Effelsberg Tutorial

Fundi Tutorials 2025

Overview

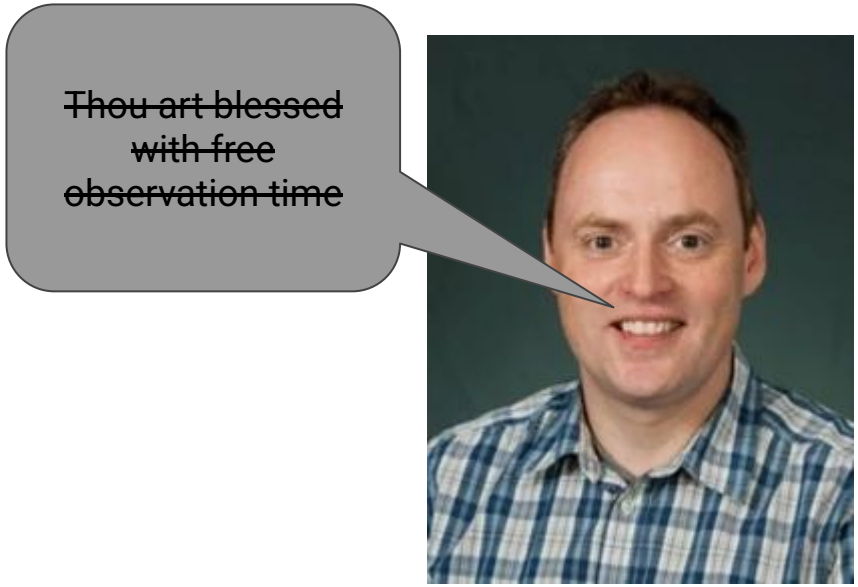
1. The 100-m telescope (technical specifications)
2. Before the observation
    a. Selecting targets
    b. Checking visibility
    c. Creating a schedule
3. Observing with effelsberg
    a. Setting up the observation
    b. Checking observation status
4. Data reduction
    a. ???

The 100-m telescope

Out situation

- Alex has granted you 2 hours on the telescope. You can observe anything you like with any receiver you want to.

- I'll help you to:
  - Decide what to observe
  - Prepare for observation
  - Run your observation



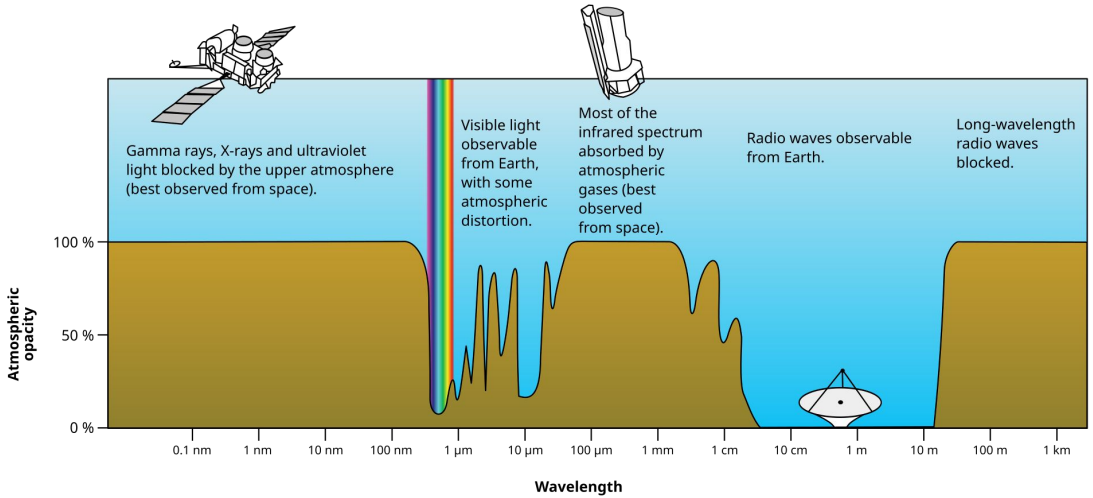
https://www.mpifr-bonn.mpg.de/person/27688

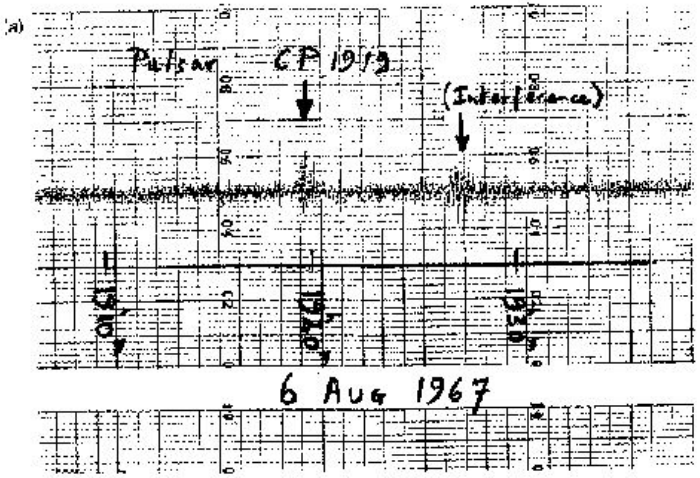
Effelsberg

- Start of operations: 1972
- Dish diameter: 100 m
- Aperture: 7.854 m^2
- Panels: 2.352
- Surface accuracy: < 0.5 mm
- Weight: 3.200 tonnes
- Operational frequencies: 0.3-96 GHz
- Slew speed: 16º/min (tilt) 30º/min (rotation)
- Pointing accuracy: 10”

The fundamentals of a radio-telescope

A radio telescope detects free EM radiation in the radio regime; turns them into an electrical signal, which is then amplified, processed and finally saved in some form. (check out Mary's lecture on Thursday “How radio telescopes work”)

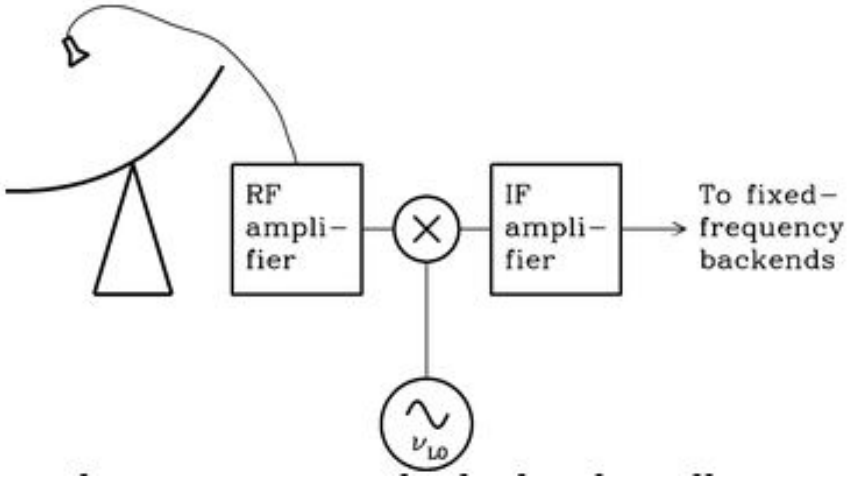




From EM wave to a file

Frontend
IF system
Backend

1. Dish - Focuses EM waves
2. Receiver - Converts free EM into AC current
3. Amplifier - Amplifies the current (LNA)
4. Mix signal down to baseband
5. Filter unwanted frequencies
6. Turn analogue signal into digital
7. Process digital signal
8. Store digital signal



Ransom & Condon, fig 3.39

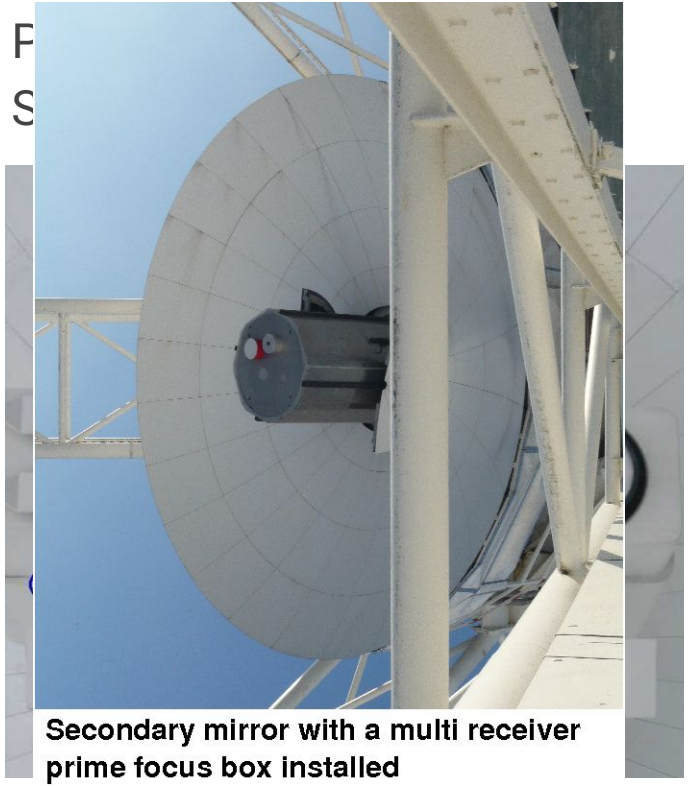
Why do I care?

To successfully observe a source, you need to understand what your telescope is capable of

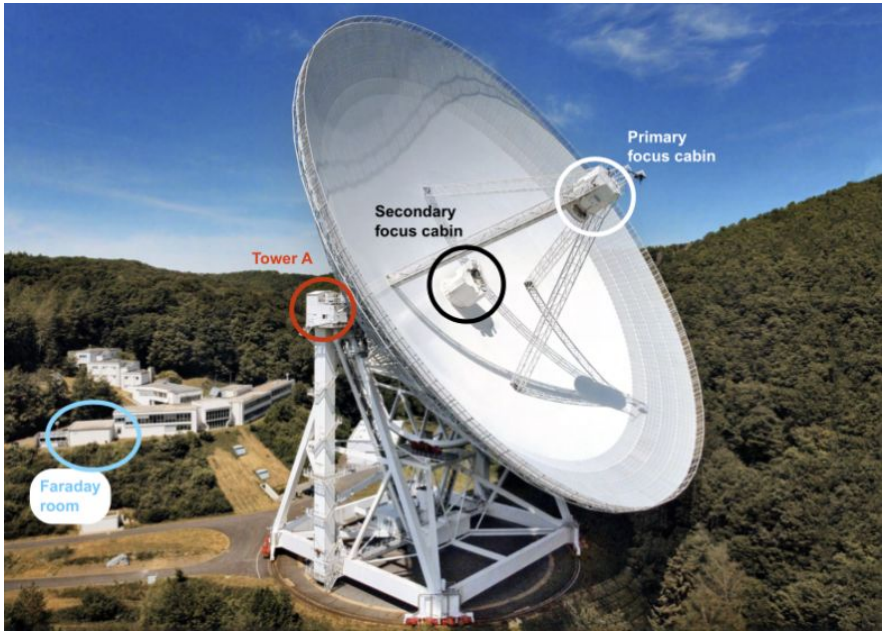
- Sensitivity vs. source flux
- Gain
- Beam size vs. source size
- Confusion limits
- Emission bandwidth vs. receiver bandwidth
- System noise (noise limits)
- Time resolution

Effelsberg Receivers

- P
- S



Secondary mirror with a multi receiver prime focus box installed



Prime focus receivers Picture							
RX Name	**Wavelength [cm]**	**Frequency range (center) [GHz]**	**Nr. of Horns**	**Polarization**	**Comment**	**Calibration information**	**Technical information**
P740mm	74	0.400-0.405 (0.402)	1	RCP	contact staff, if interested	NA	tech. data
P500mm	100-33	0.3-0.9 (0.6)	1	LCP/RCP	contact staff, if interested	more details	tech. data
P217mm 7-Beam	21	1.27-1.45 (1.36)	7	1xLCP/RCP, 6xX/Y		more details	tech. data
P180mm/P210mm (4-Box)	18/21	1.29-1.43 (1.36) / 1.57-1.72 (1.65)	1	LCP/RCP	multi-box I, polarimeter	more details	tech. data
P170mm UBB	23-5	1.3-6.0 (2.1)	1	2x linear		more details	please contact the receiver division
P26mm (4-Box)	2.6	11.7	1	1xlinear	holography RX, multi-box I	more details	tech. data
P3mm (4-Box)	0.3	84.0-95.5 (89.0)	2	LCP/RCP	multi-box I	more details	tech. data

Secondary focus receivers Picture							
RX Name	**Wavelength [cm]**	**Frequency (center) [GHz]**	**Nr. of Horns**	**Polarization**	**Comment**	**Calibration information**	**Technical information**
S130mm	13	2.2-2.3 (2.25)	1	RCP	only for geo-VLBI	more details	tech. data
S110mm	11	2.4-2.7 (2.55)	1	LCP/RCP	polarimeter	more details	tech. data
S60mm	6	4.6-5.1 (4.85)	1	LCP/RCP	polarimeter	more details	tech. data
S45mm	4.5	4.0-9.3 (6.65)	1	2xlinear		more details	tech. data
S36mm	3.6	7.9-9.0 (8.35)	1	LCP/RCP	polarimeter	more details	tech. data
S28mm Double Beam	2.8	10.3-10.6 (10.45)	2	LCP/RCP	polarimeter	more details	tech. data
S20mm Double Beam RX	2	12.0-18.0 (15.0)	2	LCP/RCP		more details	tech. data
S14mm Double Beam RX	1.3	18.0-26.0 (22.0)	2	LCP/RCP		more details	tech. data
S7mm Double Beam RX	0.7	33.5-50.0 (41.5)	2	LCP/RCP		more details	tech. data

P170mm - ultra broad-band prime focus receiver (1300-6000 MHz)

This is an ultra broad band (UBB) 2-channel system covering a range from 1300 to 6000 MHz.

Overview

RX Name	Band	Frequency range [GHz]	Polarisation	Nr. of Horns	Horn position relativ to center of focus cabin
P170mm	L/S/C	1.3-6.0	dual-linear	1	Az: 0 arcsec, Elv: 0 arcsec

Calibration Information

Frequency [GHz]	Channel	Polarisation	Tcal [K]	Tsys [K]	Sensitivity [K/Jy]	SEFD [Jy]	Aperture Eff. [%]	TMB/S [K/Jy]	Main Beam Eff. [%]	FWHM [arc-sec]	Last update
1.41	A+B	2x lin	5.7	19.8	1.3	15.2	46	1.90	68	569	first observations
1.665	A+B	2x lin	6.7	20.6	1.3	15.8	46	1.78	73	497	first observations
2.35	A+B	2x lin	8.8	16.1	1.3	12.4	46	1.68	77	363	first observations
3.35	A+B	2x lin	11.0	16.5	1.3	12.7	46	1.66	78	256	first observations
4.85	A+B	2x lin	12.5	18.8	1.3	14.5	46	1.71	76	174	first observations
5.54	A+B	2x lin	11.6	19.0	1.3	14.6	46	1.64	79	156	first observations

normalized Gain curve (G = A0 + A1·Elv + A2·Elv2)			Observed in	confirmed
A0 = 1.0	A1 = 0.0	A2 = 0.0		

EDD

Effelsberg Direct Digitization

- An IF system and backend in one
- Handles all receivers
- Digitizes data directly after amplification
- Handles multiple observation modes simultaneously

EDD - What does it mean for you?

- One system for every case
- It’s where you control the way that the raw data is handled:
  - Time resolution
  - Channel size
  - Polarization
  - Calibration (turn pol-cal diode on and off)
  - Zap-channels
  - Etc.

EDD how do I know what to use?

Not easy to know. Ask someone who has made the kind of observations.

Alternatively check this repository:
https://gitlab.mpcdf.mpg.de/mpifr-bdg/edd_provisioning_effelsberg

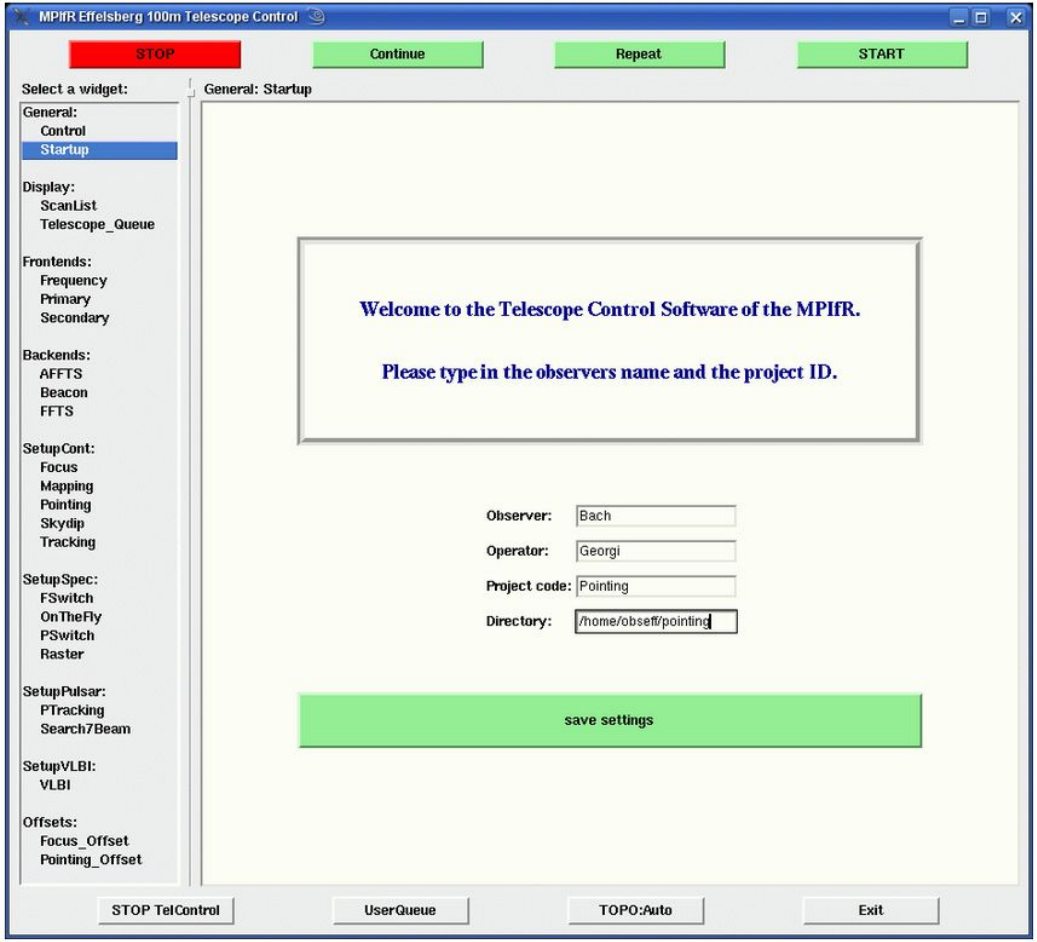
Each data reduction pipeline has a provision that dictates how the data gets processed. Different pipelines give you completely different data products:

- P170_PULSAR_SEARCH = filterbanks
- P170_PULSAR_TIMING = folded PSRFITS archives

OBSNIP

User interface (frontend)

- Select targets
- Select receivers
- Select backend (kind of)
- Check pointing and focusing
- Start/Stop observations



https://eff100mwiki.mpifr-bonn.mpg.de/doku.php?id=information_for_astronomers:user_guide:obsinp

Final note

Check out the Effelsberg wiki. It has most of the technical information that you would need
https://eff100mwiki.mpifr-bonn.mpg.de/doku.php?id=start

Need professional help? - Ramesh

Problems with EDD? - Jason Wu

Issues with pyriseset3/coastguard3? - Me

Other observers: Marlon, Pranav, Fazal, Kristen, …

2. Before the observation

During this part, we will be creating a schedule that can be used to tell Effelsberg what to observe.

You can find the schedule (and some other stuff) here:

‘/homes/jjawor/FUNDI_tutorials’

Pulsar timing observations

Select pulsar that we want to time:
B2021+51

- Is it visible?
- Can Effelsberg detect it?
- De we need polarization information?
- Do we need flux calibration?
- Do we have the ephemeris (folding only)

Observation details:

Date: 2025-02-10

UTC start: 13.30

UTC end: 16.30

Source: B2021+51

RAJ 20:22:49.8730"

DEC +51:54:50.233

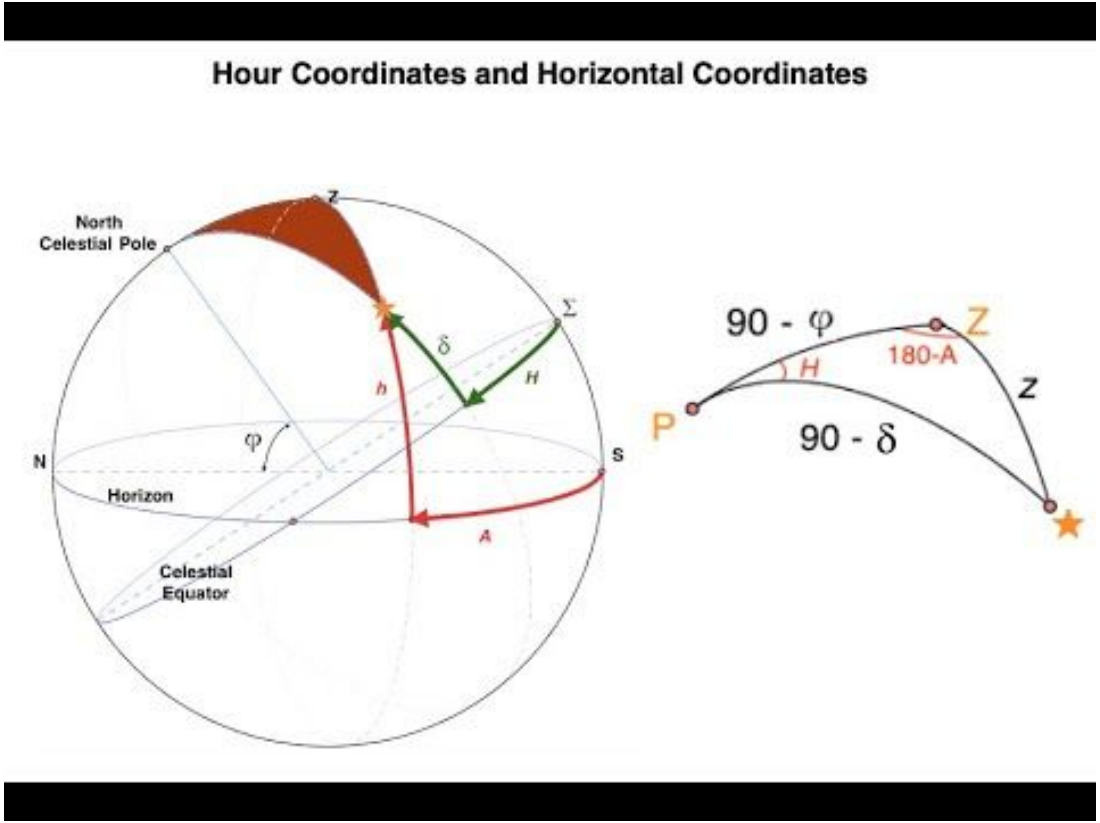
We have decided to use the UBB (P170) receiver and the P170_PULSAR TIMING pipe from EDD (This pipeline will fold out data, producing PSRFITS archives)

“”””

FE:P170mm ; EDD_PULSAR_TIMING ; Init 1

“”””

Is it visible?



α: RA

δ: DEC

h: altitude

A: Azimuth

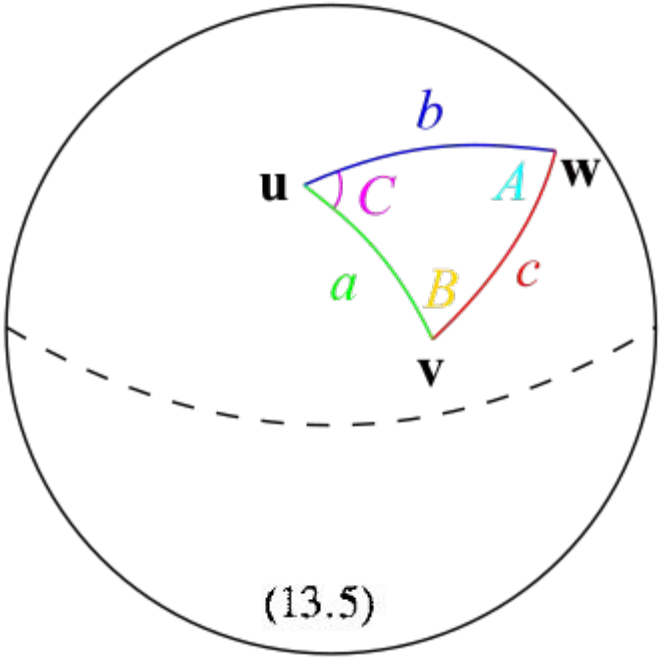
ϕ: Observers latitude

H: Local hour angle

https://auass.com/wp-content/uploads/2021/01/Astronomical-Algorithms.pdf

$$cos(C) = cos(a)\ cos(B) + sin(A)\ sin(B)\ cos(c)$$

$$\frac{sin(A)}{sin(a)} = \frac{sin(B)}{sin(b)} = \frac{sin(C)}{sin(c)}$$



Calculation of the local horizontal coordinates:

$$\tan A = \frac{\sin H}{\cos H \sin \varphi - \tan \delta \cos \varphi} \qquad (13.5)$$

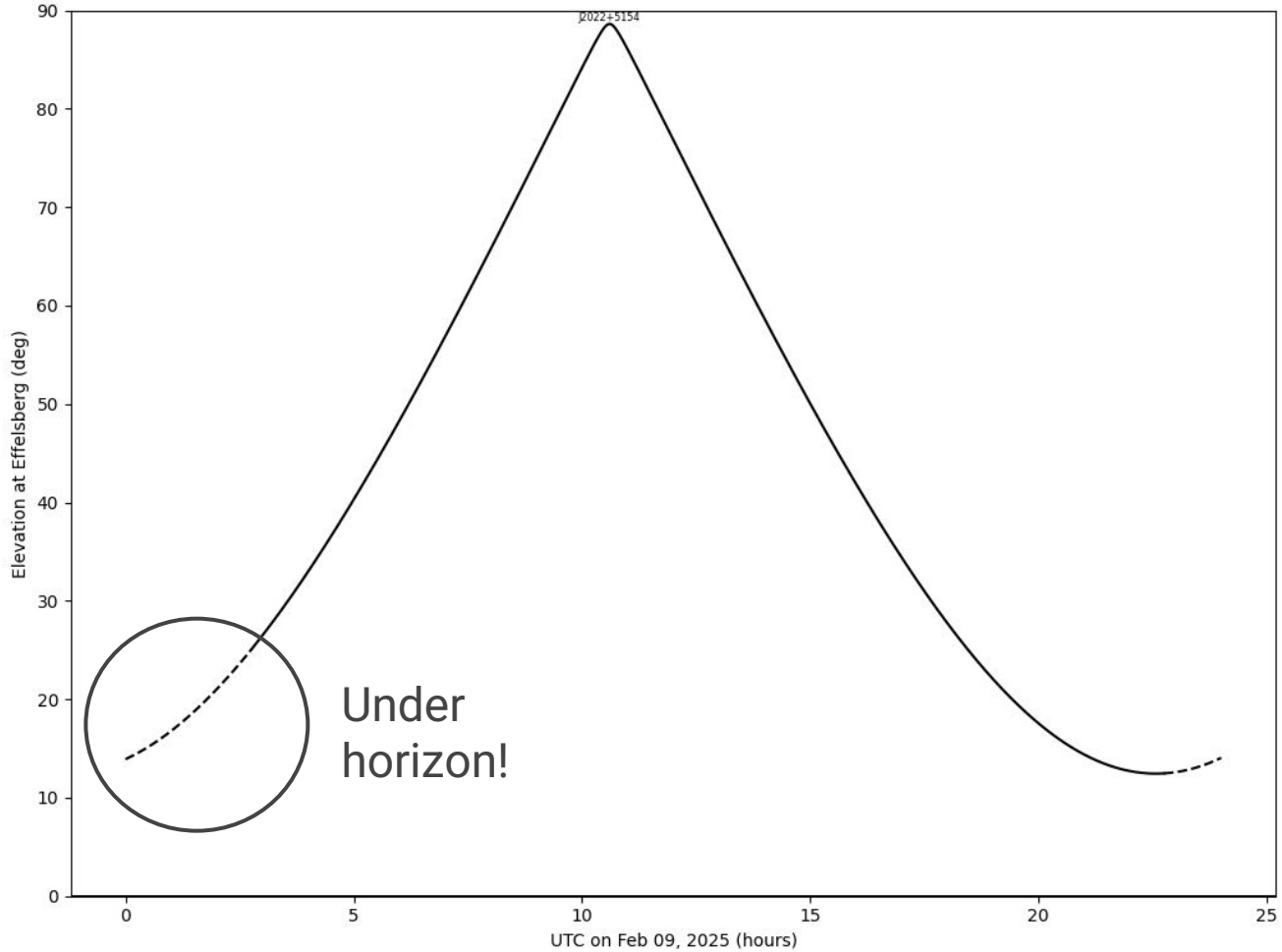
$$\sin h = \sin \varphi \sin \delta + \cos \varphi \cos \delta \cos H \qquad (13.6)$$

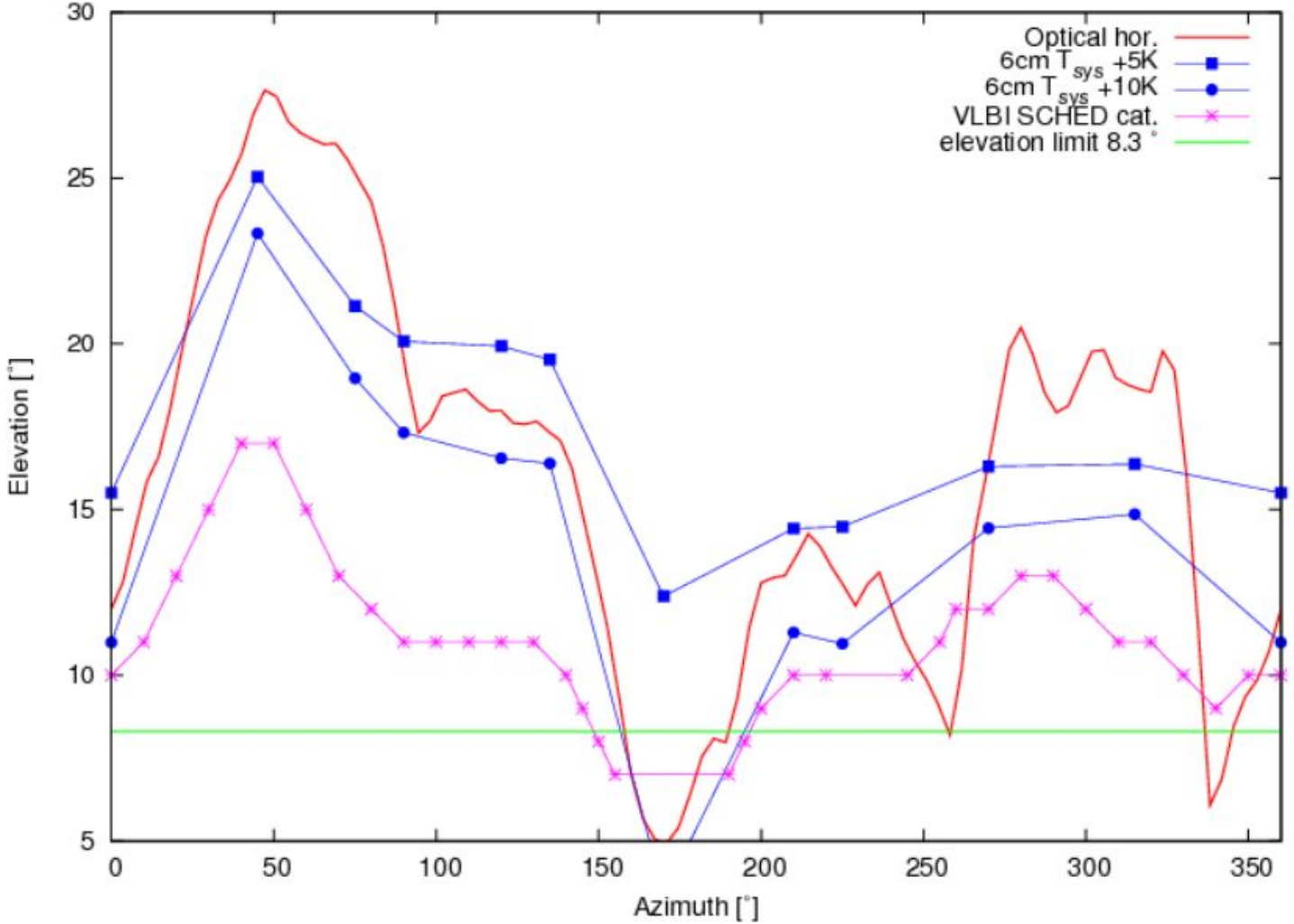
If one wishes to reckon the azimuth from the North instead of the South, add 180° to the value of A given by formula (13.5).

Is it visible? - Computerized help

Computers exist, so you can have some help from those if you don’t feel like doing math:

- Astropy
- Pyriseset(3)
  https://gitlab1.mpifr-bonn.mpg.de/jjawor/pyriseset3/-/tree/main/pyriseset3?ref_type=heads
  - Schedules
    - Can create EDD-ready schedules
  - Visibility tracks
  - Current position of sources

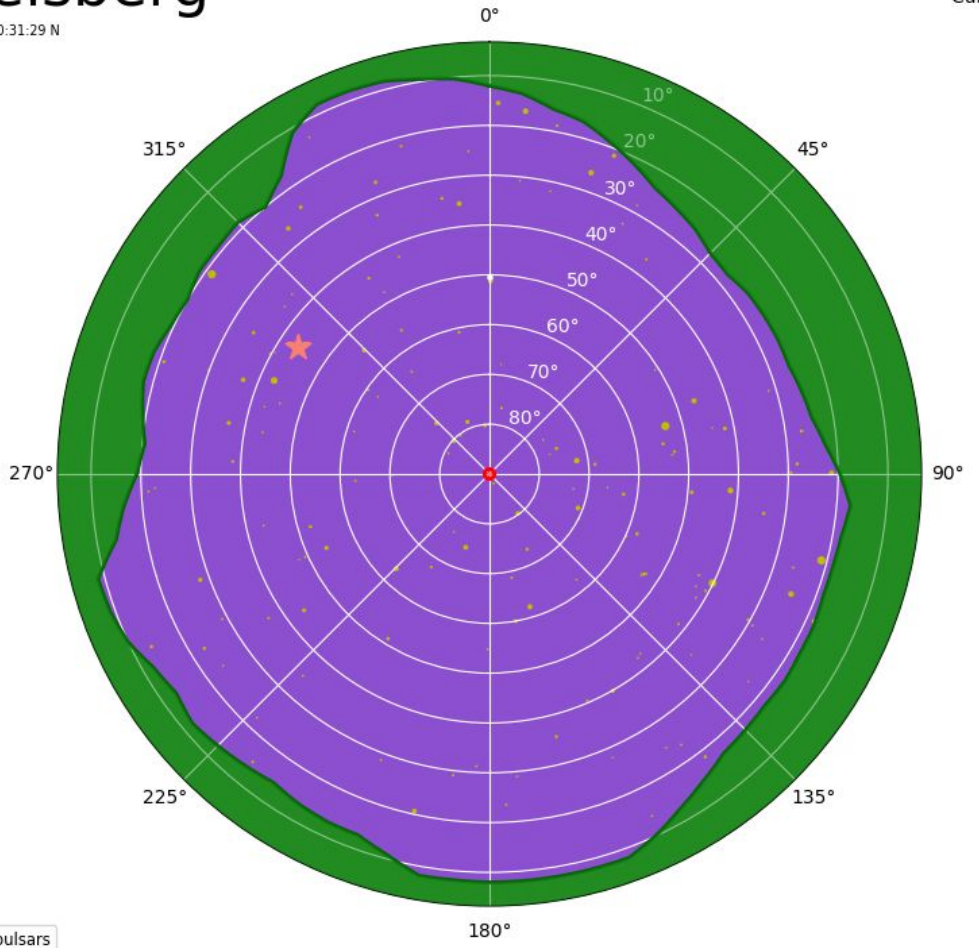

J2022+5154
Elevation at Effelsberg (deg)
UTC on Feb 09, 2025 (hours)
Under horizon!


Optical hor.
6cm T_{sys} +5K
6cm T_{sys} +10K
VLBI SCHED cat.
elevation limit 8.3 °
Elevation [°]
Azimuth [°]
30
25
20
15
10
5
0
50
100
150
200
250
300
350

Effelsberg

06:53:01 E, 50:31:29 N

Current date: Feb 09, 2025
Current LST: 01:32:59
Current UTC: 15:45:29

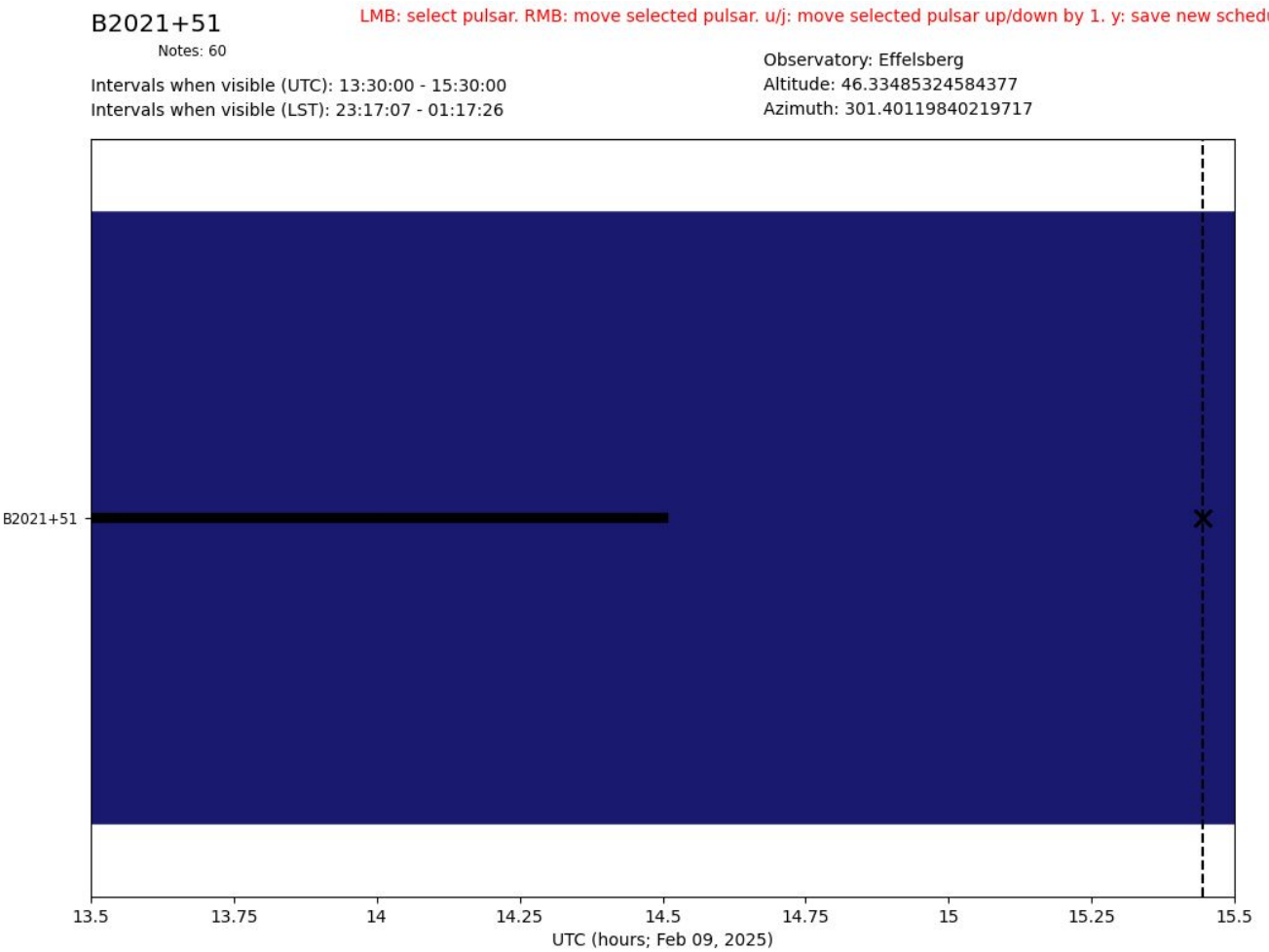


Is it visi

1. Create
   # Nam
   B2021+
2. Name i
3. Run the

```
python3 -m pyr
```

```
tc 15:30:00
```



Is it visible? - The schedule

The .txt schedule is not compatible with OBSNIP and EDD. We need to write a .sch file like this (schedule.sch):

“”””

```
SENDTO EDD JSON MEASUREMENTPREPARE
{"dig_pack_controller_2G":{"noise_diode_pattern":{"percentage":"0.0","period":"1.0"}}}
```

```
B2021+51 ; CoordinateSystem Equatorial ; Equinox J2000 ; ObjectLongitude 20h 22m 50.00s ;
ObjectLatitude +51d 54' 50.00" ; LatOff 0.0 ; LonOff 0.0 ; PMODE Search ; SCANTime 180
```

“”””

Pyriseset3 can automatically convert between the .txt and .sch schedules

Is it visible? - The schedule

“”

FE:P210mm ; EDD_PULSAR_TIMING ; Init 1

SENDTO EDD JSON MEASUREMENTPREPARE {"dig_pack_controller_2G":{"noise_diode_pattern":{"percentage":"0.0","period":"1.0"}}}

B2021+51 ; CoordinateSystem Equatorial ; Equinox J2000 ; ObjectLongitude 20h 22m 50.00s ; ObjectLatitude +51d 54' 50.00" ; LatOff 0.0 ; LonOff 0.0 ; PMODE Search ; SCANTime 180

“”

Is it visible? - do I need a schedule?

No. It is possible to manually select targets

Can Effelsberg detect it?

You can check the system equivalent flux density (SEFD) on the effelsberg wiki
SEFD: The flux density of a radio source that doubles the system temperature

Calibration Information

Frequency [GHz]	Channel	Polarisation	Tcal [K]	Tsys [K]	Sensitivity [K/Jy]	SEFD [Jy]	Aperture Eff. [%]	TMB/S [K/Jy]	Main Beam Eff. [%]	FWHM [arcsec]	Last update
1.41	A+B	2x lin	5.7	19.8	1.3	15.2	46	1.90	68	569	first observations
1.665	A+B	2x lin	6.7	20.6	1.3	15.8	46	1.78	73	497	first observations
2.35	A+B	2x lin	8.8	16.1	1.3	12.4	46	1.68	77	363	first observations
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4.85	A+B	2x lin	12.5	18.8	1.3	14.5	46	1.71	76	174	first observations
5.54	A+B	2x lin	11.6	19.0	1.3	14.6	46	1.64	79	156	first observations

Can Effelsberg detect it? - B2021+51

$$S_{min} = S_{1400} = \alpha\beta \frac{T_{sys}}{G\sqrt{(n_p \Delta f t_i)}} \left(\frac{W}{P-W} \right)$$

α: SNR, β: Digitization and processing losses (assume 1), n_p: no. of polarization channels, t_i: integration time, P: pulse period, W: Pulse profile width, G: Gain, △f: frequency bandwidth, T_{sys}: system temperature

$$\alpha = SNR = S_{1400} \frac{G}{T_{sys}} \sqrt{(2\Delta f t_i)}$$

Can Effelsberg detect it? - B2021+51

Calibration Information

Frequency [GHz]	Channel	Polarisation	Tcal [K]	Tsys [K]	Sensitivity [K/Jy]	SEFD [Jy]	Aperture Eff. [%]	TMB/S [K/Jy]	Main Beam Eff. [%]	FWHM [arcsec]	Last up-date
1.41	A+B	2x lin	5.7	19.8	1.3	15.2	46	1.90	68	569	first ob-servations

#	NAME		PSRJ		P0 (s)			P1			S400 (mJy)			S1400 (mJy)			S2000 (mJy)		
1	B2021+51	dl70	J2022+5154	dl70	0.529196917808	17	hlk+04	3.06337E-15	5	hlk+04	77	12	lylg95	27	9	lylg95	*	0	*

t_i = 300s, $\triangle f$=650MHz

SNR = 8.5

Do we need polarization calibration?

Two options:

- Polarization calibration diode
- Source with known polarization

Remember to check if the polarization channel basis on the wiki!

If you want polarization calibration you have to add it to the schedule!

Do we need polarization calibration? - The Schedule

“”””

FE:P170mm ; EDD_PULSAR_TIMING ; Init 1

SENDTO EDD JSON MEASUREMENTPREPARE
{"dig_pack_controller_2G":{"noise_diode_pattern":{"percentage":"0.5","period":"1.0"}}}

B2021+51_R ; CoordinateSystem Equatorial ; Equinox J2000 ; ObjectLongitude 20h 22m 50.00s ; ObjectLatitude +51d 54' 50.00" ; LatOff 0.5 ; LonOff 0.0 ; PMODE CalFE ; SCANTime 120

SENDTO EDD JSON MEASUREMENTPREPARE
{"dig_pack_controller_2G":{"noise_diode_pattern":{"percentage":"0.0","period":"1.0"}}}

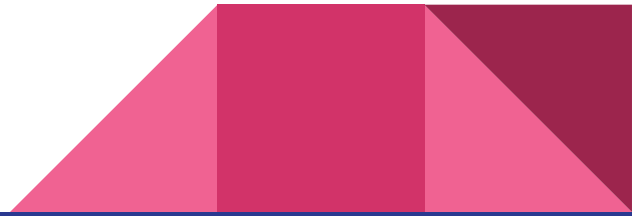
B2021+51 ; CoordinateSystem Equatorial ; Equinox J2000 ; ObjectLongitude 20h 22m 50.00s ; ObjectLatitude +51d 54' 50.00" ; LatOff 0.0 ; LonOff 0.0 ; PMODE Search ; SCANTime 180
“”””

Do we need flux calibration?

If yes. You need to include a source with a known (and stable…) flux. AGNs are the usual choices.

Keep in mind that proper calibration is non-trivial:

- Atmospheric opacity
- Antenna gain
- Antenna effective area
- Elevation gain changes
- …



Do we need flux calibration? - In practice

- Do PFP (pointing-focus-pointing) from time to time and at the start of observation!
- Observe a regular calibration source (point-like, high flux density, stable), ideally over a large range of elevations
- Measure or estimate atmospheric opacity

$$S = \frac{T_A \cdot e^{\tau / \sin(elv)}}{G(elv) \cdot \Gamma}$$

https://www.mpifr-bonn.mpg.de/948117/Bach_Calibration_ESSEA2010.pdf

Do we need flux calibration?

Check:

- https://www.mpifr-bonn.mpg.de/948117/Bach_Calibration_ESSEA2010.pdf
- J.W.M Baars, et al., 1977, A&A 61, 99
- J.D. Kraus: “Radio Astronomy”, 1986, Cygnus-Quasar-Books, Powel OH
- K. Roholfs & T.L. Wilson: “Tools of Radio Astronomy”, 1996, Springer-Verlag, Berlin
- J.W.M Baars: “The paraboloidal reflector antenna in radio astronomy and communication: theory and practice”, 2007, Springer, New York

Do we need polarization calibration? - The Schedule

Let’s add a known flux density source, the AGN 3C286.

“”

SENDTO EDD JSON MEASUREMENTPREPARE {"dig_pack_controller_2G":{"noise_diode_pattern":{"percentage":"0.5","period":"1.0"}}}

3C286_N_R ; CoordinateSystem Equatorial ; Equinox J2000 ; ObjectLongitude 13h 31m 08.00s ; ObjectLatitude +30d 30' 33.00" ; LatOff 1.0 ; LonOff 0.0 ; PMODE CalFE ; SCANTime 12

SENDTO EDD JSON MEASUREMENTPREPARE {"dig_pack_controller_2G":{"noise_diode_pattern":{"percentage":"0.5","period":"1.0"}}}

3C286_O_R ; CoordinateSystem Equatorial ; Equinox J2000 ; ObjectLongitude 13h 31m 08.00s ; ObjectLatitude +30d 30' 33.00" ; LatOff 0.0 ; LonOff 0.0 ; PMODE CalFE ; SCANTime 120

SENDTO EDD JSON MEASUREMENTPREPARE {"dig_pack_controller_2G":{"noise_diode_pattern":{"percentage":"0.5","period":"1.0"}}}

3C286_S_R ; CoordinateSystem Equatorial ; Equinox J2000 ; ObjectLongitude 13h 31m 08.00s ; ObjectLatitude +30d 30' 33.00" ; LatOff -1.0 ; LonOff 0.0 ; PMODE CalFE ; SCANTime 120

Do we need polarization calibration? - The Schedule

“”

FE:P170mm ; EDD_PULSAR_TIMING ; Init 1

SENDTO EDD JSON MEASUREMENTPREPARE {"dig_pack_controller_2G":{"noise_diode_pattern":{"percentage":"0.5","period":"1.0"}}}

3C286_N_R ; CoordinateSystem Equatorial ; Equinox J2000 ; ObjectLongitude 13h 31m 08.00s ; ObjectLatitude +30d 30' 33.00" ; LatOff 1.0 ; LonOff 0.0 ; PMODE CalFE ; SCANTime 120

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3C286_S_R ; CoordinateSystem Equatorial ; Equinox J2000 ; ObjectLongitude 13h 31m 08.00s ; ObjectLatitude +30d 30' 33.00" ; LatOff -1.0 ; LonOff 0.0 ; PMODE CalFE ; SCANTime 120

SENDTO EDD JSON MEASUREMENTPREPARE {"dig_pack_controller_2G":{"noise_diode_pattern":{"percentage":"0.5","period":"1.0"}}}

B2021+51_R ; CoordinateSystem Equatorial ; Equinox J2000 ; ObjectLongitude 20h 22m 50.00s ; ObjectLatitude +51d 54' 50.00" ; LatOff 0.5 ; LonOff 0.0 ; PMODE CalFE ; SCANTime 120

SENDTO EDD JSON MEASUREMENTPREPARE {"dig_pack_controller_2G":{"noise_diode_pattern":{"percentage":"0.0","period":"1.0"}}}

B2021+51 ; CoordinateSystem Equatorial ; Equinox J2000 ; ObjectLongitude 20h 22m 50.00s ; ObjectLatitude +51d 54' 50.00" ; LatOff 0.0 ; LonOff 0.0 ; PMODE Search ; SCANTime 180

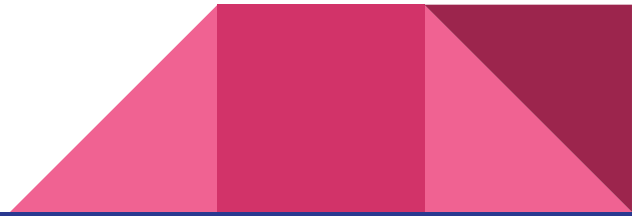
“”

Do we have the correct ephemeris?

Pulsar timing only!

If the ephemeris is wrong. The pulse in the folded archives will drift.

If you wish to update it, contact Jason.



3. Observing with Effelsberg

Steps for observing session

1. join `Mattermost for observing': **Eff100mObs** (https://mattermost.mpifr-bonn.mpg.de/eff100mobs/channels/current-observations)
2. on your day of observations, message **eff_operator** on Mattermost
    a. Introduce yourself ~30 min before observing, and say which project you will be observing for and when

    b. ask for **obseff password** (so you can scp your schedule to `obseff@observer8:/home/obseff/pulsar/Scripts/`)
        i. or, if you have access to paf0, you can ssh from pulsar@paf0 (w.o. obseff password)
    c. ask eff_operator for **vpn password** (so you can access the interface/frontend)
        i. do not login to interface yet, because someone else may be observing
        ii. Note you can tell the operator your **schedule name** and ask them to load your schedule and start observations for you.
        iii. Usually, one wants to login to the interface themselves, so they can rearrange the sources in the observing queue if necessary. Sometimes weather (or other problems) causes delays and you need to adjust your schedule on-the-fly!

Load your schedule

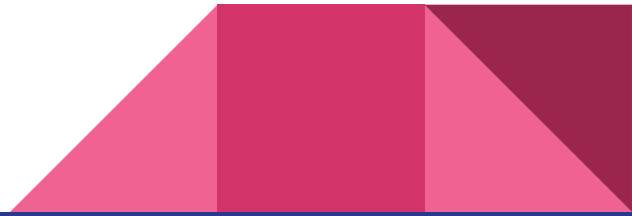
1. scp <your schedule> obseff@observer8:/home/obseff/pulsar/Scripts/
   a. The operator will give the password to you if you ask nicely

2. Check if your schedule is loaded. Also can peruse other schedules.

   ssh obseff@observer8

   cd /home/obseff/pulsar/Scripts/

   ls <your schedule>



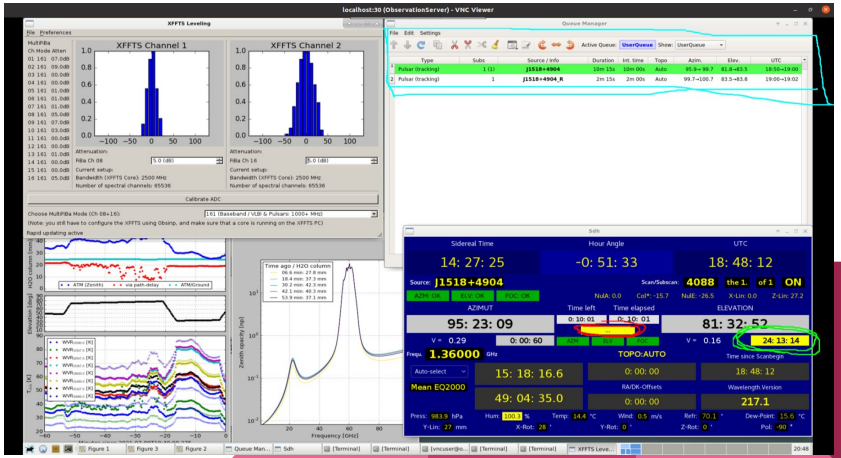
Access interface (for loading schedule; start/stop observations; adjust observing queue)*

1. I use Turbo VNC (can also use VNC viewer) to access the observing interface
2. For the ssh connections below, substitute **your username**, and you will use **your portal password** when prompted
   a. **DO NOT** use VNC password provided by Effelsberg operator here! if you enter the wrong password too many times, you will be locked out for 30 min.

The main screens:

ssh -X -f -N -L 5931:observer8:5931 username@portal.mpifr-bonn.mpg.de

ssh -X -f -N -L 5921:observer8:5921 username@portal.mpifr-bonn.mpg.de



*again, the operator can load schedule for you, and start your session

Access interface (for loading schedule; start/stop observations; adjust observing queue)*

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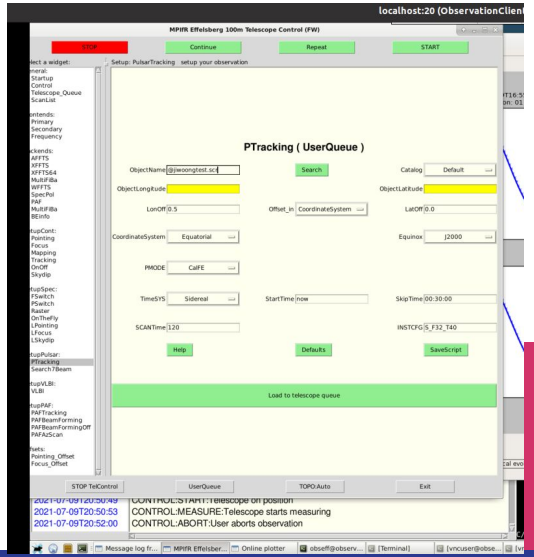


*again, the operator can load schedule for you, and start your session

Useful links

- disk quota for data product can be check here, for example baseband product
- View current schedules: https://eff100mwiki.mpifr-bonn.mpg.de/doku.php?id=schedules
- Access the EDD Dashboard (must setup proxy server access with Firefox): http://134.104.74.49:3000/

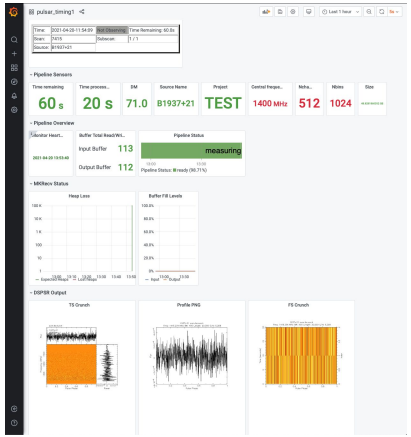
OR

- In the terminal:

  ssh -L 3000:eddinfra0:3000 <username>@portal.mpifr-bonn.mpg.de

  Web browser link:

  http://localhost:3000/?orgId=1&refresh=5s



4. Data Reduction

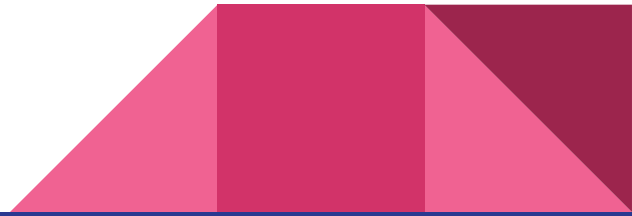
Where is my data?

Raw data files:
‘/beegfsEDD/EDD_pipeline_data/production/pipeline_data/’

Visible from the eddinfra1 machine (you need access from Uwe Bach)

Some data is automatically transferred to MPIfR servers.

E.g. pulsar timing:
‘/fpra/comiss/01/EDD_STAGING_AREA’



Exercises

1. Go to: ‘/homes/jjawor/FUNDI_tutorial’
   There, you will find a bunch of schedules and some software
   `singularity shell -B /fpra -B /homes singularity/pipeline_cg3`
   `pip install software/pyriseset3`
2. Go to the ATNF catalogue: https://www.atnf.csiro.au/research/pulsar/psrcat/
   Pick a couple of pulsars that you want to observe
3. Using pyriseset3 or astropy, check if your pulsars are on the sky
4. Make sure that your pulsars have a flux density high enough to be seen by Effelsberg
5. Create a schedule for your pulsars
6. Include a flux-calibrator source and polcal-diode observations

Observation details

UTC-start = 15.30.00

UTC-end = 16.00.00

Date = 2025/02/13

Receiver = P170 (UBB) - https://eff100mwiki.mpifr-bonn.mpg.de/doku.php?id=information_for_astronomers:rx_list

Effelsberg location - https://eff100mwiki.mpifr-bonn.mpg.de/doku.php?id=information_for_astronomers:user_guide:antenna

5. Links

Links

General information:

Effelsberg wiki - https://eff100mwiki.mpifr-bonn.mpg.de/doku.php?id=start

Observation Channel - https://mattermost.mpifr-bonn.mpg.de/eff100mobs/channels/town-square

Theory:

J.D. Kraus: “Radio Astronomy”, 1986, Cygnus-Quasar-Books, Powel OH

K. Roholfs & T.L. Wilson: “Tools of Radio Astronomy”, 1996, Springer-Verlag, Berlin

J.W.M Baars: “The paraboloidal reflector antenna in radio astronomy and communication: theory and practice”, 2007, Springer, New York

Links

Schedules

EDD repo - https://gitlab.mpcdf.mpg.de/mpifr-bdg/edd_provisioning_effelsberg

pyriseset3 - https://gitlab1.mpifr-bonn.mpg.de/jjawor/pyriseset3

astropy - https://www.astropy.org/

Observation:

VNC software - https://www.realvnc.com/en/connect/download/viewer/

Mattermost channel - https://mattermost.mpifr-bonn.mpg.de/eff100mobs/channels/current-observations

VNC tunnel ports:

ssh -X -f -N -L 5931:observer8:5931 username@portal.mpifr-bonn.mpg.de

ssh -X -f -N -L 5921:observer8:5921 username@portal.mpifr-bonn.mpg.de

ssh -L 3000:eddinfra0:3000

Links

Data Reduction

psrchive (timing) - https://psrchive.sourceforge.net/

coastguard3 (timing) -https://gitlab1.mpifr-bonn.mpg.de/jjawor/coastguard3

pulsarx (pulsar searches) - https://github.com/ypmen/PulsarX

transientx (transient searches) - https://github.com/ypmen/TransientX