

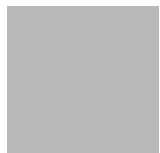
PAUL SCHERRER INSTITUT

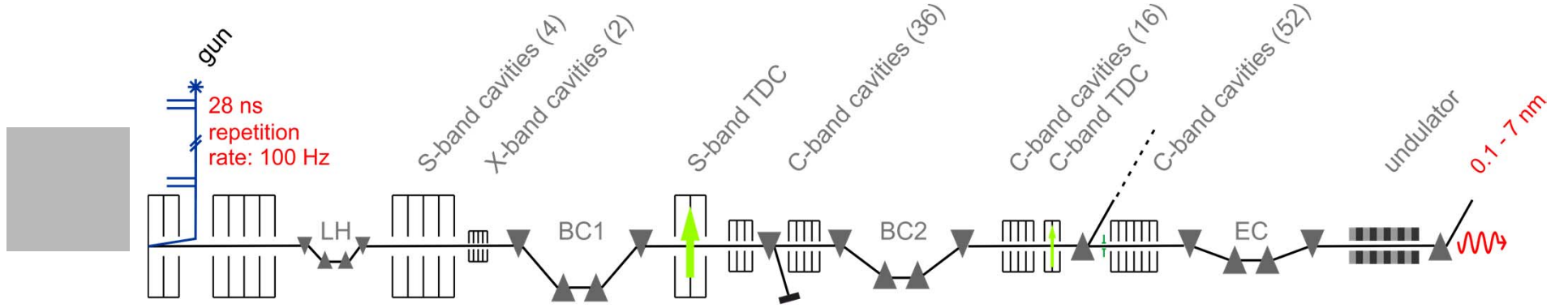


Franziska Frei :: e Beam Instrumentation :: Paul Scherrer Institut

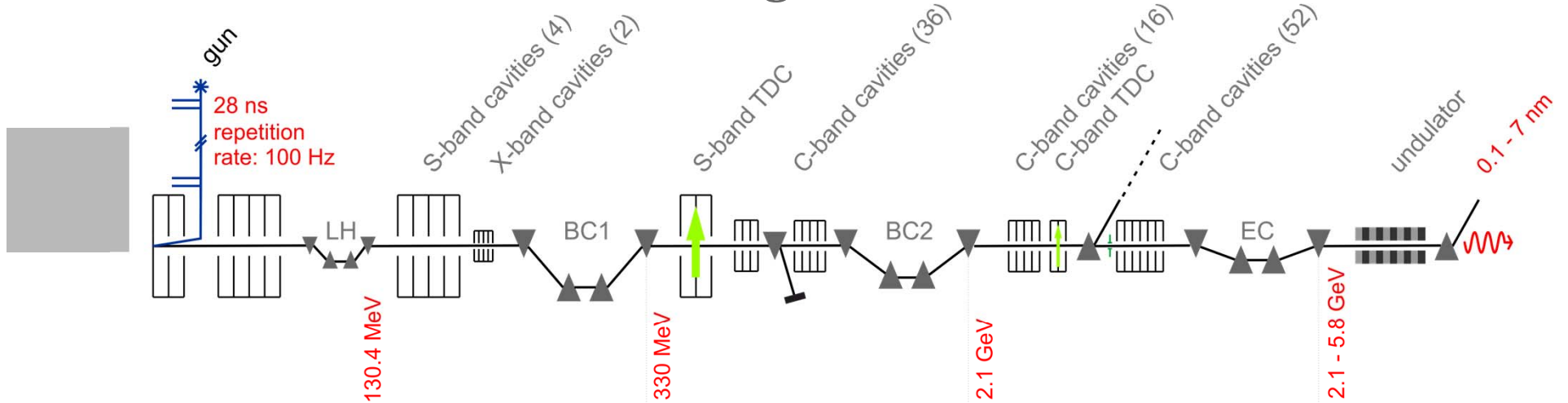
Bunch Compression Monitors @SwissFEL

Acc. Seminar, PSI, 19.02.2018





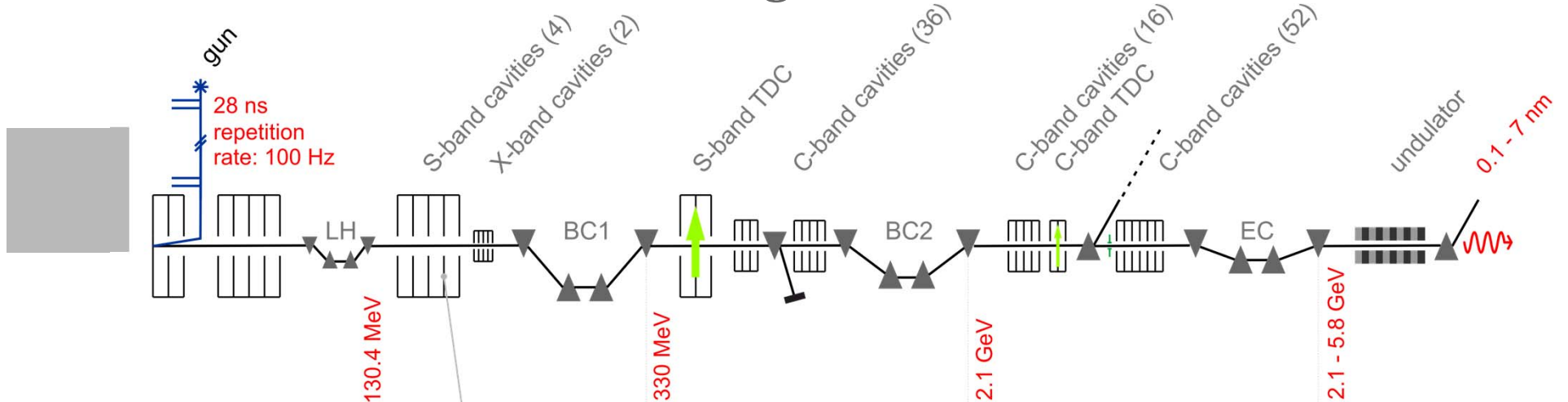
SwissFEL – Design Parameters



Broad Band Mode 200 pC	3ps	500 fs	25-50 fs	25-50 fs	rms
Long Pulse Mode 200 pC	3ps	300 fs	25 fs	25 fs	rms
Short Pulse Mode 10 pC	1ps	250 fs	3 fs	3 fs	rms
Ultra Short Pulse Mode 10 pC	1ps	250 fs	3 fs	0.7 fs	rms

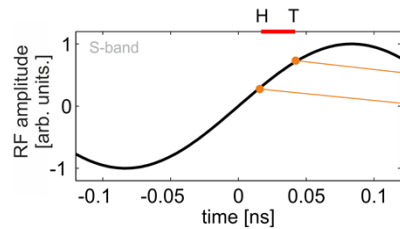
rms e-bunch length (order of magnitude)

SwissFEL – Design Parameters

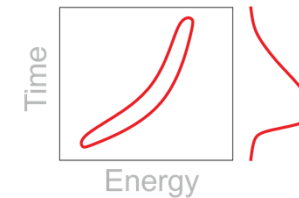


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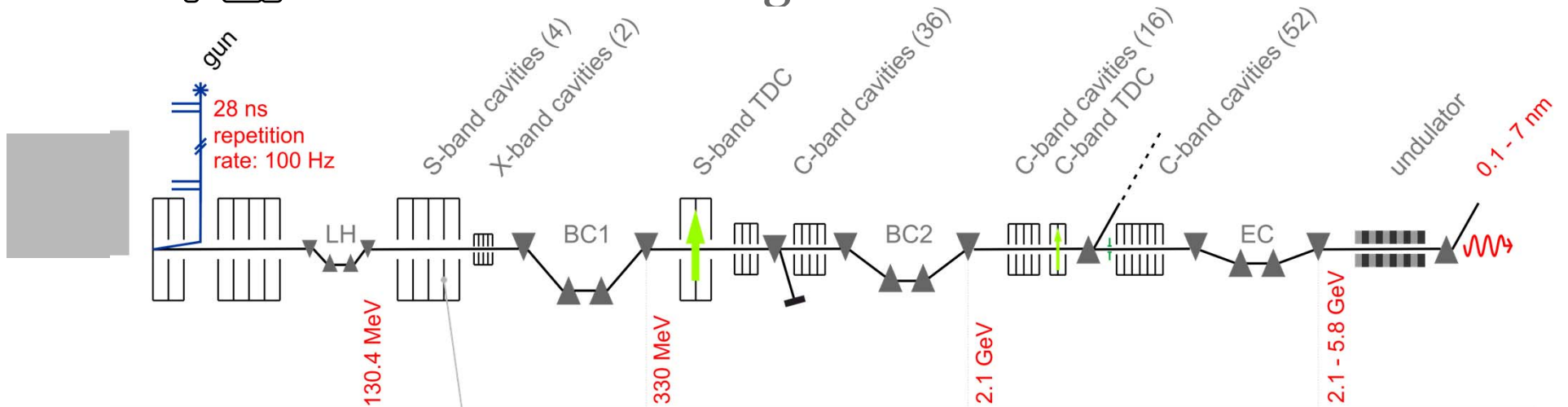
e-bunch compression at relativistic energies:



rms e-bunch length (order of magnitude)

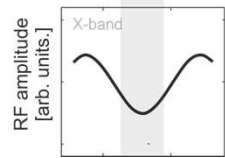
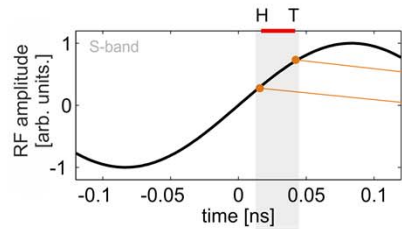


SwissFEL – Design Parameters

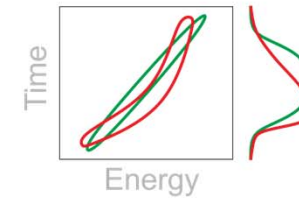


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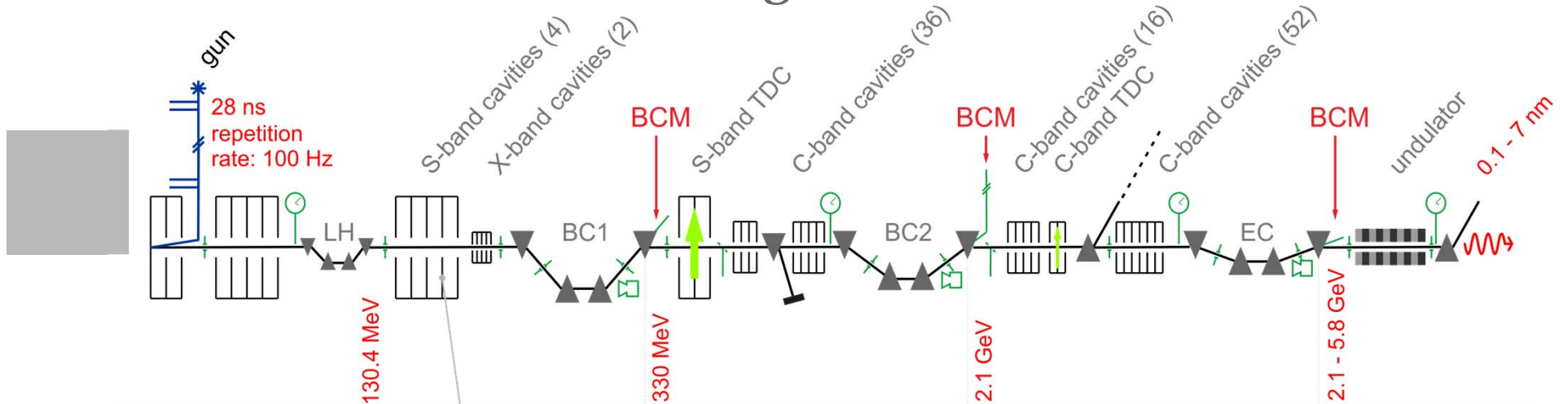
e-bunch compression at relativistic energies:



rms e-bunch length (order of magnitude)



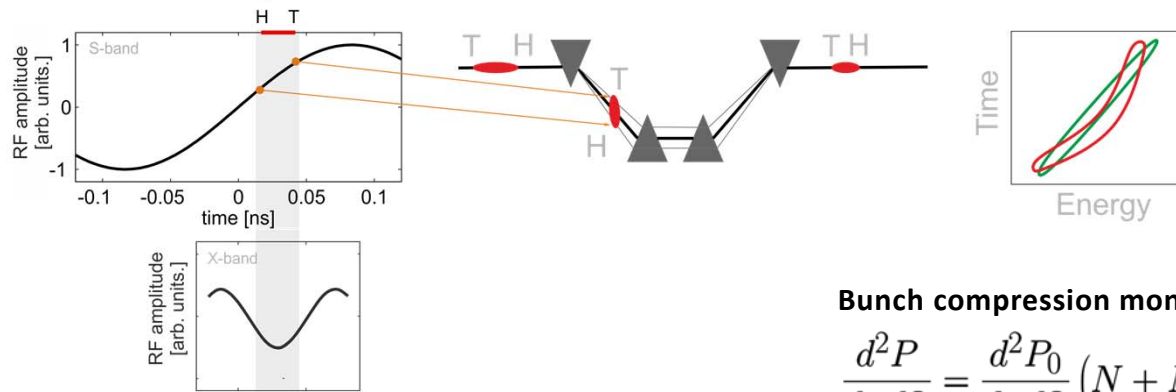
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e-bunch compression at relativistic energies:

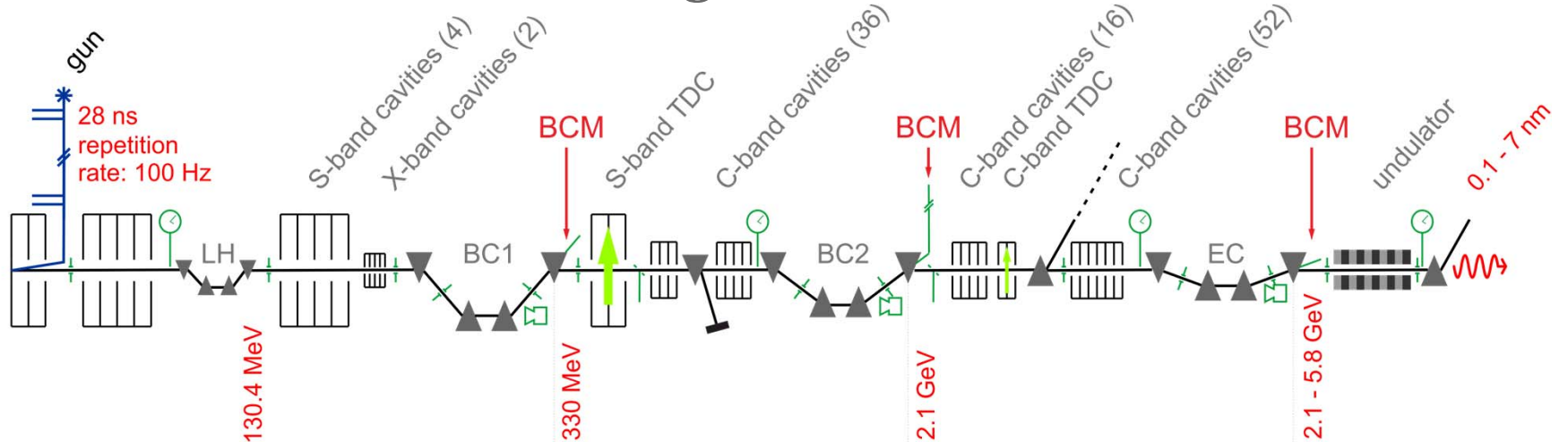
rms e-bunch length (order of magnitude)



Bunch compression monitor:

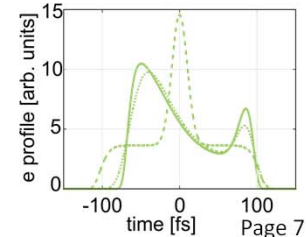
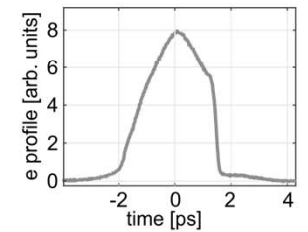
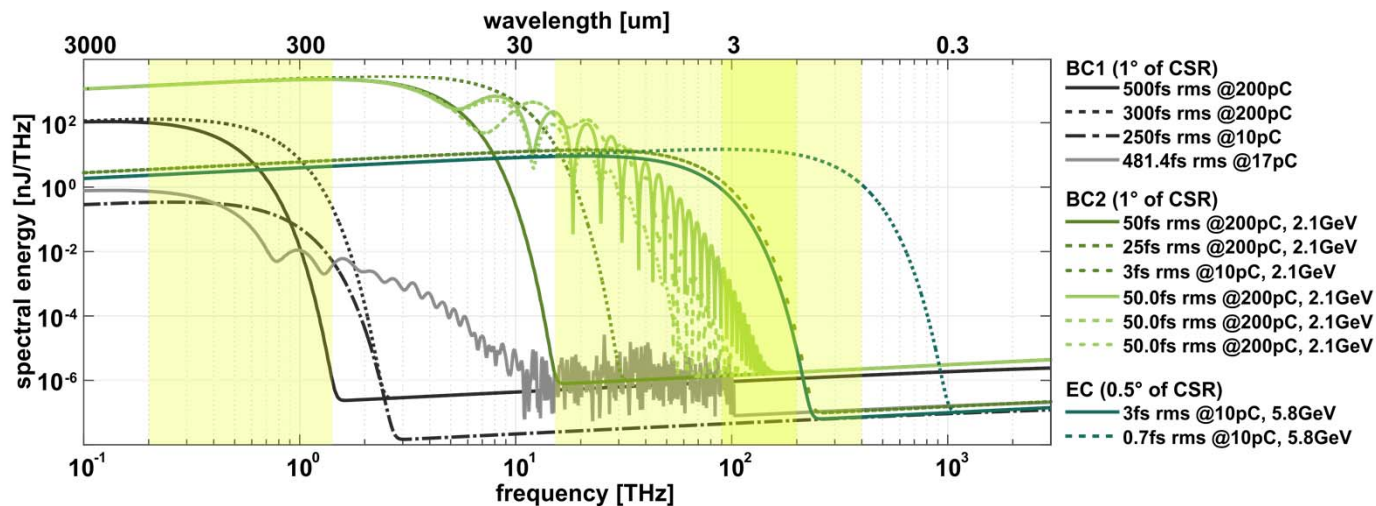
$$\frac{d^2 P}{d\omega d\Omega} = \frac{d^2 P_0}{d\omega d\Omega} (N + N(N-1)|F(\omega, \Omega)|^2)$$

SwissFEL – Design Parameters

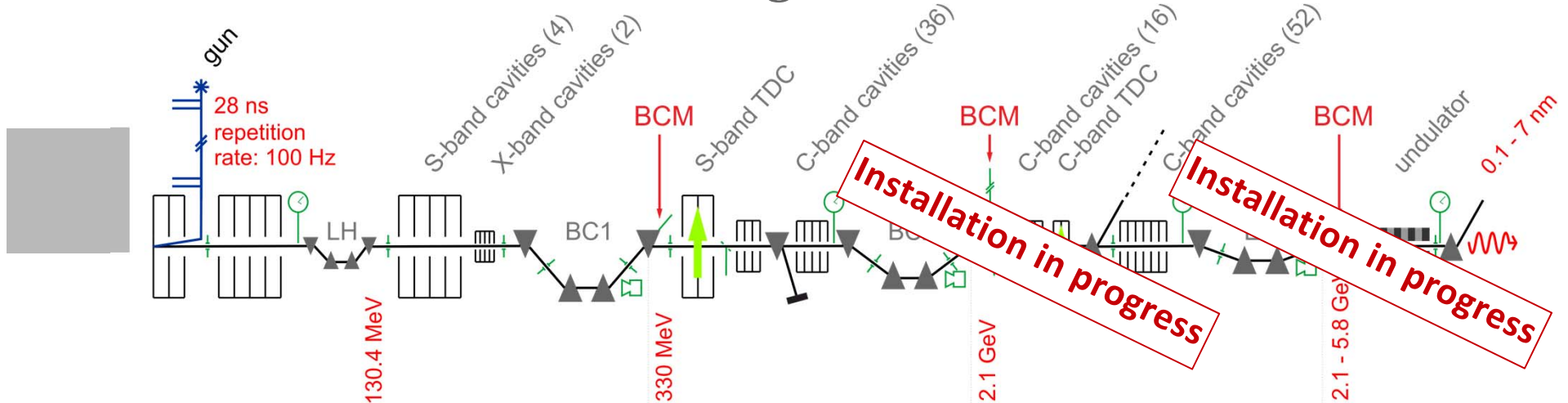


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rms e-bunch length (order of magnitude)

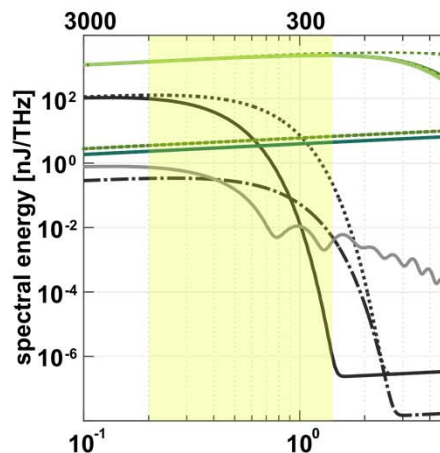


SwissFEL – Design Parameters



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rms e-bunch length (order of magnitude)



Broadband Schottky diode (ACST)

- + Broadband
- + Room temp. sensor
- + Fast
- With too high intensity they might be permanently damaged.

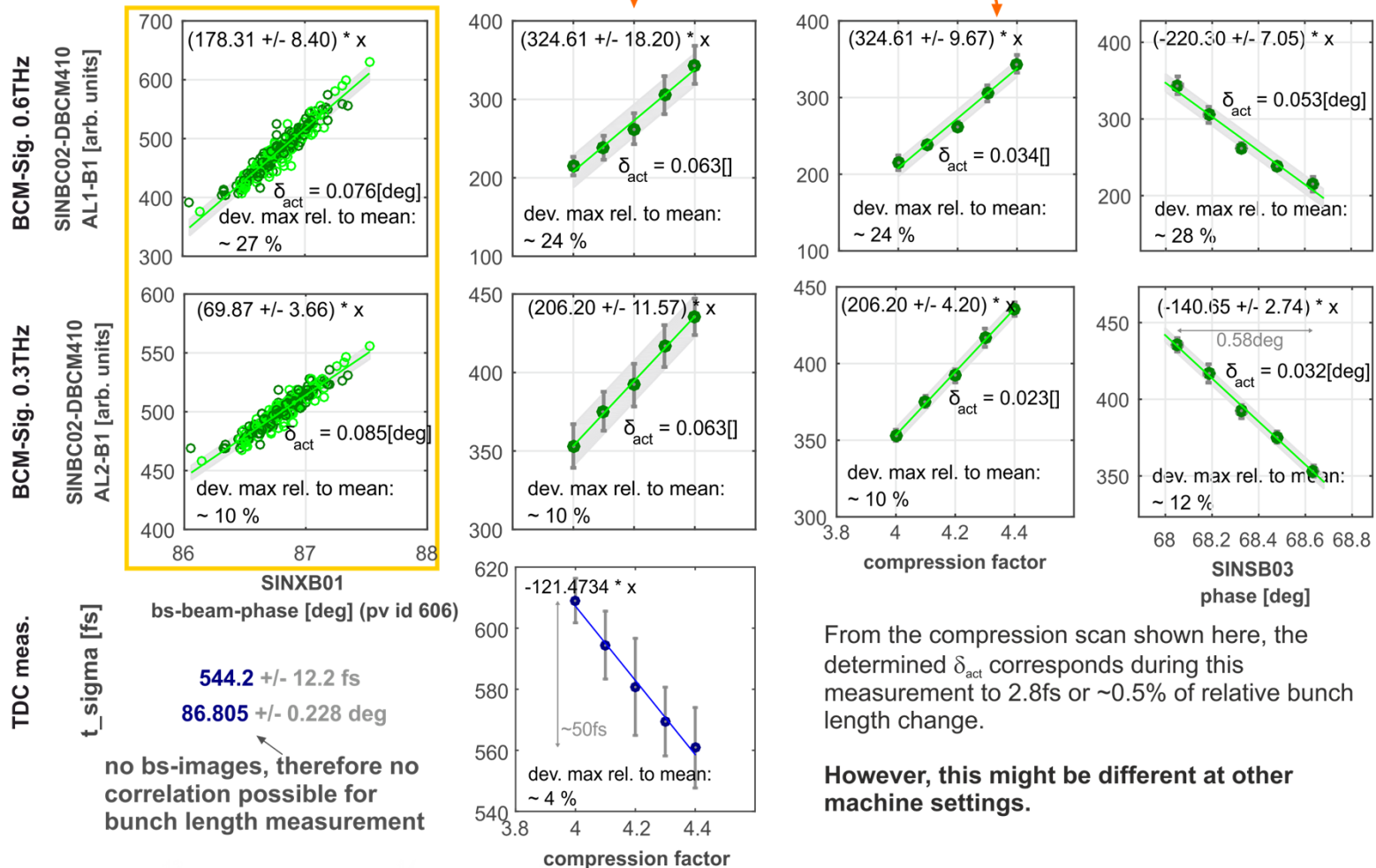
-> Read out via Button-BPM-Frontend
(Group of Boris Keil).

- Experimental results – compression

Data from: 2017-07-17_13-59-15 @ 10Hz

RESPONSE MEASUREMENTS
«Raw»-data from scan measurements

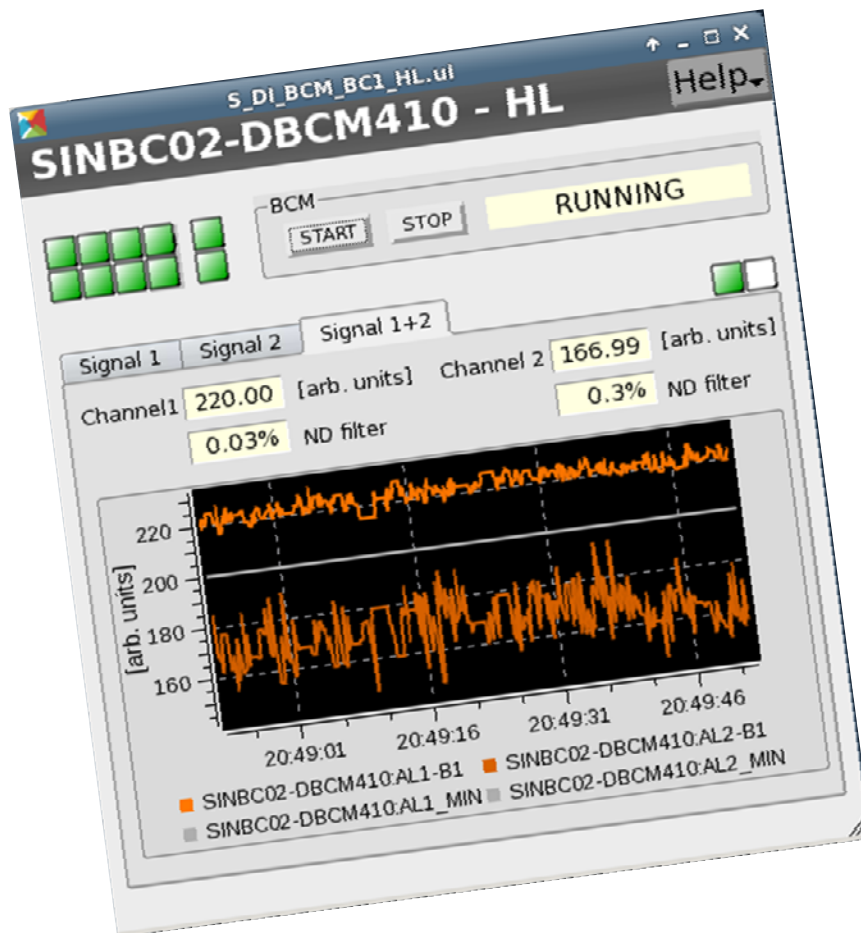
X-band phase fluctuations compensated during post analysis



From the compression scan shown here, the determined δ_{act} corresponds during this measurement to 2.8fs or ~0.5% of relative bunch length change.

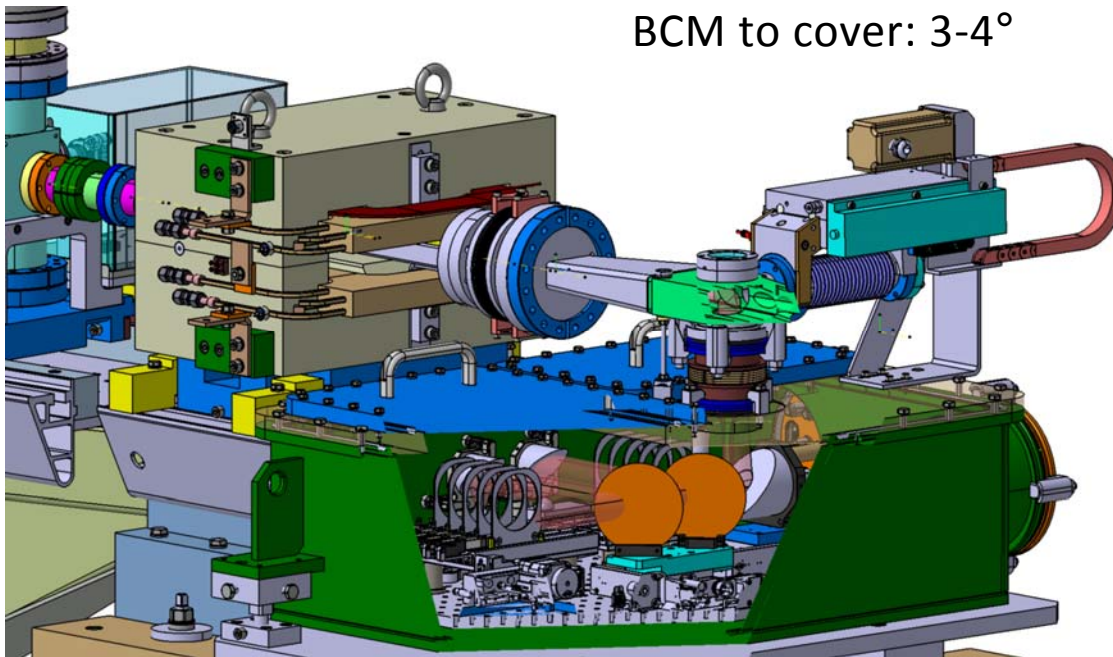
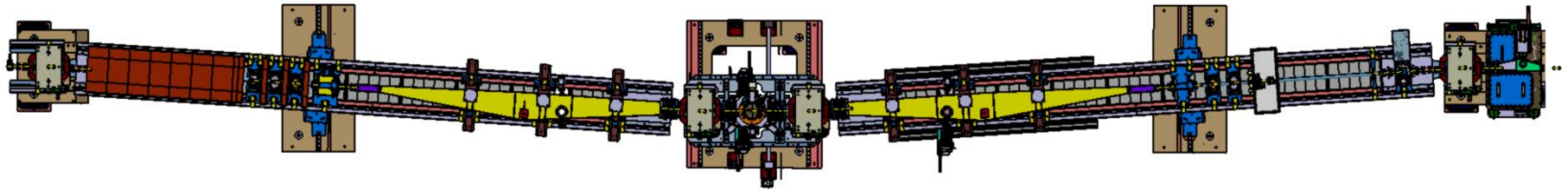
However, this might be different at other machine settings.

- Why does the position of the bunch compressor matter?
- What happens if I push start in HL-panel?
- What is the difference between Channel1 and Channel2?
- Why is a bunch showing a signal of 220 today not necessarily identical to a bunch showing 220 at a later time?
- Why is there nowhere a number showing a bunch length in fs?



SwissFEL – SINBC02 view in the tunnel

0 - $\sim 4.1^\circ$ (nominal: 3.82°)



BCM to cover: $3-4^\circ$

Currently the motors of the BCM mirror are automatically adjusted according to encoder position of BC-middle chamber.

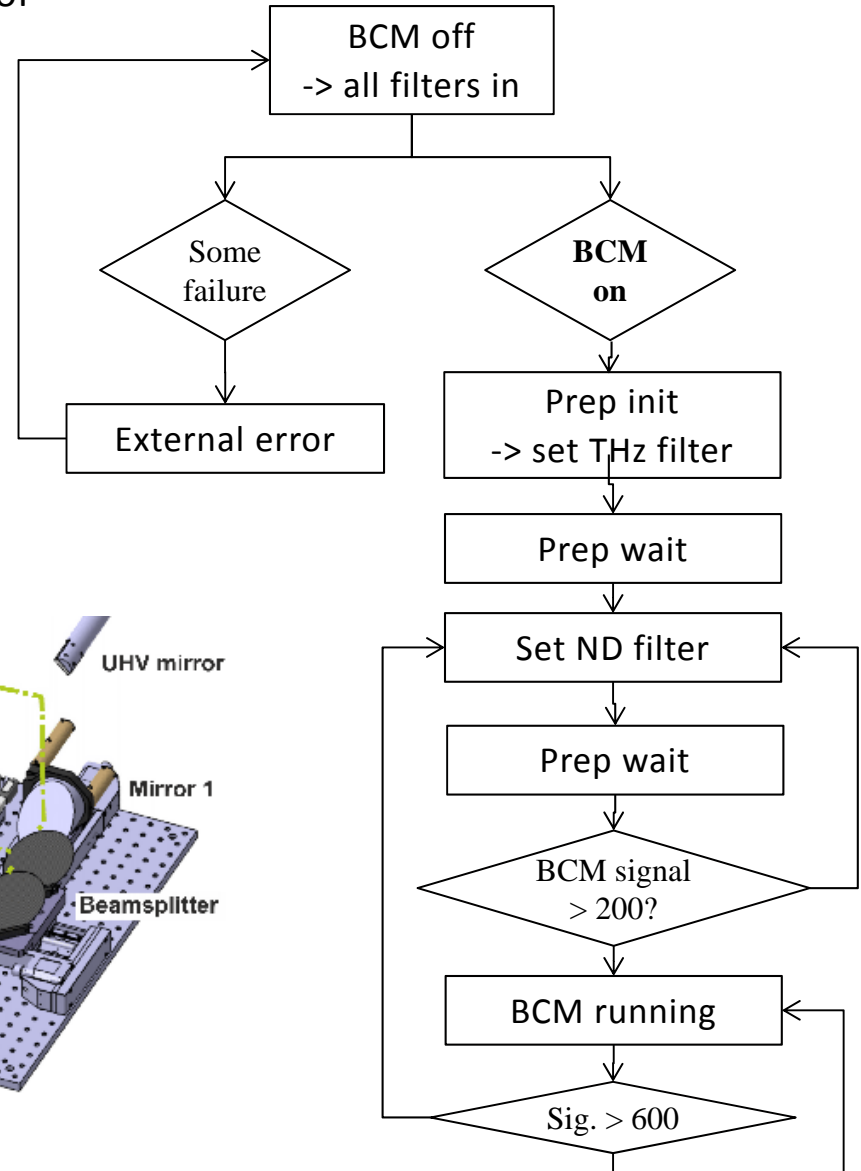
-> This is assuming the e-trajectory is in the middle of the vacuum chamber!

**-> Automatic adjustment not yet set optimal.
(would need beamtime!)**

Automatic motor adjustment -> motion control

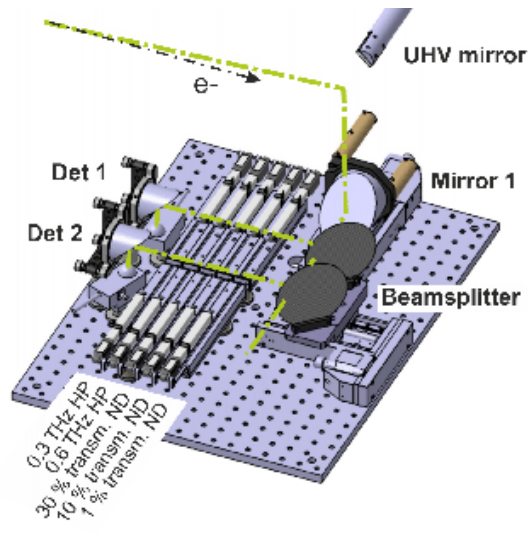
Detector protection -> calc

Automatically set filters to adjust the signal level -> state machine



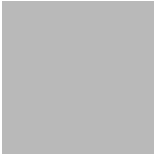
Channel1: 0.6THz high pass
-> use for shorter bunches

Channel2: 0.3THz high pass
-> use for longer bunches



Many thanks to...

Beat Rippstein, Markus Baldinger, Colette Rosenberg, Dominique Hauenstein, Nazareno Gaiffi, Goran Kotrle, Lars Binder, Günter Kolb, Daniel Treyer, Waldemar Koprek, Boris Keil, Tadej Humar, Rok Vintar, Tomaz Sustar, Benjamin Derendinger, Guido Bonderer, Erich Saiger, Giancarlo Villano, Steven Draschl, Vladimir Arsov, Kurt Bitterli, Helge Brands, Nicole Hiller, Simona Bettoni, Cigdem Ozkan, Volker Schlott, Rasmus Ischebeck, Dragutin Maier-Manojlovic, Edwin Divall, Christian Lüscher, Michael Laznovsky, Reto Meier, Goran Marinkovic, Marijo Magjar, Markus Roggli, Patrick Pollet, Stephan Hunziker, Christoph Kittel, Florian Löhl, Romain Ganter, Marco Pedrozzi, Martin Rüfenacht, Roger Kalt, Ivo Widmer, Didier Voulot, Thomas Schietinger, Simon Ebner, Sven Reiche, Roland Kobler, Johan Wickström, Thomas Scherer, Pavel Chevtsov, Adriano Zandonella, Hans Braun, Emanuel Hüsler, Florian Arns, Enrico Ebner, Matthias Moser, Martin Steinacher, Charles Zumach, Heinrich Blumer, Didier Lucy, Christian Geiselhart, Andreas Mathys, Eduard Prat, Xinyu Wang, ...

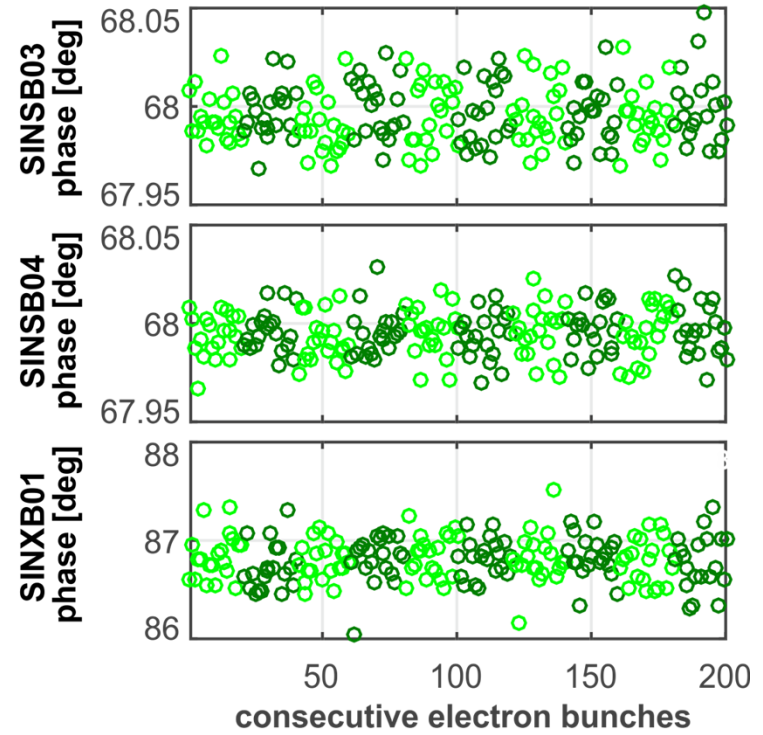
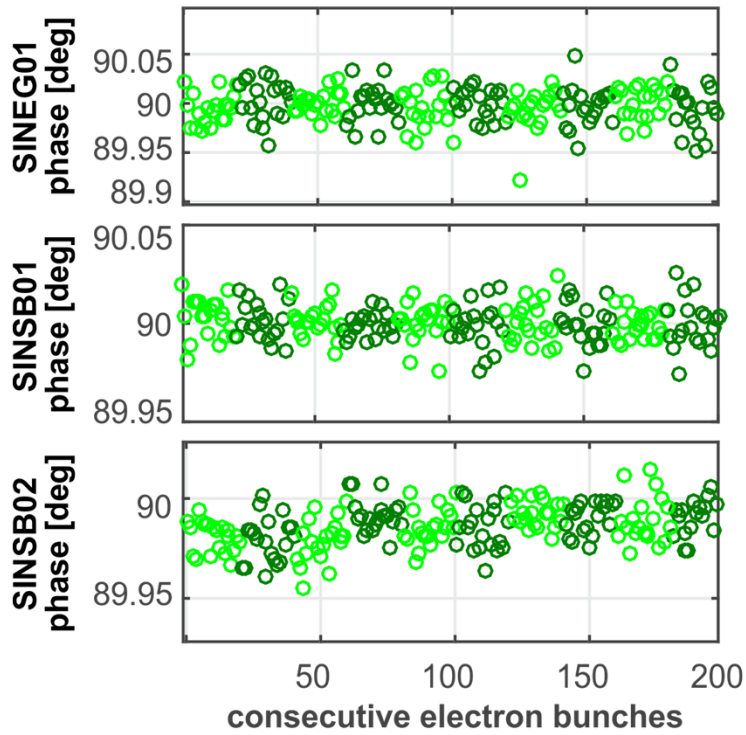


back up...

RF-time series

«time» trace of RF-phases

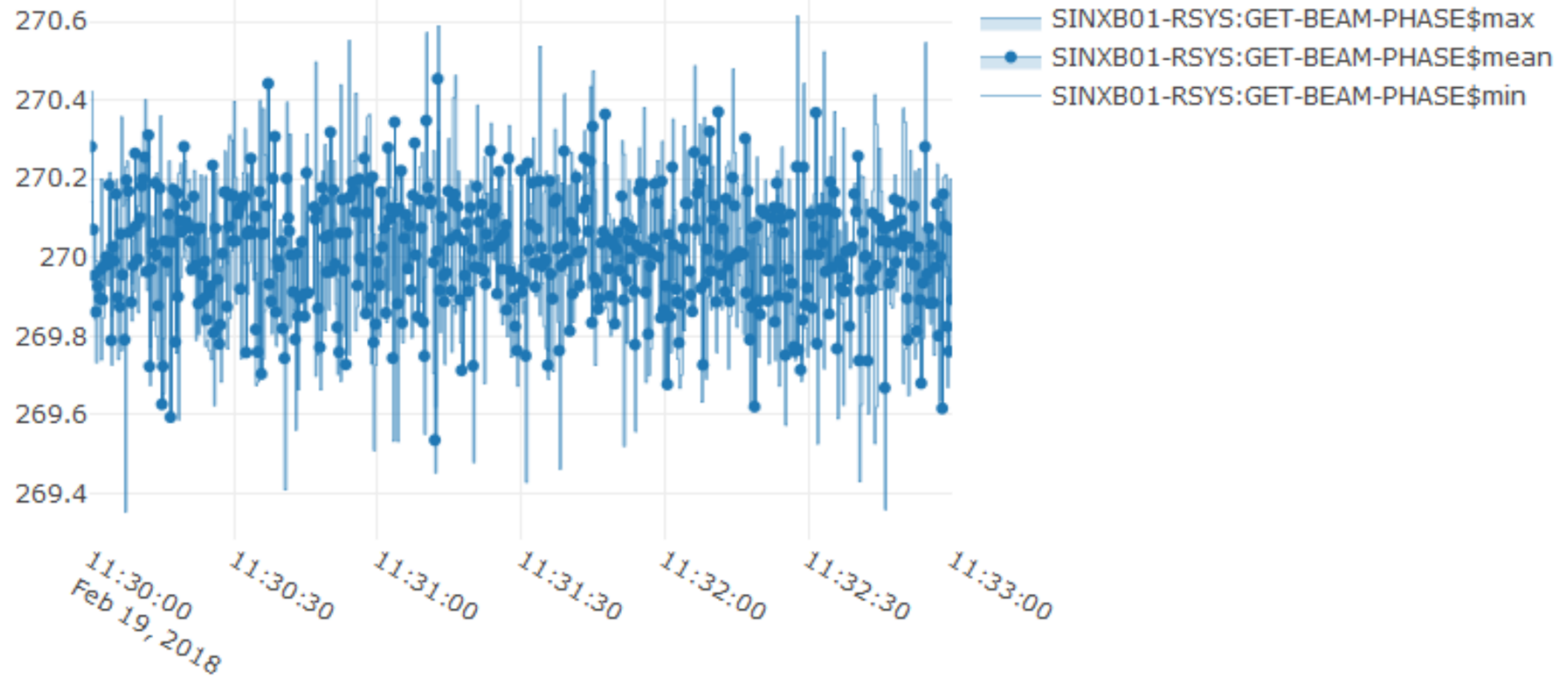
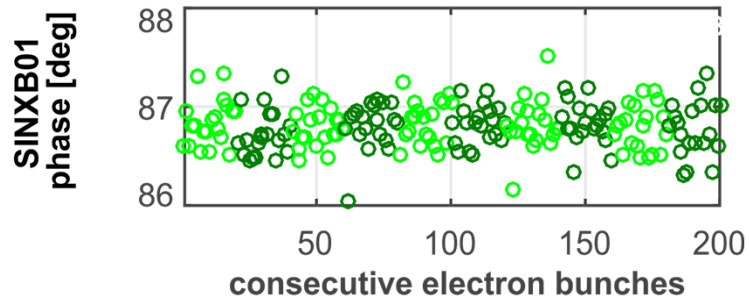
Data from: 2017-07-17_13-59-15 @ 10Hz



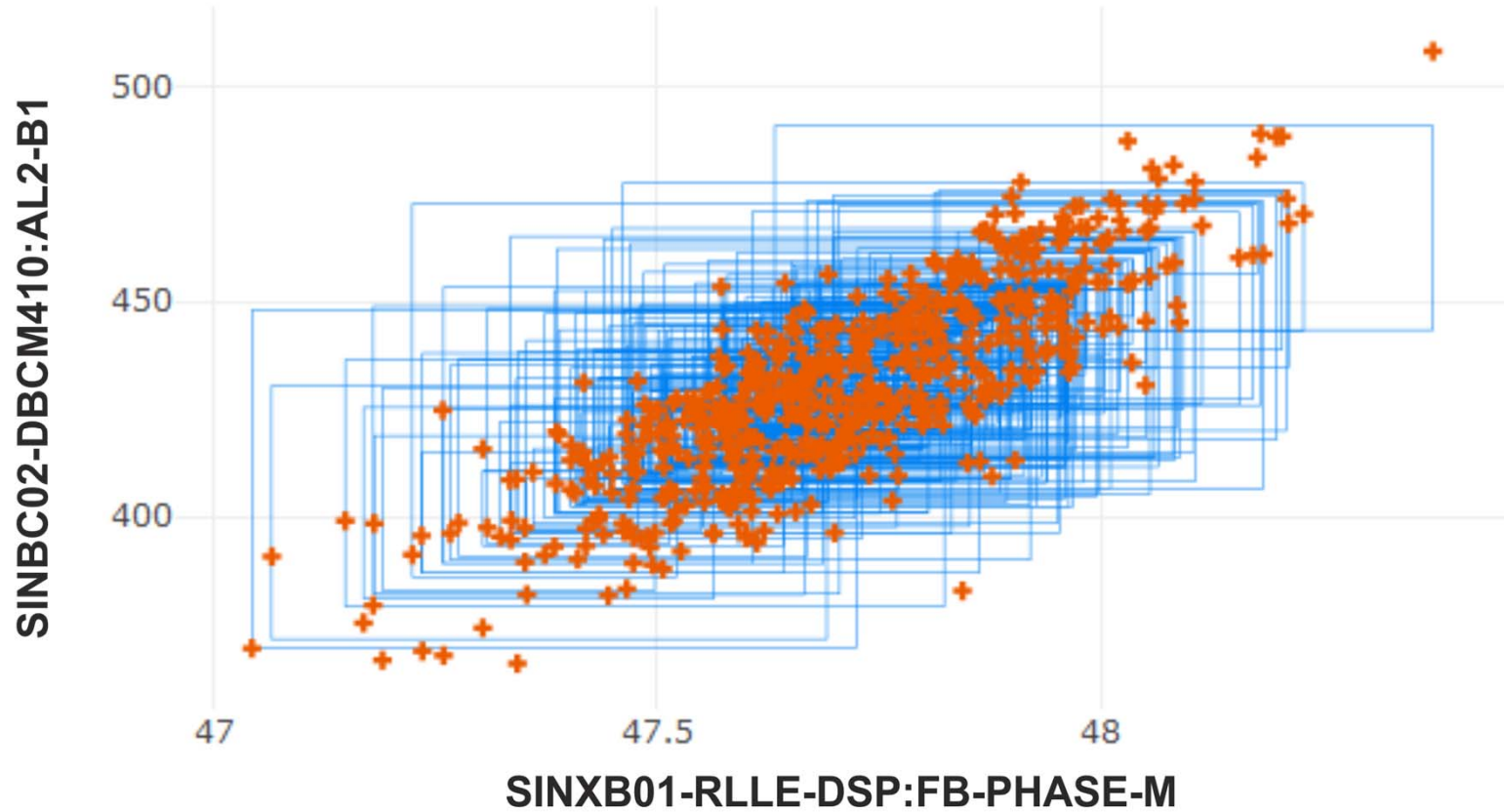
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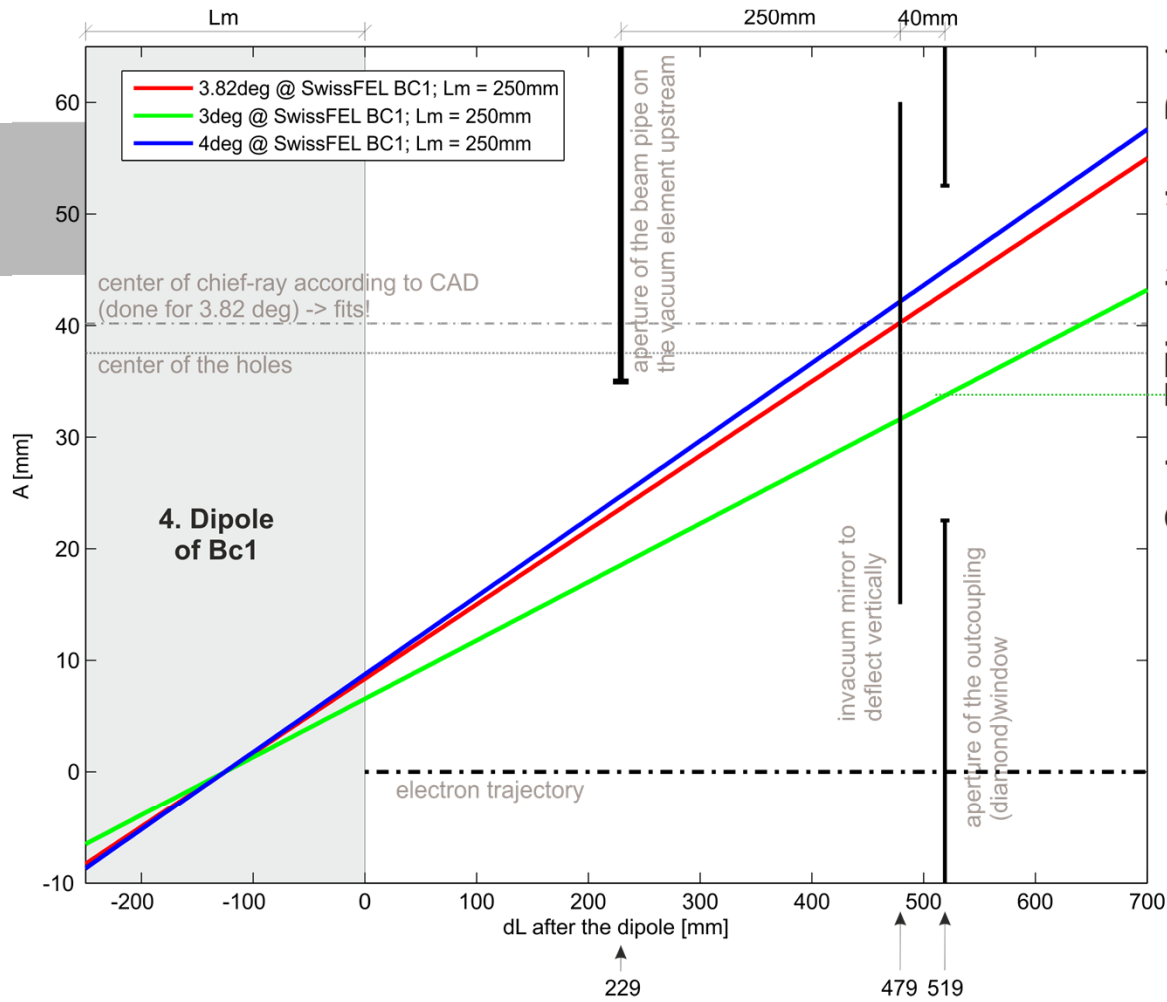
Data from: 2017-07-17_13-59-15 @ 10Hz



BCM-X-band Phase correlation



Data from: 19.2.1018, 11:33:00 - 11:34:00



SwissFEL situation Bc1

The longer the wavelength, the larger the radius. (Near Field)

