Status and
Plans for the
Cavity BPMs
on CLEAR

Johannes
Nadenau

General

CLIC BPM

Measurements
2017
September
October

Todo
Frontend
Software

Conclusion

CLIC Workshop 2018

Status and Plans for the Cavity BPMs on CLEAR

Johannes Nadenau, Alexey Lyapin,
Manfred Wendt

24.01.18

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Eigenmodes In A Cylindrical Resonator
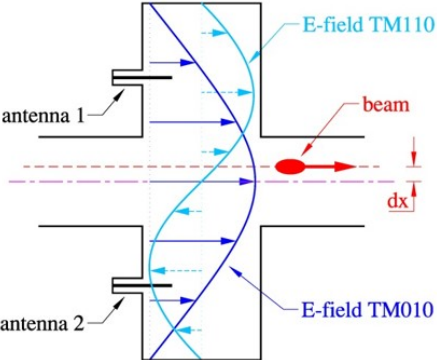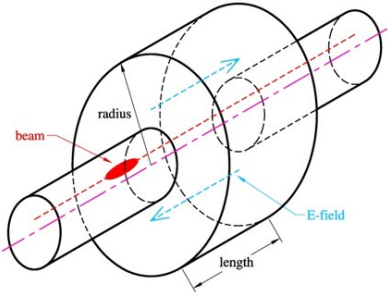
König und Meyer

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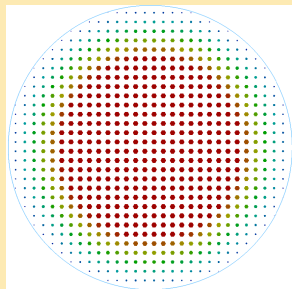Johannes
Nadenau

Measuring Method

Measurement of Monopole and Dipole mode is required
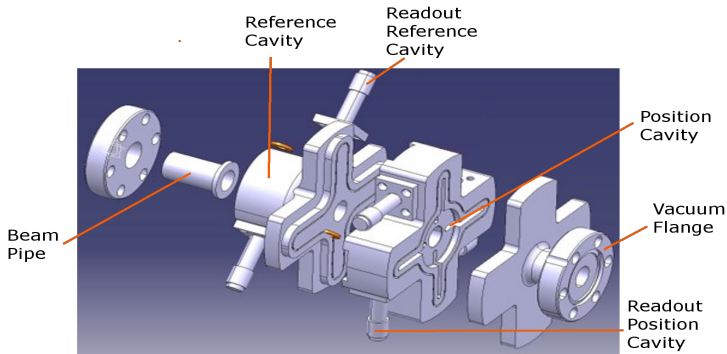$\rightarrow$ two cavities

Position Cavity
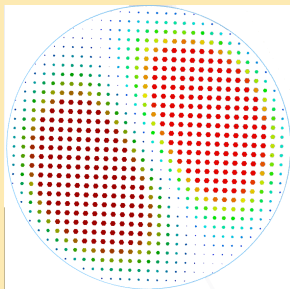
- TM_{110}
- $Z_{Shunt} \propto x$
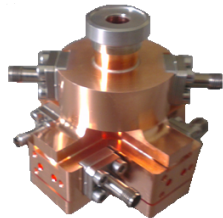- $E_{11} \propto I_{beam} \cdot x$

Reference Cavity

- TM_{010}
- $Z_{Shunt} = const$
- $E_{01} \propto I_{beam}$

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The CLIC Cavity BPM

- Required for monitoring the beam trajectory in the CLIC main linac
- High spatial ($50\,\mathrm{nm}$) and high temporal ($50\,\mathrm{ns}$) resolution

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Setup At CLEAR
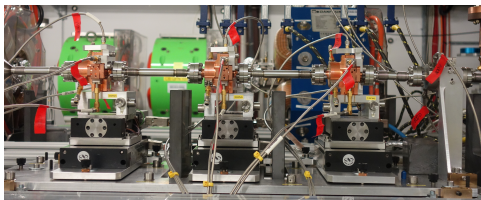
3 BPMs on ballistic
trajectory
$\rightarrow$ measure 2
$\rightarrow$ predict 3rd

2-axis translation stages
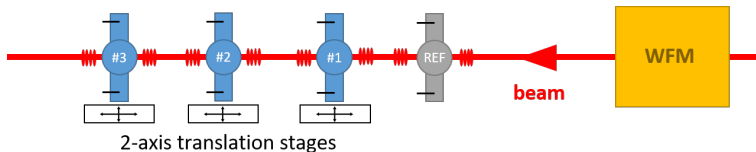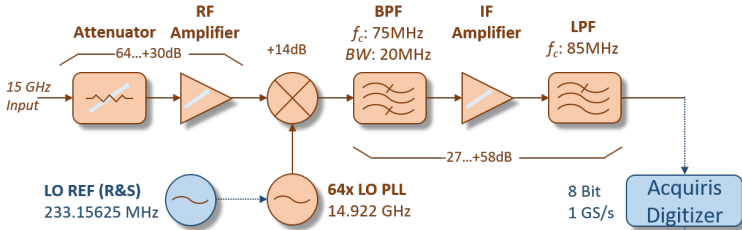
- Changed location of the setup
- Now located behind the CLIC module
  - Enable measurements with Wakefield Monitor
- + Alignment

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Frontend

Attenuator
−64...+30dB

RF Amplifier
+14dB

BPF
f_c: 75MHz
BW: 20MHz

IF Amplifier

LPF
f_c: 85MHz

15 GHz Input

27...+58dB

LO REF (R&S)
233.15625 MHz

64x LO PLL
14.922 GHz

8 Bit
1 GS/s

Acquiris Digitizer

Processing signal to enable acquirement with digitizer

- Reduce frequency to $\sim 80\,\mathrm{MHz}$
- Amplify the signal
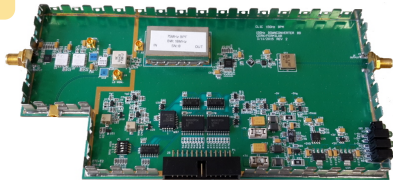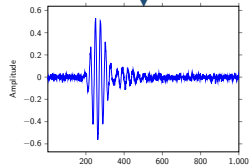
Status and
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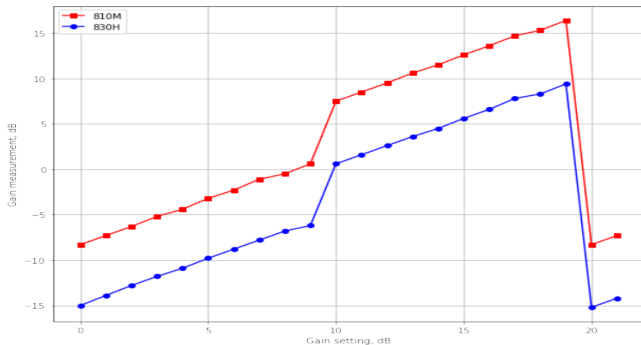Cavity BPMs
on CLEAR

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Resolution Estimate
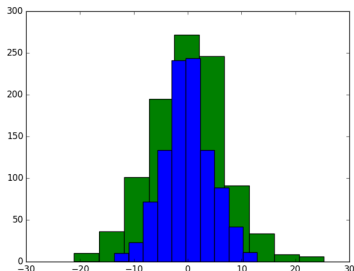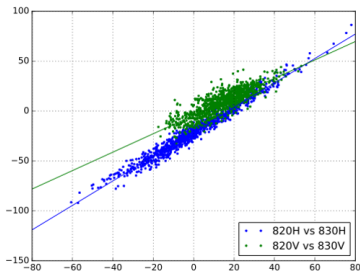
- Measurements in 2016
- Just 2 BPMs
  - 3rd one was saturated
  - Therefore no subtracting of angular jitter
- Best estimate so far: $6 \, \mu\mathrm{m}$
- Best expect with current setup: $1 \, \mu\mathrm{m}$

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Measurements in September

- Gain Measurements of the Frontend using a CW source
- Scanned RF and IF gain settings

IF Amplifier (Att=0, RF=0)

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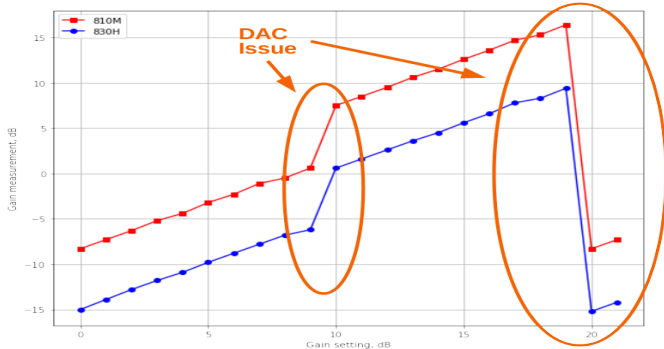
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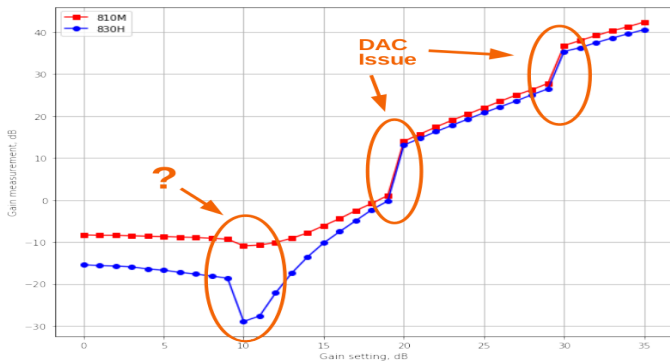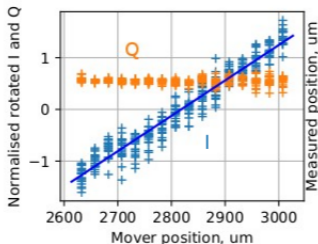
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Measurements in October

- Callibration procedure
  - Goal: Define conversion from ADC counts into beam position in mm
  - Procedure: Scan a certain x-y-area using the translation stages
- Measurements with different gain setting were done
- Beam condition: single bunch, $\sim 60\,\mathrm{pC}$
- Noise issues: several measurements not usable

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Measurements in October

Calibrations at Att=16dB, RF=20dB, IF=5dB

- Singlebunches
- $60\,\mathrm{pC}$

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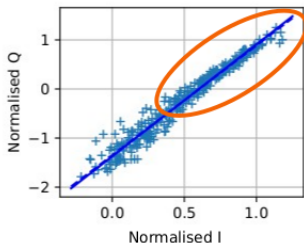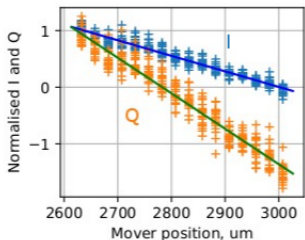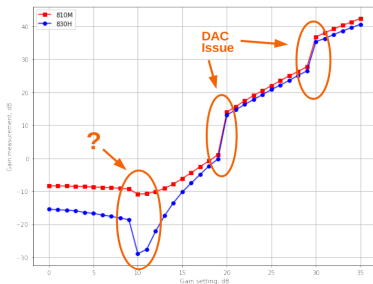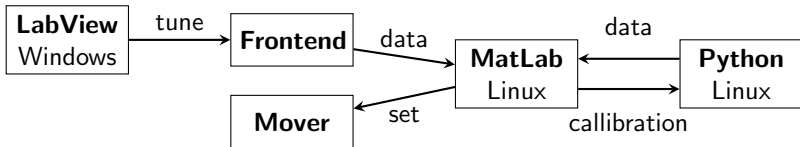
Todo - Frontend

- Detailed measurements in the lab with spare board
- Particularly follow up with the best configurations extracted from measurements in October and some simulations
- Track down DAC issue
- Reflect on modifying the electronics

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Software

- Replace LabView and MatLab through Python
- Integrate existing Python code
- Add GUI for online beam position

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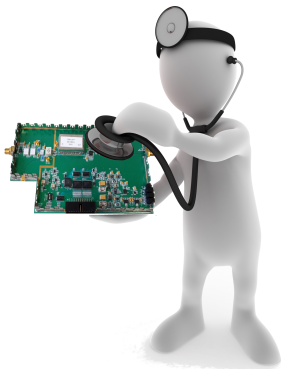
istockphoto.com

- There is work to be done
    - Examine, repair and characterize the frontend electronics
    - Rearange the elctronics in the tunnel
    - Write and checkout software for tuning the frontend with a Raspberry Pi
    - Perform Beam measurements for callibration
    - Rewrite and check out data acquisition software
- BUT: Online beam positon in 2018 is forseeable