



# Automatizing a Fourier transform spectrometer to measure millimeter and far-IR wavelength radiation

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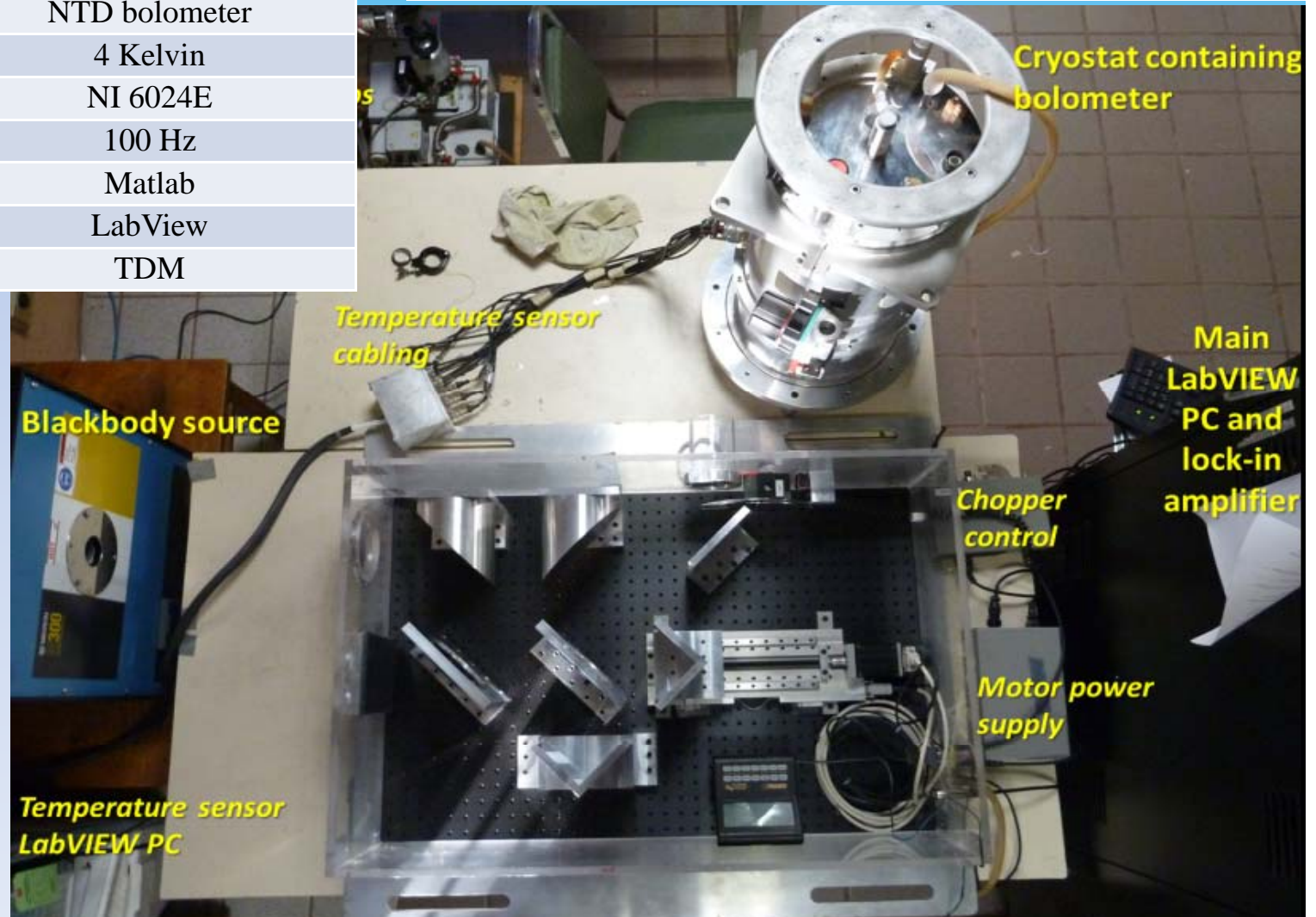
# INAOE FTS

## General characteristics

Item	Value/Description
FTS type	Martin-Puplett
Freq. range	100 – 1000 GHz
Max. Resolut.	0.5 GHz
Detector	NTD bolometer
$T_{\text{bolom}}$	4 Kelvin
DAQ	NI 6024E
Chopper Freq	100 Hz
Analysis Software	Matlab
Control Software	LabView
File system	TDM

## Linear stage characteristics

Item	Value/Description
Moving linear stage distance	$L_{\text{max}} = 0.275 \text{ m}$
Step size	$L_{\text{min}} = 0.635 \mu\text{m}$
1 revolution	1.27mm, 2000 steps
Linear stage / Motor	Servosystems / Animatics



## General INAOE FTS control diagram

SRS chopper @ 100 Hz

Cryogenic NTD bolometer @ 4 K in Oxford LHe cryostat

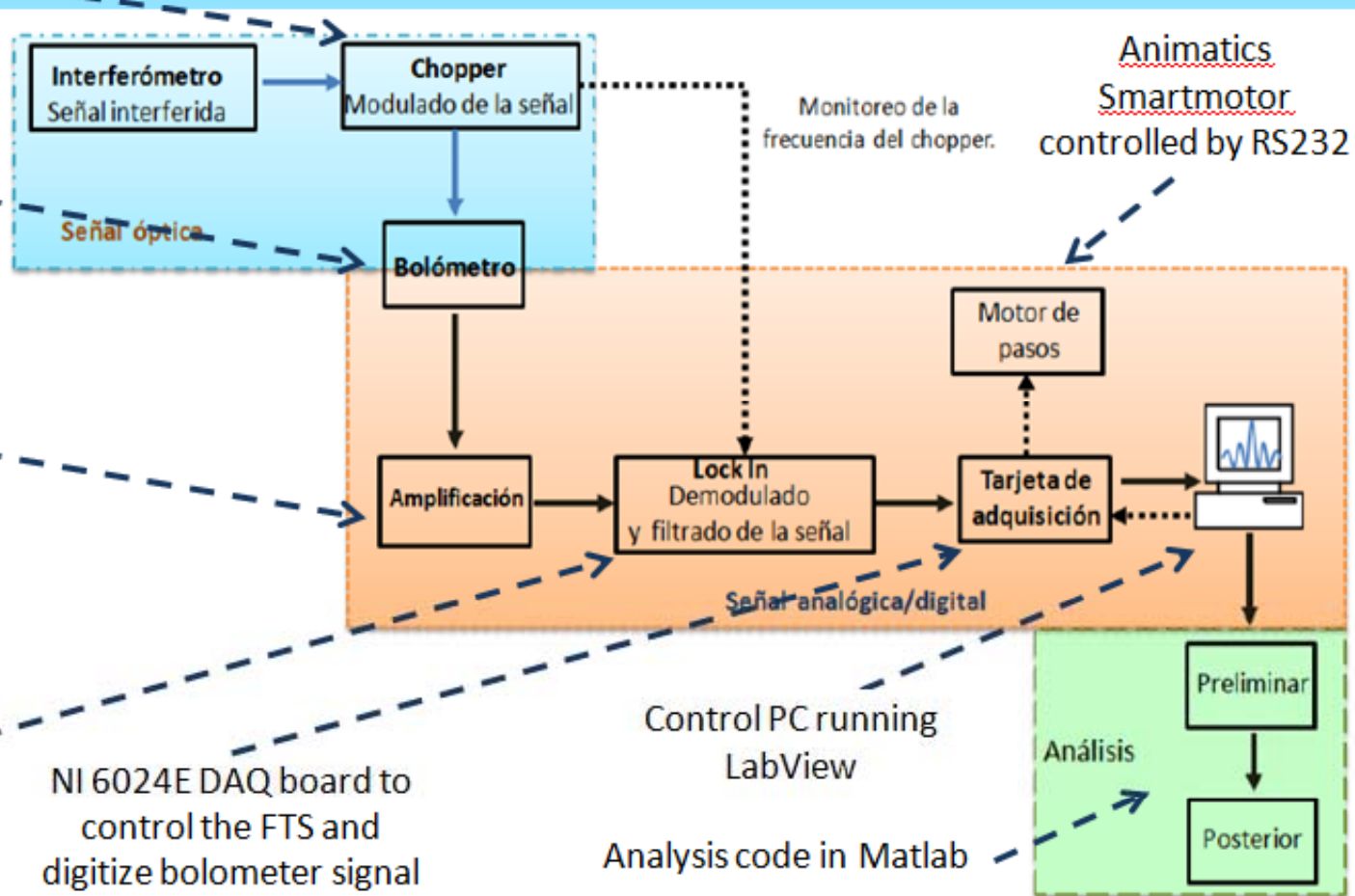
JFET preamp stage @ 120 K and room temperature custom made low-noise amplifier

SRS Lock-in amp. to demodulate signal

NI 6024E DAQ board to control the FTS and digitize bolometer signal

Control PC running LabView

Analysis code in Matlab



### Interferogram apodization and phase correction

All mathematical programming in Matlab and embedded in LabView.

# INAOE FTS main control GUI

The screenshot displays the main control interface for the INAOE Fourier Transform Spectrometer. The interface is organized into several functional areas:

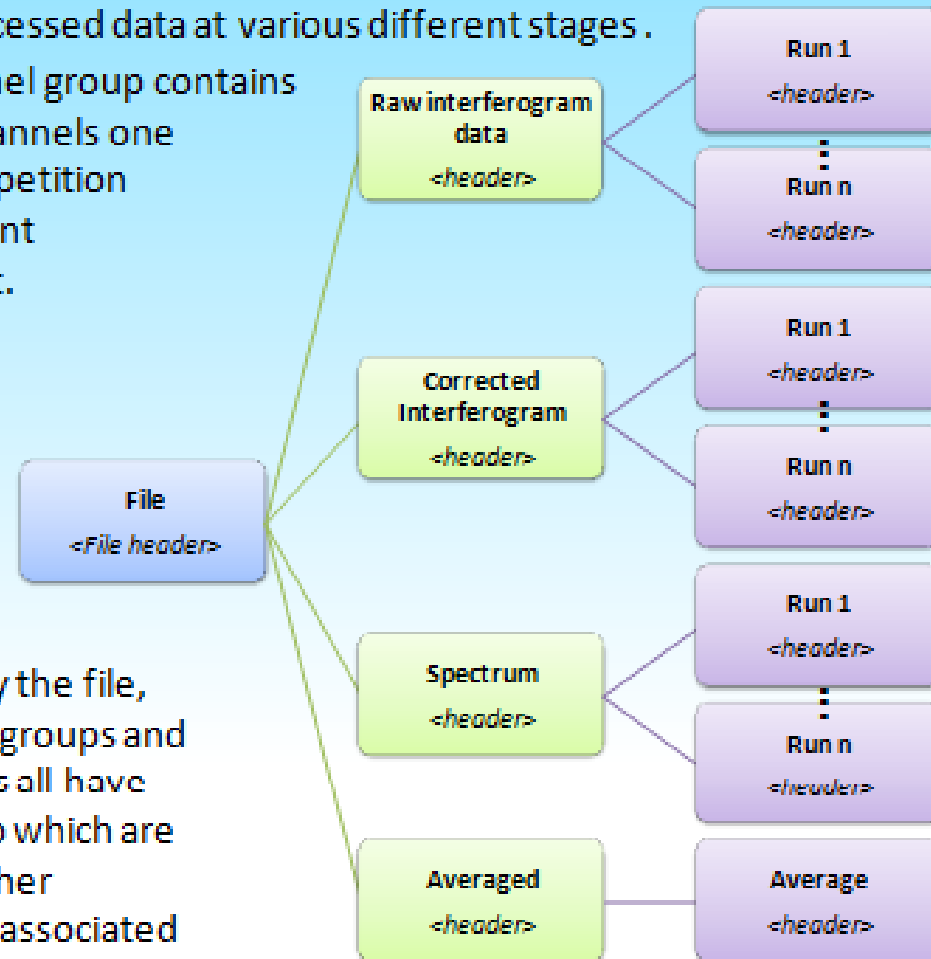
- Control Panels:** Includes knobs for "Preferred max frequency (GHz)" (set to 500) and "Preferred resolution (GHz)" (set to 1). It also features input fields for "No. of repetitions" (1), "Velocidad" (1000), "Aceleración" (10), "#Samples" (25), "Rate (Hz)" (10), "Phase correction" (checked), "Ancho" (10), and "[P1]" (1). A large green "ENGAGE!" button is prominently displayed.
- File Management:** A section for "Preferred path & name" showing the file path "D:\Documents and Settings\FTS\Mis documentos\LabVIEW Data\DIC2010\Interffts10dic2010-500-1\_02.tdm", along with "Actual name", "Title / notes", and "File author" fields.
- Progress and Status:** A red progress bar labeled "Total progress with test" and a blue bar for "Progress this iteration". A "Mirror position" indicator shows a value of -2254.
- Data Acquisition and Plotting:** A large "Instantaneous Interferogram" plot shows a green waveform over time. An inset window, labeled "Result window from 'Average tab'", shows a zoomed-in view of the waveform's amplitude over time.

Annotations with arrows point to various elements:

- Spectrum max. frequency selection
- Spectrum resolution
- Motor & DAQ config.
- Interferogram Phase correction
- File name and notes
- Iterations
- Final average
- Interferog. points
- Interferogram plotting screen
- Data acq.
- Progress
- Moving stage position
- Result window from 'Average tab'

## File and data handling system

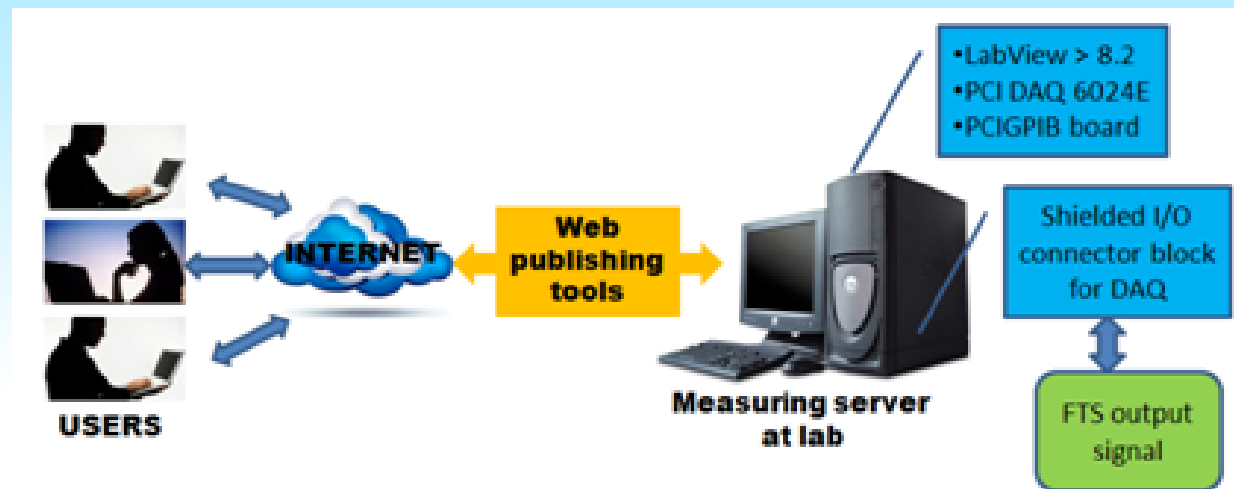
- NI technology data management (TDM) storage system
- TDM output file contains channel groups for the raw data and the processed data at various different stages .
- Each channel group contains multiple channels one for each repetition of the current experiment.



- Additionally the file, the channel groups and the channels all have headers into which are recorded other parameters associated with the data and the experimental setup.
- TDM files can be converted to several different formats for broad compatibility.

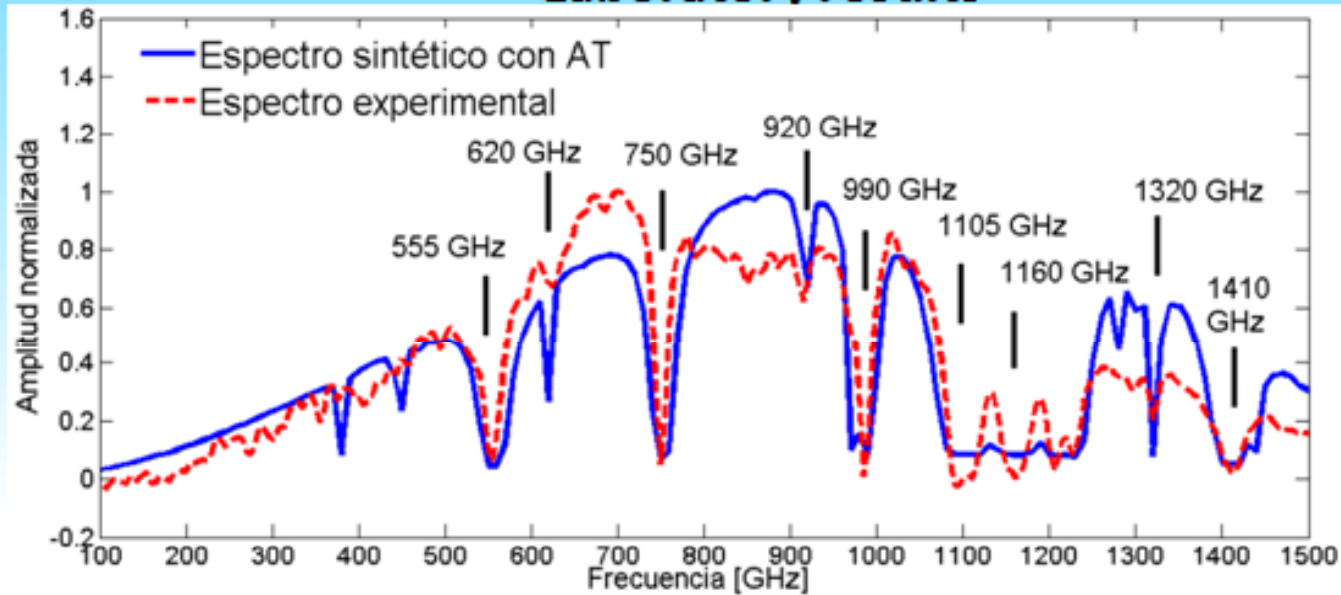
## Remote control operation

- Use of the integrated LabView Web Publishing tool.
- Allows the client to view and control the front panel of a VI remotely or just show a snapshot that updates continuously through the use of a web browser.
- The acquisition occurs on the host computer but the remote user has total control.
- At any time the operator of the host machine can assume control of the application back from the client currently in control.

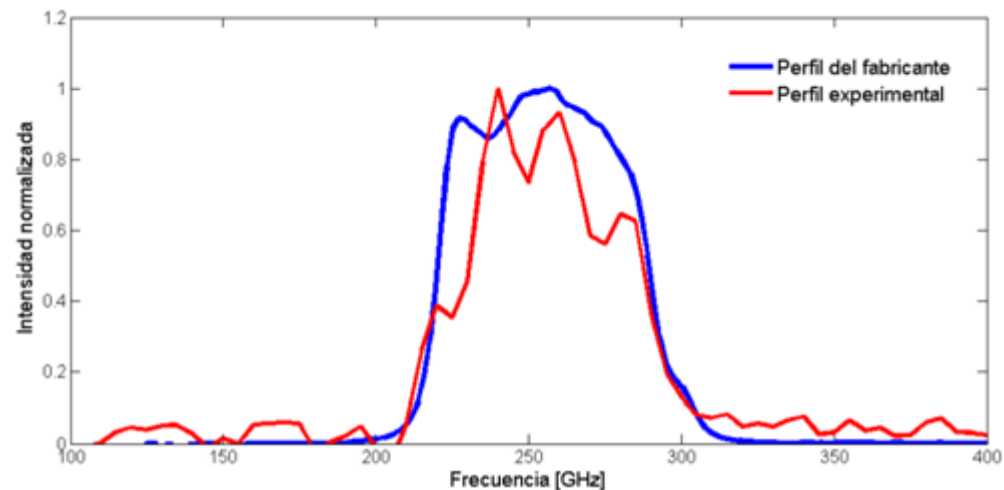




## Laboratory results



Atmospheric spectral profile of the atmosphere inside the FTS container measured in our laboratory which shows main water absorption lines and the range of operation of the instrument.



Millimeter (1.2mm) wavelength metal-mesh band-pass filter spectral profile measured in our lab.