GMVA correlations in 2018 – 2022 (sessions c182 – c212)

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GTG 09/02/2022

Fringe Tests 1

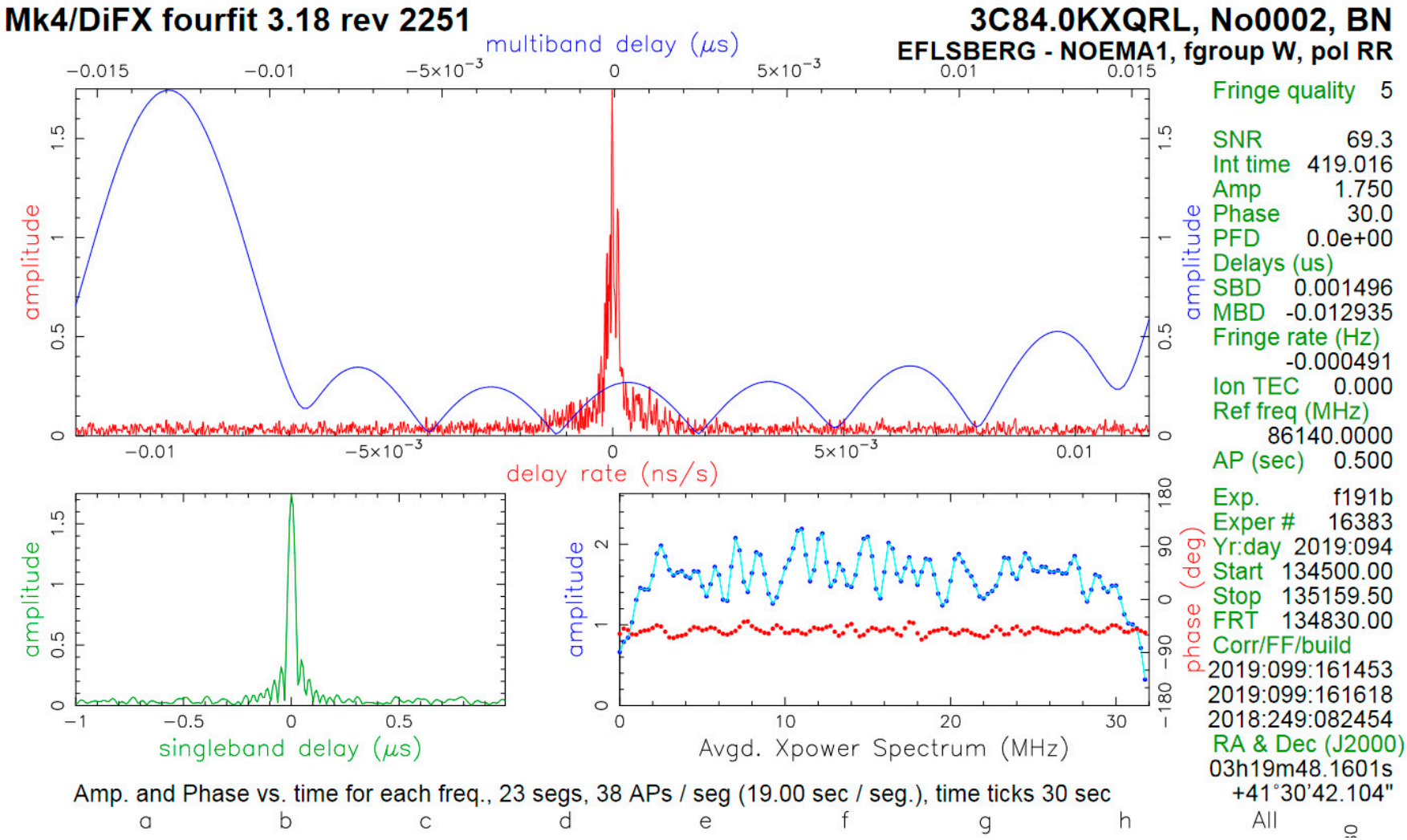
- **f191a**: 1 hr
  - 4 Gbps test of the GMVA.
  - *including* VLBA stations
  - config: VLBA – RDBE DDC 4 x 128 MHz
    Pv, On, Ys, Mh, Ef – DBBC2 8 x 64 MHz
    P3 – Pv with DBBC3 – 16 x 32 MHz
    NOEMA – R2DBE 1 x 2048 MHz

  more config details: MPIfR deki ”GMVA 4Gbps test (4.4.2019)”
- **f191b**: 2.5 hrs
  - usual 2 Gbps config for Pv, On, Ys, Mh, Ef
  - P3 and NOEMA in the same config as in f211a

Success in both tests, good fringes to all stations in all modes. some peculiarities: linear polarization in NOEMA, phase jumps between the subbands in P3.

Fringe Tests 2

- f191a, first GMVA fringes to NOEMA after the upgrade



Fringe Tests 3

- **f192a**: 4 Gbps becoming standard at this point
  - Ef, On, Ys, Mh, Pv with DBBC2
  - P3 = Pv with DBBC3
  - O6 = On DBBC2 with v107_beta4 instead of v107_beta3

  Success, only some minor problems with Ys

  LCP fringes are weaker than RCP, attributed to the board serving LCP (C) not being properly calibrated, later in the session the LCP IF was switched to board B.

  and P3 phases still need manual alignment.

Fringe Tests 4

- **f201a** Covid era starts…
  - only Ef, On, Ys, Mh in usual config (no Ys or Pv)
  - mostly success, minor problem at Mh
    "V-shape" (low middle channel amplitudes) due to a DBBC misconfiguration, fixed after the test)
  - BUT NO fringes to Ef!
- **f201b** additional emergency fringe test
  - Ef, On, Mh + Eb (Ef with RDBE, unfortunately misconfigured and useless)
  - Discovered 2 MHz LO frequency shift in Ef config due to a setup error, after fixing it fringes found to both On and Mh. **Success!**

Fringe Tests 5

- **f202a**
  - Ef, On, Ys, Mh, Pv in usual config
  - starts with testing 88 GHz mode, then back to 86 GHz

  Ef, On, Mh **fine**. **Problems** with Ys and Pv.

  Ys: very low power from the receiver in 88 GHz mode and no fringes. Polarization problems in 86 GHz, reason immediately found: λ/4 plates not installed.

  Pv: no fringes at all, wrongly set clock found to be responsible. After resetting the clock fringes confirmed in c202a (in 86 GHz), later confirmed that 88 GHz was also OK.

  Success!

Fringe Tests 6

- **f211a**
  - Ef, On, Mh, Pv, Nn
    (Ys not participating due to blind repairs)
  - Pv used DBBC3 in DDC_U_125 mode
  - **Success**, no problems found!

Fringe Tests 7

- **f212a**
  - Ef, On, Ys, Mh, Pv, Nn
  - SLACK blackout affected communication with the participants
  - Mostly without problems:
    - Pv pol swap, fixed.
    - only RCP fringes to NOEMA

    one of the polyfix units at the NOEMA correlator lost time synchronisation, resulting in adding integer seconds to vdif headers, fixed after the problem was understood.

    A scan from c212a confirmed fringes in both LCP and RCP.

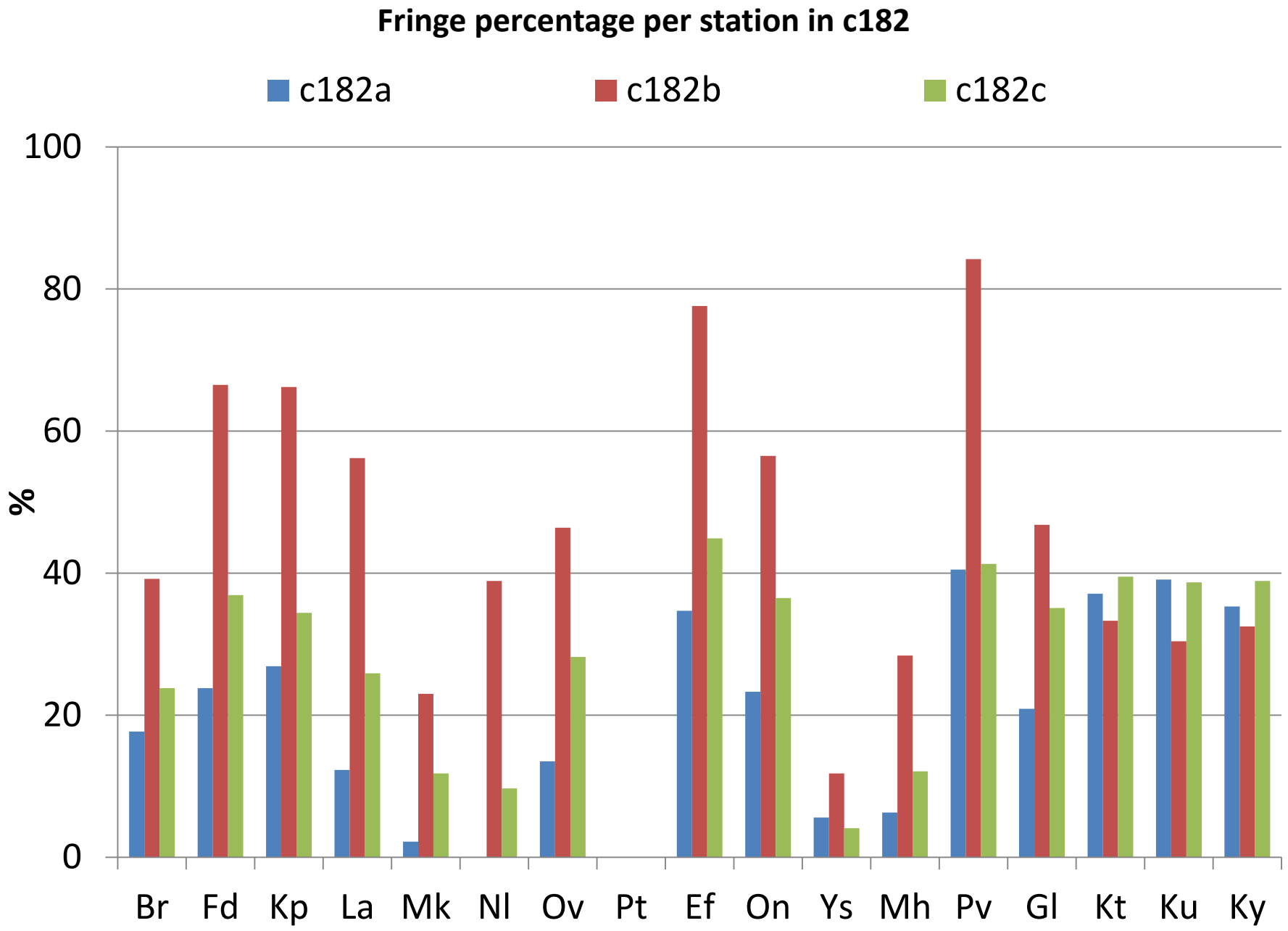
    Success!

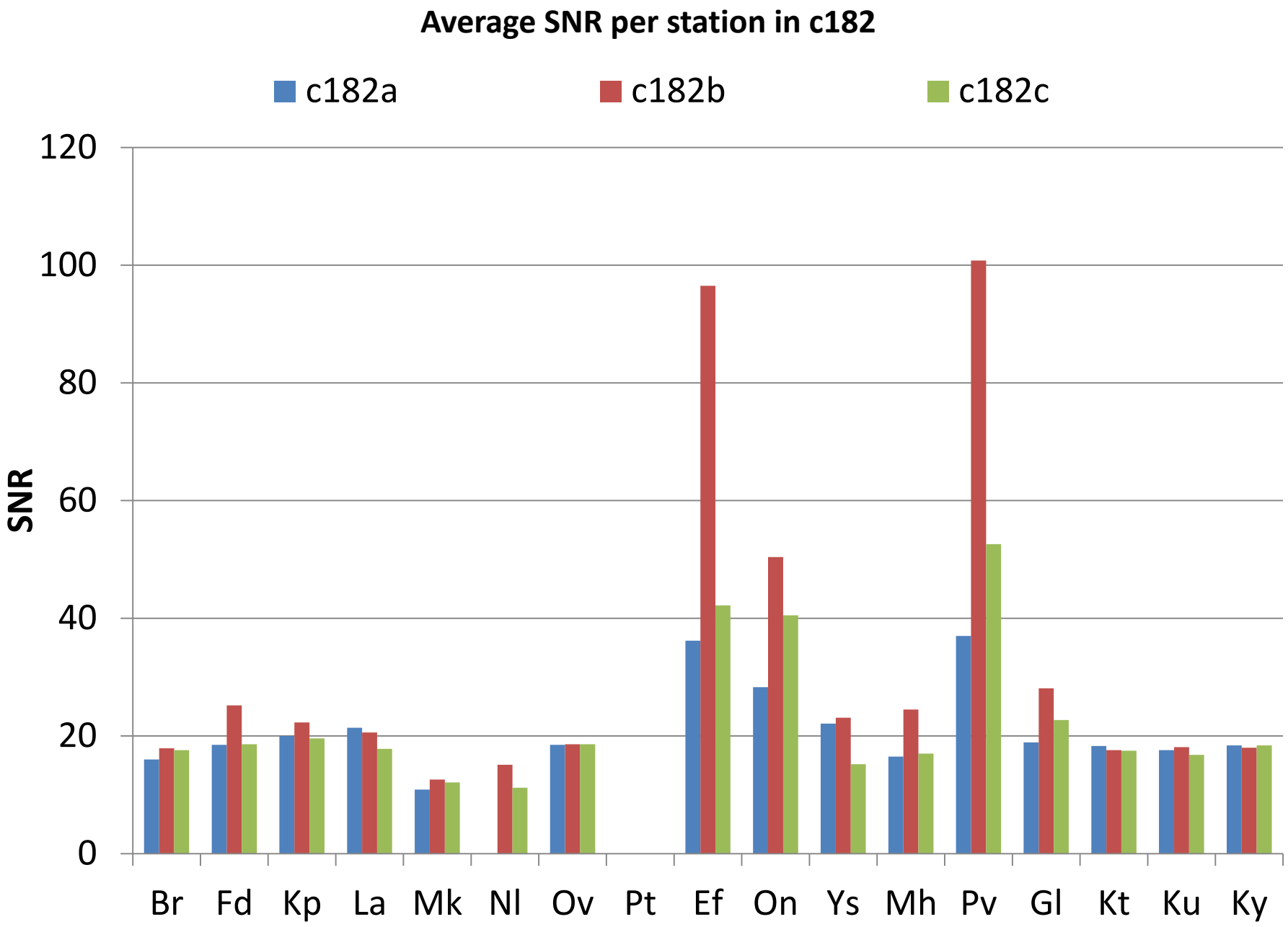
Main runs: c182

3 correlation blocks, 3 science experiments.

- GLT polarization problem (unknown polarization), never really fixed
- almost no fringes to KVN in a and b, but fixed in c
- All Pt data lost due to a Mk5 malfunction, some of Nl data recorded to an unknown Mk5 module and never found

But the main problem: **all VLBA antennas** suffer from **a control software bug**, making them to start observations late, sometimes losing up to 50% of observing time. Later fixed.


Fringe percentage per station in c182
c182a
c182b
c182c
100
80
60
40
20
0
%
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Ef
On
Ys
Mh
Pv
Gl
Kt
Ku
Ky


Average SNR per station in c182
c182a
c182b
c182c
SNR
120
100
80
60
40
20
0
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Ef
On
Ys
Mh
Pv
Gl
Kt
Ku
Ky

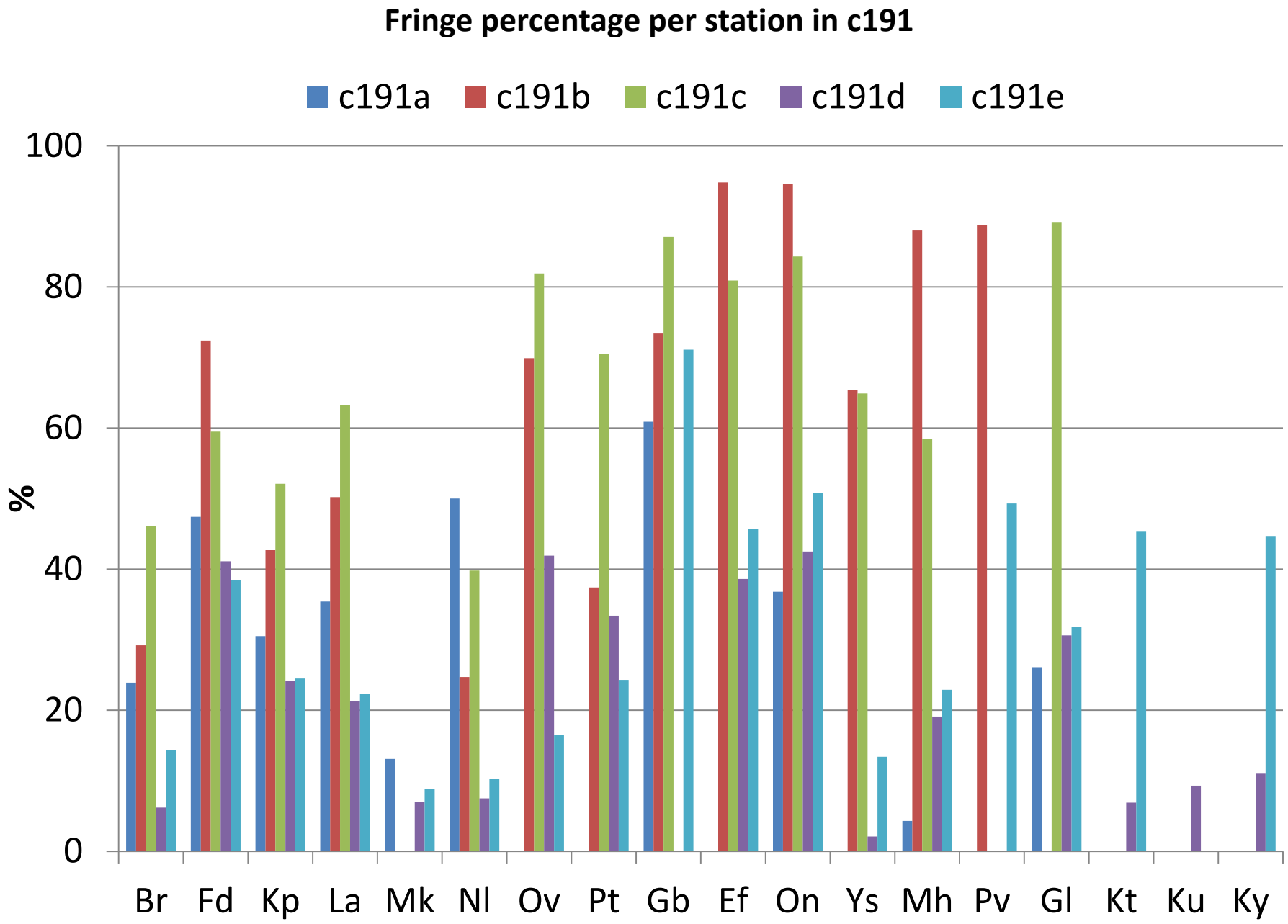
Main runs: c191

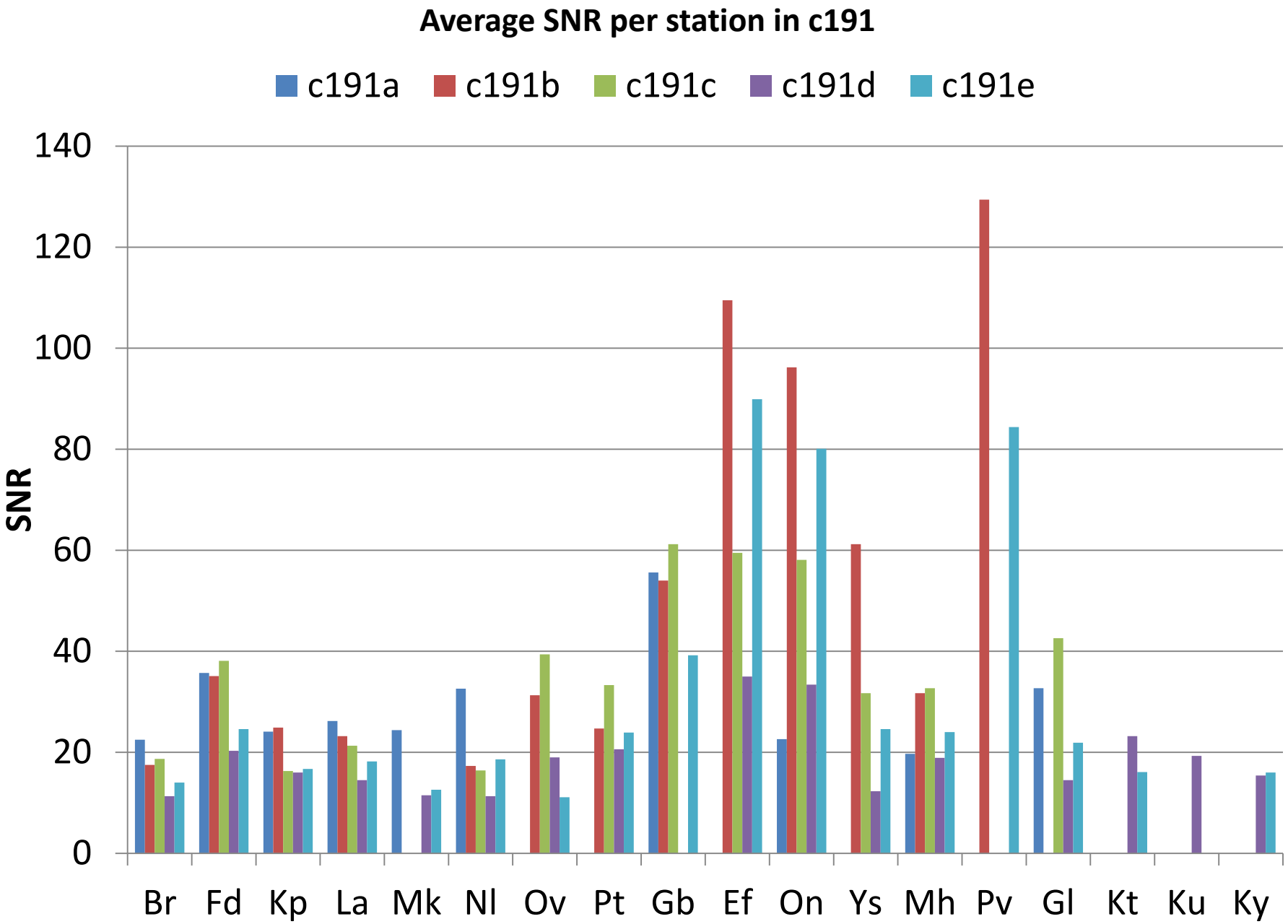
5 correlation blocks, 7 science experiments

- ALMA completely lost due to bad weather
- Pv also partially lost due to bad weather
- Mk: 3mm receiver replaced and too warm
- KVN – only a few fringes

Had to do an **additional release** after a few months (not a recorrelation, just extra postprocessing):

there were duplicate autocorrelation entries in the correlator output which lead to incorrect results of AIPS ACCOR.


Fringe percentage per station in c191
c191a
c191b
c191c
c191d
c191e
100
80
60
40
20
0
%
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Gb
Ef
On
Ys
Mh
Pv
Gl
Kt
Ku
Ky


Average SNR per station in c191
c191a
c191b
c191c
c191d
c191e
SNR
140
120
100
80
60
40
20
0
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Gb
Ef
On
Ys
Mh
Pv
Gl
Kt
Ku
Ky

Main runs: c192

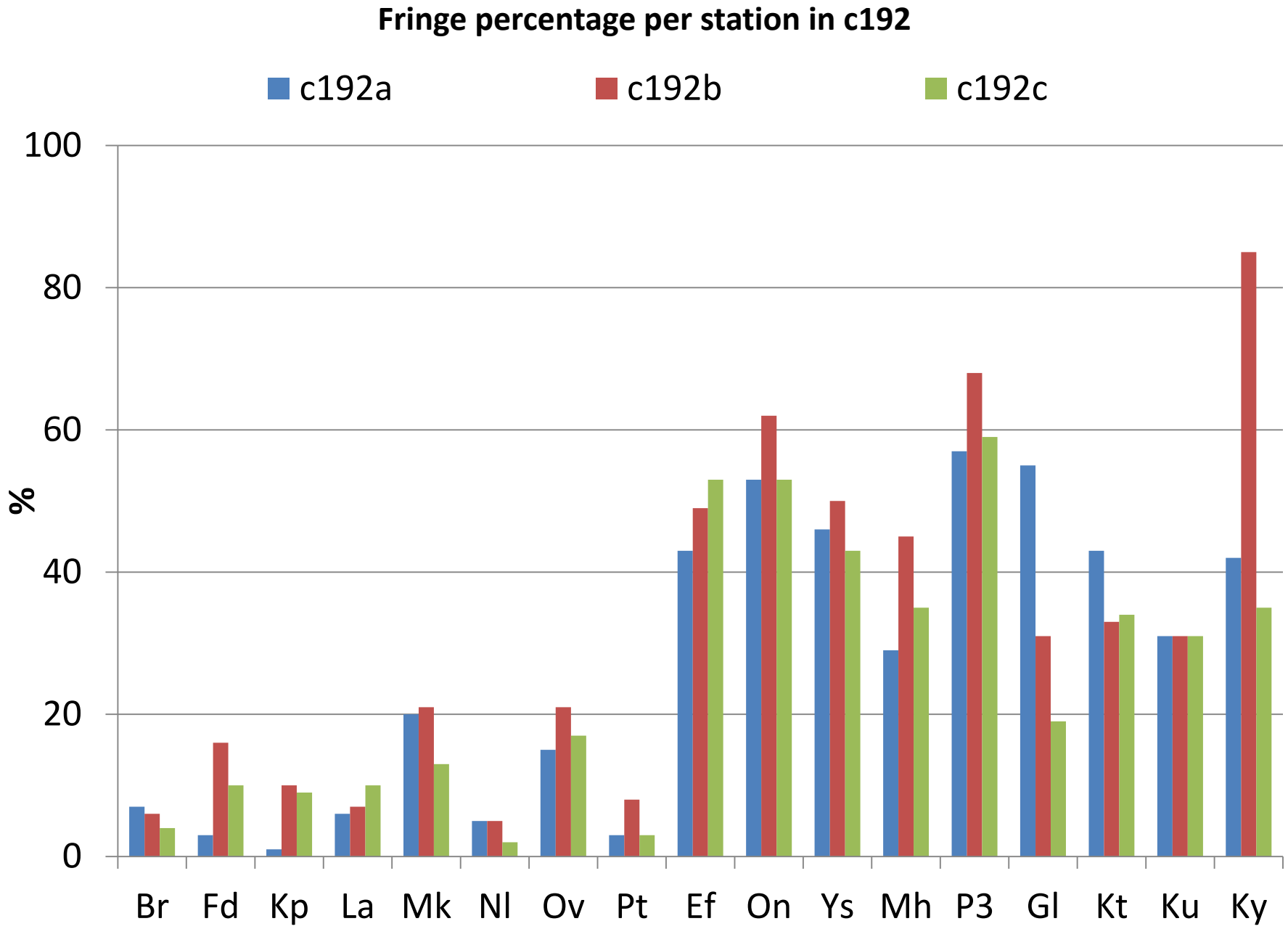
3 correlation blocks, 3 science experiments

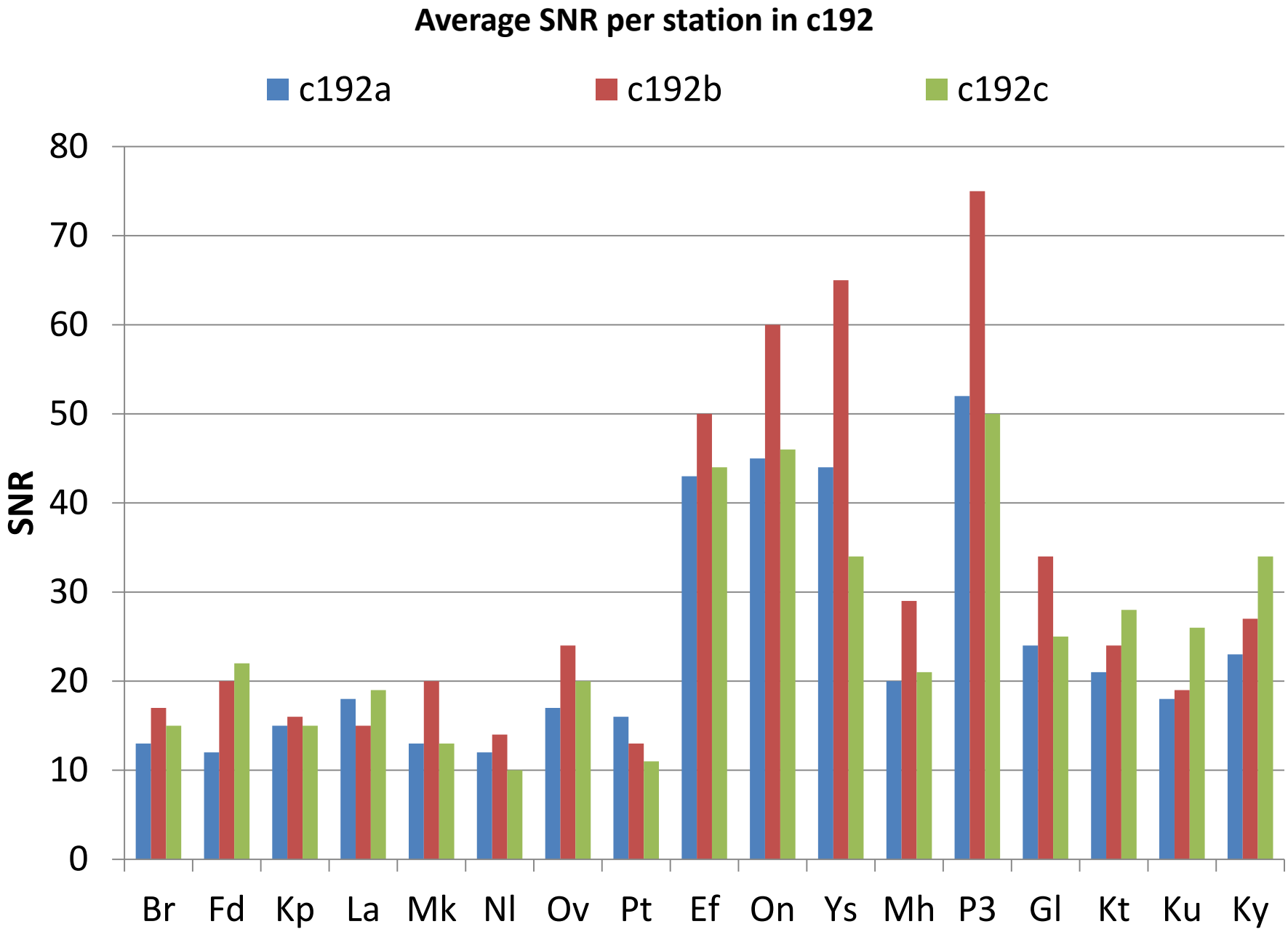
- KVN observed in 8 x 64 MHz mode for the first time, drastically improving its performance
- MB011B was correlated with 2 phase centers for the main target, Cygnus A
- Pv DBBC2 data lost most of LCP due to an unknown recording error (somehow fixed by the end of the session).

Thus there were two correlations in the release: normal 8 x 64 MHz with Pv LCP missing, and an additional 16 x 32 MHz, where Pv was replaced with P3 (DBBC3 recorded for testing purposes). The latter had both pols, but required (a lot of) additional processing:

because DBBC3 was still in the commissioning stage, phase instability and small amplitude insonsistencies for different boards were found due to hardware problems. To compensate for this, additional per band delay corrections were determined and applied during the correlation.

See the details at MPIfR Deki “Special processing of P3 (Pico Veleta DBBC3) data in C192 session”.


Fringe percentage per station in c192
c192a
c192b
c192c
100
80
60
40
20
0
%
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Ef
On
Ys
Mh
P3
Gl
Kt
Ku
Ky


Average SNR per station in c192
c192a
c192b
c192c
SNR
80
70
60
50
40
30
20
10
0
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Ef
On
Ys
Mh
P3
Gl
Kt
Ku
Ky

Main runs: c192 – VLBA problem (1)

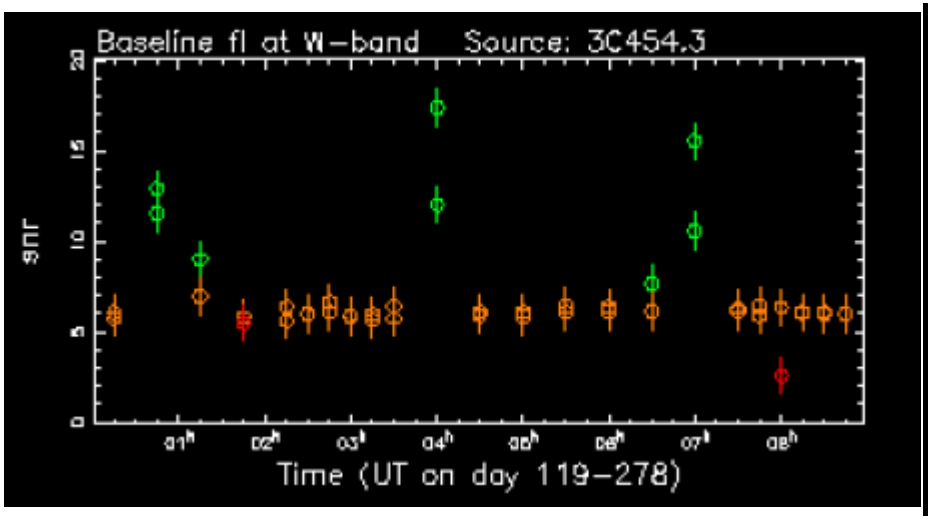
- But the main problem in c192 was the enigmatic drop of the VLBA efficiency.

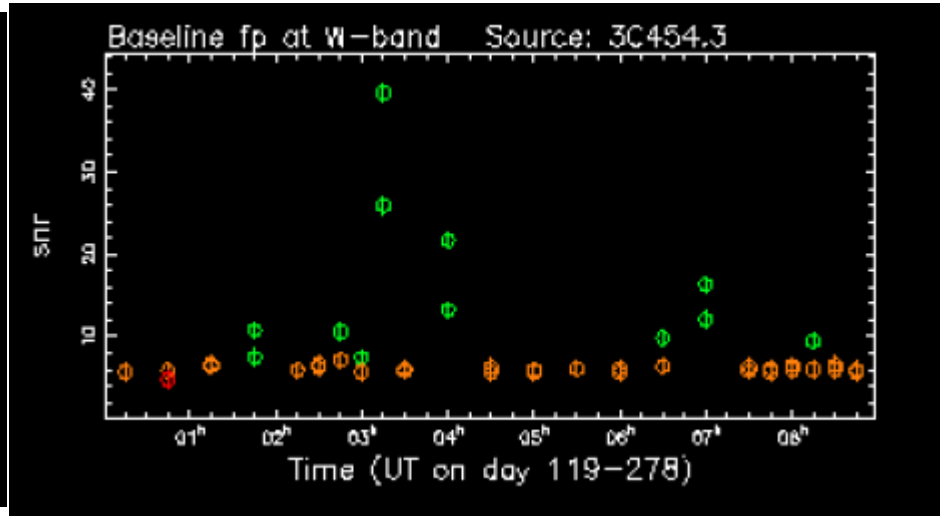
see my memo (13.12.2019) “Preliminary correlation report for Fall 2019 GMVA session (c192) addressing the "no VLBA fringes" issue” on the deki.

Main runs: c192 – VLBA problem (2)

It seemed that there were no permanent attenuation or filtering, rather VLBA antennas just "flickered" on and off. And it was related to repointing scans. Long story short, it **indicated a bug in the new VLBA pointing software**, that was successfully found and fixed.

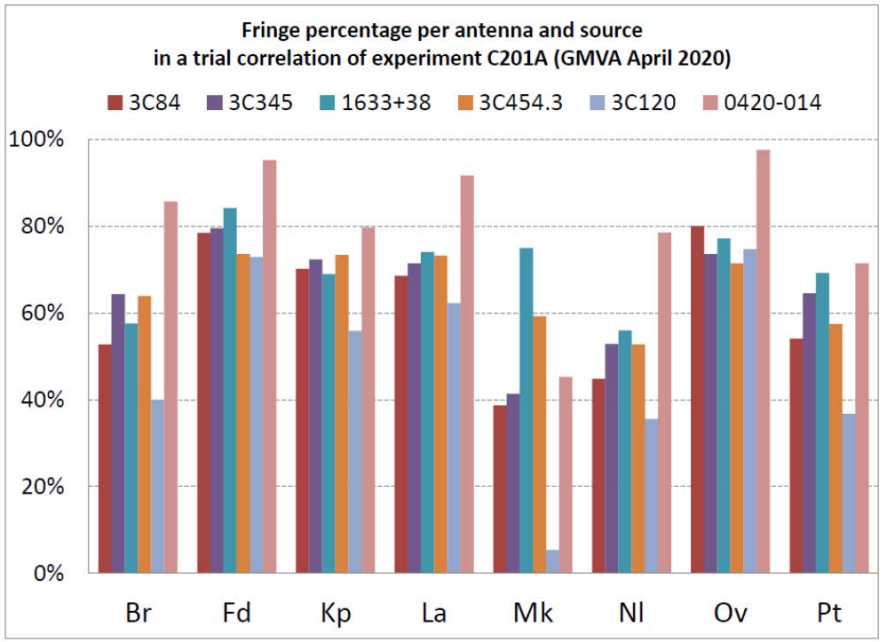
day 278	fk	fl	fm	fn	fo	fp	km	ko	kp	lm	ln	lo	lp	mn	mo	mp	no	op
scan 161 UT03:30-38	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	8/0	0/0	0/0	10/0	9/10	0/0	8/0	0/0	0/0
scan 165 UT04:00-10	21/29	17/12	19/28	11/16	130/182	13/22	17/19	59/58	24/20	10/0	0/0	43/21	9/0	0/0	70/62	11/10	28/24	40/37
scan 169 UT04:30-40	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	19/11	8/0	14/0	19/11	0/0	9/0	17/14	0/0	0/0

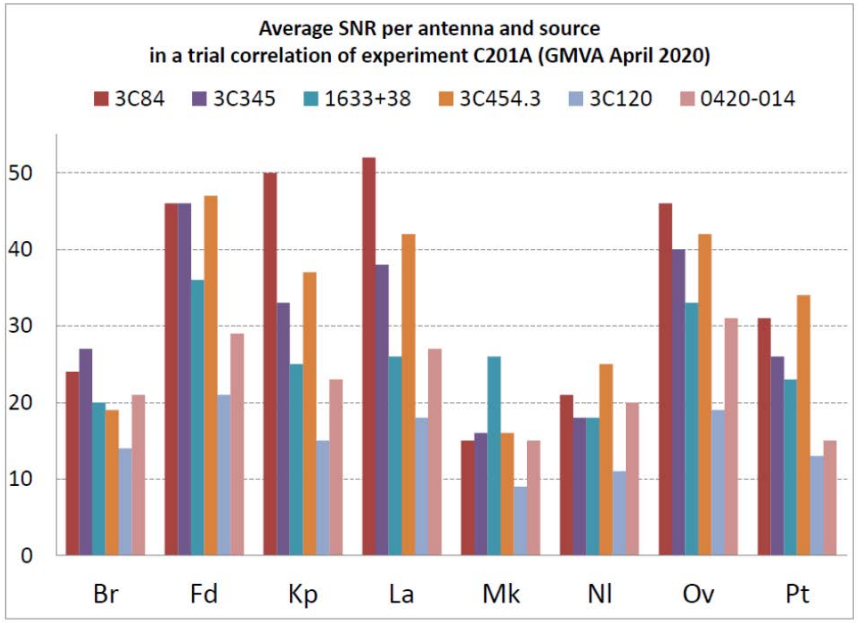




Main runs: c201 – VLBA problem (3)

All fixed! See my another memo on the deki (30.06.2020): "VLBA performance report based on a preliminary correlation of a part of C201A experiment of the GMVA April 2020 session."



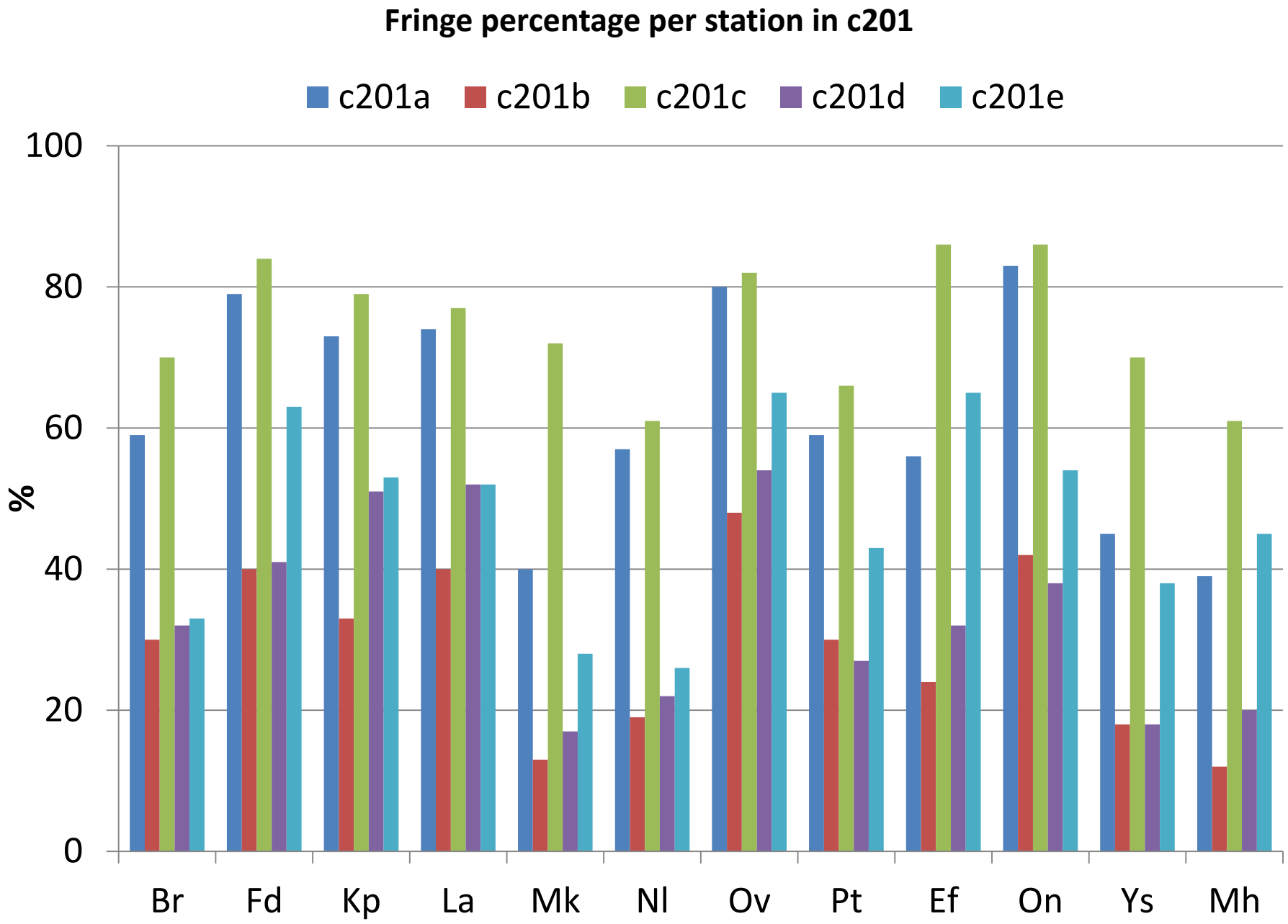


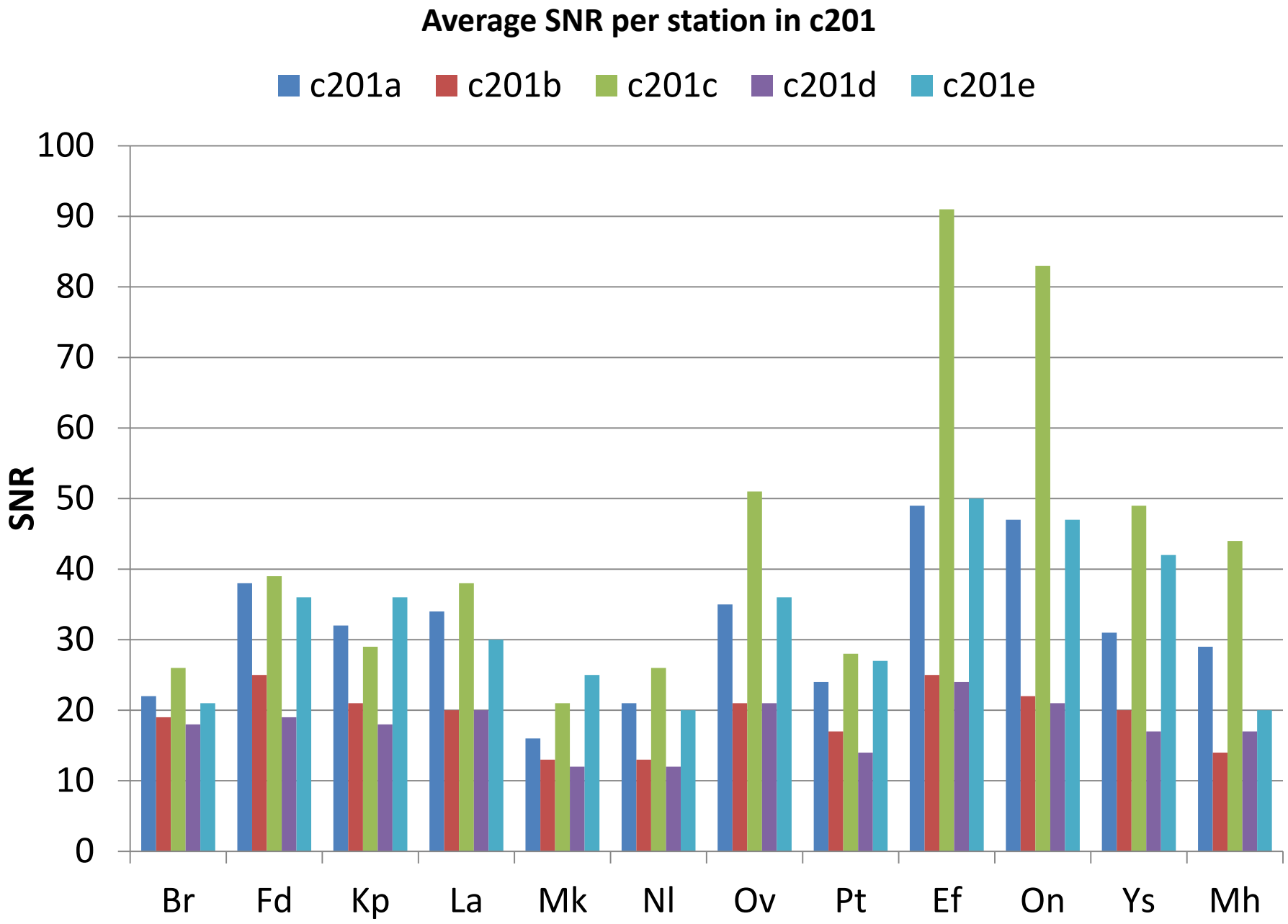
Main runs: c201

5 correlation blocks, 5 science experiments

- Due to corona no ALMA, Pv, GLT or NOEMA
- And KVN lost all data because of a disk failure before it was transferred
- Ef accidentally recorded RCP to both channels in a and part of b, but it was fixed later.

Other than this it was mostly a good and uneventful session.


Fringe percentage per station in c201
c201a
c201b
c201c
c201d
c201e
100
80
60
40
20
0
%
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Ef
On
Ys
Mh


Average SNR per station in c201
c201a
c201b
c201c
c201d
c201e
SNR
100
90
80
70
60
50
40
30
20
10
0
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Ef
On
Ys
Mh

Main runs: c202

3 correlation blocks, 11 science experiments

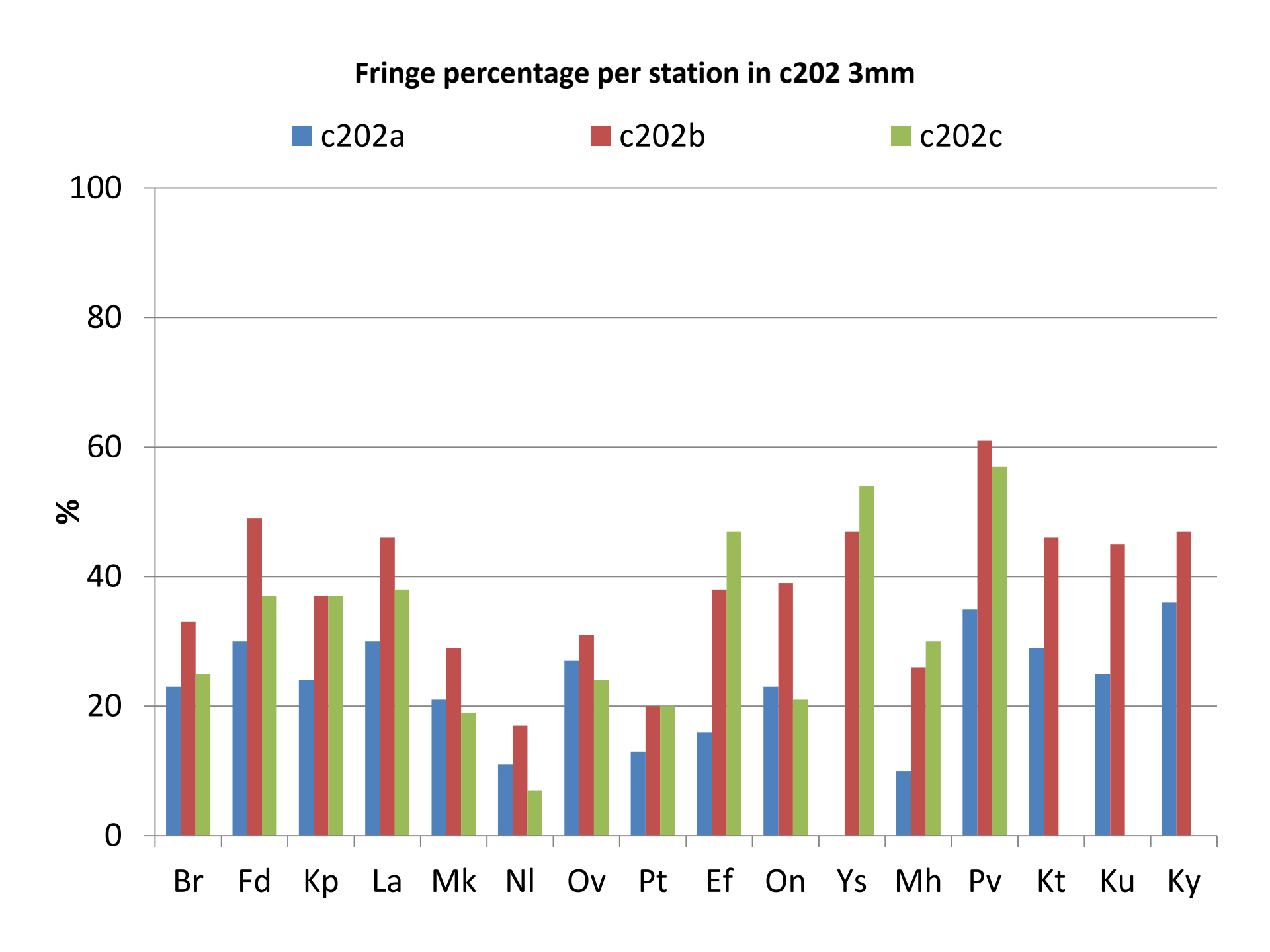
included 3mm and 7mm parts, and a part at 88GHz

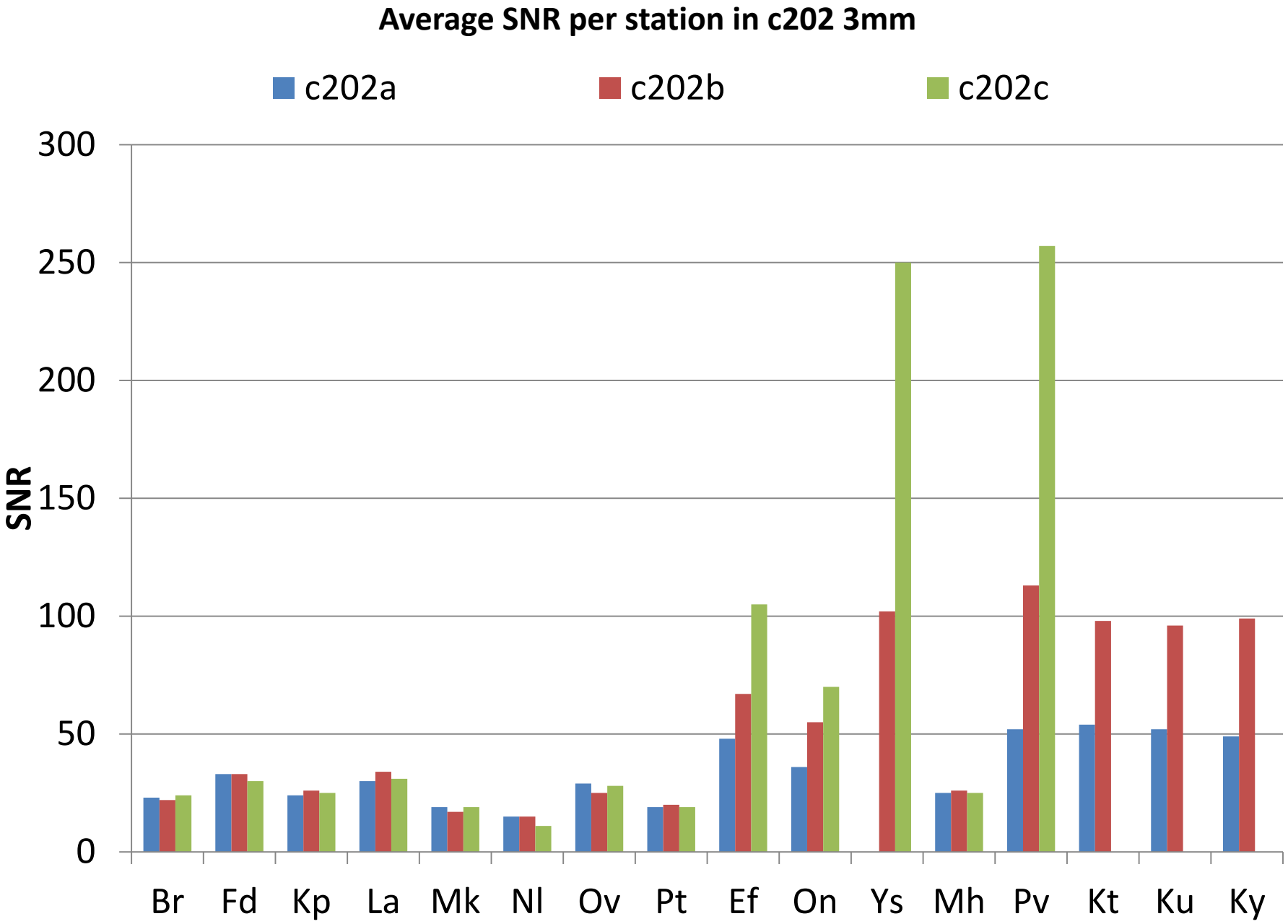
- Some strange clock problem at Ys:

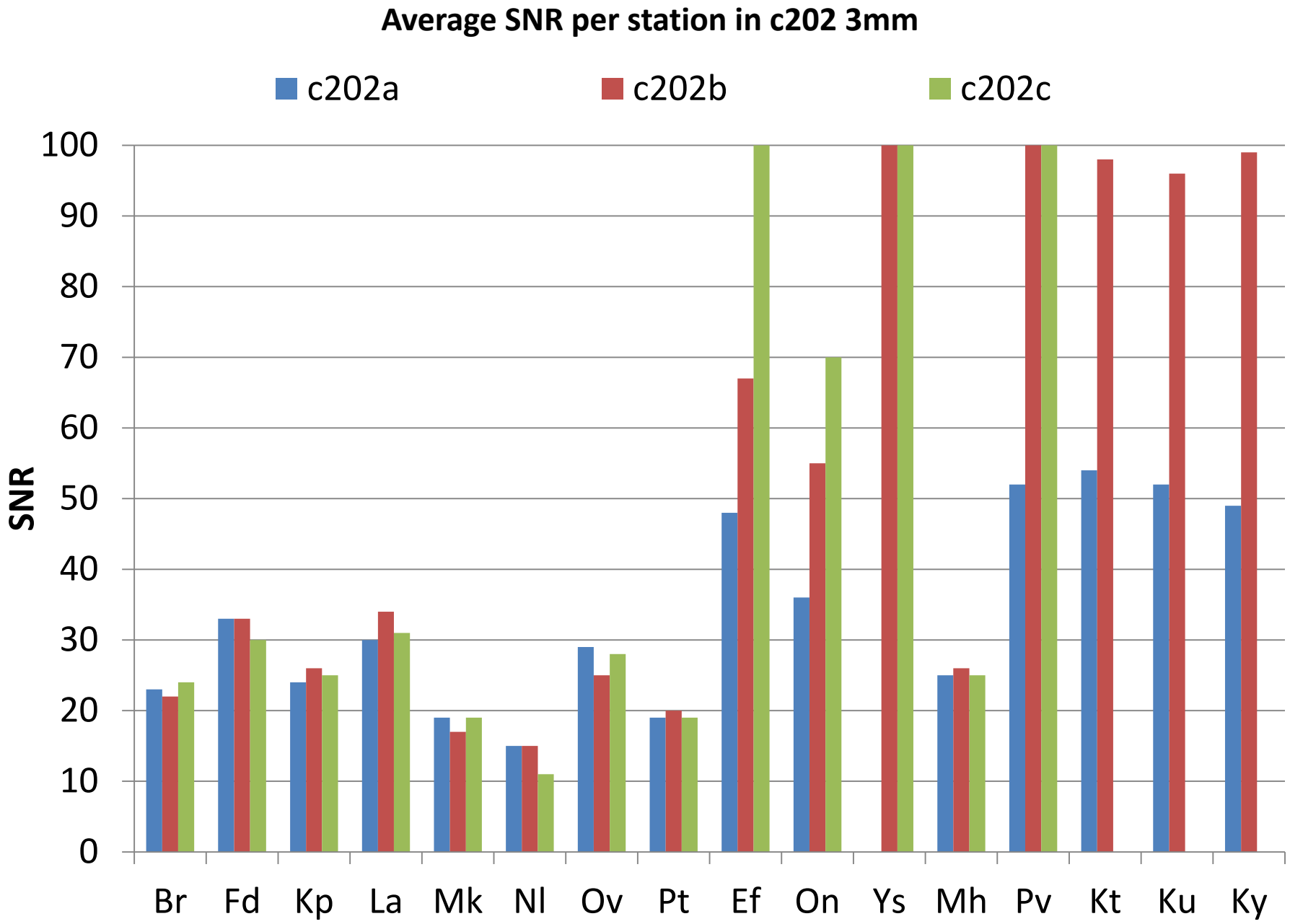
fringes found in the fringe test and part b (with clock values differing by 0.5us!), but not in part a despite an extensive search

- technical problems at Pt, Hn, and On (receiver problems by the end of the session), resulting in some loss of time

Other than that – just another nice session


Fringe percentage per station in c202 3mm
c202a
c202b
c202c
100
80
60
40
20
0
%
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Ef
On
Ys
Mh
Pv
Kt
Ku
Ky


Average SNR per station in c202 3mm
c202a
c202b
c202c
SNR
300
250
200
150
100
50
0
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Ef
On
Ys
Mh
Pv
Kt
Ku
Ky


Average SNR per station in c202 3mm
c202a
c202b
c202c
SNR
100
90
80
70
60
50
40
30
20
10
0
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Ef
On
Ys
Mh
Pv
Kt
Ku
Ky

Main runs: c211 – parts without ALMA

3 correlation blocks, 7 science experiments

included 3mm and 7mm parts

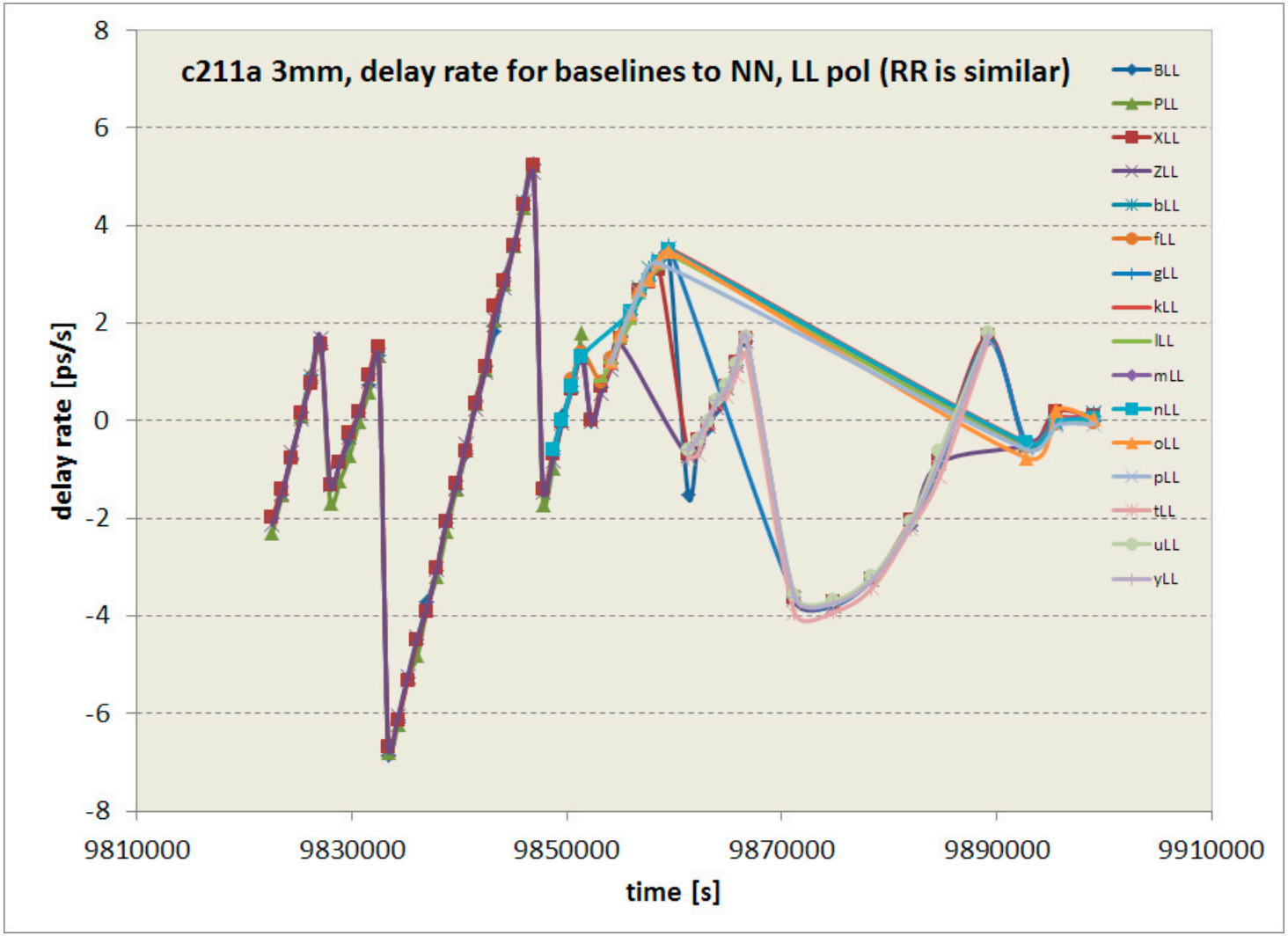
- Almost full house (Ys participated in a few scans and dropped, was still undergoing blind repairs).
- But other than that the GMVA in all its beauty: Ef, On, Mh, Pv, Nn, GLT, VLBA + GBT, KVN

However:

- Pv missed a lot of scans due to bad weather
- GBT had pointing problems and was not on source for some scans
- GLT – originally problems finding fringes, but with the fixed correlation setup excellent performance
- NOEMA showed some strange fringe rate drift, originally attributed to software glitches and fixed by applying several clock values per experiment. But after the full correlations were made and residuals plotted, it became clear that the phase center of the array needs adjustment. With the fixed position the drift is almost completely gone, right now the new release is in preparation with this adjustment applied (recorrelations of parts a and b finished).

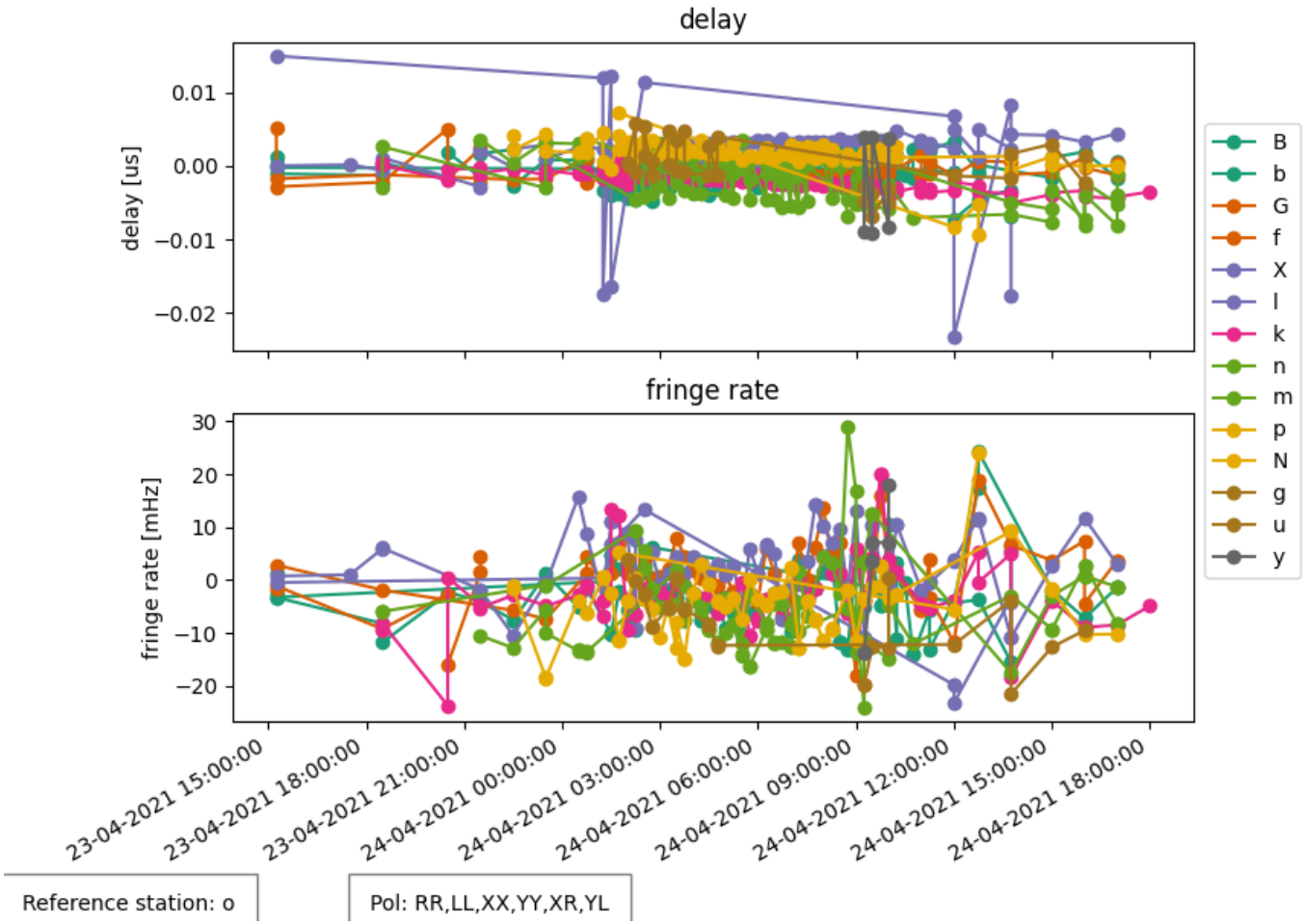
NOEMA in c211

- before recorrelation



NOEMA in c211

- after recorrelation
  (Nn is no different from the others)

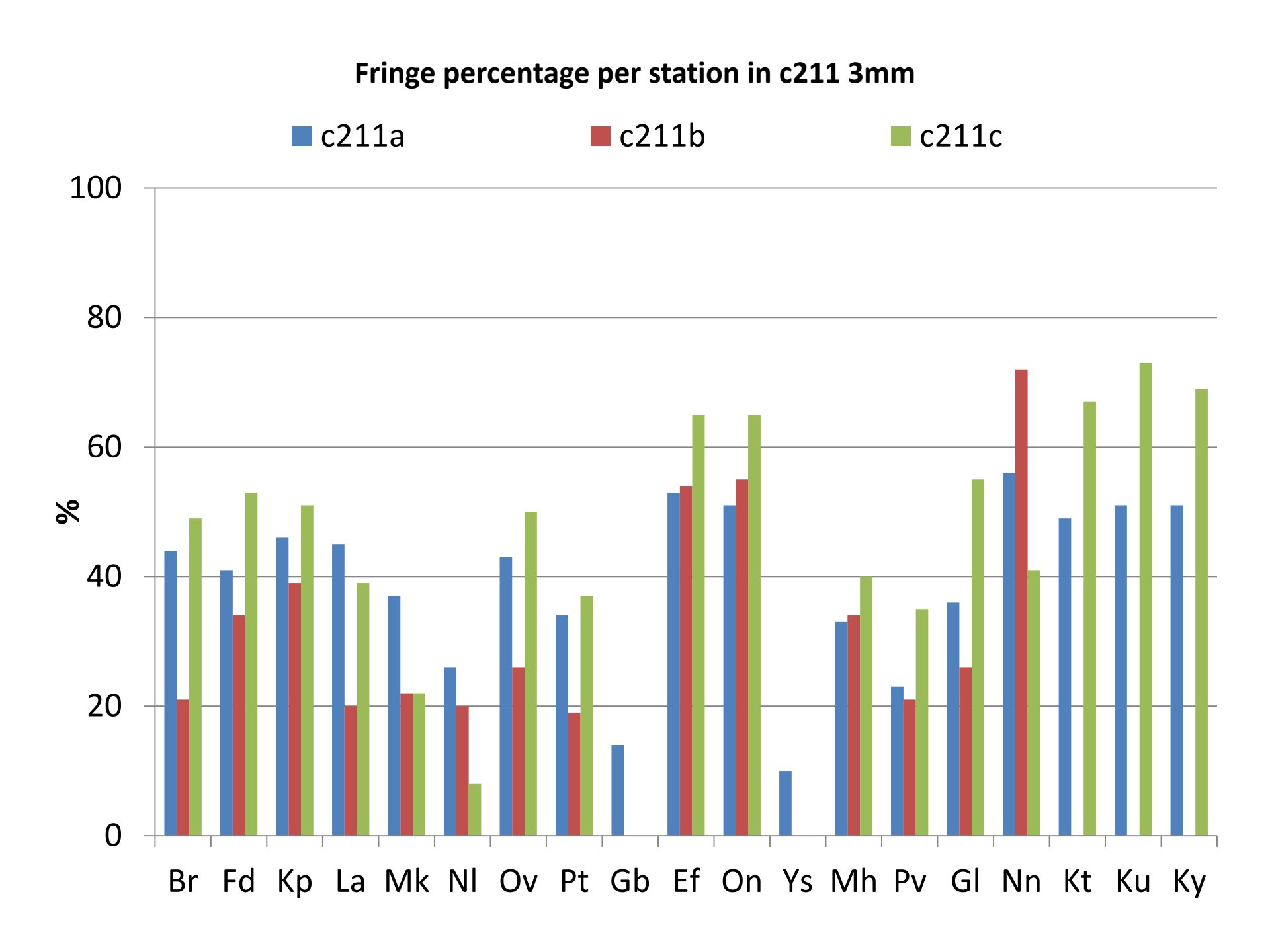


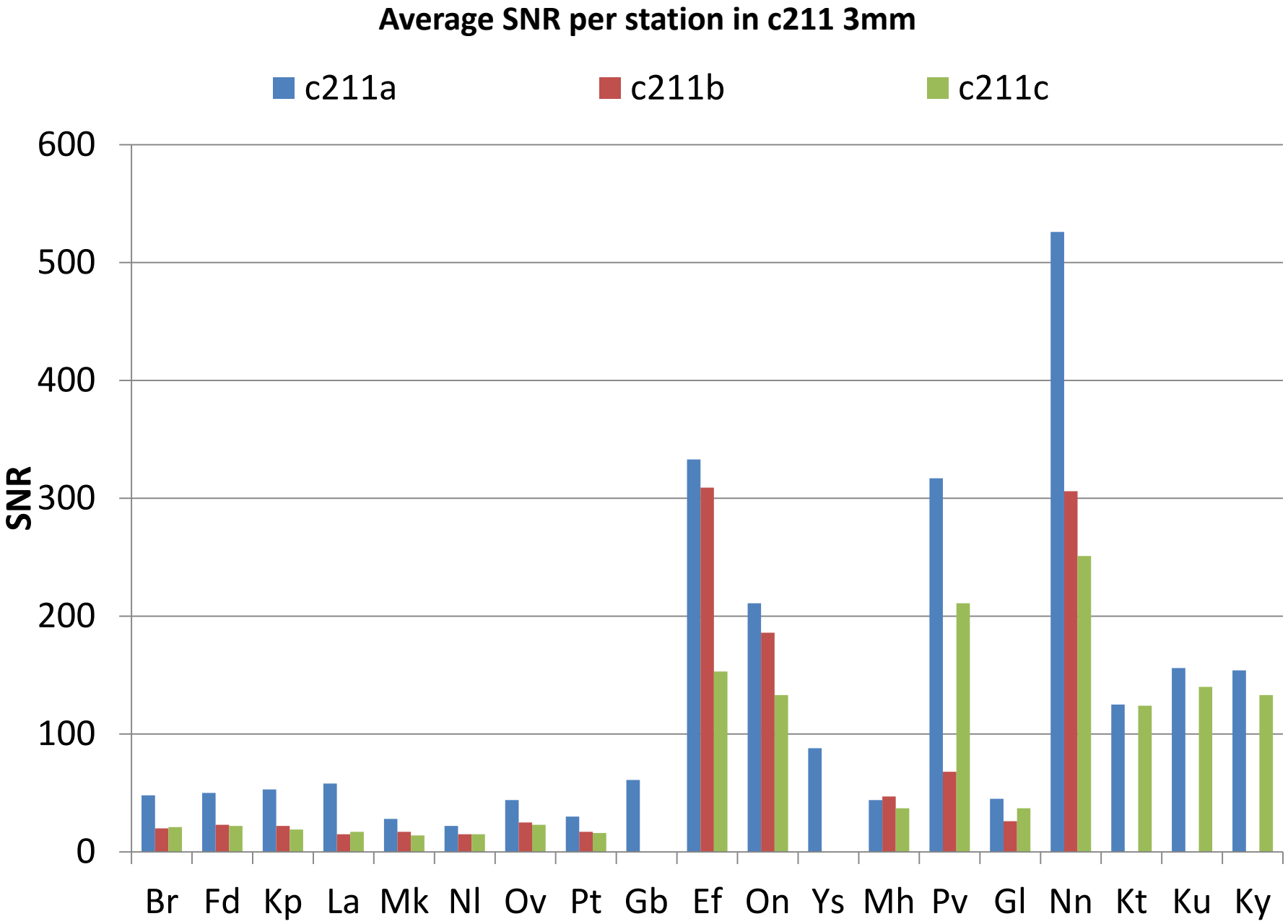
Delays statistics

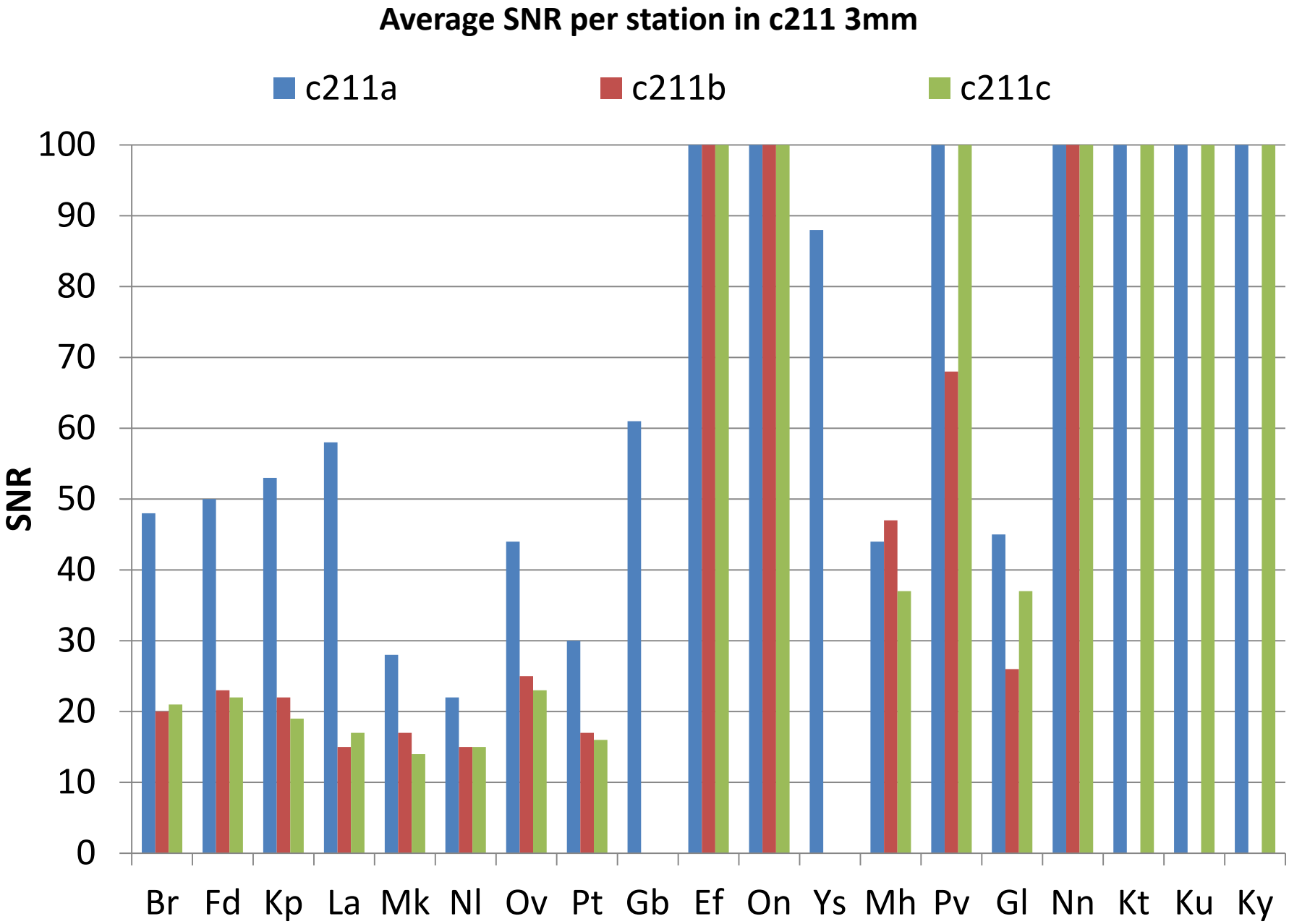
st	#pts	mean	std. dev
B	20	-0.0025	0.002448
b	80	+0.0001	0.001775
G	07	+0.0005	0.003311
f	68	-0.0007	0.000975
X	10	-0.0009	0.014727
l	76	+0.0025	0.001349
k	103	-0.0021	0.000993
n	55	-0.0020	0.003000
m	51	-0.0012	0.003084
p	73	+0.0019	0.001111
N	04	-0.0039	0.006573
g	23	+0.0012	0.002491
u	06	-0.0044	0.001392
y	06	-0.0025	0.006310

Fringe rate statistics

st	#pts	mean	std. dev
B	20	+0.2308	4.891862
b	80	-3.5828	6.386088
G	07	-3.5160	6.415865
f	68	+1.5909	5.983639
X	10	-2.3946	10.846425
l	76	+2.7285	6.579684
k	103	-2.3873	6.082024
n	55	-1.2230	7.444094
m	51	-9.3038	5.045502
p	73	-4.6263	5.440673
N	04	+11.9328	12.717023
g	23	-6.5873	5.599552
u	06	-12.8623	6.718034
y	06	+1.3673	11.570975


Fringe percentage per station in c211 3mm
c211a
c211b
c211c
100
80
60
40
20
0
%
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Gb
Ef
On
Ys
Mh
Pv
Gl
Nn
Kt
Ku
Ky

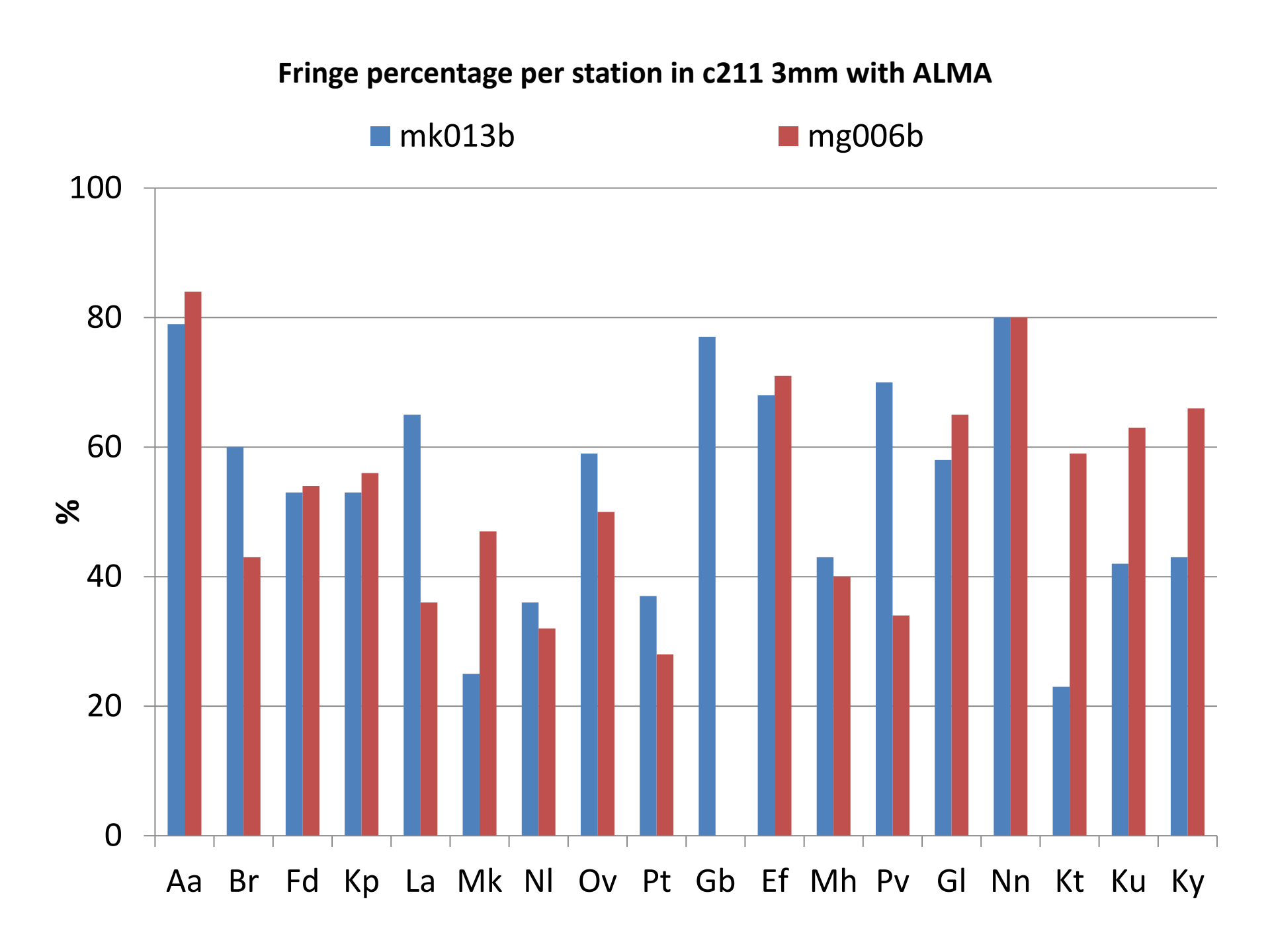

Average SNR per station in c211 3mm
c211a
c211b
c211c
SNR
600
500
400
300
200
100
0
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Gb
Ef
On
Ys
Mh
Pv
Gl
Nn
Kt
Ku
Ky

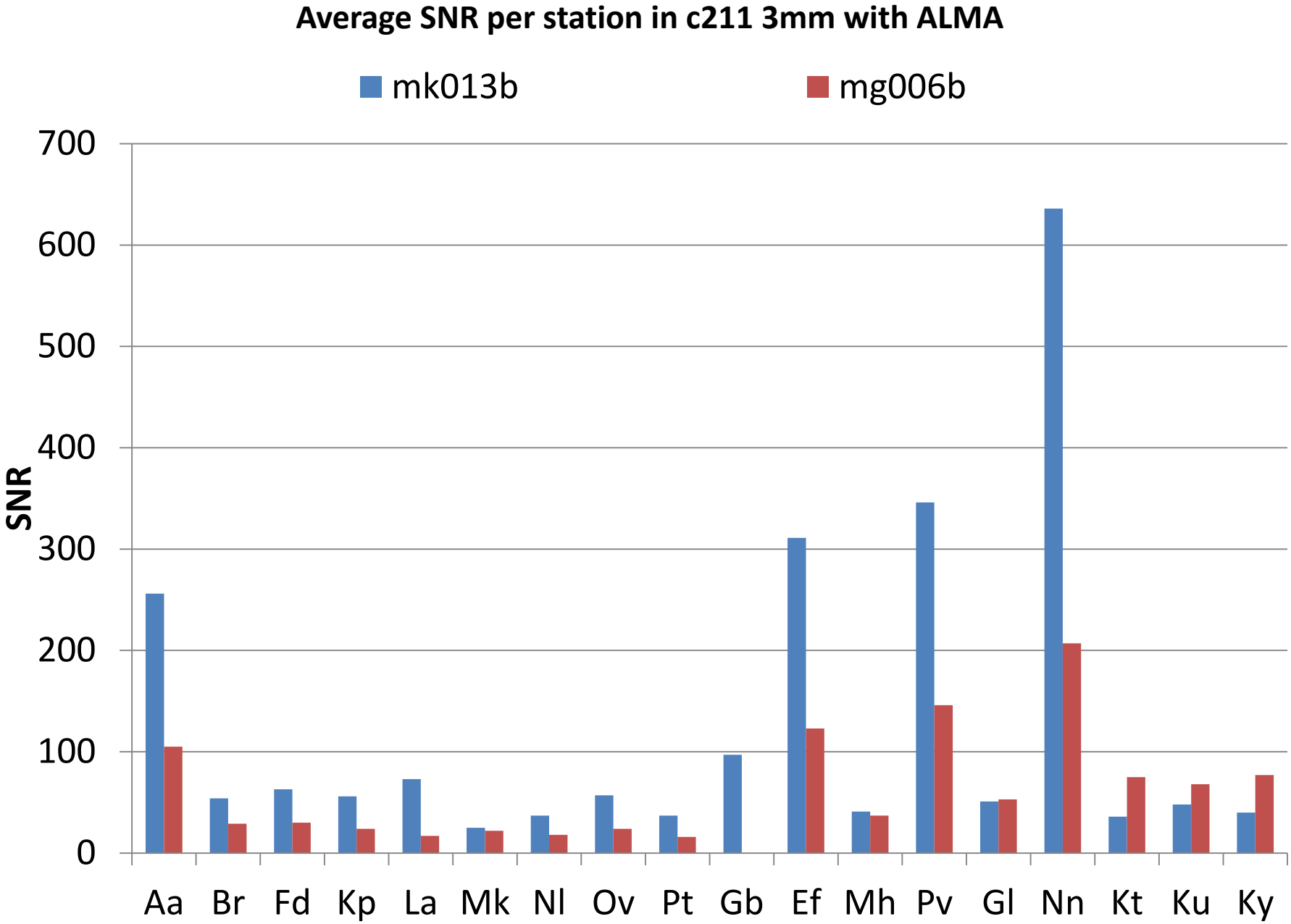

Average SNR per station in c211 3mm
c211a
c211b
c211c
SNR
100
90
80
70
60
50
40
30
20
10
0
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Gb
Ef
On
Ys
Mh
Pv
Gl
Nn
Kt
Ku
Ky

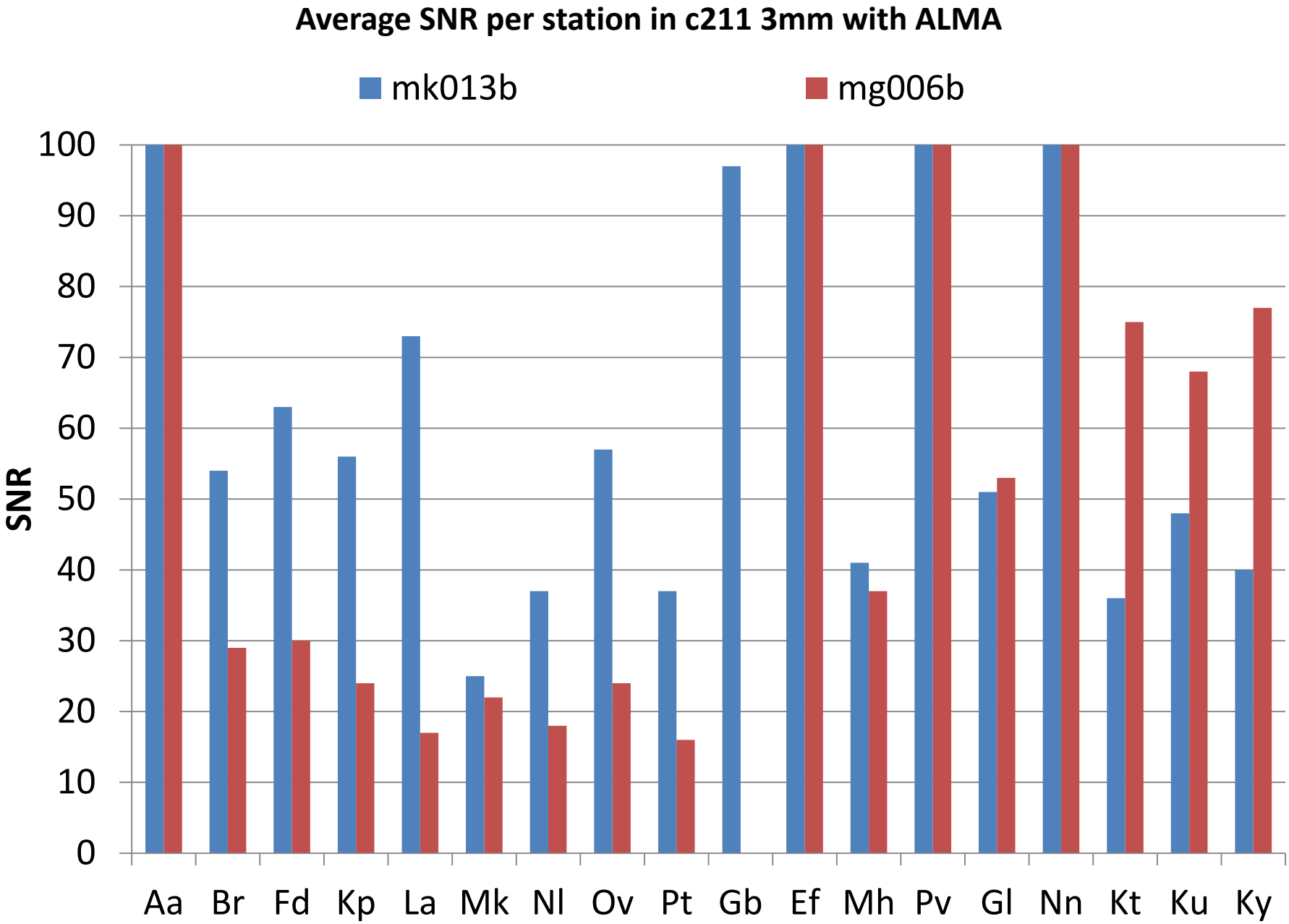
Main runs: c211 – continuum with ALMA

2 experiments

- ALMA participated in the GMVA first time since spring 2018
- No fringes found for a long time, ultimately it was determined that due to an ALMA software issue an LO shift of 3 MHz was introduced
- With the new frequency setup – **lots of fringes, excellent performance**
- DiFX 2.7 with the outputband features (“advanced zoom”, that allows not only to crop frequency bands, but also to stich them together) used to match the peculiar ALMA frequency bands with the rest of the GMVA. Unfortunately it is not yet running smoothly, so some tricks needed to be applied in correlation (separate correlation of ALMA and non-ALMA scans with different v2d files etc.).
- Worst of all, so far **polConvert fails** when applied to the correlated data, the reason is being investigated


Fringe percentage per station in c211 3mm with ALMA
mk013b
mg006b
100
80
60
40
20
0
%
Aa
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Gb
Ef
Mh
Pv
Gl
Nn
Kt
Ku
Ky


Average SNR per station in c211 3mm with ALMA
mk013b
mg006b
SNR
700
600
500
400
300
200
100
0
Aa
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Gb
Ef
Mh
Pv
Gl
Nn
Kt
Ku
Ky

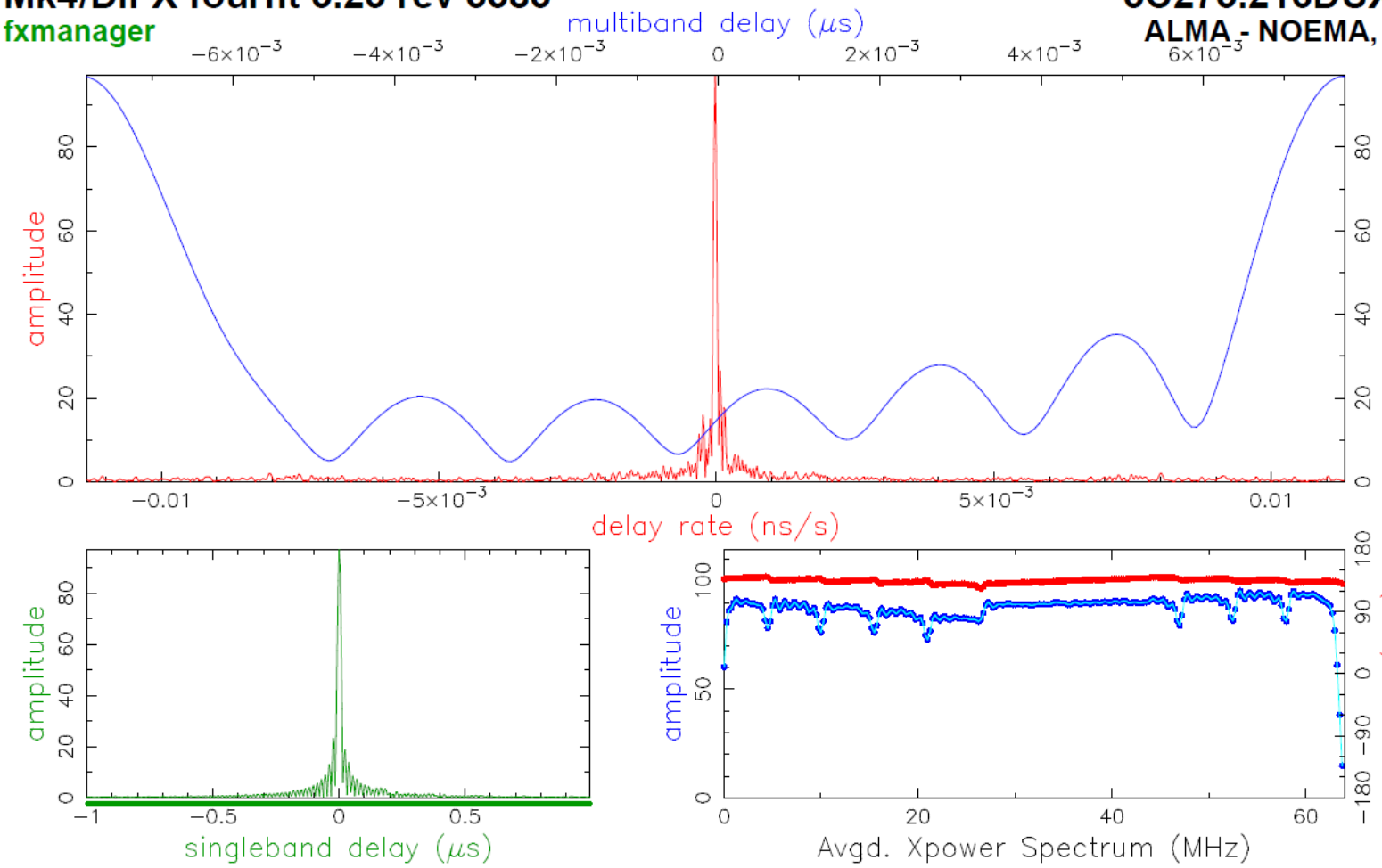

Average SNR per station in c211 3mm with ALMA
mk013b
mg006b
SNR
100
90
80
70
60
50
40
30
20
10
0
Aa
Br
Fd
Kp
La
Mk
Nl
Ov
Pt
Gb
Ef
Mh
Pv
Gl
Nn
Kt
Ku
Ky

Mk4/DiFX fourfit 3.23 rev 3383

fxmanager

3C273.216DUX, No0047, AN

ALMA - NOEMA, fgroup W, pol XR



Amp. and Phase vs. time for each freq., 22 segs, 16 APs / seg (8.19 sec / seg.), time ticks 10 sec

Fringe quality 7

SNR	3321.0
Int time	156.535
Amp	97.066
Phase	-128.6
PFD	0.0e+00
Delays (us)	
SBD	0.000516
MBD	-0.007870
Fringe rate (Hz)	
	-0.001241
Ion TEC	0.000
Ref freq (MHz)	
	86140.0000
AP (sec)	0.512
Exp.	mk013b
Exper #	16383
Yr:day	2021:113
Start	010000.00
Stop	010300.22
FRT	010130.00
Corr/FF/build	
	2022:019:052247
	2022:020:020622
	2021:298:085625
RA & Dec (J2000)	
	12h29m06.699731s
	+02°03'08.598201"

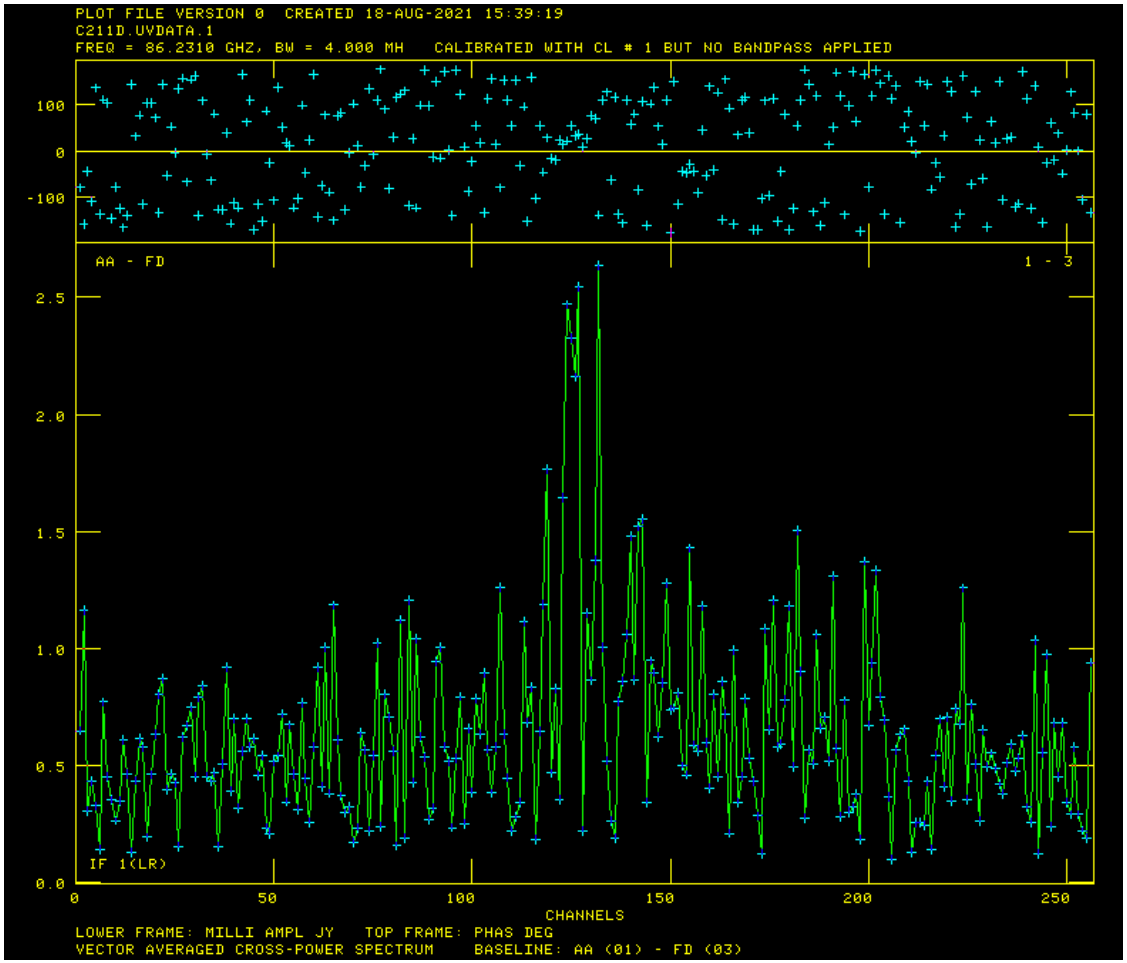
Main runs: c211 – line experiment with ALMA (1)

A small experiment targeting 4 maser sources
in Mira and supergiant stars

- A lot of trial correlations (trying various configurations) performed of this experiment with little result
- Its continuum scans actually seem to show fringes at normal ALMA config, which is why it was difficult to find out that the frequency was drastically shifted in other bands.
- Only very weak tentative fringes were found for line sources, the results are still somewhat inconclusive.

Main runs: c211 – line experiment with ALMA (2)

- Possible line detection (more details on the deki)



Main runs: c211 – 88 GHz experiment

- A few scans added to the last part of the session. Still uncorrelated.

Main runs: c212

3 correlation blocks, 9 science experiments

- Because c211 has been taking so much time, this session is not yet in production

As of the end of this month (Feb 2022) I am forced to leave MPIfR and there will no longer be a dedicated GMVA support scientist at the Bonn correlator…