Effelsberg FAST OTF Guide

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Background:

To quickly search large regions for emission (e.g. water masers) with the Effelsberg 100m telescope, we have developed a new fast "On-The-Fly" (FASTOTF) mapping mode using the new 1.3cm receiver in combination with the AK90 autocorrelator. The goal was to scan and dump data very fast (typically one spectrum per second). To get these high data rates, we had to tell the AK90 to integrate 8 (traditional) phases of 1 second each and then Fourier transform and transmit the data. The phases are set to be always on source. There is no calibration and no separate reference subscan. The necessary reference positions are taken from the edges of the maps.

For FASTOTF there is not yet any automatic data reduction by the "Online Display" program because the current Vax/VMS based telescope system cannot cope with the data rates. Instead, the data have to be processed offline with the EFF calibration program to produce CLASS spectra. Due to speed considerations, this should preferably be done on a fast Linux system with the raw data and CLASS file on local disks. A PIII 500 MHz system can produce the CLASS spectra in about $\frac{1}{7}$ of the time it takes to observe a given map.

This documents summarizes the setup and data reduction steps that are needed to use the FASTOTF mode.

- **Setting up the FASTOTF observations in OBSE**
  - First the receiver and backend have to be set up. This series of OBSE commands will set up the water maser line frequency and a correlator split mode of 4 $\times$ 2048 channels (`NSPLIT / NCHAN`) and 20 MHz bandwidth each (`NBAND`) with no frequency offsets (`NFRQ`):

    ```
    FRQRX 22.23508
    SET NSPLIT 3 NONE
    SET NCHAN 2
    SET NFRQ 0 0 0 0
    SET NBAND 20 20 20 20
    ```

  - The map sizes and integration times are set up using the "normal" OTF command "PMAP"

    ```
    PMAP /MAPSIZE 1280 20 1280 20 LAM /TIME 64 64
    ```

    for example would set up a map of size 1280$''$ $\times$ 1280$''$ with scanning along the lambda axis (right ascension or longitude) and 20$''$ spacing along the beta axis (declination or latitude). The spacing along the scanning axis is determined by the velocity and the autocorrelator phase time. In the above example the velocity is $\frac{1280''}{64\mathrm{sec}} = 20''/\mathrm{sec}$) and the autocorrelator is typically 1 second. This leads to $20''/\mathrm{sec} \times 1\mathrm{sec} = 20''$ spacing for this example. Note that the times should be multiples of 8 and the map size along the scanning axis should be multiples of 8 times the step size along the scanning axis, i.e. here 160$''$. N.B.: Due to the current setup of the Effelsberg control system one should add some buffers, e.g. a size of 1300″ and a time of 70 seconds for the example above.

- To set up the autocorrelator times and phases and to actually start the observation type

```
@ MPI$OBS:FAST_AK
```

in OBSE. There will be no online display at all during the FASTOTF scans.

- **Extracting the raw data (TH/TP files) from the Effelsberg archives (pt* files)**
  - This step is only necessary if you want to process the data in Bonn instead of in Effelsberg while observing or if you want to look at some old archived data. The Effelsberg raw data are packed into files called "pt<number>" where number is a tape number. The operators in Effelsberg and in the computing center in Bonn have logs to find the tape number for a given scan on a given day. The Bonn staff can also tell you how to extract old data from the CD-ROM archive.
  - Assuming that you have the "pt*" file(s) somewhere on a local disk, you can extract scans with A. v. Kap-herr's pfilelog command. At the MPIfR, the "pt*" files are usually located in "/homes/p017irz/sun52/rtdat". A typical command sequence would look like this:

```
cd <directory name>
/homes/p028avk/toolbox/linux/pfilelog.exe \
/homes/p017irz/sun52/rtdat/pt077004 -scan 8060
```

The data will be unpacked in the local directory which should therefore be on a local disk. There are also hp and solaris versions (replace "linux" in the above example with the system you need).

- **Processing the raw data with EFF to get CLASS spectra**
  - The EFF program reads the raw data (TH/TP files) written by the telescope control system or extracted from the "pt*" files (see above). There are VMS, Solaris and Linux versions of EFF. One should use the Linux version on a fast computer if possible, otherwise the Solaris version. Try to avoid the VMS version at all cost since the Vaxes are extremely slow.
  - While observing in Effelsberg, you can ftp the TH/TP files from the Vax to the "master" Sun workstation and run "eff" in the "obs2" account. You need to tell EFF where the raw data is, which procedure to use and which scan number to reduce. EFF is linked with the CLASS libraries, so you have all CLASS commands available. A typical command sequence would be:

```
obs2> eff
EFF> dir "/home0/obs2/rawdata"
EFF> file out classdata.100m new
EFF> procedure fastotf
EFF> dored <scan number>
```

Repeat the "dored" command for all FASTOTF scans.