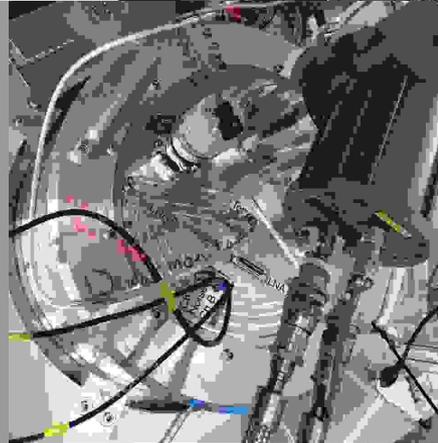
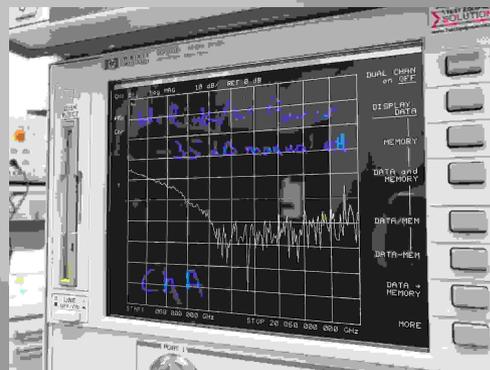
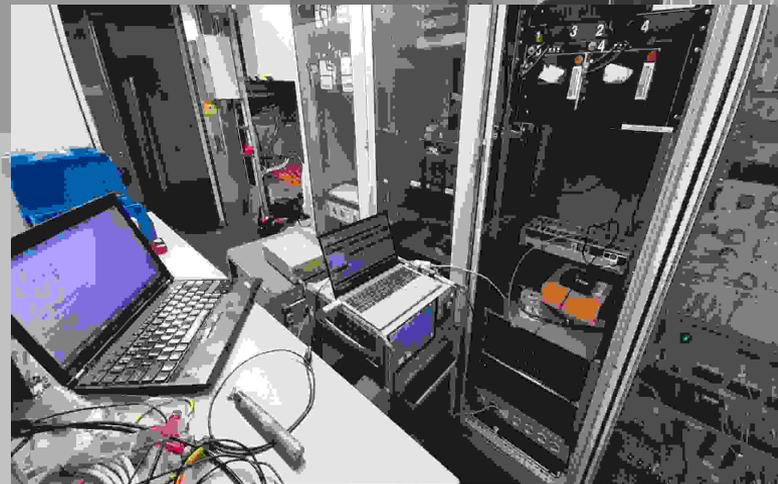


Integration of the BRAND receiver in Effelsberg

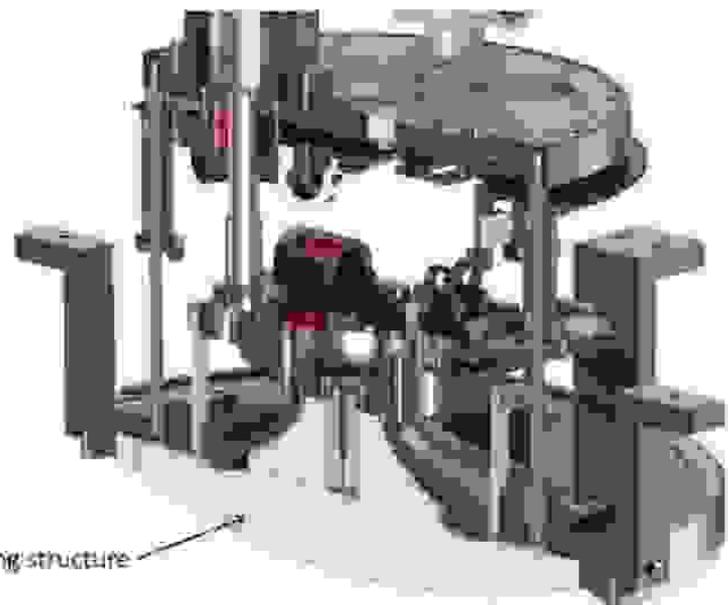
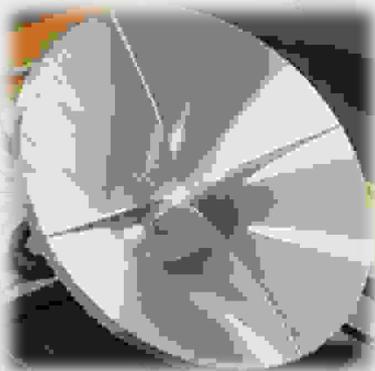
The background image shows a large-scale engineering project. A massive, white, cylindrical receiver antenna is mounted on a complex metal structure. The structure consists of a central vertical column and a horizontal cross-arm. The antenna is positioned on a platform that is part of a larger framework. In the foreground, there are several white metal beams and a railing, suggesting a walkway or service area. The overall scene is set against a clear blue sky, indicating an outdoor environment. The text is overlaid on the top half of the image.

Parisa Rahimi, Uwe Bach
25.06.2024

First sky test of BRAND analog front-end ever in Effelsberg over the course of 6 months Integration and preparation time.



BRAND Development in previous years



- Frequency range 1.5 -15.5 GHz
- Advantage application in VLBI and Geodetic, spectroscopy etc.
- Highest BW possibility of 14 GHz:
 - reduced needed observation and receiver change time
 - data availability of a wide BW at once

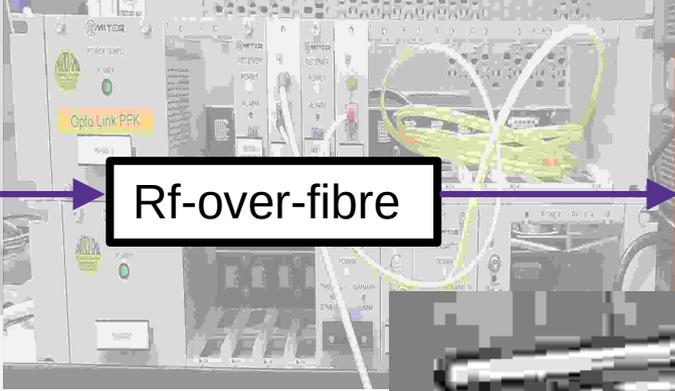
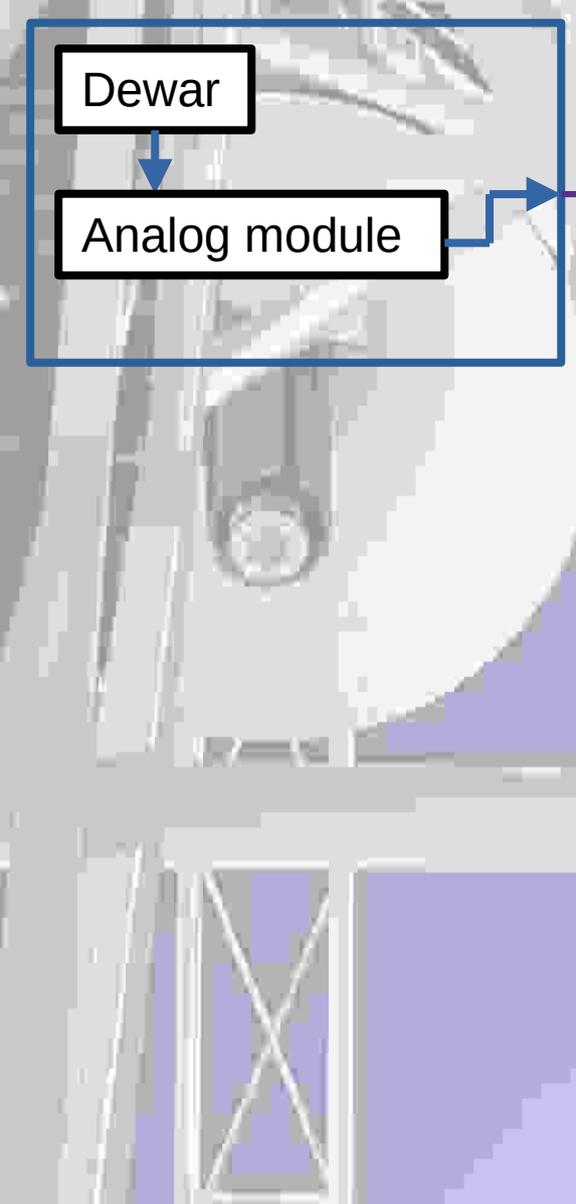


Dewar

Analog module

Rf-over-fibre

The BRAND digital front-end will be kept in Faraday room as back-end for the first rounds of integration

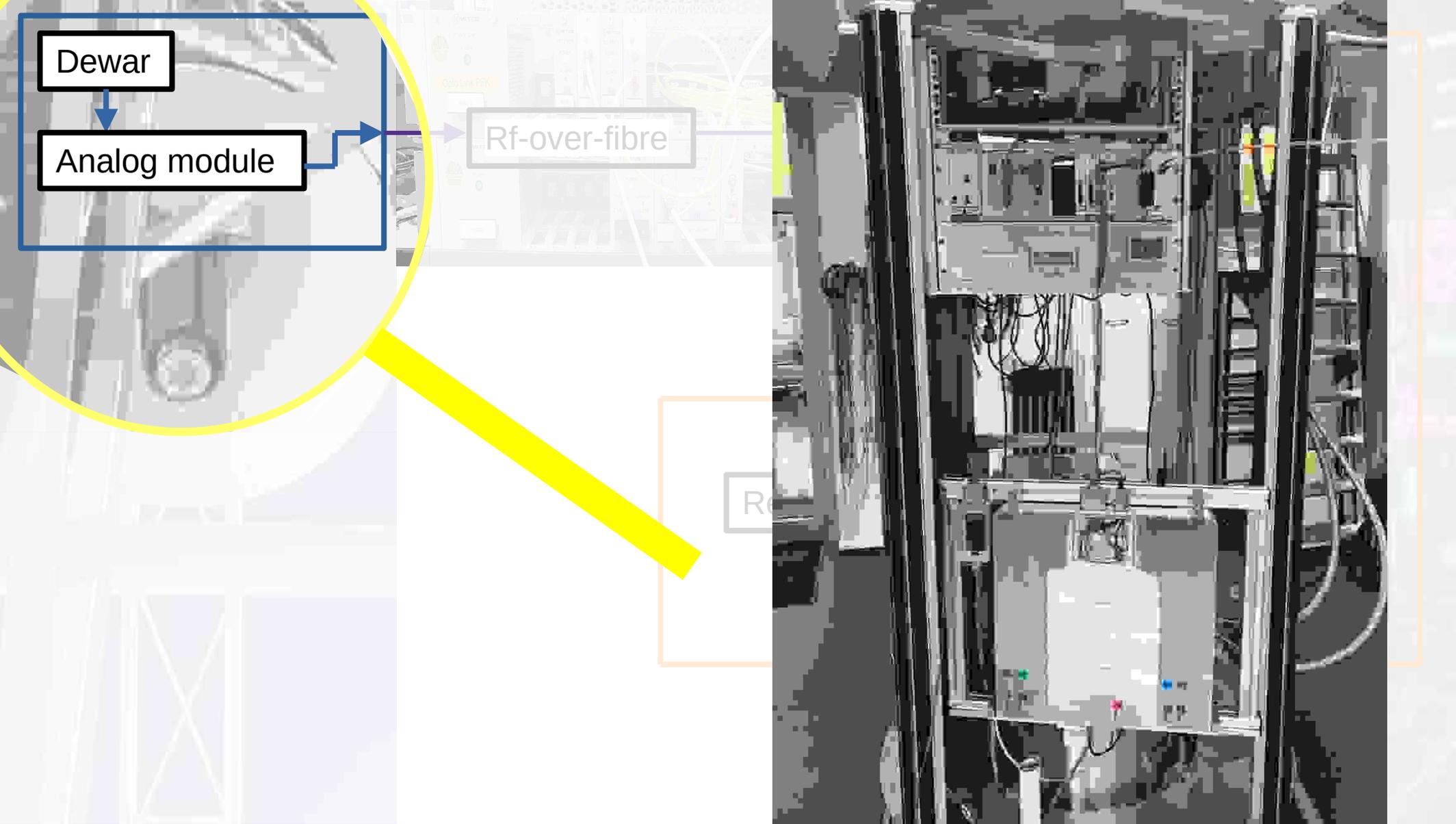


Dewar

Analog module

Rf-over-fibre

Rf



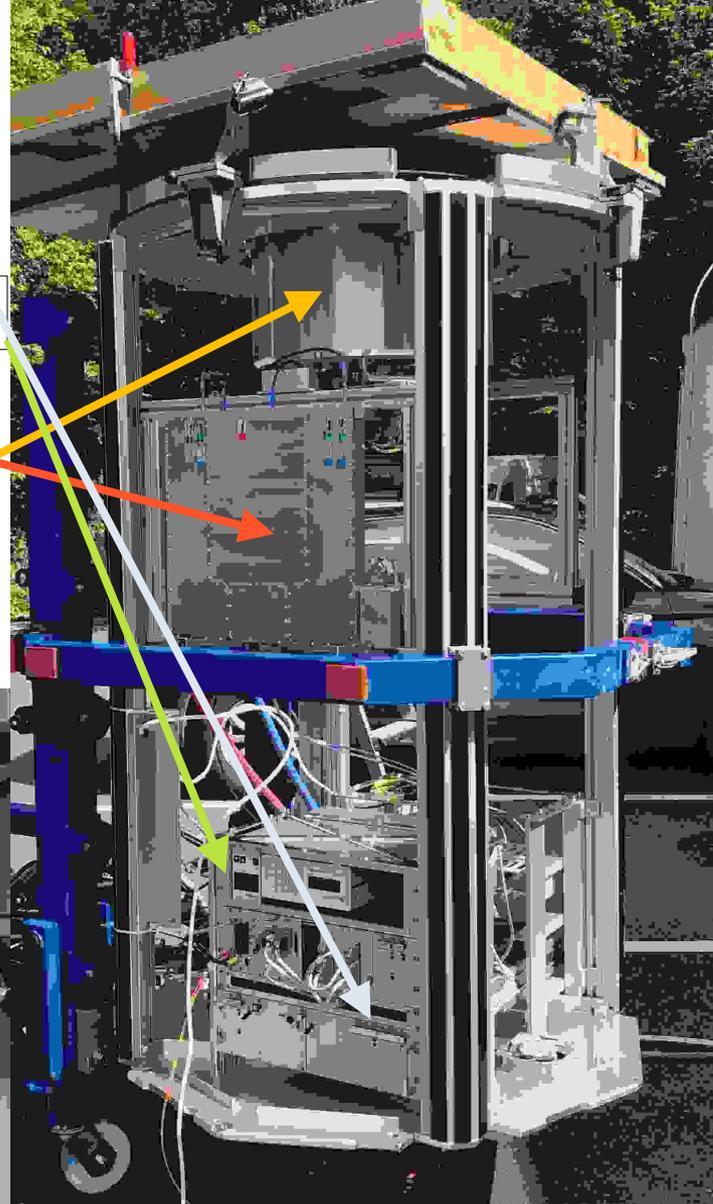
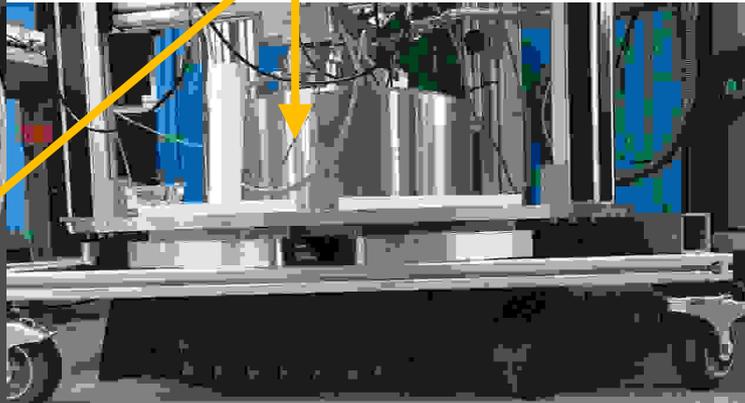
Front-end components

Control and power panels

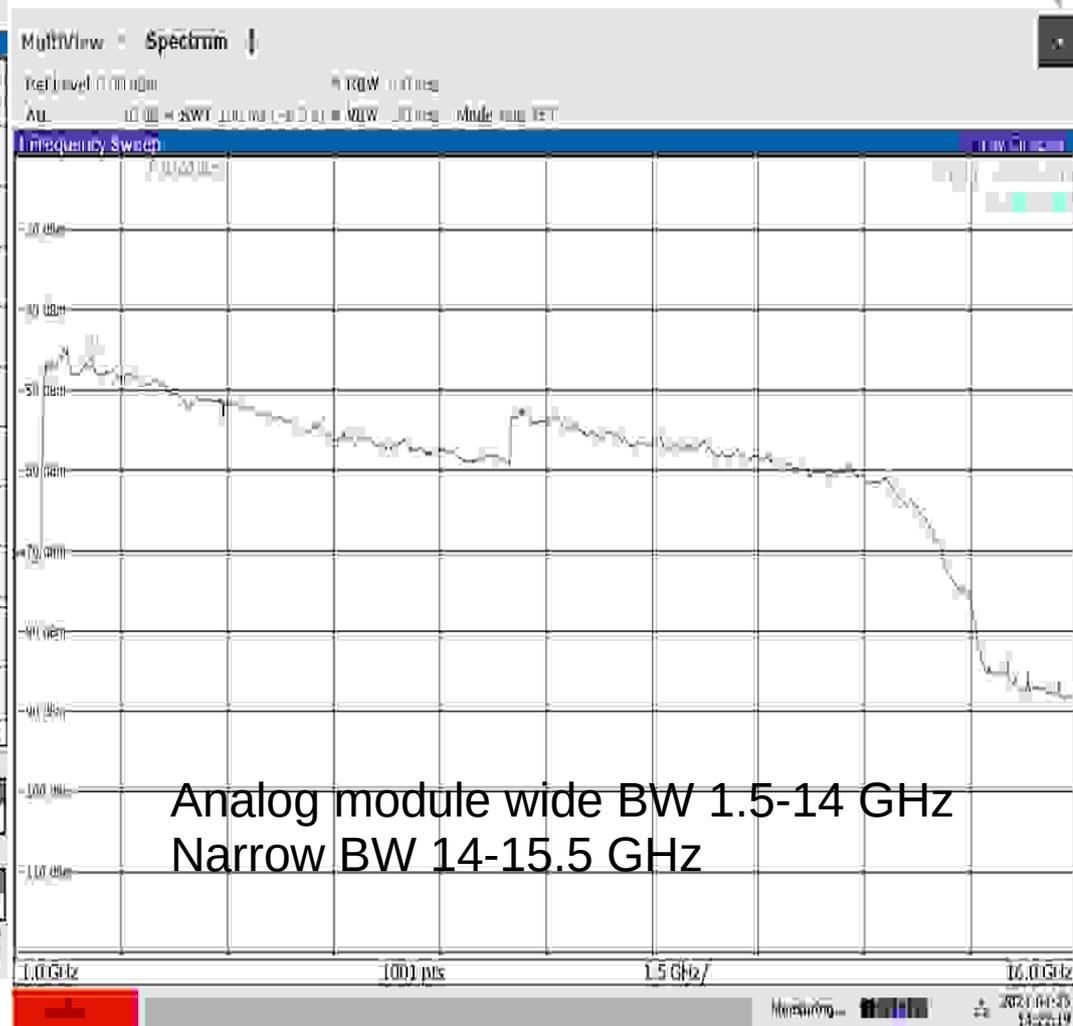
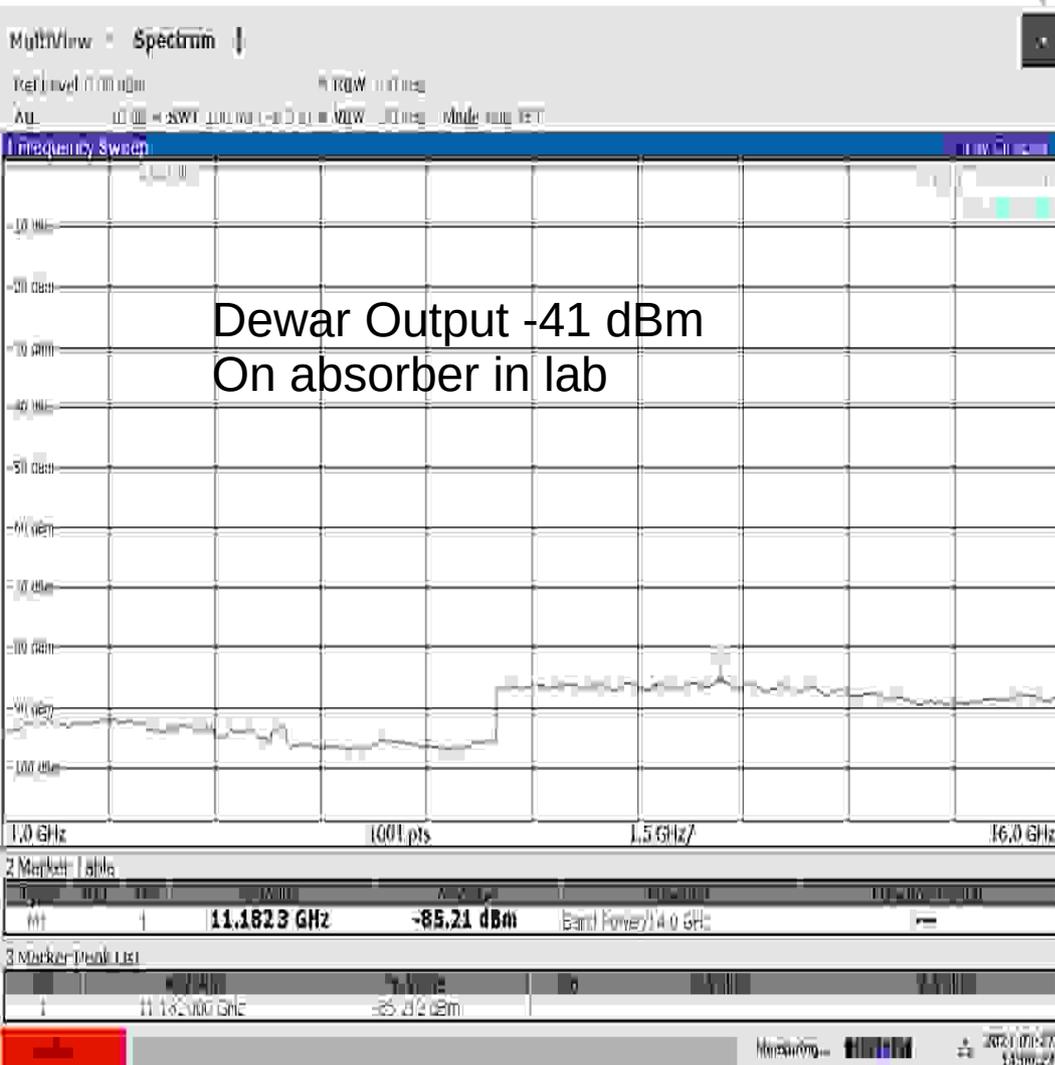
Vacuum and temperature reader

Analog module

Dewar



Gain comparison of the Dewar (left) and analog module (right)



Dewar

Analog module

Rf-over-fibre

4 GHz BW pre filter

DBBC3 down-converter

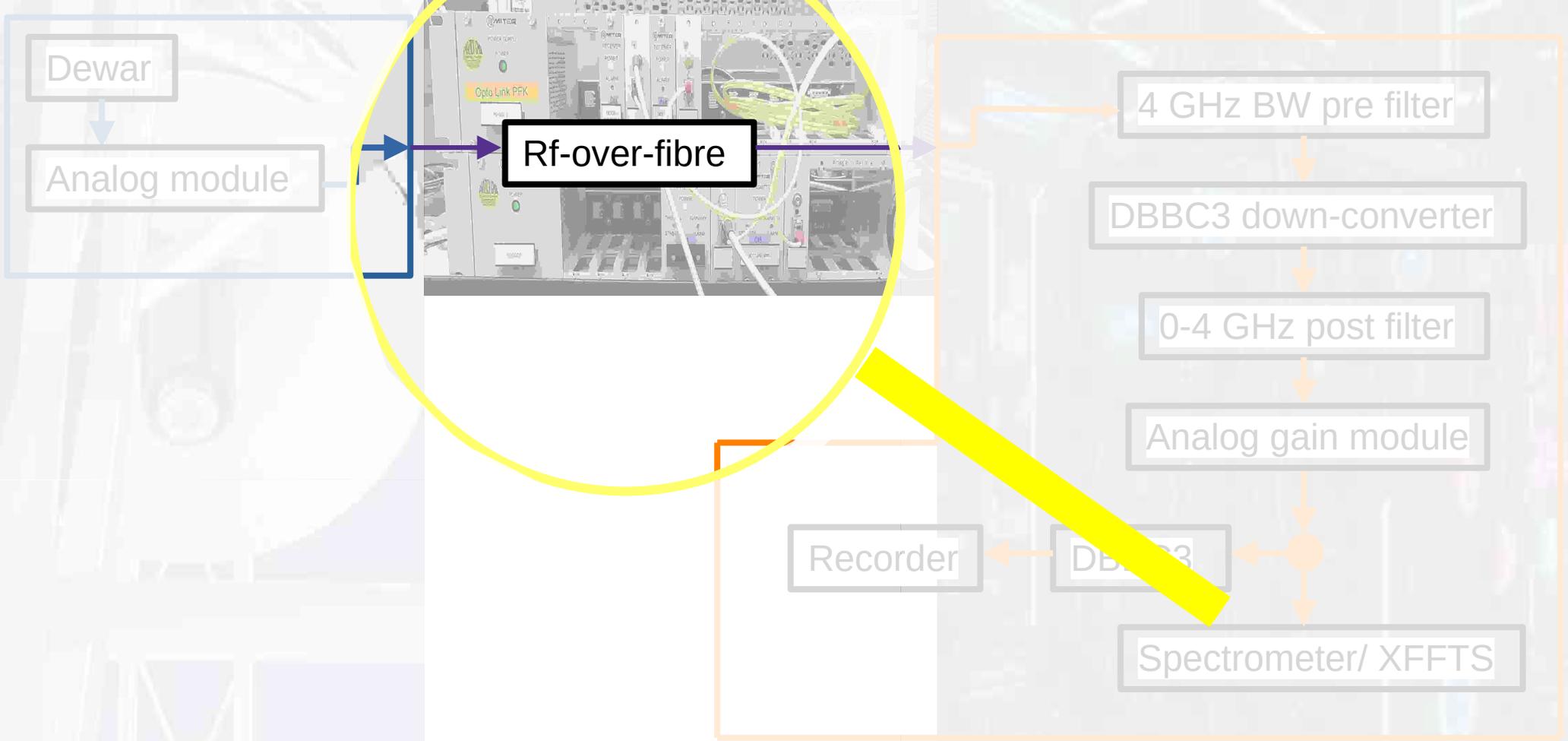
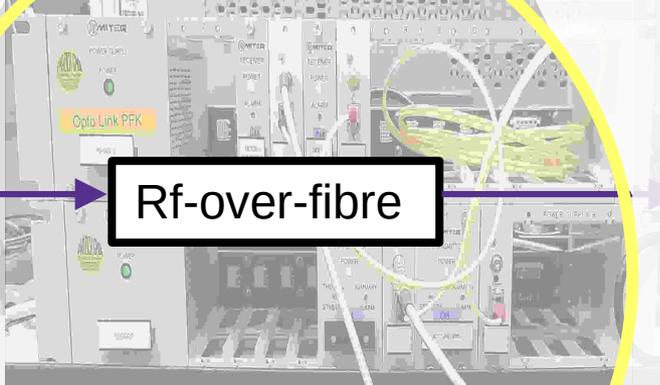
0-4 GHz post filter

Analog gain module

Recorder

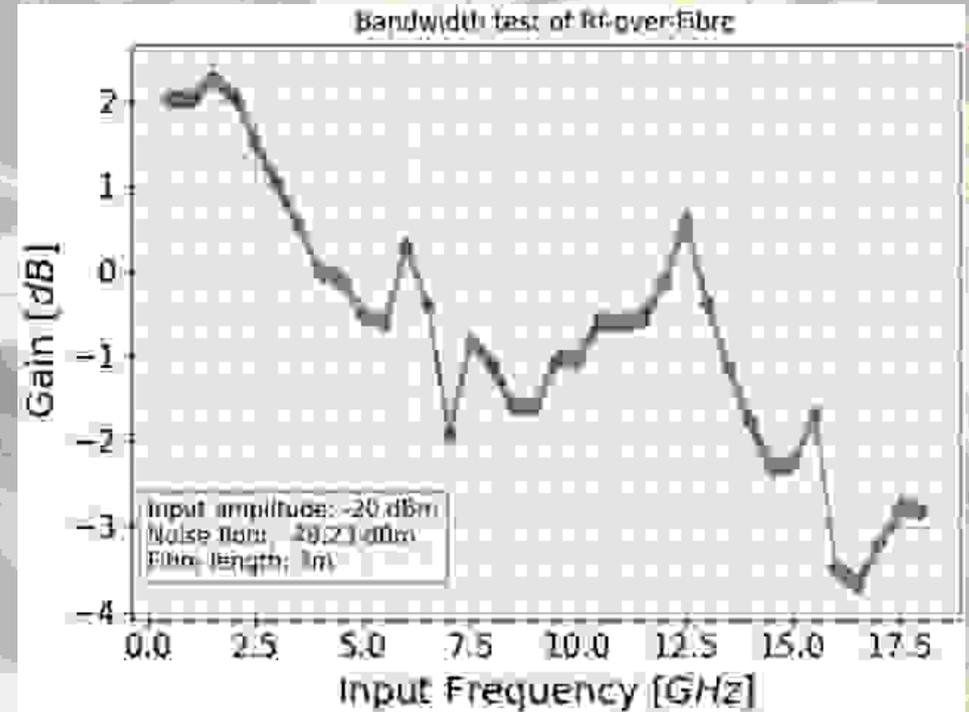
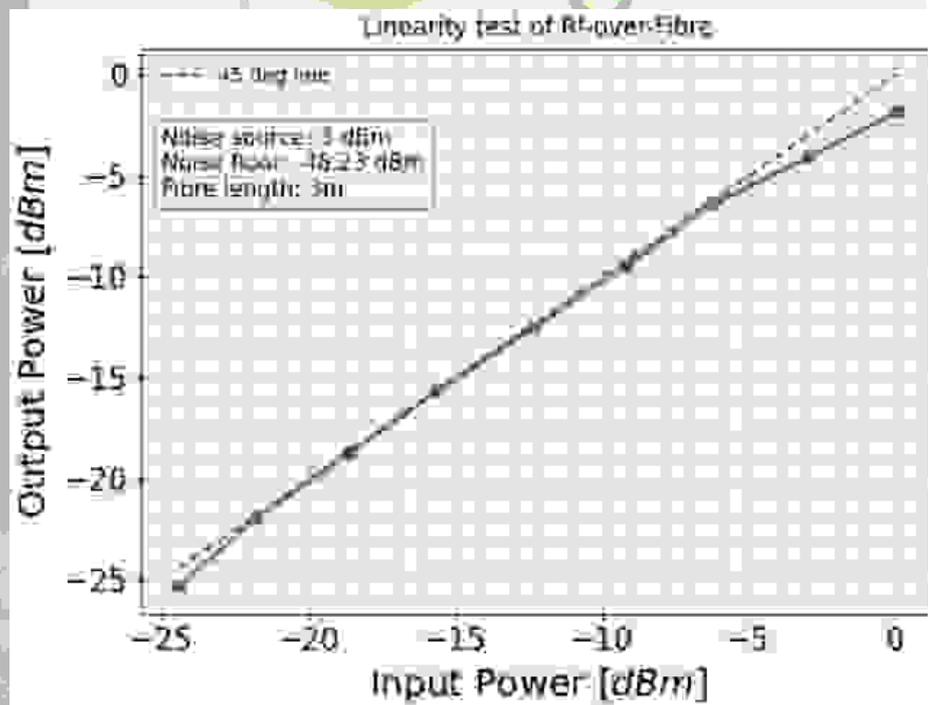
DBBC3

Spectrometer/ XFFTS



Why Rf-over-fibre?

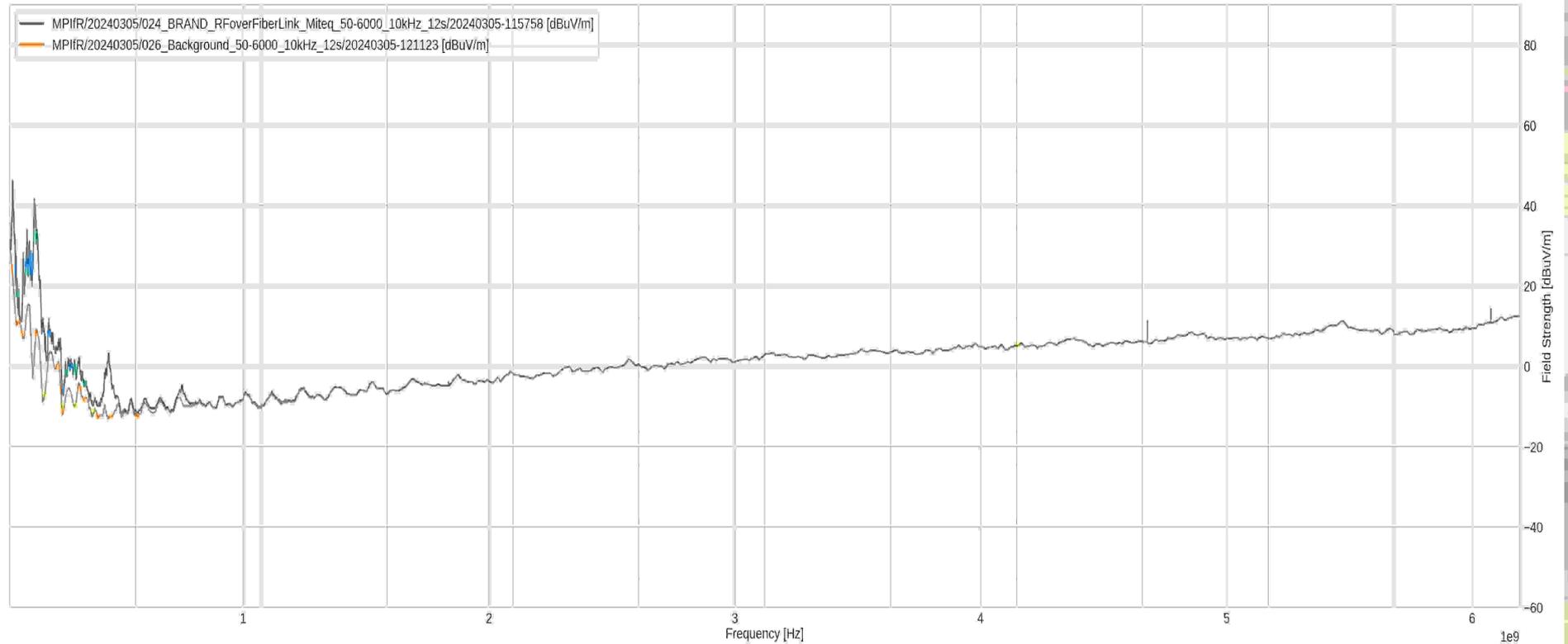
- a shield for BRAND digital front-end is yet to be designed and built to cover RFI and power dissipation issues
- BRAND digital front-end will remain in Faraday room and work as back-end, using Rf-over-fibre to transfer the signal



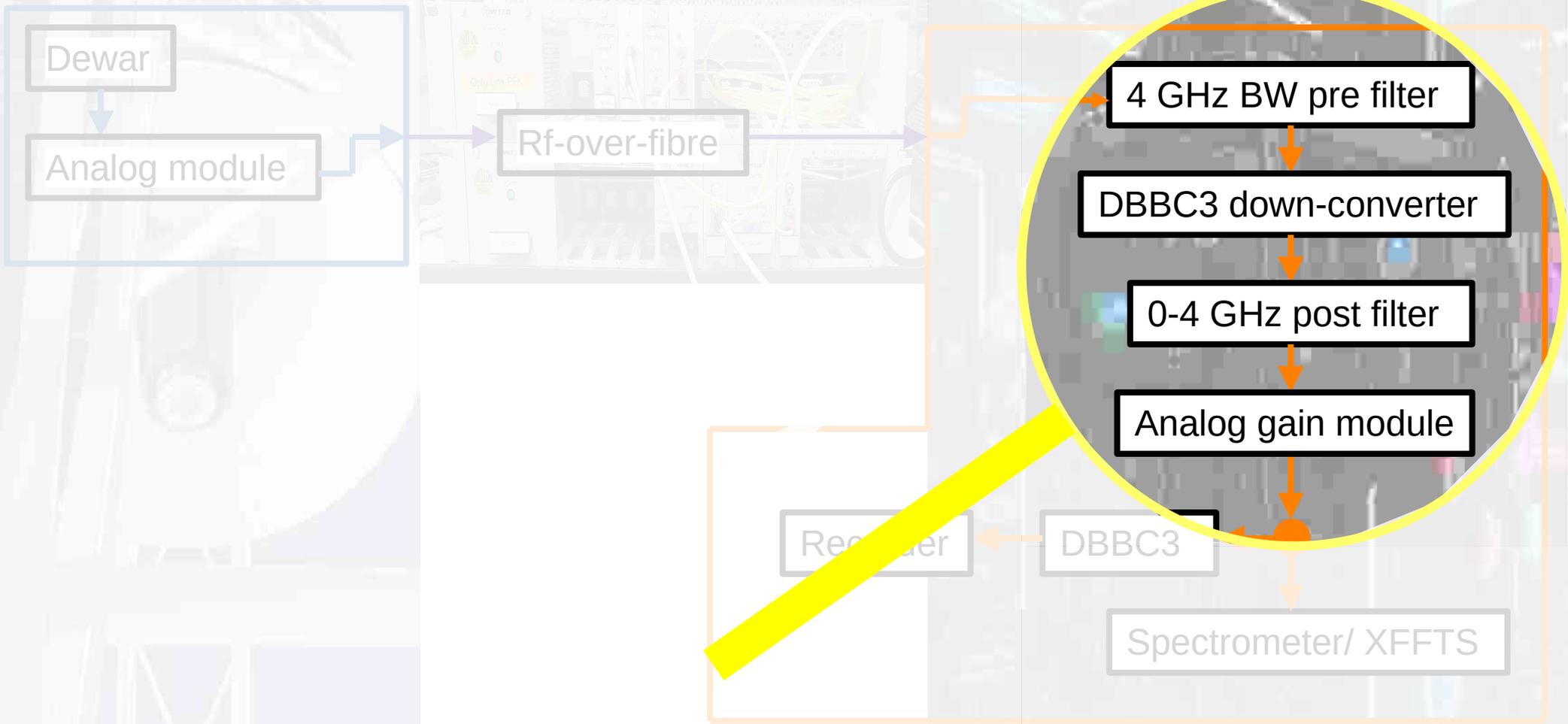
Rf-over-fibre linearity and BW with manual frequency sweeping and network analyzer

Down side of Rf-over-fibre:

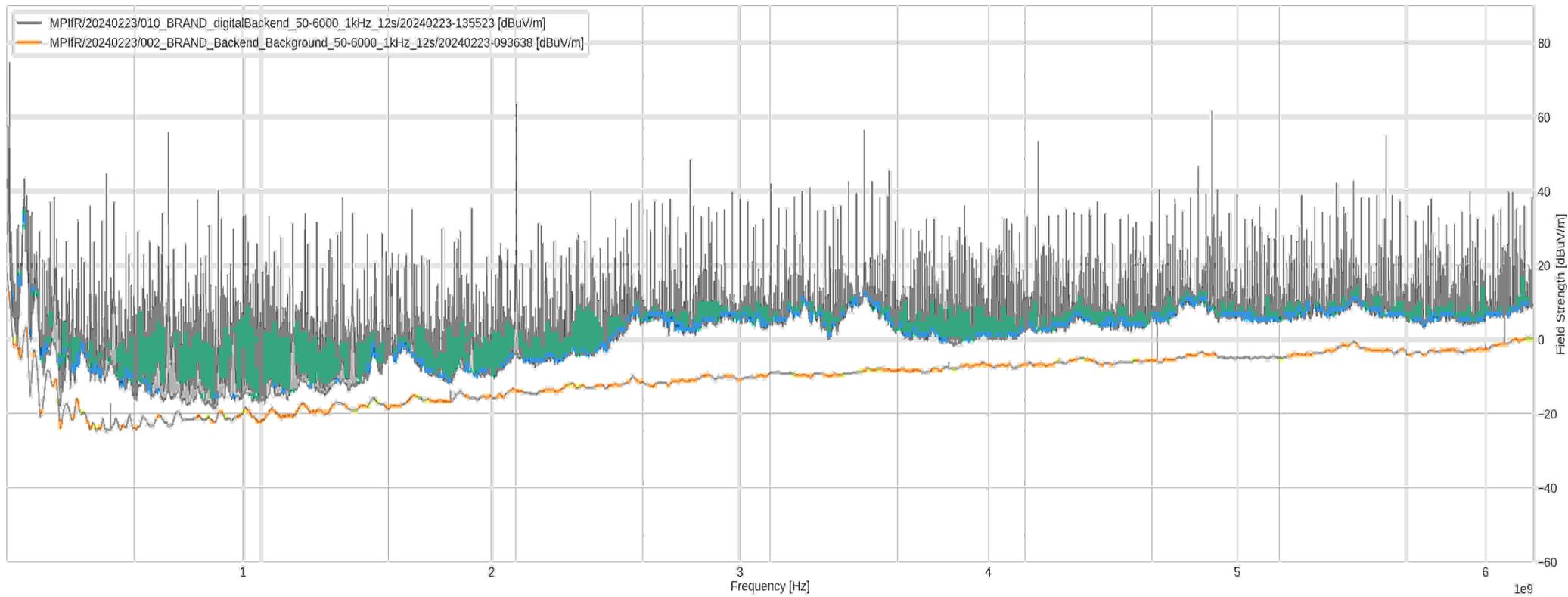
→ goes to compression and non linearity by -3 dBm → causes intermodulation → requires fine tuning of the gain values



Testing Rf-over-fibre module in the anechoic chamber in Bonn



Why Rf-over-fibre? THAT! Is why!



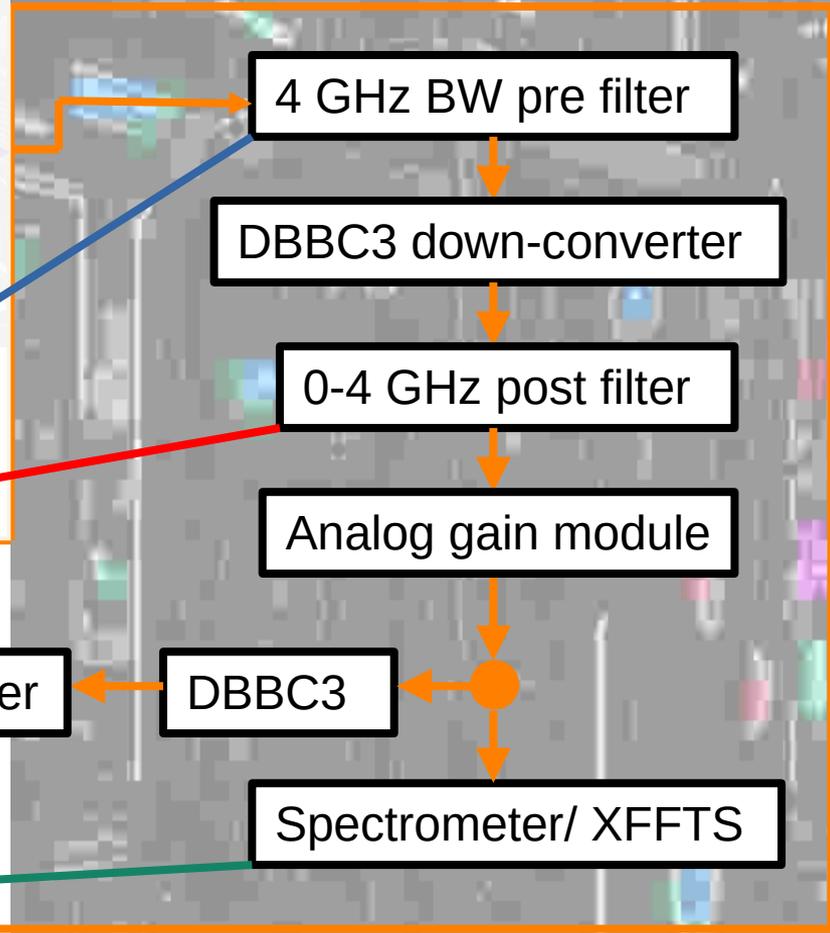
Testing the BRAND digital front-end in the anechoic chamber in Bonn

1.5 – 15.5 GHz

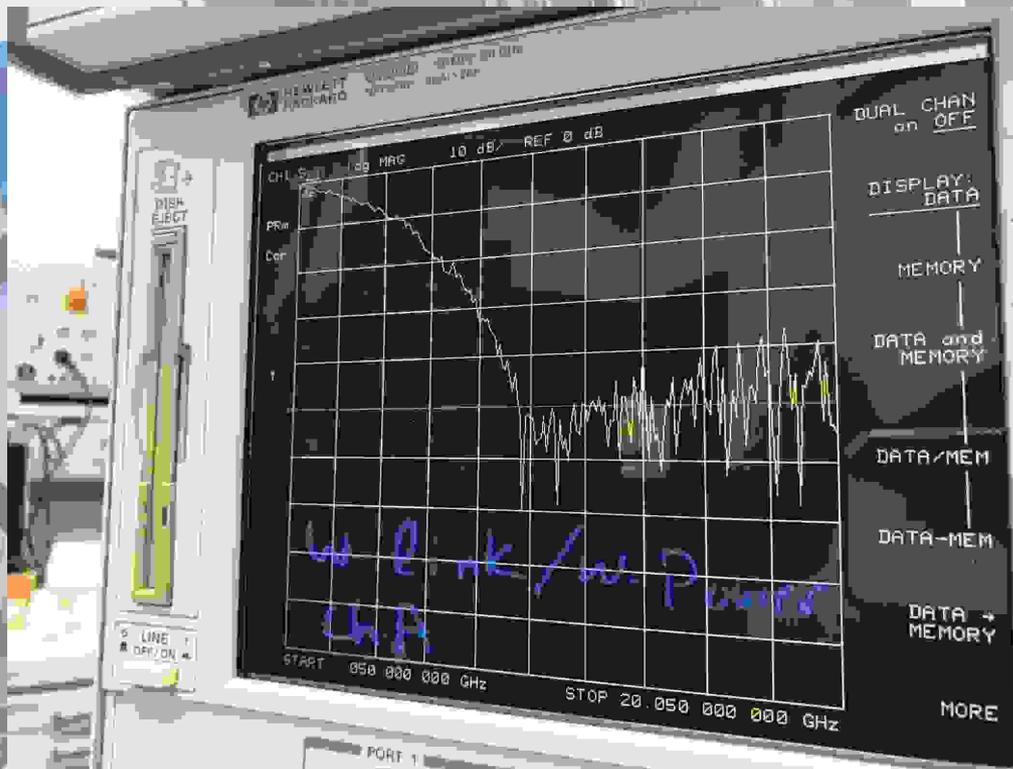
Dewar output



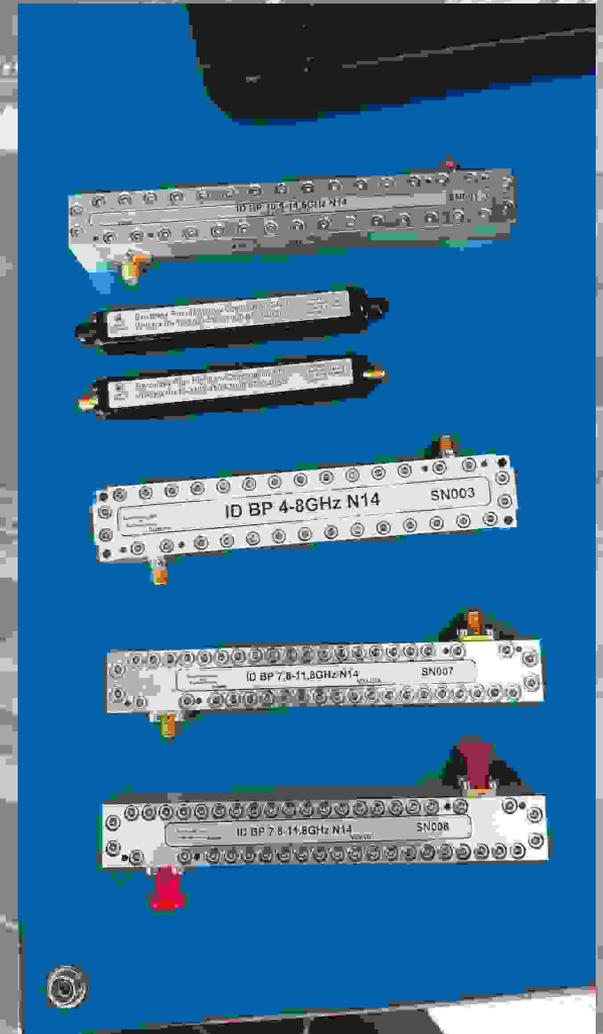
1.5 – 14 GHz



Testing analog gain module:
to regain after down-conversion
→ Down side: the gain is sloped



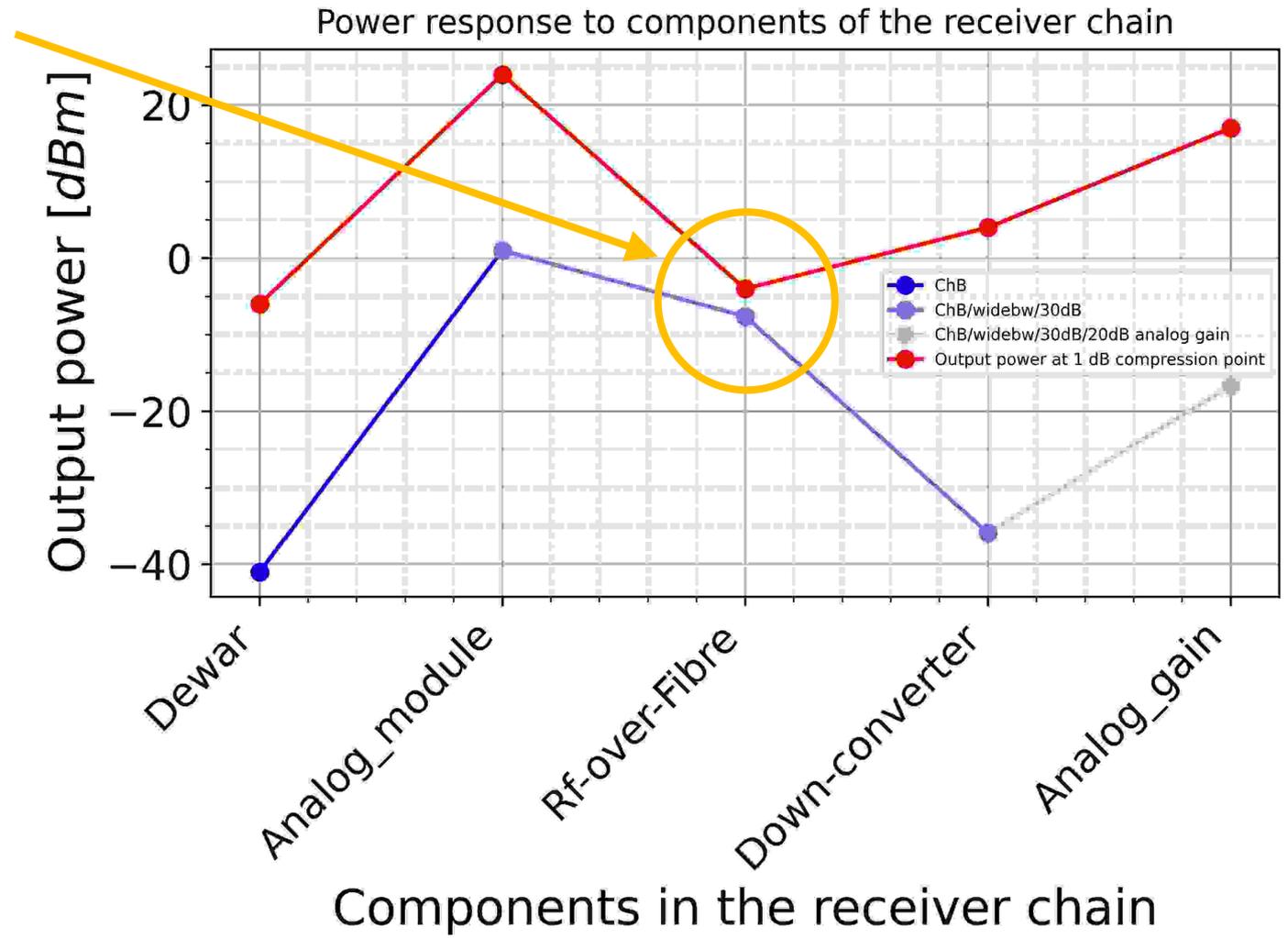
50 dB max gain possibility with steps of 1 dB



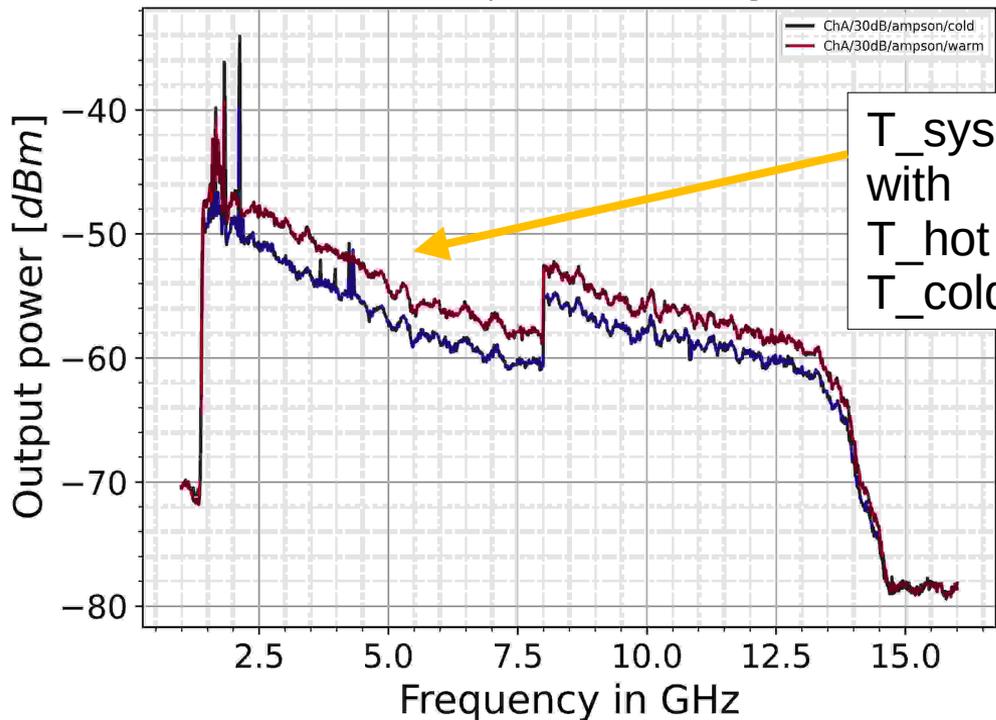
Post and pre filters for down-conversion

Rf-over-fibre is more prone to compression

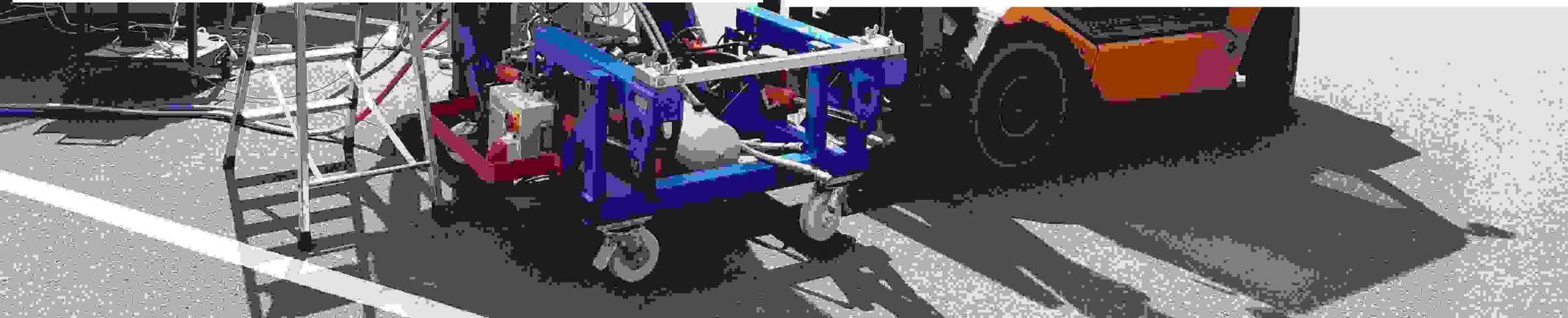
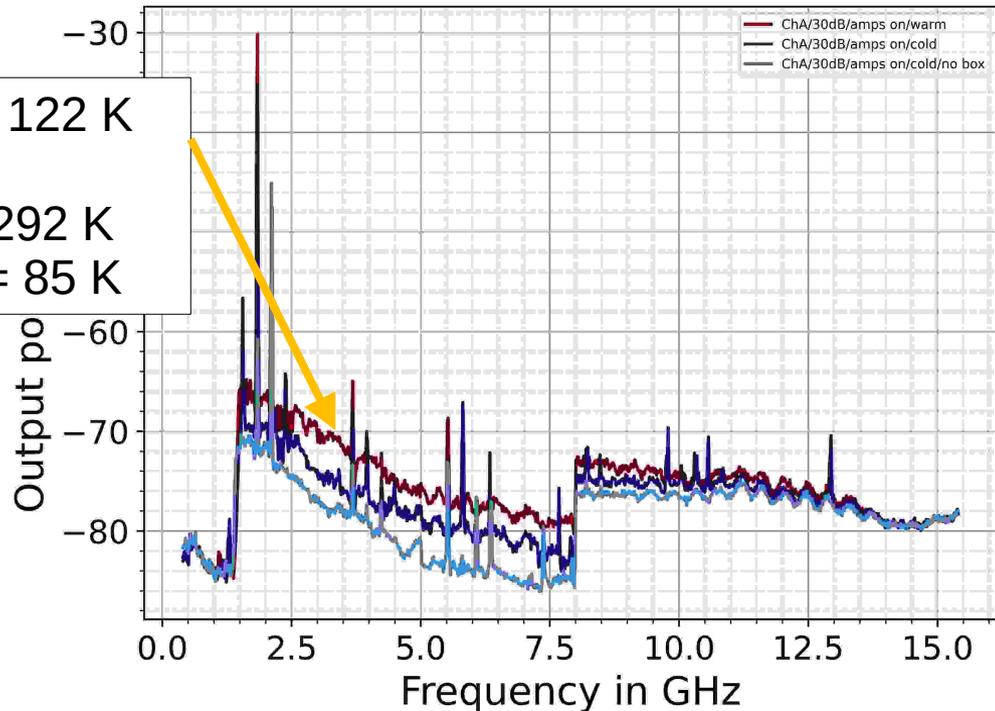
→ BRAND digital front-end in the receiver box with proper shielding



Cold and warm spectrum after analog module



Cold and warm spectrum after Rf-over-fibre with extra 20 dB attenuation





BRAND test observations



Single dish tests: 1.5 GHz to 12 GHz

- Pointings on known calibrators to estimate T_{cal} , T_{sys}
- ONOFFs with Moon ($\sim 250K$) as hot-cold, moon-sky comparison
- Spectroscopic measurements of W3 cloud

VLBI test at C-band

- Repeated 4 Gbps EVN NME N24C2 with Ef, Mc, On, and Ys

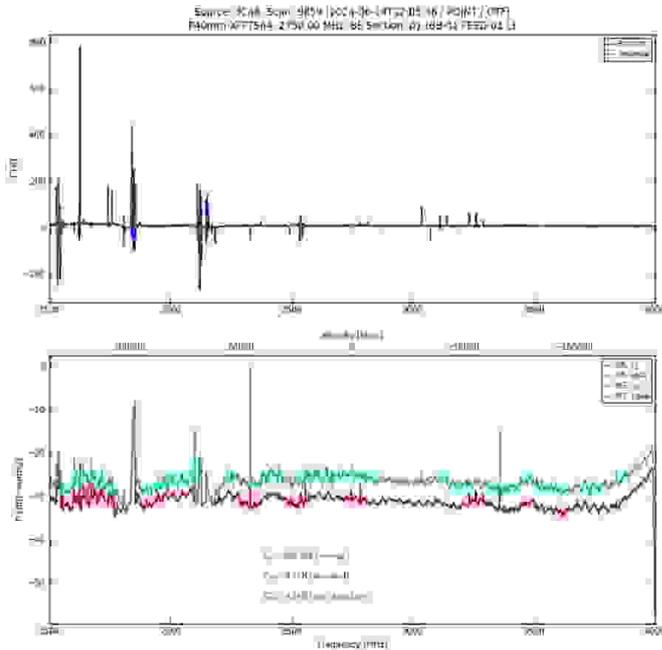
Settings: Receiver RF connected with analog optical fibre to downconverter in Faradayroom ($\sim 400m$). Downconverter: Filters of 0-4 GHz, 4-8 GHz, 8-12 GHz, with mixer and synthesizer at 4, 8, and 12 GHz, upper or lower side band on 2.5 GHz FFT spectrometer (64k channels).

BRAND test observations

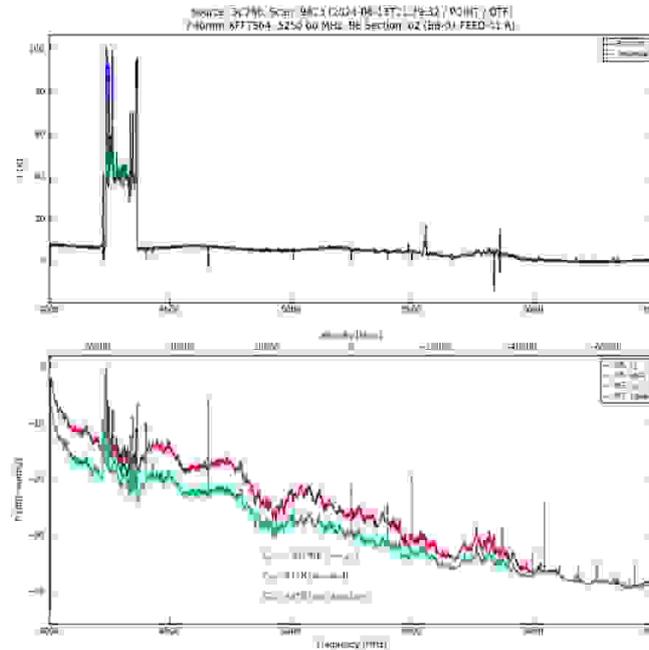


Spectrum from 1.5 to 8 GHz

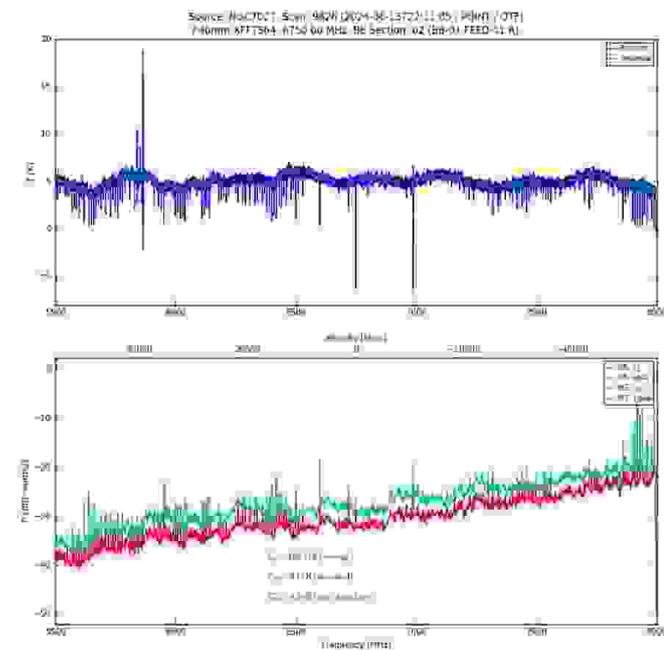
1.5 – 4 GHz



4 – 6.5 GHz



6.5 – 8 GHz



BRAND test observations



Spectrum from 6.5 to 12 GHz

6.5 – 8 GHz

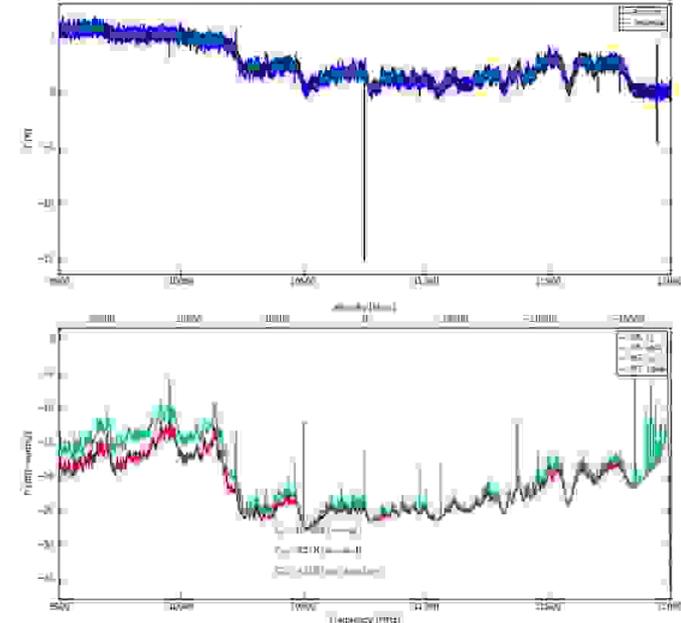
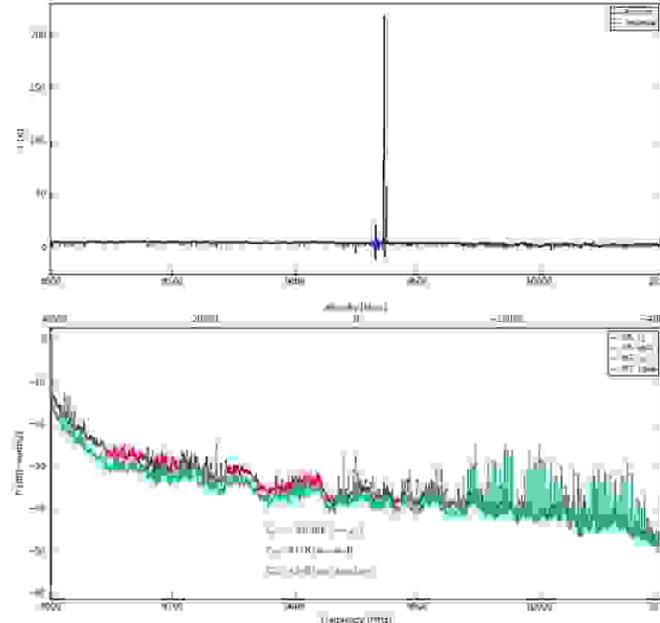
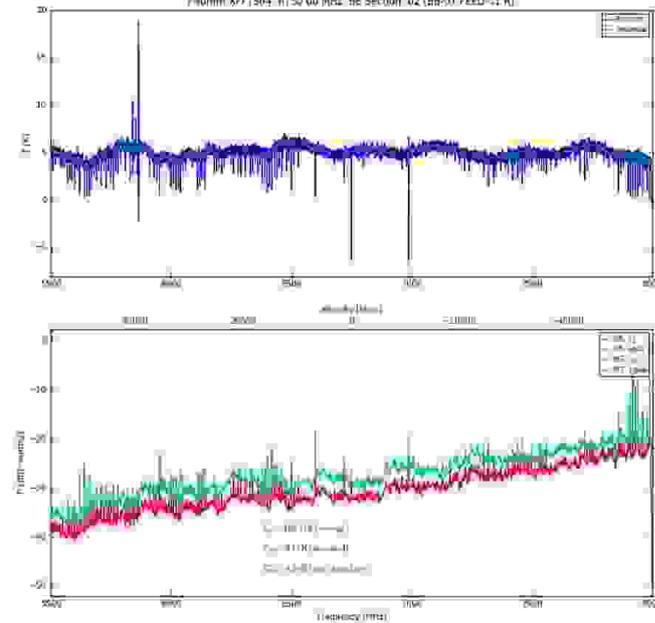
8 – 10.5 GHz

9.5 – 12 GHz

Source: HACOCT1_Scan_9629 (2024-06-13T21:11:05) [P]M0 [OTF]
740mm APFT304_6750 to MHz, BE Section 02 (BB-01 FEED-01 R)

Source: HACOCT1_Scan_9632 (2024-06-13T21:58:08) [P]M0 [OTF]
740mm APFT304_9250 to MHz, BE Section 02 (BB-01 FEED-01 R)

Source: HACOCT1_Scan_9634 (2024-06-13T21:59:00) [P]M0 [OTF]
740mm APFT304_10750 to MHz, BE Section 02 (BB-01 FEED-01 R)

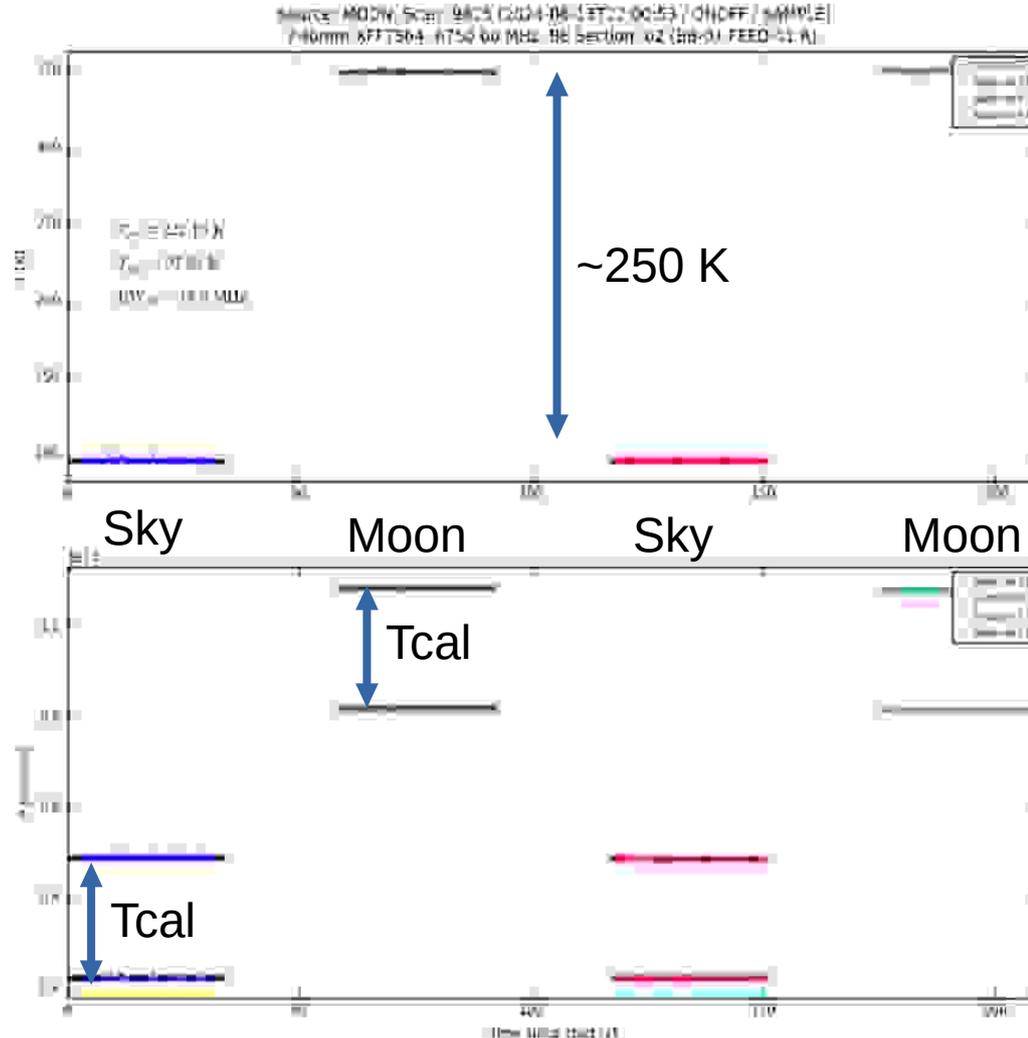


BRAND test observations



Hot-cold measurements on the Moon

- $T_{\text{sys}} \sim 80\text{-}90\text{ K}$



BRAND test observations

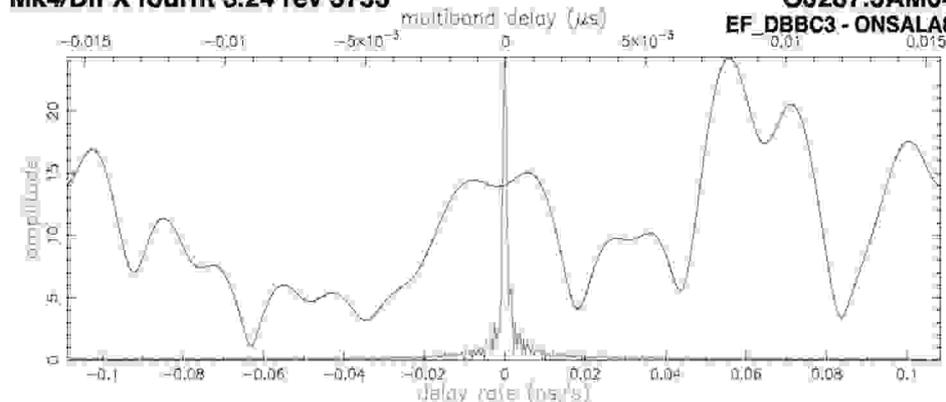


First VLBI Fringes at 4.85 GHz.

Mk4/DiFX fourfit 3.24 rev 3753

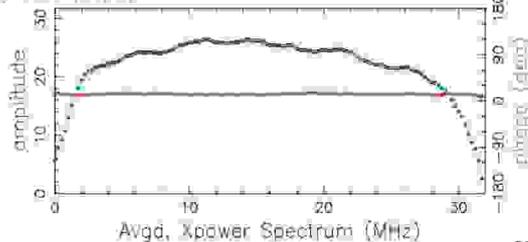
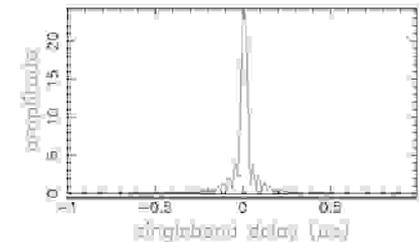
OJ287.3AM04E, No0001, EO

EF_DBBC3 - ONSALA85, fgroup C, pol LL

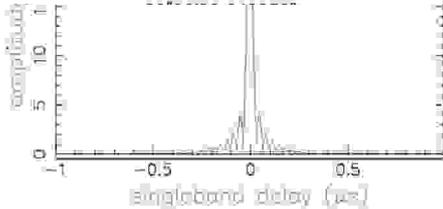


Fringe quality 2

SNR 1015.8
Int time 233.843
Amp 24.292
Phase 18.6
PFD 0.0e+00
Delays (us)
SBD 0.008945
MBD 0.007976
Fringe rate (Hz)
-0.000132
Ion TEC 0.000
Rel freq (MHz)
4600.0000
AP (sec) 1.000



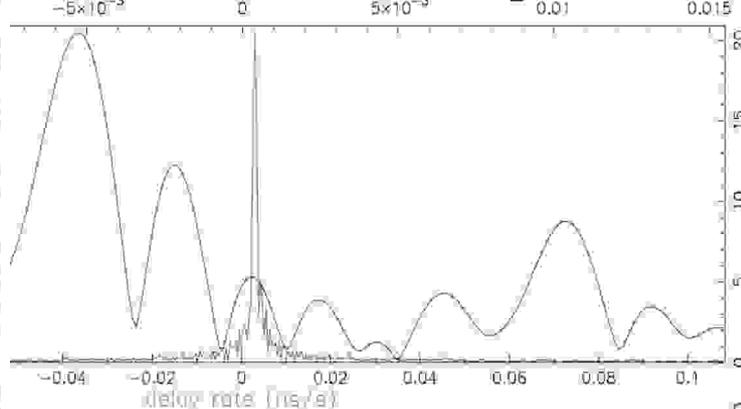
Exp. B24C1
Exper # 1234
Yr:day 2024:185
Start 160000.00
Stop 160354.00
FRT 160500.00
Corr/FF/build
2024:172:105941
2024:172:105946
2023:348:201250
RA & Dec (J2000)
08h54m48.874928s



rev 3753

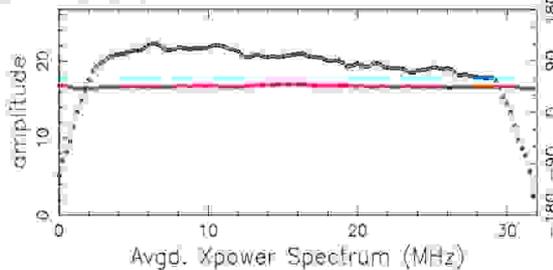
OJ287.3AM04E, No0001, EY

EF_DBBC3 - YEBES40M, fgroup C, pol RR



Fringe quality 6

SNR 873.3
Int time 233.268
Amp 20.914
Phase 51.6
PFD 0.0e+00
Delays (us)
SBD -0.004014
MBD -0.005245
Fringe rate (Hz)
0.012792
Ion TEC 0.000
Rel freq (MHz)
4600.0000
AP (sec) 1.000



Exp. B24C1
Exper # 1234
Yr:day 2024:185
Start 160000.00
Stop 160354.00
FRT 160500.00
Corr/FF/build
2024:172:105941
2024:172:105948
2023:348:201250
RA & Dec (J2000)
08h54m48.874928s

First ever lift, installation and integration of BRAND front-end has been carried over successfully over the course of 6 months.

First ever sky test and VLBI observation of BRAND front-end

First ever integration of BRAND digital front-end (used as back-end atm) will proceed soon...

With help of:

Technical and scientific staff:

Alan Roy
Parisa Rahimi
Michael Wunderlich
Sven Dornbusch
Gino Tuccari
Helge Rottmann
Christoph Kasemann
Oliver Polch
Uwe Bach
Alex Kraus
Walter Alef

Technical support staff:

Jörg Klein
Walter Schmitz
Christian Leinz
Ingo Krämer
Jan Wagner

VLBI stations staff:

Yebes:
Cristina Garcia Miro
Javier Gonzalez

Onsola:
Michael Lindqvist
Jun Yang

Medicina:
Giuseppe Maccaferri