Title: How to run a pointing session and a pointing model parameters fit
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General Note

The following notes indicate how to run a pointing session for the EMIR receivers or the NIKA2 bolometer and how to generate the new pointing model parameters after the pointing session

It is recommended that the pointing session is performed at night time, at least one day after the antenna is running in normal observations with good weather condition, no high wind and the antenna deicing off. We aim with this step to get the antenna and tower well stabilised in temperature

How to run an EMIR pointing session

- The reference receiver for the EMIR pointing model is the channel E0. Use any combination of receivers that includes the E0 tuned at 86 GHz LSB (although other frequency and/or DSB is valid too)

- Enter into the project *pointing* to run the pointing session (ask for the password to the operator or J. Peñalver)

- Start the program *xephem* (also under the *pointing* account) in mrt-lx3 to know which pointing sources are visible during the pointing session.

- Start *pako*, then under the *PAKO* prompt load the script *last_e02.pako* to load a valid receiver configuration that includes the E0 receiver

- Before starting the pointing session move the antenna more than 60° in azimuth to update the inclinometer reading. To see that new inclinometer values are obtained check in any VME machine the last entrance of the file */home/penalver/INCLIN/p4p5yymm.prn* where *yy* indicates the year and *mm* the month

- Select in *PAKO* the beam switching mode for all the pointing session

- Do a *CALIBRATION*, *POINTING* and *FOCUS* scans to confirm the good receiver operation and the good starting corrections for pointing and focus

- Then carry out among 20 and 30 *POINTING* scans well spread in the sky to cover all the azimuth range and the elevation range between 20° and 80°. Update the pointing corrections after each *POINTING* scan. Try to do all the *POINTING* scans in the shorter time to minimise the possible drift of the pointing parameters

- After, more or less, 10 POINTING scans do a FOCUS scan to update the focus correction if considered convenient. Use in *PAKO* the command *FOCUS 3* if the source is not strong enough to get a good fit

- After each valid pointing scan write down the antenna azimuth and elevation together with the correction in both coordinates. The information will be used later to fit the optimum pointing model parameters.

How to run a NIKA2 pointing session

- Enter into the NIKA2 pool to run the pointing session (check with the pool manager) and start *pako*

- Start the program *xephem* under the bolometer pool account to identify the more convenient sources for pointing

- Before starting the pointing session move the antenna more than 60° in azimuth to update the inclinometer information. To see that new inclinometer values are obtained check in any VME machine the last entrance of the file */home/penalver/INCLIN/p4p5yymm.prn* where *yy* indicates the year and *mm* the month.

- Do a first *POINTING* and *FOCUS* scans to confirm the good NIKA2 operation and the good starting corrections for the pointing and focus

- Then, carry out among 20 and 30 *POINTING* scans well spread in the sky to cover all the azimuth range and the elevation range between 20° and 80°. After each *POINTING* scan update the pointing corrections. Try to do all the *POINTING* scans in the shorter time to minimise the possible drift of the pointing parameters.

- Do a *FOCUS* scan to update the focus correction when consider it convenient.

- After each valid pointing scan write down the antenna azimuth and elevation together with the correction in both coordinates. The information will be used later to fit the optimum pointing parameters.

How to fit the pointing corrections from the pointing session

- It is strongly recommended that the pointing model parameters are changed by who knows the physical meaning of the changes applied. If necessary get the advice from A. Sievers or J. Peñalver. And finally keep informed of the modifications done to J. Peñalver

- In the computer *mrt-lx3*, under the account *pointing* change to the directory *fit* (path *mrt-lx3/vis/pointing/fit*)

- The pointing corrections from the pointing session must be entered in the file *FITIN.DAT*. This file keep the old structure used in the VAX computers, but the necessary information is entered only in the columns 3 to 6, one line per valid pointing scan, with the antenna azimuth (degrees), elevation (degrees), correction in azimuth (arcsec) and correction in elevation (arcsec) respectively. A model of the file *FITIN.DAT* with only nine lines of nine pointing scans could be seen in the file *FITIN_model.DAT*

- In the file *FITDES.DAT* select the pointing model parameters to fit. The valid parameters to fit are P1 to P3 and P7 to P9, identified in the file as *VECT 1* to *VECT 3* and *VECT 7* to *VECT 9*. The way to enable the fit of any parameter is removing the exclamation character (!) at the starting of the line. The file *FITDES_model.DAT* shows how to prepare the file to fit only the pointing model parameters P2 (*VECT 2*) and P7 (*VECT 7*)

- To fit the selected pointing model parameters, first delete the file *FITOUT.DAT* (to create a new one later automatically), then run the program *./fit.exe* (or the newer version *./fit64.exe*). The result is shown in the terminal with the *Value* to correct and the *Error* of that parameter fitted. The information is also written in the file *FITOUT.DAT*

- Usually several combinations of pointing model parameters have to be selected and tested in *FITDES.DAT* until the optimum combination is chosen. Good corrections are for those parameters where *Value* is higher than three times *Error*. But once again, any pointing parameter represents some physical imperfection of the antenna, under that criteria consider if the correction to apply has sense or not

- You could see graphically with *greg* the result of the fit. Go to the directory *fit* and follow the steps:

    $ ~~gag_mar08~~
    $ greg
    GREG> @hu_ini
            ... answer the questions
    GREG> COVERAGE   ! to display the pointing scans coverage in the sky
    GREG> SCATTER   ! to display the scatter previous and after the fit

- Finally you can implement the new pointing model parameters modifying the file *pointing-EMIR.30m* (for the EMIR receivers) or *pointing-NIKA.30m* (for the NIKA2 bolometer). The way to do that is entering in *mrt-lx1* as user *mrt* (ask the password to the operator) and following the steps indicated in the wiki page
    https://mrt-lx1.iram.es/mainWiki/OperationNotesOperatorsHowToChangePointingModel

- In general the pointing model for EMIR and NIKA2 should be the same, only the Nasmyth corrections should be different. Those are the parameters P10 and P11 for the horizontal and vertical Nasmyth offsets respectively.