SPIRE-UOL-REP-001648

Monthly Progress Report

SPIRE Test Facility and Scientific Support

Contract Number: 9F007-020251/001/SR **Date**: 3 April 2003
Prepared By: Peter Davis **Period**: March 2003

Part 1

1. Is the project on schedule? **Yes.**
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? **Yes.**

Part 2

Task 3.1: Provide SPIRE Test Facility FTS

- The only supplier capable of producing the off-axis parabola mirror in time to meet the tight SPIRE project deadlines (Waveprecision) had problems with their optical workshop. After a delay of five weeks they eventually managed to deliver the ordered mirrors. With the delivery of these mirrors, the last potential showstoppers have been eliminated as far as optical components are concerned.
- To protect the Test Facility FTS from dust and mechanical impact, Frank Klassen from the machine shop of the University of Lethbridge has manufactured a plexi-glass cover on steel beams.
- A custom shipping crate with a number of safety features (aluminium outside edges, four inches of foam on all sides, straps to manoeuvre the breadboard, latch locks for lid, double set of handles on all sides, wooden base for forklift operation on all sides) to assure that the Test Facility FTS will not get damaged during delivery to the Rutherford Appleton Laboratory (RAL), UK has been ordered from Physical Plant Management at the University of Lethbridge.
- Synchronization of the Test Facility FTS and instrument clocks is crucial to produce valid interferogram data. A solution has been developed and proposed by SPIRE staff. Greg Tompkins from the Electronics Workshop at the University of Lethbridge has developed schematics of a possible implementation of this solution. It has been discussed with the SPIRE project and is currently pending on final approval by SPIRE staff. A functioning prototype in accordance with the proposed implementation has been developed and currently undergoes extensive tests. See the schematics (Figure 1 through Figure 3) for any further details.

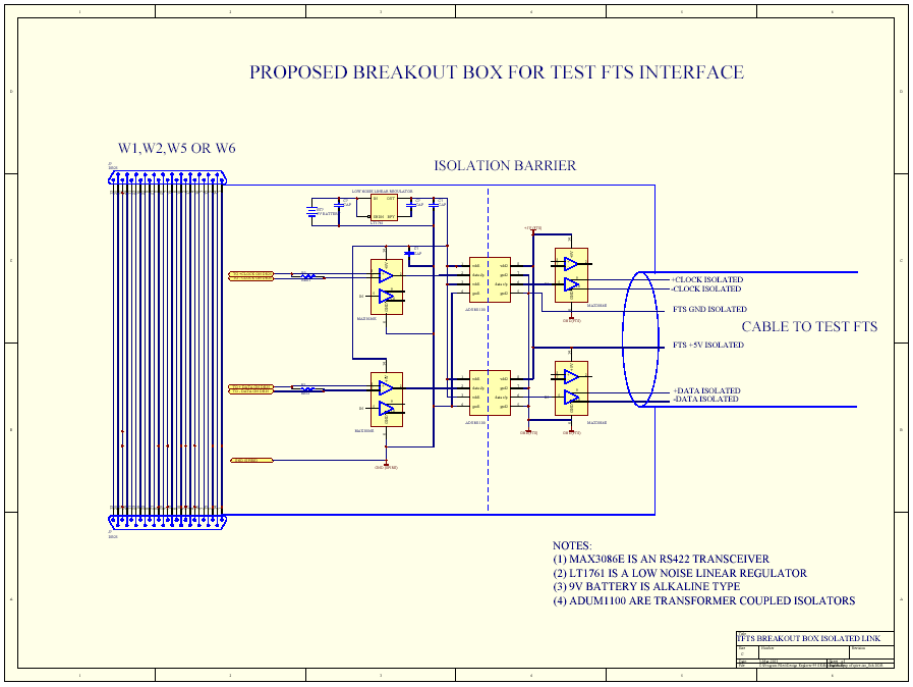

Figure 1: Breakout box to connect to the 312kHz clock signal

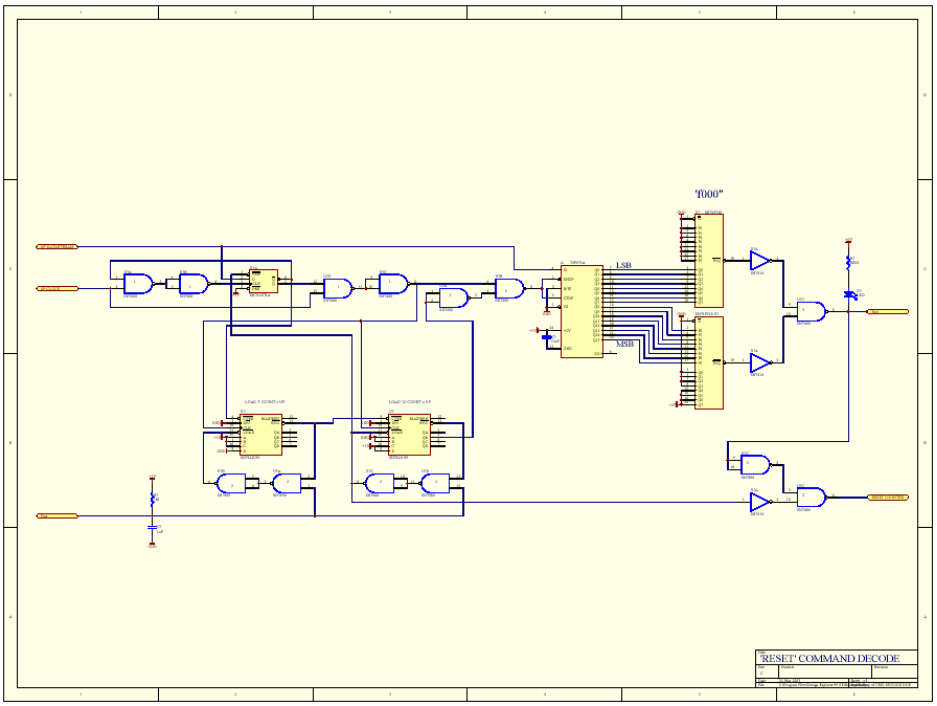

Figure 2: Command decoder

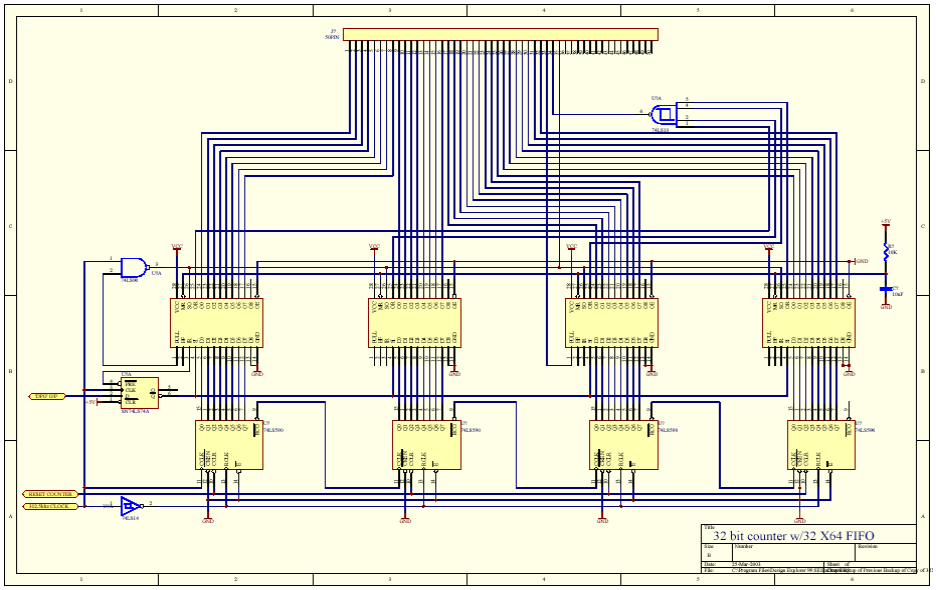

Figure 3: 32-bit counter

- The back-end of the Test Facility FTS control software is under development in C by Ian Schofield. It is currently capable of talking to the router, accepting telecommands, and sending telemetry with a complete verification of the telecommands (structure and sequence). The software is multi-threaded in order to enable exception commands. A GUI has been added for debugging.
- The front-end of the Test Facility FTS control software is under development in IDL by Trevor Fulton. It offers a comprehensive GUI and is connected to the router. It allows the user to send appropriate telecommands and now effectively replaces JyPad, a Jython scripting tool which has proven difficult to use.

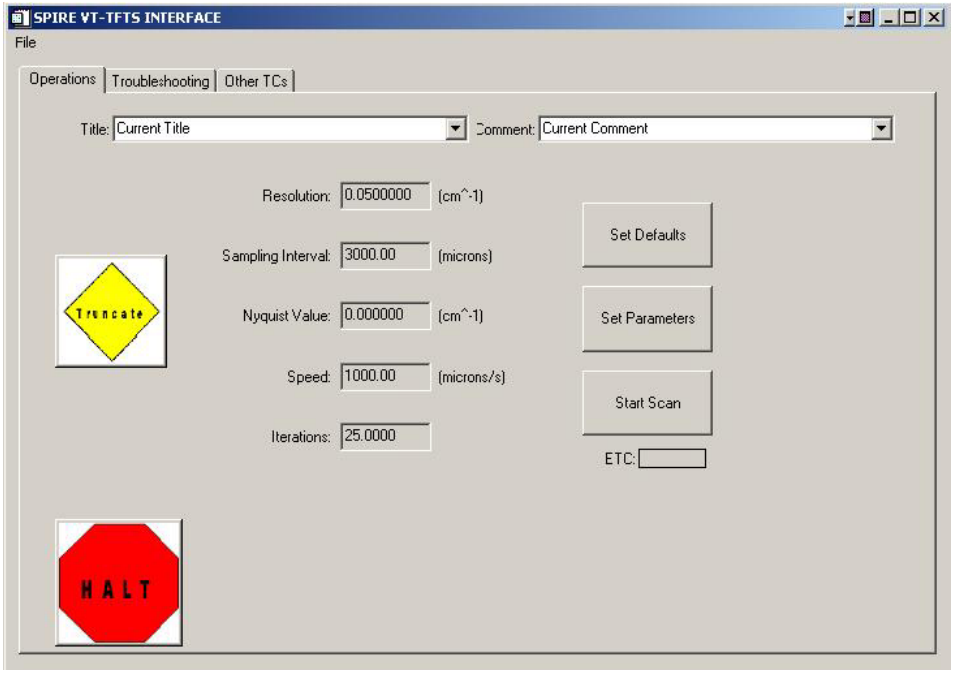

Figure 4: Screenshot of the GUI

- Additional extensive metrology tests for the linear stage from Aerotech have been performed. Data has been analyzed with the help of several IDL programs and a comprehensive report has been submitted

to CSA and PWGSC. The Aerotech stage has proven to be more than suitable for the requirements in the Test Facility FTS. The servo loop has been identified as an area of potential improvement. Please refer to the report for further details.

- Additional tests to verify the integration of the mechanical, electronic, and optical components will be necessary once the optical system has been completely assembled and the approval from the SPIRE project for the implementation of the electronics has been given.

Task 3.2: Provide SPIRE Data Analysis Software

The first part of the data simulation requires an accurate knowledge of the atmospheric spectrum at RAL over the ~ 5 m path of the beam. Using a newly developed radiative transfer model (ULTRAM) developed in IDL by Ian Chapman over the course of his M.Sc. studies, we have simulated a 'spectral data cube' for a range of typical conditions at RAL. The parameters used in this simulation were: pressure = 1013mbar, temperature =293 K, relative humidity range = 25 – 50%, spectral range = 14.9 – 50cm^{-1} (670 – 200μm). The summer, mid-latitude atmospheric model from FASCODE 3 was used to determine the abundances of all atmospheric molecular species except water vapour, which is calculated from the relative humidity. An interferogram can be made from this spectral data by performing a Fourier Transform (FT). A scan by the FTS is simulated by sampling the full interferogram at a regular spacing chosen to preserve the symmetry of the interferogram. A spectrum is recovered by performing an FT on the sampled interferogram. This spectrum is then compared to the original spectrum produced by the atmospheric model. Initial results from the analysis have shown that the original spectrum is recovered from the sampled interferogram to the numerical accuracy of the computer used for the analysis.

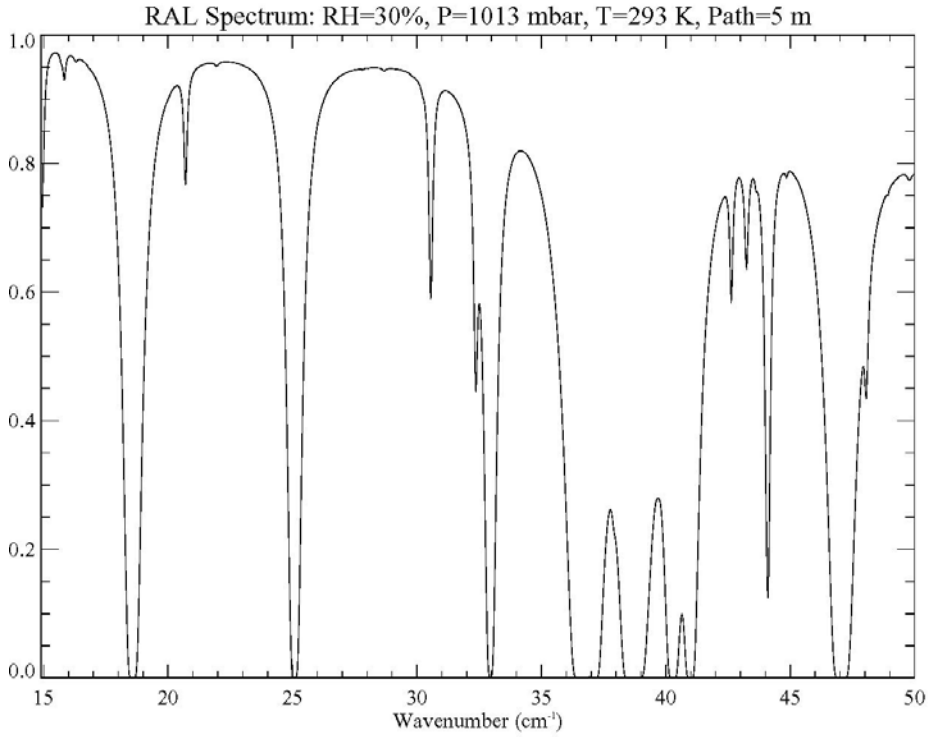

Figure 5: Expected FIR spectrum under laboratory conditions at RAL

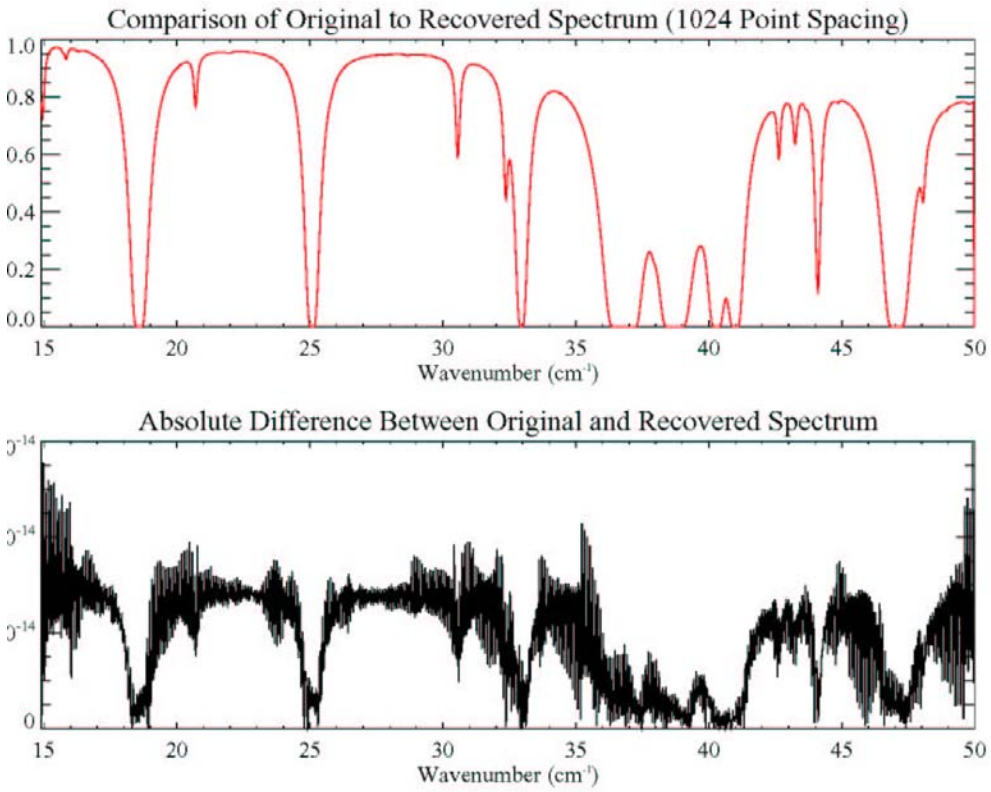

Figure 6: Double FT of the spectrum and absolute difference from the original

The main challenge for the tests to be conducted at RAL this summer is that signal data will not be measured at the same times as the position data of the FTS. The next step in the simulation of test data will be to sample the position and signal data separately, as will be done at RAL, and bring it to common sampling grid through interpolation. There are currently two methods that are being considered for solving the above challenge. We will explore both interpolation options and determine which will prove most adequate.

Task 3.3: Canadian SPIRE Team Support

- Nothing to report.

Task 3.4: SPIRE ITT and ICC Support

As part of the test team, Samuel Ronayette has done analyses on the telescope simulator, in particular on the alignment of the M2 imaging mirror with Marc Ferlet from RAL. He finished the drawings of the layout of the FIR laser bench and passed the specifications on to the optical workshop at RAL.

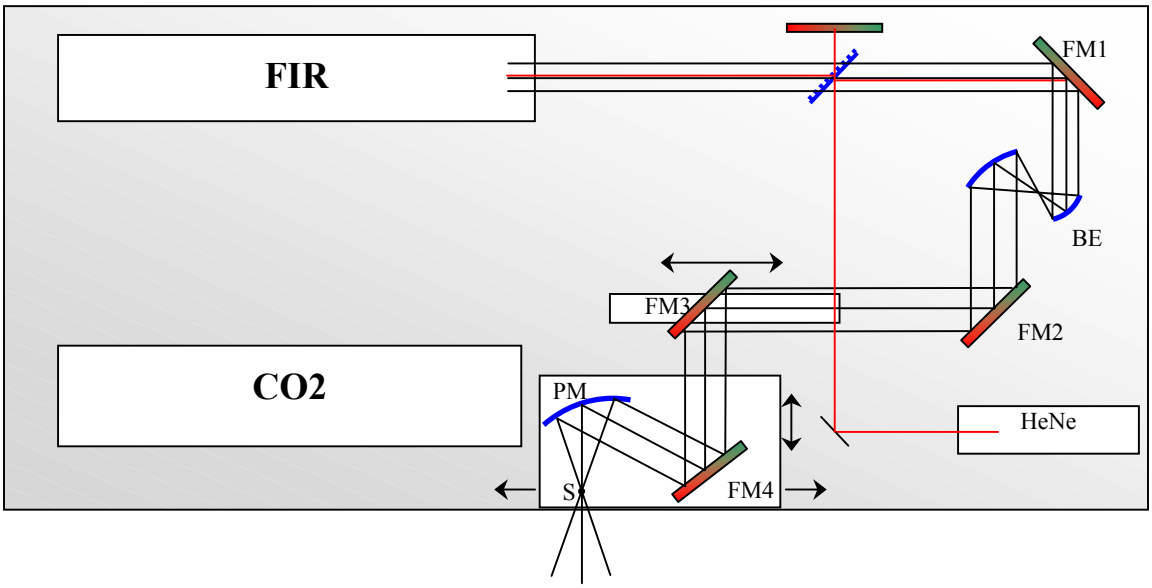

Figure 7: FIR laser bench

A suitable candidate for the ICC position has not yet been found. Discussions with the SPIRE project management have been circling around the option to hire an interim research assistant and re-advertise the position next year.