Monthly Progress Report

SPIRE Test Facility and Scientific Support

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Part 1

1. Is the project on schedule? **No.**

Although the project is currently on schedule, an anticipated delay in delivery of SPIRE hardware is beyond our control. First data from the SPIRE imaging FTS will not be available until January 2005. This will cause serious problems since two key Canadian staff are funded only through December 2004. A proposal was presented to the CSA at the JCSA meeting in Winnipeg to extend the current contract and keep Trevor Fulton, the software engineer, and Peter Davis, the project manager employed for 9 months to complete Canada's work packages.

2. Is the project within budget? **Yes.**

3. Is the project free of any areas of concern in which the assistance or guidance of Canada may be required? **No (see above).**

Part 2

Task 3.1: Provide SPIRE Test Facility FTS

- The Test Facility FTS has been delivered to the Rutherford Appleton Laboratory (RAL) in August 2003.
- A small format visible imaging FTS (IFTS) is currently under development to allow us to test the data analysis pipeline. As part of this work, an Active-X based software is being written in IDL© to allow for the control of the interferometer stage and camera system.
- Tests at RAL with the Far-Infrared laser and the Test Facility FTS have been performed by Locke Spencer (grad student) and Samuel Ronayette (Canadian member of the instrument test team). First results indicate that the designed resolution limit of the Test Facility FTS has been achieved. Moreover, the wavelength accuracy of the laser is a fraction of the resolution which attests of the instrumental line shape of the Test Facility FTS.

Task 3.2: Provide SPIRE Data Analysis Software

- A meeting on spectrometer related work packages was set up for July 22 – 26 at RAL and Imperial College (IC), London, with researchers from the Laboratoire d'Astrophysique de Marseille (LAM), RAL, and IC. Trevor Fulton and Peter Davis will travel to the UK while David Naylor will join discussions via video-conference.
- The University of Lethbridge is responsible for three work packages: Deglitching, Fourier Transformation, and Spectral Response.
- The work package <u>Deglitching</u> has seen substantial progress:
  1. Trevor Fulton, the SPIRE software engineer, has calculated more detailed models of the detectors' impulse responses based on documentation from the Jet Propulsion Laboratory. The resulting relaxation times of the five detector arrays is given below:

Array name	Bolometer time constant [ms]	Electronic filtering	Relaxation time [ms]
PLW	18	4-pole Bessel low pass filter	53
PMW	13	4-pole Bessel low pass filter	50
PSW	11	4-pole Bessel low pass filter	49
SLW	4.2	6-pole Bessel low pass filter	10
SSW	4.2	6-pole Bessel low pass filter	10

  2. The various operating modes of the instrument were studied in terms of their response to cosmic rays. Cosmic rays hits on the photometer will result in short-lived spikes where the relaxation will not be visible because of the low sampling frequency. It will therefore be necessary to develop schemes to flag the resulting spikes. This will be particularly challenging for the photometer scanning modes. Similarly, the continuous scanning mode of the spectrometer will see short-lived spikes. In contrast, in the step and integrate mode cosmic ray hits will affect only single measurements.
  3. Todd Atkinson, a physics student from the University of Alberta, developed a detection algorithm for the single-sided part of the interferogram, based on the next-neighbour algorithm which was tested in version 1.0 of the Technical Note on Deglitching. Optimization of the deglitching routine for the SPIRE instrument is currently on-going.
  4. Todd also implemented a comparative deglitching routine for the central peak region of interferograms. Its performance will be determined with simulated data.
  5. Andres Rebolledo, a computer science student from the University of Lethbridge, has completed the first empirical quantification of the glitch population: He analyzed data from the pre-vibration test campaign on the cryogenic qualification model (CQM) to qualify the kind of glitches measured with the photometer long wavelength (PLW) detector array. Looking for unusually steep slopes and fitting an exponential relaxation for data over a period of 110 pixel-hours yielded two

distinct types of glitches: 43 cosmic rays with a relaxation time constant of $\tau = 48 \pm 17$ ms, which confirms the theoretically predicted $\tau = 53$ ms. 79 slowly recovering glitches with time constants of $\tau = 403 \pm 22$ ms.

Amplitude > 3 Sigma, RMS < 0.05
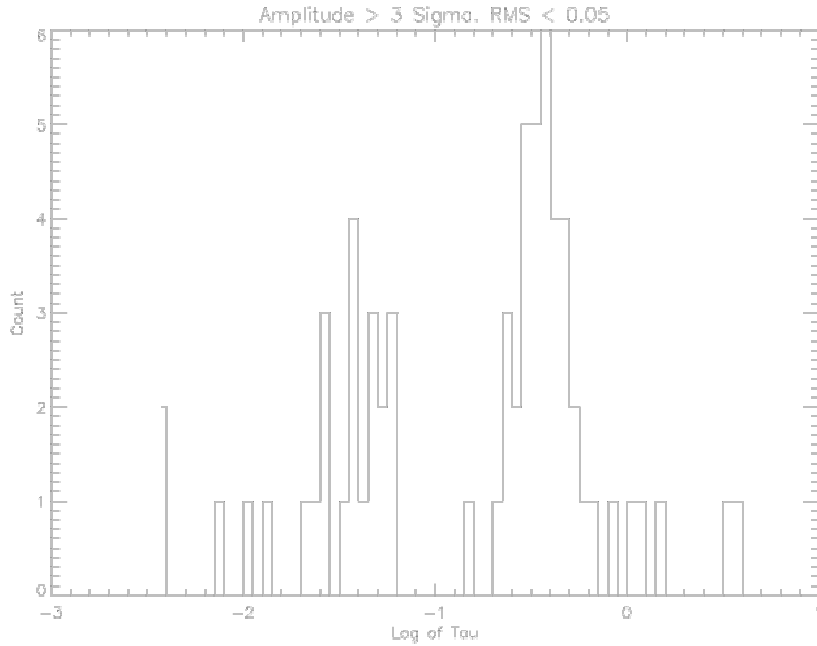
Figure 1: Distribution of all glitches from the SPIRE CQM data;
the region from log τ = -2 to –1 contains the cosmic ray events

- The work package <u>Fourier Transformation</u> has seen first results on the performance of the library to iteratively perform an efficient Fourier Transformation on non-uniformly sampled data (iNFFT): Trevor Fulton studied the iNFFT source code to clarify the iterative schemes available in the library. The performance of three of the four schemes offered by the iNFFT library was benchmarked against a regridding approach which allows the use of a straightforward FFT routine. The error, measured by the RMS of a sample spectrum indicates that the iterative methods are in fact superior: After four iterations, the RMS had converged to 0.0027 for all three schemes, while the error with the best regridding scheme was more than 25 times larger: 0.0746. The performance of both approaches will be qualified in more detail. In particular, we plan to explore the options available in the iNFFT library and the impact of phasecorrection on the results.

- The updated schedule for the collaboration with LAM is given below:

Time	Task	Progress
May 15	Data Product Definition	First draft currently under review
May 15	Spectrometer Test Data	OK
May 31	Flow diagram for work package FT, v1.0	OK
May 31	Pre- and post-ambles (with extensive data checking)	Version 1.0 was developed at LAM
June/July	Implement and benchmark NFFT vs. re-grid & FFT (in C)	On-going
June/July	Implement and benchmark deglitching routines (in IDL)	On-going
July 22-26	Meeting at RAL on Deglitching and FT	Meetings are under preparation
July/August	Implement and benchmark phasecorrection LAM vs. UoL (in IDL)	
Sep/Oct	Implementation in Java	
January 2005 and onwards	Start testing of pipeline with PFM data, implement changes, finalize tasks	

Task 3.3: Canadian SPIRE Team Support

- The next SPIRE Science Team Meeting will take place at RAL, UK, September 28 – 30, 2004.

Task 3.4: SPIRE ITT and ICC Support

- Asier Abreu, the Canadian member of the SPIRE instrument control team at RAL, and Samuel Ronayette, the Canadian member of the SPIRE test team at RAL, are currently preparing the next test campaign, due to start in late July.

Task 3.6: Public Outreach Program

- The public outreach website is currently under development. The launch date for the website is planned for August 31, 2004.
- A job ad for an applied study in the fall 2004 to develop hands-on programs with the City of Lethbridge's Nature Centre has been placed with the Applied Study Office at the University of Lethbridge.