimated.

The sentence "For the BAT the errors on the angles can be calculated in the same way as the angles are calculated from the interpolation." was added. I don't really understand what this means and it should be clarified what this means. Is the distance from the calibration values used and if so, how?

[FTS-26] Fig. 12 is redundant with Fig. 3 in the same document. Is it necessary to reproduce this figure twice, or can the text refer to a single figure?

Kept as is

2.2.3 First Level Deglitching

[FTS-41] DONE

[FTS-42] The calibration file containing the glitch identification method parameters does not need to include bias dependence because the task adapts dynamically to the level of noise present in the data and cosmic ray glitches should be much stronger than any change in noise due to the bias setting. Therefore one set of parameters will be sufficient.

Not relevant anymore since the calibration product was scrapped.

[FTS-43] DONE

[FTS-44] DONE

2.2.4 Remove Electrical Crosstalk

[FTS-54] In the photometer pipeline, they have been discussing whether to swap the order of first level deglitching and electrical crosstalk removal. This is because some crosstalk may be caused by glitches



FTS Pipeline Scientific Validation: Documentation Review Responses

and so would not be removed correctly if the strongest glitches have already been removed. This also makes sense for the FTS pipeline, although should be tested.

Not needed at the moment. This will be decided in Phase 3 of the validation and any change recommended at that point.

[FTS-55] Verify how the calibration framework traces not only where the calibration data were derived but also what the related error is and how it will impact the science data.

My understanding is that an error (or uncertainty) matrix should be added to the calibration file. This could be discussed more in the errors document and so no change required at the moment.

2.2.5 Clipping Correction

[FTS-64] DONE

[FTS-65] DONE

2.2.6 Time-Domain Phase Correction

[FTS-74] DONE

[FTS-75] DONE

[FTS-76] DONE

[FTS-77] DONE

[FTS-78] DONE

2.2.7 Nonlinearity Correction

[FTS-82] DONE

[FTS-83] DONE

[FTS-84] DONE

2.2.8 Bath Temperature fluctuation correction

[FTS-90] DONE

2.2.9 Interferogram Creation

[FTS-100] DONE

[FTS-101] In the SDI product there are OPD error & Signal error. It is not clear where these errors are defined/computed/estimated.

This is not related to pointing but the creation of the OPD grid. This point could be answered in consultation with Trevor.

2.2.10 SCal and Telescope Correction

[FTS-107] DONE

[FTS-108] DONE

[FTS-109] DONE

2.2.11 Interferogram Baseline Correction

[FTS-118] DONE



2.2.12 Level 2 Deglitching

[FTS-124] Clarify the calibration file.

There will be no calibration file for this task and so the dummy calibration file should be removed.

[FTS-125] Describe the way the signal error is modified from the Input to the Output.

This should be done in the proposed error document.

2.2.13 Phase Correction

[FTS-132] The "Non-linear (Optical) Phase Correction Table" contents should be clarified – i.e. the difference between the phases and phase errors. In addition, in this step the interferogram is from the source only (after removal of telescope & SCAL emission), therefore we need only one optical phase, i.e. that for the input beam from the sky.

The terminology Telescope Port Phase and Reference Phase Error is not obvious and the latter still makes reference to four different phases. This should be updated in consultation with Trevor.

2.2.14 Apodisation

[FTS-137] DONE

[FTS-138] State which apodising function will be used in the SPG pipeline.

The algebraic expression is there but the definition of x is not specified: $x = \text{OPD}/\text{OPD}_{\text{max}}$, which is different from how x is used in the other sections of the document.

[FTS-139] DONE

[FTS-140] DONE

2.2.15 Fourier Transform

[FTS-142] DONE

[FTS-143] What is the difference between the Count and the Scan Number in the metadata of the output product?

Still to be done

[FTS-144] Explain how the spectral error is derived.

This should be done in the proposed error document.

2.2.16 Flux Conversion

[FTS-154] The description should be updated to reflect the changes proposed to Trevor's document.

Two points are still to be done:

State clearly that point-source calibration is the baseline calibration for the SPIRE FTS and will be applied in the SPG pipeline. Most scientific observations will lie between the two extreme cases of point and extended homogeneous sources. Observers will be advised to apply a correction for extended sources on top of the point-source calibration.

Take account of the fact that flux calibration may depend on BSM position (if vignetting depends on BSM position for example). This (potential ?) issue should at least be mentioned.



Project Document

Ref: SPIRE
Issue: 1.0
Date: 20/Feb/09
Page: 15 of 22

FTS Pipeline Scientific Validation:
Documentation Review Responses

2.2.17 Spatial Regridding

[FTS-170] DONE

[FTS-171] A comment should be added to state that both fixed coordinates (RA and Dec) and moving coordinates (e.g. Solar System objects) should be dealt with.

DONE. Definition of spectral cube will be developed and added later on.



2.3 Module Requirements Document

This section lists the comments made in the Phase 1 documentation review by their identifier [FTS-xx], with comments on whether the recommendation was implemented. As many of the recommendations were not implemented, the original comment is repeated here, with notes in blue detailing what is still to be done.

2.3.1 General Comments

[FTS-13] "Some modules specifically name calibration products and some do not. A convention should be found and if this involves naming calibration products specifically, all of the spectrometer modules should be updated accordingly."

This has not been addressed. Trevor's modules do not name calibration products specifically, but some of the other modules do name specific products.

[FTS-14] "Correct propagation of errors through each task should be listed as a requirement." to the General Requirements (Sect 3.1).

Still to be implemented

[FTS-15] DONE

[FTS-16] Table made more explanatory so this point is no longer required.

[FTS-17] DONE

[FTS-18] DONE

[FTS-19] "Section 3: TBD and TBC's should be filled in."

Still not changed for

GEN-040, The module shall allow all inputs and processing options to be specified on the command line

A general specification for a common interface is given in TBD

SPIRE-PERF-010 The module shall be able to process normal observations on a standard desktop machine

The assumption is that the machine will have a minimum of 1 GByte of memory, 10 GByte of free hard disk space and a processor equivalent to a 1GHz Intel Core processor, TBD

SPIRE-PERF-020 The module shall be able to process typical data on a standard desktop machine in less than 30 mins (TBC)

The definition of typical data will vary from one AOT to another. However, all such typical observations should take less than 8 (TBC) hours for their observations

These sound like requirements for the IA portion of the SPIRE-DP. We should ask the software team and then the management team to define suitable effort to fill in the TBD and TBCs.

[FTS-20] "Section 3: SPIRE-PERF-010: "normal observation" should be defined more precisely."

Still to be implemented. We suggest something like: "normal observation (i.e. observation of a couple of hours duration)"

[FTS-21] "Section 3.2: We need some mechanism to document the specific quality control metrics each task uses. It could either be a stand-alone document or a mandatory sub-section "Quality Control Metrics" could be introduced for each task."



FTS Pipeline Scientific Validation:
Documentation Review Responses

There is a QC section (Sect 10) which mentions a Quality Control Requirements Document (RD01). This points to the general Product Specifications Document. We think there should be a specific QC Metrics document added to the reference document list as QC metrics have not been added to each task section (a first version of such a document has been issued for the spectrometer).

[FTS-22] "Section 3.4 Documentation Requirements:

- SPIRE-DOC-010 should mention that this is the "software" design of the module. It should also contain the implementation details (which should not be in the Programmer's Guide).
- SPIRE-DOC-060 should come before SPIRE-DOC-020
- SPIRE-DOC-020 should not include implementation details and should mention that the Programmer's Guide is in fact Javadoc (it is normally referred to as the Developer's Reference Manual rather than Programmer's Guide).
- SPIRE-DOC-030 should be updated to be consistent with the plans for combining individual module User Guides into the final Astronomer User Guide.
- SPIRE-DOC-040: the test plan should detail the module test harnesses, plus other tests as applicable.
- SPIRE-DOC-050 should be clear about the difference between Validation and Verification (e.g. from Wikipedia: "*verification is ensuring that the product has been built according to the requirements and design specifications, while validation ensures that the product actually meets the user's needs, and that the specifications were correct in the first place. Verification ensures that 'you built it right'. Validation confirms that the product, as provided, will fulfil its intended use*"). The test report should contain verification, and the validation is done as part of the current review."

All points still to be implemented

[FTS-23] "In many of the spectrometer modules, the fact that the input is derived from an observation using an AOT. Should this be removed from individual modules and included as an overall requirement? Maybe it doesn't apply to all photometer modules though."

Still to be implemented (or response required if nothing should be changed)

[FTS-24] DONE

2.3.2 Compute BSM Angles

[FTS-27] DONE

[FTS-28] DONE

[FTS-29] DONE

[FTS-30] "Sections 5.11.4.1 and 5.11.4.2 and 5.11.4.3: Beam Steering Mirror Chopping Sensor should be replaced with Beam Steering Mirror Chop Sensor Signal."

Still to be implemented: there are still places where the word "chopper" is used. This is wrong and should be replaced by "chop" when it refers to one of the two possible axes of movement of the BSM.

[FTS-31] "It should be made clear that for the photometer jiggle observations a BSMT is the input, but for scan map and spectrometer observations it is NHK (see Chris' Document)."

Still to be implemented (although BSM will eventually be added to the telemetry for the spectrometer – but the requirement should still specify the possibility to use NHK for spectrometer or scan map modes).

[FTS-32] Calibration product was updated, so this comment no longer applies



FTS Pipeline Scientific Validation: Documentation Review Responses

[FTS-33] "Section 5.11.4.3: Should be "decimal degrees" and "the SPIRE Data Products Specification" (but could this document be referenced as an Applicable Document rather than being written each time specifically)."

Still to be implemented. Although the units might have changed to arcseconds. This should be checked and updated accordingly.

[FTS-34] "BSMConverter-FUN-010 should mention BSMT or NHK"

Still to be implemented

[FTS-35] "BSMConverter-FUN-020 should specifically mention that the conversion is from ADU to angle."

Still to be implemented

2.3.3 SPIRE Instrument Pointing Product

(new section)

Additional Comments:

[FTS-Ph2-41] The description of the input data products is too detailed for the module requirements – some parts should be moved to Chris' Document.

[FTS-Ph2-42] SPOINT-FUN-040 mentions a PixAngOff product. This should be DetAngOff.

2.3.4 Electrical Crosstalk

[FTS-56] DONE

Additional comments:

[FTS-Ph2-43] This module has been moved before First Level Deglitching but that has not been done in Trevor and Chris' documents (pending Phase 3 pipeline testing). The order of modules will need to be finalised in the document after Phase 3 testing is completed.

[FTS-Ph2-44] Sect 6.2.4.1: last sentence should be removed

[FTS-Ph2-45] Sect 6.2.4.2: The sentence "The matrix is surely symmetric" should be changed. It should not be a requirement that the matrix is symmetric. Therefore, this sentence should say "Although the matrix is expected to be symmetric, the module should not assume it is". A functional requirement should be added to say "The module should not assume the crosstalk matrix is symmetric".

2.3.5 First Level Deglitching

[FTS-45] "The module owner should be updated to Dominique Benielli."

Surnames should be added to module owners

[FTS-46] DONE

[FTS-47] "The reference in the introduction is not needed. The algorithm is described in Trevor's document."

Still to be implemented (the references should be removed – should refer to Trevor's document instead, as that contains the full list of references)

[FTS-48] "It should be specified whether the input control parameters are contained within a calibration product or whether they are keyword inputs to the task."



FTS Pipeline Scientific Validation:
Documentation Review Responses

Still to be implemented – it should be made clear in section 6.3.4.2 that these parameters are keyword inputs to the task.

[FTS-49] “DEG-FUN-050 should mention that flagging follows the policy set out in the Masks Document.”

**Still to be implemented
(see for example what was done for 2nd level deglitching IFGMDEGLITCH-FUN-013)**

[FTS-50] “Requirements on the reconstructed timeline should be included – for example a requirement on the noise properties of the reconstructed data compared to the input data.”

Still to be implemented. This requirement should be drafted in consultation with Bernhard Schulz

[FTS-51] “The first sentence in section 5.7.1.1 and DEG-FUN-010 should read “... in the form of a spectrometer or photometer detector timeline.” This task does not operate on interferograms.”

Still to be implemented

[FTS-52] “Clarify how the task treats samples which have been masked by earlier processing tasks. Are these samples ignored, used as is, or replaced with dummy values?”

Still to be implemented

[FTS-53] “Specify all mask bits which are set by this task and state their respective meanings”

Note that the point about the reference to the Masks Policy document is already made in [FTS-49]. The meaning of mask bits is defined in that document, so should just make sure that the correct reference is made to the Masks Policy Document.

2.3.6 Clipping Correction

[FTS-66] “The module description states that a sinc interpolation is used but the other documents say that an 8th order polynomial is used. Confirm that an 8th order polynomial is used and update the document accordingly.”

Still to be implemented

[FTS-67] “CLIPPING-FUN-030 should also be made consistent with the other documents.”

Still to be implemented – by other documents, we mean the description presented in Trevor and Chris' documents

[FTS-68] “If there will be a mask bit that keeps track of which clipped samples have been corrected, a Functional Requirement should be added to state the name and function of this mask bit (with reference to the Mask Policy document).”

Still to be implemented. Indeed, there is such a mask bit (TRUNCATED_UNCORR).

2.3.7 Time Domain Phase

[FTS-79] DONE



FTS Pipeline Scientific Validation:
Documentation Review Responses

2.3.8 Non-Linearity

[FTS-85] "There is a long description of the task. This could be transferred to Trevor's document so that the detailed description does not need to be maintained in all three documents."

Still to be implemented

[FTS-86] "Applicable and Reference documents should be removed from this section and incorporated into the general document list."

Still to be implemented

[FTS-87] DONE

[FTS-88] The text has been changed so this is no longer needed.

2.3.9 Bath Temperature

[FTS-91] DONE

[FTS-92] "Applicable and Reference documents should be removed from this section and incorporated into the general document list."

Still to be implemented

[FTS-93] The same requirements are used for both photometer and spectrometer

[FTS-94] "There is extra information in the description section that is not included in the other documents. This should be removed and placed in Trevor's document."

Still to be implemented. This should be coordinated with Trevor.

[FTS-95] "The nomenclature in equations should be the same as used in Chris' document."

Still to be implemented (for example in Sect 6.6.3 and TCOR-FUN-080 and 090, Chris uses S_T whereas the requirements use Q_T)

2.3.10 Interferogram Creation

[FTS-102] DONE

Additional comments

[FTS-Ph2-46] CREATEIFGM-OUT-030 should be changed to mention Solar System coordinates as well as RA and Dec.

2.3.11 SCAL

[FTS-110] "References are made to the model based approach as well as the empirical one. A convention should be determined for whether both empirical and model based requirements are included in the document, or whether only the one in current use is included. If both are to be included, a separate section should be added to describe the requirements for the model based SCAL and telescope removal task."

Still to remove "TBD" in the empirical description, and make clear that the empirical version is to be used at launch.

[FTS-111] DONE

[FTS-112] DONE (empirical and model based approaches have been separated)



2.3.12 Baseline Correction

[FTS-119] DONE
[FTS-120] DONE
[FTS-121] DONE

2.3.13 Level 2 Deglitching

No comments

2.3.14 Channel Fringing

[FTS-128] This has been moved to the last Section of the document.

2.3.15 Phase Correction

[FTS-133] DONE

2.3.16 Apodisation

No comments

2.3.17 Fourier Transform

[FTS-145] DONE

2.3.18 Flux Conversion

[FTS-155] DONE

[FTS-156] "This single module should maintain the two calibration products from the original tasks as input. Robust names should be identified for these products."

The latest version of the pipeline description still contains two calibration products. One is for the instrument (RSRF) and one for the overall calibration using an astronomical object. Activities on this are coming up (Videocon initiated by Matt, calibration table review by Sarah and Ed). Therefore the requirements can be left unchanged for now but may need updating depending on the decisions made in the coming weeks.

2.3.19 Optical Crosstalk

[FTS-159] Requirements have been written jointly for spectrometer and photometer. This is OK even though there are two separate tasks for spectrometer and photometer.

Additional comments

[FTS-Ph2-47] The Input Data section and requirement OptCrossTask-FUN-010 should be modified to say that the input is a spectrometer detector spectrum (SDS) and not a spectrometer detector timeline (SDT).

2.3.20 Spectral Averaging

[FTS-163] DONE
[FTS-164] DONE
[FTS-165] DONE
[FTS-166] DONE



Project Document

Ref: SPIRE
Issue: 1.0
Date: 20/Feb/09
Page: 22 of 22

FTS Pipeline Scientific Validation:
Documentation Review Responses

2.3.21 Spatial Regridding

[FTS-172] Investigation not carried out but could be done later

[FTS-173] DONE

[FTS-174] DONE