



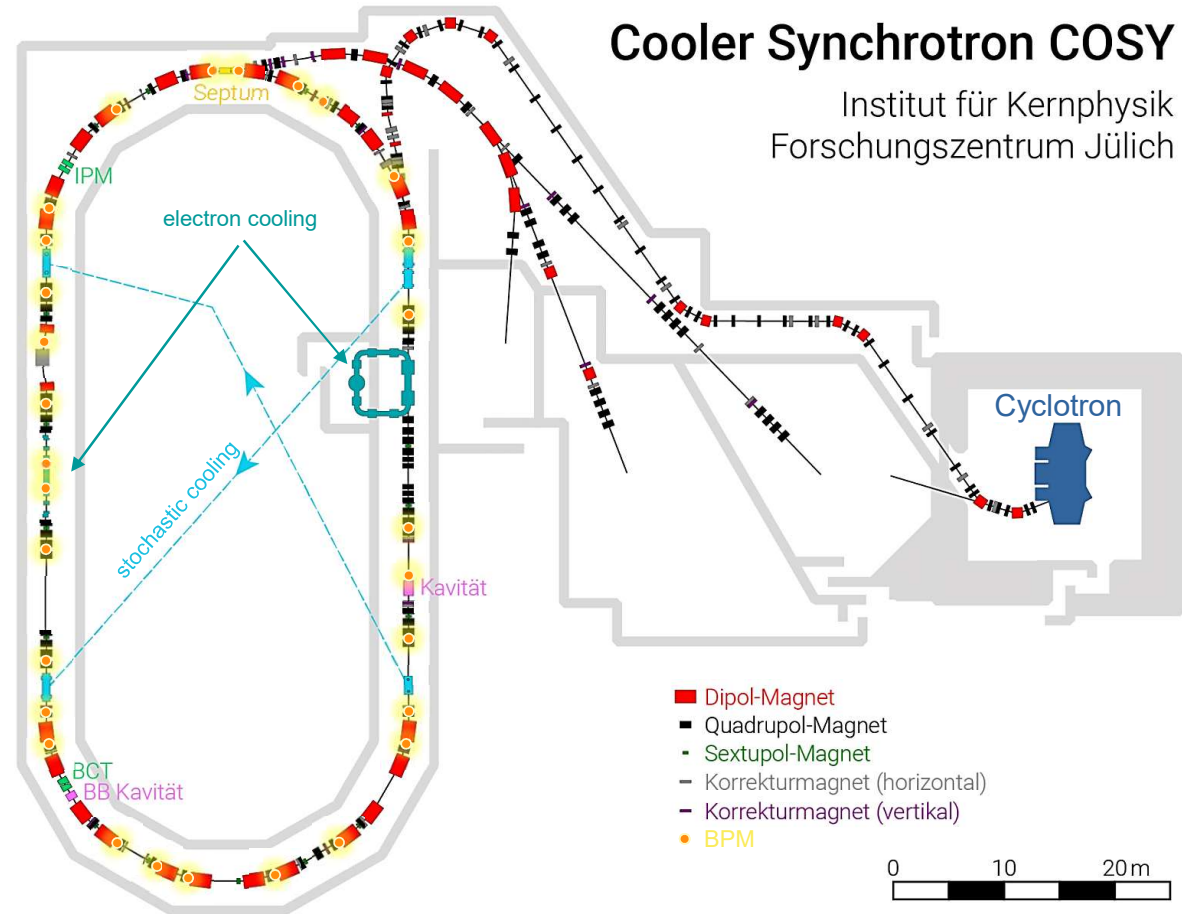
UPDATE ON THE OPERATIONAL EXPERIENCE OF THE LIBERA HADRON AT COSY

12.5.2022 | LIBERA WORKSHOP 2022
C. BÖHME

COOLER SYNCHROTRON COSY

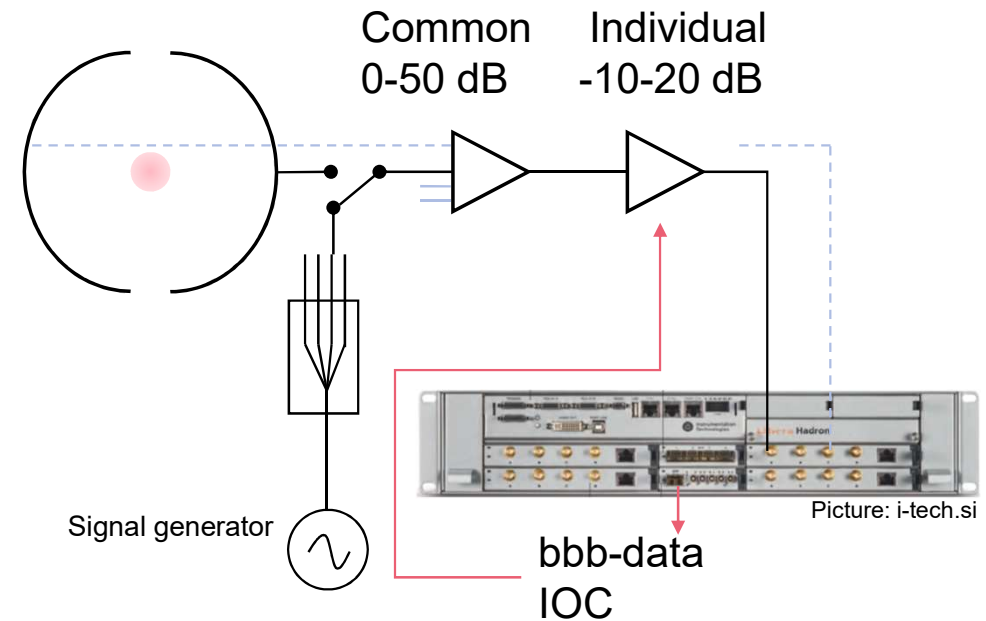
- 84 m circumference
- Internal experiments and 3+2 external beam-lines
- Polarised and unpolarised protons and deuterons
- Momentum: 0.3 – 3.7 GeV/c
- 29 BPMs -> 8 Libera Hadron
- Cooling: 2 electron cooler, stochastic cooling
- Spin manipulation devices
 - Wien filter
 - Siberian snake

Mitglied der Helmholtz-Gemeinschaft



PRE-AMP GAIN BALANCING

ON		Global Ready/OK		Desired delta: <input type="text" value="0.0050"/>		HELP		Active from <input type="text" value="4.0 sec"/> to <input type="text" value="Infinity sec"/>		21.40 / 60.0 sec					
all ON															
BPM	ENA	OK	ITER	STEP	DELTA	SLOPE	OFFSET	BPM	ENA	OK	ITER	STEP	DELTA	SLOPE	OFFSET
1 X			7	0.001C	0.0097	7.8427	-0.883°	1 Y			14	0.001C	0.0076	7.8050	1.3409
2 X			5	0.001C	0.0022	7.8086	-1.215°	2 Y			4	0.001C	0.0014	7.8031	-2.624°
6 X			6	0.001C	0.0041	7.8425	-2.648°	6 Y			5	0.001C	0.0022	7.8198	-4.215°
7 X			5	0.001C	0.0059	7.8219	0.8628°	7 Y			4	0.001C	0.0023	7.8244	-2.193°
8 X			3	0.001C	0.0013	7.8212	-3.389°	8 Y			4	0.001C	0.0065	7.8122	-2.559°
9 X			4	0.001C	0.0080	7.8345	2.2110°	9 Y			2	0.001C	0.0080	7.7982	-0.052°
10 X			2	0.001C	0.0038	7.8171	-0.433°	10 Y			3	0.001C	0.0043	2.9443	-0.698°
11 X			4	0.001C	0.0038	7.8102	-1.014°	11 Y			5	0.001C	0.0041	2.9589	0.5605°
12 X			8	0.001C	0.0056	7.8299	-0.042°	12 Y			3	0.001C	0.0004	2.9536	-0.717°
13 X			4	0.001C	0.0010	7.8153	-4.200°	13 Y			4	0.001C	0.0008	2.9483	-1.695°
14 X			3	0.001C	0.0064	7.7973	-0.717°	14 Y			4	0.001C	0.0054	2.9596	-1.419°
15 X			4	0.001C	0.0031	7.8061	-1.200°	15 Y			2	0.001C	0.0037	2.9373	-0.602°
16 X			8	0.001C	0.0139	7.8445	-0.154°	16 Y			5	0.001C	0.0005	2.9523	1.1199°
17 X			5	0.001C	0.0050	7.8079	-1.635°	17 Y			3	0.001C	0.0106	7.7973	0.0021°
18 X			4	0.001C	0.0106	7.8151	-4.724°	18 Y			4	0.001C	0.0010	7.7989	-2.844°
19 X			5	0.001C	0.0023	7.8178	5.1312°	19 Y			8	0.001C	0.0039	7.8212	-5.427°
ecolgun X			4	0.001C	0.0020	5.3032	-5.675°	ecolgun Y			4	0.001C	0.0019	5.2873	3.0970°
ecolcol X			4	0.001C	0.0064	5.2940	-0.859°	ecolcol Y			5	0.001C	0.0024	5.2843	-0.277°
20 X			4	0.001C	0.0027	7.8322	-5.687°	20 Y			6	0.001C	0.0033	7.8178	3.8214°
anke2 X			7	0.001C	0.0046	7.8103	-0.346°	anke2 Y			20	0.001C	0.0052	7.7906	-2.646°
21 X			5	0.001C	0.0001	7.8338	0.5217°	21 Y			4	0.001C	0.0012	7.8173	-1.322°
22 X			5	0.001C	0.0019	7.8121	-0.115°	22 Y			4	0.001C	0.0000	7.8041	-2.510°
23 X			5	0.001C	0.0012	7.8244	-0.052°	23 Y			3	0.001C	0.0031	2.9557	1.7764°
24 X			8	0.001C	0.0109	7.8301	-0.201°	24 Y			4	0.001C	0.0006	2.9511	0.2496°
25 X			7	0.001C	0.0016	10.0207	13.183°	25 Y			0	0.001C	0.0000	0.0000	0.0000°
26 X			11	0.001C	0.0035	7.8240	-1.941°	26 Y			2	0.001C	0.0058	2.9510	0.6647°
27 X			8	0.001C	0.0060	7.7892	-1.318°	27 Y			2	0.001C	0.0003	2.9680	0.2625°
28 X			7	0.001C	0.0072	7.8321	-3.934°	28 Y			4	0.001C	0.0026	2.9499	2.0643°
29 X			6	0.001C	0.0042	7.8102	-2.606°	29 Y			5	0.001C	0.0007	7.7852	0.9529°



- Iterative process
- Performed simultaneously for all BPMs
- Uses bbb data to get as close to 0 position as possible
- Has to be (ideally) performed after every gain change
- Time for all BPM:
 - With preparations: ~5 min
 - Measurement time only: ~10 s

LIBERA PROBLEMS 2021

- IOC stability

- When used heavily we managed to get the IOC unstable quite easy

- Advanced logging / alarming would help resolve issues faster

- Failing IOC has impact on other software functions like SSH access or libera-ireg function

- Hardware

- 10 units running (8 production + 2 test) with 35 ADC cards since 2018
- One unit had to be send back for repair (firmware issue)
- One ADC card was replaced, but then working fine in test unit (since mid March '21)
- New order of Hardware came with new firmware
-> upgrade of old units seamless

```
dbScan warning from '10 second' scan thread:
Scan processing averages 62.00 seconds (60.79 .. 63.41).
Over-runs have now happened 96 times in a row.
To fix this, move some records to a slower scan rate.
```

```
CA.Client.Exception.....
Warning: "Virtual circuit disconnect"
Context: "op=0, channel=libera04:evrx:events:t2:timestamp,
        type=DBR_TIME_STRING, count=1, ctx="libera04.cc.kfa-juelich.de:5064"
Source File: ../getCopy.cpp line 92
Current Time: Wed Feb 17 2021 11:28:37.843214410
```

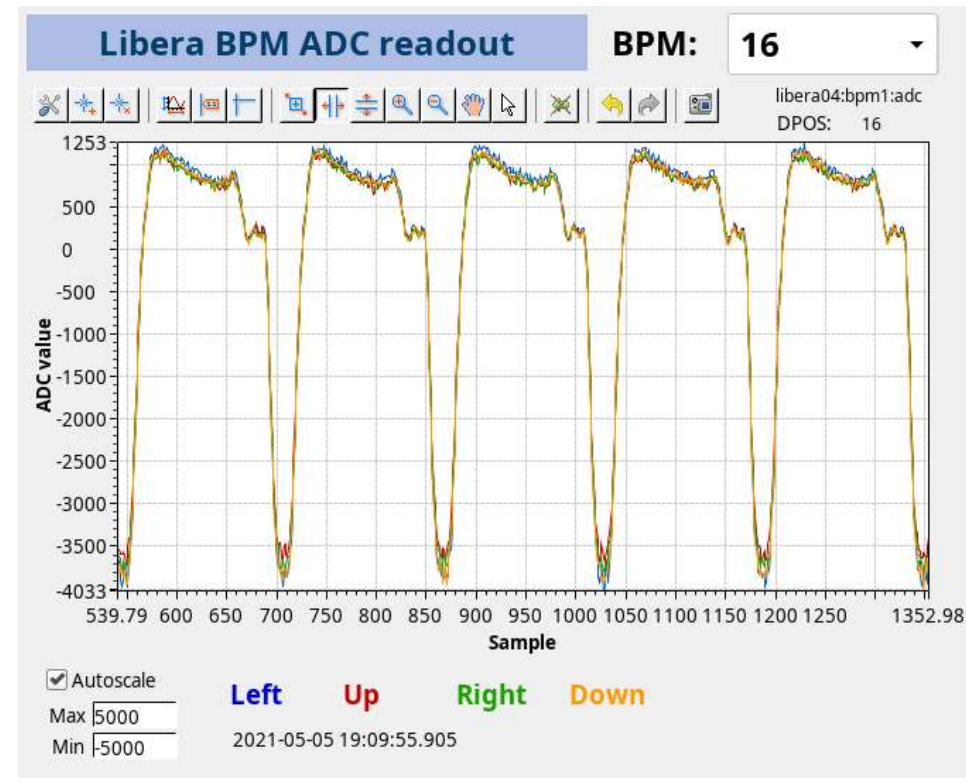


UPDATE 2022

- Hardware
 - No other failures were reported
- IOC stability
 - Operation without annoying disruptions, still regular re-boots of the systems necessary
 - Software reboot: about one per day (out of 8 devices)
 - Hardware reboot: about once a month (out of 8 devices)
- Update received
 - Installation went through quite well (small hiccup's) on test device
 - No long-term tests performed yet
 - Goal to update production devices end of year.

LIBERA PROBLEMS 2021

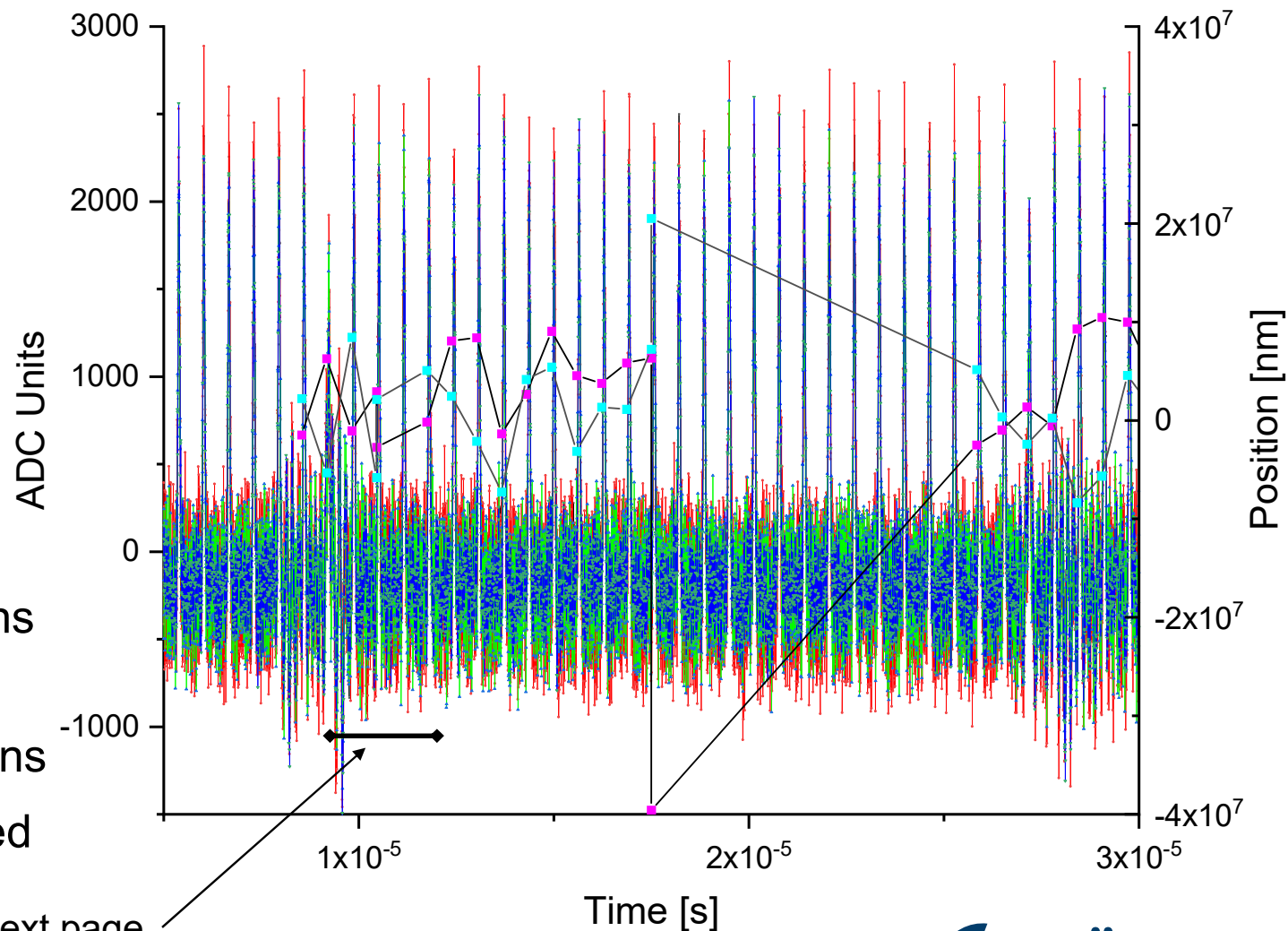
- Barrier Bucket operation
 - Hard edges of a bunch due to RF settings
- Bunch recognition system is likely to not detect a position
 - BBB algorithm has problems recognising the bunches
 - Has worked in recent beam time, but in previous not reliably
 - NBA algorithm as well
 - Only few tries to get it to work by now



Picture: V. Kamerdzhev

UPDATE 2022

- Inversion of ADC data possible
 - Shown data is inverted
 - By editing XML-settings, fast switching (e.g. PV) needed for FAIR
- Then algorithm recognises positions
 - Dropouts? More investigations necessary. See Picture.
- NBA-Algorithm delivers positions
 - More PVs have to be changed then expected

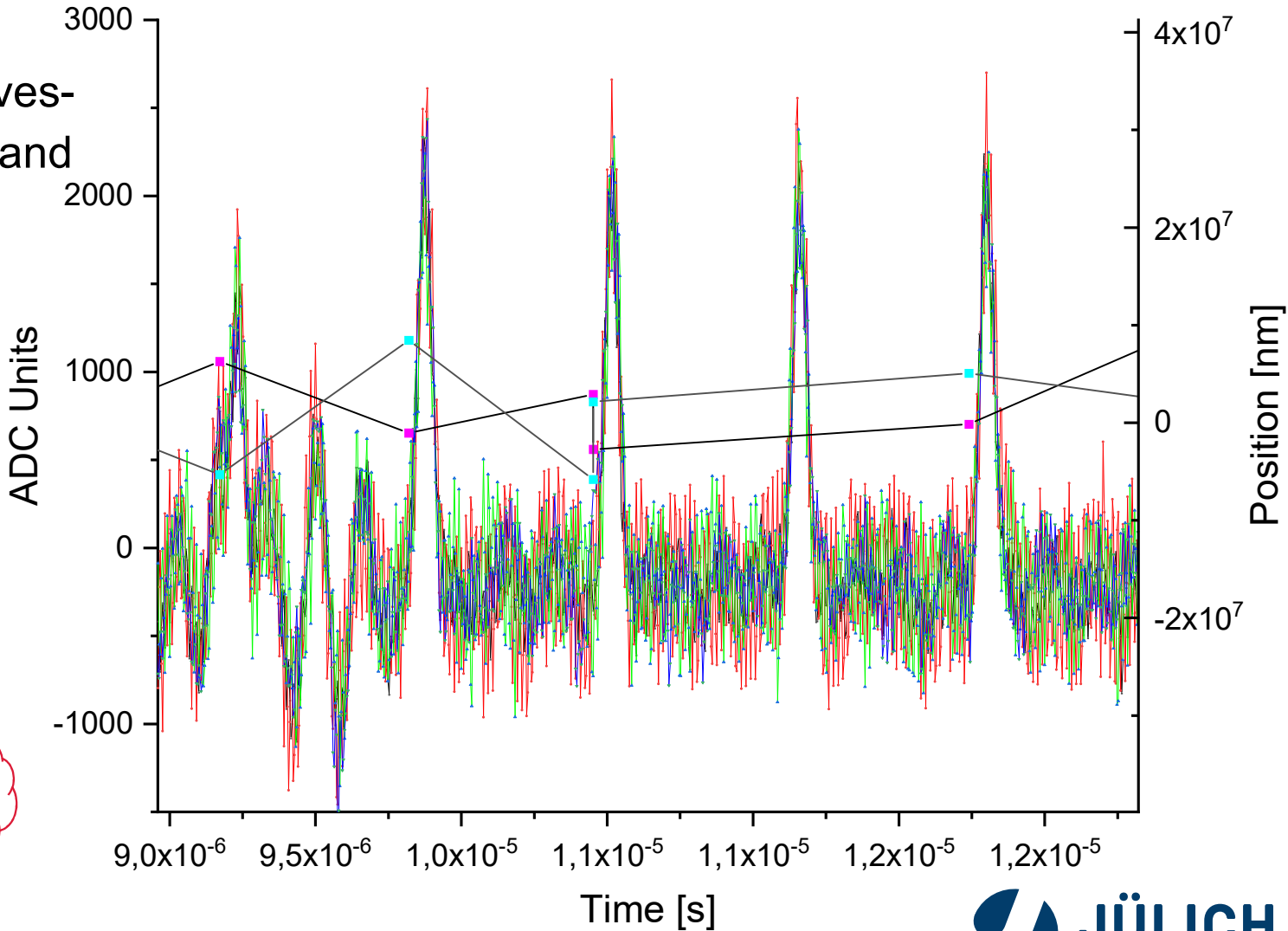


Zoom next page

BARRIER BUCKET

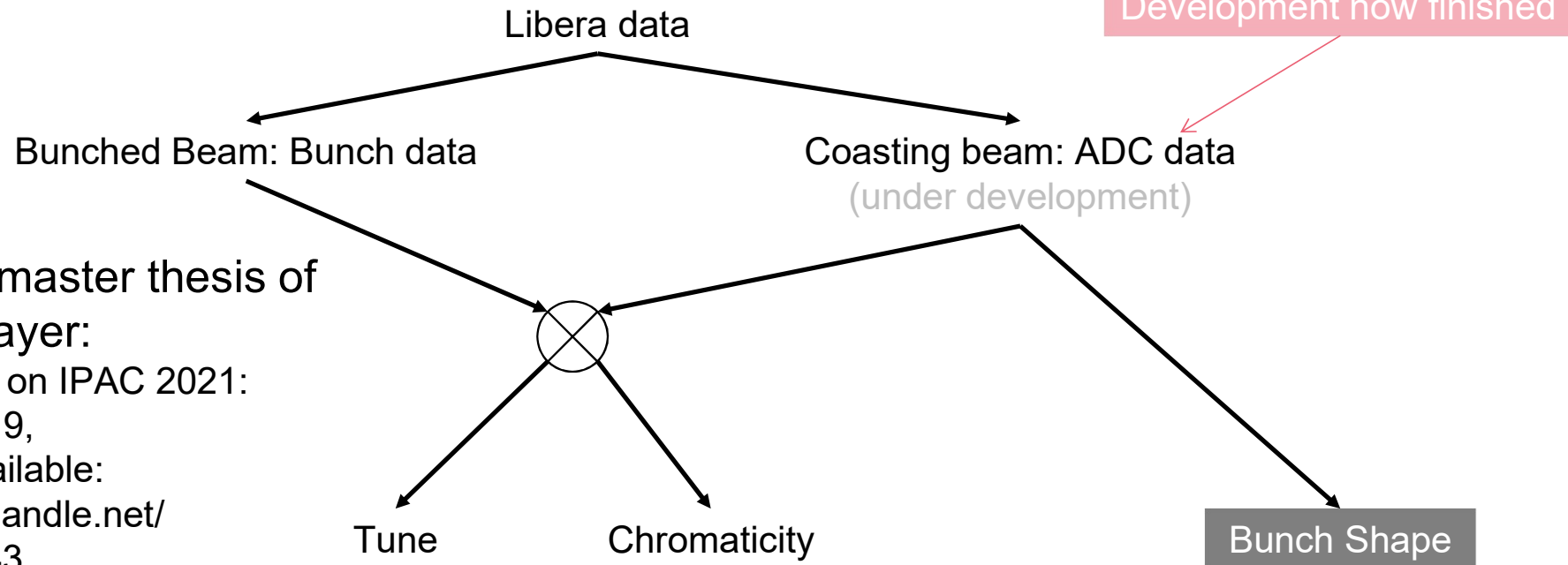
- Preliminary data, further investigations planned on test stand
- Bunches Missed
- Double bunch?

X pos	Y pos	Time low
2664869	4157948	3573
9050334	5406886	3735
4570466	-3115951	3895
3761803	1335308	4055
5843999	1142774	4215
6337194	7238514	4375
-39571097	20526840	4375
-2487986	5167895	6459



USER APPLICATIONS BASED ON LIBERA DATA

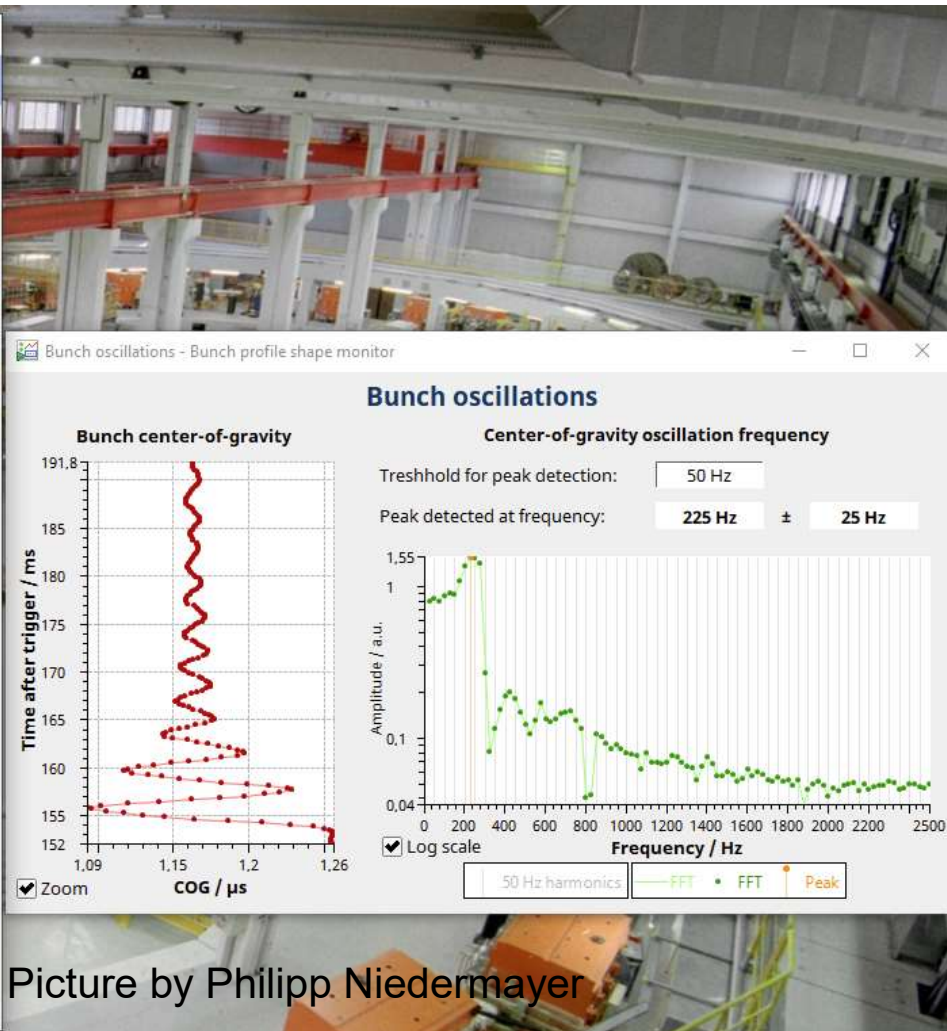
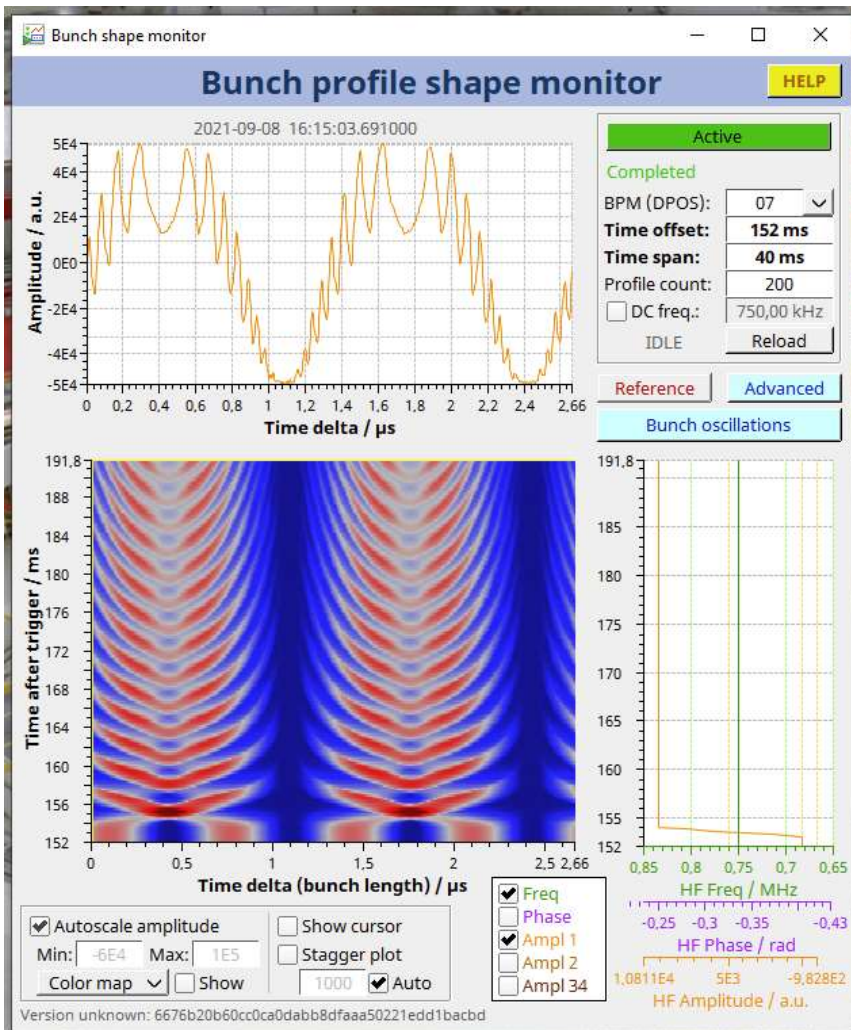
Data structure



- Done within the master thesis of Philipp Niedermayer:
 - Presented on IPAC 2021: MOPAB319,
 - Thesis available: <http://hdl.handle.net/2128/27943>
- Last year only applications with bunched beam were available, now extension to coasting beam.

USER APPLICATIONS BASED ON LIBERA DATA

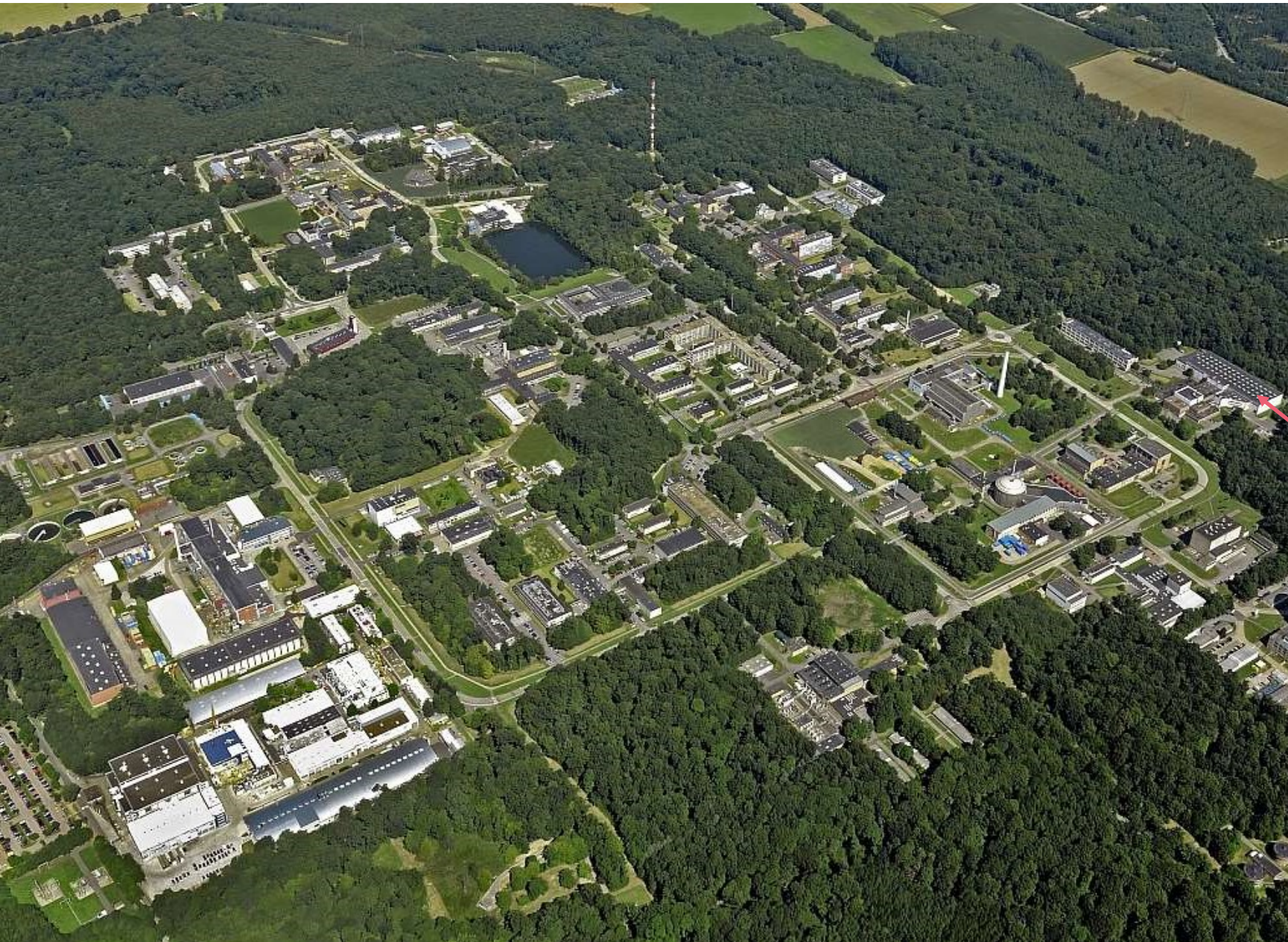
- Not running on Libera hardware but standalone/ external



Picture by Philipp Niedermayer

CONCLUSION

- The Libera offers a wide range of information of beam properties.
 - These can be used for calculating vital machine parameters.
- Downloading a huge amount of data fast with the EPICS version is a problem.
 - For un-bunched beam raw ADC-data has to be processed.
 - In our experience the data download takes time.
- Reaction on the last-year critics:” the EPICS-IOC performance could be better, as failing IOC is the main problem we face”
 - Update was made available
 - Long-term tests still have to be performed
- What we would like to have improved:
 - Polarity-change on-the-fly (in EPICS version e.g. via PV)



THANK YOU

- Research center
aerial view

COSY accelerator