

MPIfR Fast Fourier Transform Spectrometer (FFTS1)

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This memo provides brief instructions on using the Fast Fourier Transform Spectrometer (FFTS), developed for the Caltech Submillimeter Observatory (CSO) by the Max-Planck-Institut für Radioastronomie (MPIfR), with the CSO facility heterodyne receivers through the standard User Interface Program (UIP).

The basic characteristics of the FFTS are summarized below.

	Wideband Mode	High Resolution Mode
Signal Processing	4-tap WOLA with Flat Top Window	
Total Bandwidth	1000 MHz	500 MHz
Resolution	8192 channels	
Channel Spacing	122 kHz	61 kHz
Equivalent Noise Bandwidth	117 kHz	58 kHz

The FFTS can be used either with the new generation 4–8 GHz IF receivers or the 1–2 GHz IF receivers in the Side Cabin. The FFTS can process the 4–8 GHz IF of the former directly. For the latter, a separate IF processing system, developed for the array acousto-optical spectrometer (AAOS), up-converts the 1–2 GHz IF to 6–7 GHz. The center of the spectrometer can be positioned anywhere within either IF passband. The FFTS can be operated simultaneously with the existing acousto-optical spectrometers (AOSs).

UIP's AOS command has been replaced with the (more appropriately named) **SPECTROMETER** command, which supports the FFTS. In addition to all the parameters and options present for the AOS command, the **SPECTROMETER** command provides two new options, `/FFTS1W` and `/FFTS1N`. The `/FFTS1W` option specifies that the MPIfR FFTS should be active in the 1000 MHz bandwidth mode, while the `/FFTS1N` option specifies that the FFTS should be active in the 500 MHz bandwidth mode. They take an optional frequency offset in GHz as their argument that specifies the position of the FFTS relative to the IF center. The center IF defaults to 1.5 GHz (6.5 GHz after up-conversion) if the 1–2 GHz IF receiver is active *when* the command is issued, or 6.0 GHz otherwise. Some examples are shown below.

```
UIP> SPECTROMETER /FFTS1W
```

will start the FFTS in the 1000 MHz bandwidth mode, while

```
UIP> SPECTROMETER /FFTS1N
```

will switch the FFTS to the 500 MHz bandwidth mode (use of the `/BANDWIDTH` option has been deprecated).

```
UIP> SPECTROMETER /FFTS1 -0.25
```

will shift the center of the FFTS to the IF of 5.75 GHz when one of the 4–8 GHz IF receivers is in use, or to the IF of 1.25 GHz when one of the 1–2 GHz IF receivers is active (the original `/FFTS1` option can still be used for this purpose).

In order for the FFTS to be configured correctly, the receiver (specifically whether the 4–8 GHz IF receiver or 1–2 GHz IF one) has to be selected using the `L0` command *before* the `SPECTROMETER` command is issued to change the bandwidth or IF offset.

The telescope identifier of the FFTS in the CLASS header is `CS0 FFTS 1W` when the spectrometer is in the 1000 MHz bandwidth mode, or `CS0 FFTS 1N` when it is in the 500 MHz bandwidth mode.

The temperature calibration (TCAL) scheme has been changed for the FFTS to take advantage of its higher dynamic range. The input IF signal level is auto-adjusted on the *sky* before the TCAL scan. Only for the 230 GHz receivers, an extra 3 dB attenuation is added while the integrations on the ambient temperature load and sky are taken. In contrast, the input IF signal level of the AOSs is auto-adjusted on the *ambient temperature load* before the TCAL scan, then it is *readjusted* on the *sky* after the calibration.

One annoying bug, which will not be fixed, is that the FFTS occasionally gets stuck in a failure mode where it takes *twice longer to integrate*, or it will not integrate at all. To solve this problem, the server program needs to be restarted. To do so, start the VNC viewer on the computer `cso-ffts` in the AOS lab. as the user `FFTS`. The password can be found in the control room. Then type `^C` in the terminal within the VNC environment to kill the running server and restart it by typing `./startWOLA` (we are using the WOLA core instead of the regular windowed FFT core).